LABORATRORIES OF THE ELECTROTECHNICAL INSTIUTE
SWITCHGEAR AND CONTROLGEAR TESTING LABORATORY
M. Pożaryskiego 28; 04-703 WARSZAWA, Poland, tel. (+48 22) 812 23 38 fax. (+48 22) 812 04 07

TEST REPORT No. 8281/NZL/NBR/2012

Object of tests: **Secondary terminal box of HV combined transformer**

Manufacturer: **ABB Sp. z o.o., ul. Żegańska 1, 04-713 Warszawa**
Oddział w Przasnyszu, 06-300 Przasnysz/Poland, ul. Leszno 59

Test performed: Verification of the degree of protection IP55

Normative document: PN-EN 60529:2003, EN 60529;1991 + A1:2000, IDT

Ordered by: **ABB Sp. z o.o., ul. Żegańska 1, 04-713 Warszawa**
Oddział w Przasnyszu, 06-300 Przasnysz/Poland, ul. Leszno 59

Contract/Order No.: BSK/579/NZL/2012 on 12.07.2012	Reference number: 504-023826/038
Objects delivered for tests: 09.07.2012	Date of tests completion: 10.07.2012

The test results presented in this report relate only to the samples tested.

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PCA
AB 074

The Switchgear and Controlgear Testing Laboratory of the Electrotechnical Institute is accredited by Polish Centre of Accreditation in accordance with PN-EN ISO/IEC 17025:2005 in the scope of:
testing of low and high voltage alternating and direct current switchgear and controlgear

ACCREDITATION CERTYFICATE No. AB 074

Tested by:
Domański
Janusz Domański, M.Sc. Eng.

Head of the Team of Laboratories IEI:
Robert Franaszek, M.Sc. Eng.

WARSAW, 2012-07-13

This Test Report contains of 7 pages and 1 Annex.

CONTENTS

1. Location and time of tests

The tests were performed at Switchgear and Controlgear Testing Laboratory of the Electrotechnical Institute in Warsaw.

Date of tests: 09 and 10 July 2012.

2. Test object

The Manufacturer – **ABB Sp. z o.o., ul. Żegańska 1, 04-713 Warszawa Oddział w Przasnyszu/ Poland** has provided to tests the Secondary terminal box of HV combined transformer.

The technical documentation of the Secondary terminal box of HV combined transformer is given on Annex 1. The name plate of the combined transformer is given on Photo 1.

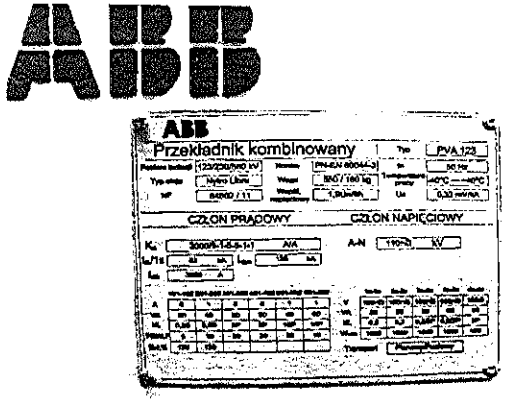

Photo 1 – The nameplate of HV combined transformer

3. Scope of tests

Verification of the degree of protection IP55 according to:

PN-EN 60529:2003	Stopnie ochrony zapewnianej przez obudowy (Kod IP)
EN 60529:1991 + A1:2000, IDT	Degrees of protection provided by enclosures (IP Code)

The test results are given in Table bellow

Item	Test	Requirements acc. to	Testing acc. to	Test result
1	Visual inspection	PN-EN 60529:2003 Clause 11	PN-EN 60529:2003 Clause 11	Positive
2	Verification of the degree of protection IP5X	PN-EN 60529:2003 Clauses 5 and 11	PN-EN 60529:2003 Clauses 13.4 and 13.6	Positive
3	Verification of the degree of protection IPX5	PN-EN 60529:2003 Clauses 6 and 11	PN-EN 60529:2003 Clauses 14 and 14.2.5	Positive

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4. Description and the test results

4.1. Visual inspection

Inspection was made according to PN-EN 60529:2003, Clause 11.

During inspection were checked:

- overall quality,
- compliance of the implementation with the design documentation and with the identification documents.

Test result of inspection is **positive.**

4.2. Verification of the degree of protection IP55

4.2.1. Verification of the degree of protection against solid foreign objects (IP5X)

Verification of the protection against solid foreign objects, indicated by the first characteristic numeral 5, was performed according to the PN-EN 60529:2003, Clauses 13.4 and 13.5.

The test was performed in the dust chamber type ST 2500 U. Secondary terminal box of HV combined transformer before test in the dust chamber is given on Photo 2, and after test – on Photo 3.

Test conditions during test:

- ➢ ambient air temperature – 25 °C
- ➢ relative humidity – 60 %
- ➢ atmospheric pressure – 1000 hPa
- ➢ working volume of dust chamber – 2,5 m^3
- ➢ duration of test – 8 h

After test no deposit of talcum powder was observed inside the box.

Test result of IP5X verification is **positive.**

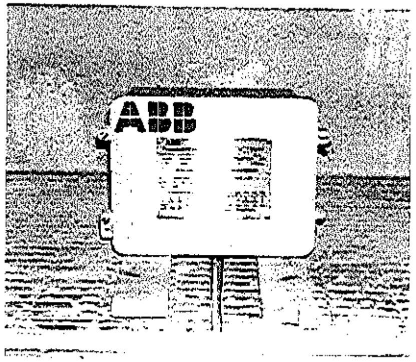

Photo 2 – Secondary terminal box in a dust chamber before IP5X test

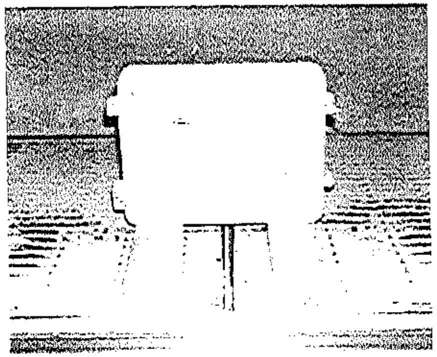

Photo 3 – Secondary terminal box in a dust chamber after IP5X test

4.2.2. Verification of the degree of protection against ingress of water (IPX5)

Verification of the protection against ingress of water, indicated by the first characteristic numeral 5, was performed according to the PN-EN 60529:2003, Clause 14.2.5.

The object under test, mounted as in normal use, was spread from all practicable directions with a stream of water from a standard test nozzle.

Test conditions:

- internal diameter of the nozzle – 6,3 mm
- rate of water flow – 12,5 l/min ± 5%
- distance from nozzle to box enclosure – (2,5 – 3,0) m
- test duration – 3 min

Secondary terminal box of HV combined transformer during IPX5 test is given on Photos 4 and 5.

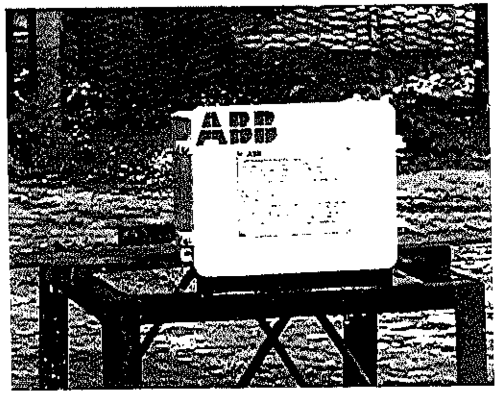

Photo 4 – Secondary terminal box of combined transformer during IPX5 test

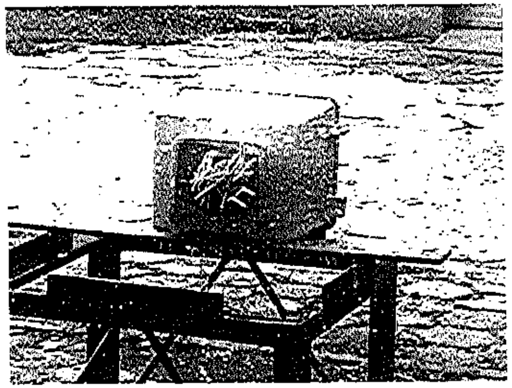

Photo 5 – Secondary terminal box of combined transformer during IPX5 test

After the IPX5 test inside the box was observed only a small amount of water. The water has entered through a vent – see Photo 6. The amount of water and its location does not indicate deterioration in working conditions of combined transformer or impair safety.

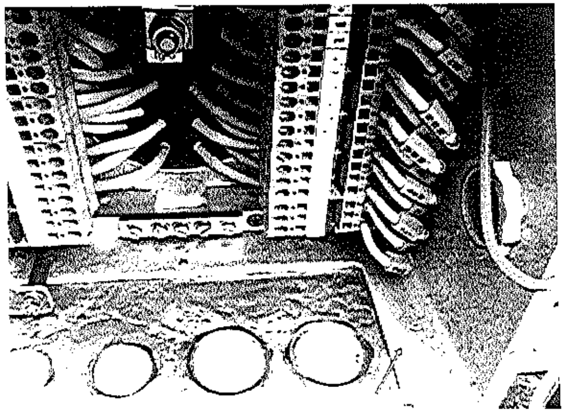

Photo 6 – Secondary terminal box of combined transformer after IPX5 test

The result of IPX5 verification is **positive.**

The verification results of the degree of protection IP55 provided by enclosure of the secondary terminal box of HV combined transformer is **positive.**

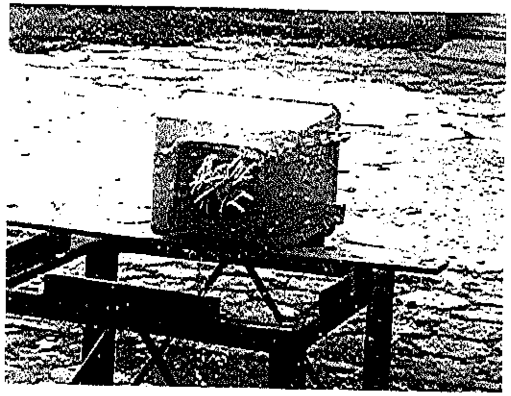

Photo 5 – Secondary terminal box of combined transformer during IPX5 test

After the IPX5 test inside the box was observed only a small amount of water. The water has entered through a vent – see Photo 6. The amount of water and its location does not indicate deterioration in working conditions of combined transformer or impair safety.

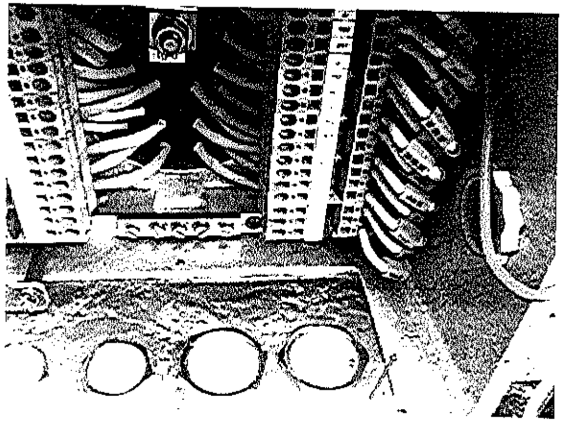

Photo 6 – Secondary terminal box of combined transformer after IPX5 test

The result of IPX5 verification is **positive.**

The verification results of the degree of protection IP55 provided by enclosure of the secondary terminal box of HV combined transformer is **positive.**

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5. Conclusion

The secondary terminal box of HV combined transformer, designed according to the drawings No. 2GKK311093R and No. 2GKK614010 complies with the requirements of PN-EN 60529:2003 and EN 60529:1991 +A1:2000, stated for the degree of protection IP55.

LABORATRORIES OF THE ELECTROTECHNICAL INSTIUTE
SWITCHGEAR AND CONTROLGEAR TESTING LABORATORY

Annex 1 to TEST REPORT No. 8281/NZL/NBR/2012
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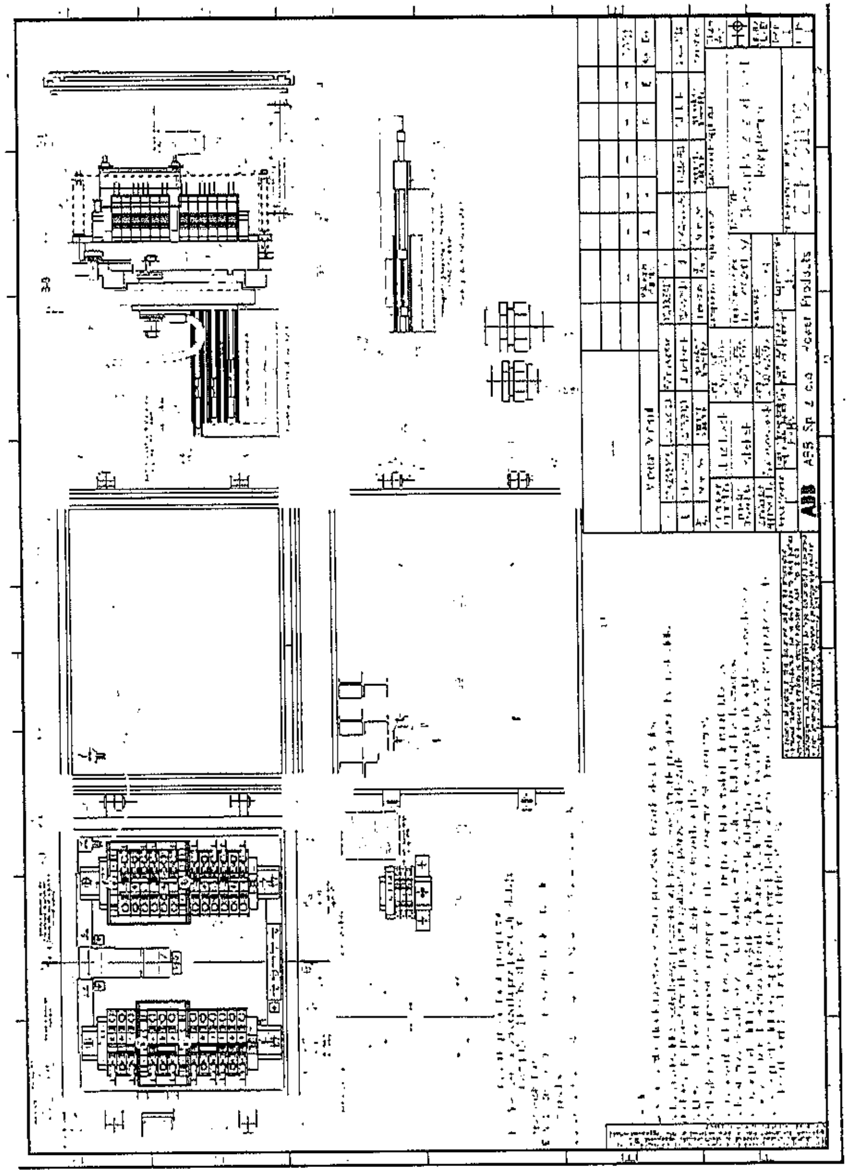

LABORATRORIES OF THE ELECTROTECHNICAL INSTIUTE
SWITCHGEAR AND CONTROLGEAR TESTING LABORATORY

Annex 1 to TEST REPORT No. 8281/NZL/NBR/2012
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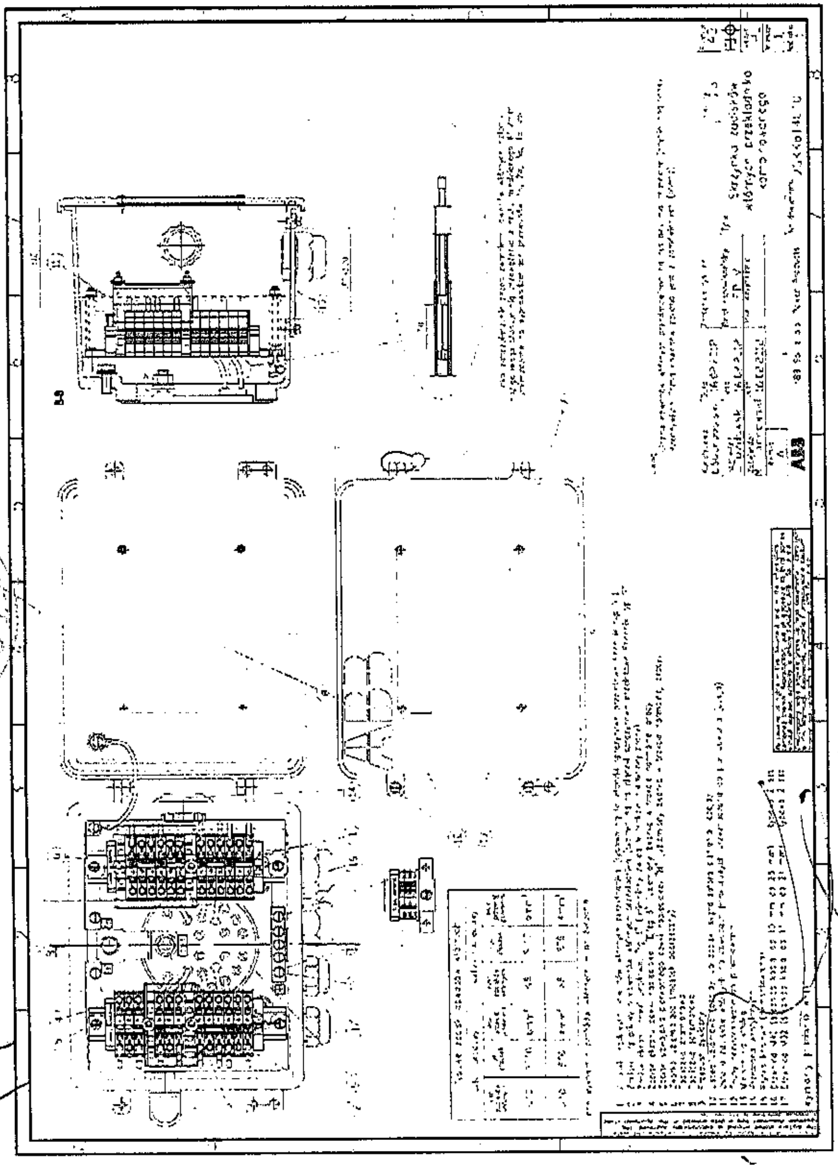

POLSKIE CENTRUM AKREDYTACJI
POLISH CENTRE FOR ACCREDITATION

Sygnatariusz EA MLA
EA MLA Signatory

CERTYFIKAT AKREDYTACJI
LABORATORIUM BADAWCZEGO
ACCREDITATION CERTIFICATE OF TESTING LABORATORY
Nr **AB 272**

Potwierdza się, że: / This is to confirm that:

INSTYTUT ENERGETYKI
LABORATORIUM WYSOKICH NAPIĘĆ
ul. Mory 8, 01-330 Warszawa

spełnia wymagania normy PN-EN ISO/IEC 17025:2005
meets requirements of the PN-EN ISO/IEC 17025:2005 standard

Akredytowana działalność jest określona w Zakresie Akredytacji Nr AB 272
Accredited activity is defined in the Scope of Accreditation No AB 272

Akredytacja pozostaje w mocy pod warunkiem przestrzegania
wymagań jednostki akredytującej określonych w kontrakcie Nr AB 272
This accreditation remains in force provided the Laboratory observes
the requirements of Accreditation Body defined in the Contract No AB 272

Certyfikat akredytacji ważny do dnia 16.07.2019 r.
The certificate of accreditation is valid until 16.07.2019

Akredytacji udzielono dnia 01.03.2000 r.
Accreditation was granted on 01.03.2000

1

p.o. DYREKTORA
POLSKIEGO CENTRUM AKREDYTACJI

LUCYNA OLBORSKA

Warszawa, 22 maja 2015 roku

000160

POLSKIE CENTRUM AKREDYTACJI

POLISH CENTRE FOR ACCREDITATION

Sygnatariusz EA MLA
EA MLA Signatory

CERTYFIKAT AKREDYTACJI

JEDNOSTKI CERTYFIKUJĄCEJ WYROBY

ACCREDITATION CERTIFICATE FOR PRODUCT CERTIFICATION BODY

Nr AC 117

Potwierdza się, że: / This is to confirm that:

INSTYTUT ENERGETYKI
INSTYTUT BADAWCZY
ZESPÓŁ ds. CERTYFIKACJI
ul. Mory 8, 01-330 Warszawa

spełnia wymagania normy PN-EN ISO/IEC 17065:2013-03
meets requirements of the PN-EN ISO/IEC 17065:2013-03 standard

Akredytowana działalność jest określona w Zakresie Akredytacji Nr AC 117
Accredited activity is defined in the Scope of Accreditation No AC 177

Akredytacja pozostaje w mocy pod warunkiem przestrzegania wymagań jednostki akredytującej określonych w kontrakcie Nr AC 117
This accreditation remains in force provided the Body observes the requirements of Accreditation Body defined in the Contract No AC 117

Certyfikat akredytacji ważny do dnia 03.02.2021 r.
The certificate of accreditation is valid until 03.02.2021

Akredytacji udzielono dnia 04.02.2005 r.
Accreditation was granted on 04.02.2005

005287

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DYREKTOR
POLSKIEGO CENTRUM AKREDYTACJI

LUCYNA OLBORSKA

Warszawa, 27 stycznia 2017 roku

000161

POLSKIE CENTRUM AKREDYTACJI
POLISH CENTRE FOR ACCREDITATION

Sygnatariusz EA MLA
EA MLA Signatory

CERTYFIKAT AKREDYTACJI
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ACCREDITATION CERTIFICATE OF TESTING LABORATORY
Nr AB 324

Potwierdza się, że: / This is to confirm that:

INSTYTUT ENERGETYKI
LABORATORIUM URZĄDZEŃ ROZDZIELCZYCH
ul. Mory 8, 01-330 Warszawa

spełnia wymagania normy PN-EN ISO/IEC 17025:2005
meets requirements of the PN-EN ISO/IEC 17025:2005 standard

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Accredited activity is defined in the Scope of Accreditation No AB 324

Akredytacja pozostaje w mocy pod warunkiem przestrzegania
wymagań jednostki akredytującej określonych w kontrakcie Nr AB 324
This accreditation remains in force provided the Laboratory observes
the requirements of Accreditation Body defined in the Contract No AB 324

Certyfikat akredytacji ważny do dnia 27.12.2019 r.
The certificate of accreditation is valid until 27.12.2019

Akredytacji udzielono dnia 28.12.2000 r.
Accreditation was granted on 28.12.2000

DYREKTOR
POLSKIEGO CENTRUM AKREDYTACJI

LOlborska

LUCYNA OLBORSKA

1

Warszawa, 24 listopada 2015 roku

POLSKIE CENTRUM AKREDYTACJI
POLISH CENTRE FOR ACCREDITATION

Sygnatariusz EA MLA
EA MLA Signatory

CERTYFIKAT AKREDYTACJI
LABORATORIUM BADAWCZEGO
ACCREDITATION CERTIFICATE OF TESTING LABORATORY
Nr AB 323

Potwierdza się, że: / This is to confirm that:

INSTYTUT ENERGETYKI
LABORATORIUM WIELKOPRĄDOWE
ul. Mory 8, 01-330 Warszawa

spełnia wymagania normy PN-EN ISO/IEC 17025:2005
meets requirements of the PN-EN ISO/IEC 17025:2005 standard

Akredytowana działalność jest określona w Zakresie Akredytacji Nr AB 323
Accredited activity is defined in the Scope of Accreditation No AB 323

Akredytacja pozostaje w mocy pod warunkiem przestrzegania wymagań jednostki akredytującej określonych w kontrakcie Nr AB 323
This accreditation remains in force provided the Laboratory observes the requirements of Accreditation Body defined in the Contract No AB 323

Certyfikat akredytacji ważny do dnia 27.12.2019 r.
The certificate of accreditation is valid until 27.12.2019

Akredytacji udzielono dnia 28.12.2000 r.
Accreditation was granted on 28.12.2000

ВЯРНО С
ОРИГИНАЛА

DYREKTOR
POLSKIEGO CENTRUM AKREDYTACJI

LUCYNA OLBORSKA

1

Warszawa, 16 listopada 2015 roku

ABB

PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number* IT 08-01-007

Strona / *Page* 1
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No *SL*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	TYP PRZEKŁADNIKA *Instrument transformer's type* Kombinowany *Combined IT*	 Napięciowy *Voltage IT*	 Prądowy *Current IT*
1	Sprawdzenie wykonania cewki nn: • sprawdzenie poprawności oznaczeń kolejnych uzwojeń • pomiar liczby zwojów • pomiar rezystancji uzwojeń *VT low voltage coil inspection:* • *Verification of terminal markings* • *No. of turns measurement* • *Resistance measurement*	- Dokumentacja techniczna 2GKK314041 2GKK314095 *- Technical documentation* *2GKK314041* *2GKK314095*	- pkt. 3a, 3b, 3c - pkt. 6a, 6b, 6c - *item* 3a, 3b, 3c - *item* 6a, 6b, 6c	Nawijalnia Nr 2 *Coil winding shop No.2*	–	✓* *część napięciowa *voltage part only*	✓	-
2	Kontrola uzwojonego rdzenia CT: • Sprawdzenie oznaczeń zacisków • Próba izolacji międzyzwojowej (badanie kontrolne na próbce) • Pomiar rezystancji i liczby zwojów • Badania dokładności • Pomiar współczynników: FS/ALF/Kssc*Ktd/K$_R$/Ts/Ek/Ie • Pomiar wymiarów geometrycznych *CT wound core inspection:* • *Verification of terminal markings* • *Intern-turn overvoltage test (sample test)* • *Resistance and No. of turns measurement* • *Tests for accuracy* • *Measurement of factors:* FS/ALF/Kssc*Ktd/K$_R$/Ts/Ek/Ie • *Measurement of geometric dimensions*	Dokumentacja techniczna 2GKK314020 IEC 61869-2 *Technical documentation.* *2GKK314020* IEC 61869-2	-pkt. I -*pkt.* 7.3.6; 7.3.204; 7.3.5; 7.2.6.202; 7.3.201; 7.3.202; 7.3.203; 7.2.6.206 - item I -*cl.* 7.3.6; 7.3.204; 7.3.5; 7.2.6.202; 7.3.201; 7.3.202; 7.3.203; 7.2.6.206	Nawijalnia Nr 2 *Coil winding shop No.2*	–	✓* *część prądowa *current part only*	-	✓

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.2015	P. Dębski		17.03.2015

ABB

PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number*
IT 08-01-007

No *Sl.*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	TYP PRZEKŁADNIKA *Instrument transformer's type* Kombinowany *Combined IT*	 Napięciowy *Voltage IT*	 Prądowy *Current IT*
3	Kontrola wejściowa materiałów: - sprawdzenie i weryfikacja materiałów wejściowych *Incoming goods control:* - *inspection and verification of incoming goods*	Plan kontroli w SAP QM Inspection plans in SAP QM	Dokumentacja *Documentation*	Kontrola jakości *Quality control*	--	✓	✓	✓
4	Kontrola procesu uzwajania cewki napięciowej: • Pomiar średnicy końcowej cewki • Liczba lutowań *Winding process control of voltage coil:* • *Measurement of the final diameter* • *Number of soldering*	- Dokumentacja techniczna 2GKK338001 2GKK314111 *- Technical documentation* 2GKK338001 2GKK314111	Parametry wg dokumentacji Parameters acc. to documentation	Nawijalnia nr 1 *Coil winding shop No.1*	--	✓	✓	-

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.2015	P. Dębski		17.03.2015

ABB	PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN *Routine test plan and main assembly operations for HV instrument transformers*	Numer / *Number* IT 08-01-007	Strona / *Page* 3 Stron / *Pages* 9
		TYP PRZEKŁADNIKA ***Instrument transformer's type***	

No *Sl.*	**Badanie** ***Test***	**Badanie według:** ***Test according to:***	**Wymaganie według:** ***Requirement according to:***	**Miejsce badania:** ***Place of test:***	**Uwagi** ***Remarks***	**Kombinowany** ***Combined IT***	**Napięciowy** ***Voltage IT***	**Prądowy** ***Current IT***
5	Proces izolowania cewki napięciowej - sprawdzenie wymiarów zewnętrznych (średnica, szerokość cewki) - pomiar rezystancji *Insulation process of voltage coil* *- Check of the external dimensions (diameter, width)* *-Resistance measurement*	Instrukcja technolog. - IT 08-01-015; - oraz 2GKK338001 2GKK314111 *Technological instruction.* *- IT 08-01-015* *and* 2GKK338001 2GKK314111	- pkt. 4.3 - cl. 4.3	Nawijalnia nr 1 *Coil winding shop No.1*	--	✓	✓	
6	Montaż rdzenia i cewki nn w cewce napięciowej pierwotnej - Sprawdzenie poprawności montażu. *Assembly process of LV coil and core in primary voltage coil* - *Assembly correctness inspection*	Instrukcja technolog. IT 08-01-009 *Technological instruction.* *- IT 08-01-009*	pkt. 7 *cl. 7*	Nawijalnia nr 1 *Coil winding shop No.1*	--	✓	✓	-

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.2015	P. Dębski		17.03.2015

ABB

PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number*
IT 08-01-007

Strona / *Page* 4
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TYP PRZEKŁADNIKA
Instrument transformer's type

No *Sl.*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	Kombinowany *Combined IT*	Napięciowy *Voltage IT*	Prądowy *Current IT*
7	Proces wstępnego izolowania cewki prądowej - Pomiar średnicy wewnętrznej *Initial insulation of the current coil* *- Measurement of the internal diameter*	Instrukcja technolog. IT 08-01-001 *Technological instruction.* *- IT 08-01-001*	pkt. 17 *cl. 17*	Nawijalnia nr 1 *Coil winding shop No.1*	–	✓	-	✓
8	Proces izolowania cewki prądowej -Pomiar wymiarów geometrycznych *Insulation of the current coil* *- Dimensions measurement*	Dokumentacja techniczna. 2GKK328018 2GKK314163 *The technical documentation.* 2GKK328018 2GKK314163	pkt. 6 *cl. 6*	Nawijalnia nr 1 *Coil winding shop No.1*	–	✓	-	✓
9	Proces nawijania przepustu prądowego i napięciowego - Sprawdzenie wymiarów *Voltage and current bushing winding process* *- Dimensions check*	Instrukcja technolog. IT 08-01-017; oraz 2GKK310230 2GKK310314 2GKK314121 *Technological instruction.* *IT 08-01-017;and* 2GKK310230 2GKK310314 2GKK314121	pkt. 4 *cl. 4*	Nawijalnia nr 1 *Coil winding shop No.1*	–	✓	✓	✓

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.2015	P. Dębski		17.03.2015

ABB

PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number* IT 08-01-007

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No *Sl.*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	TYP PRZEKŁADNIKA *Instrument transformer's type* Kombinowany *Combined IT*	 Napięciowy *Voltage IT*	 Prądowy *Current IT*
10	Proces suszenia cewek *Coils' vacuum drying proces*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	pkt. V i VI *Cl. V and VI*	Autoklaw *Autoclave*	--	✓	✓	✓
11	Badanie oleju: - przy dostawie - przygotowany do zalania przekładników - po zalaniu przekładników *Oil tests:* *- at the delivery* *- prepared for IT filling* *- after IT filling*	Instrukcja technolog. IT 08-01-035 Technological instruction IT 08-01-035	Pkt.4 Item 4.	Kontrola jakości *Quality control*	--	✓	✓	✓

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Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.2015	P. Dębski		17.03.2015

ABB	PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN *Routine test plan and main assembly operations for HV instrument transformers*	Numer / *Number* IT 08-01-007	Strona / *Page* 6 Stron / *Pages* 9
		TYP PRZEKŁADNIKA ***Instrument transformer's type***	

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12	Montaż przekładnika: (cewki prądowej, cewki napięciowej) - sprawdzenie rezystancji uzwojenia pierwotnego cewki prądowej *IT assembly:* *(current coil, voltage coil)* *- Primary winding resistance measurement of the current coil*	Instrukcja technolog. IT 08-01-003; oraz 2GKK310202, 2GKK310302, 2GKK2100001 *Technological instruction IT 08-01-003 and: 2GKK310202, 2GKK310302 2GKK2100001*	pkt. VII *Cl. VII*	Stanowisko montażowe przekładników *IT's assembly station*	--	✓	✓	✓
13	Sprawdzenie oznaczeń zacisków *Verification of the terminal markings*	IEC 61869-1 IEC 61869-2 IEC 61869-3	p. 6.13; 7.3.6 p. 6.13 p. 6.13 *Cl. 6.13; 7.3.6* *Cl. 6.13* *Cl. 6.13*	Kontrola jakości *Quality control*	--	✓	✓	✓
14	Napełnianie olejem i proces impregnacji przekładników *Oil filling and impregnation process of the ITs*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	pkt. VIII *Cl. VIII*	Stanowisko impregnacji Impregnation station	--	✓	✓	✓

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
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PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number*
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No *Sl.*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	TYP PRZEKŁADNIKA *Instrument transformer's type* Kombinowany *Combined IT*	 Napięciowy *Voltage IT*	 Prądowy *Current IT*
15	Sprawdzenie szczelności przekładnika *Oil tightness verification*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	pkt. IX *Cl. IX*	Kontrola jakości *Quality control*	--	✓	✓	✓
16	Próba izolacji uzwojeń pierwotnych napięciem o częstotliwości sieciowej oraz pomiar wyładowań niezupełnych *Power-frequency voltage withstand tests on primary windings and partial discharge measurement*	IEC 61869-1 IEC 61869-2 IEC 61869-3 IEC 60270	p. 7.3.1 i 7.3.2 p. 7.3.1 p.7.3.1; 7.3.2 *Cl. 7.3.1 and 7.3.2* *Cl. 7.3.1* *Cl. 7.3.1 and 7.3.2*	Kontrola jakości *Quality control*	--	✓	✓	✓
17	Próba izolacji uzwojeń wtórnych napięciem o częstotliwości sieciowej *Power-frequency voltage withstand test on secondary windings*	IEC 61869-1	p. 7.3.3 p. 7.3.4 *Cl. 7.3.3* *Cl. 7.3.4*	Kontrola jakości *Quality control*	--	✓	✓	✓
18	Próba izolacji międzyzwojowej *Inter-turn overvoltage test*	IEC 61869-2	p. 7.3.204 *Cl. 7.3.204*	Kontrola jakości *Quality control*	--	✓* *część prądowa *current part only*	-	✓
19	Badania dokładności przekładnika prądowego *Tests for accuracy of the current transformer*	IEC 61869-2	*7.3.6; 7.3.204; 7.3.5; 7.2.6.202; 7.3.201; 7.3.202; 7.3.203; 7.2.6.206*	Kontrola jakości *Quality control*	--	✓* *część prądowa *current part only*	-	✓

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.201	P. Dębski		17.03.2015

ABB	PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN *Routine test plan and main assembly operations for HV instrument transformers*	Numer / *Number* IT 08-01-007	Strona / *Page* 8 Stron / *Pages* 9
		TYP PRZEKŁADNIKA ***Instrument transformer's type***	

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20	Badania dokładności przekładnika napięciowego *Tests for accuracy of the voltage transformer*	IEC 61869-3	p. 7.3.5 *cl. 7.3.5*	Kontrola jakości *Quality control*	--	✓* *część napięciowa *voltage part only*	✓	-
21	Pomiar rezystancji uzwojeń *Measurement of the windings' internal resistance*	--	Zamówienie (wg wymagania spec.) *Order (on request only)*	Kontrola jakości *Quality control*	--	✓	✓	✓
22	Pomiar pojemności i współczynnika strat dielektrycznych *Capacitance and dielectric dissipation factor measurement*	IEC 61869-1 IEC 61869-2 IEC 61869-3	pkt. 7.4.3 *cl. 7.4.3*	Kontrola jakości *Quality control*	--	✓	✓	✓
23	Sprawdzenie ustawienia wskaźnika poziomu oleju *Oil level indicator inspection*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	pkt. X *Item: X*	Kontrola jakości *Quality control*	--	✓	✓	✓
24	Końcowe oględziny *Final visual inspection*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	Dokumentacja techniczna, zamówienie *Technical documentation, order*	Kontrola jakości *Quality control*	--	✓	✓	✓

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
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PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number*
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No *SL*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	TYP PRZEKŁADNIKA *Instrument transformer's type* Kombinowany *Combined IT*	Napięciowy *Voltage IT*	Prądowy *Current IT*
25	Odbiór klienta *Customer's inspection*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	pkt. XIV *Item: XIV*	*Według odrębnych ustaleń* *According to separate agreement*	Pracownicy ABB i przedstawiciele klienta *ABB's staff and customer's representatives*	✓	✓	✓
26	Pakowanie i przekazanie do magazynu *Packing and transfer to warehouse*	Instrukcja technolog. IT 08-01-003 *Technological instruction IT 08-01-003*	pkt. XIV *Item: XIV*	Kontrola jakości *Quality control*	–	✓	✓	✓

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
Ł. Lubieniecki		16.03.2015	J. Duzdowski		16.03.2015	P. Dębski		17.03.2015

Uwaga / Remark

✓ - ma zastosowanie / applicable

– - nie ma zastosowanie / not applicable

ABB

PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number*
IT 08-01-007

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Stron / *Pages* 9

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1	Sprawdzenie wykonania cewki nn: • sprawdzenie poprawności oznaczeń kolejnych uzwojeń • pomiar liczby zwojów • pomiar rezystancji uzwojeń *VT low voltage coil inspection:* • *Verification of terminal markings* • *No. of turns measurement* • *Resistance measurement*	- Dokumentacja techniczna 2GKK314041 2GKK314095 *- Technical documentation* *2GKK314041* *2GKK314095*	- pkt. 3a, 3b, 3c - pkt. 6a, 6b, 6c - *item* 3a, 3b, 3c - *item* 6a, 6b, 6c	Nawijalnia Nr 2 *Coil winding shop No.2*	--	✓* *część napięciowa *voltage part only*	✓	-
2	Kontrola uzwojonego rdzenia CT: • Sprawdzenie oznaczeń zacisków • Próba izolacji międzyzwojowej (badanie kontrolne na próbce) • Pomiar rezystancji i liczby zwojów • Badania dokładności • Pomiar współczynników: FS/ALF/Kssc*Ktd/K$_R$/Ts/Ek/Ie • Pomiar wymiarów geometrycznych *CT wound core inspection:* • *Verification of terminal markings* • *Intern-turn overvoltage test (sample test)* • *Resistance and No. of turns measurement* • *Tests for accuracy* • *Measurement of factors:* FS/ALF/Kssc*Ktd/K$_R$/Ts/Ek/Ie • *Measurement of geometric dimensions*	Dokumentacja techniczna 2GKK314020 IEC 61869-2 *Technical documentation.* *2GKK314020* IEC 61869-2	-pkt. I -*pkt. 7.3.6; 7.3.204; 7.3.5; 7.2.6.202; 7.3.201; 7.3.202; 7.3.203; 7.2.6.206* - item I -*cl. 7.3.6; 7.3.204; 7.3.5; 7.2.6.202; 7.3.201; 7.3.202; 7.3.203; 7.2.6.206*	Nawijalnia Nr 2 *Coil winding shop No.2*	--	✓* *część prądowa *current part only*	-	✓

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PLAN KONTROLI ORAZ GŁÓWNYCH CZYNNOŚCI TECHNOLOGICZNYCH PRZEKŁADNIKÓW WN

Routine test plan and main assembly operations for HV instrument transformers

Numer / *Number* IT 08-01-007

Strona / *Page* 2
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No *SL*	Badanie *Test*	Badanie według: *Test according to:*	Wymaganie według: *Requirement according to:*	Miejsce badania: *Place of test:*	Uwagi *Remarks*	TYP PRZEKŁADNIKA *Instrument transformer's type* Kombinowany *Combined IT*	Napięciowy *Voltage IT*	Prądowy *Current IT*
3	Kontrola wejściowa materiałów: - sprawdzenie i weryfikacja materiałów wejściowych *Incoming goods control:* - *inspection and verification of incoming goods*	Plan kontroli w SAP QM Inspection plans in SAP QM	Dokumentacja *Documentation*	Kontrola jakości *Quality control*	--	✓	✓	✓
4	Kontrola procesu uzwajania cewki napięciowej: • Pomiar średnicy końcowej cewki • Liczba lutowań *Winding process control of voltage coil:* • *Measurement of the final diameter* • *Number of soldering*	- Dokumentacja techniczna 2GKK338001 2GKK314111 *- Technical documentation* 2GKK338001 2GKK314111	Parametry wg dokumentacji Parameters acc. to documentation	Nawijalnia nr 1 *Coil winding shop No.1*	--	✓	✓	-

Opracował *Prepared by*	Podpis *Signature*	Data *Date*	Sprawdził *Checked by*	Podpis *Signature*	Data *Date*	Zatwierdził *Approved by*	Podpis *Signature*	Data *Date*
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		TYP PRZEKŁADNIKA ***Instrument transformer's type***	

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5	Proces izolowania cewki napięciowej - sprawdzenie wymiarów zewnętrznych (średnica, szerokość cewki) - pomiar rezystancji *Insulation process of voltage coil* *- Check of the external dimensions (diameter, width)* *-Resistance measurement*	Instrukcja technolog. - IT 08-01-015; - oraz 2GKK338001 2GKK314111 *Technological instruction.* *- IT 08-01-015* *and* 2GKK338001 2GKK314111	- pkt. 4.3 - cl. 4.3	Nawijalnia nr 1 *Coil winding shop No.1*	–	✓	✓	–
6	Montaż rdzenia i cewki nn w cewce napięciowej pierwotnej - Sprawdzenie poprawności montażu. *Assembly process of LV coil and core in primary voltage coil* *- Assembly correctness inspection*	Instrukcja technolog. IT 08-01-009 *Technological instruction.* *- IT 08-01-009*	pkt. 7 *cl. 7*	Nawijalnia nr 1 *Coil winding shop No.1*	–	✓	✓	–

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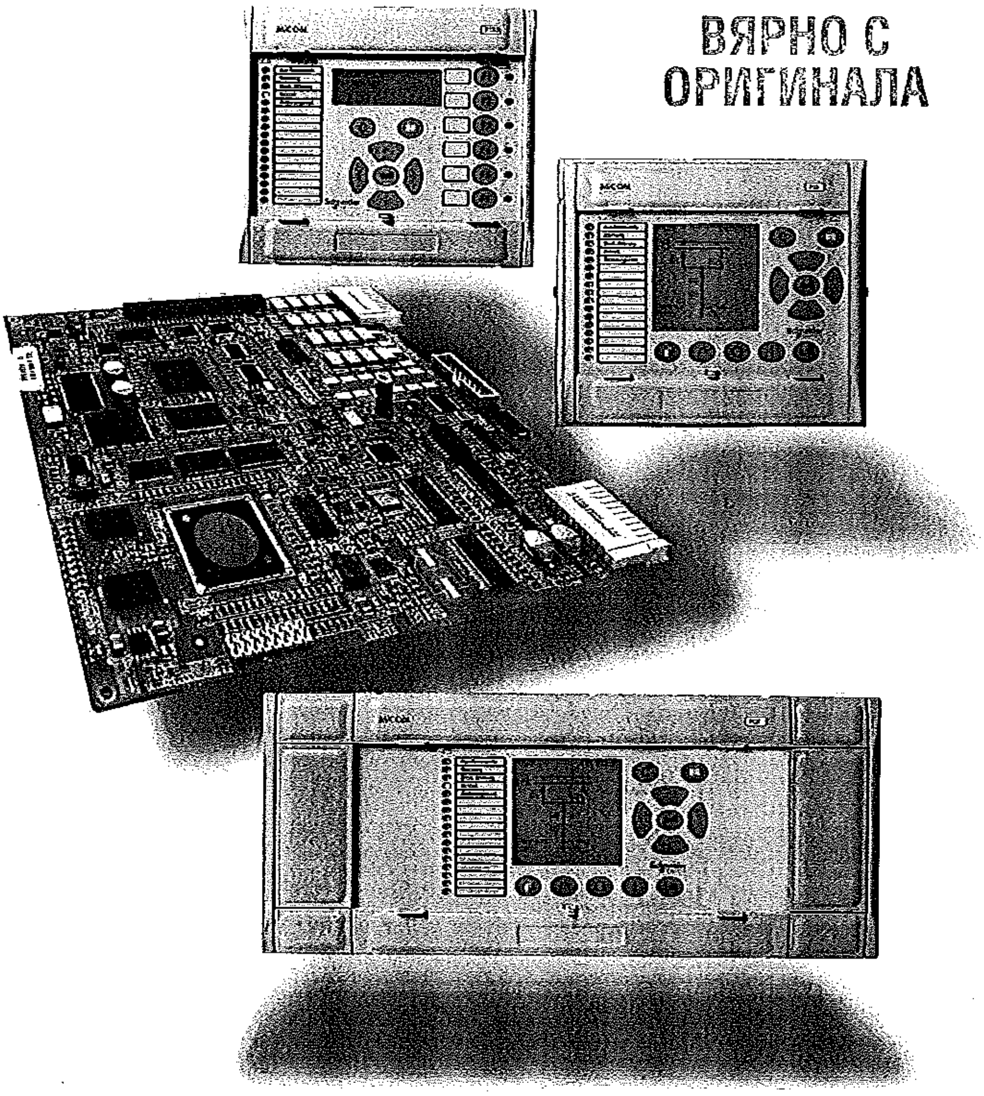
MiCOM P30

The new generation

НЕОЛЕТ ООД
НЕОЛЕТ Ltd.
Stara Zagora
Стара Загора

ВЯРНО С
ОРИГИНАЛА

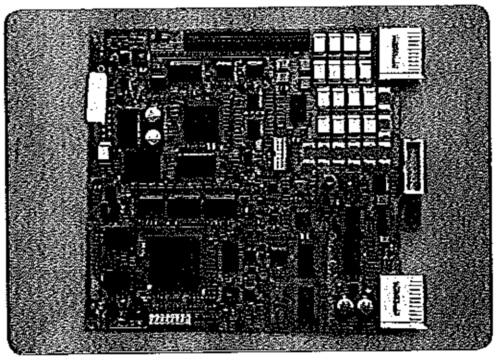


ВЯРНО С
ОРИГИНАЛА

Schneider
Electric

Technical characteristics of the new MiCOM Px30 range

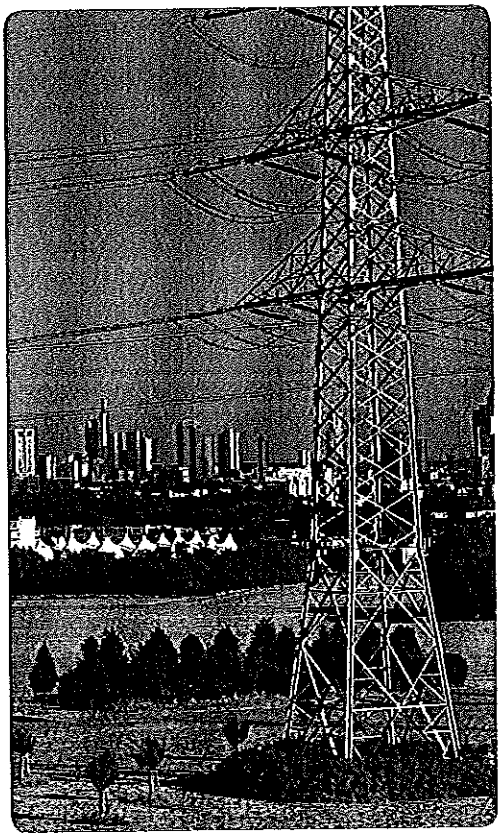
- Q/V-protection and 3rd stages of over-/undervoltage protection function compliant to grid connection requirements for decentralized generation plants
- Consistent current measurement with sensitive and maximum dynamic range
- Higher sensitivity of directional power protection
- Smaller minimum reach settings of distance protection
- Harmonisation of supplementary functions of distance protection devices
- Common directional ground short-circuit protection and signalling scheme
- Power swing blocking and out of step tripping
- Additional LOGIC with extended length timers
- Inrush stabilisation individually settable for each DTOC and IDMT stages
- Enhanced and extended fault data acquisition
- Cyber security



New processor hardware

In addition to serial front port communication with MiCOM S1 Studio, a new file transfer for fast data exchange is also now available.

Data models with customised description texts, user-defined bay types or specific character sets for the graphic display can now be downloaded to the device in a single step without affecting settings or requiring time consuming reboots of the devices.

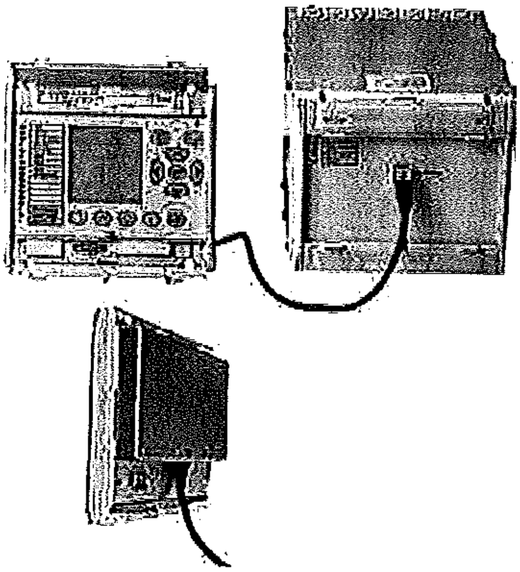


Launch schedule:

Available now: MiCOM P132/139, P433/435/437/439, P631/632/633/634
Available from March 2015: MiCOM P532, MiCOM C434

MiCOM Px3x Detachable HMI

ВЯРНО С ОРИГИНАЛА



NEW HUMAN-MACHINE INTERFACE FOR MiCOM Px30

Schneider Electric announces the option of detachable HMI (DHMI) for a variety of modular protection devices and combined protection and control equipment. The DHMI is especially designed for applications where the devices are to be directly integrated in the panels of MV switchgear installations.

Today, the design of primary equipment in a compact MV switchgear installation complicates the arrangement of secondary equipment, such that the space available for device housing does not accommodate good HMI ergonomics.

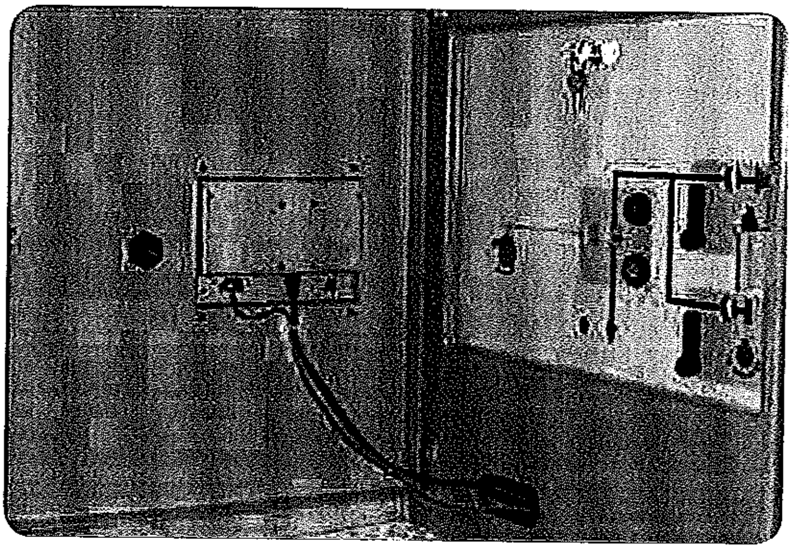
In this situation, decoupling the location of the active chassis from the HMI offers great advantages, as only the DHMI need be tied to an installation visible at the front of the MV switchgear cells.

Protection devices and combined protection and control equipment can be installed within the LV compartment of the switchgear cell, at any height, and in any orientation to achieve the best fit. Site of the chassis does not constrain sight of the HMI!

Minimized dimensions of the DHMI unit allow easy integration in MV switchgear cells with small mounting depth.

Specific Features

- Standardized design for all MiCOM Px30 devices
- New tri-color LEDs for extended visualization
- Easy integration in switchgear



Schneider Electric

ВЯРНО С ОРИГИНАЛА

NEOSET Ltd.

DHMI FOR MiCOM Px30 RANGE

Features

- Standardized RJ45 cables (Ethernet cables, max. length 10m) can be used for the connection between the main chassis and DHMI. A 3m long connection cable is included in the delivery.
- It is possible to establish or interrupt the connection to the DHMI at any time. The unit is automatically detected at plug-in.
- Operating and configuration of the relay/control unit's functionality is via the DHMI.
- Functioning of the relay/controller is ensured even if the DHMI is not available. In such a case, access to the main unit is via its PC interface.
- Tri-color LEDs allow multiple annunciation of different operating conditions (e.g. ready signals of protection functions).
- No requirement for large panel cut-outs. Merely drilling a hole for the Ethernet cable is required.

Hardware Variants

- Main device chassis has 4 LEDs and interface connector for one DHMI.
- DHMI with graphic display for modular combined protection and control equipment.
- DHMI with text display for modular protection devices.

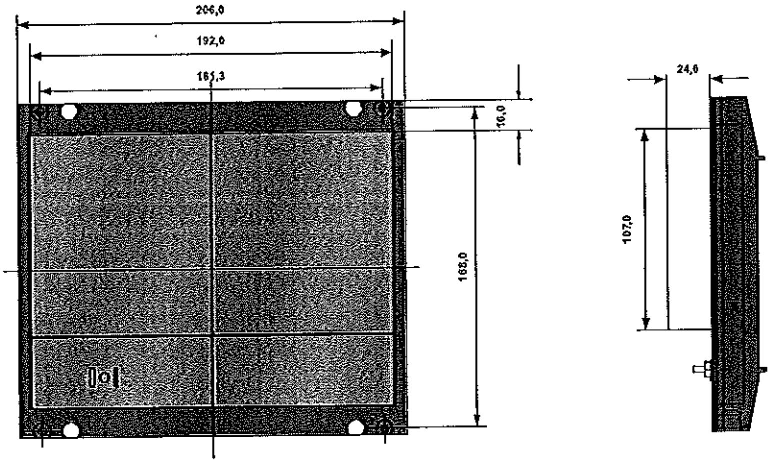
Functionality

- Easy access to all settings, records and controls in the main device.
- New programmable tri-color LEDs (red, green, yellow) for better visualization.
- 6 user-configurable function keys for the DHMI with text display.

Application

- Combined protection and control devices MiCOM P139 and MiCOM P439.
- Directional overcurrent feeder management device MiCOM P132.
- Distance protection devices MiCOM P433 and MiCOM P435.
- Transformer differential protection devices MiCOM P631 through MiCOM P634.
- Catenary protection for rail applications MiCOM P436 and MiCOM P438.

Dimensioned Drawings



Site of the chassis does not constrain sight of the HMI !

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www.schneider-electric.com

Publishing: Schneider Electric
Design: Schneider Electric
Printing:

000179

MiCOM Px3x Series

(including C434)

Redundant Ethernet Board

ВЯРНО С
ОРИГИНАЛА

НЕОРЕТ ООД
Stara Zagora Ltd.
Стара Загора

Application Guide

Issue: G
Release: 10 / 2013

Schneider
Electric

2 Hardware description

Two boards are available for using IEC61850, the single Ethernet board and the redundant Ethernet board. Both are required for communications but the redundant Ethernet board allows an alternative path to be always available, providing bumpless redundancy.

Industrial network failure can be disastrous. Redundancy provides increased safety and reliability, but also devices can be added to or removed from the network without network downtime.

2.1 Px3x Redundancy protocols

The following list shows Schneider Electric's implementation of Ethernet redundancy, which has three variants with embedded IEC 61850, plus SHP, RSTP and DHP redundancy protocols.

- Rapid Spanning Tree Protocol (RSTP IEEE 802.1w) 1300 nm multi mode 100BaseFx fiber optic Ethernet ports (ST® connector) and **modulated** IRIG-B input.

  Note: This board offers compatibility with any RSTP device.

- Self Healing Protocol (SHP) 1300 nm multi mode 100BaseFx fiber optic Ethernet ports (ST® connector) and **modulated** IRIG-B input.

  Note: This board offers compatibility with C264-SWR202 and MiCOM H35x multi-mode switches. Self healing Protocol is a Schneider Electric proprietary solution providing extremely fast recovery time.

- Dual Homing Protocol (DHP) 1300 nm multi mode 100BaseFx fiber optic Ethernet ports (ST® connector) and **modulated** IRIG-B input

  Note: This board offers compatibility with C264-SWD202 and MiCOM H36x multi-mode switches. Dual Homing Protocol is a Schneider Electric proprietary solution providing bumpless redundancy to the IED.

All of these boards have connections for a watchdog relay and an RS485 link.

The redundant Ethernet board is fitted into Slot 2 of the IED. Each Ethernet board has two MAC addresses, one for the managed embedded switch and one for the IED.

2.2 Modules

The MiCOM Px3x devices are constructed from standard hardware modules. The following table lists the item numbers of the three variants of the Redundant Ethernet board:

Type	Itemnumber	Description	Width
A	9651 531	KE Dual Ethernet SHP + RS 485 + IRIG-B	4T
A	9651 532	KE Dual Ethernet RSTP + RS 485 + IRIG-B	4T
A	9651 533	KE Dual Ethernet DualHoming + RS 485 + IRIG-B	4T

Table 01: Redundant Ethernet board variants

ВЯРНО С ОРИГИНАЛА

Stara Zagora

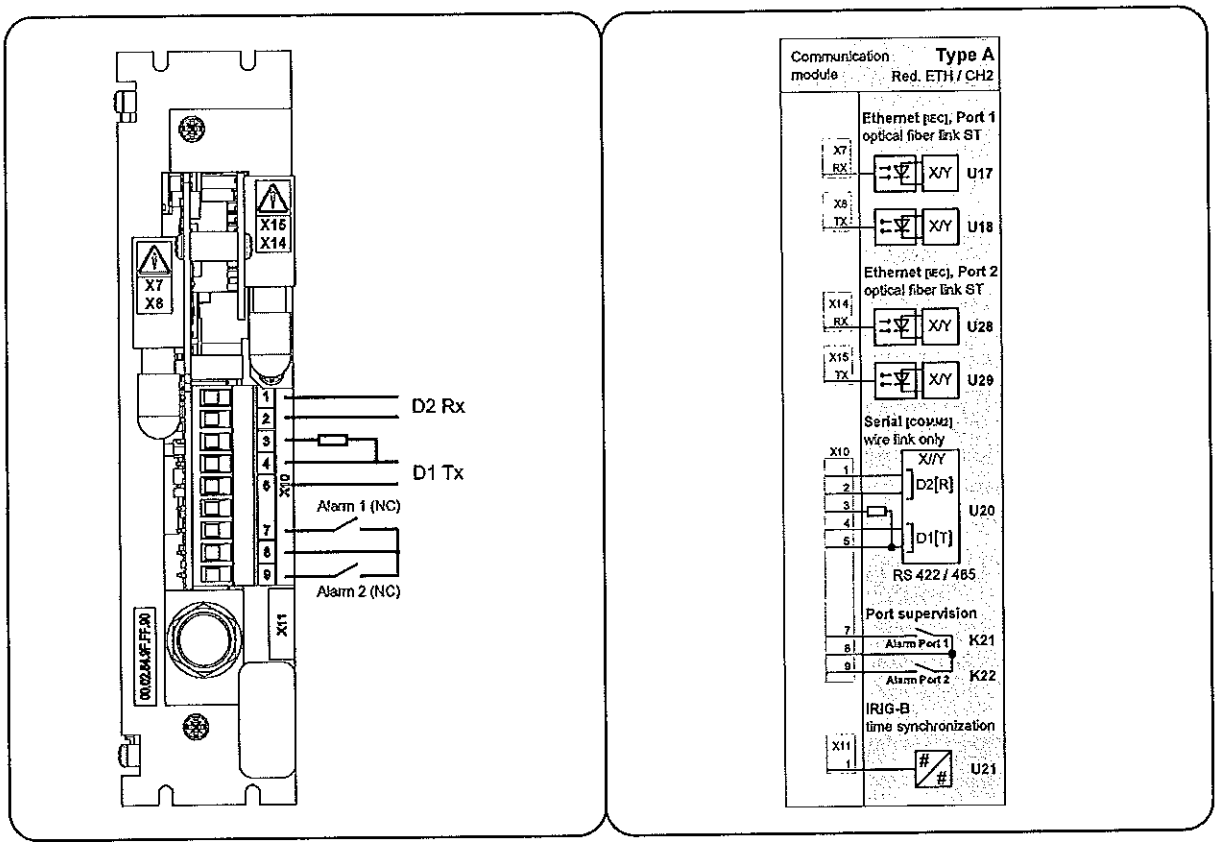

Figure 03: Redundant Ethernet board connection

Pin	Connections
1-2	D2 Rx
3	220 Ohm terminator resistor
4-5	D1 Tx

Table 04: RS422/485 configuration and default values

Pin	Closed	Open
7-8	Link ok Channel 1 (A)	Link fail Channel 1 (A)
8-9	Link ok Channel 2 (B)	Link fail Channel 2 (B)

Table 05: Fiber defect connector (watchdog relay) configuration and default values

ВЯРНО С
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000133

3.2 Self healing protocol (SHP)

SHP is applied to double ring network topologies. When a fiber is broken, both end stations detect the break. Using both the primary and redundant networks the ring is automatically reclosed.

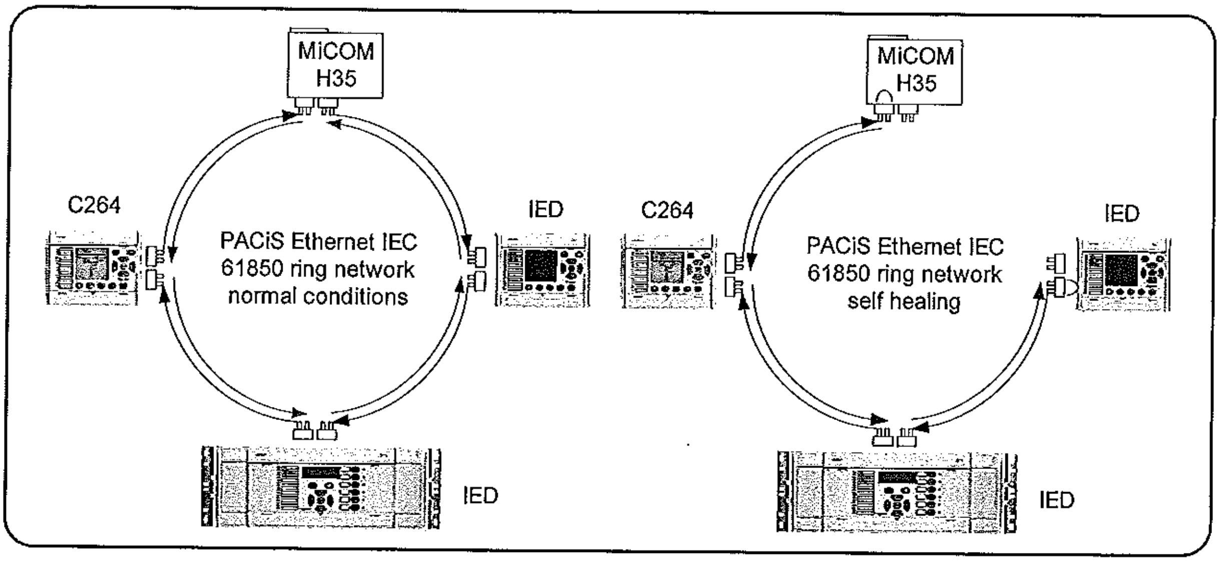

Figure 05: MiCOM IEDs, C264 and H35x Ethernet switch with self healing ring facilities

The MiCOM Px3x, C264 and H35x are repeaters with a standard 802.3 Ethernet switch plus the self healing manager (SHM). Figure 06 shows the internal architecture of such a device.

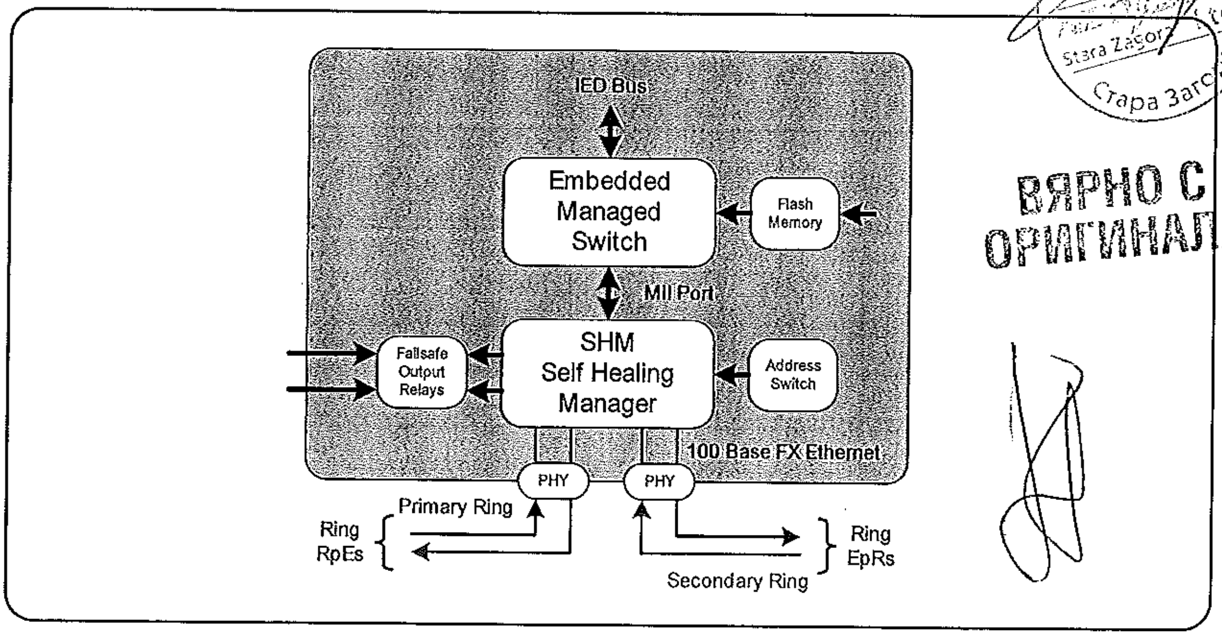

Figure 06: Internal architecture of MiCOM IEDs, and C264 and H35x switches

ВЯРНО С ОРИГИНАЛА

The SHM functions manage the ring. If the fiber optic connection between two devices is broken, the network continues to run correctly.

Normally the Ethernet packets travel on the primary fiber in the same direction, and only a checking frame (4 octets) is sent every 5 µs on the secondary fiber in the opposite direction.

If the link goes down, both SHM's immediately start the network self-healing. At one side of the break, received messages are no longer sent to the primary fiber but are sent to the secondary fiber. On the other

3.3 Dual homing protocol (DHP)

The dual homing mechanism functions manage the double star. If the optical fiber connection between two devices is broken, the network continues to operate correctly.

The dual homing mechanism handles topologies where a device is connected to two independent networks. One is the main link, the other is the backup. Both are active at the same time.

In sending mode, packets from the device are sent by the DHM to the two networks. In receive mode, the duplicate discard principle is used. This means that when both links are up, the MiCOM H36x receives the same Ethernet frame twice. The Dual Homing Manager transmits the first frame received to upper layers for processing, and the second frame is discarded. If one link is down, the frame is sent through the link, received by the device, and passed to upper layers for processing.

Schneider Electric's dual homing mechanism fulfills automation requirements by delivering a very fast recovery time for the entire network (less than 1 ms).

To increase reliability some specific mechanisms are used:

- Each frame carries a sequence number which is incremented and inserted into both frames.
- Specific frames are used to synchronize the discard mechanism.

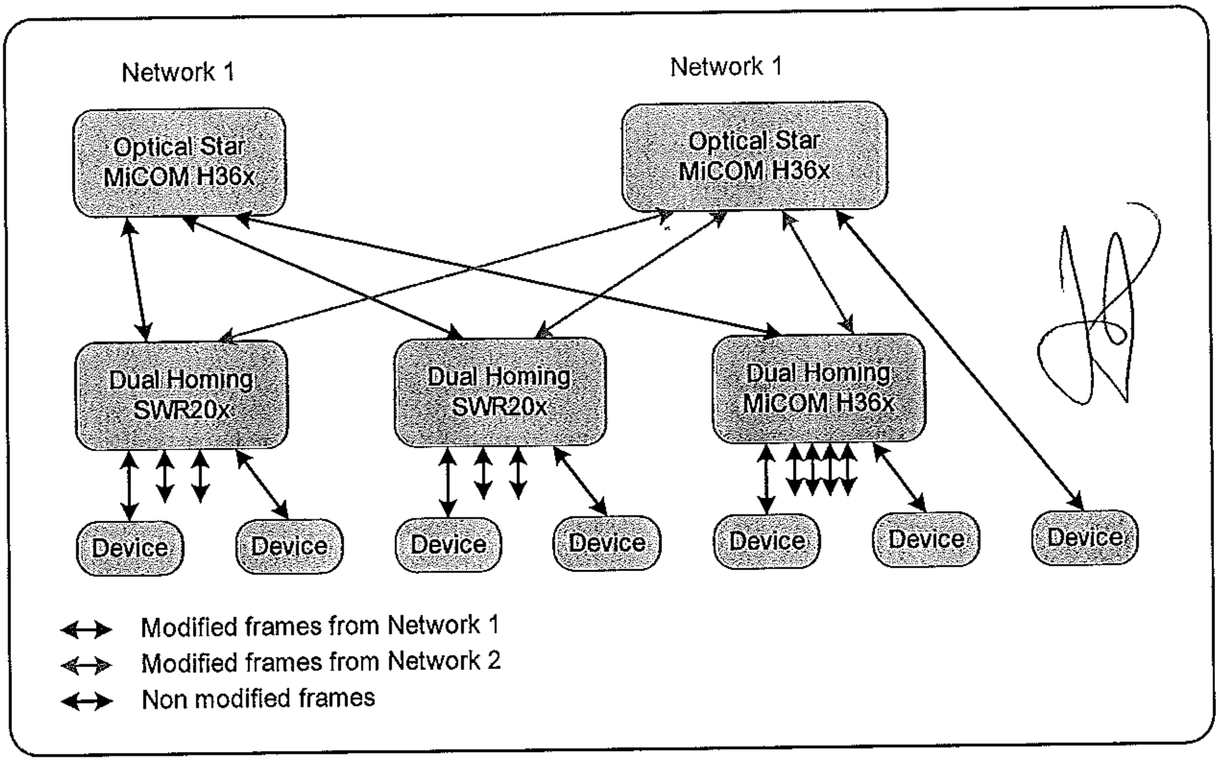

Figure 09: Dual homing mechanism

The MiCOM H36x is a repeater with a standard 802.3 Ethernet switch, plus the dual homing manager. Figure 10 shows the internal architecture of such a device.

3.4 Generic functions for all redundant Ethernet boards

The following apply to all three redundant Ethernet protocols (RSTP, SHP and DHP).

Ethernet 100Base Fx

The fiber optic ports are full duplex 100 Mbps ST connectors.

Forwarding

The MiCOM Px3x, C264, Hx1x and Hx5x switches support store and forward mode. The MiCOM switch forwards messages with known addresses to the appropriate port. The messages with unknown addresses, the broadcast messages and the multicast messages are forwarded out to all ports except the source port. MiCOM switches do not forward error packets, 802.3x pause frames or local packets.

Priority tagging

802.1p priority is enabled on all ports.

Simple Network Management Protocol - SNMP

Simple Network Management Protocol (SNMP) is the network protocol developed to manage devices in an IP network. SNMP relies on a Management Information Base (MIB) that contains information about parameters to supervise. The MIB format is a tree structure, with each node in the tree identified by a numerical Object IDentifier (OID). Each OID identifies a variable that can be read or set using SNMP with the appropriate software. The information in the MIBs is standardized.

Redundant Ethernet board MIB Structure

The SNMP MIB consists of distinct OIDs, each of which refers to a defined collection of specific information used to manage devices on the SCHNEIDER ELECTRIC network. The SCHNEIDER ELECTRIC MIB uses three types of OID (sysDescr, sysUpTime and sysName).

Address												Name
0												CCITT
	1											ISO
		3										Org
			6									DOD
				1								Internet
					2							mgmt
						1						Mib-2
							1					sys
								1				sysDescr
								3				sysUpTime
								4				sysName

Table 06: Redundant Ethernet board MIB Structure

4 Configuration

An Internet Protocol (IP) address is a logical address assigned to devices in a computer network that uses the Internet Protocol for communication between nodes. IP addresses are stored as binary numbers but they are usually displayed in the following format.

10.86.254.85

Both the IED and the redundant Ethernet board have their own IP address. Figure 12 shows the IED as IP1 and the redundant Ethernet board (REB) as IP2. Note that IP1 and IP2 must be different and in the same subnet mask.

The switch IP address must be configured through the network.

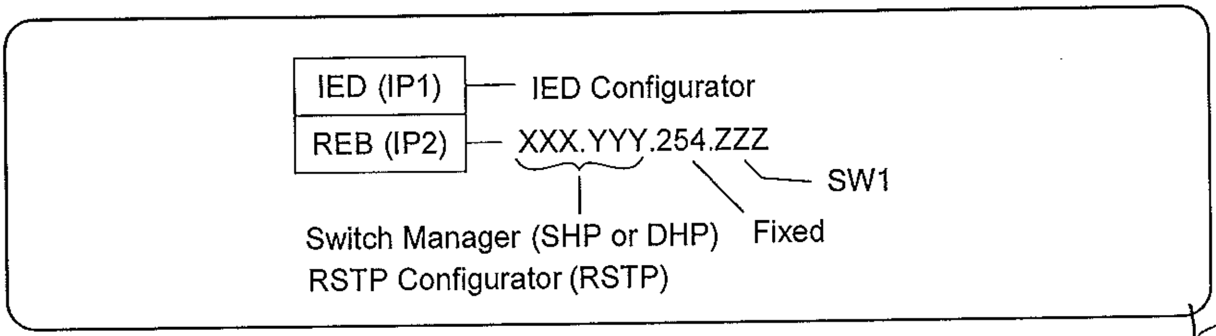

Figure 12: IED and redundant Ethernet board IP address configuration

4.1 Configuring the IED IP address

The IP address of the IED is configured using the IED Configurator software in MiCOM S1 Studio. If using IEC 61850 the IED IP address is set using the IED Configurator. The available range is 1 to 254 in the last octet of the IED IP address. It is recommended to select an octet from the range 128 to 254 to avoid a potential equality with the board IP address.

Note: In the IED Configurator, set the port type to **Copper**, not **Fiber**.

4.2 Configuring the board IP address

The IP address of the redundant Ethernet board is configured in both software and hardware, as shown in Figure 12. Therefore this must be configured before connecting the IED to the network to avoid an IP address conflict.

Configuring the first two octets of the board IP address

If using Self Healing Protocol or Dual Homing Protocol, the first two octets are configured using Switch Manager or an SNMP MIB browser (see section 3.4). An H35 (SHP) or H36 (DHP) network device is needed in the network to configure the Redundant Ethernet Board IP address using SNMP.

If using Rapid Spanning Tree Protocol, the first two octets are configured using the RSTP Configurator software tool or using an SNMP MIB browser.

5 Commissioning

5.1 SHP ring connection

Connect Es to Rs and Ep to Rp until it makes a ring, as shown in Figure 14.

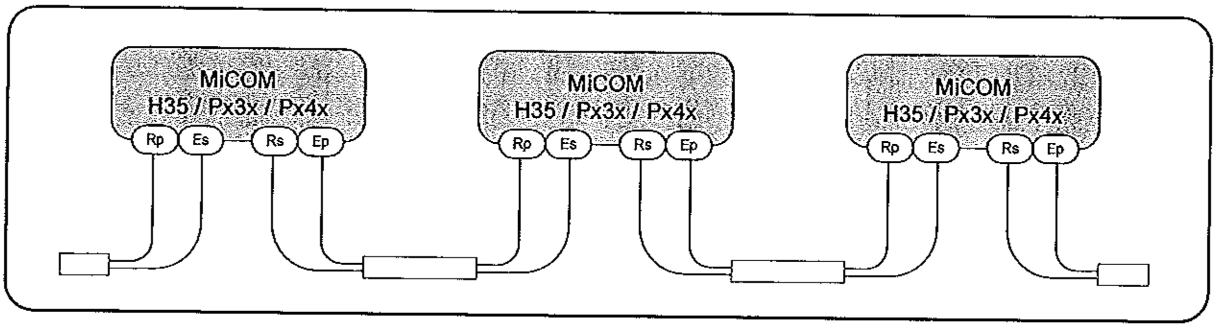

Figure 14: Dual Ethernet ring connections

5.2 DHP star connection

Connect Tx to Rx and Rx to Tx on each device as shown in Figure 15.

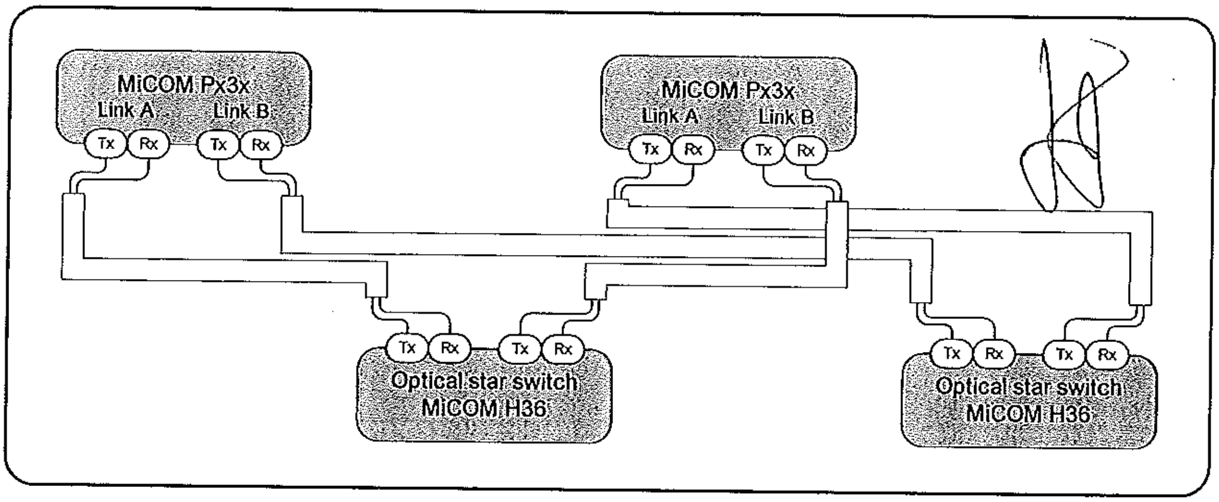

Figure 15: Dual Ethernet star connections

НЕОЛЕТ ООД

5.4 RSTP star connection

Figure 17 shows IED 1 to IED n with the RSTP variant of redundant Ethernet boards connected in a star topology. The star topology can have one or more high-end RSTP-enabled Ethernet switches to interface with other networks, control centers, or IEDs. The Ethernet switch is an RSTP enabled switch with a greater number of ports. The Ethernet switch, which is connected to the controlling PC, should be configured as the root bridge. The bridge priority of the Ethernet switch should be configured to the minimum value in the network.

The IEDs are placed at two hop distance from the root bridge, therefore the Max Age parameter has no impact on star topology.

The maximum number of IEDs that can be connected in the star network depends on the number of ports available in the Ethernet switch, provided that the hop count from the root bridge is less than the Max Age parameter.

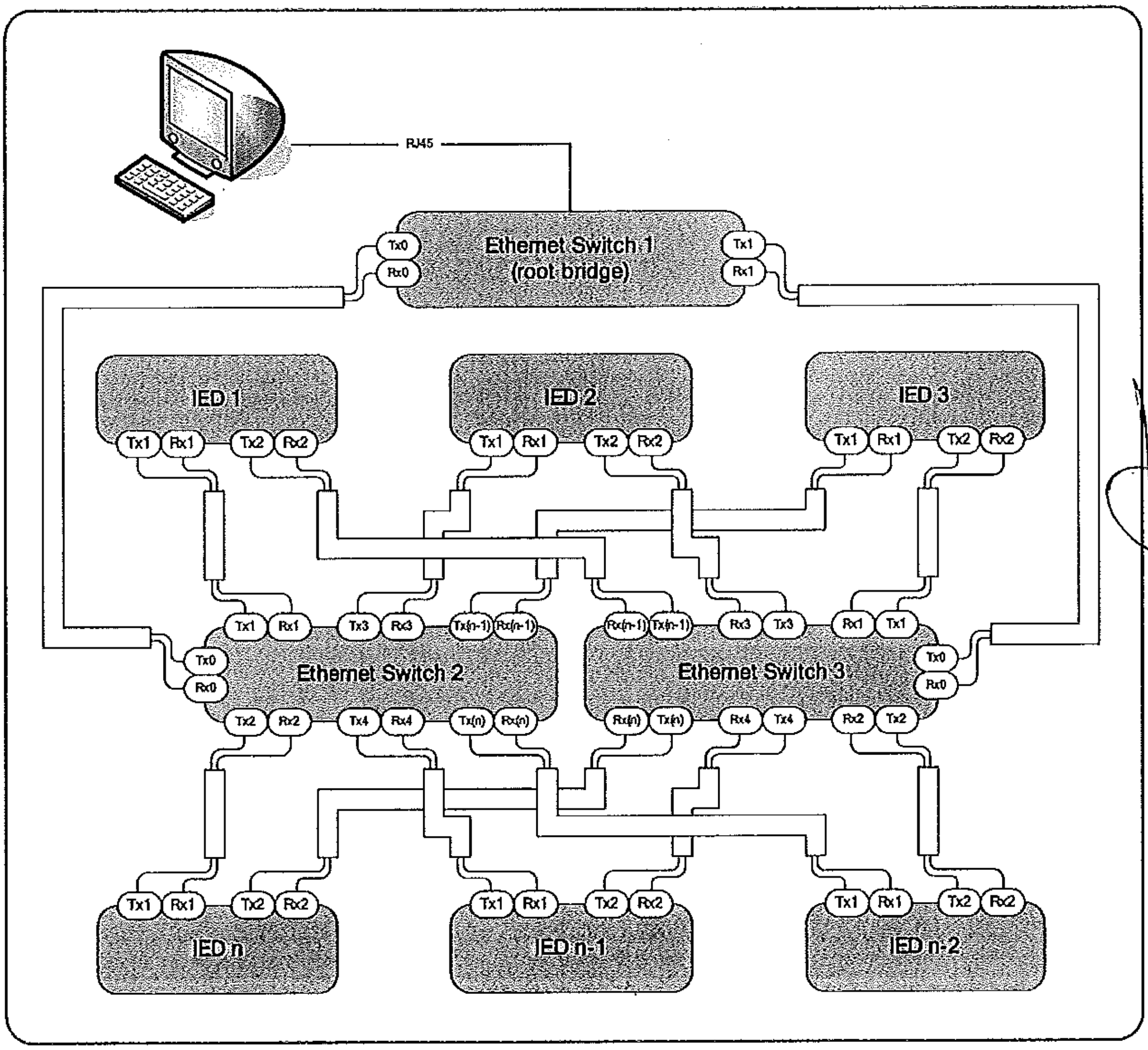

Figure 17: Dual Ethernet star and ring topology

If Max Age is configured as 40 seconds, the maximum number of IEDs that can be connected in the network is (40-1) = 39. According to the IEEE 802.1w standard, the maximum value for the Max Age parameter is limited to 40. To use the maximum number of IEDs in the ring, the following configuration should be used.

Max Age	40 seconds
Forward Delay	30 seconds
Hello Time	2 seconds
Bridge Priority	As required by the end user.

The IEEE 802.1w standard defines the relation between Max Age and Forward Delay as:

2 * (Forward Delay – 1.0 seconds) >= Max Age

To have the maximum number of nodes in the RSTP network, the number of rings can be increased, depending on the number of ports available in the root bridge.

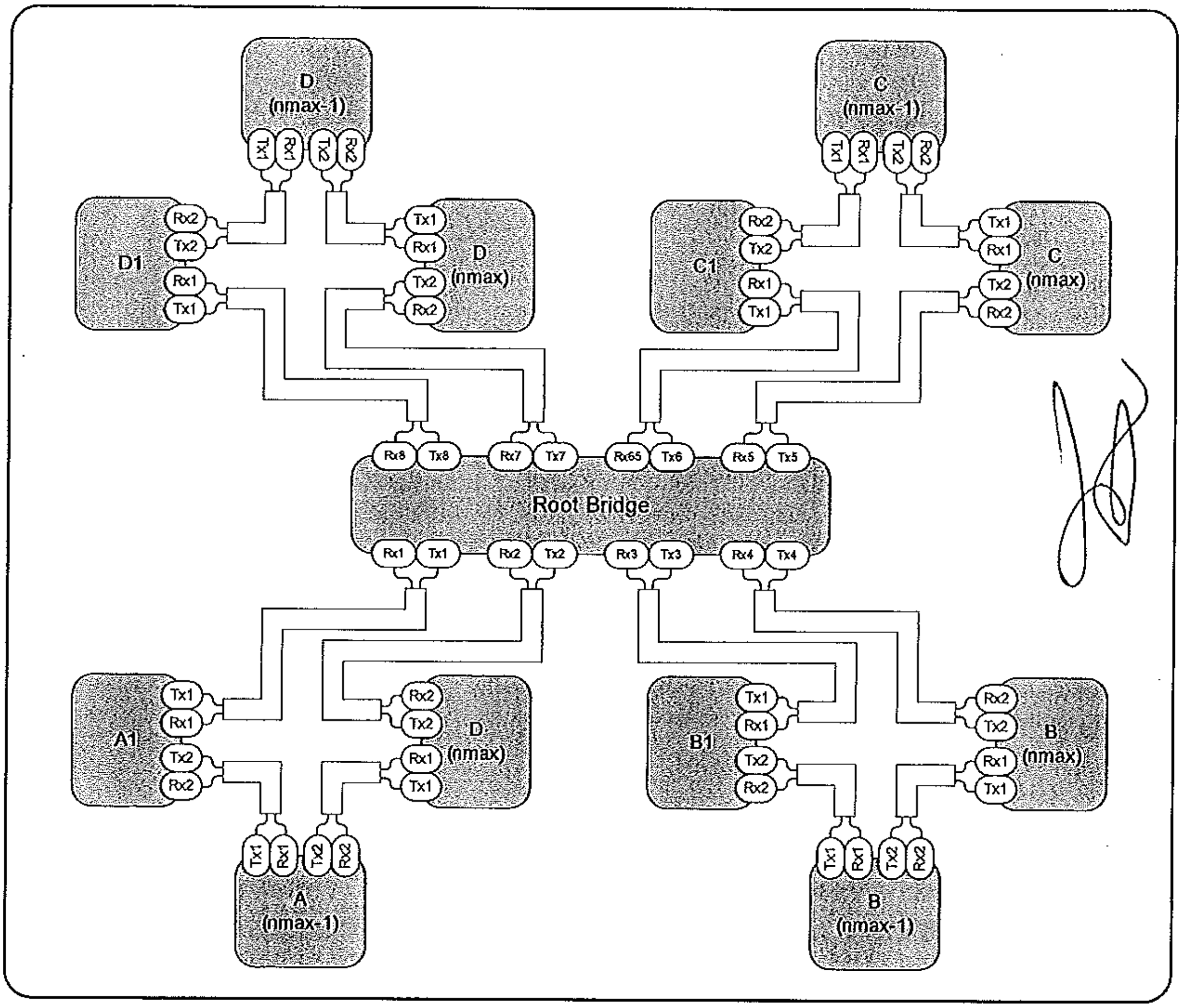

Figure 18: Combined RSTP star and ring topology

7 Cortec

Below cortec (partial example) covers all Px3x IEDs using the redundant Ethernet board. Using redundant Ethernet board for Px30 requires the new power supply unit PSU 2 with order identifiers as listed below.

Px3x English																		
18 character cortec	1234	5	6	7	8	9	10	11	12, 13					14	15	16	17	18
AFS Generic Standard Cortec Px3x	Px3x-								-3xx	-4xx	-5xx	-6xx	-7xx	-47x	-46x	-9x x	-9x x	-8xx
Power supply and additional binary I/O options:																		
VA,nom = 24 … 60 VDC							E											
VA,nom = 60 … 250 VDC / 100 … 230 VAC							F											
VA,nom = 24 … 60 VDC and 6 output relays							G											
VA,nom = 60 … 250 VDC / 100 … 230 VAC and 6 output relays							H											
VA,nom = 24 … 60 VDC and 6 binary inputs and 3 output relays							J											
VA,nom = 60 … 250 VDC / 100 … 230 VAC and 6 binary inputs and 3 output relays							K											
VA,nom = 24 … 60 VDC and 4 high break contacts							L											
VA,nom = 60 … 250 VDC / 100 … 230 VAC and 4 high break contacts							M											
With communication / information interface:																		
Protocol IEC61850, redundant connection [21]																-98		
For connection to 100 Mbit/s Ethernet, glass fiber ST, SHP and IRIG-B input for clock synchronization and 2nd interface (RS485, IEC 60870-5-103)																1		
For connection to 100 Mbit/s Ethernet, glass fiber ST, RSTP and IRIG-B input for clock synchronization and 2nd interface (RS485, IEC 60870-5-103)																2		
For connection to 100 Mbit/s Ethernet, glass fiber ST, dual homing and IRIG-B input for clock synchronization and 2nd interface (RS485, IEC 60870-5-103)																3		

21) IEC61850 redundant connection with power supply options E to M only

Table 08: Cortec for Px3x IEDs using the redundant Ethernet board

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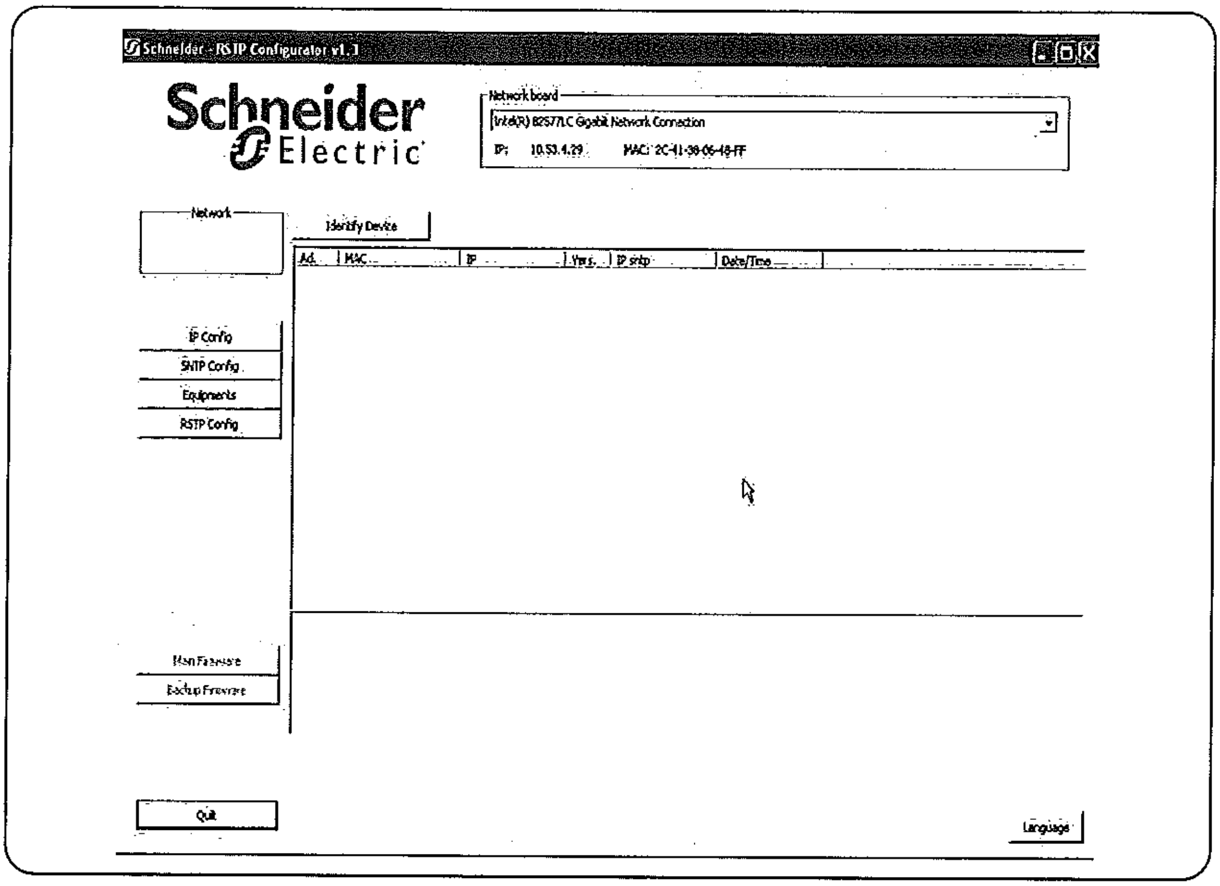

Network board: Intel(R) 82577LC Gigabit Network Connection

IP: 10.53.4.29 MAC: 2C-41-38-06-48-FF

A1.4 Device identification

To configure the redundant Ethernet board, go to the main window and click **Identify Device**.

Note: Due to the time needed to establish the RSTP protocol, it is necessary to wait 25 seconds between connecting the PC to the IED and clicking the **Identify Device** button.

The redundant Ethernet board connected to the PC is identified and its details are listed.

- Device address
- MAC address
- Version number of the firmware
- SNTP IP address
- Date & time of the real-time clock, from the board.

ВЯРНО С ОРИГИНАЛА

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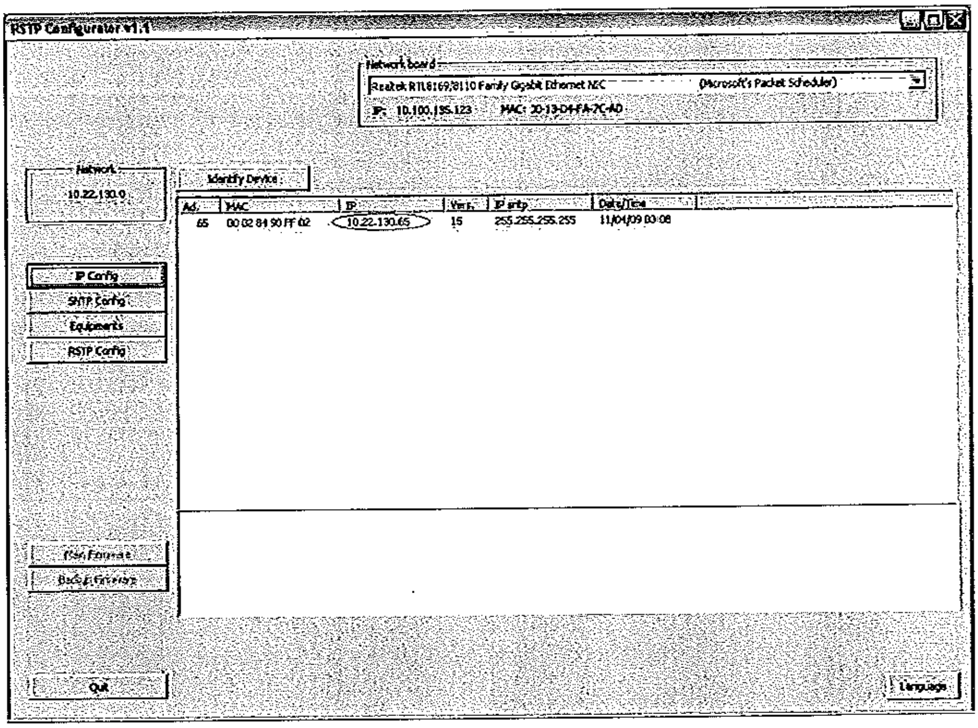


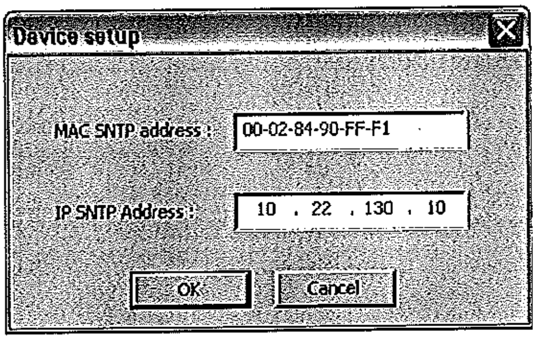
Ad.	MAC	IP	Vers.	IP sntp	Date/Time
65	00 02 84 90 FF 02	10.22.130.65	15	255.255.255.255	11/04/09 00:08

A1.6 SNTP IP address configuration

To configure SNTP server IP address, go to the main window and click the **SNTP Config** button. The **Device setup** screen appears.

Enter the required SNTP MAC and server IP address. Then click **OK**.

The updated SNTP server IP address appears in the main screen.



MAC SNTP address : 00-02-84-90-FF-F1

IP SNTP Address : 10 . 22 . 130 . 10

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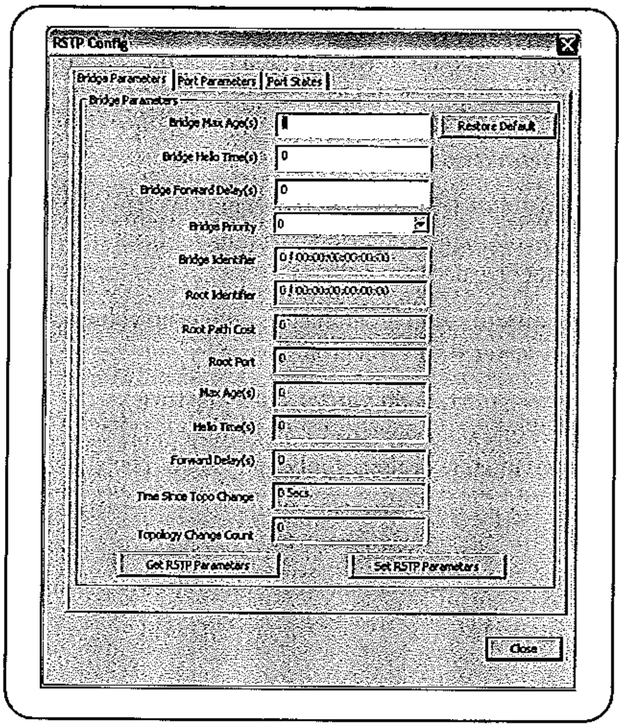
A1.8 RSTP configuration

To view or configure the RSTP Bridge Parameters, go to the main window and click the device address to select the device. The selected device MAC address appears highlighted.

Click the **RSTP Config** button. The RSTP Config screen appears.

To view the available parameters in the board that is connected, click the **Get RSTP Parameters** button.



Bridge Parameters

Bridge Max Age(s):
Bridge Hello Time(s): 0
Bridge Forward Delay(s): 0
Bridge Priority: 0
Bridge Identifier: 0 / 00:00:00:00:00:00
Root Identifier: 0 / 00:00:00:00:00:00
Root Path Cost: 0
Root Port: 0
Max Age(s): 0
Hello Time(s): 0
Forward Delay(s): 0
Time Since Topo Change: 0 Secs.
Topology Change Count: 0

To set the configurable parameters such as **Bridge Max Age, Bridge Hello Time, Bridge Forward Delay,** and **Bridge Priority,** modify the parameter values according to Table 1 and click **Set RSTP Parameters.**

S.No	Parameter	Default value (second)	Minimum value (second)	Maximum value (second)
1	Bridge Max Age	20	6	40
2	Bridge Hello Time	2	1	10
3	Bridge Forward Delay	15	4	30
4	Bridge Priority	32768	0	61440

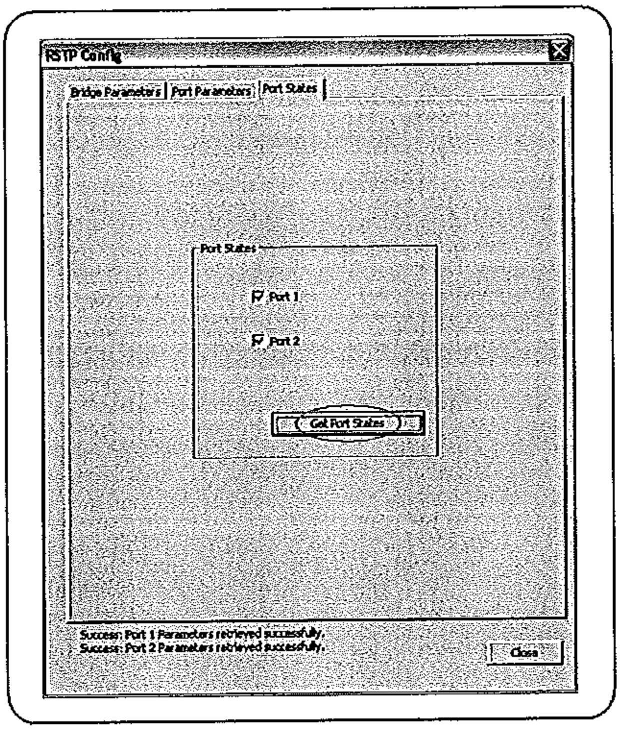
RSTP configuration parameters ranges and default values

Port states

This is used to see which ports of the board are enabled or disabled.

From the main window, click the device address to select the device. The **RSTP Config** window appears.

Select the Port States tab then click the Get Port States button. This lists the ports of the Ethernet board. A tick shows they are enabled.



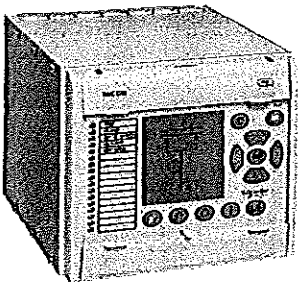
☑ Port 1

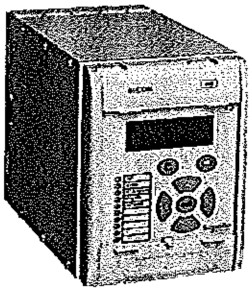
☑ Port 2

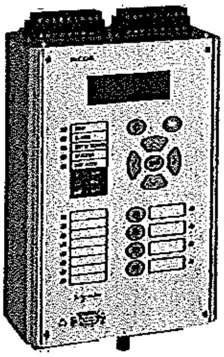
Success: Port 1 Parameters retrieved successfully.
Success: Port 2 Parameters retrieved successfully.

MiCOM P13x range

Feeder management, overcurrent protection and switchgear control


MiCOM P139 - One Box Feeder Management


MiCOM P132 - Tailored Feeder Management


MiCOM P130C - Compact Feeder Protection

MiCOM P13x range provides the complete solution for feeder protection and switchgear control by using one common platform. Starting from stand-alone overcurrent or voltage & frequency protection up to multifunctional one-box feeder management solutions, including specific operation and control automation like synchronising, 2-pole bay control and direct switchgear control.

The broad spectrum of protection functions enables the user to cover a wide range of applications in the protection of cables and overhead lines, transformers and motors in solidly, low-impedance, resonant-grounded or isolated network systems.

Individual customisation allows the user to optimise the configuration to find the best technical solution whilst also optimising investment costs. Combining a highly robust hardware design with excellent reliability and guaranteed long life allows users the confidence in selecting MiCOM P13x. High customer value over the entire lifecycle of the product is proven with 80,000 MiCOM P13x devices installed to date.

The intuitive user interface and the various communication interfaces allow fast and comprehensive setting and reading of the extensive recordings. Numerous integrated communication protocols provide interfacing to almost any kind of substation control or SCADA system.

Furthermore the integrated InterMiCOM protection interface provides direct end-to-end communication between two protection devices.

The compact case of the P130C and the 19" modular case variants of the P132/P139 provide a flexible solution for easy integration of the devices into any substation environment. Both case variants are available for flush mounting and wall-surface mounting. P132 also has a narrow 24TE version and the detachable HMI available on P132 or P139 allows installation in space limited cubicle designs.

Customer Benefits

- Standardized functionality for all MiCOM P13x
- Function keys for easy maintenance and operation
- High availability and reliability with redundant communication facilities
- Integrated 2-pole and direct motor drive control for switchgears
- Adapt to changing system conditions using 4 available setting groups to optimise protection
- Proven long years operation experience

Schneider Electric

Application

For the different requirements in system protection the integrated functions follow the availability of CT and VT inputs (order options). The following preferred applications are available

- P130C/ P132 with VT only:
  Voltage and Frequency Protection
- P13x with CT only:Directional Time-Protection
  Non-Directional Time-Overcurrent
- P13x with CT and VT:
  Directional Time-Overcurrent Protection

MiCOM P132 and P139 are provided with enhanced switchgear control capabilities.

Main functions

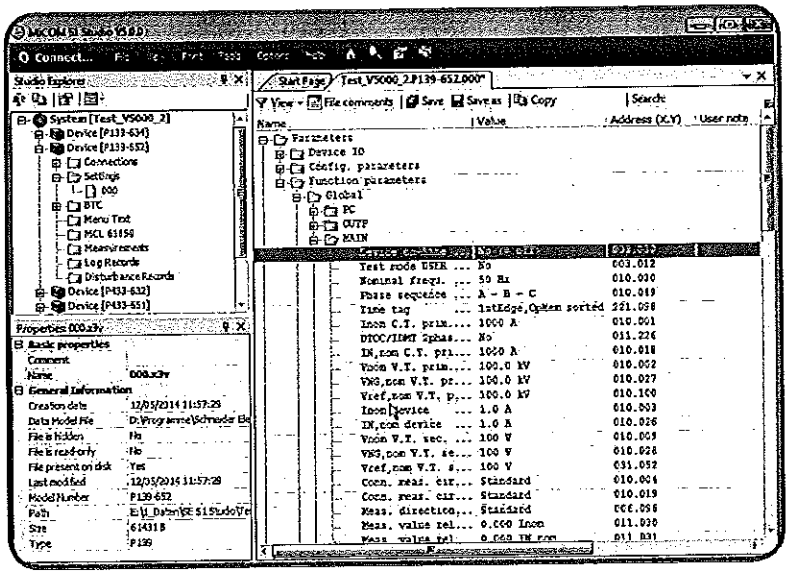
Autonomous function groups can be individually configured or disabled to suit a particular application. To improve user friendliness and clarity only activated Function Groups can be customized, all other parameter are not visible.

This permits an extensive scope of functions and use of the device in many or universal applications, whilst also providing a straight-forward setting procedure and adaptation to the protection and control tasks under consideration.

Global functions

Available in all P13x devices:

- Parameter subset selection (4 setting groups)
- Metering
- Operating data recording
- Overload recording
- Ground fault recording
- Earth-fault recording of all CT/VT inputs and binary signals



System [Test_V5000_2]
- Device [P133-634]
- Device [P133-652]
  - Connections
  - Settings
    - 000
  - BTC
  - Menu Text
  - MCL 61850
  - Measurements
  - Log Records
  - Disturbance Records
- Device [P433-632]
- Device [P433-551]

Properties 000.x3v

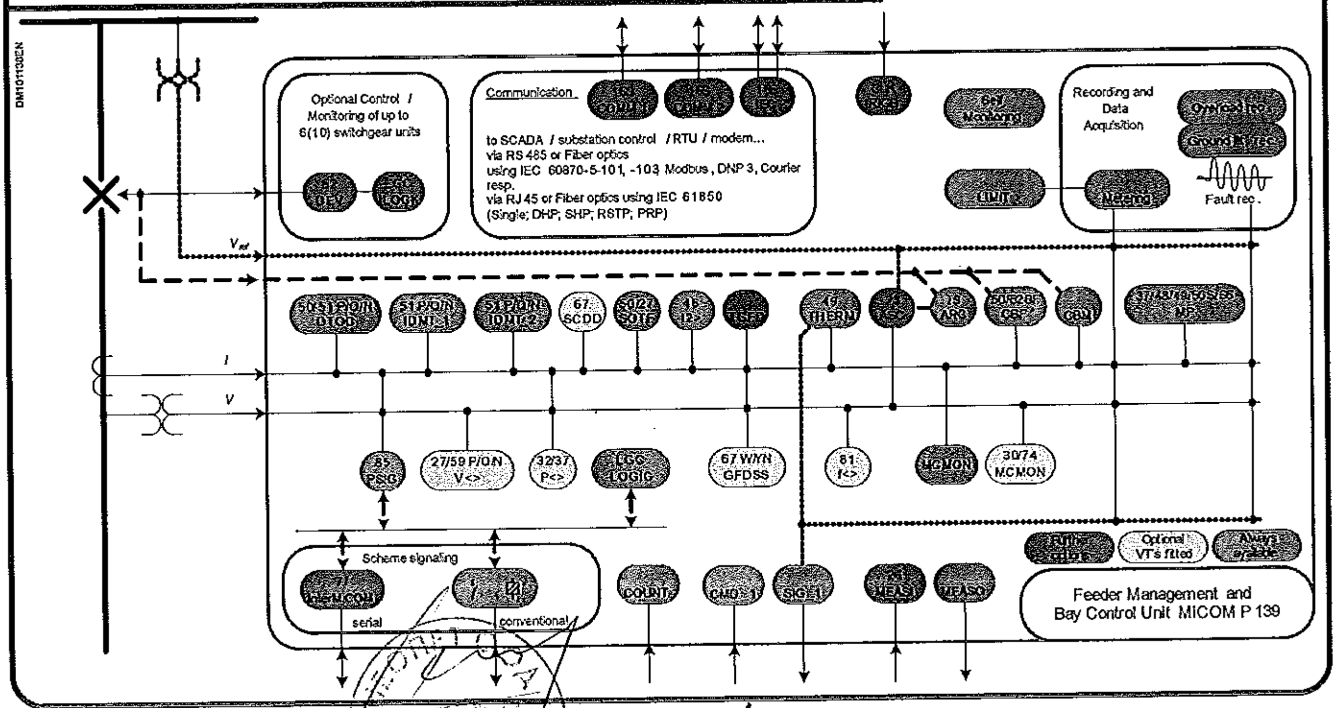
Basic properties	
Comment	
Name	000.x3v
General Information	
Creation date	12/05/2014 11:57:29
Data Model File	D:\Programme\Schneider Ele
File is hidden	No
File is read-only	No
File present on disk	Yes
Last modified	12/05/2014 11:57:29
Model Number	P139-652
Path	E:\1_Daten\SE S1 Studio\Ve
Size	61431 B
Type	P139

Parameters
- Device ID
- Config. parameters
- Function parameters
  - Global
    - PC
    - OUTP
    - MAIN

Name	Value	Address (X.Y)	User note
Test mode USER ...	No	003.012	
Nominal frequ. ...	50 Hz	010.030	
Phase sequence ...	A - B - C	010.049	
Time tag ...	1stEdge,OpMen sorted	221.098	
Inom C.T. prim....	1000 A	010.001	
DTOC/IDMT 2phas...	No	011.226	
IN,nom C.T. pri...	1000 A	010.018	
Vnom V.T. prim....	100.0 kV	010.002	
VNG,nom V.T. pr...	100.0 kV	010.027	
Vref,nom V.T. p...	100.0 kV	010.100	
Inom device ...	1.0 A	010.003	
IN,nom device ...	1.0 A	010.026	
Vnom V.T. sec. ...	100 V	010.009	
VNG,nom V.T. se...	100 V	010.028	
Vref,nom V.T. s...	100 V	031.052	
Conn. meas. cir...	Standard	010.004	
Conn. meas. cir...	Standard	010.019	
Meas. direction...	Standard	006.096	
Meas. value rel...	0.000 Inom	011.030	
Meas. value rel...	0.000 IN,nom	011.031	

Simple Function Selection by Mouseclick

Function diagram



to SCADA / substation control / RTU / modem...
via RS 485 or Fiber optics
using IEC 60870-5-101, -103 Modbus, DNP 3, Courier resp.
via RJ 45 or Fiber optics using IEC 61850
(Single; DHP; SHP; RSTP; PRP)

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ANSI	IEC 61850(2)	Group	Function	P130C(3)	P132(3)	P139
50P	DtpPhsPTOCx	DTOCx	Definite-time phase o/c	3	3	3
50Q	DtpNgsPTOCx	DTOCx	Definite-time neg.-sequence o/c	3	3	3
50N	DtpEftPTOCx	DTOCx	Definite-time neutral/residual o/c	4	4	4
51 P	ItpPhsPTOCx	IDMTx	Inverse-time phase o/c	1	2 x 1	2 x 1
51Q	ItpNgsPTOCx	IDMTx	Inverse-time neg.-sequence o/c	1	2 x 1	2 x 1
51N	ItpEftPTOCx	IDMTx	Inverse-time neutral/residual o/c	1	2 x 1	2 x 1
Including protection applications as: Cold load pick up; High-impedance phase and sensitive ground fault protection						
67P/N	DtpPhs-/DtpResRDIRx	SCDD	Short circuit direction detection	□	□	□
	PHAR1	MAIN	Inrush stabilisation	■	■	■
85-21	PsgPhsPSCH1	PSIG	Protective signaling	■	■	■
50/27	SofPhs-/ SofEftPSOF1	SOTF	Switch onto fault	■	■	■
67W/YN	PSDE1	GFDSS	Ground fault direction determination	□	□	□
	PTEF1	TGFD	Transient GF direction determination		□	□
14/37/48/49/ 49LR/50S/66	MotPMRI1/ MotPMSS1/ MotPTTR1/ ZMOT1	MP	Motor	■	■	■
46	UbpNgsPTOCx	I2>	Imbalance	■	■	■
49	ThmPTTR1	THERM	Thermal overload	■	■	■
27/59 P	VtpPhsPTyVx	V<>	Phase over/ undervoltage	(4)	(6)	(6)
27/59/47 P	VtpPssPTyVx	V<>	Positive sequence over/undervoltage	(4)	(4)	(4)
27/59/47 Q	VtpNgsPTOVx	V<>	Negative sequence overvoltage	(2)	(2)	(2)
27/59/47 N	VtpResPTOVx	V<>	Neutral overvoltage	(2)	(2)	(2)
27/59 P	VtpRefPTyVx	V<>	Over/ undervoltage		(4)	(4)
81	FrqPTyFx	f<>	f, df/dt, Df/Dt - ROCOF	(4)	(4)	(4)
32	PdpAct-/PdpReaPDyPx	P<>	Directional power	□	□	□
79	RREC1	ARC	Auto-reclosing control	3-pole	.3-pole	3-pole
25	RSYN1	ASC	Automatic synchronism check	□	□	□
50BF (62BF)	RBRFx	CBF	Circuit breaker failure	(1)	1	1
30/74	AlmGGIO1	MCMON	Measuring circuit monitoring, Broken Conductor	1	1	1
30/74	AlmGGIO1	CTS	Current transformer supervision			
		LIMIT	Limit value monitoring	■	■	■
	XCBR1	CBM	Circuit breaker monitoring		■	■
LGC	PloGGIOx	LOGIC	Programmable logic, incl. Trip Circuit Supervision(TCS)	■	■	■
Measuring inputs	Mmuxxx		Phase and neutral currents	(3 + 1)	3 + 1	3 + 1
			Phase and neutral voltages	(3)	(3 + 1)	(3 + 1)
			Sync-check reference voltage		(1)	(1)
(max; depend on config)		INP	Opto inputs	2	4 ... 70	10 ... 70
(max; depend on config)		OUTP	Output relays (high break outputs)	8	8-32 (16)	14- 28 (16)
		FKEY	Function keys	4	6(1)	5
26	RtdGGIO1		RTD inputs		(9)	(9)
	IdcGGIO1	MEASI	1x Measuring data input 20 mA		□	□
		MEASO	2 x Measuring data output 20 mA		□	□
	LLN0.SGCB	PSS	Parameter subset selection	■	■	■
	PTRCx/ RDRE1	FT_RC	Fault recording	■	■	■
52	XCBRx, XSWIx,CSWIx	DEVxx	Controllable switchgear units		1 (3)	3 (10)
		CMD_1	Single-pole commands		12	26
		SIG_1	Single-pole signals		12	64
LGC		ILOCK	Interlocking logic		□	■
		COUNT	Binary counters		4	4
16S		COMMx	DNP3, IEC60870-5-101/103, Modbus, Courier	□	□	□
CLK		IRIGB	Time synchronisation IRIG-B	□	□	□
16E		IEC	Ethernet Interface RJ 45 or FO, IEC 61850		□	□
			Redundant Ethernet (RSTP/SHP/DHP/PRP)		□	□
	GosGGIOx	GOOSE	GOOSE Communication		128	128
		COMM3	InterMiCOM interface	□	□	□

■ = STANDARD; □ or (x) = ORDER OPTION; (1) = Not for P132 in 24 TE; (2) not for P130C; (3) P130C/ P132 with CT

ВЯРНО С ОРИГИНАЛА

Time-overcurrent protection

P13x provides 3-phase, residual and negative-sequence overcurrent protection with instantaneous, definite time or inverse time characteristic.

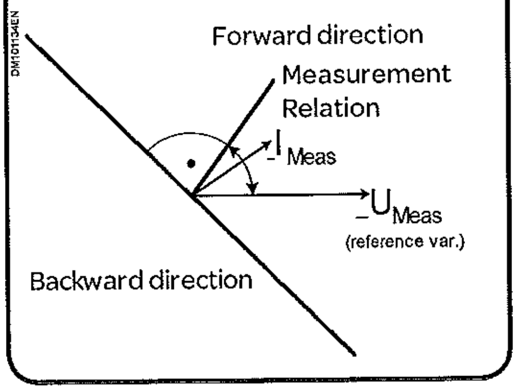
The operating values of all overcurrent stages can be dynamically changed (Cold load pickup). Inrush stabilization can be assigned to all overcurrent stages individually.
The residual and negative-sequence current stages can be integrated into general starting signal.

Short-circuit direction determination

For directional operated overcurrent protection, the overcurrent stages can be individually assigned whether they are forward, backward or non-directional.

Direction determination is performed in separate measuring systems for the phase and residual current elements, respectively.

Directional characteristic



Earth-fault direction determination

For the determination of the earth-fault direction in isolated or Peterson-coil compensated power systems two proven methods are provided:

- Wattmetric or Admittance (steady-state signals)
- Transient method

Switch on to fault protection

Closing of a circuit breaker might inadvertently lead to a short-circuit fault due to a maintenance earth clamp not yet removed. Switch on to fault provides an instantaneous trip during a settable time after a manual close command.

Directional power protection

Monitor of the active and reactive power limits and detection of power drop and reversal of direction.

Over/Undervoltage protection

The **three stage** Over/Undervoltage protection allows the multi-stage evaluation of directly measured and internally calculated voltages.

Over/Underfrequency protection

The **four-stage** Over/Underfrequency protection can be operated also combined with differential frequency gradient monitoring (df/dt) for system decoupling applications or with medium frequency gradient monitoring (Δf/Δt) for load shedding applications.

Circuit breaker failure protection

This function could be used to trigger a second trip coil, for instance. With the trip command, two timer stages are started for circuit breaker action monitoring. If the current still exceeds still the set current threshold after the first timer stage, a second trip command will be issued.

Circuit breaker monitoring

This function provides the user with several criteria for the assessment of circuit breaker wear:

- Remaining operations based on the CB wear curve
- Mechanical operations count
- Interrupted currents sum (linear and squared)
- Accumulated current-time integrals of trips

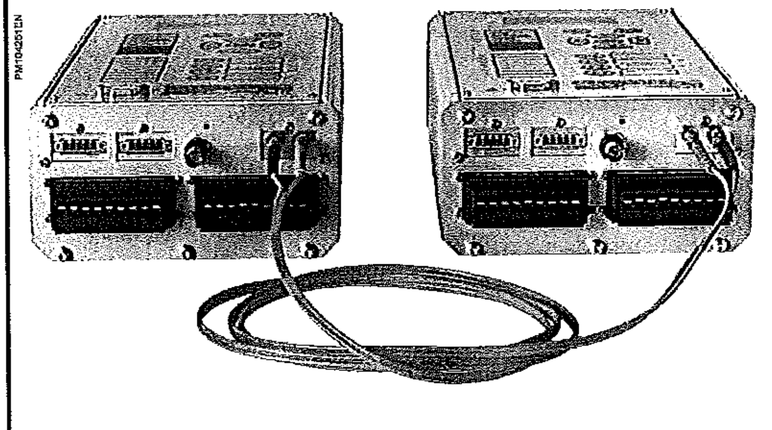
For each of these criteria, a signaling threshold can be set by the user.

Protective signaling

Protective signaling can be used in conjunction with short-circuit direction determination by pilot wires or the optional protection interface InterMiCOM on both ends of the line section to be protected.

Protection interface InterMiCOM

InterMiCOM provides eight end-to-end signal bits, assignable to any function within a MiCOM device. Default failsafe states can be set in case of channel outage.



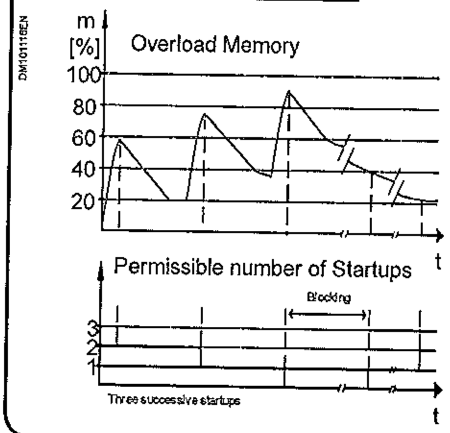
InterMiCOM with Compact Devices

MiCOM P13x for rapid and selective fault clearance in your power system

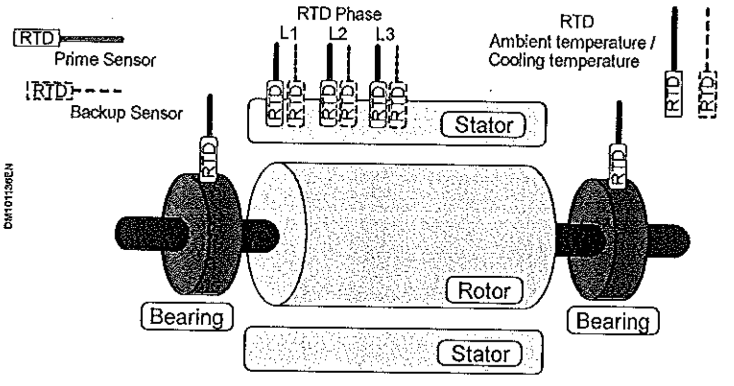
ВЯРНО С ОРИГИНАЛА

000139

Motor start-up supervision



Temperature detection of a motor for limit monitoring and thermal overload protection



Motor protection

For the protection of directly switched HV induction motors with thermally critical rotor, the following specially matched protection functions are provided:

- Recognition of operating mode
- Rotor overload protection using a thermal replica
- Choice of or logarithmic tripping characteristic
- Motor start up frequency supervision
- Different cooling for rotating and stopped motors
- Control logic for heavy starting and locked rotor

Using the optional RTD inputs, direct monitoring of the temperature of the stator windings and the bearings can be set up with the P132 and P139.

Measured data inputs and outputs

For acquisition of an externally measured variable or output of measurements P132/P139 can be provided with one 0 to 20 mA input and two 0 to 20 mA outputs.

Settable scaling allows a simple modification of the input respective outputs ranges (e.g. 0 to 10 mA, 4 to 20 mA). Up to 10 optional resistance temperature detectors (RTD) are provided for direct temperature acquisition.

Depending on the set operating mode, the RTD's operate in parallel or the RTD's can be subdivided into regular inputs and reserve inputs.

Thermal overload protection

P13x range provides thermal overload protection for lines, transformers and stator windings of High Voltage motors. The highest of the three phase currents serves to track a first-order thermal replica according to IEC 255-8. For the P132/9 the temperature of the cooling medium can be taken into account in the thermal replica using the optional RTD inputs or the optional 20 mA input. The user has a choice of using a thermal replica on the basis of either relative or absolute temperature.

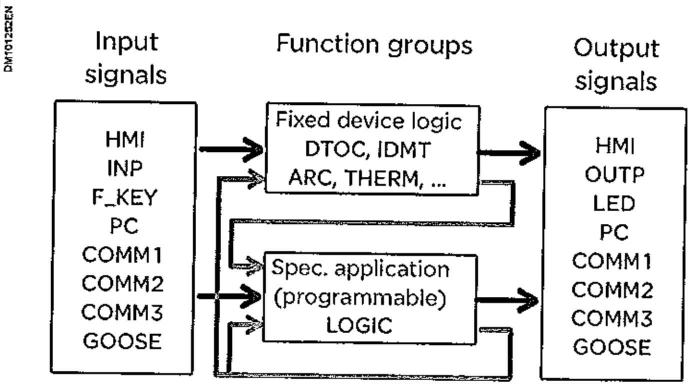
Umbalance Protection

The negative-sequence current is determined from the filtered fundamental wave of the three phase currents. The evaluation of the negative-sequence current is performed in two time-overcurrent stages with definite-time delay.

Programmable Logic

User-configurable logic allows defining logic operations on binary signals within a framework of Boolean equations.Any of the signals of the protection device can be linked by logic 'OR' or 'AND' operations with the possibility of additional negation operations

Programmable scheme logic



Switchgear Control functions

The control functions are designed for the control of up to ten electrically operated switchgear units (P139) equipped with electrical check-back signaling located in the bay of a medium or high voltage substation.

External auxiliary devices are largely obviated through the integration of binary inputs and power outputs that are independent of auxiliary voltages, by the direct connection option for current and voltage transformers and by the comprehensive interlocking capability.

P139 is provided with over 250 pre-defined bay types (P132 approx 80). These include the assignment of binary inputs and outputs for the switchgear unit control and monitoring and the interlocking logic. Pre-defined IEC standard descriptions for switchgear devices and busbars can be simply modified by setting phase if there is any need to adapt to customer specification.

New customized bay types can be created with the separate tool Bay Type Configurator "BTC" and downloaded to P139.

The P132/P139 issues switching command outputs with the integration of switching readiness and permissibility tests; subsequently the P132 and P139 monitor the intermediate position times of the switchgear units. If a switchgear malfunction is detected, this fact will be indicated (e.g. by an appropriately configured LED indicator).

Optional high break output contacts allow direct control of motor operated HV/ MV primary switchgears as disconnectors or earthing switches. With this integrated solution external motor power relays could be fully replaced. Minimising the dimensions of the low voltage compartments of Metal Clad switchgear panels and improving the installation costs and quality by reduction of external components and manual work are two such advantages.

The acquisition of further binary inputs is in the form of single-pole operating signals; they are processed in accordance with their significance for the substation (circuit breaker readiness, for example). In addition to the switching command output, triggering of binary outputs by single-pole commands is possible.

Automatic synchronism check

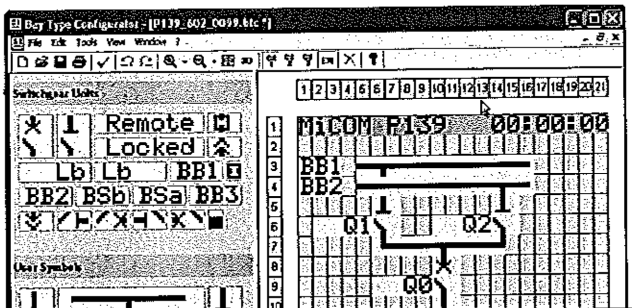
This option for the P132 and P139 can be used in conjunction with automatic or manual (re)closure and the close command of the optional control function. In non-radial networks this ensures that reclosure will proceed only if the synchronism conditions are met.

Auto-reclosing control (ARC)

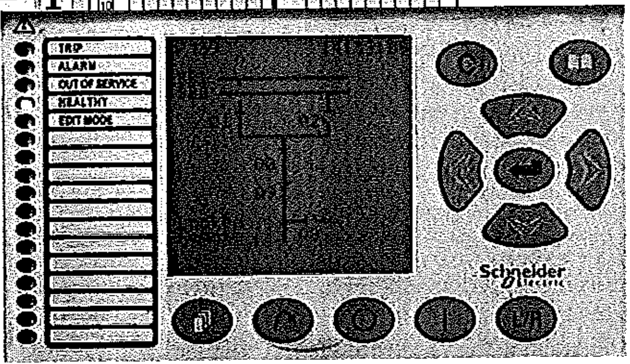
Auto-reclosing control (ARC) operates in three-phase mode. ARC cycles with one high-speed reclosing (HSR) and up to nine subsequent time-delay reclosings (TDR) may be configured by the user.

Binary counter

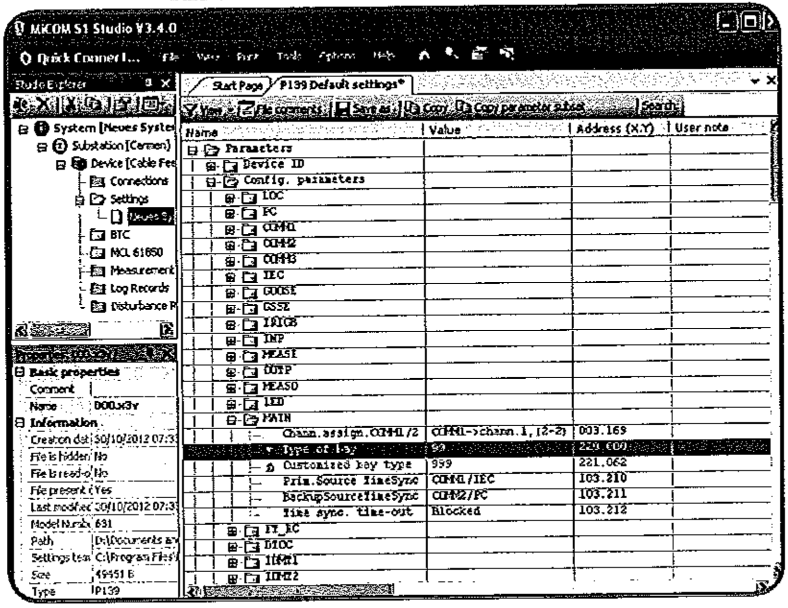
For the acquisition of binary counts, four binary inputs may be configured (P132/P139). In the event of loss of operating voltage, the count is stored.



Bay type creation with BTC



Selection of bay type



Name	Value	Address (X.Y)	User note
Chann.assign.COMM1/2	COMM1->chann.1,(2-2)	003.169	
Type of bay	99	220.000	
Customized bay type	999	221.062	
Prim.Source TimeSync	COMM1/IEC	103.210	
BackupSourceTimeSync	COMM2/PC	103.211	
Time sync. time-out	Blocked	103.212	

> "Proven control, advanced communication, complete local control with simple data handling"

Information interfaces

Information exchange is done via the local control panel, the PC interface and two optional communication interfaces.

The first communication interface has settable protocols conforming to IEC 60870-5-103/ -101, DNP 3.0, Modbus and Courier or provides alternatively protocol conforming to IEC 61850 (Redundant) and is intended for integration with substation control systems.

The 2nd communication interface (COMM2) conforms to IEC 60870-5-103 and is intended for central settings or remote access.

Clock synchronization can be achieved using one of the protocols or using the IRIG-B signal input.

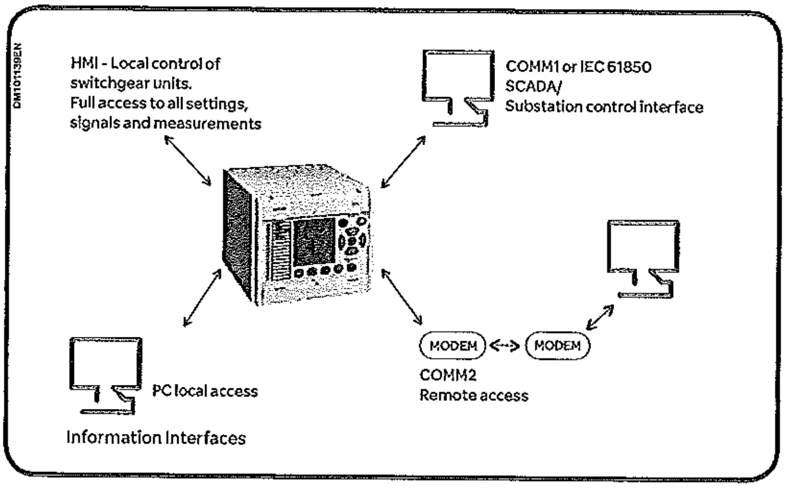
Local control and graphic display

From the Local Control Panel all data required for operation of the protection and control unit could be entered, the data important for system management are read out and the local control of switchgear units is executed.

With the help of the Display Panels, the user is able to carry out a quick and up-to-date check of the state of the bay.

On the Bay Panel the selected bay is displayed as a single-pole equivalent network (single line diagram) with the updated switchgear status. Moreover, ancillary information is displayed.

Up to 28 status signals are displayed on the Signal Panels which are activated automatically upon status changes. Moreover, presentation modes for the display of status data and status change information can be selected.



Information Interfaces

Selected measured values are displayed on the Measured Value Panels. The type of measured values shown (such as measured operating data or measured fault values) will depend on the prevailing conditions in the substation.

The Event Panel displays the most recent events with time-tagging such as the opening of a switchgear unit.

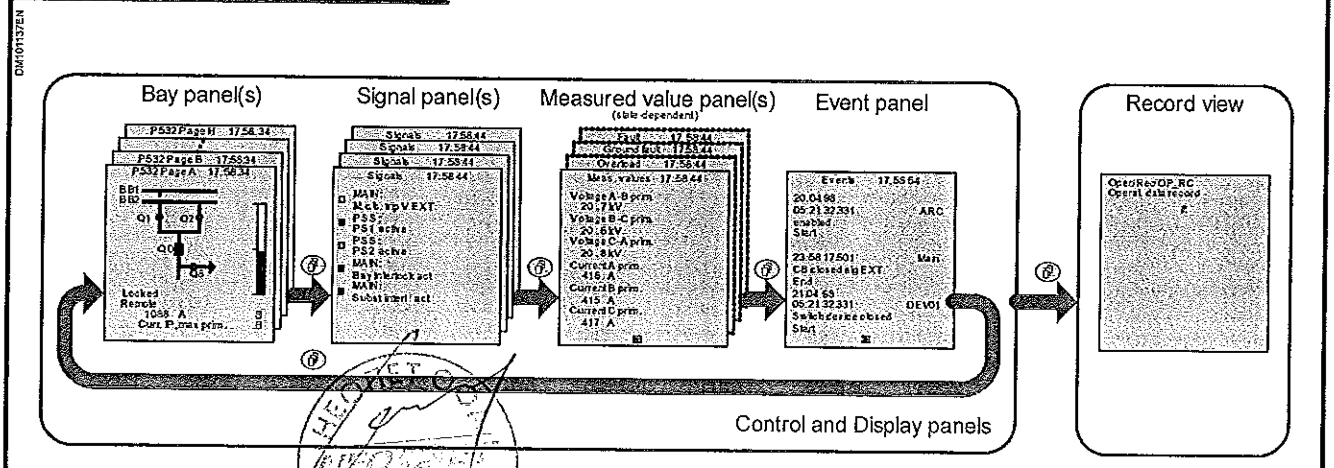
Function keys

The function keys provide easy local control of processes or functions by the user.

A single function can be assigned to each function key that allows manually opening and closing of the CB, enabling and disabling of functions, quick navigation with the selected menu jump list or reset of stored information.

For each function key, the user can define an operating mode suitable to the assigned functionality. To guard against inadvertent or unauthorized use each function key is protected with a password.

Local control with graphical HMI



ВЯРНО С ОРИГИНАЛА

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Device Track Record

More than 130,000 devices installed (PSxxx and P13x)

- **1991:** PS 4xx Series- First multi-functional, numerical time-overcurrent devices
- **1998:** PS 982 - First one-box solution for time-overcurrent protection and control
- **2001:** MiCOM P139 ➔ 45,000 devices installed since 2001
- **2003:** MiCOM P130C ➔ 12,000 devices installed since 2003
- **2004:** MiCOM P132 ➔ 22,000 devices installed since 2004
- **2006:** MiCOM P132/P139 - IEC 61850 interface
- **2008:** MiCOM P132 - HMI with 6 configurable function keys,
- **2009:** MiCOM P132 - 24TE mounting case option
- **2012:** MiCOM P132/ P139 - Redundant Ethernet Interface for IEC 61850 (SHP/ DHP /RSTP)
- **2013:** MiCOM P132/ P139 New powerful processor
- **2014:** MiCOM P132/ P139 -Redundant Eth. Interface PRP

ВЯРНО С ОРИГИНАЛА

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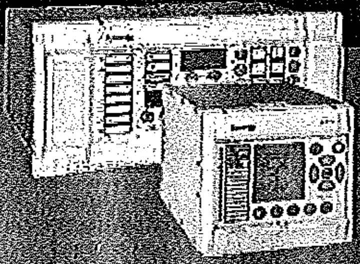
Maximize protection

Easergy MiCOM series 30, 40
Comprehensive range of digital protection relays



ВЯРНО С
ОРИГИНАЛА

schneider-electric.com

Life Is On | Schneider Electric

> "Your electrical equipment is under control. With Easergy protection relays, you get maximum energy availability for your process and application."

ВЯРНО С ОРИГИНАЛА

Increase energy availability

Maximize energy availability and the profits generated by your installation while protecting life and property.

The flexible Easergy MiCOM series 30, 40 protection relay range

Offers scalable levels of functionality and hardware options to best suit your protection requirements, and allows you to choose the most cost-effective solution for your application.

The versatile hardware and common relay management software (Easergy Studio) allows simple configuration and installation in different applications.

A well-known user friendliness, based on a standard and simple user interface across the entire range makes Easergy MiCOM ideal in any environment, from the more complex bay level control with mimic, to the simplest LCD display with menu interrogation.

1999

Launch of Easergy MiCOM protection relays

Keep informed to operate intelligently

Every Easergy MiCOM relay provides you with intuitive access to all system information in your own language so that you can manage your electrical installation effectively.

If an unpredictable situation occurs, clear and complete information puts you in a position to make the right decisions immediately. The electrical supply is restored without delay.

2017

Over 600 000 Easergy MiCOM units installed around the world

Augment installation availability

Easergy MiCOM relays maintain high energy availability thanks to their diagnostics function that continuously monitors network status.

In-depth analysis capabilities and high Schneider Electric reliability ensure that the equipment is de-energised only when absolutely necessary. Risks are minimised and servicing time reduced by predicting maintenance operations.

> “The Easergy MiCOM protection relay range provides the capability for a wide variety of protection, control, measurement, and communication.”

“With Easergy protection relays, you can count on simple, high-performance products and the support of top-notch Schneider Electric teams. Meet your obligations the easy way.”

Improve satisfaction

Save time at every step in project development and installation to consistently meet your project deadlines.

Go for cyber security

Cyber security functions improve the quality of services and minimizing any risk to interrupt the deliveries resulting from accidental or intentional actions. Cyber security is an ongoing process that encompasses procedures, policies, software, and hardware. One of the key aspects of the cyber security is to define a security policy. This security policy structures the roles and responsibilities within the organization. The Schneider Electric SAT Tool is able to map the organization, company or department security policy already defines to each single element of the system (HMI, IED, Network element, etc). Therefore, it creates an efficient way to define the access restriction to any device of the system. This tool is using the RBAC (Role Based Access Control) concept.

Make settings easily

A single PC software tool for the entire Easergy range makes system start-up and operation particularly easy. The user-friendly program, Easergy Studio, guides you step by step from the initial programming to final commissioning. Easergy protection relays produce a detailed report on system configuration and all the activated protection functions.

Communicate the open way

In addition to the DNP3, IEC 60870-5-103, Courier and Modbus standards, Easergy MiCOM protection relays complies with IEC 61850 Edition 1 & 2 (GOOSE messages, TCP/IP redundancy) and uses the communication protocol that is today's market standard to interface with all brands of electrical-distribution devices. Ethernet redundancy implementation (HSR/PRP), Dual IP features, and Rapid Spanning Tree Protocol (RSTP IEEE 802.1D 2004) provide also augmented reliability and availability.

Easergy warranty process

The extended 10-year warranty applies to Easergy MiCOM under the following conditions:

- Register the product until 18 month by flashing the QR code in the front face with "My Schneider" smartphone application,
- Products that follow ProDiag MV RELAY diagnosis conducted every FOUR YEARS (normal operating conditions).
- Replaced or repaired product provided with the latest version of hardware and firmware, functionally compliant with the original product.

Easergy 10 years Warranty

Increase your capabilities...

The long term successful operation experience of the Easergy MiCOM series and the consistently following of new technology trends for new developments combined with specific customized solutions give our customers high confidence in the reliability of their long term investments.

Easergy MiCOM series 30

Fulfills the network protection requirements of utility, industrial and renewable applications with particular focus on integrated feeder bay control management and provides dedicated railway protection devices. Multifunctional devices designed for selective short-circuit protection, ground fault protection and overload protection of transmission lines, transformers and cables in medium- and high-voltage systems.

Specific features and benefits are:

- Flexible modular Input/Output options together with platform wide interoperability allowing simple product adaptation to changing requirements by cost optimized life cycle maintenance.
- Protection can be operated on solidly or (low-) impedance grounded, with Petersen coil resonant grounded or with isolated neutral star point networks.
- Various hardware options with selectable 24TE, 40TE, 84TE mounting case; detachable HMI option; conversable surface/ flush mounting or the optional Pin, Ring and Hybrid terminal connection variants provide a maximum on adaptability to any customer need or spatial constraint, by offering nearly the same protection functionality in all hardware variants.
- Full Programmable Scheme Logic (PSL) and function keys in addition to the high number of proven fixed protection functions allow deep customization by a maximum operational safety.

Easergy MiCOM series 40

Fulfills the protection requirements for a wide market of utility and industrial application and offers a wide range of protection functions. Any element in the utility & industrial network (Line, Transformer, Generator, Motor, Busbar and CB), from generation to transmission, can be protected by an Easergy MiCOM series 40 device.

Specific features and benefits are:

- Full range of protection devices and one with the largest installed base worldwide in transmission and distribution utilities and power plants.
- The well-known, powerful and user-friendly Programmable Scheme Logic (PSL), provides a maximum on functionality to cover any protection application (from basic to really advanced ones).
- Detailed post-mortem analysis required by exigent customers is fully included thanks to its powerful disturbance and events recording features.

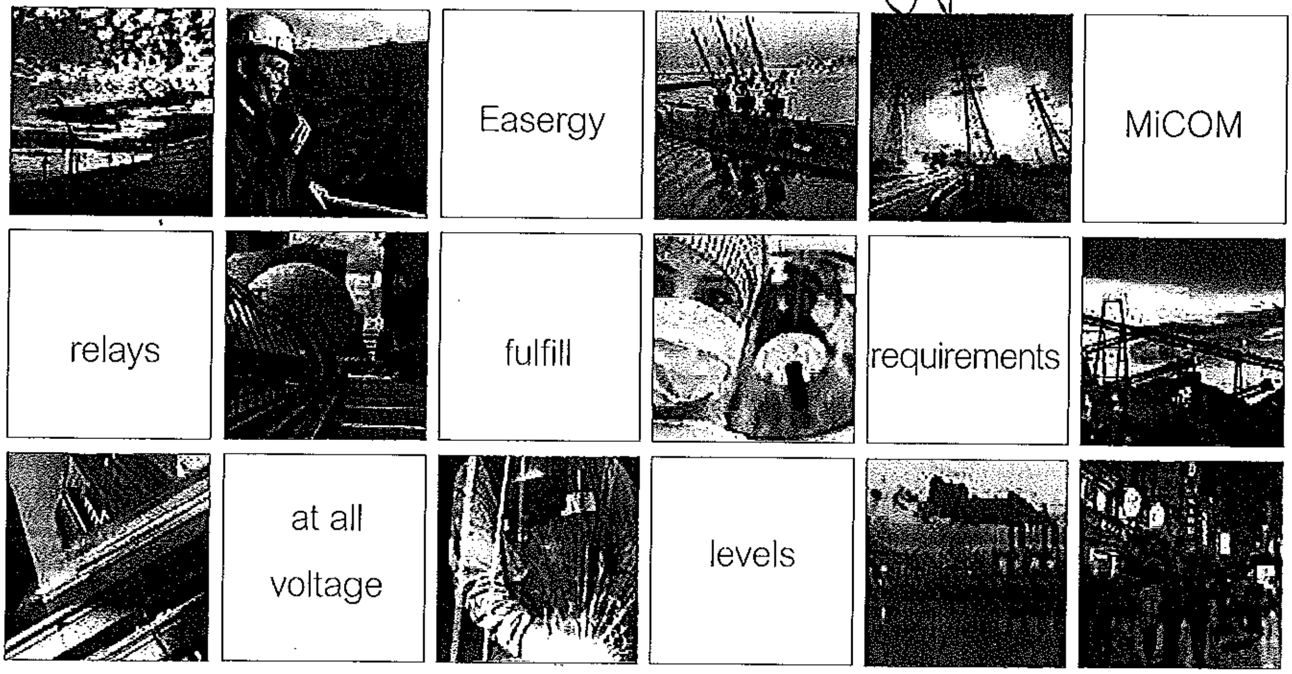
...with a comprehensive range

The individual strengths of both series together with the common setting tool provide a maximum of flexibility for any customer need.

Easergy MiCOM series offer a FULL RANGE of protection devices for complete solution from cost-effective to high-end network protection and bay control for all applications and segments.

Easergy MiCOM applications	series 30	series 40
Feeder*	P13x	P14x
Motor & Voltage & Frequency	P13x	P24x
Generator		P34x
Distance	P43x	P44x
Line differential	P53x	P54x
Transformer	P63x	P64x
Busbar		P74x
Breaker failure & Auto-reclose		P84x
Railway	P13x, P43x, P63x	

* Easergy MiCOM C434 bay controller is also available. Please contact us for more information.



Save time...

The **Easergy Studio** programming and operating software provides a single environment for the entire range.

Configuration

Equipment setup

Upload data on-line from the relay or off-line from a data model template

Protection activation

Enable protection functions

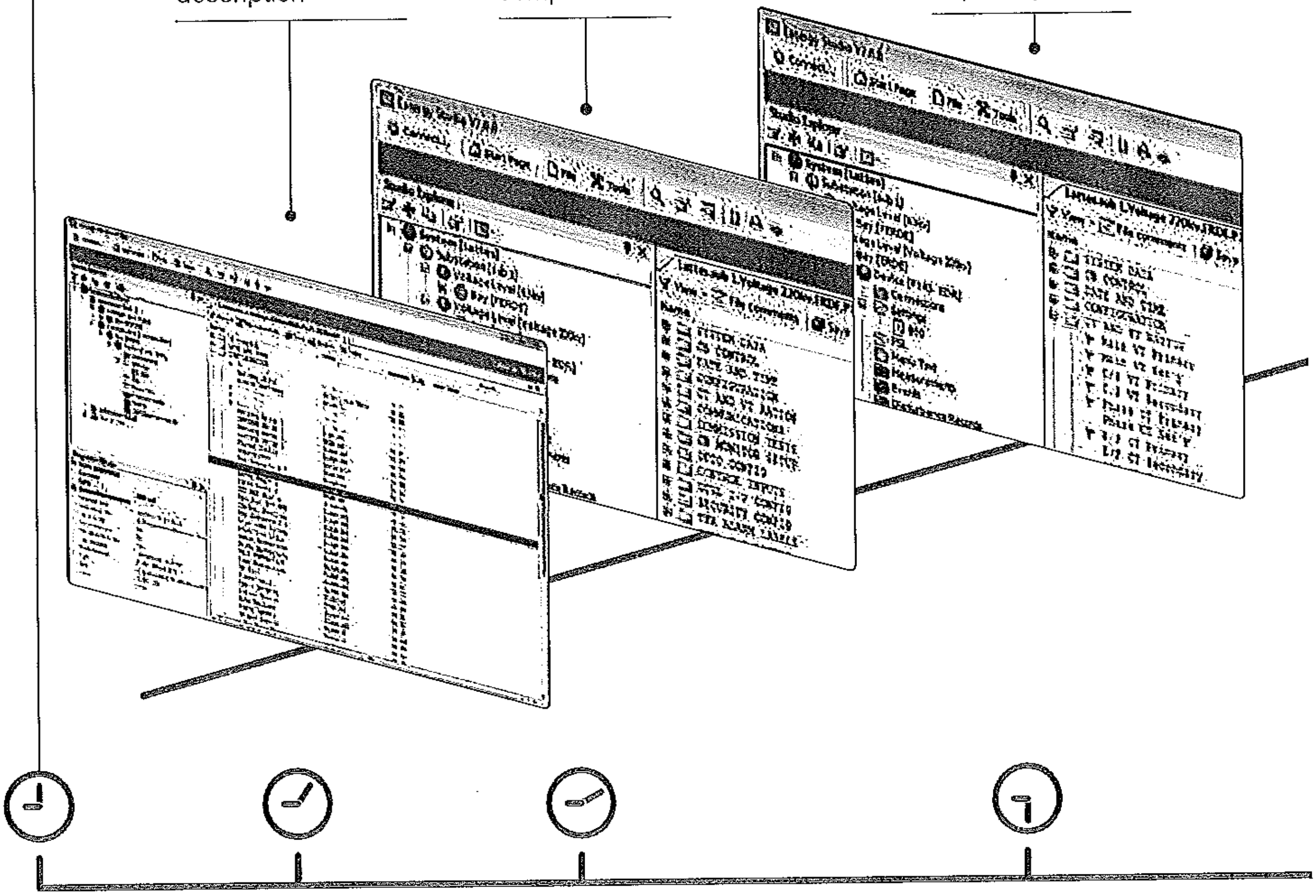
Summary of functions

Easily and quickly apply protection, control, and monitoring settings

Automatic hardware description

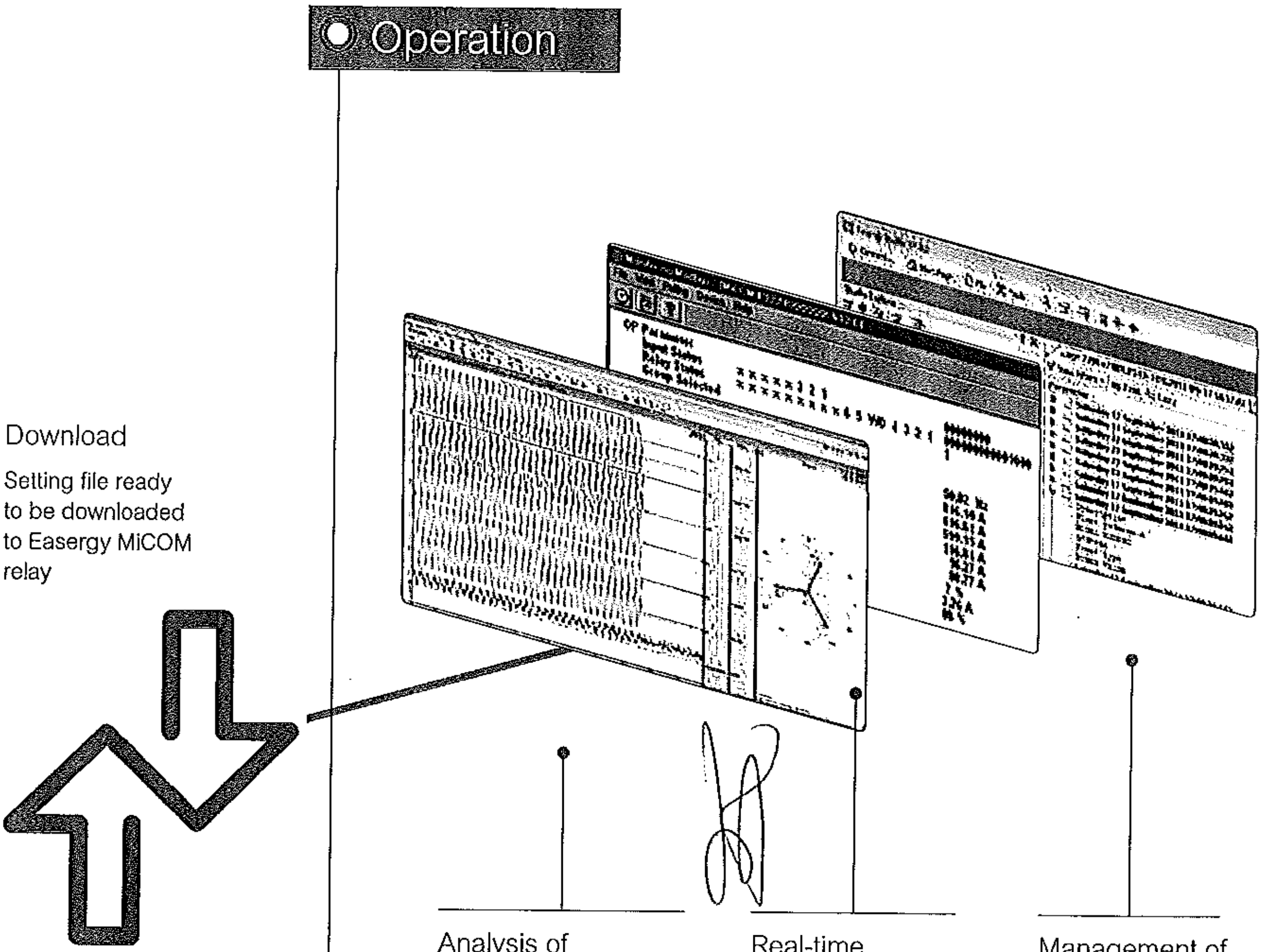
Application compliance

Fine tune capability



...with a simple operating software

The result is a simple, user-friendly approach for fast commissioning.



Operation

Download

Setting file ready to be downloaded to Easergy MiCOM relay

Export

Straightforward facility for commissioning

Analysis of waveform capture

Display, analysis, and printing of disturbance records

Real-time supervision

Supervision of the status of all the relays in the electrical installation

Management of events

Display of event records in chronological order

ВЯРНО С
ОРИГИНАЛА

Protect your network...

Protect

Easergy MiCOM protection relays combine best-in-class protection techniques with the latest technology for dependability, high quality, and the best possible protection.

Secure

For operational security, Easergy MiCOM offers Role-Based Access Control (RBAC), encrypted passwords, port hardening, alarms, logs, monitoring, and the Security Access Tool (SAT) to help your existing staff manage access without advanced skills or training.

Communicate

Local and remote communication is provided and designed for use with the Easergy Studio software. Easergy MiCOM devices provide IEC 61850 Edition 1 & 2 communication and GOOSE messaging, and Dual IP (PRP/HSR) for physical Ethernet network segregation and redundancy. Port types, quantities, and protocols vary by product.

Configure

Settings are defined via the Easergy Studio support package. This intuitive software lets you manage settings for your entire Easergy MiCOM installed base, with multiple independent setting groups. They can be activated locally, remotely, or via a dedicated input condition, which allows different system operating conditions or adaptive relaying, and you can import IEDs into systems from pre-configured IEC 61850 SCD files.

...with a complete set of tools

Measure

Easergy MiCOM devices measure and store a wide range of highly accurate values including current, voltage, frequency, power, and others, from instantaneous or derived values. You can view measurements on the device or transfer them via communication ports.

Record

Locally and remotely viewable, event records are generated by status changes to logic inputs, outputs, settings, and alarms. All records are time tagged to a resolution of 1ms and are retained even during auxiliary supply interruptions. These devices also capture information about faults and disturbances, and oscillographic analysis using Easergy Studio provides quick analysis of analogue and digital signals.

Control

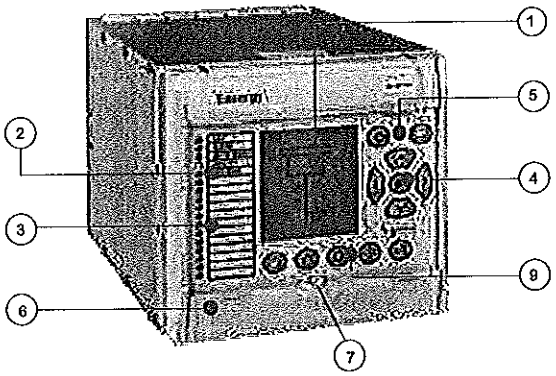
Fully programmable function keys and programmable tri-state LEDs are available. Some Easergy MiCOM devices provide programmable hot-keys for direct menu access (e.g. Trip/Close command). Time synchronization can be implemented from various sources including an optional IRIG-B port or communication protocol.

Scheme

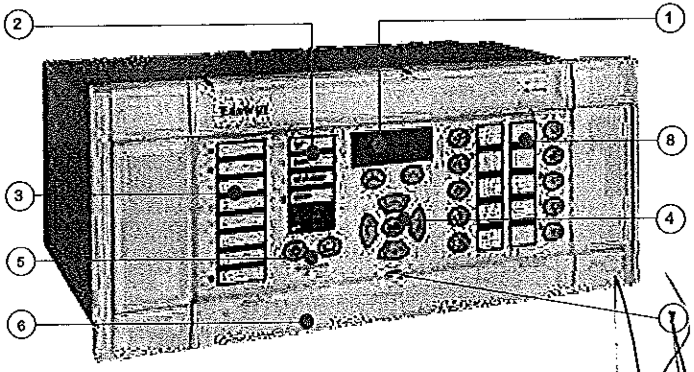
You can use Easergy Studio to configure programmable scheme logic. Easergy MiCOM devices use graphical programming or Boolean equations. Programmable graphical logic in these relays is an extremely powerful tool. Users can customize protection and control functions or add additional supervision or custom schemes, e.g. trip circuit supervision or frequency restoration. This logic is event driven so that protection is not delayed. An online status monitoring feature is also available.

Simplify your operation...

Easergy MiCOM series 30 with bay control



Easergy MiCOM series 40



The front panel user interfaces comprises:

1. A back-lit liquid crystal display (series 30, 40)
   Graphic LCD display (series 30)
2. 4 fixed function LEDs (series 40)
   5 fixed function LEDs (series 30)
3. Up to 18 user programmable LEDs
4. Menu navigation and data entry keys
5. "READ" and "CLEAR" keys for viewing and reset of alarms
6. Front communication port
7. Facility for fitting a security seal
8. Programmable function keys
9. Switchgear control keys for control for up to 10 devices with graphical HMI, with text HMI up to 3 (series 30)

User languages:

The user interface and menu text is available in English, French, German, and Spanish as a standard. Other languages, e.g. Russian and Chinese, are supported on some relays depending on the market requirements.

The ability to customize the menu text and alarm descriptions is also supported. User language options provide true global convenience

Wiring

External connections are made via ring-type terminal. These take pin-type terminals along with the series 30 relays as an option.

ВЯРНО С
ОРИГИНАЛА

...with a user friendly design

Case construction

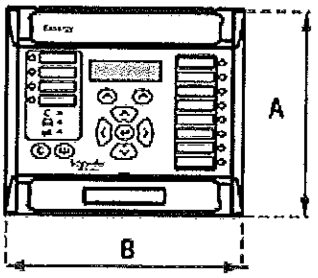
Easergy MiCOM devices are housed in specially designed cases that provide a high density of functionality within the product. Communication ports and model/ serial number information is concealed by upper and lower covers on certain models.

Physical protection of the front panel user interface and prevention of casual access is provided by an optional transparent front cover (selected models only), which can be fitted or omitted, since the front panel has been designed to IP52 protection against dust and water.

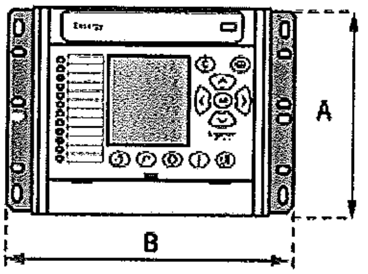
The cases are suitable for either rack or panel mounting. An option for surface mounting is also supported on the series 30 for installations with space limitations.

The differing case widths of relays can be combined with or without the use of standard blanking plates to form a complete 19" mounting. This saves space and allows for a neat installation.

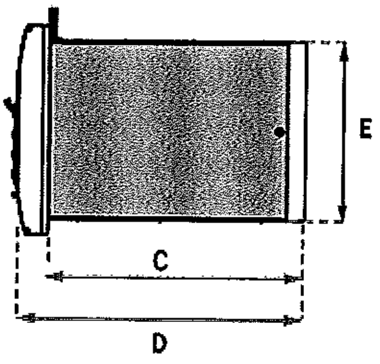
Front view



Front view
(Surface option)



Side view



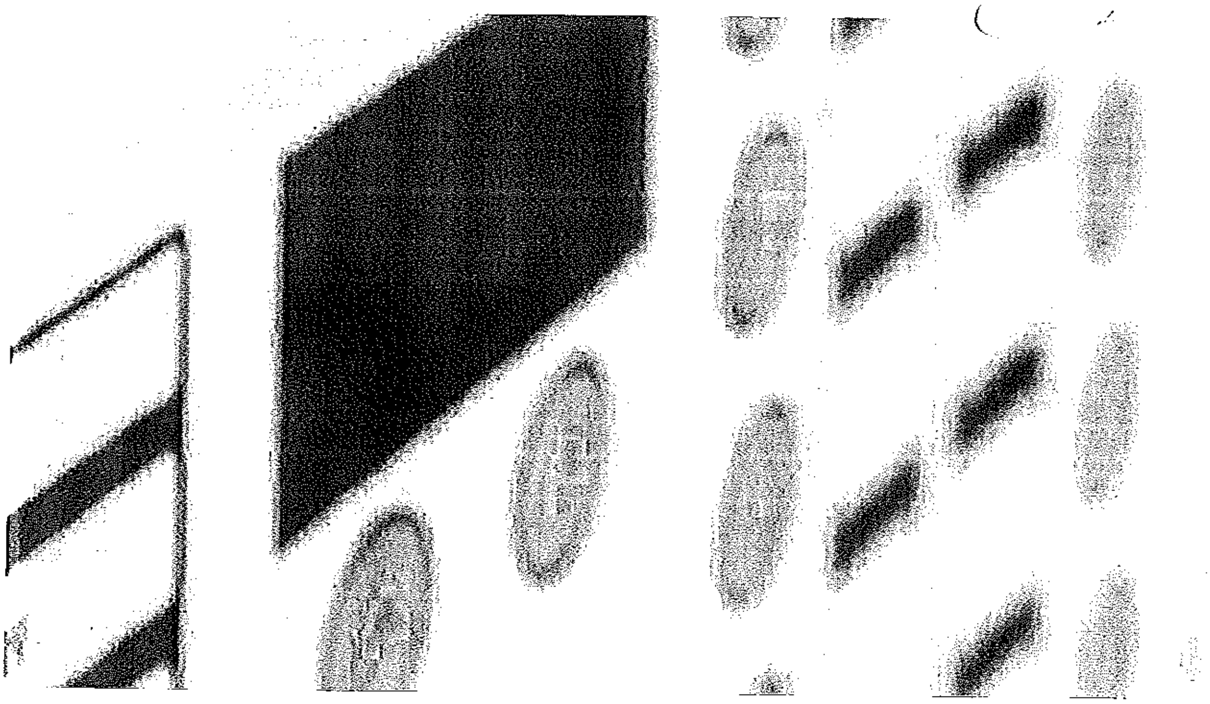
Easergy MiCOM Dimensions (in mm)		A	B	C	D	E
series 30	24TE	184,5	186.4	227.9	253.6	177.5
	40TE		260.2			
	84TE		481.6			
	24TE Surface		186.4		257.1	
	40TE Surface		260.2			
	84TE Surface		481.6			
series 40	40TE	177	206	240 (incl. wiring)	270 (incl. wiring)	157.5 max
	60TE		309.6			
	80TE		413.2			
	80TE Rack		483			

Note: Maximum sizes for guidance only, for specific product information please check the relevant product documentation.

Technical data description

Power supplies	Nominal Voltage Vnom.	Operate Range (V)	
		dc	ac
Easergy MiCOM series 30	24-60 Vdc	19-66	-
	60-250 Vdc / 100-230 Vac	48-275	90-253
Easergy MiCOM series 40	24-32 Vdc	19-38	-
	48-110 Vdc / 40-100 Vac	37-150	32-110
	110-250 Vdc / 100-240 Vac	87-300	80-265

Digital Inputs	Auxiliary Voltage	Thresholds (V)
Easergy MiCOM series 30	Standard Variant > 18 V (VA, min: 24-250 Vdc)	Standard variant with switching threshold at 65% of 24 Vdc (VA,min) Special variant: 65% of 127 Vdc (VA,nom) 65% of 250 Vdc (VA,nom) 65% of 110 Vdc (VA,nom) 65% of 220 Vdc (VA,nom)
Easergy MiCOM series 40	Universal programmable voltage thresholds	
	24/27, 30/34, 48/54, 110/125 and 220/250 Vdc	



General series data	Easergy MiCOM series 30	Easergy MiCOM series 40
Frequency 50/60 Hz	■	■
Dual rated 1 A / 5 A	■	■
Opto inputs	max 82	max 64
Output contacts	max 48	max 60
High break contacts	max 16	max 8
Continuous carry	5 A / 8 A / 10 A	10 A
Short duration current	30 A for 0.5 (3 s)	30 A for 3 s
LED indication (freely programmable)	23 (19)	22 (18)
Function keys / Hot keys	6	10 / 2
Settings groups	4	4
Fault records	8	15
Event records	1000	250-512
Disturbance records	16.4 s (max 8 rec.)	75 s (max 10.5 s/rec.)
Programmable logic	Fully programmable	Graphical / Fully programmable
IRIG B	Option	Option
LCD display	Alphanumeric / Graphical	Alphanumeric
Front port	EIA(RS) 232	EIA(RS) 232
Rear Port / 2nd rear port	Yes / Option	Yes / Option
Courier	EIA(RS)485 or fibre	K-Bus / EIA(RS) 485 or fibre
Modbus	EIA(RS)485 or fibre	EIA(RS) 485 or fibre
IEC 60870-5-103	EIA(RS)485 or fibre	EIA(RS) 485 or fibre
IEC 60870-5-101	EIA(RS)485 or fibre	No
DNP3.0	EIA(RS)485 or fibre	EIA(RS) 485 or Ethernet (RJ45, fibre)
IEC 61850	Wire RJ45 or fibre	Wire RJ45 or fibre
Terminals	Pin or Ring	Ring

C00218

Feeder management and overcurrent relays

Easergy MiCOM series		30		40			
model		P132	P139	P141	P142	P143	P145
CHARACTERISTICS	Case size	24, 40 or 84TE	40 or 84TE	40TE	40TE	60 or 80TE	60TE
	CT Inputs	4	4	5	5	5	5
	VT Inputs	4 or 5	4 or 5	3	3	3 or 4	3 or 4
	Opto Inputs (max)	70	70	8	16	32	32
	Output Contacts (max)	32	28	8	15	30	32
	High Break Contacts	16	16		4	8	8
	RTDs (max. option)	10	10				
	Analogue Input / Output (max)	1/2	1/2				
	Function Keys / Hotkeys	■	■	■	■	■	■
	Bay Control & Monitoring	Mimic	Graphical Mimic				
	Interlocking logic	■	■				
ANSI	**PROTECTION FUNCTION**	**P132**	**P139**	**P141**	**P142**	**P143**	**P145**
25	Check synchronising	■	■			■	■
32	Directional power	■	■	■	■	■	■
32V	Voltage controlled direct. reactive power	■	■				
34	Master sequence device		■				
37	Undercurrent	■	■	■	■	■	■
46	Negative sequence overcurrent	■	■	■	■	■	■
46BC	Broken conductor	■	■	■	■	■	■
47	Negative sequence over voltage	■	■	■	■	■	■
48	Incomplete sequence relay	■	■				
49	Thermal overload	■	■	■	■	■	■
50/51N	Ground fault	■	■	■	■	■	■
50/51P	3 Phase overcurrent	■	■	■	■	■	■
50/51P/N	1 Phase or earth overcurrent	■	■				
50BF	Circuit breaker failure	■	■	■	■	■	■
51LR	Motor	■	■				
51V	Voltage controlled overcurrent	■	■	■	■	■	■
59/27	Over / Under voltage	■	■	■	■	■	■
59N	Residual over voltage	■	■	■	■	■	■
64	Restricted earth fault	■	■	■	■	■	■
66	Startup monitoring	■	■				
67N	Transient ground fault detection	■	■				
67N	Ground fault directional	■	■	■	■	■	■
67N	Sensitive directional earth fault	■	■	■	■	■	■
67P	Phase directional	■	■	■	■	■	■
67W	Wattmetric earth fault	■	■	■	■	■	■
79	Auto-reclose	■	■		■	■	■
81	Under / Over frequency	■	■	■	■	■	■
81P	Under frequency load shedding	■	■				
81R	Rate of change of frequency	■	■	■	■	■	■
85	Protective signalling	■	■				
86	Lock-out	■	■	■	■	■	■
CTS	Current transformer supervision	■	■	■	■	■	■
SOTF	Switch on to fault	■	■	■	■	■	■
TCS	Trip circuit supervision	■	■	■	■	■	■
VTS	Voltage transformer supervision	■	■	■	■	■	■
YN	Neutral admittance	■	■	■	■	■	■
	Circuit breaker monitoring	■	■	■	■	■	■
	Cold load pick-up	■	■	■	■	■	■
	Inrush blocking	■	■	■	■	■	■
	InterMiCOM	■	■	■	■	■	■
	Limit value monitoring	■	■				

Detailed option availability depends on model selection.

Motor management relays

Easergy MiCOM series		30		40		
model		P132	P139	P241	P242	P243
CHARACTERISTICS	Case size	24, 40 or 84TE	40 or 84TE	40TE	60TE	80TE
	CT Inputs	4	4	4	4	7
	VT Inputs	4 or 5	4 or 5	3	3	3
	Opto Inputs (max)	70	70	12	16	16
	Output Contacts (max)	32	28	11	16	16
	RTDs / Thermistors	10/0	10/0	10/0	10/0	10/0
	Analogue Input / Output (max)	1/2	1/2	4/4	4/4	4/4
	Function keys / Hotkeys	■	■	■	■	■
	Bay Control & Monitoring	Mimic	Graphical Mimic			
	Interlocking logic	■	■	■	■	■

ANSI	PROTECTION FUNCTION	P132	P139	P241	P242	P243
14	Speed switch input	■	■	■	■	■
25	Check synchronising	■	■			
27LV	Reacceleration	■	■	■	■	■
30/46/86	Unbalance / Lock out	■	■	■	■	■
32L/O/R	Directional power	■	■			
32R	Reverse power	■	■	■	■	■
37	Loss of load	■	■	■	■	■
37P/37N	Undercurrent	■	■	■	■	■
38/49	Thermal overload	■	■	■	■	■
40	Loss of field			■	■	■
46	Negative sequence overcurrent	■	■	■	■	■
47	Negative sequence over voltage	■	■	■	■	■
47N	Neutral over voltage	■	■			
50/51P	Phase overcurrent	■	■	■	■	■
50BF	Circuit breaker failure	■	■	■	■	■
50N/51N	Ground fault	■	■	■	■	■
50S/51LR/ 51S	Locked rotor	■	■	■	■	■
55	Out of step			■	■	■
59/27	Under / Over voltage	■	■	■	■	■
59N	Residual over voltage	■	■	■	■	■
64N/32N	Wattmetric earth fault	■	■	■	■	■
66/48/51	Startup monitoring	■	■	■	■	■
67N	Ground fault directional	■	■			
67N	Sensitive directional earth fault	■	■	■	■	■
67P	Phase directional	■	■			
81O	Over frequency	■	■			
81U	Under frequency	■	■	■	■	■
81R	Rate of change of frequency	■	■			
87M	Motor differential					■
CTS	Current transformer supervision	■	■	■	■	■
TCS	Trip circuit supervision	■	■	■	■	■
VTS	Voltage transformer supervision	■	■	■	■	■
	Anti Backspin			■	■	■
	Clio board			■	■	■
	Circuit breaker monitoring	■	■	■	■	■

ВЯРНО С
ОРИГИНАЛА

Detailed option availability depends on model selection

Ltd.
Stara Zagora
Стара Загора

000220

Generator management relays

Easergy MiCOM series		40			
model		P342	P343	P344	P345
CHARACTERISTICS	Case size	40 or 60TE	60 or 80TE	80TE	80TE
	CT Inputs	5	8	8	9
	VT Inputs	4	4	5	6
	Opto Inputs (max)	24	32	32	32
	Output Contacts (max)	24	32	32	32
	High Break Contacts	4	8	8	8
	RTDs	10	10	10	10
	Analogue Input / Output (max)	4/4	4/4	4/4	4/4
	Function keys / Hotkeys	■	■	■	■
	Interlocking logic	■	■	■	■

ANSI	PROTECTION FUNCTION	P342	P343	P344	P345
21	Under-impedance	■	■	■	■
24	Overfluxing	■	■	■	■
25	Check synchronising	■	■	■	■
27TN/59TN	100 % stator earth fault (3rd)		■	■	■
32L/O/R	Directional power	■	■	■	■
37N/37P	Sensitive phase & earth fault undercurrent	■	■	■	■
38/49	Thermal overload	■	■	■	■
40	Loss of field	■	■	■	■
460C	Negative sequence overcurrent	■	■	■	■
46T	Negative sequence thermal	■	■	■	■
47	Negative sequence over voltage	■	■	■	■
49T	Thermal overload	■	■	■	■
50/27	Unintentional energisation		■	■	■
50/51P	Phase overcurrent	■	■	■	■
50BF	Circuit breaker failure	■	■	■	■
50N/51N	Ground fault	■	■	■	■
50DT	Interturn / split phase		■	■	■
51V	Voltage dependent O/C	■	■	■	■
59/27	Under / over voltage	■	■	■	■
59N	Residual over voltage	■	■	■	■
64	Restricted earth fault	■	■	■	■
64N/32N	Wattmetric earth fault	■	■	■	■
64R	Rotor earth fault (MiCOM P391 option)	■	■	■	■
64S	100 % stator earth fault (low frequency)				■
67N	Sensitive directional earth fault	■	■	■	■
67P	Phase directional	■	■	■	■
67W	Wattmetric sensitive earth fault	■	■	■	■
78	Pole slipping		■	■	■
81AB	Turbine abnormal frequency	■	■	■	■
81	Under / over frequency	■	■	■	■
87G/87GT	Generator differential		■	■	■
CTS	Current transformer supervision	■	■	■	■
TCS	Trip circuit supervision	■	■	■	■
VTS	Voltage transformer supervision	■	■	■	■
	Circuit breaker monitoring	■	■	■	■

Detailed option availability depends on model selected.

ВЯРНО С
ОРИГИНАЛА

000221

Distance protection relays

Easergy MiCOM series		30				40					
model		P433	P435	P437	P439	P441	P442	P443	P444	P445	P446
CHARACTERISTICS	Case size	24, 40 or 84TE	40 or 84TE	84TE	40 or 84TE	40TE	60TE	80TE	80TE	40 or 60TE	80TE
	CT Inputs	4	4	4 or 5	4	4	4	5	4	4	8
	VT Inputs	4 or 5	4 or 5	4 or 5	4 or 5	4	4	4	4	4	5
	Opto Inputs (max)	70	82	36	70	8	16	32	24	16	24
	Output Contacts (max)	32	48	48	28	14	21	32	46	16	32
	High Break Contacts	4	4	4	16		Option	Option	Option	Option	Option
	RTDs (option)	1	1	1	1						
	Analogue Input / Output (max)	1/2	1/2	1/2	1/2						
	Function keys / hotkeys	■	■	■	■	■	■	■	■	■	■
	Bay control & monitoring	Mimic	Mimic		Graph. Mimic						
	Interlocking logic	■	■		■						

ANSI	PROTECTION FUNCTION	P433	P435	P437	P439	P441	P442	P443	P444	P445	P446
21/21N	Distance	■	■	■	■	■	■	■	■	■	■
25	Check synchronising	■	■	■	■	■	■	■	■	■	■
32	Directional power	■	■	■	■						
32V	Voltage controlled directional reactive power	■	■		■						
46	Negative sequence overcurrent	■	■	■	■	■	■	■	■	■	■
46/67	Directional negative sequence			■		■	■	■	■	■	■
46BC	Broken conductor	■	■	■	■	■	■	■	■	■	■
49	Thermal overload	■	■	■	■	■	■	■	■	■	■
50/27	Switch on-to fault	■	■	■	■	■	■	■	■	■	■
50/51N	Earth fault	■	■	■	■	■	■	■	■	■	■
50/51P	Phase overcurrent	■	■	■	■	■	■	■	■	■	■
50ST	Stub bus protection	■	■	■	■	■	■	■	■	■	■
59/27	Over / under voltage	■	■	■	■	■	■	■	■	■	■
59N	Residual over voltage	■	■	■	■	■	■	■	■	■	■
62/50BF	Circuit breaker failure	■	■	■	■	■	■	■	■	■	■
67N	Earth fault directional	■	■	■	■	■	■	■	■	■	■
67N	Transient ground fault detection	■	■		■						
67P	Phase directional					■	■	■	■	■	■
67W	Wattmetric earth fault	■	■		■						
68	Out of step tripping	■	■	■	■			■			■
78	Power swing blocking	■	■	■	■	■	■	■	■	■	■
79	Auto-reclose	3 pole	1/3 p	1/3 p	3 pole	3 pole	1/3 p	1/3 p	1/3 p	3 pole	1/3 p
81	Over / under frequency	■	■	■	■	■	■	■	■	■	■
81R	Rate of change of frequency	■	■	■	■			■		■	■
81P	Under-frequency load shedding	■	■		■						
85	Channel aided scheme logic	■	■	■	■	■	■	■	■	■	■
CVTS	Capacitive voltage transformer supervision					■	■		■		
TCS	Trip Circuit Supervision	■	■	■	■	■	■	■	■	■	■
VTS/CTS	Voltage / current transformer supervision	■	■	■	■	■	■	■	■	■	■
ΔI / ΔV	Delta directional comparison							■			■
YN	Neutral admittance	■	■		■						
	InterMiCOM	■	■	■	■	■	■	■	■	■	■
	Mutual compensation			■		■	■	■	■		■

Detailed option availability depends on model selection.

ВЯРНО С
ОРИГИНАЛА

000222

Line differential protection relays

Easergy MiCOM series		30	40						
model		P532	P541	P542	P543	P544	P545	P546	P547
CHARACTERISTICS	Case size	40 or 84TE	40TE	60TE	60TE	60TE	80TE	80TE	80TE
	CT Inputs	4	3	3	5	8	5	8	5
	VT Inputs	4 or 5			4	5	4	5	4
	Opto Inputs (max)	46	8	16	16	16	32	24	24
	Output Contacts (max)	30	7	14	14	14	32	32	32
	High Break Contacts	16			Option	Option	Option	Option	Option
	RTDs (option)	■							
	Analogue Input / Output (max)	1/2							
	Function keys / hotkeys	■	■	■	■	■	■	■	■
	Bay control & monitoring	Text or Graph. Mimic							
	Interlocking logic	■							

ANSI	PROTECTION FUNCTION	P532	P541	P542	P543	P544	P545	P546	P547
21	Distance				■	■	■	■	■
25	Check synchronising	■			■	■	■	■	■
46	Negative sequence overcurrent	■			■	■	■	■	■
49	Thermal overload	■	■	■	■	■	■	■	■
51LR	Motor	■							
50/51N	Earth fault	■	■	■	■	■	■	■	■
50/51P	Phase overcurrent	■	■	■	■	■	■	■	■
50BF	Circuit breaker failure	■	■	■	■	■	■	■	■
59/27	Over / under voltage	■			■	■	■	■	■
64W	Wattmetric earth fault	■			■	■	■	■	■
67N	Earth fault directional	■			■	■	■	■	■
67N	Sensitive directional earth fault	■			■	■	■	■	■
67N	Transient ground fault detection	■							
67P	Phase directional	■			■	■	■	■	■
78	Power swing blocking				■	■	■	■	■
79	Auto-reclose	3 pole		3 pole	1/3 pole	1/3 pole	1/3 pole	1/3 pole	1/3 pole
81	Under / over frequency	■			■	■	■	■	■
87L	Line differential (terminal)	2	2/3	2/3	2/3	2/3	2/3	2/3	
87L	Phase comparison								■
CTS	CT supervision				■	■	■	■	■
TCS	Trip circuit supervision	■	■	■	■	■	■	■	■
	2 breaker configuration					■		■	
	2nd harmonic restraint	■	■	■	■	■	■	■	
	Copper wire signalling	■							
	Direct / permissive inter tripping	■	■	■	■	■	■	■	
	FO signalling	■	■	■	■	■	■	■	
	In Zone transformer		■	■	■	■	■	■	
	PLC signalling								■
	SDH / Sonet networks				■	■	■	■	
	Vector compensation		■	■	■	■	■	■	

ВЯРНО С
ОРИГИНАЛА

Detailed option availability depends on model selection.

000223

Transformer protection relays

Easergy MiCOM series		30				40		
model		P631	P632	P633	P634	P642	P643	P645
CHARACTERISTICS	Case size	24 or 40TE	40 or 84TE	40 or 84TE	84TE	40TE	60TE	60 or 80TE
	CT Inputs	6	8	12	15	8	12	18
	VT Inputs		1	1	1	1 or 2	1 or 4	1 or 4
	Opto Inputs (max)	4	34	40	34	12	24	24
	Output Contacts (max)	14	22	30	22	12	24	24
	Analogue Input / Output (max)		1/2	1/2	1/2	4/4	4/4	4/4
	High Break Contacts	4	4	4	4	4	4	8
	RTDs (option)		1	1	1	10	10	10
	Function Keys / Hotkeys	■	■	■	■		■	■
	Bay control & monitoring		Mimic	Mimic				
	Interlocking logic		■	■				

ANSI	PROTECTION FUNCTION	P631	P632	P633	P634	P642	P643	P645
24	Overexcitation		■	■	■	■	■	■
46	Negative sequence overcurrent	■	■	■	■	■	■	■
47	Negative sequence over voltage					■	■	■
49	Thermal overload	■	■	■	■	■	■	■
50/51N	Ground fault	■	■	■	■	■	■	■
50/51P	Phase overcurrent	■	■	■	■	■	■	■
50BF	Circuit breaker failure	■	■	■	■	■	■	■
59/27	Over / under voltage		■	■	■		■	■
67N	Ground fault directional					■	■	■
67P	Phase directional					■	■	■
81	Under / over frequency		■	■	■	■	■	■
87G/64	Restricted earth fault		2	3	3	2	3	3
87T	Transformer diff. (windings)	2	2	3	4	2	3	3
CTS	CT supervision	■	■	■	■	■	■	■
TCS	Trip Circuit Supervision	■	■	■	■	■	■	■
VTS	VT supervision					■	■	■
	2 nd harmonic restraint	■	■	■	■	■	■	■
	Overfluxing / 5th harmonic	■	■	■	■	■	■	■

ВЯРНО С
ОРИГИНАЛА

Detailed option availability depends on model selection.

Busbar protection relays

Easergy MiCOM series		40			
model		P741* (CU)	P742* (PU)	P743* (PU)	P746
Charact.	Case size	80TE	40TE	60TE	80TE
	CT Inputs		4	4	18/21
	VT Inputs				3/0
	Opto Inputs (max)	8	16	24	40
	Output Contacts (max)	8	8	21	32
	Function Keys/Hotkeys	■		■	■
ANSI	PROTECTION FUNCTION	P741	P742	P743	P746
50/51N	Ground fault		■	■	■
50/51P	Phase overcurrent		■	■	■
50BF	Circuit breaker failure	■	■	■	■
87BB	Busbar	■	■	■	■
87CZ	Check Zones	■			■
87P	Phase segregated differential	8 zones			4 zones
87P	Sensitive earth fault differential	8 zones			
CTS	CT supervision	■	■	■	■
TCS	Trip Circuit Supervision	■	■	■	■
VTS	VT supervision		■	■	■
	Phase comparison				■
	CT saturation detection		■	■	
	CT supervision		■	■	■

* Central Unit (CU) can manage up to 28 Peripheral Units (PU)

Interconnection, auto-reclose & breaker failure protection relays

Easergy MiCOM series		40		
model		P341	P841	P849
Charact.	Case size	40 TE or 60TE	60TE or 80 TE	80TE
	CT Inputs	4	5 or 8	
	VT Inputs	5	4 or 5	
	Opto Inputs (max)	16 or 24	16 or 24	64
	Output Contacts (max)	15 or 24	14 or 32	60
	High break contact		Option	Option
ANSI	PROTECTION FUNCTION	P341	P841	P849
25	Check synchronising	■	1 or 2	
27	Under voltage	■	■	
47/27D	Phase sequence voltage		■	
50BF	Breaker failure protection	■	1 or 2	
59	Over voltage	■	■	
59N	Residual over voltage	■	■	
64	Restricted earth fault	■	■	
64N/32N	Wattmetric earth fault	■	■	
67P	Phase directional with DLR option	■		
79	Auto-reclose		1 or 2 CBs	
81	Under / over frequency	■	■	
81R	Rate of change of frequency (df/dt+t)	■	■	
dVq	Voltage vector shift	■		
TCS	Trip circuit supervision	■	■	■
	Tripping mode		1p / 3p	■
	Ferroresonance detection		■	

Detailed option availability depends on model selection.

Rail protection relays

Easergy MiCOM series		30			
model		P138	P436	P438	P638
CHARACTERISTICS	Case size	40 or 84TE	40 or 84TE	40 or 84TE	84TE
	CT Inputs	2	3	3	5
	VT Inputs	1	2	2	1
	Opto Inputs (max)	22	34	28	38
	Output Contacts (max)	48	46	46	64
	RTDs (option)	1	1	1	1
	Analogue Input / Output (max)	1/2	1/2	1/2	1/2
	Function Keys / Hotkeys	■	■	■	■
ANSI	PROTECTION FUNCTION	P138	P436	P438	P638
21/21N	Distance		■	■	
27/59	Over / under voltage	■	■	■	■
49	Thermal overload	■	■	■	■
50/27	Switch on-to fault		■	■	
50H	High current supervision		■	■	
50/51N	High current earth fault (tank protection)	■			■
50/51P	Phase overcurrent		■	■	■
62/50BF	Circuit breaker failure	■	■	■	■
67P	Phase directional	■	■	■	■
81	Under / over frequency	■			■
86	Lock-out	■	■	■	■
87T	Transformer differential (windings)				2
di/dt,dv/dt, dφ/dt	Train startups		■	■	
Hz	Rail catenary protection		16 2/3	25/50/60	
TCS	Trip circuit supervision	■	■	■	■
CTS	Current transformer supervision		■	■	
VTS	Voltage transformer supervision	■	■	■	
	2nd harmonic restraint		■	■	■
	Defrost protection			■	
	High impedance fault detection			■	
	InterMiCOM		■	■	

ВЯРНО С
ОРИГИНАЛА

Detailed option availability depends on model selection.

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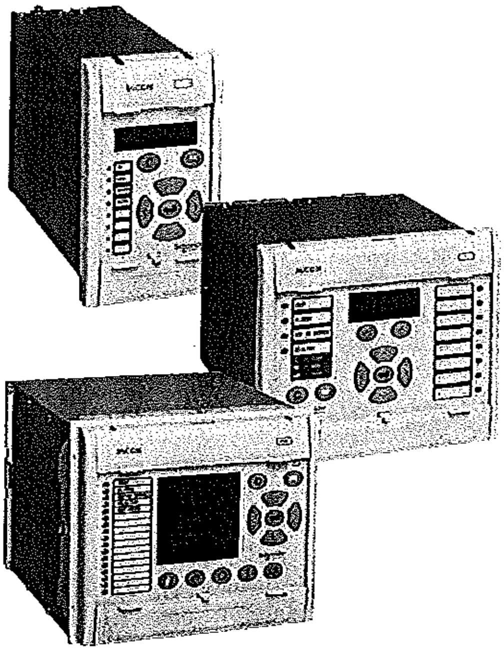
ВЯРНО С
ОРИГИНАЛА

Schneider Electric Industries SAS
35, rue Joseph Monier - CS 30323
F92506 Rueil-Malmaison Cedex

NRJED116740EN

MiCOM Range

10, 20, 30 and 40 Series Key Features



The MiCOM range of relays offers varying levels of functionality and hardware options to best suit the protection requirements, and allows the customer to choose the most cost effective solution for their application. The 10, 20, 30 and 40 series hardware platforms are the building blocks of the MiCOM protection relay range providing the capability for a wide variety of protection, control, measurement, monitoring and communication funtions.

The versatile hardware allows for application in many installations and a common relay management software (MiCOM S1 Studio) makes for easy configuration and application.

A standard and simple user interface across the range makes this ideal in any environment, from the more complex bay level control and mimic to the more simple LCD display and interrogation facility.

Numerous integrated communication protocols allow easy interfacing to most substation control or SCADA systems. The majority of MiCOM 30 and 40 series relays can be supplied with ethernet, to allow a full IEC 61850 solution for the substation.

THE MiCOM RANGE OFFERS COMPREHENSIVE PROTECTION SOLUTIONS AT ALL POWER SYSTEM LEVELS SUCH AS:

Generation

- Integrated Generator Protection

Utility

- Distance Protection
- Line Differential
- Transformer Management
- Busbar Protection
- Stand Alone Breaker Fail Protection
- Directional/Non-Directional Overcurrent
- Feeder Management and One Box Solutions
- Voltage & Frequency Protection

Industrial

- Motor Management
- Interconnection Protection

Railway

- Feeder Management
- Transformer Management
- Distance Protection

CUSTOMER BENEFITS

- One single configuration software: MiCOM S1 Studio
- 1A/5A dual rated inputs
- Scalable hardware
- Flexible mounting options
- Standardized user interfaces
- Wide range of communication protocols

ВЯРНО С
ОРИГИНАЛА

Schneider Electric

000228

COMMON FEATURES

- 1A/5A dual rated CT's
- Event and Disturbance Recording
- Various casing and mounting options
- Relays have rear RS 485 port with choice of protocols and front RS 232 for local setting
- A number of auxiliary supply and digital input voltage options

20 Series Relays (Px2x)

It will fulfil the basic requirements of industrial, Utility & Building applications providing simplicity and ease of use in a wide range of installations.

- Scalable solutions where type and quantity of protection features is model dependent
- Flexible logic equations available on most models
- Compact hardware options for easy installation
- Common functions throughout the range
- Multi-language HMI
- Advanced protection functions

30 Series Relays (Px3x)

Designed to meet the rigorous requirements of MV & HV applications with particular focus on feeder and transformer protection and control.

- Protection with Bay level control options to facilitate feeder management
- Input/Output quantity selectable based on requirements
- A number of Rear Port hardware options available with a wide range of Protocols selectable via software
- Protection functions available for unearthed/Petersen coil earthed systems
- Surface and flush mounted (including detachable HMI option) as well as compact case models available in the range
- Full Programmable Scheme Logic and Function keys

40 Series Relays (Px4x)

It fulfils the protection requirements for a wide market of Utility and industrial systems and offers a wide range of protection functions.

- Full Programmable Scheme logic available with Graphic Configuration Tool for easy setting
- Scalable Input / Output hardware depending on requirements
- Operating voltage selectable via Software for Opto inputs
- Hardware accessories available for easy mounting in racks or panels.

ВЯРНО С
ОРИГИНАЛА

The MiCOM range of relays fulfils the requirements at all voltage levels for Industrial, Utility, Building, Railways and Smart Grid Systems.

APPLICATIONS

Px1x Series*

The preferred applications are as follows:

- **P11x:** Universal Overcurrent protection for main or back-up protection on LV or MV systems

Px2x Series

The preferred applications are as follows:

- **P12x:** Universal Overcurrent protection for main or back-up protection on MV and HV systems
- **P22x:** Motor Protection Series for LV and MV systems
- **P52x:** Line Differential protection for MV and HV systems with multiple communication options
- **P72x:** Dedicated high impedance differential protection
- **P821:** Dedicated Breaker Failure Protection suitable for HV and MV systems
- **P92x:** Voltage and frequency protection suitable for generators, motors and feeders

Px3x Series

The range is especially suitable for Petersen coil earthing requirements. The preferred applications are:

- **P13x:** Feeder management relays and one box solution for MV and HV systems (including railway feeder)
- **P43x:** Distance protection for MV and HV systems and rail catenary requirements
- **P53x:** Line differential protection for MV and HV systems
- **P63x:** Differential protection for transformers, generators and motors (including railway transformers).

Px4x Series

The preferred applications are:

- **P14x:** Feeder management relay suitable for MV and HV systems
- **P24x:** Rotating Machine Management relay for application on a wide range of synchronous and induction machines
- **P34x:** Generator protection for small to sophisticated generator systems and interconnection protection
- **P44x:** Full scheme Distance protection relays for MV and HV systems.
- **P54x:** Line Differential protection relays for HV systems with multiple communication options as well phase comparison protection for use with PLC.
- **P64x:** Differential protection for transformers.
- **P74x:** Numerical Busbar protection suitable for application on MV and HV busbars.
- **P84x:** Multifunction terminal IED with professional autoreclosing and CB failure functions.

---

* For more information please see product documentation

CONTROL

Programmable Scheme Logic

Flexible logic equations as well as block logic is available in a number of 20 series relays, see figure 1.

Powerful graphical logic available in the 30 and 40 series relays allows the user to customize the protection and control functions of the relay. It is also used to program the functionality of the opto-isolated inputs, relay outputs, LED and user alarms.

The Programmable Scheme Logic can be used to implement additional supervision features, such as trip circuit supervision or implement complex logic such as frequency restoration schemes. Schemes have been developed capable of supervising the trip coil and circuit with the circuit breaker open or closed.

The Px40 gate logic includes OR, AND, NOT, SR and most of logical gates with the ability to invert the inputs and outputs, and provide feedback. Logic timers are available even for relay contact conditioning. The system is optimized (event driven) to ensure that the protection outputs are not delayed by the PSL operation.

The Programmable Scheme Logic is configured using the graphical MiCOM S1 Studio PC software, as shown in Figure 2

The Px30 logic can be created using Boolean Equations or a graphical interface as shown in figure 3.

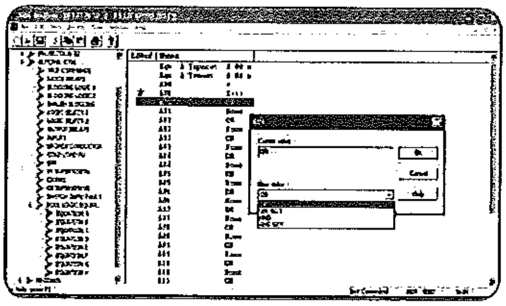


Figure 1: Flexible logic for Px20

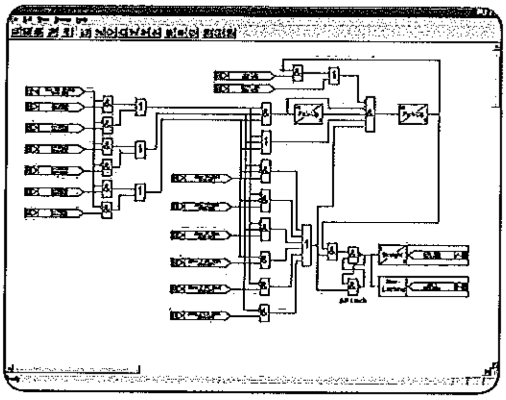


Figure 2: Programmable logic for Px40

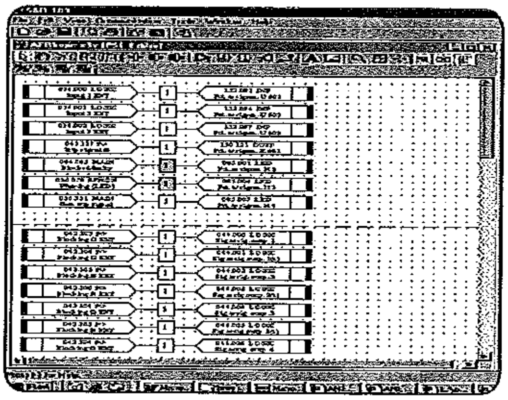


Figure 3: Programmable logic for Px30

Independent Protection Settings Groups

Up to two setting groups are supported in the 20 Series whereas the 30 and 40 series can offer up to four independent setting groups. These can be activated locally, remotely or via a dedicated input and are used to allow for different system operating conditions and where adaptive relaying is applied.

Measurement & Post Fault Analysis

The MiCOM Range of relays are capable of measuring and storing a wide range of system quantities such as Current, Voltage, Frequency, Power etc. depending on the relay functionality.

All event, fault and disturbance records are time tagged to a resolution of 1ms using the internal real time clock and are stored in non-volatile memory. A supervised lithium battery ensures that the real time clock and records are maintained during auxiliary supply interruptions.

Where relays are communicating to a SCADA system, the protocols' telegrams can be used for external time synchronization or alternatively an optional IRIG-B port is available for accurate time synchronization on all Px30 and Px40 MiCOM relays. Some relays can also use an opto input to synchronize the relay's clock.

Power System Measurement

A comprehensive set of measurement values including instantaneous and derived values are available on the relays.

These measured values can be displayed on the front LCD display or transferred locally or remotely as per the user requirements.

POST FAULT ANALYSIS

Event Records

These are generated for status changes to logic inputs and outputs, modifications to one or more setting parameters and alarm signals. All events are time-tagged and stored in chronological order in a cyclic memory where the oldest record is overwritten once the relay's maximum event count is exceeded. These are readily available for viewing on the LCD, or extraction via the communication ports.

Fault Records

At least 5 records are supported on all relays and for every fault; the following information is captured in the relay records:

- A fault number
- The date and time
- The active setting group
- The function that issued the trip
- The magnitude of the current/voltage that gave rise to the trip command

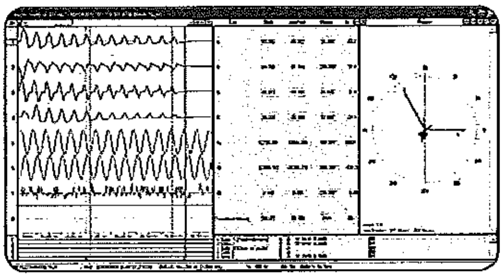


Figure 4: Oscillography analysis using MiCOM S1 Studio Software for optimum results

Disturbance Records

The internal disturbance recorder will record the sampled values of all analogue input variables such as phase currents and voltages etc. where applicable during a fault. Oscillographic analysis can be performed using MiCOM S1 Studio which will provide the means to quickly analyse analogue and digital signals on the same time-scale for convenience. Disturbance records can be extracted from the relay via the communication ports and saved in the COMTRADE format.

ВЯРНО С ОРИГИНАЛА

RELAY COMMUNICATIONS

As standard, a front communication port is available for local access to the relay. An auxiliary rear communication port is available as an option on relays providing an engineering port for easy access to settings, records and measurements for protection engineers. A main rear communications port is also available for interface to a SCADA system. A number of protocols are available as an option for this purpose. (See cortec code for each relay)

Local Communication

The front EIA(RS)232 communication port has been designed for use with the MiCOM S1 Studio software and is primarily for configuring the relay settings and programmable scheme logic. It is also used to locally extract event, fault and disturbance record information and can be used as a commissioning tool by viewing all relay measurements simultaneously. In Px20 / Px30 the front EIA(RS)232 is also used to upgrade relay software. In Px40 a separate front parallel port is used for this.

Rear Communication

The rear communication port is based upon EIA(RS)485 voltage levels and is designed for permanent multidrop connection to network control and data acquisition systems. An optional fibre optic communications port is also supported on the 30 and 40 platforms.

In general, the following protocols are available at ordering or via setting selection on the relays.

- Courier/K-Bus
- Modbus
- IEC 60870-5-103
- DNP3.0

The following protocol is only available on Px30 / Px40 relay models with an Ethernet port currently.

- IEC 61850

Fig 5 illustrates the flexibility with which the MiCOM range of relays can be integrated into a SCADA system as well as provide engineering data for remote access by utility engineers.

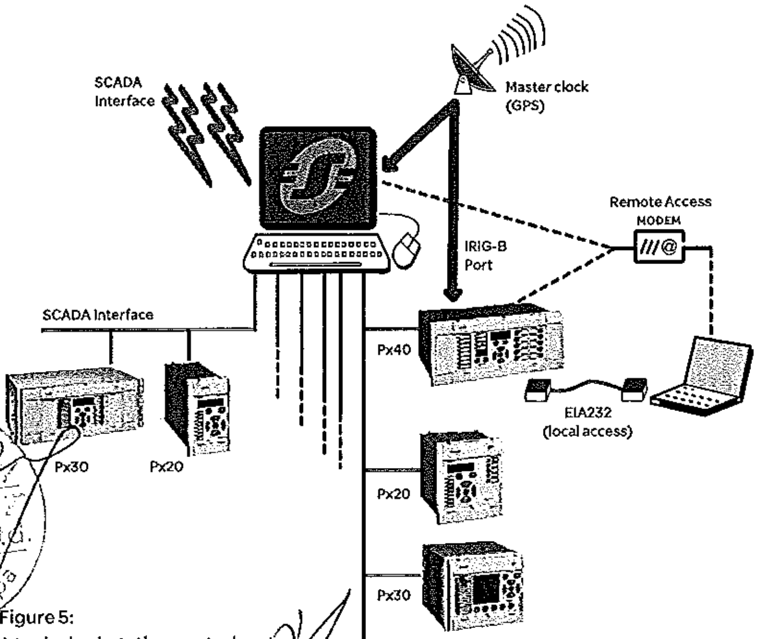


Figure 5:
A typical substation control system

USER INTERFACES

The user interface and menu text are available in English, French, German and Spanish as standard. Other languages such as for example Russian and Italian are supported on some relays depending on market requirements.

The ability to customize the menu text and alarm descriptions is also supported on Px30 and Px40.

The front panel user interfaces, as shown in Figures 6, 7 & 8 comprise:

(1) A back-lit liquid crystal display (20, 30, 40 series) Graphic LCD display (30 series only)
(2) Four fixed function LEDs (20, 40 series) Five fixed function LEDs (30 series)
(3) Up to Four user programmable LEDs (20 series) Up to Eight user programmable LEDs (40 series) Twelve user programmable LEDs (30 series)
(4) Menu navigation and data entry keys.
(5) "READ" and "CLEAR" keys for viewing and reset of alarms
(6) An upper cover identifying the product name, which may be raised to view full product model number, serial number and rating information.
(7) A lower cover concealing the front EIA(RS)232 port, download/monitor port and battery compartment. Cover not available on compact case.
(8) Facility for fitting a security seal
(9) Bay control keys up to 6 bays control (30 series)
(10) Programmable Function keys (compact range, 30 and 40 series)

SELF MONITORING

Comprehensive Self monitoring procedures within the device ensure that internal hardware and software errors are detected thus ensuring a high degree of reliability. Automatic tests are performed during start-up and cyclic self monitoring tests are performed during operation. Any deviations are stored in non-volatile memory and the result of the fault diagnosis determines whether a blocking of the device will occur or whether an alarm is only issued.

User language options that provide true global convenience

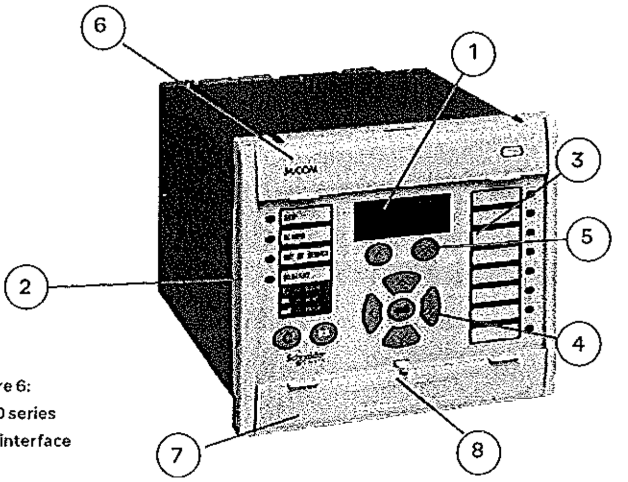


Figure 6: Px40 series user interface

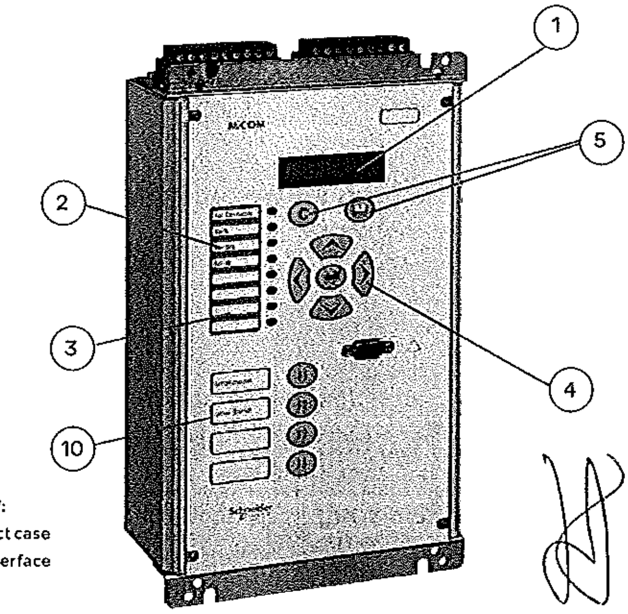


Figure 7: Compact case user interface

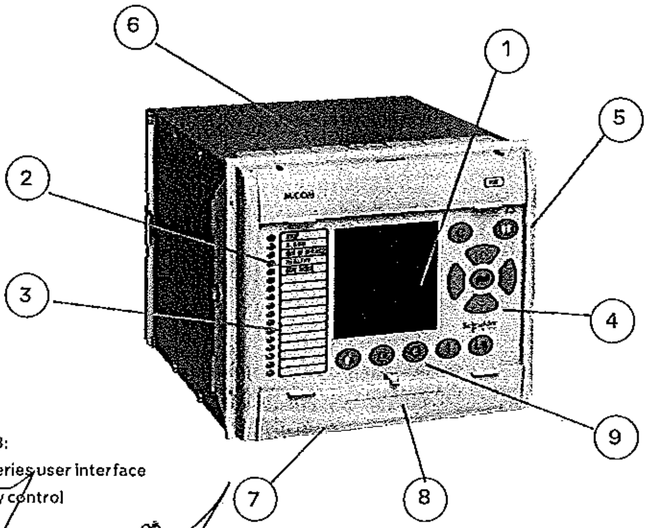


Figure 8: Px30 series user interface with bay control

ВЯРНО С
ОРИГИНАЛА

MECHANICAL DESCRIPTION

Cases

The MiCOM series relays are housed in a specially designed case providing a high density of functionality within the product. Communication ports and model/serial number information is concealed by upper and lower covers.

Physical protection of the front panel user interface and prevention of casual access is provided by an optional transparent front cover, which can be fitted or omitted according to choice, since the front panel has been designed to IP52 protection against dust and water

The cases are suitable for either rack or panel mounting as shown in Fig.9.

An option for surface mounting is also supported on the 30 series range and a compact case option is available on a few 20 and 30 series relays for installations with space limitations.

Taking into account the differing case widths -relays can be combined with or without the use of standard blanking plates to form a complete 19" mounting. This saves space and allows for a neat installation.

Wiring

External connections are made via ring type terminal except on the compact case. These take pin type terminals along with the 30 series relays as an option.

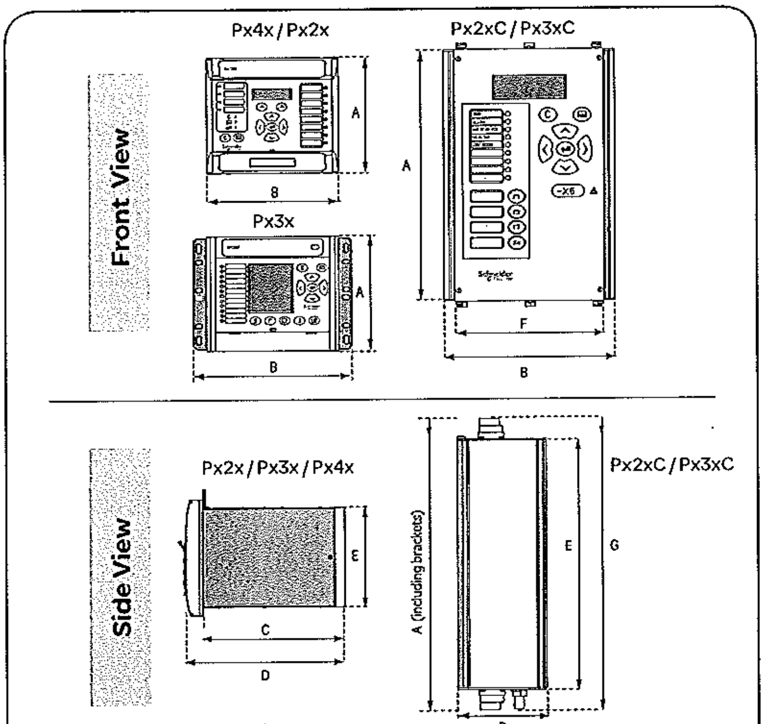


Figure 9: Typical case dimensions

Typical Case Dimensions Table

		A	B	C	D	E	F	G
Px20	20-TE	177	103	240 (incl. wiring)	270 (incl. wiring)	157,5		
	30-TE		155	139,8. 223	166,4 249,6.	155,2 156		
Px30	40-TE	184,5	213,4	227,9	253,6	177,5		
	40-TE Rack		260,2					
	84-TE		434,8					
	84-TE Rack		481,6					
	40-TE Surface		260,2		257,1	177,5		
	84-TE Surface		481,6					
P40	40-TE	177	206	240	270 (incl. wiring)	157,5 max		
	60-TE		309,6					
	80-TE		413,2					
	80-TE Rack		483					
Px20C / Px30C	Compact	294,4	175,6		88,5	253	162,5	294,4
	Compact (incl. brack)	310						

Note: Maximum sizes for guidance only, for specific product information please check the relevant product documentation. (All dimensions in mm)

1) In addition 24TE case variant available for P132.

TECHNICAL DATA

Power supplies

A wide range of power supply options are available at the ordering stage.

	Nominal Voltage Vnom.	Operate Range (V)	
		dc	ac
Px20 Ph 2	24-250 Vdc / 48-240 Vac	19.2-300	38.4-264
	48-250 Vdc / 48-240 Vac	38.4-300	38.4-264
Px30	24-60 Vdc 60-250 Vdc / 100-230 Vac	19-72 48-300	- 100-230
Px40	24-48 Vdc	19-65	-
	48-110 Vdc / 30-100 Vac	37-150	24-110
	110-250 Vdc / 100-240 Vac	87-300	80-265

Digital Inputs

A wide range of opto input voltages are supported throughout the range

	Auxiliary Voltage	Thresholds (V)
Px20 Ph 2	24- 250 Vdc / 48-240 Vac	> 19.2 Vdc/ac (Variant code"Z")
	48- 250 Vdc / 48-240 Vac	> 19.2 Vdc/ac (Variant code"Z") > 105 Vdc (Variant code "H") > 77V (70% of Uaux. 110 Vdc; Variant code "V") > 154V (70% of Uaux. 220 Vdc; Variant code "W")
Px30	**Thresholds**	
	Standard Variant > 18 (Uaux. 24-250 Vdc)	**Further Options** > 73 V (67% of Uaux. 110 Vdc) > 90 V (60-70% of Uaux. 125/150 Vdc) > 146 V (67% of Uaux. 220 Vdc) > 155 V (60-70% of Uaux. 220/250 Vdc)
Px40	**Universal Opto Inputs with programmable voltage thresholds**	
	24/27, 30/34, 48/54, 110/125 and 220/250 Vdc	

General Series Data

	Px20	Px20C	Px30	Px30C	Px40
Frequency 50/60Hz	X	X	X	X	X
Dual rated 1A/5A	X	X	X	X	X
CT thermal ratings continuous: 4 Inom for 10s: 30 Inom for 1s: 100 Inom	X	X	X	X	X
Opto Inputs	max 12	max 7	max. 64	max 2	max. 40
Output Contacts	max 9.	max 8	max 48	max 8	max. 46
Carry: continuous	5A	5A	5A	5A	10A
Make and carry	30A for 3s	30A for 3s	30A for 0.5s	30A for 0.5s	30A for 3s
LED Indication (freely programmable)	8 (4)	8 (4)	23/18 (for products with text display)	17 (12)	22 (18)
Function Keys / Hot Keys	No	4	6 (for products with text display)	4	10 functions/2 hotkeys (available on some models)
Settings Groups	up to 8	2	4	4	4 (2)
Fault Records	25	5	8	8	5
Event Records	250	75	200	100	250-512
Disturbance Records	5 (15s max)	8 (24s max)	8 (16.4 s max)	8 (16.4 s max)	75 s max.
Programmable logic	Flexible logic (available on some models)	Simple 'AND' logic	Fully programmable	Fully programmable	Fully programmable
IRIG B	Option	No	Option	Option	Option
LCD Display	Alphanumeric	Alphanumeric	Alphanumeric / Graphical (some models only)	Alphanumeric	Alphanumeric
Front Port (RS 232)	Yes	Yes	Yes	Yes	Yes
Rear Port	Yes, 2nd rear port option	Yes	Yes, 2nd rear port option	Yes, 2nd rear port option	Yes, 2nd rear port option
Courier	EIA(RS)485 (available on some models)	No	EIA(RS)485 or fiber	EIA(RS)485 or fiber	K-Bus/ EIA(RS) 485 or fiber (some models only)
Modbus	EIA(RS)485	EIA(RS)485/Glass fiber	EIA(RS)485 or fiber	EIA(RS)485 or fiber	EIA(RS) 485 or fiber(some models only)
IEC 60870-5-103	EIA(RS)485	EIA(RS)485/Glass fiber	EIA(RS)485 or fiber	EIA(RS)485 or fiber	EIA(RS) 485 or fiber(some models only)
IEC 60870-5-101	No	No	EIA(RS)485 or fiber	EIA(RS)485 or fiber	No
DNP3.0	EIA(RS)485 (available on some models only)	No	EIA(RS)485 or fiber	EIA(RS)485 or fiber	EIA(RS) 485 or fiber (some models only)
IEC 61850	No	No	Available with Ethernet board	No	Available with Ethernet board
One Box Bay Control with Mimic	No	No	Yes (available on some models)	No	No
Terminals	Ring	Pin	Pin or Ring Type	Pin	Ring

ВЯРНО С ОРИГИНАЛА

MiCOM Series Data

FEEDER MANAGEMENT RELAYS

	Device	P114D CT Powered	P115 CT Powered	P116 Dual Powered	P120	P121	P122	P122C	P123	P125	P126	P127	P130C	P132	P138 Rail	P139	P141	P142	P143	P144	P145
CT Inputs		4	4	4	1	4	4	4	4	1	4	4	4	4	2	4	5	5	5	5	5
VT inputs		-	-	-	-	-	-	-	-	1	1	3	3	4/5	1	4/5	3	3	3/4	42	3/4
Opto Inputs (max)1		2	2	6	2	2	3	7	5	4	7	12	2	40	16	64	8	16	32	16	32
Output Contacts (max)1		4	4	7	5	5	7	8	9	7	9	9	8	32	24	28	8	15	30	15	32
Output for Striker Triggering		1	1	1	-	-	-	-	-	-	-	-	-	-	–	-	-	-	-	-	-
Magnetic Flags		-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RTDs (max. option)		-	-	-	-	-	-	-	-	-	-	-	-	10	1	10	-	-	-	-	-
Analogue I/O (max. option)		-	-	-	-	-	-	-	-	-	-	-	-	1/2	1/2	1/2	-	-	-	-	-
Function Keys/Hotkeys		-	-	-	-	-	-	X	-	-	-	-	X	X	-	X	X	X	X	X	X
Bay Control & Monitoring		-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
- with Mimic		-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Interlocking Logic		-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X
Protection																					
1 Phase or Earth overcurrent	50/51P/N	-	-	-	X	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-
3 Phase overcurrent	50/51P	X	X	X	-	X	X	X	X	-	X	X	X	X	-	X	X	X	X	X	X
Ground fault	50/51N	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Phase directional	67P	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X
Ground Fault directional	67N	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Sensitive directional earthfault	67N	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X
Transient Ground Fault directional	67N	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
Wattmetric earthfault	67W	-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	X	X	X
Neutral admittance	YN	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X
Restricted earthfault	64	-	-	-	X	X	X	-	X	X	X	X	-	X	-	X	X	X	X	X	X
Voltage controlled overcurrent	51V	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X	X	X	X
Negative sequence overcurrent	46	-	-	X	-	-	X	X	X	-	X	X	X	X	-	X	X	X	X	X	X
Thermal overload	49	-	-	X	-	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X
Undercurrent	37	-	-	X	-	-	X	X	X		X	X	X	X	-	X	X	X	X	X	X
Over/Under voltage	27/59	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X
Residual over voltage	59N	-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	X	X	X
Negative sequence overvoltage	47	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X
Over/Under frequency	81O/U	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X
Rate of change of frequency	87R	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X
Incomplete sequence relay	48	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-
Master sequence device	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Lock-out	86	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Directional Power	32	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	-	-	-	-	-
Circuit breaker failure	50BF	-	X	X	-	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X
Motor	49LR	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-
Startup Monitoring	66	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-
Autoreclose	79	-	-	X	-	-	-	-	X	-	X	X	X	X	-	X	-	X	X	X	X
Check synchronising	25	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	X	-	X
Broken conductor	46BC	-	-	X	-	-	X	X	X	-	X	X	X	X	-	X	X	X	X	X	X
Voltage transformer supervision	VTS	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X
Current transformer supervision	CTS	-	-	-	-	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X
Cold load pick-up		-	-	X	-	-	X	X	X	-	X	X	X	X	-	X	X	X	X	X	X
Inrush blocking		-	-	X	-	-	X	-	X	-	-	X	X	X	-	X	X	X	X	X	X
Switch on to fault	SOTF	-	-	X	-	-	-	-	X	-	X	X	X	X	-	X	X	X	X	X	X
Circuit breaker monitoring		-	-	X	-	-	X	X	X	-	X	X	-	X	-	X	X	X	X	X	X
Trip Circuit Supervision	TCS	-	-	X	-	-	X	X	X	-	X	X	-	X	-	X	X	X	X	X	X
Limit value monitoring		-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	-	-	-	-	-
Protective Signaling	85	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-
InterMicom		-	-	-	-	-	-	-	-	-	-	-	X	X	-	X	X	X	X	X	X

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3V0 measured input and allows vee connected VTs.

MOTOR AND GENERATOR MANAGEMENT RELAYS

	Device	P130	P132	P139	P220	P225	P241	P242	P243	P341	P342	P343	P344	P345
CT Inputs		4	4	4	4	4	4	4	7	4	5	8	8	9
VT inputs		3	4/5	4/5	-	1 or 3	3	3	3	4	4	4	5	7
Opto Inputs (max)[1]		2	40	64	5	6 or 11	8	16	16	16	24	32	32	32
Output Contacts (max)[1]		8	32	32	6	6	7	16	16	15	24	32	32	32
RTDs/thermistors (option)		-	10/0	10/0	6/0 or 4/2	10/3 or 0/0	10/0	10/0	10/0	-	10/0	10/0	10/0	10/0
Analogue I/O (option)		-	1/2	1/2	0/1	0/2 or 0/0	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
Function Keys/Hotkeys		X	X	X	-	-	X	X	X	X	X	X	X	X
Interlocking Logic		-	X	X	-	-	X	X	X	X	X	X	X	X
Protection														
Motor Protection														
Short circuit	50/51	X	X	X	X	X	X	X	X					
Motor Differential	87M	-	-	-	-	-	-	-	X	-	-	-	-	-
Locked Rotor	50S/51LR/51S	X	X	X	X	X	X	X	X	-	-	-	-	-
Reverse Power	32R	X	X	X	-	-	X	X	X	-	-	-	-	-
Reacceleration	27LV	X	X	X	X	X	X	X	X	-	-	-	-	-
Startup Monitoring/Excessive long start	66/48/51	X	X	X	X	X	X	X	X	-	-	-	-	-
Negative sequence overvoltage	47	X	X	X	-	-	X	X	X	-	-	-	-	-
Out of Step	55	-	-	-	-	-	X	X	X	-	-	-	-	-
Loss of load	37	X	X	X	X	X	X	X	X	-	-	-	-	-
Undercurrent	37P/37N	X	X	X	X	X	X	X	X	-	-	-	-	-
Unbalance/Lock-out	30/46/86	X	X	X	X	X	X	X	X	-	-	-	-	-
Speed switch inputs	14	-	-	-	X	X	X	X	X					
Anti Backspin		-	-	-	-	X	X	X	X					
Generator Protection														
Generator Differential	87G/87GT	-	-	-	-	-	-	-	-	-	-	X	X	X
Interturn/split phase	50DT	-	-	-	-	-	-	-	-	-	-	X	X	X
Underimpedance	21	-	-	-	-	-	-	-	-	-	X	X	X	X
Pole Slipping	78	-	-	-	-	-	-	-	-	-	-	X	X	X
Directional Power	32L/O/R	X	X	X	-	-	-	-	-	X	X	X	X	X
Loss of Field	40	-	-	-	-	-	X	X	X	-	X	X	X	X
Restricted earthfault	64	-	-	-	-	-	-	-	-	X	X	X	X	X
100% Stator earth fault (3rd harmonic)	27TN	-	-	-	-	-	-	-	-	-	-	X	X	X
100% Stator Earth Fault (Low Freq. Injection)	64S	-	-	-	-	-	-	-	-	-	-	-	-	X
Overfluxing	24	-	-	-	-	-	-	-	-	-	X	X	X	X
Unintentional energisation at standstill	50/27	-	-	-	-	-	-	-	-	-	X	X	X	X
Voltage dependent O/C	51V	-	-	-	-	-	-	-	-	-	X	X	X	X
Rotor Earth Fault (MiCOM P391 option)	64R	-	-	-	-	-	-	-	-	-	X	X	X	X
Ancillary Functions														
Phase overcurrent	50/51P	X	X	X	X	X	X	X	X	X	X	X	X	X
Phase directional	67P	X	X	X	-	-	-	-	-	X	X	X	X	X
Ground fault	50N/51N	X	X	X	X	X	X	X	X	X	X	X	X	X
Ground Fault directional	67N	X	X	X	-	-	-	-	-	X	-	-	-	-
Sensitive directional earthfault	67N	X	X	X	-	-	X	X	X	-	X	X	X	X
Wattmetric earthfault	64N/32N	X	X	X	-	-	X	X	X	X	X	X	X	X
Negative sequence overcurrent	46OC	X	X	X	-	X	X	X	X	-	X	X	X	X
Negative sequence thermal	46T	-	-	-	-	-	-	-	-	-	X	X	X	X
Thermal overload	38/49	X	X	X	X	X	X	X	X	X	X	X	X	X
Under/Over voltage	27/59	X	X	X	-	X	X	X	X	X	X	X	X	X
Residual over voltage	59N	X	X	X	-	-	X	X	X	X	X	X	X	X
Negative sequence overvoltage	47	X	X	X	-	-	-	-	-	X	X	X	X	X
Under frequency	81U	X	X	X	-	-	X	X	X	X	X	X	X	X
Over frequency	81O	X	X	X	-	-	-	-	-	X	X	X	X	X
Turbine abnormal frequency	81AB	-	-	-	-	-	-	-	-	-	X	X	X	X
Voltage vector shift	dVq	-	-	-	-	-	-	-	-	X	-	-	-	-
Rate of change of frequency	81R	X	X	X	-	-	-	-	-	X	-	-	-	-
Circuit breaker failure	50BF	X	X	X	-	X	X	X	X	X	X	X	X	X
Circuit breaker monitoring		[illegible]	X	X	X	X	X	X	X	X	X	X	X	X
Trip Circuit Supervision	TCS	X	X	X	X	X	X	X	X	X	X	X	X	X

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Stara Zagora Ltd.

000236

DISTANCE RELAYS

	Device		P430C	P433	P435	P436 Rail	P437	P438 Rail	P439	P441	P442	P443	P444	P445
CT Inputs			4	4	4	2	4/5	3	4	4	4	4	4	4
VT inputs			3	4/5	4/5	1	4/5	2	4/5	4	4	4	4	4
Opto Inputs(max)[1]			2	52	52	28	32	28	46	8	16	24	24	24
Output Contacts(max)[1]			8	36	46	46	46	46	26	14	21	32	46	32
RTDs (option)			-	1	1	1	1	1	1	-	-	-	-	-
Analogue I/O (option)			-	1/2	1/2	1/2	1/2	1/2	1/2	-	-	-	-	-
Function Key/Hotkeys			X	X	X	-	X	-	-	X	X	X	X	X
Bay Control & Monitoring with Mimic			-	-	-	-	-	-	X	-	-	-	-	-
Interlocking Logic			-	-	-	-	-	-	X	-	-	-	-	-
Protection														
Distance Protection														
Distance	21/21N		X	X	X	X	X	X	X	X	X	X	X	X
Autoreclose	79	3 pole	X	X	-	-	-	-	X	X	-	-	-	X
		1/3 pole	-	-	X	-	X	-	-	-	X	X	X	-
Power Swing Blocking	78		X	X	X	-	X	-	X	X	X	X	X	-
Out of step tripping	68		X	X	X	-	X	-	X	-	-	-	-	-
Check synchronising	25		-	X	X	-	X	-	X	X	X	X	X	X
Directional Power	32		X	X	X	-	X	-	X	-	-	-	-	-
Switch on-to fault	50/27		X	X	X	X	X	X	X	X	X	X	X	X
Mutual Compensation			-	-	-	-	X	-	-	X	X	X	X	-
Rail Catenary Protection	HZ		-	-	-	16 2/3	-	25/50/60	-	-	-	-	-	-
Defrost Protection			-	-	-	-	-	X	-	-	-	-	-	-
Train startups	di/dt,dv/dt,dΦ/dt		-	-	-	X	-	X	-	-	-	-	-	-
Phase overcurrent	50/51P		X	X	X	X	X	X	X	X	X	X	X	X
Phase directional	67P		-	-	-	X	-	X	-	X	X	X	X	X
Delta directional comparison	el/eV		-	-	-	-	-	-	-	-	-	X	-	-
Ground fault	50/51N		X	X	X	-	X	-	X	X	X	X	X	X
Ground Fault directional	67N		X	X	X	-	X	-	X	X	X	X	X	X
Transient Ground Fault directional	67N		-	X	X	-	-	-	X	-	-	-	-	-
Neutral admittance	YN		X	X	X	-	-	-	X	-	-	-	-	-
Wattmetric earthfault	67W		X	X	X	-	-	-	X	-	-	-	-	-
Negative sequence overcurrent	46		X	X	X	-	X	-	X	X	X	X	X	X
Directional negative sequence	46/67		X	X	X	-	X	-	X	X	X	X	X	X
Thermal overload	49		X	X	X	X	X	X	X	X	X	X	-	X
Under/Over voltage	27/59		X	X	X	X	X	X	X	X	X	X	X	X
Residual over voltage	59N		X	X	X	-	X	-	X	-	-	X	-	X
Over/Under frequency	81U		X	X	X	-	X	-	X	-	-	-	-	-
Rate of change of frequency	81R		X	X	X	-	X	-	X	-	-	-	-	-
Circuit breaker failure	50BF		X	X	X	X	X	X	X	X	X	X	X	X
Broken Conductor	46BC		-	X	X	-	X	-	X	X	X	X	X	X
Stub Bus Protection	50ST		X	X	X	-	X	-	X	X	X	X	X	X
Voltage/Current transformer supervision	VTS/CTS		X	X	X	X	X	X	X	X	X	X	X	X
Capacitive voltage transformer supervision	CVTS		-	-	-	-	-	-	-	X	X	-	X	-
Channel Aided Scheme Logic	85		X	X	X	-	X	-	X	X	X	X	X	X
Trip Circuit Supervision	TCS		X	X	X	X	X	X	X	X	X	X	X	X
InterMicom			X	X	X	X	X	X	X	X	X	X	X	X

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C00237

LINE DIFFERENTIAL, TRANSFORMER AND BUSBAR PROTECTION RELAYS

	Device	P521	P530C	P532	P541	P542	P543	P544	P545	P546	P547	P630C	P631	P632	P633	P634	P642	P643	P645	P721	P723	P741	P742	P743	P746
CT Inputs		4	4	4	4	4	5	9	5	9	4	6	6	8	12	15	8	12	18	2	8	4	4	4	6
VT inputs		-	3	4/5	-	-	4	3	4	3	-	-	-	1	1	1	2	4	4	-	-	-	-	-	1
Opto Inputs (max) [1]		5	2	46	8	16	16	16	24	24	8	2	4	34	40	34	12	24	24	2	5	8	16	24	40
Output Contacts (max) [1]		8	8	30	7	14	14	14	32	32	8	8	14	22	30	22	12	24	24	4	8	8	8	21	32
Analogue I/O (option)		-	-	1/2	-	-	-	-	-	-	-	-	-	1/2	1/2	1/2	4/4	4/4	4/4	-	-	-	-	-	-
RTDs (option)		-	-	1	-	-	-	-	-	-	-	-	-	1	1	1	10	10	10	-	-	-	-	-	-
Function Keys/Hotkeys		-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	X	-	X	X
Interlocking Logic		-	X	X	-	X	X	X	X	X	X	-	-	X	X	-	-	-	-	-	-	X	-	X	-
Protection																									
Line Differential	87P	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 terminal		X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/3 terminal		-	-	-	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FO signalling		X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metallic signalling		X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SDH/Sonet network		-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
In-Zone transformer		X	-	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2nd harmonic restraint		X	X	X	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vector Compensation		X	-	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transient Bias (CT saturation)		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 breaker configuration		-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct/Permissive Intertripping		X	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phase Comparison	87PC	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLC signalling		-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transformer Differential	87P	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-
Windings		-	-	-	-	-	-	-	-	-	-	2	2	2	3	4	2	3	5	-	-	-	-	-	-
Restricted earth fault	87G/ 64	-	-	-	-	-	-	-	-	-	-	-	-	2	3	3	2	3	5	1	-	-	-	-	-
Overfluxing/5th harmonic		-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-
Overexcitation	24	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	-	-	-	-	-
2nd harmonic restraint		-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-
Busbar Protection	87BB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Central unit (Nbr of Feeders)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No limit	up to 28	-	-	up to 18
Peripheral units - 8 zones		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-
Phase segregated differential	87P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	8 zones	-	-	2 zones
Sensitive earth fault differential	87N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	6 zones	-	-	-
Check Zone	87CZ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	X
CT Saturation Detection		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X
Fibre optic signalling		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	X	X	X	-
Ancillary Functions																									
Phase overcurrent	50/51P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	X	X	X
Phase directional	67P	-	X	X	-	-	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
Ground fault	50/51N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	X	X	X
Ground Fault directional	67N	-	X	X	-	-	X	X	X	X	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-
CT supervision	CTS	-	-	-	-	-	X	X	X	X	-	-	X	X	X	X	-	-	-	X	X	X	X	X	X
Sensitive directional earthfault	67N	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wattmetric earth fault	64W	-	X	X	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distance Protection	21	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power Swing Blocking	78	-	-	-	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Check Synchronism	25	-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Negative sequence overcurrent	46	X	X	X	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-
Thermal overload	49	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-
Loss of load/Undercurrent	37	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Under/Over frequency	81U/O	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	-	-	-	-	-	-
Circuit breaker failure	50BF	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X
Autoreclose	79	-	3 pole	3 pole	-	3 pole	1/3 pole	-	1/3 pole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Over/Under voltage	27/59	-	X	X	-	-	X	X	X	X	-	-	-	X	X	X	-	X	X	-	-	-	-	-	-
Trip Circuit Supervision	TCS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

ВЯРНО С
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1 - Please note that some relays may have a limit on max. I/O when used as a combination.

000238

VOLTAGE, FREQUENCY AND ANCILLARY PROTECTION RELAYS

	Device	P821	P841A	P841B	P921	P922	P923
CT Inputs		4	3	3	-	-	-
VT inputs		-	4	5	4	4	4
Opto Inputs(max)		5	16	24	2	5	5
Output Contacts(max)		9	14	32	4	8	8
Protection							
Breaker Failure Protection	50BF	X	1	1/2	-	-	-
2 Stage		X	-	-	-	-	-
Pole Discrepancy		X	-	-	-	-	-
Dead Zone Function		X	-	-	-	-	-
Autoreclose	79	-	1	1/2	-	-	-
Mesh Corner/Single Switch		-	-	-	-	-	-
Check Sync	25	-	1	2	-	-	-
Ferroresonance Suppression		-	X	X	-	-	-
Open Line Detector	DLO	-	-	-	-	-	-
High Speed Breaker Fail	50BF	-	-	-	-	-	-
Fast Hybrid Output contacts		-	-	-	-	-	-
3 pole tripping		-	X	X	-	-	-
Voltage and Frequency Protection							
Undervoltage	27	-	X	X	X	X	X
Overvoltage	59	-	X	X	X	X	X
Residual Overvoltage	59N	-	X	X	X	X	X
Phase Sequence Voltage	47/27D	-	X	X	-	X	X
Under/Over frequency	81U/O	-	X	X	-	X	X
Rate of change of Frequency (df/dt+t)	81R	-	X	X	-	-	X
Frequency supervised Rate of change of Frequency (f+df/dt)	81RF	-	-	-	-	-	yes by logic
Frequency supervised average Rate of change of Frequency (f+ef/et)	81RAV	-	-	-	-	-	-
Generator Abnormal Frequency	81AB	-	-	-	-	-	-
Load Restoration logic		-	-	-	-	-	-
Trip Circuit Supervision	TCS	X	X	X	-	X	X

ВЯРНО С ОРИГИНАЛА

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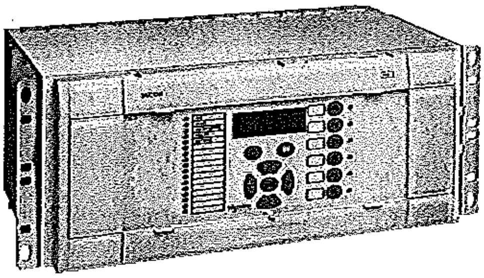
MiCOM P63x

Transformer Differential Protection with CTS



Modular P63x

CURRENT TRANSFORMER SUPERVISION

Schneider Electric announces the launch of innovative new current transformer supervision (CTS) in its transformer differential protection.

The CTS feature is used to detect failure of one or more of the AC phase current inputs to the relay. Failure of a phase CT or an open circuit of the secondary wiring can lead to incorrect operation of current based protection elements. Additionally, interruption of the CT secondary wiring can induce high voltages presenting a danger to life and insulation.

In firmware version -606 an innovative CTS method has been implemented. The patent pending scheme is designed on the ratio of the negative and positive sequence current levels for all winding terminals.

The advantage of this scheme is that no additional CT or VT inputs are needed aside from those necessary for biased differential protection, therefore further secondary equipment and wiring is not required.

KEY FEATURES

- The technique allows application of CTS to any differential protection scheme. Operation is independent of the primary power system configuration and is unaffected by transformer winding configuration, load levels,single-phase load imbalance from railway traction or methods of earthing.
- Fast operating CTS detection allows the relay to desensitize the biased differential protection characteristic to avoid maloperation, while maintaining discrimination between internal and external faults.
- Indication of the faulty CT set can be programmed to block affected protection and/or alarm after a set time delay.

Customer Benefits

- Current based method - VTs not required
- Technique is independent of system configuration
- Self-resetting upon restoration of CT supplies - no need for user intervention

Schneider Electric

CTS OVERVIEW

Operating Conditions

The logic diagram illustrates the basic operation of the CTS function.

Faulty End Determination

The faulty end is determined by the measurement of high negative sequence current on exactly one end and none or only low levels measured on all other ends. If at any end positive sequence current is below the pick up threshold, then the I2/I1> not exceeded condition is set without any measurement.

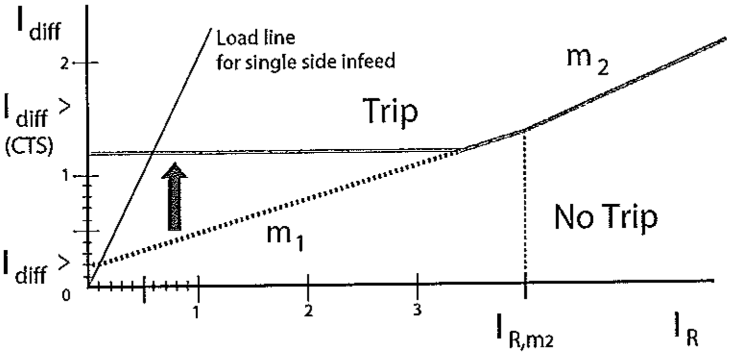
Signaling and Indication

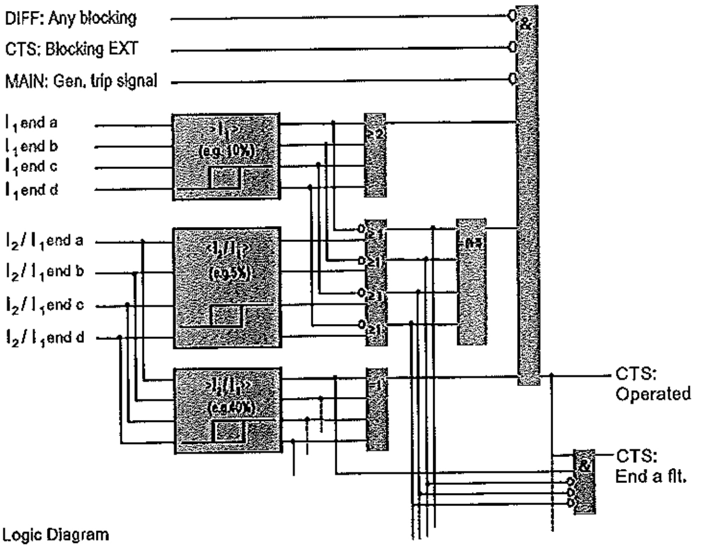
CT failure condition signaling can be delayed by a settable delay timer to prevent signaling under transient system conditions. The signals may be latched once the failure condition has been present for a set minimum time. Signals for each end can be used to selectively block the restricted earth fault (REF) protection associated to that end.

Biased Differential Stability

As soon as a CTS condition is detected, the function will raise the low set threshold of the differential protection, to the Idiff>(CTS) setting.

This threshold should be set above maximum load current to ensure differential protection will not operate under load conditions, but remains active for higher short-circuit currents, which is predominantly the case for internal faults.





Logic Diagram

Other features in P63x relay

- Now available with Regional English data model providing Px40-style setting texts
- Biased differential protection
- Restricted earth fault protection configurable as biased or high impedance (P632-P634)
- IDMT and DT overcurrent protection
- Thermal overload protection
- Under / overvoltage protection (P632-P634)
- Under / overfrequency protection (P632-P634)
- Overfluxing protection (P632-P634)
- Broken conductor detection for up to four windings
- IRIG-B time synchronization
- Remote communications via serial protocols using EIA-485 or optical fiber (IEC60870-5-101, -103, Modbus, DNP3, Courier)
- Ethernet communications over optical fiber or copper cabling
- and more...

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ОРИГИНАЛА

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Notes

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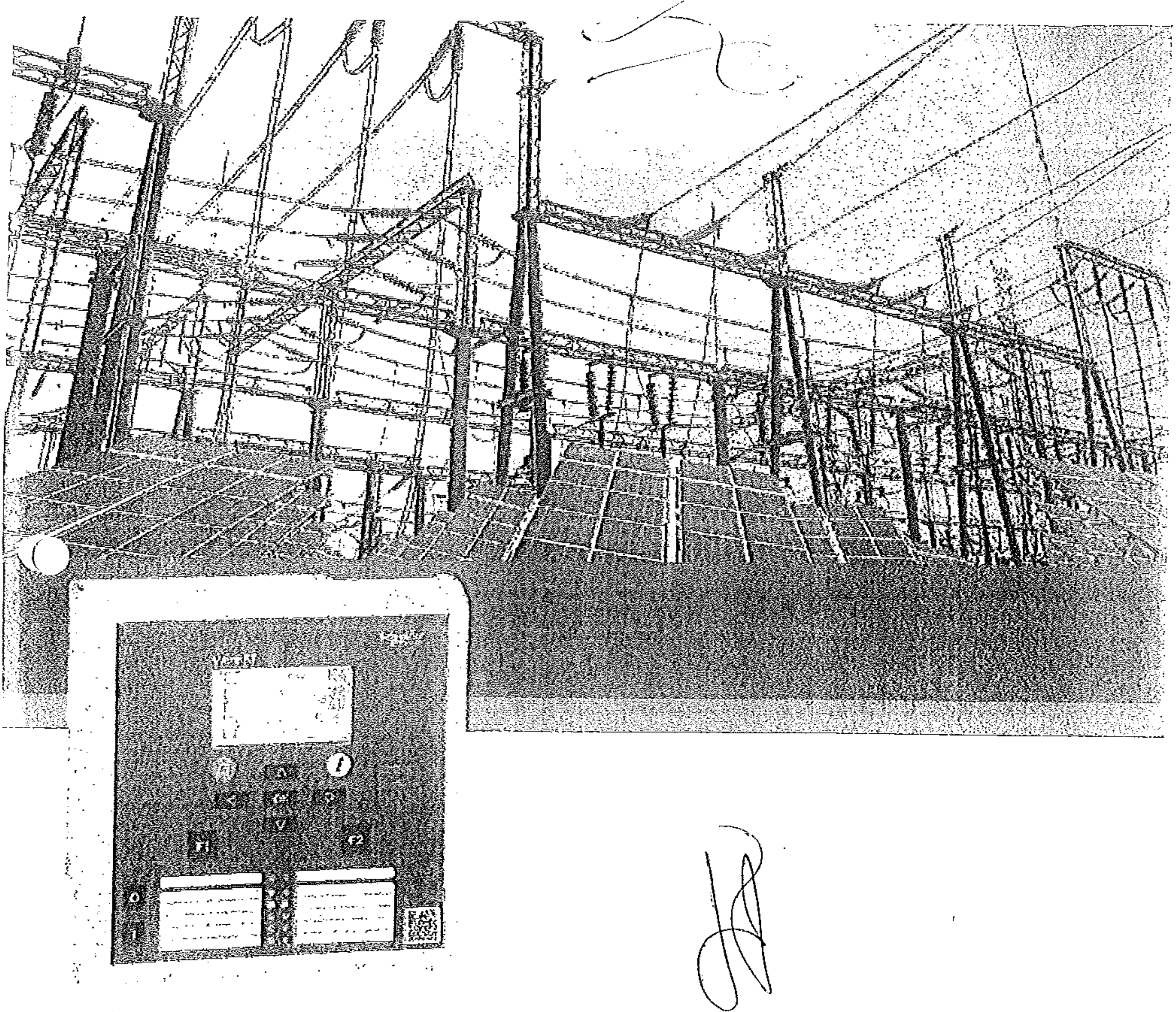
ОРИГИНАЛА

Notes



VAMP 57

Multipurpose feeder and motor protection relay

The VAMP 57 feeder manager has been developed to cover basic protection needs for OEMs, utilities and industrial applications. Thanks to its cost-effective and flexible design, the VAMP 57 provides an excellent alternative for various protection applications.

User-friendliness has always been a feature of VAMP products, and the VAMP 57 is no exception.

The rapid setting and download/upload is achieved with the unique VAMPSET setting software which dramatically improves usability.

m.vamp.fi

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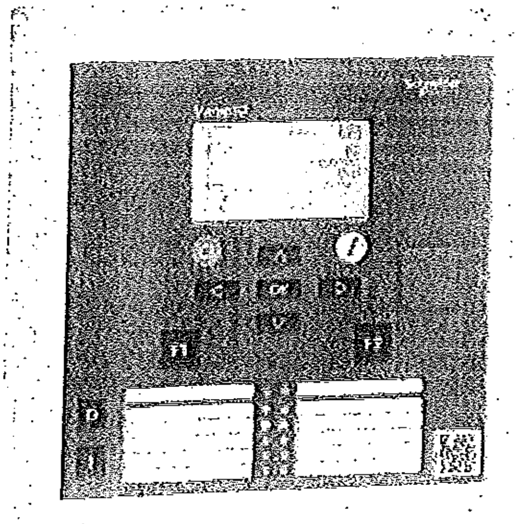
Life Is On | Schneider Electric

Feeder and motor protection



The VAMP 57 comprises dedicated circuit breaker control push buttons.

VAMP 57 at a glance

Robust hardware

- User selectable Ethernet, RS485 or RS232 based communication interface
- Designed for demanding industrial conditions

Common technology for cost efficiency

- Powerful CPU supporting IEC 61850
- Thanks to four setting groups adaptation to various protection schemes is convenient

User-friendly and high functionality

- Common firmware platform with other VAMP range protection devices
- Standard USB connection (type B) for setting software (VAMPSET)

Modern Human Machine Interface (HMI)

- Clear LCD display for alarms and events
- Single line diagram mimic with control, indication and live measurements
- Programmable function keys and LEDs
- Circuit breaker ON / OFF control

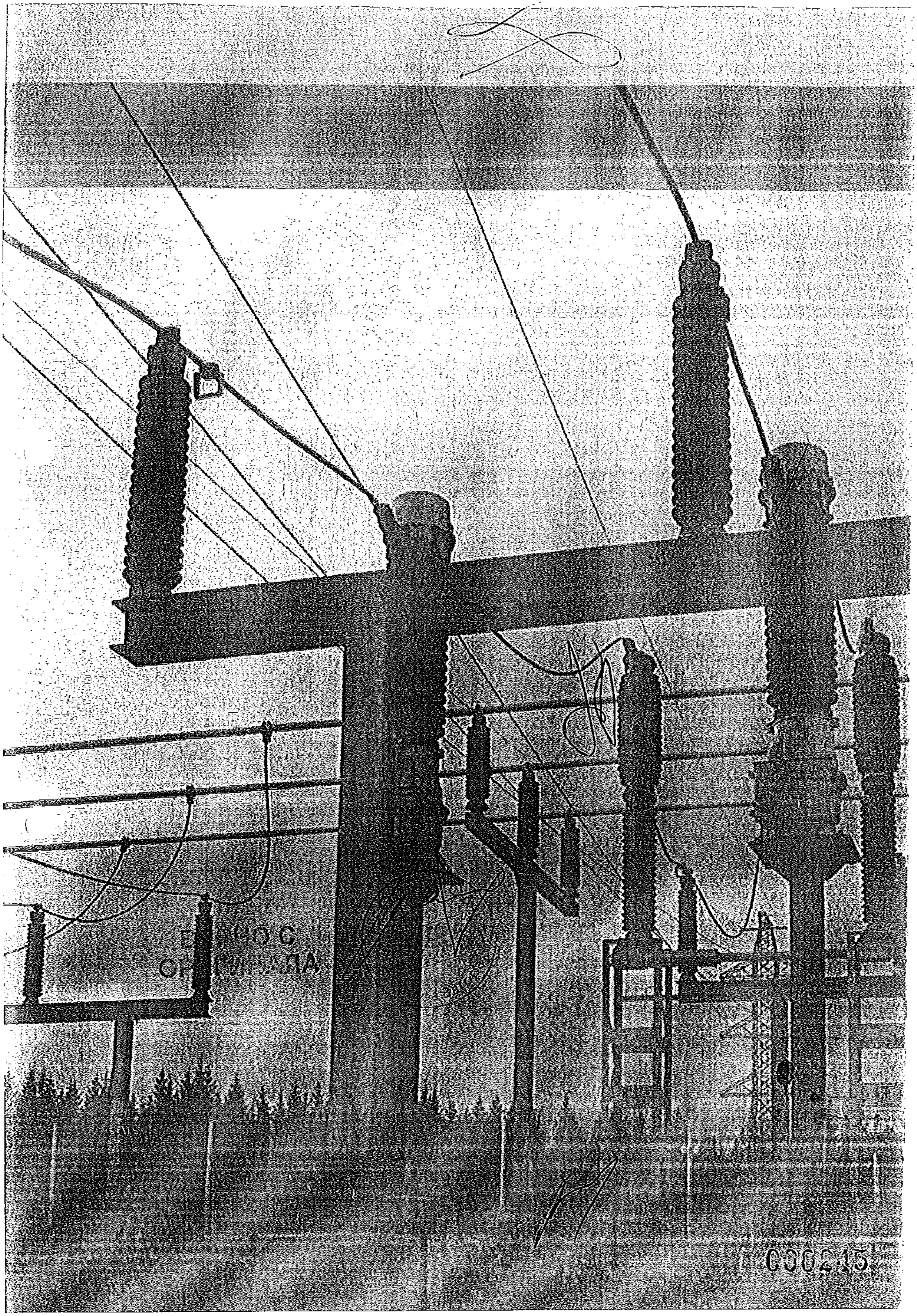
Superior protection

The VAMP 57 protection relay family is based on proven technology concepts developed in close cooperation with customers. VAMP products have been designed around user-friendliness, a feature which is proven in our customer reports day after day.

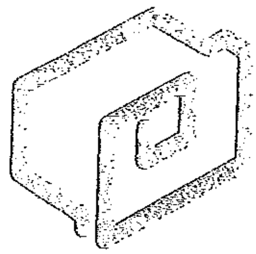
The VAMP 57 feeder manager has been developed to cover basic protection needs for OEMs, utilities and industrial applications. Thanks to its cost-effective and flexible design, the VAMP 57 provides an excellent alternative for various protection applications.

VAMP 57 combines further protection functions such as directional earth fault for feeder and motor protection.

ВЯРНО С ОРИГИНАЛА



User friendly HMI interface



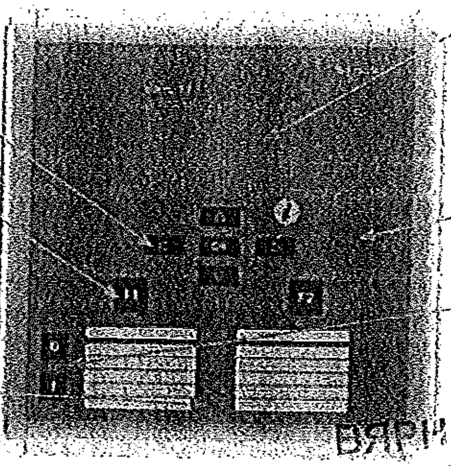
Ease of use

A great deal of effort has gone into the design of the operational aspects of the new products.

Unicode support allows the menu text and settings to be translated by user into various international languages including for example Russian and Chinese. The informative human machine interface shows all of the required information for the user with support of customised legend texts.

The VAMP 57 protection relay concept has been extended with a number of features that make installation and testing of the relays even more efficient and user-friendly.

HMI interface of VAMP 57



Navigation push buttons

Function buttons with:
- User configurable legend texts
- Object control
- Protection setting group selection
- Freely programmable

Programmable LEDs
- User configurable legend texts
- 12 LEDs, 2 fixed (power, self-diagnostic) and 8 freely programmable (2 for push buttons)

128 x 64 LCD dot matrix display
- Single line diagram and freely assignable analogue values
- Unicode language support

Local port
- USB interface

Control buttons
- Direct or select-execute CB control
- Possibility for password protection

ВЯРНО С ОРИГИНАЛА

The template for user legend texts is a part of the product documentation.

The texts are printed on a transparent film allowing customisation of the relay.

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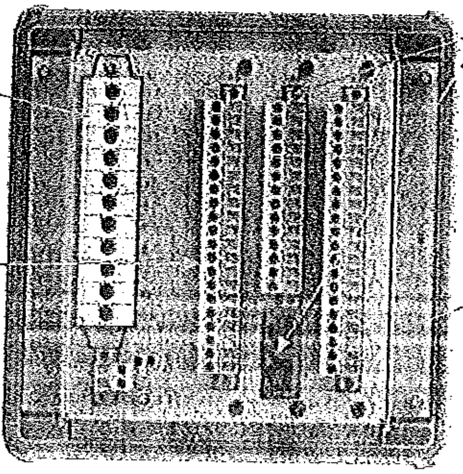


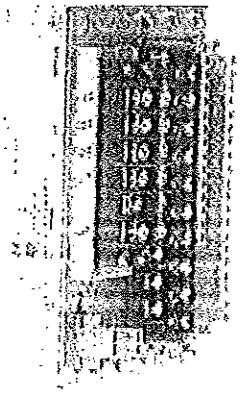
Analog interface
- 4 x CT
- 1 x U
- Auxiliary power supply

Analog interface and DI / DO
- Presence of this module is order code dependent
- 3 x U
- 3 x trip relay
- 6 x DI

Combined DI and communication interface card
- 8 x DI
- Remote port: RS485 or Ethernet (RJ-45 redundant)

Inputs and outputs
- 2 x DI
- 4 x trip relay
- 1 x alarm relay

Ring-lug terminals for X1 and X5 slots are specified with type designation code: 4 = 1A/5A & 1U (100/110V), X1 and X5 ring lugs



Communication

Wide range of protocols including IEC 61850

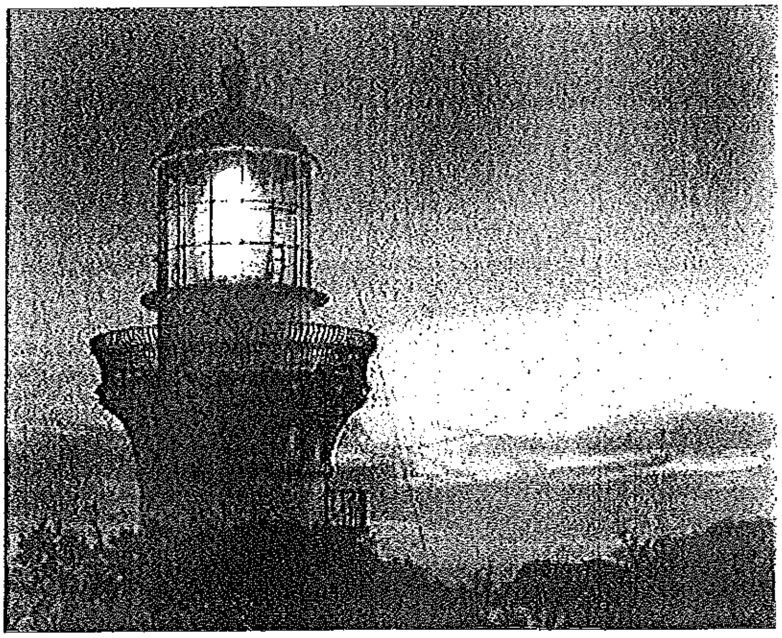
VAMP is an expert in communication with vast experience in interfacing different system integrators, SCADA, RTUs, PLCs and gateways using a large number of supported protocols. Flexible adaptation of the communication protocols together with powerful and easy to use software tools are the key to successful integration.

IEC 61850

The IEC 61850 protocol can be used to read or write static data or to receive events sent spontaneously from the relay. In addition, the interface allows peer-to-peer communication between the relays, known as GOOSE. The IEC 61850 interface is configured with familiar, user-friendly VAMPSET software.

The IEC 61850 datamodel, data-sets, report control blocks and GOOSE communication are configured according to the requirements of the system configuration. VAMPSET is also used to produce ICD files, which may be needed for the substation integration.

VAMP 57 Communication protocols	
• IEC 60870-5-101	• IEC 61850
• IEC 60870-5-103	• Human-Machine-Communication, display
• Modbus TCP	• Human-Machine-Communication, PC
• Modbus RTU	• Ethernet IP
• DNP 3.0	• Profibus DP
• SPA-bus communication	



Order code digit	B = RS-485 + 8DI	C = 2xRJ45 + 8DI	D = 2xLC + 8DI	E = RJ+232+8DI with IRIG-B	F = LC+232+8DI with IRIG-B
Communication	Two-wire RS485 serial	Double Ethernet (RSTP) RJ45	Double Ethernet (RSTP) LC	RS232 and Ethernet RJ-45	RS232 and Ethernet LC
Protocols	IEC60870-5-101, IEC 60870-5-103, Modbus RTU and SPA	IEC 61850 IEC 60870-5-101, Modbus TCP, DNP 3.0 and Ethernet IP		IEC 61850, Modbus TCP, DNP 3.0, IEC60870-5-101, IEC 60870-5-103, Modbus RTU and SPA	
Other				IRIG-B input and External I/O communication	
I/O	8 x DI				

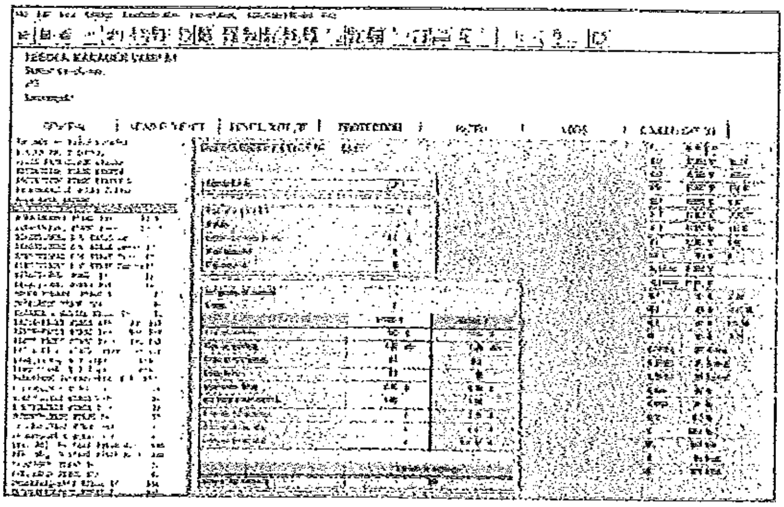
ВЯРНО С ОРИГИНАЛА

Ltd.
Стара Загора

VAMPSET

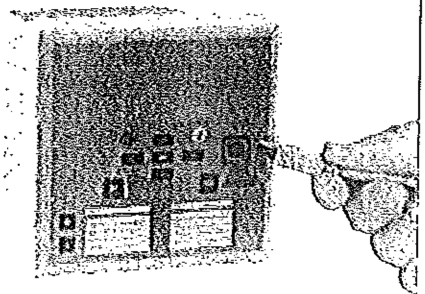
Setting and Configuration Tool

VAMPSET is a user-friendly, free-of-charge relay management software for setting parameters and configuring VAMP relays. Via the VAMPSET software, relay parameters, configurations and recorded data can be exchanged between PC and VAMP relays. Supporting the COMTRADE format, VAMPSET also incorporates tools for analysing relay events, waveforms and trends from data recorded by the relays, e.g. during a network fault situation.

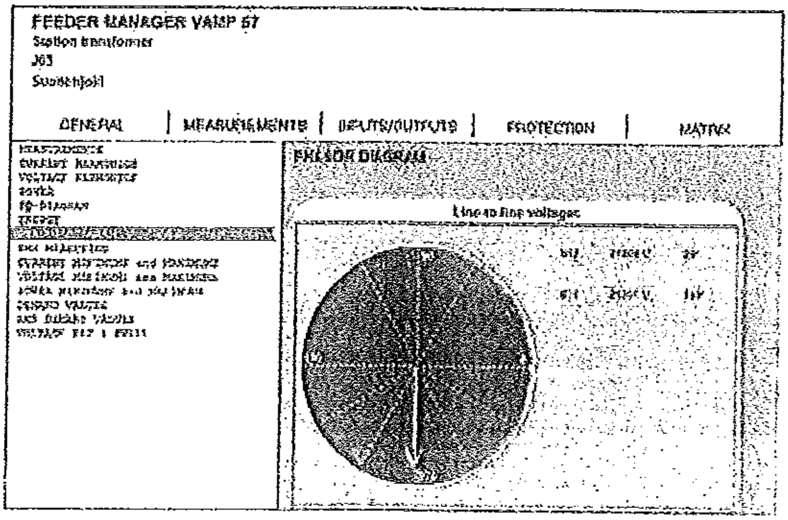


Relay's setting views are organised to several folders in the VAMPSET setting tool views in order to conveniently find right data for parameterisation of the IED. The setting tool displays on-line measurements in each folder view.

The VAMPSET software is future-proof, supporting future updates and new VAMP products.



Standard USB communication cable can be used.



The phase sequences for currents and voltages can be read on-line from the clear and explicit phasor diagram screen for easy commissioning of the relay .

ВЯРНО С
ОРИГИНАЛА

Measurements and condition monitoring

The VAMP 57 offers a complete set of measurement functions to replace the conventional metering functions of switchgear and controlgear installations. The measurement functions cover phase, line and residual currents, current imbalance, system frequency and harmonics from phase currents. Condition monitoring continuously monitors trip circuits, breaker wear and current transformers.

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Type of measurement	IEC Symbol	Protection function / measurement
Primary current	3I	Three-phase current
	I0	Zero sequence current
	I1	Positive sequence current
	I2	Negative sequence current
	I2 / I1	Ratio of negative and positive current
	IL	Average and maximum demand current
Primary voltage	3U	Phase-to-earth, phase-to-phase voltages
	U0	Zero sequence voltage
	U1	Positive sequence voltage
	U2	Negative sequence voltage
	U2 / U1	Ratio of negative and positive voltage
	Xfault	Short-circuit fault reactance, Fault location
	Xfault	Earth-fault reactance, Fault location
Frequency	f	System frequency
Power	P	Active power
	Prms	RMS Active power
	Q	Reactive power
	Qrms	RMS Reactive power
	S	Apparent power
	Srms	RMS Apparent power
	E+, E-	Active Energy, exported / imported
	Eq+, Eq-	Reactive Energy, exported / imported
	CosPhi	Cosine Phi
	TanPhi	Tan Phi
		Power Angle
	PF	Power factor
		Phasor diagram view of voltages
		Phasor diagram view of currents
Harmonics	I	2nd to 15th harmonics and THD of currents
	U	2nd to 15th harmonics and THD of voltages
		Condition monitoring CB wear
		Condition monitoring CT supervision
		Trip Circuit Supervision (TCS)
		Voltage interruptions
Voltage sags/swells	U	Voltage sags / swells
	⇨	Disturbance recorder

Protection stages

ВЯРНО С
ОРИГИНАЛА

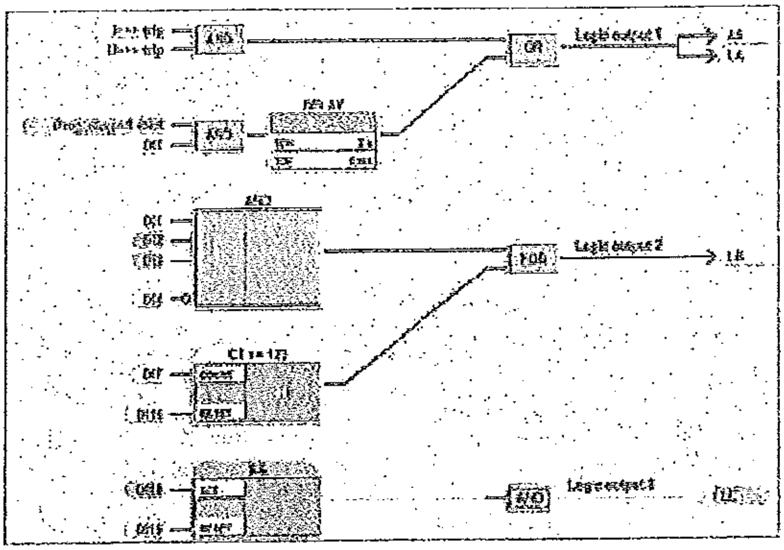
Coming now, VAMP 57 feeder and motor protection relay includes necessary protection functions and control features for basic feeder and motor protection applications

Type of fault.	IEEE Device No.	IEC Symbol	Protection function/measurement	Voltage option B 4 x U		Voltage option A 1 x U	
				Feeder Protection	Motor Protection	Feeder Protection	Motor Protection
Overcurrent	50/51	3I >, 3I >>, 3I >>>	Overcurrent	●	●	●	●
	51V	Iv>	Restrained overcurrent	●	●	●	●
	50 HS	SOTF	Switch on to fault	●	●	●	●
Earth-fault	50N/51N	I_0 >, I_0 >> I_0 >>>, I_0 >>>>, I_0 >>>>>	Earth-fault	●	●	●	●
	67	Iφ>, Iφ>>, Iφ>>>, Iφ>>>>	Directional overcurrent	●	●		
	67N	$I_{0\varphi}$>, $I_{0\varphi}$>>, $I_{0\varphi}$>>>	Directional earth fault	●	●	●	●
	67NI	I0INT >U	Intermittent transient earth fault	●		●	
	46	I2 / I1 >	Current unbalance	●		●	
Motor	37	I<	Undercurrent	●	●	●	●
	46	I2 >	Current unbalance		●		●
	47	I2 >>	Incorrect phase sequence		●		●
	48	IST >>	Stall		●		●
	51LR	ILr>	Locked rotorj		●		●
	66	N>	Frequent start		●		●
Overload	49	T>	Thermal overload	●	●	●	●
Voltage	59N	U0>, U0>>	Zero sequence voltage	●	●	●	●
	59	U>, U>>, U>>>	Overvoltage	●	●		
	27	U<, U<<, U<<<	Undervoltage	●	●		
Frequency	81H/81L	f ><, f >><<	Overfrequency and underfrequency	●	●		
	81L	f <, f <<	Underfrequency	●	●		
	81R	df/dt	Rate of change of frequancy	●	●		
	68F2	If2>	Magnetizing inrush	●	●	●	●
Capacitor	60NC	DIc>	Capacitor bank unbalance protection	●	●	●	●
	59C	Uc>	Capacitor overvoltage protection	●		●	
Other	68F5	If5>	Over excitation	●	●	●	●
	32	P<, P<<	Reverse power	●	●		
	79		Auto reclose function	●		●	
	50BF	CBFP	Circuit-breaker failure	●	●	●	●
	25		Synchrocheck	●	●		
	86		Latched trip	●	●	●	●
	99	Prg1-8	Programmable stages	●	●	●	●

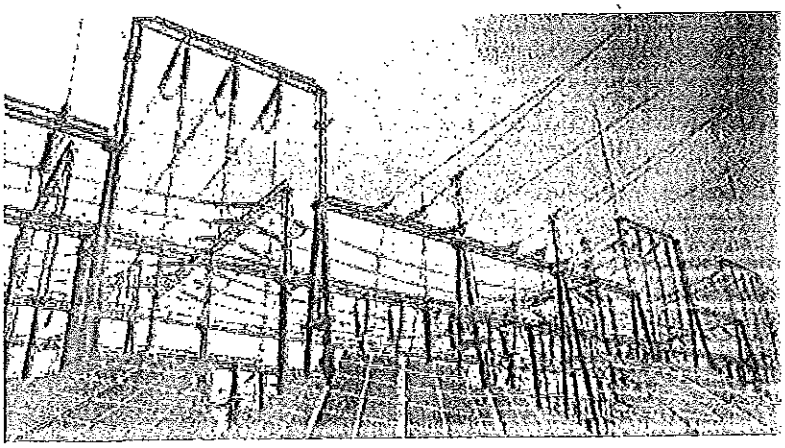
Programmable stages

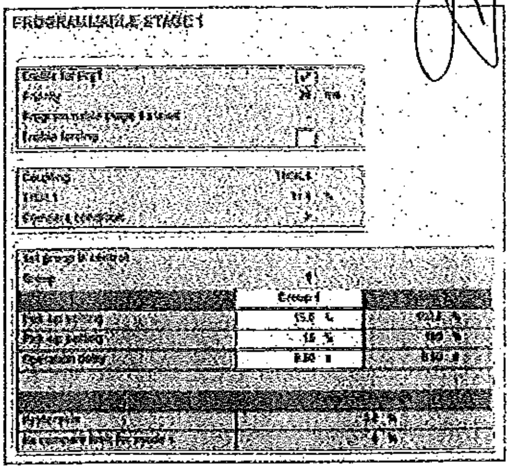
ВЯРНО С
ОРИГИНАЛА

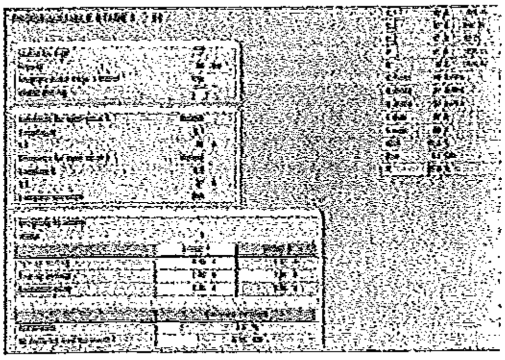
There are now eight stages available to use with various applications. Each stage can monitor any analogue (measured or calculated) signal and issue start and trip signals. Programmable stages extend the protection functionality of the manager series to a new level. For example, if four stages of frequency are not enough, with programmable stages, the maximum of 12 can be reached. Other examples are using the stages to issue an alarm when there are a lot of harmonics (THD) or indicating reverse power condition.



Programmable logic: The logic editor has colours to enable viewing of active statuses. Furthermore, each input status can be also seen on-line in VAMPSET view .







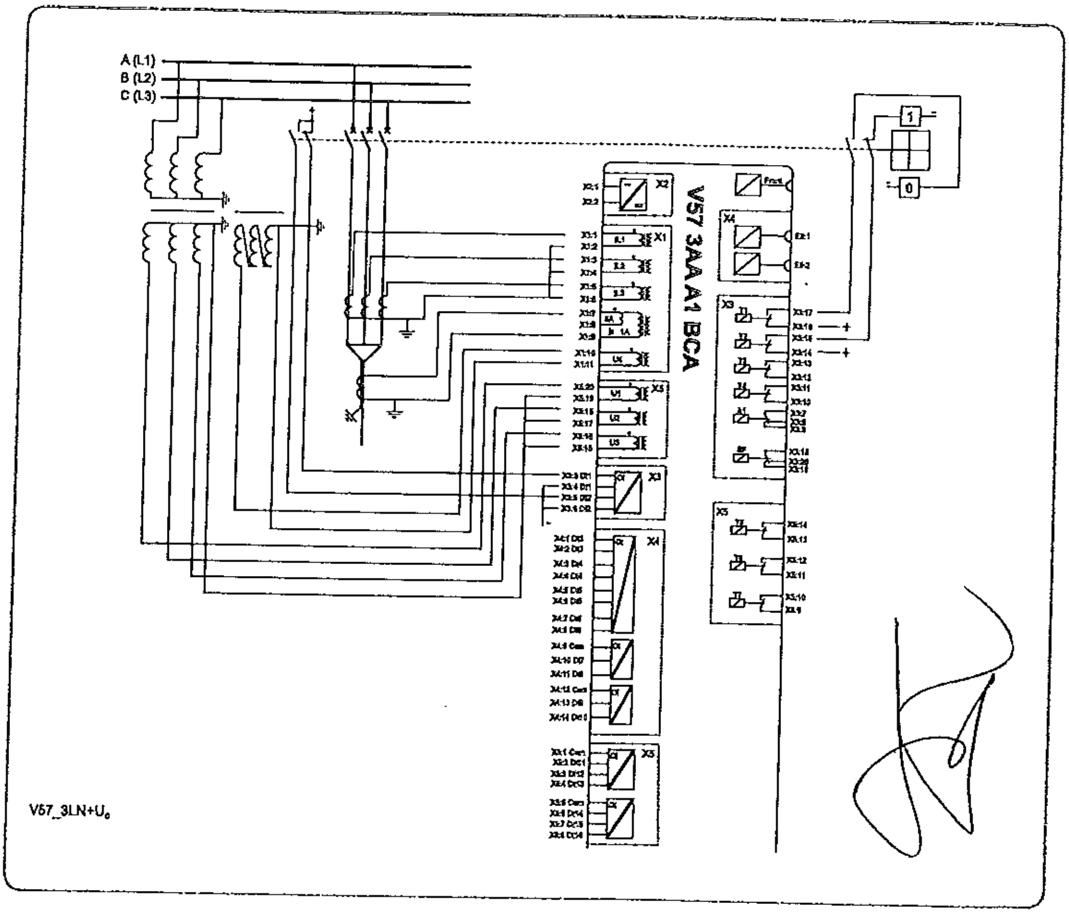
Programmable stage has a possibility to compare two freely selectable signals between each other. Using this feature the user can create comparison function using relay's own measured or calculated signals. One or both of the signals can be connected to comparison function over GOOSE.

Connections

ВЯРНО С ОРИГИНАЛА

Connection diagram: 3LN + Uo

Voltage scaling mode	3LN + Uo
Voltages measured by VTs	UL1, UL2, UL3, Uo
Values calculated	U12, U23, U31, U1, U2, U2/U1, f
Protection functions not available	ANSI 25



Inputs / Outputs

The VAMP 57 hosts various optional modules in order to upgrade the relay functionality from basic to more advanced applications.

	V57F-xxxAxBxA	V57F-xxxAxAxA
Analog inputs	3 x I 1 x Io 4 x U	3 x I 1 x Io 1 x U
Digital inputs	16	10
Trip relays	7	4
Signal relays	1	1
Self-diagnostic	1	1
Front port	USB	
Optional rear port	RS232 / RS485/Ethernet	

Dimensional drawings

Panel mounting VAMP 57

ВЯРНО С ОРИГИНАЛА

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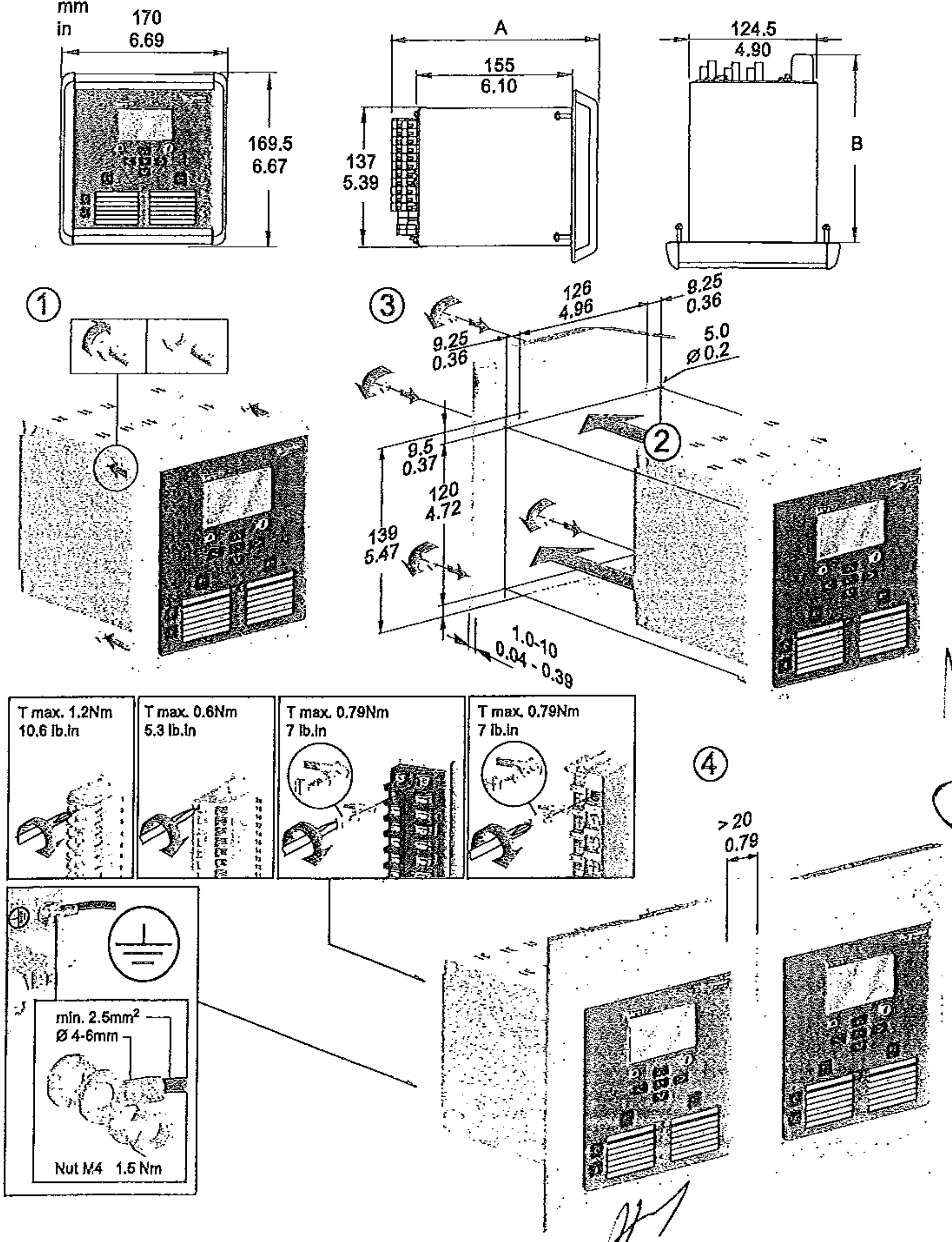
	A	B
V57F-3	205 mm / 8.07"	182 mm / 7.17"
V57F-4	206 mm / 8.11"	183 mm / 7.20"



Order codes

V 57 ☐-☐☐☐☐☐☐☐☐-☐

Application
F = Feeder / Motor, 4xI, 1xU, 2DI, 5DO

Phase currents & voltage input, X1
3 = 1 A / 5 A & 1U (100 / 110V)
4 = 1 A / 5 A & 1U (100 / 110V), X1 and X5 ring lugs

Earth-fault current input , X1
A = 1 A / 5 A
B = 0,2 A / 1 A

Nominal Supply Voltage [V] , X2
A = Power A 48 - 230 V (range: 40 - 265 V ac/dc)
B = Power B 24V (range: 18 - 36 V dc)

Future option
A = None

DI nominal voltage (V)
1 = 24 V ac/dc
2 = 110 V ac/dc
3 = 220 V ac/dc

Voltage measurements + I/O , X5
A = None
B = 3U (100 / 110 V) + 6DI + 3DO

I/O with comms , X4
B = RS485 + 8DI
C = 2 x RJ-45 + 8DI
D = 2 x LC + 8DI
E = RJ + 232 + 8DI with IRIG-B
F = LC + 232 + 8DI with IRIG-B

Future option
A = Future

Other
C = Conformal coating

Note: For exact DI, DO and AI amount see table on page 10

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Accessories

Order code	Description	Note
VX052-3	USB programming cable (Vampset)	Cable length 3 m
V57PSC	V57 Panel Seal Cover	
VX082	V57 (RS232) - VSE(D9)	Cable length 2.5 m
VX083	V57 (RS232) - Remote / Extension / IRIG-B (3xD9)	Cable length 2.5 m
VX084	V57 (RS232) - VPA 3CG Profibus adapter cable	Cable length 3 m
VSE001PP	Fiber optic module (plastic - plastic)	Max. distance 30 m
VSE001GG	Fiber optic module (glass - glass)	Max. distance 1 km
VPA3CG	Profibus DP fieldbus option adapter	

Main technical data

Auxiliary voltage	
Voltage range	40-265 V ac/dc
Measuring circuit	
Rated phase current I_N	1 A / 5 A
Current measuring range	0.005-50 x I_N
Rated neutral current I_{0N}	1 A or 5 A
Current measuring range	0.003-10 x I_N
Thermal withstand	4 x I_N (continuous) 100 x I_N (for 1 s)
Rated frequency f_N	50 / 60 Hz (45-65 Hz)
Rated voltage Un	**100 V (configurable for VT secondaries 50-120 V)**
Voltage measuring range	0-160 V (100 V/110 V)
Continuous voltage withstand	250 V
Burden	< 0.5 VA
Digital inputs	
Digital inputs (external voltage max 265 V)	16
Nominal operation voltage DI1 – DI16	1: 24-230 V ac/dc (max. 265 V ac/dc)
	2: 110-230 V ac/dc (max. 265 V ac/dc)
	3: 220-230 V ac/dc (max. 265 V ac/dc)
Typical switching treshold	1: 12 V ac/dc
	2: 75 V ac/dc
	3: 155 V ac/dc
Outputs	
Rated voltage	250 V ac/dc
Continuous carry	5 A
Trip contacts	7
Signal contacts	1

Main technical data

Disturbance tests

	Standard & Test class / level	Test value
Emission	IEC/EN 60255-26 (ed3)	
Conducted	EN 55022, Class A & IEC 60255-25 & CISPR 22	0.15-80 MHz
Emitted	EN 55011, Class A & IEC 60255-25 & CISPR 11	30 - 1 000 MHz
Immunity	IEC/EN 60255-26 (ed3)	
1Mhz damped oscillatory wave	IEC/EN 61000-4-18 & IEC 60255-22-1	± 2.5 kVp CM, ± 2.5 kVp DM
Static discharge (ESD)	IEC/EN 61000-4-2 Level 4 & IEC 60255-22-2	± 8 kV contact, ± 15 kV air
Fast transients (EFT)	IEC/EN 61000-4-4 Level 4 & IEC 60255-22-4	± 4kV, 5/50 ns, 5 kHz
Surge	IEC/EN 61000-4-5 Level 3 & IEC 60255-22-5	± 2 kV, 1.2/50 ms, CM ± 1 kV, 1.2/50 ms, DM
Conducted HF field	IEC/EN 61000-4-6 Level 3 & IEC 60255-22-6	0.15 - 80 MHz, 10 Vemf
Emitted HF field	IEC/EN 61000-4-3 Level 3 & IEC 60255-22-3	80-2700 MHz, 10 V/m
Voltage alternative component	IEC/EN 61000-4-17	15 % of operating voltage (DC) / 10 min
Voltage dips	IEC/EN 61000-4-29 & IEC/EN 61000-4-11	30 %/ 1 s, 60 %/0.1 s, 100 % / 0.05 s
Voltage short interruptions	IEC/EN 61000-4-29 & IEC/EN 61000-4-11	30 %/10 ms, 100%/10 ms, 60 %/100 ms 100 %/5000 ms
Power-frequency magnetic field	IEC/EN 61000-4-8	300 A/m (continuous), 1000 A/m 1-3 s
Pulse magnetic field	IEC/EN 61000-4-9 Level 5	1000 A/m, 1.2/50 µs

Electrical safety tests

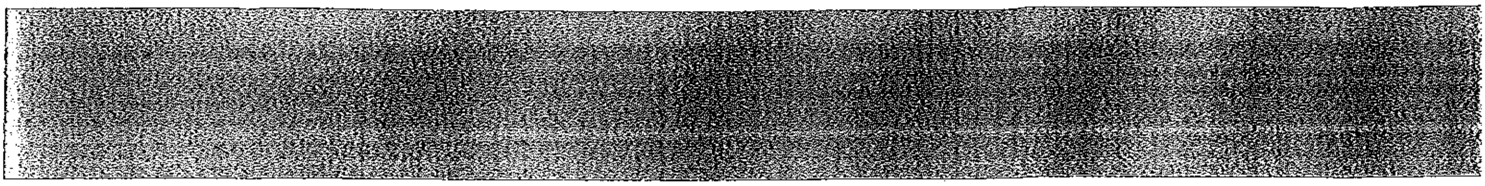
	Standard & Test class / level	Test value
Impulse voltage withstand	IEC/EN 60255-27 & EN 60255-5, Class III	5 kV, 1.2/50 µs, 0.5 J, communication 1 kV
Dielectric test	IEC/EN 60255-27 & EN 60255-5, Class III	2 kV, 50 Hz, communication 0,5 kV
Insulation resistance	IEC/EN 60255-27 & EN 60255-5	
Protective bonding resistance	IEC/EN 60255-27	
Power supply burden	IEC/EN 60255-1	

Mechanical tests

	Standard & Test class / level	Test value
Device in operation		
Vibrations	IEC 60255-21-1, Class II/ IEC 60068-2-6, Fc	1 Gn, 10 Hz – 150 HZ
Shocks	IEC 60255-21-2, Class II/ IEC 60068-2-27, Ea	10 Gn/11 ms
Seismic	IEC 60255-21-3 Method A, Class II	2 G horizontal / 1 G vertical , 1 Hz-35 Hz
Device de-energized		
Vibrations	IEC 60255-21-1, Class II/ IEC 60068-2-6, Fc	2 Gn, 10 Hz – 150 HZ
Shocks	IEC 60255-21-2, Class II/ IEC 60068-2-27, Ea	30Gn/11 ms
Bump	IEC 60255-21-2, Class II/ IEC 60068-2-27, Ea	20 Gn/16 ms

Environmental tests

	Standard & Test class / level	Test value
Device in operation		
Dry heat	EN/IEC 60068-2-2, Bd	+65°C (149°F)
Cold	EN/IEC 60068-2-1, Ad	-40°C (-40°F)
Damp heat, cyclic	EN / IEC 60068-2-30, Db	• From 25°C (77°F) to 55°C (131°F) • From 93% RH to 98% RH • Testing duration: 6 days
Damp heat, static	EN/IEC 60068-2-78, Cab	• 40°C (104°F) • 93% RH • Testing duration: 10 days
Device in storage		
Dry heat	EN / IEC 60068-2-2, Bb	+70°C (158°F)
Cold	EN / IEC 60068-2-1, Ad	-40°C (-40°F)



Environmental conditions

	Standard & Test class / level
Ambient temperature, in-service	-40 to 65°C (-40 to 149°F)
Ambient temperature, storage	-40 to 70°C (-40 to 158°F)
Relative humidity	< 95%, no condensation allowed
Maximum operating altitude	2000 m (6561.68 ft)

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Casing

	Standard & Test class / level
Degree of protection (IEC 60529)	IP54 Front panel, IP20 rear side
Dimensions (W* x H* x D)	170 x 170 x 205 / 6.69 x 6.69 x 8.07 in
Weight	2.5 kg (5.519 lb)

* dimension of collar

Package

	Standard & Test class / level
Dimensions (W x H x D)	260 x 210 x 300 mm / 10.23 x 8.26 x 11.81 in
Weight (Terminal, Package and Manual)	3.2 kg (7.054 lb)

The VAMP 57 is designed with user-friendliness in mind.

Device Track record

- Schneider Electric's VAMP range specialises in protection relays, arc flash protection and measuring and monitoring units for power systems.
- VAMP's medium-voltage and sub-transmission protection relays are used in numerous applications, from overhead line feeders and substations to power plants and industrial power system. Many of them have unique integrated arc flash fault protection functionality to enhance the safety of both people and property and has made VAMP a leading range in arc flash protection worldwide. VAMP products meet the latest international standards and regulations.

ВЯРНО С
ОРИГИНАЛА

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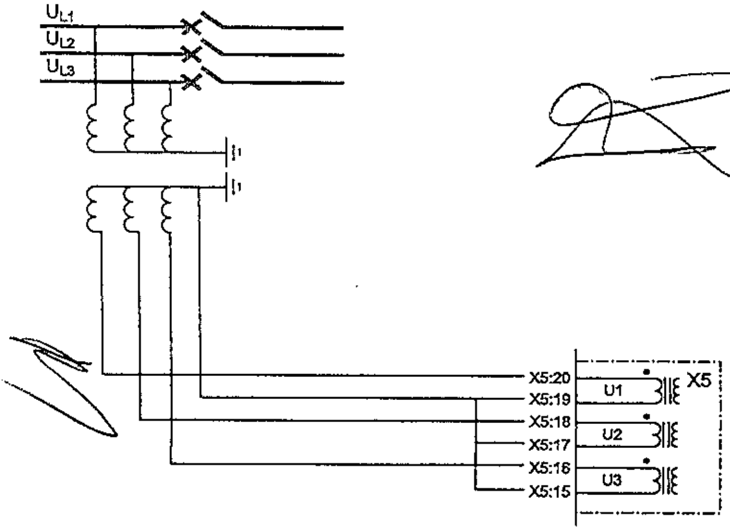
3.8 Voltage measurement modes

Multiple channel voltage measurement

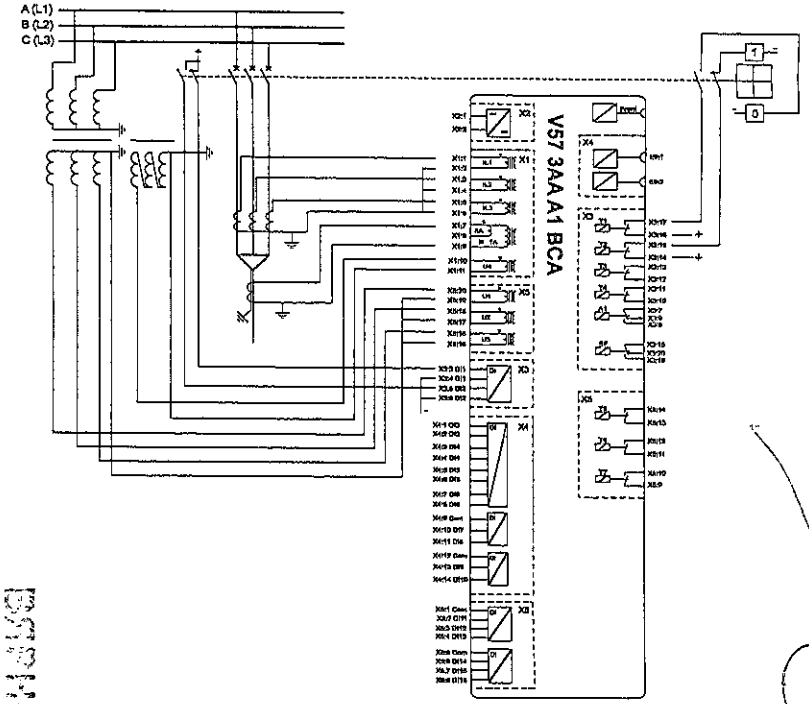
VAMP 57 has 9 different voltage measurement modes.

Mode	U1	U2	U3	U4
3LN	UL1	UL2	UL3	-
3LN+U$_0$	UL1	UL2	UL3	U$_0$
3LN+LLy	UL1	UL2	LLy	UL3
3LN+LNy	UL1	UL2	LNy	UL3
2LL+U$_0$	U12	U23	U$_0$	-
2LL+U$_0$+LLy	U12	U23	LLy	U$_0$
2LL+U$_0$+LNy	U12	U23	LNy	U$_0$
LL+U$_0$+LLy+LLz	U12	U12y	U12z	U$_0$
LL+U$_0$+LNy+LNz	UL1	UL1y	UL1z	U$_0$



3LN

- Voltages measured by VTs:
  UL1, UL2, UL3
- Values calculated:
  UL12, UL23, UL31, Uo, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 67NI, 25



3LN+U$_0$

This connection is typically used for feeder and motor protection schemes.

- Voltages measured by VTs:
  UL1, UL2, UL3, Uo
- Values calculated:
  UL12, UL23, UL31, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 25

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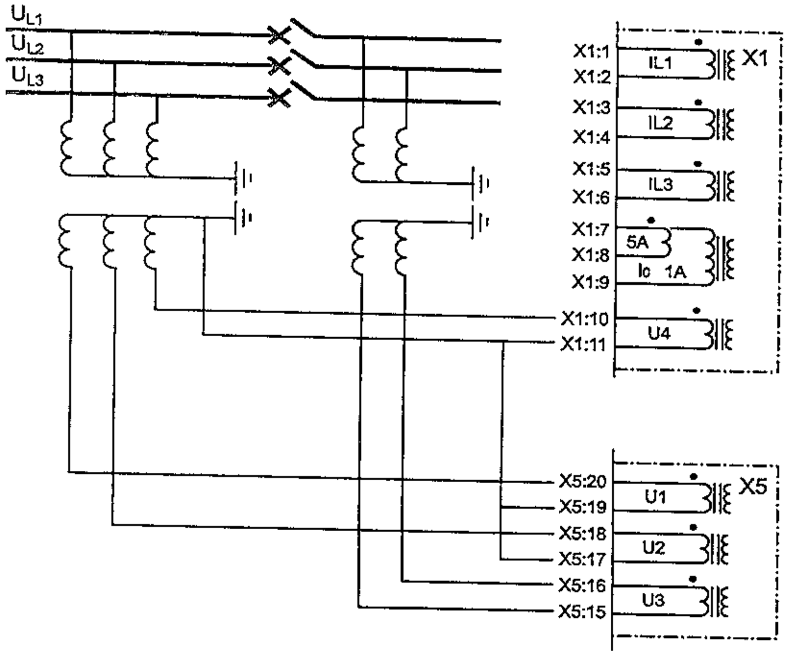
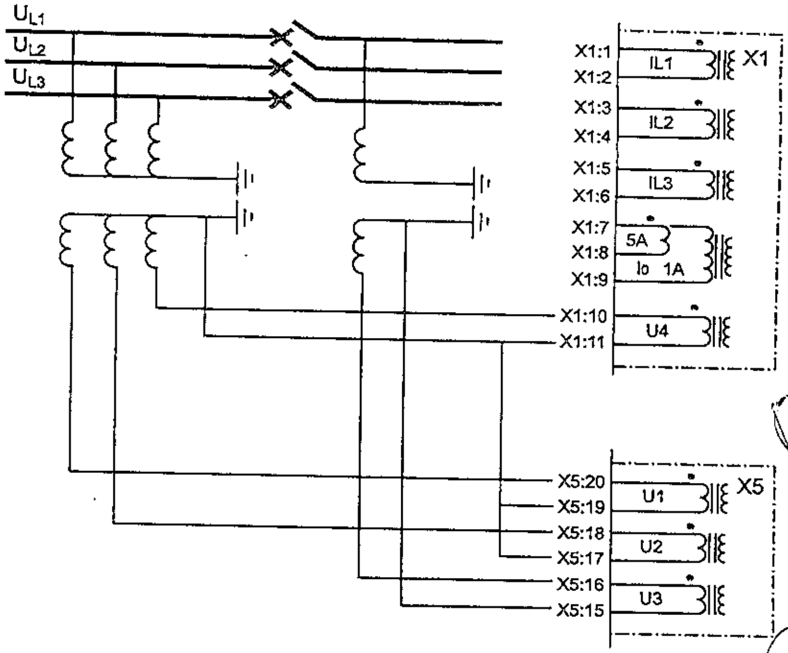


3LN+LLy

Connection of voltage transformers for synchrocheck application. The other side of the CB has line-to-line connection for reference voltage.

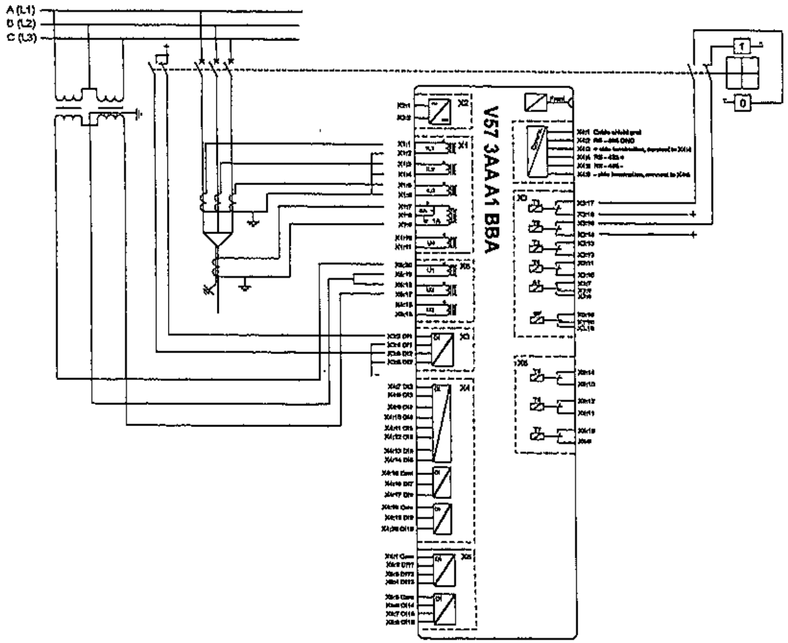
- Voltages measured by VTs:
  UL1, UL2, UL3, UL12y
- Values calculated:
  UL12, UL23, UL31, Uo, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 67NI



3LN+LNy

This connection is typically used for feeder protection scheme where line-to-neutral voltage is required for synchrocheck application.

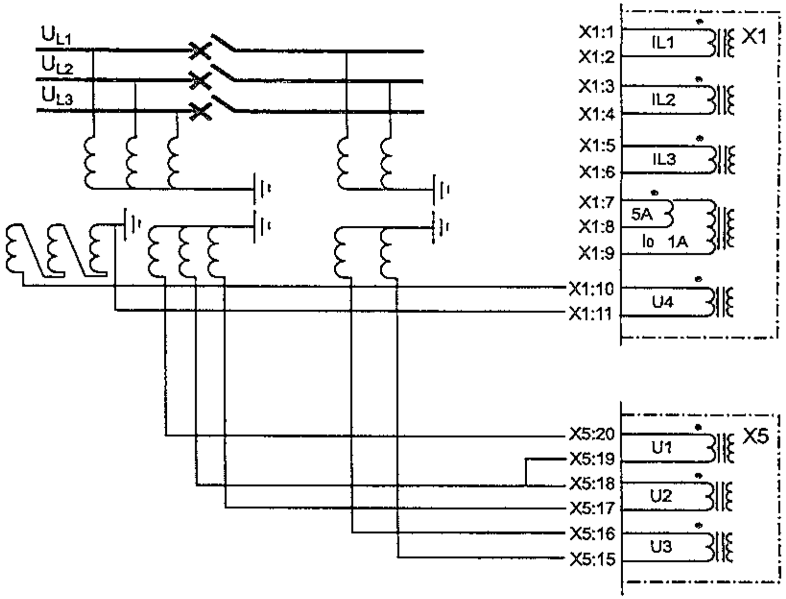
- Voltages measured by VTs:
  UL1, UL2, UL3, UL1y
- Values calculated:
  UL12, UL23, UL31, Uo, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 67NI



2LL+U_0

Connection of two line-to-line and residual voltage measurement scheme.

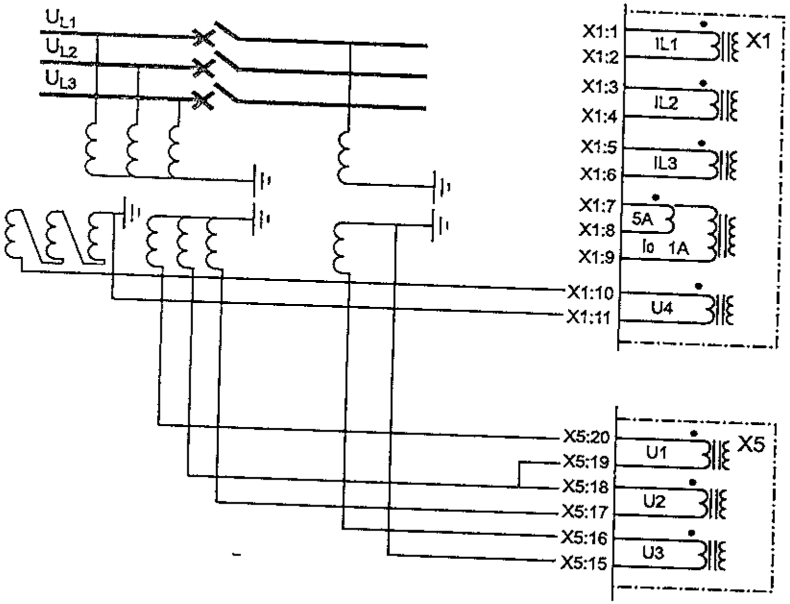
- Voltages measured by VTs:
  UL12, UL23, Uo
- Values calculated:
  UL1, UL2, UL3, U31, U1, U2, f
- Measurements available: All
- Protection functions not available: 25



2LL+U_0+LLy

Connection of two line-to-line and residual voltage scheme. Line-to-line reference voltage is taken from other side of the CB for synchrocheck scheme.

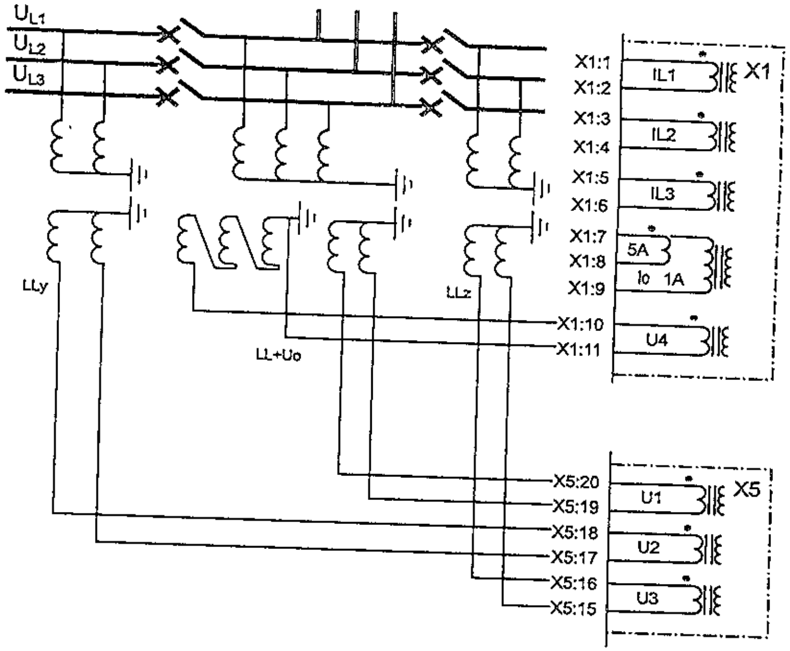
- Voltages measured by VTs:
  UL12, UL23, Uo, UL12y
- Values calculated:
  UL31, UL1, UL2, UL3, U1, U2, f, fy
- Measurements available: All
- Protection functions available: All



2LL+U$_0$+LNy

Connection of two line-to-line and residual voltage scheme. The other side of the CB has phase-to-neutral connection for synchrocheck.

- Voltages measured by VTs:
  UL12, UL23, Uo, UL1y
- Values calculated:
  UL31, UL1, UL2, UL3, U1, U2, f, fy
- Measurements available: All
- Protection functions available: All

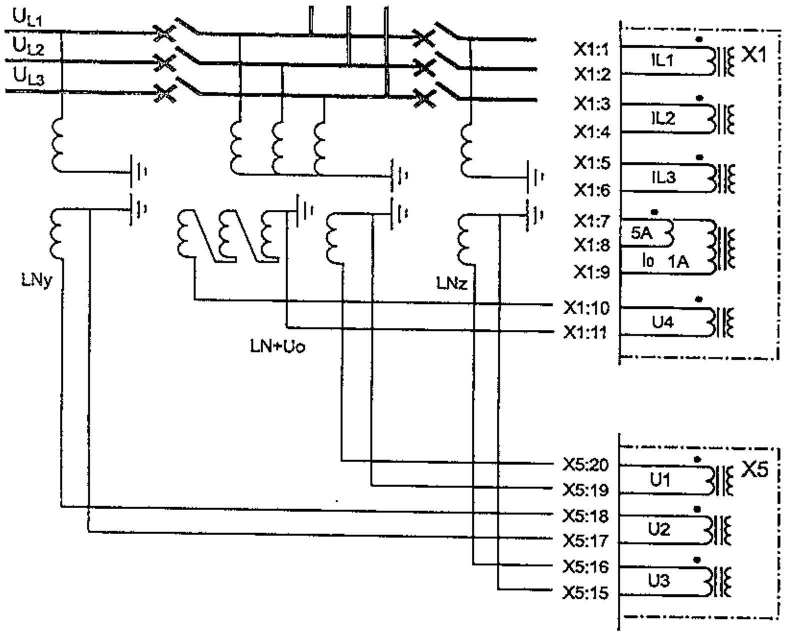


ВЯРНО С ОРИГИНАЛА

LL+U$_0$+LLy+LLz

This scheme has two CBs to be synchronized. Left side of the bus bar has line-to-line and right side line-to-line connection for synchrocheck's reference voltages. In the middle system voltages are measured by phase-to-neutral and open delta connection.

- Voltages measured by VTs:
  UL12, Uo, UL12y, UL12z
- Values calculated:
  UL1, UL2, UL3, U23, U31, f, fy, fz
- Measurements available: -
- Protection functions available: Single phase voltage protection



LN+U_0+LNy+LNz

This scheme has two CBs to be synchronized. Left and right sides of the bus bar have line-to-neutral connections for synchrocheck's reference voltages. In the middle system voltages are measured by phase-to-neutral and open delta connection.

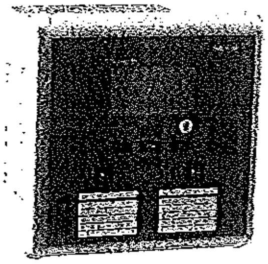
- Voltages measured by VTs:
  UL1, Uo, UL1y, UL1z
- Values calculated:
  U12, U23, U31, UL2, UL3, f, fy, fz
- Measurements available: -
- Protection functions available: Single phase voltage protection

VAMP 57

Protection IED

Publication version: V57/en M/A003

User manual



Schneider Electric

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Stara Zagora Ltd.

Стара Загора

Trace back information:
Workspace Main version a83
Checked in 2015-10-19
Skribenta version 4.6.006

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ВЯРНО С ОРИГИНАЛА

Stara Zagora Ltd.

1 General

1.1 Legal notice

Copyright

Disclaimer

No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this document. This document is not intended as an instruction manual for untrained persons. This document gives instructions on device installation, commissioning and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact Schneider Electric and request the necessary information.

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1.2 Safety information and password protection

Important information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

⚠ The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

⚠ This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

User qualification

Electrical equipment should be installed, operated, serviced, and maintained only by trained and qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Password protection

Use IED's password protection feature in order to protect untrained person interacting this device.

⚠ WARNING

WORKING ON ENERGIZED EQUIPMENT

Do not choose lower Personal Protection Equipment while working on energized equipment.

Failure to follow these instructions can result in death or serious injury.

1.3 Relay features

Table 1.1: List of protection functions

IEEE/ANSI code	IEC symbol	Function name
25	Δf, ΔU, Δφ	Synchrocheck
27	U<, U<<, U<<<	Undervoltage protection
32	P<, P<<	Reverse power protection
37	I<	Undercurrent protection
46	$I_2/I_1>$	Current unbalance protection in feeder mode
46	$I_2>$	Current unbalance protection in motor mode *
47	$I_2>>$	Phase reversal / incorrect phase sequence protection *
48	$I_{ST}>$	Stall protection *
49	T>	Thermal overload protection *
50/51	I>, I>>, I>>>	Overcurrent protection
50BF	CBFP	Circuit-breaker failure protection
50N/51N	$I_0>, I_0>>, I_0>>>, I_0>>>>$	Earth fault protection
59	U>, U>>, U>>>	Overvoltage protection
59N	$U_0>, U_0>>$	Zero sequence voltage protection
66	N>	Frequent start protection *
67	$I_\varphi>, I_\varphi>>, I_\varphi>>>, I_\varphi>>>>$	Directional overcurrent protection
67N	$I_{0\varphi}>, I_{0\varphi}>>$	Directional earth-fault, low-set stage, sensitive, definite or inverse time (can be used as non directional)
67NI	$I_{0INT}>$	Intermittent transient earth fault protection
68F2	$I_{f2}>$	Magnetishing inrush
68F5	$I_{f5}>$	Transformer overexitation
81H/81L	f><, f><<	Overfrequency and underfrequency protection
81L	f<, f<<	Underfrequency protection
81R	df/dt	Rate of change of frequency (ROCOF) protection
99	Prg1-8	Programmable stages

* Only available when application mode is motor protection

Further the relay includes a disturbance recorder.

The relay communicates with other systems using common protocols, such as the Modbus RTU, ModbusTCP, IEC 60870-5-103, IEC 60870-5-101, IEC 61850, SPA bus, Ethernet / IP and DNP 3.0.

1.3.1 User interface

The relay can be controlled in three ways:

- Locally with the push-buttons on the relay front panel
- Locally using a PC connected to the USB port on the front
- Via remote control over the optional remote control port on the relay rear panel.

1.4 Related documents

Document	Identification*)
VAMP Relay Mounting and Commissioning Instructions	VRELAY_MC_xxxx
VAMPSET Setting and Configuration Tool User Manual	VVAMPSET_EN_M_xxxx

**) xxxx = revision number*

Download the latest software and manual at www.schneider-electric.com or m.vamp.fi.

1.5 Document conventions

Convention	Example
Menu names are presented in bold.	Open the **File** menu.
Buttons in software are presented in bold.	Click **OK**.
Parameter names are presented in *italics*.	Select the *Stage enabled* parameter.
Parameter values are presented in *italics*.	The parameter value is *Off*.
Push-buttons on local HMI are presented by icons.	To enter the menu, press ▣.

1.6 Abbreviations

ANSI	American National Standards Institute. A standardization organisation.
CB	Circuit breaker
CBFP	Circuit breaker failure protection
cosφ	Active power divided by apparent power = P/S. (See power factor PF). Negative sign indicates reverse power.
CT	Current transformer
CT_{PRI}	Nominal primary value of current transformer
CT_{SEC}	Nominal secondary value of current transformer
Dead band	See hysteresis.
DI	Digital input
DO	Digital output, output relay
Document file	Stores information about the IED settings, events and fault logs.
DSR	Data set ready. An RS232 signal. Input in front panel port of VAMP relays to disable rear panel local port.
DST	Daylight saving time. Adjusting the official local time forward by one hour for summer time.
DTR	Data terminal ready. An RS232 signal. Output and always true (+8 Vdc) in front panel port of VAMP relays.
FFT	Fast Fourier transform. Algorithm to convert time domain signals to frequency domain or to phasors.
FPGA	Field-programmable gate array
HMI	Human-machine interface
Hysteresis	I.e. dead band. Used to avoid oscillation when comparing two near by values.
I_{MOT}	Nominal current of the protected motor
I_N	Nominal current. Rating of CT primary or secondary.
I_{SET}	Another name for pick up setting value I>
I_{0N}	Nominal current of I_0 input in general
I_{0SET}	Another name for pick up setting value $I_0>$
IEC	International Electrotechnical Commission. An international standardization organisation.
IEC-101	Abbreviation for communication protocol defined in standard IEC 60870-5-101
IEC-103	Abbreviation for communication protocol defined in standard IEC 60870-5-103
IED	Intelligent electronic device
IEEE	Institute of Electrical and Electronics Engineers
LAN	Local area network. Ethernet based network for computers and IEDs.
Latching	Output relays and indication LEDs can be latched, which means that they are not released when the control signal is releasing. Releasing of latched devices is done with a separate action.
LCD	Liquid crystal display
LED	Light-emitting diode
Local HMI	IED front panel with display and push-buttons
NTP	Network Time Protocol for LAN and WWW
P	Active power. Unit = [W]
PF	Power factor. The absolute value is equal to cosφ, but the sign is '+' for inductive i.e. lagging current and '-' for capacitive i.e. leading current.
P_M	Nominal power of the prime mover. (Used by reverse/under power protection.)

PT	See VT
pu	Per unit. Depending of the context the per unit refers to any nominal value. For example for overcurrent setting 1 pu = 1 x I_{MODE}.
Q	Reactive power. Unit = [var] acc. IEC
RMS	Root mean square
S	Apparent power. Unit = [VA]
SF	IED status inoperative
SNTP	Simple Network Time Protocol for LAN and WWW
SPST	sigle pole single throw
SPDT	sigle pole double throw
TCS	Trip circuit supervision
THD	Total harmonic distortion
U_{0SEC}	Voltage at input U_c at zero ohm ground fault. (Used in voltage measurement mode "2LL+U_0")
U_A	Voltage input for U_{12} or U_{L1} depending of the voltage measurement mode
U_B	Voltage input for U_{23} or U_{L2} depending of the voltage measurement mode
U_C	Voltage input for U_{31} or U_0 depending of the voltage measurement mode
U_N	Nominal voltage. Rating of VT primary or secondary
UTC	Coordinated Universal Time (used to be called GMT = Greenwich Mean Time)
VAMPSET	Configuration tool for VAMP protection devices
VT	Voltage transformer i.e. potential transformer PT
VT_{PRI}	Nominal primary value of voltage transformer
VT_{SEC}	Nominal secondary value of voltage transformer
Webset	http configuration interface

1.7 Periodical testing

The protection IED and cabling must periodically be tested according to the end-user's safety instructions, national safety instructions or law. Manufacturer recommends functional testing being carried minimum every five (5) years.

It is proposed that the periodic testing is conducted with a secondary injection principle for those protection stages which are used in the IED.

000266

2 Introduction

VAMP 57 includes all the essential protection functions needed to protect feeders and motors in distribution networks of utilities, industry and power plants. Further, the device includes several programmable functions, such as trip circuit supervision and circuit breaker protection and communication protocols for various protection and communication situations.

It has good protection against harsh environments. Protective level is IP54.

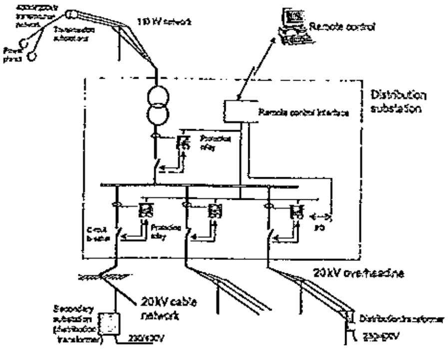
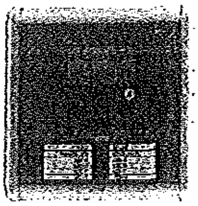


Figure 2.1: Application of the feeder and motor protection device

ВЯРНО С
ОРИГИНАЛА

2.1 Local HMI



1. Navigation push-buttons
2. LED indicators
3. 128 x 64 LCD
4. Local port
5. Object control buttons

Figure 2.2: VAMP 57 local HMI

Push-buttons

Symbol	Function
↶	CANCEL push-button for returning to the previous menu. To return to the first menu item in the main menu, press the button for at least three seconds.
i	INFO push-button for viewing additional information, for entering the password view and for adjusting the LCD contrast.
F1	Programmable function push-button.
F2	Programmable function push-button.
↵	ENTER push-button for activating or confirming a function.
▲	UP navigation push-button for moving up in the menu or increasing a numerical value.
▼	DOWN navigation push-button for moving down in the menu or decreasing a numerical value.
◄	LEFT navigation push-button for moving backwards in a parallel menu or selecting a digit in a numerical value.
►	RIGHT navigation push-button for moving forwards in a parallel menu or selecting a digit in a numerical value.
I	Circuit Breaker ON push-button
O	Circuit Breaker OFF push-button

LEDs

VAMP 57 IED has 12 LEDs on front. Two LEDs represents units general status (On & 🔧), two LEDs for function buttons (F1 & F2) and 8 user configurable LEDs (A - H). When the IED is powered the "ON" LED will lit as green. During normal use "Service" LED is not active, it activates only when error occurs or the IED is not operating correctly. Should this happen contact your local representative for further guidance. The Service LED and SF contact are assigned to work together. Manufacturer recommends that SF output is hardwired into the substation's automation system for alarm purposes.

LED can lit either green or red. The LEDs on the local HMI can be configured in VAMPSET. To customise the LED texts on the local HMI, the texts can be written on a template and then printed on a transparency. The transparencies can be placed to the pockets beside the LEDs.

LED indicator	Meaning	Measure/ Remarks
Power LED lit	The auxiliary power has been switched on	Normal operation state
Status LED lit	Internal fault, operates in parallel with the self supervision output relay	The relay attempts to reboot [REBOOT]. If the error LED remains lit, call for maintenance. The Service LED and SF contact are assigned to work together. Manufacturer recommends that SF output is hardwired into the substation's automation system for alarm purposes.
A- H LED lit	Application-related status indicators.	Configurable
F1 / F2 LED lit	Corresponding function key pressed / activated	Depending of function programmed to F1 / F2

Enter password

1. On the local HMI, press i and ▼.
2. Enter the four-digit password and press ↵.

Adjusting LCD contrast (while correct password is enabled)

1. Press i and adjust the contrast.
   - To increase the contrast, press ▲.
   - To decrease the contrast, press ▼.
2. To return to the main menu, press ↶.

Release all latches (while correct password is enabled)

1. Press i
   - To release the latches, press ↵.
   - To release, choose "Release" parameter and press ↵.

Control object (while password and selective control is enabled)

When selective control is enabled, control operation needs confirmation (select-execute)

1. Press I to close object.
   - Press I again to confirm.
   - Press ↶ to cancel.
2. Press O to open object.
   - Press O again to confirm.
   - Press ↶ to cancel.

Control object (while password and direct control is enabled)

When direct control is enabled, control operation is done without confirmation

1. Press I to close object.
2. Press O to open object.

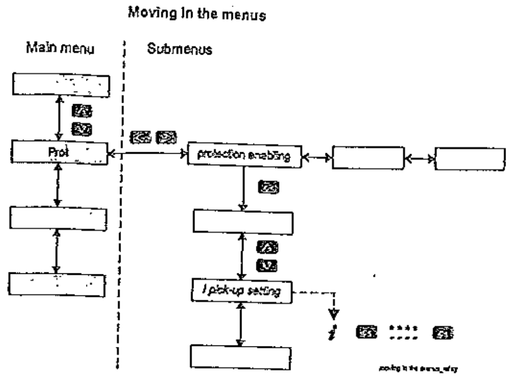


Figure 2.3: Moving in menus using local HMI

- To move in the main menu, press ▲ or ▼.
- To move in submenus, press ► or ◄.
- To enter a submenu, press ► and use ▼ or ▲ for moving down or up in the menu.
- To edit a parameter value, press *i* and OK. Key in four-digit password and press OK.
- To go back to the previous menu, press ⊗.
- To go back to the first menu item in the main menu, press ⊗ for at least three seconds.

NOTE: To enter the parameter edit mode, key in the password. When the value is in edit mode, its background is dark.

2.2 VAMPSET setting and configuration tool

VAMPSET is a software tool for setting and configuring the VAMP IEDs. VAMPSET has a graphical interface, and the created documents can be saved and printed out for later use.

To use VAMPSET, you need

- PC with Windows XP (or newer) operating system installed
- VX052 or equivalent USB cable for connecting the IED to the PC (USB-cable provided by VAMP is recommended)
- Experience in using the Windows operating system

NOTE: Download the latest VAMPSET version at www.schneider-electric.com or m.vamp.fi

2.2.1 Folder view

In VAMPSET version 2.2.136, a feature called "Folder view" was introduced.

The idea of folder view is to make it easier for the user to work with relay functions inside VAMPSET. When folder view is enabled, VAMPSET gathers similar functions together and places them appropriately under seven different folders (GENERAL, MEASUREMENTS, INPUTS/OUTPUTS, MATRIX, LOGS and COMMUNICATION). The contents (functions) of the folders depend on the relay type and currently selected application mode.

Folder view can be enabled in VAMPSET via Program Settings dialog (Settings -> Program Settings), see Figure 2.4.

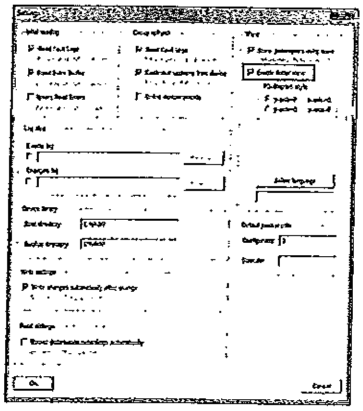


Figure 2.4: Enable folder view setting in Program Settings dialog

NOTE: It is possible to enable/ disable the folder view only when VAMPSET is disconnected from the relay and there is no configuration file opened.

When folder view is enabled, folder buttons become visible in VAMPSET, see Figure 2.5. Currently selected folder appears in bold.

Figure 2.5: Folder view buttons

2.3 Configuring the system with VAMPSET

Before configuring the protection relay, you need

- PC with adequate user rights
- VAMPSET setting and configuration tool downloaded to the PC
- USB cable (VX052) for connecting the IED with the PC

2.3.1 Setting up the communication

- Connect the USB cable between the PC and the local port of the IED.

Defining the PC serial port settings

NOTE: Ensure that the communication port setting on the PC corresponds to the IED setting.

1. Open the **Device Manager** on the PC and check the USB Serial Port number (COM) for the IED.
2. Open the VAMPSET setting and configuration tool on the PC.
3. On the VAMPSET **Settings** menu, select **Communication Settings**.
4. Select the correct port under the **Port** area and click **Apply**.

Defining the VAMPSET communication settings

1. On the local HMI, go to the **CONF/ DEVICE SETUP** menu and check the local port bit rate.
2. On the VAMPSET **Settings** menu, select **Communication Settings**.
3. Under the **Local** area, select the corresponding speed (bps) from the drop-down list and click **Apply**.
4. In VAMPSET **Settings** menu, select **Program Settings**.

NOTE: If faster operation is needed, change the speed to 187500 bps both in VAMPSET and in the IED.

Connecting the IED

1. On the VAMPSET **Communication** menu, select **Connect Device**.
2. Enter the password and click **Apply**. VAMPSET connects to the device.

NOTE: The default password for the configurator is *2*.

2.3.2 Writing the settings to the IED

- In the VAMPSET **Communication** menu, select **Write All Settings To Device** to download the configuration to the IED.

NOTE: To save the IED configuration information for later use, also save the VAMPSET document file on the PC.

2.3.3 Saving the VAMPSET document file

Save the IED configuration information to the PC. The document file is helpful for instance if you need help in troubleshooting.

1. Connect the IED to the PC with an USB cable.
2. Open the VAMPSET tool on the PC.
3. On the **Communication** menu, select **Connect device**.
4. Enter the configurator password. The IED configuration opens.
5. On the **File** menu, click **Save as**.
6. Type a descriptive file name, select the location for the file and click **Save**.

NOTE: By default, the configuration file is saved in the VAMPSET folder.

---

3 Measurement functions

3.1 Measurements for protection functions

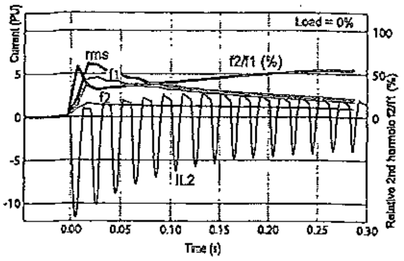


Figure 3.1: Example of various current values of a transformer inrush current

All the direct measurements are based on fundamental frequency values. Most protection functions are also based on the fundamental frequency values.

Figure 3.1 shows a current waveform and the corresponding fundamental frequency component f1, second harmonic f2, and rms value in a special case, when the current deviates significantly from a pure sine wave.

ВЯРНО С ОРИГИНАЛА

3.2 Measurement accuracy

Table 3.1: Phase current inputs I_{L1}, I_{L2}, I_{L3}

Measuring range	0.025 – 250 A
Inaccuracy:	
I ≤ 7.5 A	±0.5 % of value or ±15 mA
I > 7.5 A	±3 % of value
The specified frequency range is 45 Hz – 65 Hz.	

Table 3.2: Voltage input U

Measuring range	0.5 – 175 V
Inaccuracy	±0.5 % or ±0.3 V
The usage of voltage inputs depends on the configuration parameter voltage measurement mode. For example, U is the zero sequence voltage input U_0 if the mode "U_0" is selected. The specified frequency range is 45 Hz – 65 Hz.	

Table 3.3: Voltage input U_0 / U_4

Measuring range	0.5 – 175 V
Inaccuracy	±0.5 % or ±0.3 V
The specified frequency range is 45 Hz – 65 Hz.	

Table 3.4: Residual current input I_0

Measuring range	0.003 – 10 x I_{0N}
Inaccuracy:	
I ≤ 1.5 xI_N	±0.3 % of value or ±0.2 % of I_{0N}
I > 1.5 xI_N	±3 % of value
The rated input I_N is 5A and 1 A. It is specified in the order code of the relay. The specified frequency range is 45 Hz – 65 Hz.	

Table 3.5: Frequency

Measuring range	16 Hz – 75 Hz
Inaccuracy	±10 mHz
The frequency is measured from voltage signals when least four voltages are measured. With only one voltage (F&I) the frequency is measured from currents.	

Table 3.6: THD and harmonics

Inaccuracy I, U > 0.1 PU	±2 % units
Update rate	Once a second
The specified frequency range is 45 Hz – 65 Hz.	

NOTE: These measurement accuracies are only valid for the user interface and communication.

3.3 RMS values

RMS currents

The device calculates the RMS value of each phase current. The minimum and the maximum of RMS values are recorded and stored (see Chapter 3.6 Minimum and maximum values).

$$I_{RMS} = \sqrt{I_{f1}^2 + I_{f2}^2 + ... + I_{f15}^2}$$

RMS voltages

The device calculates the RMS value of each voltage input. The minimum and the maximum of RMS values are recorded and stored (see Chapter 3.6 Minimum and maximum values).

$$U_{RMS} = \sqrt{U_{f1}^2 + U_{f2}^2 + ... + U_{f15}^2}$$

3.4 Harmonics and Total Harmonic Distortion (THD)

The device calculates the THDs as percentage of the base frequency for currents and voltages. The device calculates the harmonics from the 2nd to the 15th of phase currents and voltages. (The 17th harmonic component will also be shown partly in the value of the 15th harmonic component. This is due to the nature of digital sampling.)

The harmonic distortion is calculated using equation

$$THD = \frac{\sqrt{\sum_{i=2}^{15} h_i^2}}{h_1}$$

h_1 = Fundamental value

h_{2-15} = Harmonics

Example

h_1 = 100 A, h_3 = 10 A, h_7 = 3 A, h_{11} = 8 A

$$THD = \frac{\sqrt{10^2 + 3^2 + 8^2}}{100} = 13.2\%$$

For reference the RMS value is

$$RMS = \sqrt{100^2 + 10^2 + 3^2 + 8^2} = 100.9A$$

Another way to calculate THD is to use the RMS value as reference instead of the fundamental frequency value. In the example above the result would then be 13.0 %.

3.5 Demand values

The relay calculates average i.e. demand values of phase currents I_{L1}, I_{L2}, I_{L3} and power values S, P and Q.

The demand time is configurable from 10 minutes to 60 minutes with parameter "Demand time".

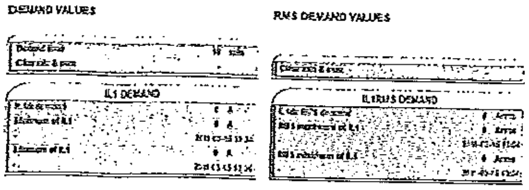


Figure 3.2: Demand values

Table 3.7: Demand value parameters

Parameter	Value	Unit	Description	Set
Time	10 – 30	min	Demand time (averaging time)	Set
Fundamental frequency values				
IL1da		A	Demand of phase current IL1	
IL2da		A	Demand of phase current IL2	
IL3da		A	Demand of phase current IL3	
Pda		kW	Demand of active power P	
PFda			Demand of power factor PF	
Qda		Kvar	Demand of reactive power Q	
Sda		kVA	Demand of apparent power S	
RMS values				
IL1RMSda		A	Demand of RMS phase current IL1	
IL2RMSda		A	Demand of RMS phase current IL2	
IL3RMSda		A	Demand of RMS phase current IL3	
Prmsda		kW	Demand of RMS active power P	
Qrmsda		kvar	Demand of RMS reactive power Q	
Srmsda		kVA	Demand of RMS apparent power S	

Set = An editable parameter (password needed).

3.6 Minimum and maximum values

Minimum and maximum values are registered with time stamps since the latest manual clearing or since the device has been restarted. The available registered min & max values are listed in the following table.

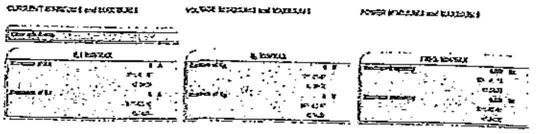


Figure 3.3: Minimum and maximum values

Min & Max measurement	Description
IL1, IL2, IL3	Phase current (fundamental frequency value)
IL1RMS, IL2RMS, IL3RMS	Phase current, rms value
I_0	Residual current
U_A, U_B, U_C, U_D	Voltages, fundamental fequency values
U_ARMS, U_BRMS, U_CRMS, U_DRMS	Line-to-neutral voltages, RMS value
U12, U23, U31	Line-to-line voltage
Uo	Zero sequence voltage
f	Frequency
P, Q, S	Active, reactive, apparent power
IL1da, IL2da, IL3da	Demand values of phase currents
IL1da, IL2da, IL3da (rms value)	Demand values of phase currents, rms values
PFda	Power factor demand value
P.F.	Power factor

The clearing parameter "ClrMax" is common for all these values.

Table 3.8: Parameters

Parameter	Value	Description	Set
ClrMax	- Clear	Reset all minimum and maximum values	Set

3.7 Maximum values of the last 31 days and 12 months

Maximum and minimum values of the last 31 days and the last twelve months are stored in the non-volatile memory of the relay. Corresponding time stamps are stored for the last 31 days. The registered values are listed in the following table.

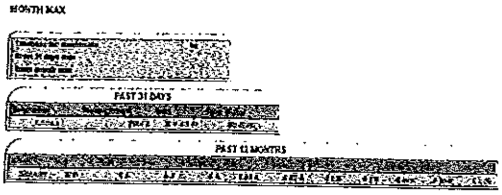


Figure 3.4: Past 31 days and 12 month maximums/minimums can be viewed in "month max" menu.

Measurement	Max	Min	Description	31 days	12 months
IL1, IL2, IL3	X		Phase current (fundamental frequency value)		
Io	X		Residual current		
S	X		Apparent power	X	X
P	X	X	Active power	X	X
Q	X	X	Reactive power	X	X

Timebase can be a value from one cycle to one minute. Also demand value can be used as timebase and its value can be set between 10 - 60 minutes. Demand value menu is located under the "logs" leaflet -> demand values.

Table 3.9: Parameters of the day and month registers

Parameter	Value	Description	Set
Timebase		Parameter to select the type of the registered values	Set
	20 ms	Collect min & max of one cycle values *	
	200 ms	Collect min & max of 200 ms average values	
	1 s	Collect min & max of 1 s average values	
	1 min	Collect min & max of 1 minute average values	
	demand	Collect min & max of demand values (Chapter 3.5 Demand values)	
ResetDays		Reset the 31 day registers	Set
ResetMon		Reset the 12 month registers	Set

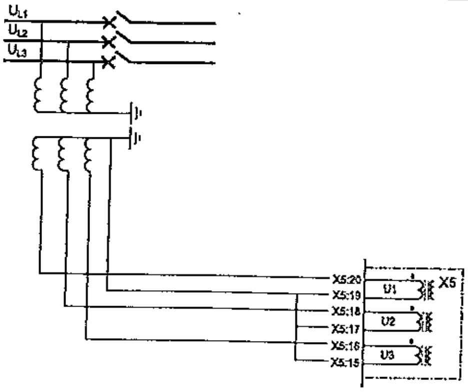
* This is the fundamental frequency rms value of one cycle updated every 20 ms.

3.8 Voltage measurement modes

Multiple channel voltage measurement

VAMP 57 has 9 different voltage measurement modes.

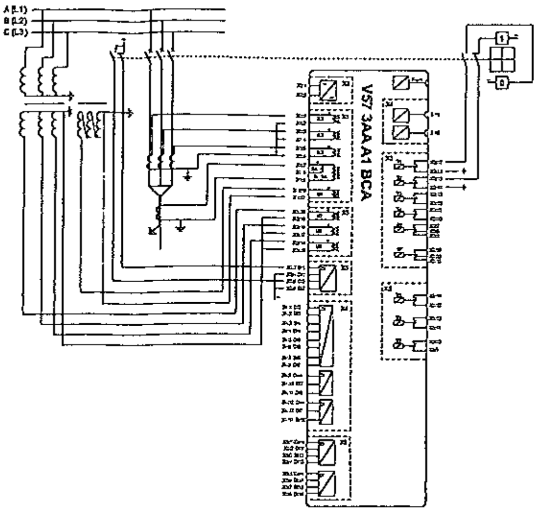
Mode	U1	U2	U3	U4
3LN	UL1	UL2	UL3	-
3LN+U_0	UL1	UL2	UL3	U_0
3LN+LLy	UL1	UL2	LLy	UL3
3LN+LNy	UL1	UL2	LNy	UL3
2LL+U_0	U12	U23	U_0	-
2LL+U_0+LLy	U12	U23	LLy	U_0
2LL+U_0+LNy	U12	U23	LNy	U_0
LL+U_0+LLy+LLz	U12	U12y	U12z	U_0
LL+U_0+LNy+LNz	UL1	UL1y	UL1z	U_0



3LN

- Voltages measured by VTs:
  UL1, UL2, UL3
- Values calculated:
  UL12, UL23, UL31, Uo, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 67NI, 25

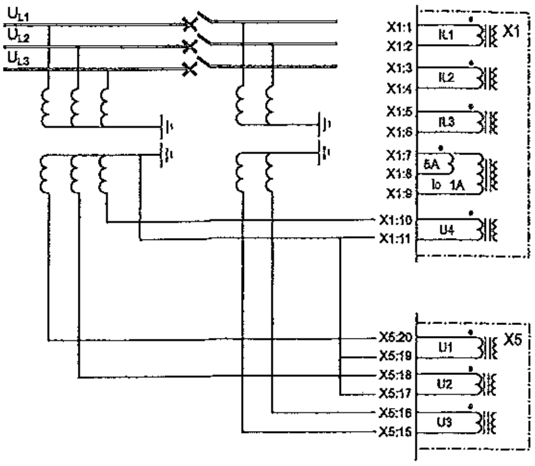
000270



3LN+U_0

This connection is typically used for feeder and motor protection schemes.

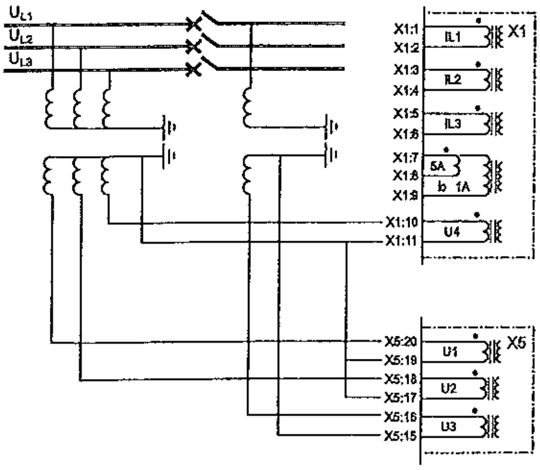
- Voltages measured by VTs:
  UL1, UL2, UL3, Uo
- Values calculated:
  UL12, UL23, UL31, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 25



3LN+LLy

Connection of voltage transformers for synchrocheck application. The other side of the CB has line-to-line connection for reference voltage.

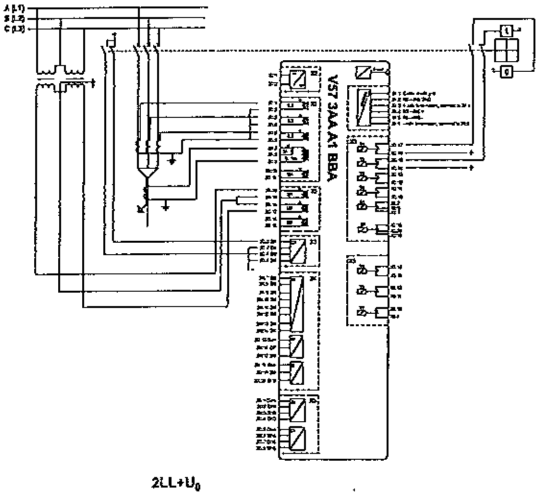
- Voltages measured by VTs:
  UL1, UL2, UL3, UL12y
- Values calculated:
  UL12, UL23, UL31, Uo, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 67NI



3LN+LNy

This connection is typically used for feeder protection scheme where line-to-neutral voltage is required for synchrocheck application.

- Voltages measured by VTs:
  UL1, UL2, UL3, UL1y
- Values calculated:
  UL12, UL23, UL31, Uo, U1, U2, U2/U1, f
- Measurements available: All
- Protection functions not available: 67NI

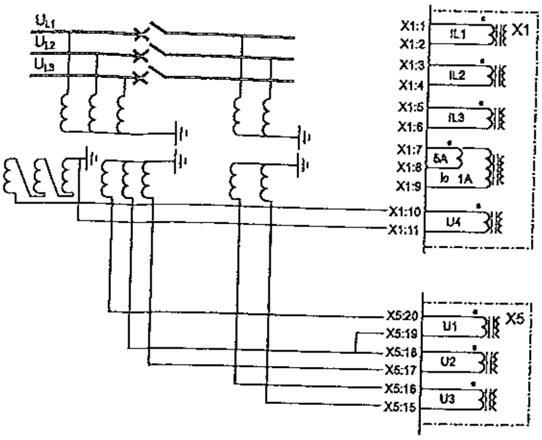


2LL+U_0

Connection of two line-to-line and residual voltage measurement scheme.

- Voltages measured by VTs:
  UL12, UL23, Uo
- Values calculated:
  UL1, UL2, UL3, U31, U1, U2, f
- Measurements available: All
- Protection functions not available: 25

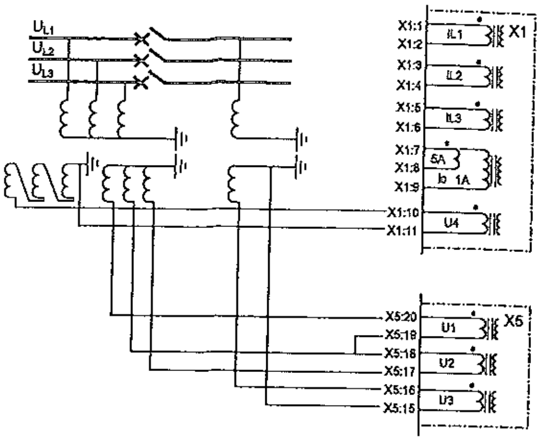
000271



2LL+U_0+LLy

Connection of two line-to-line and residual voltage scheme. Line-to-line reference voltage is taken from other side of the CB for synchrocheck scheme.

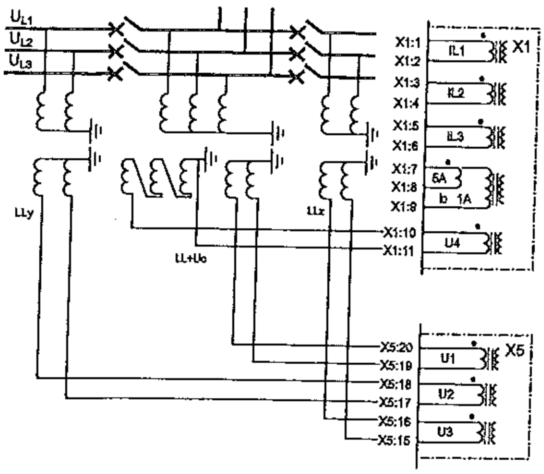
- Voltages measured by VTs:
  UL12, UL23, Uo, UL12y
- Values calculated:
  UL31, UL1, UL2, UL3, U1, U2, f, fy
- Measurements available: All
- Protection functions available: All



2LL+U_0+LNy

Connection of two line-to-line and residual voltage scheme. The other side of the CB has phase-to-neutral connection for synchrocheck.

- Voltages measured by VTs:
  UL12, UL23, Uo, UL1y
- Values calculated:
  UL31, UL1, UL2, UL3, U1, U2, f, fy
- Measurements available: All
- Protection functions available: All



LL+U_0+LLy+LLz

This scheme has two CBs to be synchronized. Left side of the bus bar has line-to-line and right side line-to-line connection for synchrocheck's reference voltages. In the middle system voltages are measured by phase-to-neutral and open delta connection.

- Voltages measured by VTs:
  UL12, Uo, UL12y, UL12z
- Values calculated:
  UL1, UL2, UL3, U23, U31, f, fy, fz
- Measurements available: -
- Protection functions available: Single phase voltage protection

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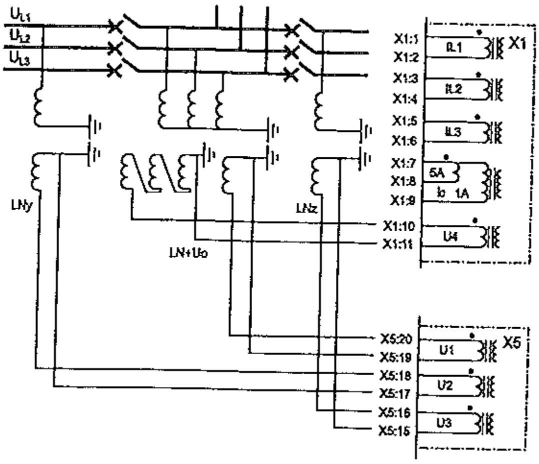

LN+U_0+LNy+LNz

This scheme has two CBs to be synchronized. Left and right sides of the bus bar have line-to-neutral connections for synchrocheck's reference voltages. In the middle system voltages are measured by phase-to-neutral and open delta connection.

- Voltages measured by VTs:
  UL1, Uo, UL1y, UL1z
- Values calculated:
  U12, U23, U31, UL2, UL3, f, fy, fz
- Measurements available: -
- Protection functions available: Single phase voltage protection

3.9 Direction of power and current

Figure 3.5 shows the concept of three phase current direction and sign of cosφ and power factor PF. Figure 3.6 shows the same concepts, but on a PQ-power plane.

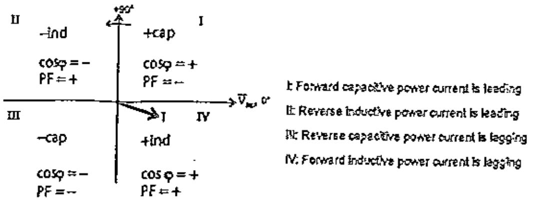

Figure 3.5: Quadrants of voltage/current phasor plane

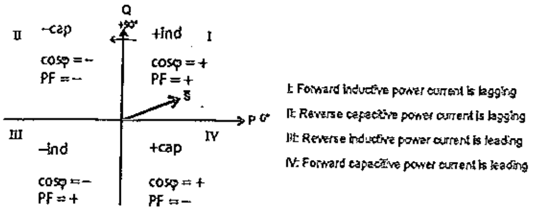

Figure 3.6: Quadrants of power plane

Table 3.10: Power quadrants

Power quadrant	Current related to voltage	Power direction	cosφ	Power factor PF
+ inductive	Lagging	Forward	+	+
+ capacitive	Leading	Forward	+	-
- inductive	Leading	Reverse	-	+
- capacitive	Lagging	Reverse	-	-

3.10 Symmetric components

In a three phase system, the voltage or current phasors may be divided in symmetric components according C. L. Fortescue (1918). The symmetric components are:

- Positive sequence 1
- Negative sequence 2
- Zero sequence 0

Symmetric components are calculated according the following equations:

$$\begin{bmatrix} \underline{S}_0 \\ \underline{S}_1 \\ \underline{S}_2 \end{bmatrix} = \frac{1}{3} \begin{bmatrix} 1 & 1 & 1 \\ 1 & \underline{a} & \underline{a}^2 \\ 1 & \underline{a}^2 & \underline{a} \end{bmatrix} \begin{bmatrix} \underline{U} \\ \underline{V} \\ \underline{W} \end{bmatrix}$$

$\underline{S}_0$ = zero sequence component

$\underline{S}_1$ = positive sequence component

$\underline{S}_2$ = negative sequence component

$\underline{a} = 1\angle 120^\circ = -\frac{1}{2} + j\frac{\sqrt{3}}{2}$, a phasor rotating constant

$\underline{U}$ = phasor of phase L1 (phase current)

$\underline{V}$ = phasor of phase L2

$\underline{W}$ = phasor of phase L3

3.11 Primary secondary and per unit scaling

Many measurement values are shown as primary values although the relay is connected to secondary signals. Some measurement values are shown as relative values - per unit or per cent. Almost all pick-up setting values are using relative scaling.

The scaling is done using the given CT, VT in feeder mode and furthermore motor name plate values in motor mode.

The following scaling equations are useful when doing secondary testing.

3.11.1 Current scaling

NOTE: The rated value of the device's current input, for example 5 A or 1A, does not have any effect in the scaling equations, but it defines the measurement range and the maximum allowed continuous current. See Table 10.1 for details.

Primary and secondary scaling

	Current scaling
secondary → primary	$I_{PRI} = I_{SEC} \cdot \frac{CT_{PRI}}{CT_{SEC}}$
primary → secondary	$I_{SEC} = I_{PRI} \cdot \frac{CT_{SEC}}{CT_{PRI}}$

For residual current to input I_0 use the corresponding CT_{PRI} and CT_{SEC} values. For ground fault stages using I_{0Calc} signals use the phase current CT values for CT_{PRI} and CT_{SEC}.

Examples:

1. **Secondary to primary**
   CT = 500 / 5
   Current to the relay's input is 4 A.
   => Primary current is I_{PRI} = 4 x 500 / 5 = 400 A
2. **Primary to secondary**
   CT = 500 / 5
   The relay displays I_{PRI} = 400 A
   => Injected current is I_{SEC} = 400 x 5 / 500 = 4 A

Per unit [pu] scaling

For phase currents

1 pu = 1 x I_{MODE} = 100 %, where

I_{MODE} is the rated current according to the mode. See Chapter 1.6 Abbreviations

For residual currents

1 pu = 1 x CT_{SEC} for secondary side and 1 pu = 1 x CT_{PRI} for primary side.

	Phase current scaling	Residual current ($3I_0$) scaling
secondary → per unit	$I_{PU} = \frac{I_{SEC} \cdot CT_{PRI}}{CT_{SEC} \cdot I_{MODE}}$	$I_{PU} = \frac{I_{SEC}}{CT_{SEC}}$
per unit → secondary	$I_{SEC} = I_{PU} \cdot CT_{SEC} \cdot \frac{I_{MODE}}{CT_{PRI}}$	$I_{SEC} = I_{PU} \cdot CT_{SEC}$

Examples:

1. **Secondary to per unit**

   CT = 750 / 5

   Current injected to the relay's inputs is 7 A.

   Per unit current is I_{PU} = 7 / 5 = 1.4 pu = 140 %
2. **Secondary to per unit for phase currents**

   CT = 750/5

   Current injected to the relay's inputs is 7 A.

   => Per unit current is I_{PU} = 7 x 750 / (5 x 525) = 2.00 pu = 2.00 x I_{MODE} = 200 %
3. **Per unit to secondary**

   CT = 750 / 5

   The device setting is 2 pu = 200 %.

   Secondary current is I_{SEC} = 2 x 5 = 10 A

4. **Per unit to secondary for phase currents**
   CT = 750 / 5
   I_{MODE} = 525 A
   The relay setting is 2 x I_{MODE} = 2 pu = 200 %.
   Secondary current is I_{SEC} = 2 x 5 x 525 / 750 = 7 A
5. **Secondary to per unit for residual current**
   Input is I_0.
   CT_0 = 50 / 1
   Current injected to the relay's input is 30 mA.
   Per unit current is I_{PU} = 0.03 / 1 = 0.03 pu = 3 %
6. **Per unit to secondary for residual current**
   Input is I_0.
   CT_0 = 50 / 1
   The relay setting is 0.03 pu = 3 %.
   Secondary current is I_{SEC} = 0.03 x 1 = 30 mA
7. **Secondary to per unit for residual current**
   Input is I_{0Calc}.
   CT = 750 / 5
   Currents injected to the relay's I_{L1} input is 0.5 A.
   I_{L2} = I_{L3} = 0.
   Per unit current is I_{PU} = 0.5 / 5 = 0.1 pu = 10 %
8. **Per unit to secondary for residual current**
   Input is I_{0Calc}.
   CT = 750 / 5
   The relay setting is 0.1 pu = 10 %.
   If I_{L2} = I_{L3} = 0, then secondary current to I_{L1} is I_{SEC} = 0.1 x 5 = 0.5 A

3.11.2 Voltage scaling

Primary/secondary scaling of line-to-line voltages

	Line-to-line voltage scaling	
	Voltage measurement mode = "2LL+U$_0$"	Voltage measurement mode = "3LN"
secondary → primary	$U_{PRI}=U_{SEC}\cdot\frac{VT_{PRI}}{VT_{SEC}}$	$U_{PRI}=\sqrt{3}\cdot U_{SEC}\cdot\frac{VT_{PRI}}{VT_{SEC}}$
primary → secondary	$U_{SEC}=U_{PRI}\cdot\frac{VT_{SEC}}{VT_{PRI}}$	$U_{SEC}=\frac{U_{PRI}}{\sqrt{3}}\cdot\frac{VT_{SEC}}{VT_{PRI}}$

Examples:

1. **Secondary to primary. Voltage measurement mode is "2LL+U$_0$"**
   VT = 12000/110
   Voltage connected to the device's input U_A or U_B is 100 V.
   => Primary voltage is U_{PRI} = 100x12000/110 = 10909 V.
2. **Secondary to primary. Voltage measurement mode is "3LN**
   VT = 12000/110
   Three phase symmetric voltages connected to the device's inputs U_A, U_B and U_C are 57.7 V.
   => Primary voltage is U_{PRI} = √3 x58x12000/110 = 10902 V
3. **Primary to secondary. Voltage measurement mode is "2LL+U$_0$"**
   VT = 12000/110
   The relay displays U_{PRI} = 10910 V.
   => Secondary voltage is U_{SEC} = 10910x110/12000 = 100 V
4. **Primary to secondary. Voltage measurement mode is "3LN**
   VT = 12000/110
   The relay displays U_{12} = U_{23} = U_{31} = 10910 V.
   => Symmetric secondary voltages at U_A, U_B and U_C are U_{SEC} = 10910/√3 x110/12000 = 57.7 V.

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Per unit [pu] scaling of line-to-line voltages

One per unit = 1 pu = 1xU_N = 100 %, where U_N = rated voltage of the VT.

	Line-to-line voltage scaling	
	Voltage measurement mode = "2LL+U$_0$", "1LL+U$_0$/LLy", "2LL/LLy", "LL/LLy/LLz"	Voltage measurement mode = "3LN"
secondary → per unit	$U_{PU}=\frac{U_{SEC}}{VT_{SEC}}\cdot\frac{VT_{PRI}}{U_N}$	$U_{PU}=\sqrt{3}\cdot\frac{U_{SEC}}{VT_{SEC}}\cdot\frac{VT_{PRI}}{U_N}$
per unit → secondary	$U_{SEC}=U_{PU}\cdot VT_{SEC}\cdot\frac{U_N}{VT_{PRI}}$	$U_{SEC}=U_{PU}\cdot\frac{VT_{SEC}}{\sqrt{3}}\cdot\frac{U_N}{VT_{PRI}}$

Examples:

1. **Secondary to per unit. Voltage measurement mode is "2LL+U$_0$"**
   VT = 12000/110
   Voltage connected to the device's input U_A or U_B is 110 V.
   => Per unit voltage is U_{PU} = 110/110 = 1.00 pu = 1.00xU_N = 100 %
2. **Secondary to per unit. Voltage measurement mode is "3LN"**
   VT = 12000/110
   Three symmetric phase-to-neutral voltages connected to the device's inputs U_A, U_B and U_C are 63.5 V
   => Per unit voltage is U_{PU} = √3x63.5/110x12000/11000 = 1.00 pu = 1.00xU_N = 100 %
3. **Per unit to secondary. Voltage measurement mode is "2LL+U$_0$"**
   VT = 12000/110
   The relay displays 1.00 pu = 100 %.
   => Secondary voltage is U_{SEC} = 1.00x110x11000/12000 = 100.8 V
4. **Per unit to secondary. Voltage measurement mode is "3LN"**
   VT = 12000/110
   U_N = 11000 V
   The relay displays 1.00 pu = 100 %.
   => Three symmetric phase-to-neutral voltages connected to the device 's inputs U_A, U_B and U_C are
   U_{SEC} = 1.00x110/√3 x11000/12000 = 58.2 V

Per unit [pu] scaling of zero sequence voltage

	Zero-sequence voltage (U_0) scaling	
	Voltage measurement mode = "2LL+U$_0$", "1LL+U$_0$/LLy"	Voltage measurement mode = "3LN"
secondary -> per unit	$U_{PU}=\frac{U_{SEC}}{U_{0SEC}}$	$U_{PU}=\frac{1}{VT_{SEC}}\cdot\frac{\left\|\overline{U}_a+\overline{U}_b+\overline{U}_c\right\|_{SEC}}{\sqrt{3}}$
per unit -> secondary	$U_{SEC}=U_{PU}\cdot U_{0SEC}$	$\left\|\overline{U}_a+\overline{U}_b+\overline{U}_c\right\|_{SEC}=\sqrt{3}\cdot U_{PU}\cdot VT_{SEC}$

Examples:

1. **Secondary to per unit. Voltage measurement mode is "2LL+U$_0$"**
   U_{0SEC} = 110 V (This is a configuration value corresponding to U_0 at full earth fault.)
   Voltage connected to the device's input U_C is 22 V.
   => Per unit voltage is U_{PU} = 22/110 = 0.20 pu = 20 %
2. **Secondary to per unit. Voltage measurement mode is "3LN"**
   VT = 12000/110
   Voltage connected to the device's input U_A is 38.1 V, while U_A = U_B = 0.
   => Per unit voltage is U_{PU} = (38.1+0+0)/(√3x110) = 0.20 pu = 20 %
3. **Per unit to secondary. Voltage measurement mode is "2LL+U$_0$"**
   U_{0SEC} = 110 V (This is a configuration value corresponding to U_0 at full earth fault.)
   The device displays U_0 = 20 %.
   => Secondary voltage at input U_C is U_{SEC} = 0.20x110 = 22 V
4. **Per unit to secondary. Voltage measurement mode is "3LN"**
   VT = 12000/110
   The device displays U_0 = 20 %.
   => If U_B = U_C = 0, then secondary voltages at U_A is
   USEC = √3x0.2x110 = 38.1 V

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4 Control functions

4.1 Output relays

The output relays are also called digital outputs. Trip contacts can be controlled by using relay output matrix or logic function. Also forced control is possible. When using force controlling it has to be first enabled in the "relays" menu.

The output relays are also called digital outputs. Any internal signal can be connected to the output relays using "OUTPUT MATRIX". An output relay can be configured as latched or non-latched.

The position of the contact can be checked in "output matrix" and "relays" menu. An output relay can be configured as latched or non-latched. Latched relay contacts can be set free by pressing the "enter" key of the IED or by releasing from VAMPSET setting tool.

The difference between trip contacts and signal contacts is the DC breaking capacity. The contacts are single pole single throw (SPST) normal open type (NO), except signal relay A1 which has change over contact single pole double throw (SPDT).

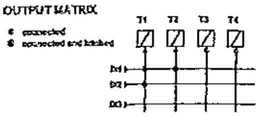
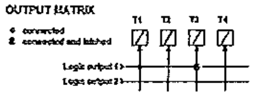


Figure 4.1: Trip contacts can be connected to protection stages or other similar purpose in "output matrix" menu.



Notice the difference between latched and non-latched connection. Logic output will be assigned automatically in output matrix as well when logic is built.

Figure 4.2: Trip contacts can be assigned directly to outputs of logical operators.

Trip contacts can be controlled by using relay output matrix or logic function. Also forced control is possible. When using force controlling it has to be first enabled in the "relays" menu.

The position of the contact can be checked in "output matrix" and "relays" menu. An output relay can be configured as latched or non-latched. Latched relay contacts can be set free by by releasing from VAMPSET setting tool or pressing the "releasing all latches" on the IED. See pictures or instructions below.

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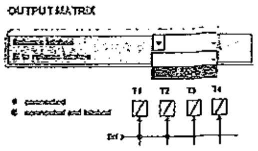

Figure 4.3: Latched output matrix signals released by using VAMPSET setting tool.

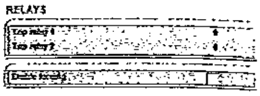

Figure 4.4: Trip contact can be viewed, forced to operate in "relays" menu.

Release all latches (while correct password is enabled)

1. Press *i*.
   - To release the latches, press ⏎.
   - To release choose "Release" parameter and press ⏎.

Default numbering of DI / DO

Power supply card outputs are not visible in 'relay config' menu

Table 4.1: Parameters of output relays

Parameter	Value	Unit	Description	Note
T1 – T7	0 1		Status of trip output relay	F
A1	0 1		Status of alarm output relay	F
SF	0 1		Status of the SF relay In VAMPSET, it is called as "Service status output"	F
Force	On Off		Force flag for output relay forcing for test purposes. This is a common flag for all output relays and detection stage status, too. Any forced relay(s) and this flag are automatically reset by a 5-minute timeout.	Set
NAMES for OUTPUT RELAYS (editable with VAMPSET only)				
Description	String of max. 32 characters		Names for DO on VAMPSET screens. Default is	Set

F = Editable when force flag is on. Set = An editable parameter (password needed).

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4.2 Digital inputs

Digital inputs are available for control purposes.

The polarity – normal open (NO) / normal closed (NC) – and a delay can be configured according the application by using the local HMI or VAMPSET.

Digital inputs can be used in many operations. The status of the input can be checked in relay "output matrix" and "digital inputs" menu. Digital inputs makes possible to change group, block/enable/disable functions, to program logics, indicate object status, etc.

The digital inputs do require an external control voltage (ac or dc). Digital input will be activated after activation voltage exceeds. Deactivation follows when the voltage drops below threshold limit.

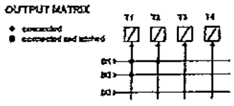
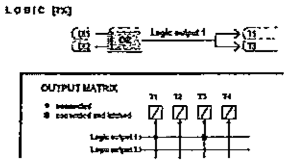


Figure 4.5: Digital inputs can be connected to trip contacts or other similar purpose in "output matrix" menu.



Notice the difference between latched and non-latched connection. Logic output will be assigned automatically in output matrix as well when logic is built.

Figure 4.6: Digital inputs can be assigned directly to inputs/outputs of logical operators.

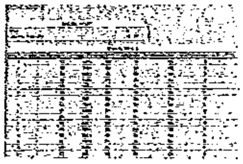


Figure 4.7: Digital inputs can be viewed, named and changed between NO/NC in "Digital inputs" menu.

In case that inputs are energized by using AC voltage "mode" has to be selected as AC.

All essential information of digital inputs can be found from the same location "digital inputs" menu. DI on/off events and alarm display (pop-up) can be enabled and disabled in "digital inputs" menu. Individual operation counters are located in the same menu as well.

Label and description texts can be edited with VAMPSET according the application. Labels are the short parameter names used on the local panel and descriptions are the longer names used by VAMPSET.

Digital input delay determines the activation and de-activation delay for the input. See picture below to indicate how DI behaves when the delay is set to 1.0 seconds.

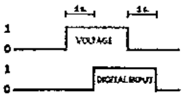


Figure 4.8: Digital inputs behaviour when delay is set to one second.

Table 4.2: Parameters of digital inputs

Parameter	Value	Unit	Description	Note
Mode	DC, AC		Used voltage of digital inputs	Set
Input	DI1 – DI16		Number of digital input.	
State	0, 1		Status of digital input 1 – digital input x.	
Polarity	NO NC		For normal open contacts (NO). Active edge is 0 -> 1 For normal closed contacts (NC) Active edge is 1 -> 0	Set
Delay	0.00 – 60.00	s	Definite delay for both on and off transitions	Set
On event	On		Active edge event enabled	Set
	Off		Active edge event disabled	
Off event	On		Inactive edge event enabled	Set
	Off		Inactive edge event disabled	
Alarm display	no		No pop-up display	Set
	yes		Alarm pop-up display is activated at active DI edge	
Counters	0 – 65535		Cumulative active edge counter	(Set)
NAMES for DIGITAL INPUTS (editable with VAMPSET only)				
Label	String of max. 10 characters		Short name for DIs on the local display Default is "DI1 - DIx". x is the maximum number of the digital input.	Set
Description	String of max. 32 characters		Long name for DIs. Default is "Digital input 1 – Digital input x". x is the maximum number of the digital input.	Set

Set = An editable parameter (password needed).

4.3 Virtual inputs and outputs

There are virtual inputs and virtual outputs, which can in many places be used like their hardware equivalents except that they are only located in the memory of the device. The virtual inputs acts like normal digital inputs. The state of the virtual input can be changed from local display, communication bus and from VAMPSET. For example setting groups can be changed using virtual inputs.

Virtual inputs can be used in many operations. The status of the input can be checked in "output matrix" and "virtual inputs" menu. Status is also visible on local mimic display if so selected. Virtual inputs can be selected to be operated trough function buttons F1 and F2, trough local mimic or simply by using the virtual input menu. Virtual inputs makes possible to change group, block/enable/disable functions, to program logics and other similar to digital inputs.

Activation and reset delay of input is approximately 5ms. See specification below:

Table 4.3: Virtual input and output

Number of inputs	4
Number of outputs	6
Activation time	< 5 ms
Reset time	< 5 ms

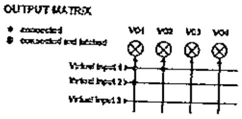
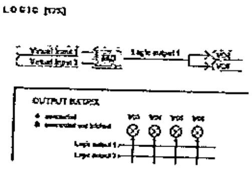


Figure 4.9: Virtual inputs and ouputs can be used for many purpose in "output matrix" -menu.



Notice the difference between latched and non-latched connection.

Figure 4.10: Virtual inputs and outputs can be assigned directly to inputs/outputs of logical operators.

INPUT SIGNALS > VIRTUAL INPUT

The virtual inputs do act like digital inputs, but there are no physical contacts. These can be controlled via the local HMI and communication protocols. Virtual inputs are shown in the output matrix and the block matrix. Virtual inputs can be used with the user's programmable logic and to change the active setting group etc.

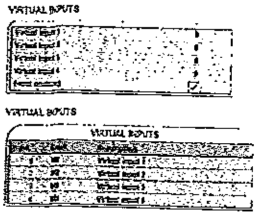


Figure 4.11: Virtual inputs can be viewed, named and controlled in "Virtual inputs" -menu.

Table 4.4: Parameters of virtual inputs

Parameter	Value	Unit	Description	Set
VI1-VI4	0 1		Status of virtual input	
Events	On Off		Event enabling	Set
NAMES for VIRTUAL INPUTS (editable with VAMPSET only)				
Label	String of max. 10 characters		Short name for VIs on the local display Default is "VIn", n = 1 – 4	Set
Description	String of max. 32 characters		Long name for VIs. Default is "Virtual input n", n = 1 – 4	Set

Set = An editable parameter (password needed).

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OUTPUT SIGNALS > VIRTUAL OUTPUT

The virtual outputs do act like output relays, but there are no physical contacts. Virtual outputs are shown in the output matrix and the block matrix. Virtual outputs can be used with the user's programmable logic and to change the active setting group etc.

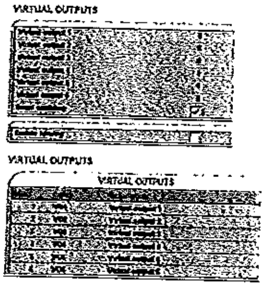

Figure 4.12: Virtual Outputs can be viewed, named and force controlled in "Virtual outputs" -menu. Virtual outputs menu is located under the "device menu" leaflet -> output signals. Virtual output contects are in "DO" -menu when 64 x 128 LCD display is installed.

Table 4.5: Parameters of virtual outputs

Parameter	Value	Unit	Description	Set
VO1-VO6	0 1		Status of virtual output	F
Events	On Off		Event enabling	Set
NAMES for VIRTUAL OUTPUTS (editable with VAMPSET only)				
Label	String of max. 10 characters		Short name for VOs on the local display Default is "VOn", n=1 - 6	Set
Description	String of max. 32 characters		Long name for VOs. Default is "Virtual output n", n=1 - 6	Set

Set = An editable parameter (password needed). F = Editable when force flag is on.

4.4 Matrix

4.4.1 Output matrix

By means of the output matrix, the output signals of the various protection stages, digital inputs, logic outputs and other internal signals can be connected to the output relays, virtual outputs, etc.

There are general purpose LED indicators – "A", "B", "C" to "H" – available for customer-specific indications on the front panel. Their usage is define in a separate OUTPUT MATRIX.

Furthermore there are two LED indicators specified for keys F1 and F2. In addition, the triggering of the disturbance recorder (DR) and virtual outputs are configurable in the output matrix.

An output relay or indicator LED can be configured as latched or non-latched. A non-latched relay follows the controlling signal. A latched relay remains activated although the controlling signal releases.

There is a common "release all latches" signal to release all the latched relays. This release signal resets all the latched output relays and indicators with CPU and FPGA control. The reset signal can be given via a digital input, via HMI or through communication. The selection of the input is done with the VAMPSET software under the menu "Release output matrix latches".

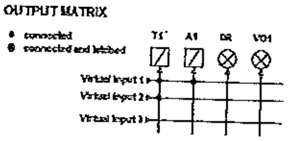

Figure 4.13: Trip and alarm relays together with virtual outputs can be assigned in output matrix. Also automatic triggering of disturbance recorder is done in output matrix.

4.4.2 Blocking matrix

By means of a blocking matrix, the operation of any protection stage can be blocked. The blocking signal can originate from the digital inputs or it can be a start or trip signal from a protection stage or an output signal from the user's programmable logic. In the Figure 4.14, an active blocking is indicated with a black dot (•) in the crossing point of a blocking signal and the signal to be blocked.

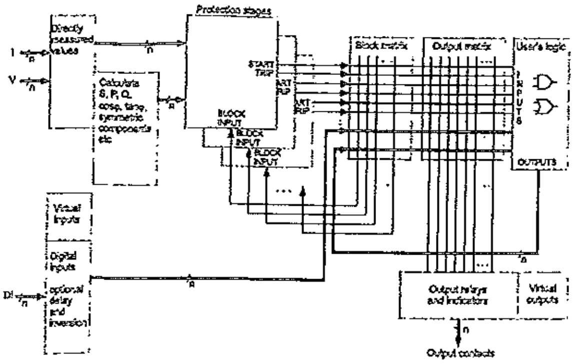

Figure 4.14: Blocking matrix and output matrix

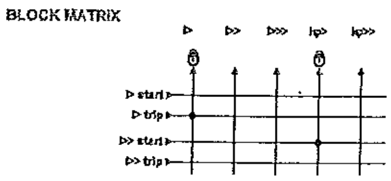

Figure 4.15: All protection stages can be blocked in block matrix.

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4.5 Controllable objects

The device allows controlling of six objects, that is, circuit-breakers, disconnectors and grounding switches. Controlling can be done by "select-execute" or "direct control" principle.

The object block matrix and logic functions can be used to configure interlocking for a safe controlling before the output pulse is issued. The objects 1 – 6 are controllable while the objects 7 – 8 are only able to show the status.

Controlling is possible by the following ways:

- through the local HMI
- through a remote communication
- through a digital input
- through the function key

The connection of an object to specific output relays is done via an output matrix (object 1 – 6 open output, object 1 – 6 close output). There is also an output signal "Object failed", which is activated if the control of an object is not completed.

Object states

Each object has the following states:

Setting	Value	Description
Object state	Undefined (00)	Actual state of the object
	Open	
	Close	
	Undefined (11)	

Basic settings for controllable objects

Each controllable object has the following settings:

Setting	Value	Description
DI for 'obj open'	None, any digital input, virtual input or virtual output	Open information
DI for 'obj close'		Close information
DI for 'obj ready'		Ready information
Max ctrl pulse length	0.02 – 600 s	Pulse length for open and close commands
Completion timeout	0.02 – 600 s	Timeout of ready indication
Object control	Open/Close	Direct object control

If changing states takes longer than the time defined by "Max ctrl pulse length" setting, object is inoperative and "Object failure" matrix signal is set. Also undefined-event is generated. "Completion timeout" is only used for the ready indication. If "DI for 'obj ready'" is not set, completion timeout has no meaning.

Each controllable object has 2 control signals in matrix:

Output signal	Description
Object x Open	Open control signal for the object
Object x Close	Close control signal for the object

These signals send control pulse when an object is controlled by digital input, remote bus, auto-reclose etc.

Settings for read-only objects

Setting	Value	Description
DI for 'obj open'	None, any digital input, virtual input or virtual output	Open information
DI for 'obj close'		Close information
Object timeout	0.02 – 600 s	Timeout for state changes

If changing states takes longer than the time defined by "Object timeout" setting, and "Object failure" matrix signal is set. Also undefined-event is generated.

4.5.1 Controlling with DI

Objects can be controlled with digital input, virtual input or virtual output. There are four settings for each controllable object:

Setting	Active
DI for remote open / close control	In remote state
DI for local open / close control	In local state

If the device is in local control state, the remote control inputs are ignored and vice versa. Object is controlled when a rising edge is detected from the selected input. Length of digital input pulse should be at least 60 ms.

4.5.2 Local/Remote selection

In Local mode, the output relays can be controlled via a local HMI, but they cannot be controlled via a remote serial communication interface.

In Remote mode, the output relays cannot be controlled via a local HMI, but they can be controlled via a remote serial communication interface.

The selection of the Local/Remote mode is done by using a local HMI, or via one selectable digital input. The digital input is normally used to change a whole station to a local or remote mode. The selection of the L/R digital input is done in the "Objects" menu of the VAMPSET software.

4.5.3 Controlling with I/O

VAMP 57 also has dedicated control buttons for object. (I) stands for object close and (O) controls object open command internally. Control buttons are configured in OBJECTS view.

Table 4.6: Parameters of function keys

Parameter	Value	Unit	Description	Set
Disabled Object 1 – 6	- Obj1 – Obj6		Green button (I) closes selected object if password is enabled Red button (O) opens selected object if password is enabled	Set
Mode for control butons	Selective Direct		Control operation needs confirmation (select-execute) Control operation is done without confirmation	

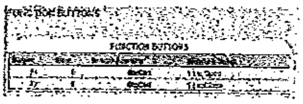
4.5.4 Controlling with F1 & F2

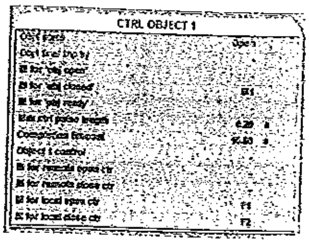
Objects can be controlled with F1 & F2.

As default these keys are programmed to toggle F1 and F2. It is possible to configure F1 & F2 to toggle VI1 – VI4 or act as object control. Selection of the F1 and F2 function is made with the VAMPSET software under the FUNCTION BUTTONS menu.

Table 4.7: Parameters of F1, F2

Parameter	Value	Unit	Description	Set
F1 – F2 VI1 – VI4	0		Function key toggles Virtual input 1 – 4 and Function button 1 – 2 between on (1) and off (0)	Set
ObjCtrl PrgFncs	1		When Object conrol in chosen F1 and F2 can be linked in OBJECTS to desired objects close/open command.	





CTRL OBJECT 1

Obj1 state Open

Obj1 final trip ty

DI for 'obj open'

DI for 'obj closed' DI1

DI for 'obj ready'

Max ctrl pulse length 0.20 s

Completion timeout 10.00 s

Object 1 control

DI for remote open ctrl

DI for remote close ctrl

DI for local open ctrl F1

DI for local close ctrl F2

Selected object and control is shown in VAMPSET software under the menu "FUNCTION BUTTONS". If no object with local control is selected '-' is shown. If multiple local controls are selected for one key '?' is shown.

4.6 Auto-reclose function (79)

The VAMP protection relays include a sophisticated Auto-reclosing (AR) function. The AR function is normally used in feeder protection relays that are protecting an overhead line. Most of the overhead line faults are temporary in nature. Even 85% can be cleared by using the AR function.

General

The basic idea is that normal protection functions will detect the fault. Then the protection function will trigger the AR function. After tripping the circuit-breaker (CB), the AR function can reclose the CB. Normally, the first reclose (or shot) is so short in time that consumers cannot notice anything. However, the fault is cleared and the feeder will continue in normal service.

Terminology

Even though the basic principle of AR is very simple; there are a lot of different timers and parameters that have to be set.

In VAMP relays, there are five shots. A shot consists of open time (so called "dead" time) and close time (so called "burning" time or discrimination time). A high-speed shot means that the dead time is less than 1 s. The time-delayed shot means longer dead times up to 2-3 minutes.

There are four AR lines. A line means an initialization signal for AR. Normally, start or trip signals of protection functions are used to initiate an AR-sequence. Each AR line has a priority. AR1 has the highest and AR4 has the lowest one. This means that if two lines are initiated at the same time, AR will follow only the highest priority line. A very typical configuration of the lines is that the instantaneous overcurrent stage will initiate the AR1 line, time-delayed overcurrent stage the AR2 line and earth-fault protection will use lines AR3 and AR4.

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For more information about auto-reclosing, please refer to our application note "Auto-reclosing function in VAMP protection relays".

The auto-reclose (AR) matrix in the following Figure 4.16 describes the start and trip signals forwarded to the auto-reclose function.

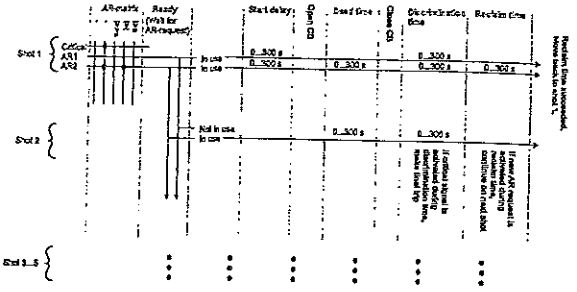

Figure 4.16: Auto-reclose matrix

After the start delay the circuit-breaker (CB) will be opened if it is closed. When the CB opens, a dead time timer is started. Each shot from 1 to 5 has its own dead time setting.

After the dead time the CB will be closed and a discrimination time timer is started. Each shot from 1 to 5 has its own discrimination time setting. If a critical signal is activated during the discrimination time, the AR function makes a final trip. The CB will then open and the AR sequence is locked. Closing the CB manually clears the "locked" state.

After the discrimination time has elapsed, the reclaim time timer starts. If any AR signal is activated during the reclaim time or the discrimination time, the AR function moves to the next shot. The reclaim time setting is common for every shot.

If the reclaim time runs out, the auto-reclose sequence is successfully executed and the AR function moves to ready -state and waits for a new AR request in shot 1.

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A trip signal from the protection stage can be used as a backup. Configure the start signal of the protection stage to initiate the AR function. If something fails in the AR function, the trip signal of the protection stage will open the CB. The delay setting for the protection stage should be longer than the AR start delay and discrimination time.

If a critical signal is used to interrupt an AR sequence, the discrimination time setting should be long enough for the critical stage, usually at least 100 ms.

Manual closing

When CB is closed manually with the local panel, remote bus, digital inputs etc, the reclaim-state is activated. Within the reclaim time all AR requests are ignored. It is up to protection stages to take care of tripping. Trip signals of protection stages must be connected to a trip relay in the output matrix.

Manual opening

Manual CB open command during AR sequence will stop the sequence and leaves the CB open.

Reclaim time setting

- Use shot specific reclaim time: No
  Reclaim time setting defines reclaim time between different shots during sequence and also reclaim time after manual closing.
- Use shot specific reclaim time: Yes
  Reclaim time setting defines reclaim time only for manual control. Reclaim time between different shots is defined by shot specific reclaim time settings.

Support for 2 circuit breakers

AR function can be configured to handle 2 controllable objects. Object 1 – 6 can be configured to CB1 and any other controllable object can be used as CB2. The object selection for CB2 is made with **Breaker 2 object** setting. Switching between the two objects is done with a digital input, virtual input, virtual output or by choosing **Auto CB selection**. AR controls CB2 when the input defined by **Input for selecting CB2** setting is active (except when using auto CB selection when operated CB 1 or 2 is that which was last in close state). Control is changed to another object only if the current object is not close.

Blocking of AR shots

Each AR shot can be blocked with a digital input, virtual input or virtual output. Blocking input is selected with **Block** setting. When selected input is active the shot is blocked. A blocked shot is treated like it doesn't exist and AR sequence will jump over it. If the last shot in use is blocked, any AR request during reclaiming of the previous shot will cause final tripping.

Starting AR sequence

Each AR request has own separate starting delay counter. The one which starting delay has elapsed first will be selected. If more than one delay elapses at the same time, an AR request of the highest priority is selected. AR1 has the highest priority and AR4 has the lowest priority. First shot is selected according to the AR request. Next AR opens the CB and starts counting dead time.

Starting sequence at shot 2 – 5 & skipping of AR shots

Each AR request line can be enabled to any combination of the 5 shots. For example making a sequence of Shot 2 and Shot 4 for AR request 1 is done by enabling AR1 only for those two shots.

NOTE: If AR sequence is started at shot 2 – 5 the starting delay is taken from the discrimination time setting of the previous shot. For example if Shot 3 is the first shot for AR2, the starting delay for this sequence is defined by Discrimination time of Shot 2 for AR2.

Critical AR request

Critical AR request stops the AR sequence and cause final tripping. Critical request is ignored when AR sequence is not running and also when AR is reclaiming.

Critical request is accepted during dead time and discrimination time.

Shot active matrix signals

When starting delay has elapsed, active signal of the first shot is set. If successful reclosing is executed at the end of the shot, the active signal will be reset after reclaim time. If reclosing was not successful or new fault appears during reclaim time, the active of the current shot is reset and active signal of the next shot is set (if there are any shots left before final trip).

AR running matrix signal

This signal indicates dead time. The signal is set after controlling CB open. When dead time ends, the signal is reset and CB is controlled close.

Final trip matrix signals

There are 5 final trip signals in the matrix, one for each AR request (1 – 4 and critical). When final trip is generated, one of these signals is set according to the AR request which caused the final tripping. The final trip signal will stay active for 0.5 seconds and then resets automatically.

DI to block AR setting

This setting is useful with an external synchro-check device. This setting only affects re-closing the CB. Re-closing can be blocked with a digital input, virtual input or virtual output. When the blocking input is active, CB won't be closed until the blocking input becomes inactive again. When blocking becomes inactive the CB will be controlled close immediately.

Table 4.8: Setting parameters of AR function

Parameter	Value	Unit	Default	Description
ARena	ARon; ARoff	-	ARon	Enabling/disabling the autoreclose
ExtSync	None, any digital input, virtual input or virtual output	-	-	The digital input for blocking CB close. This can be used for Synchrocheck.
AR_DI	None, any digital input, virtual input or virtual output	-	-	The digital input for toggling the ARena parameter
AR2grp	ARon; ARoff	-	ARon	Enabling/disabling the autoreclose for group 2
ReclT	0.02 – 300.00	s	10.00	Reclaim time setting. This is common for all the shots.
CB	Obj1 – Obj6		Obj1	Breaker object in use
CB1	Obj1 – Obj6		Obj1	Breaker 1 object
CB2	Obj1 – Obj6		-	Breaker 2 object
AutoCBSel	On; Off		off	Enabling/disabling the auto CB selection
CB2Sel	None, any digital input, virtual input or virtual output		-	The digital input for selecting the CB2.
ARreq	On; Off	-	Off	AR request event
ShotS	On; Off	-	Off	AR shot start event
ARlock	On; Off	-	Off	AR locked event
CritAr	On; Off	-	Off	AR critical signal event
ARrun	On; Off	-	Off	AR running event
FinTrp	On; Off	-	Off	AR final trip event
ReqEnd	On; Off	-	Off	AR end of request event
ShtEnd	On; Off	-	Off	AR end of shot event
CriEnd	On; Off	-	Off	AR end of critical signal event
ARUnl	On; Off	-	Off	AR release event
ARStop	On; Off	-	Off	AR stopped event
FTrEnd	On; Off	-	Off	AR final trip ready event

Parameter	Value	Unit	Default	Description
ARon	On; Off	-	Off	AR enabled event
ARoff	On; Off	-	Off	AR disabled event
CRITri	On; Off	-	On	AR critical final trip on event
AR1Tri	On; Off	-	On	AR AR1 final trip on event
AR2Tri	On; Off	-	On	AR AR2 final trip on event
Shot settings				
DeadT	0.02 – 300.00	s	5.00	The dead time setting for this shot. This is a common setting for all the AR lines in this shot
AR1	On; Off	-	Off	Indicates if this AR signal starts this shot
AR2	On; Off	-	Off	Indicates if this AR signal starts this shot
AR3	On; Off	-	Off	Indicates if this AR signal starts this shot
AR4	On; Off	-	Off	Indicates if this AR signal starts this shot
Start1	0.02 – 300.00	s	0.02	AR1 Start delay setting for this shot
Start2	0.02 – 300.00	s	0.02	AR2 Start delay setting for this shot
Start3	0.02 – 300.00	s	0.02	AR3 Start delay setting for this shot
Start4	0.02 – 300.00	s	0.02	AR4 Start delay setting for this shot
Discr1	0.02 – 300.00	s	0.02	AR1 Discrimination time setting for this shot
Discr2	0.02 – 300.00	s	0.02	AR2 Discrimination time setting for this shot
Discr3	0.02 – 300.00	s	0.02	AR3 Discrimination time setting for this shot
Discr4	0.02 – 300.00	s	0.02	AR4 Discrimination time setting for this shot

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Table 4.9: Measured and recorded values of AR function

	Parameter	Value	Unit	Description
Measured or recorded values	Obj1	UNDEFINED; OPEN; CLOSE; OPEN_REQUEST; CLOSE_REQUEST; READY; NOT_READY; INFO_NOT_AVAILABLE; FAIL	-	Object 1 state
	Status	INIT; RECLAIM_TIME; READY; WAIT_CB_OPEN; WAIT_CB_CLOSE; DISCRIMINATION_TIME; LOCKED; FINAL_TRIP; CB_FAIL; INHIBIT	-	AR-function state
	Shot#	1 – 5	-	The currently running shot
	ReclT	RECLAIMTIME; STARTTIME; DEADTIME; DISCRIMINATIONTIME	-	The currently running time (or last executed)
	SCntr		-	Total start counter
	Fail		-	The counter for failed AR shots
	Shot1*		-	Shot1 start counter
	Shot2*		-	Shot2 start counter
	Shot3*		-	Shot3 start counter
	Shot4*		-	Shot4 start counter
	Shot5*		-	Shot5 start counter

* There are 5 counters available for each one of the two AR signals.

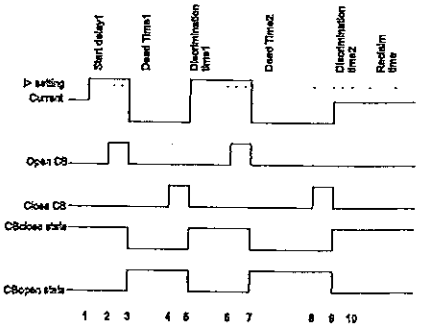

Figure 4.17: Example sequence of two shots. After shot 2 the fault is cleared.

1. Current exceeds the I> setting; the start delay from shot 1 starts.
2. After the start delay, an OpenCB relay output closes.
3. A CB opens. The dead time from shot 1 starts, and the OpenCB relay output opens.
4. The dead time from shot 1 runs out; a CloseCB output relay closes.
5. The CB closes. The CloseCB output relay opens, and the discrimination time from shot 1 starts. The current is still over the I> setting.
6. The discrimination time from the shot 1 runs out; the OpenCB relay output closes.
7. The CB opens. The dead time from shot 2 starts, and the OpenCB relay output opens.
8. The dead time from shot 2 runs out; the CloseCB output relay closes.
9. The CB closes. The CloseCB output relay opens, and the discrimination time from shot 2 starts. The current is now under I> setting.
10. Reclaim time starts. After the reclaim time the AR sequence is successfully executed. The AR function moves to wait for a new AR request in shot 1.

4.7 Logic functions

The device supports customer-defined programmable logic for boolean signals. User configurable logic can be used to create something that is not provided by the relay as a default. The logic is designed by using the VAMPSET setting tool and downloaded to the device. Functions available are:

Table 4.10: Available logic functions and their memory use

Logic functions	No. of gates reserved	Max. no. of input gates	Max. no. of logic outputs
AND	1	32 (An input gate can include any number of inputs.)	20
OR	1		
XOR	1		
AND+OR	2		
CT (count+reset)	2		
INVAND	2		
INVOR	2		
OR+AND	2		
RS (set+reset)	2		
RS_D (set+D+load+reset)	4		

Logic is made with VAMPSET setting tool. Consumed memory is dynamically shown on the configuration view in percentage. The first value indicates amount of used inputs, second amount of gates and third values shows amount of outputs consumed.

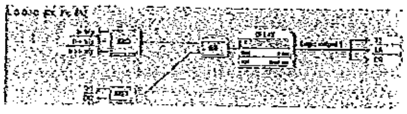

Figure 4.18: Logic can be found and modified in "logic" menu in VAMPSET setting tool

Percentages show used memory amount.

Inputs/Logical functions/Outputs- used. None of these is not allowed to exceed 100%. See guide below to learn basics of logic creation:

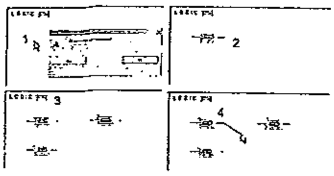

Figure 4.19: How to create logical nodes.

1. Press empty area to add a logic gate, confirm new function by pressing "Yes".
2. Logic function is always "AND" -gate as a default.
3. While logic increases the capacity is increasing as well.
4. To joint logic functions, go on top of the output line of gate and hold down mouse left -> make the connection to other logic functions input.

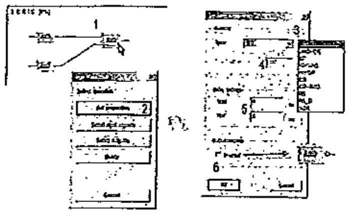

Figure 4.20: Logic creation.

1. Left click on top of any logic function to activate the "Select operation" view.
2. Edit properties button opens the "Function properties" window.
3. Generally it is possible to choose the type of logic function between and/or/counter/swing -gate.
4. When counter is selected, count setting may be set here.
5. Separate delay setting for logic activation and dis-activation.
6. Possible to invert the output of logic. Inverted logic output is marked with circle.

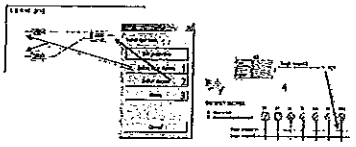

Figure 4.21: Logic creation

1. Select input signals can be done by pressing the following button or by clicking mouse left on top of the logic input line.
2. Select outputs can be done by pressing the following button or by clicking mouse left on top of the logic output line.
3. This deletes the logic function.
4. When logic is created and settings are written to the IED the unit requires a restart. After restarting the logic output is automatically assigned in output matrix as well.

NOTE: Whenever writing new logic to the IED the unit has to be restarted.

4.8 Local panel

VAMP 57 has one LCD matrix display.

All the main menus are located on the left side and to get in to certain submenu, user has to move up and down the main menus.

4.8.1 Mimic display

VAMP 57 has a mimic display enabled as a default. Mimic can be modified according the application or disabled if not needed. Mimic display can be configured only by using Vampset -setting tool. It is not possible to create mimic by using the local HMI of the IED.

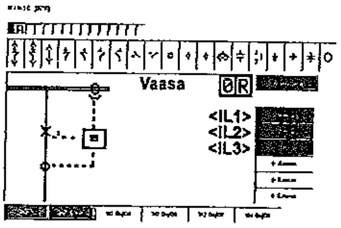

Figure 4.22: It is possible to modify local panel mimic in "Mimic" menu. Mimic menu is located under the "device menu" leaflet. In order to have mimic menu, it has to be enabled. Mimic menu can be enabled in "local panel configuration" menu. Mimic cannot be enabled/disabled by using the local panel of the IED.

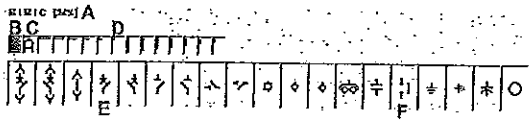

Figure 4.23: Creating mimic is completed by using different options below.

A) Percentage indicates the amount of memory used by the mimic. 100% is the maximum.

B) Clear object/drawings by going on top of it or clear the whole mimic by clicking an empty area. When clearing object/drawing while moving the mouse on top of it, the color turns to red.

C) Text tool.

D) Different type of line tools. To move existing drawings/objects on mimic go on top of it and hold down mouse left and move around. When you are on top of drawing/object it changes the color to green.

E) Different type of configurablel objects. Number of the object corresponds to the number in OBJECT -menu.

F) Some predefined drawings.

NOTE: To enable new drawings and changes in mimic press "Write changes to device" or "Write current view to device" button when using Vampset -setting tool.

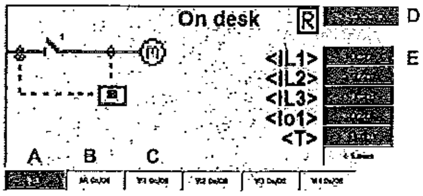

Figure 4.24: Mimic display can hold different type of information which is specified below. It is also possible to change status of certain items while local control is enabled.

A) Remote/Local selection defines whether certaina actions are granted or not. In remote state it is not possible to locally enable/disable auto-reclosing or to control objects. Remote / Local state can be changed in objects -menu as well.

B) Creates auto-reclosing on/off selection to mimic.

C) Creates virtual input activation on local mimic display.

D) Describes the location of IED. Text comes from device info menu.

E) Up to six user configurable measurements.

Table 4.11: Mimic functionality

Parameter	Value	Unit	Description	Set
Sublocation	Text field		Up to 9 characters. Fixed location.	Set
Object 1 – 8	1 – 8		Click on top of the object to change the control number between 1 and 8. Number 1 corresponds to object 1 in objects -menu.	Set
Local / Remote mode	L R		Local / Remote control. R stands for remote. Remote local state can be changed in objects -menu as well. Position can be changed.	Set
Auto-reclosure	0 1		Possible to enable/disable auto-reclosure localy in local mode (L) or remotely in remote mode (R). Position can be changed.	Set
Measurement display 1 – 6	IL1 – IL3, I0, U12, U23, U31, UL1, UL2, UL3, U0, f, P, Q, S, P.F., CosPhi, E+, Eq+, E-, Eq-, ARStart, ARFail, ARShot1 – 5, IFLT, Starts, Trips, I0Calc, IL1 – IL3da, IL, Pda, Qda, Sda, T, fSYNC, USYNC, IL1 – IL3Min, IL1 – IL3Max, IL1 – IL3daMax, VAI1 – VAI5		Up to 6 freely selectable measurements.	Set
Virtual input 1 – 4	0 1		Change the status of virtual inputs while the password is enabled. Position can be changed.	Set

Set = Settable.

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4.8.2 Local panel configuration

Information displayed on the measurement view is configured in local panel configuration menu.

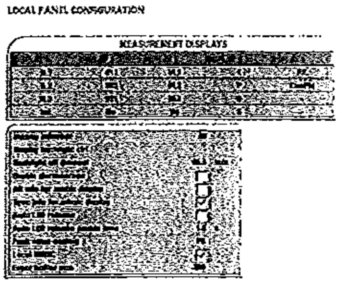

Figure 4.25: Local panel configuration menu.

Table 4.12: Local panel configuration

Parameter	Value	Unit	Description	Set
Display 1 – 5	IL1 – 3, I0, U12, U23, U31, UL1, UL2, UL3, U0, f, P, Q, S, P.F., CosPhi, E+, Eq+, E-, Eq-, ARStart, ARFail, ARShot1 – 5, IFLT, Starts, Trips, I0Calc, IL1-3da, IL, Pda, Qda, Sda, T, fSYNC, USYNC, fL1 – 3, dIL1 – 3		20 (5 x 4) freely configurable measurement values can be selected	Set (*)
Display contrast	50 – 210		Contrast can be changed in the device menu as well.	Set
Display backlight control	DI1 – 16, VI1 – 4, VO1 – 6		Activates the backlight of the display.	Set (*)
Backlight off timeout	0.0 – 2000.0	min	Configurable delay for backlight to turns off when IED is not used. Default value is 60 minutes. When value is zero (0.0) backlight stays on all the time.	Set
Enable alarm screen	Checked Unchecked		Pop-up text box for events. pop-up events can be checked individually by pressing enter, but holding the button for 2 seconds checks all the events at once.	Set
AR info for mimic display	Checked Unchecked		Auto reclosure status visible on top of the local mimic display.	Set

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Parameter	Value	Unit	Description	Set
Sync I info for mimic display	Checked Unchecked		Synchro-check status visible on top of the local mimic display. Operates together with auto-reclosure.	Set
Auto LED release	Checked Unchecked		Enables automatic LED release functionality.	Set
Auto LED release enable time	0.1 – 600	s	Default 1.5 s. When new LED/LEDs is/are latched, previous active latches will be released automatically if the set time has passed.	Set
Fault value scaling	PU, Pri		Fault values per unit or primary scaled.	Set
Local MIMIC	Checked Unchecked		Enable / disable the local mimic (enabled as default).	Set
Event buffer size	50 – 2000		Event buffer size. Default setting is 200 events.	Set

Set = Settable. (*) = Inputs vary according the IED type.

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4.8.3 Function buttons

VAMP 57 has two function buttons F1 & F2 and control buttons for breaker control. See picture below:

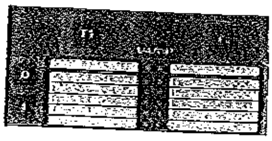

Figure 4.26: Function buttons (1) and Control buttons (2)

There are two independent function keys, F1 and F2, available in the device front panel. As default, these keys are programmed to toggle VI1 and VI2. It is possible to change F1 & F2 to toggle other VI's or to act as object control.

Table 4.13: Parameters of F1, F2

Parameter	Value	Unit	Description	Set
F1 – F2 VI1 – VI4	0		Function key toggles Virtual Input 1 – 4 and Function button 1 – 2 between on (1) and off (0)	Set
ObjCtrl PrgFncs	1		When Object control in chosen F1 and F2 can be linked in OBJECTS to desired objects close/open command.	

Control object (while at least operator level password is enabled and mode is selective)

1. Press I to close object.
   - Press I again to confirm.
   - Press O to cancel
2. Press O to open object
   - Press O again to confirm.
   - Press I to cancel

Control object (while least operator level password is enabled and mode is direct)

- Press I to close object.

- Press O to open object

NOTE: Password usage in breaker control can be disabled in OBJECTS setting.

4.8.4 Setting group control

Setting groups are controlled by using digital inputs or other assigned inputs. When assigned input is not active group 1 is active. When controlled input activates the group 2 is activated as well. See picture below:

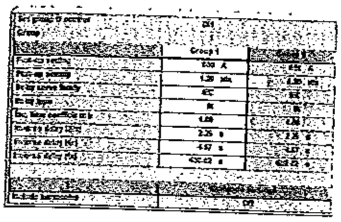

Figure 4.27: Groups are controlled by assigning a input to 'Set group DI control'.

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5 Protection functions

Each protection stage can independently be enabled or disabled according to the requirements of the intended application.

5.1 Maximum number of protection stages in one application

The device limits the maximum number of enabled stages to about 30, depending of the type of the stages.

5.2 General features of protection stages

Setting groups

Most stages have two setting groups. Changing between setting groups can be controlled manually or using any of the digital inputs, virtual inputs, virtual outputs or LED indicator signals. By using virtual I/O the active setting group can be controlled using the local panel display, any communication protocol or using the inbuilt programmable logic functions.

Forcing start or trip condition for testing

The status of a protection stage can be one of the followings:

- **Ok = '-'**
  The stage is idle and is measuring the analog quantity for the protection. No fault detected.
- **Blocked**
  The stage is detecting a fault but blocked by some reason.
- **Start**
  The stage is counting the operation delay.
- **Trip**
  The stage has tripped and the fault is still on.

The blocking reason may be an active signal via the block matrix from other stages, the programmable logic or any digital input. Some stages also have inbuilt blocking logic. For more details about block matrix, see Chapter 4.4.2 Blocking matrix.

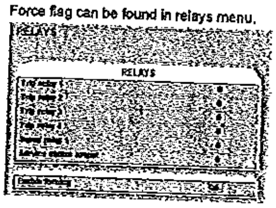
Forcing start or trip condition for testing purposes

There is a "Force flag" parameter which, when activated, allows forcing the status of any protection stage to be "start" or "trip" for a half second. By using this forcing feature any current or voltage injection to the device is not necessary to check the output matrix configuration, to check the wiring from the output relays to the circuit breaker and also to check that communication protocols are correctly transferring event information to a SCADA system.

After testing the force flag will automatically reset 5-minute after the last local panel push button activity.

The force flag also enables forcing of the output relays and forcing the optional mA outputs.

Force flag can be found in relays menu.



Start and trip signals

Every protection stage has two internal binary output signals: start and trip. The start signal is issued when a fault has been detected. The trip signal is issued after the configured operation delay unless the fault disappears before the end of the delay time.

Output matrix

Using the output matrix the user connects the internal start and trip signals to the output relays and indicators. For more details, see Chapter 4.4.1 Output matrix.

Blocking

Any protection function can be blocked with internal and external signals using the block matrix (Chapter 4.4.2 Blocking matrix). Internal signals are for example logic outputs and start and trip signals from other stages and external signals are for example digital and virtual inputs.

Some protection stages have also inbuilt blocking functions. For example under-frequency protection has inbuilt under-voltage blocking to avoid tripping when the voltage is off.

When a protection stage is blocked, it won't pick-up in case of a fault condition is detected. If blocking is activated during the operation delay, the delay counting is frozen until the blocking goes off or the pick-up reason, i.e. the fault condition, disappears. If the stage is already tripping, the blocking has no effect.

Retardation time

Retardation time is the time a protection relay needs to notice, that a fault has been cleared during the operation time delay. This parameter is important when grading the operation time delay settings between relays.

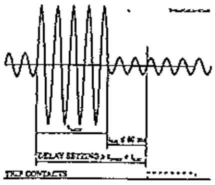


Figure 5.1: Definition for retardation time. If the delay setting would be slightly shorter, an unselective trip might occur (the dash line pulse).

For example when there is a big fault in an outgoing feeder, it might start i.e. pick-up both the incoming and outgoing feeder relay. However the fault must be cleared by the outgoing feeder relay and the incoming feeder relay must not trip. Although the operating delay setting of the incoming feeder is more than at the outgoing feeder, the incoming feeder might still trip, if the operation time difference is not big enough. The difference must be more than the retardation time of the incoming feeder relay plus the operating time of the outgoing feeder circuit breaker.

Figure 5.1 shows an overvoltage fault seen by the incoming feeder, when the outgoing feeder does clear the fault. If the operation delay setting would be slightly shorter or if the fault duration would be slightly longer than in the figure, an unselective trip might happen (the dashed 40 ms pulse in the figure). In VAMP devices the retardation time is less than 50 ms.

Reset time (release time)

Figure 5.2 shows an example of reset time i.e. release delay, when the relay is clearing an overcurrent fault. When the relay's trip contacts are closed the circuit breaker (CB) starts to open. After the CB contacts are open the fault current will still flow through an arc between the opened contacts. The current is finally cut off when the

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arc extinguishes at the next zero crossing of the current. This is the start moment of the reset delay. After the reset delay the trip contacts and start contact are opened unless latching is configured. The precise reset time depends on the fault size; after a big fault the reset time is longer. The reset time also depends on the specific protection stage.

The maximum reset time for each stage is specified in Chapter 10.3 Protection functions. For most stages it is less than 95 ms.

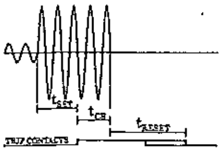

Figure 5.2: Reset time is the time it takes the trip or start relay contacts to open after the fault has been cleared.

Hysteresis or dead band

When comparing a measured value against a pick-up value, some amount of hysteresis is needed to avoid oscillation near equilibrium situation. With zero hysteresis any noise in the measured signal or any noise in the measurement itself would cause unwanted oscillation between fault-on and fault-off situations.

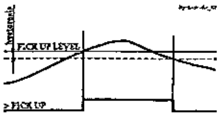

Figure 5.3: Behaviour of a greater than comparator. For example in overvoltage stages the hysteresis (dead band) acts according this figure.

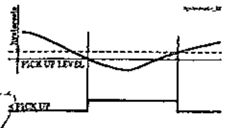

Figure 5.4: Behaviour of a less than comparator. For example in under-voltage and under frequency stages the hysteresis (dead band) acts according this figure.

5.3 Application modes

The application modes available are the feeder protection mode and the motor protection mode. In the feeder protection mode all current dependent protection functions are relative to nominal current In derived by CT ratios. The motor protection functions are unavailable in the feeder protection mode. In the motor protection mode all current dependent protection functions are relative to motor's nominal current Imot. The motor protection mode enables motor protection functions. All functions which are available in the feeder protection mode are also available in the motor protection mode. Default value of the application mode is the feeder protection mode.

The application mode can be changed with VAMPSET software or from CONF menu of the device. Changing the application mode requires configurator password.

5.4 Current protection function dependencies

The current based protection functions are relative to I_{MODE}, which is dependent of the application mode. In the motor, protection mode all of the current based functions are relative to I_{MOT} and in the feeder protection mode to I_N with following exceptions.

I_2> (46), I_2>> (47), I_{ST}> (48), N> (66) are always dependent on I_{MOT} and they are only available when application mode is in the motor protection.

5.5 Overcurrent protection I> (50/51)

Overcurrent protection is used against short circuit faults and heavy overloads.

The overcurrent function measures the fundamental frequency component of the phase currents. The protection is sensitive for the highest of the three phase currents. Whenever this value exceeds the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation delay setting, a trip signal is issued.

Three independent stages

There are three separately adjustable overcurrent stages: I>, I>> and I>>>. The first stage I> can be configured for definite time (DT) or inverse time operation characteristic (IDMT). The stages I>> and I>>> have definite time operation characteristic. By using the definite delay type and setting the delay to its minimum, an instantaneous (ANSI 50) operation is obtained.

Figure 5.5 shows a functional block diagram of the I> overcurrent stage with definite time and inverse time operation time. Figure 5.6 shows a functional block diagram of the I>> and I>>> overcurrent stages with definite time operation delay.

Inverse operation time

Inverse delay means that the operation time depends on the amount the measured current exceeds the pick-up setting. The bigger the fault current is the faster will be the operation. Accomplished inverse delays are available for the I> stage. The inverse delay types are described in Chapter 5.29 Inverse time operation. The device will show the currently used inverse delay curve graph on the local panel display.

Inverse time limitation

The maximum measured secondary current is 50 x I_N. This limits the scope of inverse curves with high pick-up settings. See Chapter 5.29 Inverse time operation for more information.

Cold load and inrush current handling

See Chapter 6.3 Cold load pick-up and magnetising inrush.

Setting groups

There are two settings groups available for each stage. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

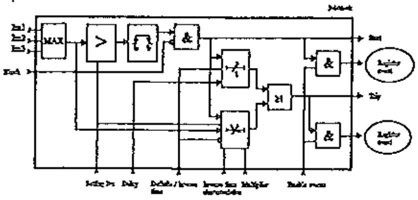

Figure 5.5: Block diagram of the three-phase overcurrent stage I>.

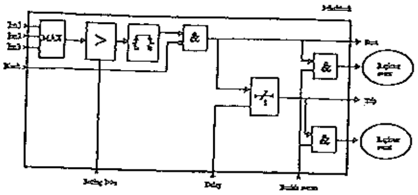

Figure 5.6: Block diagram of the three-phase overcurrent stage I>> and I>>>.

Table 5.1: Parameters of the overcurrent stage I> (50/51)

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
TripTime		s	Estimated time to trip	
SCntr			Cumulative start counter	Clr
TCntr			Cumulative trip counter	Clr
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. This flag is automatically reset 5 minutes after the last front panel push button pressing.	Set
ILmax		A	The supervised value. Max. of IL1, IL2 and IL3	
Status			Current status of the stage	
I>		A	Pick-up value scaled to primary value	
I>		xI_{MODE}	Pick-up setting	Set
Curve			Delay curve family:	Set
	DT		Definite time	
	IEC, IEEE, IEEE2, RI, PrgN		Inverse time. See Chapter 5.29 Inverse time operation.	

Parameter	Value	Unit	Description	Note
Type			Delay type	Set
	DT		Definite time	
	NI, VI, EI, LTI, Parameters		Inverse time. See Chapter 5.29 Inverse time operation.	
t>		s	Definite operation time (for definite time only)	Set
k>			Inverse delay multiplier (for inverse time only)	Set
Dly20x		s	Delay at 20xImode	
Dly4x		s	Delay at 4xImode	
Dly2x		s	Delay at 2xImode	
Dly1x		s	Delay at 1xImode	
IncHarm		On/off	Include Harmonics	
Delay curves			Graphic delay curve picture (only local display)	
A, B, C, D, E			User's constants for standard equations. Type=Parameters. Chapter 5.29 Inverse time operation.	Set
Recorded values	LOG1		Date and time of trip	
	Type		Fault type	
	Flt	xI_{MODE}	Fault current	
	Load	xI_{MODE}	Pre-fault current	
	Edly	%	Elapsed delay time	
	SetGrp		Active set group during fault	

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Table 5.2: Parameters of the overcurrent stages I>>, I>>> (50/51)

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
ILmax		A	The supervised value. Max. of IL1, IL2 and IL3	

Parameter	Value	Unit	Description	Note
I>>, I>>>		A	Pick-up value scaled to primary value	
I>>, I>>>		xI_{MODE}	Pick-up setting	Set
t>>, t>>>		s	Definite operation time.	Set
IncHarm		On/off	Include Harmonics	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There is detailed information available of the eight latest faults: Time stamp, fault type, fault current, load current before the fault, elapsed delay and setting group.

Table 5.3: Recorded values of the overcurrent stages (8 latest faults) I>, I>>, I>>> (50/51)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Type			Fault type
	1-N		Ground fault
	2-N		Ground fault
	3-N		Ground fault
	1-2		Two phase fault
	2-3		Two phase fault
	3-1		Two phase fault
	1-2-3		Three phase fault
Flt		xI_{MODE}	Maximum fault current
Load		xI_{MODE}	1 s average phase currents before the fault
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1, 2		Active setting group during fault

5.5.1 Remote controlled overcurrent scaling

Pick-up setting of the three over current stages can also be controlled remotely. In this case only two scaling coefficients are possible: 100% (the scaling is inactive) and any configured value between 10% - 200% (the scaling is active). When scaling is enabled all settings of group one are copied to group two but the pick-up value of group two is changed according the given value (10-200%).

- This feature can be enabled/disabled via VAMPSET or by using the local panel. When using VAMPSET the scaling can be activated and adjusted in the "protection stage status 2" –menu. When using the local panel similar settings can be found from the "prot" -menu.
- It is also possible to change the scaling factor remotely by using the modbus TCP –protocol. When changing the scaling factor remotely value of 1% is equal to 1. Check the correct modbus address for this application from the VAMPSET or from the communication parameter list.

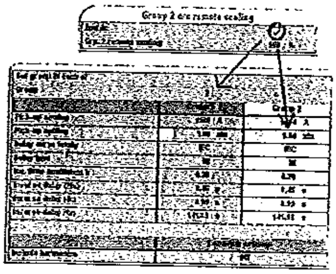

Figure 5.7: Remote scaling example.

In the Figure 5.7 can be seen the affect of remote scaling. After enabling group is changed from group one to group two and all settings from group one are copied to group two. The difference is that group two uses scaled pick-up settings.

NOTE: When remote scaling function is used, it replaces all the settings of group 2. So this function cannot be used simultaneously with normal group change.

5.6 Directional phase overcurrent I_φ> (67)

Directional overcurrent protection can be used for directional short circuit protection. Typical applications are

- Short circuit protection of two parallel cables or overhead lines in a radial network.
- Short circuit protection of a looped network with single feeding point.
- Short circuit protection of a two-way feeder, which usually supplies loads but is used in special cases as an incoming feeder.
- Directional overcurrent protection in low impedance earthed networks. Please note that in this case the device has to connected to line-to-neutral voltages instead of line-to-line voltages. In other words the voltage measurement mode has to be "3LN" (See chapter Chapter 3.8 Voltage measurement modes).

The stages are sensitive to the amplitude of the highest fundamental frequency current of the three measured phase currents.

In phase to phase and in three phase faults, the fault angle is determined by using angles between positive sequence of currents and voltages. In phase to ground faults, the fault angle is determined by using fault phase current and the healthy line to line voltage. For details of power direction, see Chapter 3.9 Direction of power and current.

A typical characteristic is shown in Figure 5.8. The base angle setting is –30°. The stage will pick up, if the tip of the three phase current phasor gets into the grey area.

NOTE: If the maximum possible earth fault current is greater than the used most sensitive directional over current setting, the device has to be connected to the line-to-neutral voltages instead of line-to-line voltages in order to get the right direction for earth faults, too. (For networks having the maximum possible earth fault current less than the over current setting, use 67N, the directional earth fault stages.)

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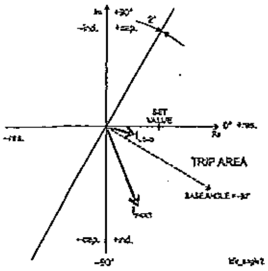

Figure 5.8: Example of protection area of the directional overcurrent function.

Three modes are available: dirctional, non-direct, and directional+back-up (Figure 5.9). In the non-directional mode the stage is acting just like an ordinary overcurrent 50/51 stage.

Directional+back-up mode works the same way as directional mode but it has undirectional back-up protection in case a close-up fault will force all voltages to about zero. After the angle memory hold time, the direction would be lost. Basically the directional+backup mode is required when operation time is set longer than voltage memory setting and no other undirectional back-up protection is in use.

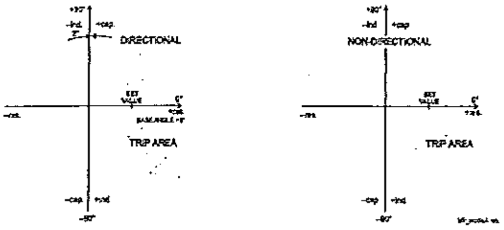

Figure 5.9: Difference between directional mode and non-directional mode. The grey area is the trip region.

An example of bi-directional operation characteristic is shown in Figure 5.10. The right side stage in this example is the stage I_φ> and the left side is I_φ>>. The base angle setting of the I_φ> is 0° and the base angle of I_φ>> is set to –180°.

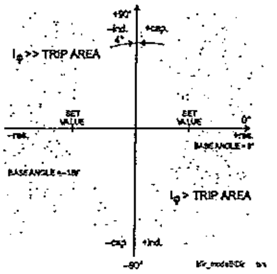

Figure 5.10: Bi-directional application with two stages I_φ> and I_φ>>.

When any of the three phase currents exceeds the setting value and – in directional mode – the phase angle including the base angle is within the active ±88° wide sector, the stage picks up and issues a start signal. If this fault situation remains on longer than the delay setting, a trip signal is issued.

Four independent stages

There are four separately adjustable stages available: I_φ>, I_φ>>, I_φ>>> and I_φ>>>>.

Inverse operation time

Stages I_φ> and I_φ>> can be configured for definite time or inverse time characteristic. See Chapter 5.29 Inverse time operation for details of the available inverse delays. Stages I_φ>>> and I_φ>>>> have definite time (DT) operation delay. The device will show a scaleable graph of the configured delay on the local panel display.

Inverse time limitation

The maximum measured secondary current is 50 x I_N. This limits the scope of inverse curves with high pick-up settings. See Chapter 5.29 Inverse time operation for more information.

Cold load and inrush current handling

See Chapter 6.3 Cold load pick-up and magnetising inrush

Setting groups

There are two settings groups available for each stage. Switching between setting groups can be controlled by digital inputs, virtual inputs (mimic display, communication, logic) and manually.

Table 5.4: Parameters of the directional overcurrent stages I_φ>, I_φ>> (67)

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
TripTime		s	Estimated time to trip	
SCntr			Cumulative start counter	Clr
TCntr			Cumulative trip counter	Clr
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
ILmax		A	The supervised value. Max. of IL1, IL2 and IL3	-
Iφ>, Iφ>>		A	Pick-up value scaled to primary value	
Iφ>, Iφ>>		xImode	Pick-up setting	Set
Curve			Delay curve family:	Set
	DT		Definite time	
	IEC, IEEE, IEEE2, RI, PrgN		Inverse time. See Chapter 5.29 Inverse time operation.	
Type			Delay type	Set
	DT		Definite time	
	NI, VI, EI, LTI, Parameters		Inverse time. See Chapter 5.29 Inverse time operation.	
t>		s	Definite operation time (for definite time only)	Set
k>			Inverse delay multiplier (for inverse time only)	Set
Dly20x		s	Delay at 20xImode	
Dly4x		s	Delay at 4xImode	
Dly2x		s	Delay at 2xImode	
Dly1x		s	Delay at 1xImode	

Parameter	Value	Unit	Description	Note
Mode	Dir Undir Dir+back-up		Directional mode (67) Undirectional (50/51) Directional and undirectional back-up	Set
Offset		°	Angle offset in degrees	Set
U/I angle		°	Measured U_1/I_1 angle	
U1		% Un	Measured positive sequence voltage	
A, B, C, D, E			User's constants for standard equations. Type=Parameters. See Chapter 5.29 Inverse time operation.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Table 5.5: Parameters of the directional overcurrent stages I_φ>>>, I_φ>>>> (67)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SgrpDI			Digital signal to select the active setting group	Set
	-		None	
	Dix		Digital input	
	Vix		Virtual input	
	LEDx		LED indicator signal	
	Vox		Virtual output	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
ILmax		A	The supervised value. Max. of IL1, IL2 and IL3	
Iφ>>>, Iφ>>>>		A	Pick-up value scaled to primary value	
Iφ>>>, Iφ>>>>		xImode	Pick-up setting	Set
t>>> t>>>>		s	Definite operation time (for definite time only)	Set
Mode	Dir Undir Dir+back-up		Directional (67) Undirectional (50/51) Directional and undirectional back-up	Set
Offset		°	Angle offset in degrees	Set
UI angle		°	Measured U_1/I_1 angle	
U1		% Un	Measured positive sequence voltage	

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There are detailed information available of the eight latest faults: Time stamp, fault type, fault current, load current before the fault, elapsed delay and setting group.

Table 5.6: Recorded values of the directional overcurrent stages (8 latest faults) I_φ>, I_φ>>, I_φ>>>, I_φ>>>> (67)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Type			Fault type
	1-N		Ground fault
	2-N		Ground fault
	3-N		Ground fault
	1-2		Two phase fault
	2-3		Two phase fault
	3-1		Two phase fault
	1-2-3		Three phase fault
	1-2-N		Two phase fault with earth contact
	2-3-N		Two phase fault with earth contact
	3-1-N		Two phase fault with earth contact
	1-2-3-N		Three phase fault with earth contact
Flt		xIn	Maximum fault current
Load		xIn	1 s average phase currents before the fault
EDly		%	Elapsed time of the operating time setting. 100% = trip
Angle		°	Fault angle in degrees
U1		xUn	Positive sequence voltage during fault
SetGrp	1, 2		Active setting group during fault
Direction mode			Dir, undir, dir+back-up

5.7

Current unbalance stage I_2/I_1> (46) in feeder mode

The purpose of the unbalance stage is to detect unbalanced load conditions, for example a broken conductor of a heavy loaded overhead line in case there is no earth fault. The operation of the unbalanced load function is based on the negative phase sequence component I_2 related to the positive phase sequence component I_1. This is calculated from the phase currents using the method of symmetrical components. The function requires that the measuring inputs are connected correctly so that the rotation direction of the phase currents are as in Chapter 9.7 Connection examples. The unbalance protection has definite time operation characteristic.

$$K2=\frac{I_2}{I_1}$$

$$I_1 = I_{L1} + aI_{L2} + a^2I_{L3}$$

$$I_2 = I_{L1} + a^2I_{L2} + aI_{L3}$$

$$\underline{a}=1\angle 120^\circ=-\frac{1}{2}+j\frac{\sqrt{3}}{2}$$, a phasor rotating constant

Table 5.7: Setting parameters of the current unbalanced stageI_2/I_1> (46) in feeder mode

Parameter	Value	Unit	Default	Description
I2/I1>	2 – 70	%	20	Setting value, I2/I1
t>	1.0 – 600.0	s	10.0	Definite operating time
Type	DT INV	-	DT	The selection of time characteristics
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Table 5.8: Measured and recorded values of of the current unbalanced stageI_2/I_1> (46) in feeder mode

	Parameter	Value	Unit	Description
Measured value	I2/I1		%	Relative negative sequence component
Recorded values	SCntr			Cumulative start counter
	TCntr			Cumulative start counter
	Flt		%	Maximum I_2/I_1 fault component
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

5.8

Current unbalance stage I_2> (46) in motor mode

Current unbalance in a motor causes double frequency currents in the rotor. This warms up the surface of the rotor and the available thermal capacity of the rotor is much less than the thermal capacity of the whole motor. Thus an rms current based overload protection (see Chapter 5.18 Thermal overload protection T> (49)) is not capable to protect a motor against current unbalance.

The current unbalance protection is based on the negative sequence of the base frequency phase currents. Both definite time and inverse time characteristics are available.

Inverse delay

The inverse delay is based on the following equation.

Equation 5.1:

$$T=\frac{K_1}{\left(\frac{I_2}{I_{MOT}}\right)^2-K_2^2}$$

T = Operation time

K_1 = Delay multiplier

I_2 = Measured and calculated negative sequence phase current of fundamental frequency.

I_{MOT} = Nominal current of the motor

K_2 = Pick-up setting I_2> in pu. The maximum allowed degree of unbalance.

Example:

K_1 = 15 s

I_2 = 22.9 % = 0.229 x I_{MOT}

K_2 = 5 % = 0.05 x I_{MOT}

$$t=\frac{15}{\left(\frac{0.229}{1}\right)^2-0.05^2}=300.4$$

The operation time in this example will be five minutes.

More stages (definite time delay only)

If more than one definite time delay stages are needed for current unbalance protection, the freely programmable stages can be used (Chapter 5.28 Programmable stages (99)).

Setting groups

There are two settings groups available. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

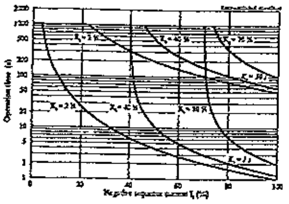

Figure 5.11: Inverse operation delay of current unbalance stage I_2>. The longest delay is limited to 1000 seconds (=16min 40s).

Table 5.9: Parameters of the current unbalance stage I_2> (46) in motor mode

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
I2/Imot		% Imot	The supervised value.	
I2>		% Imot	Pick-up setting	Set
t>		s	Definite operation time (Type=DT)	Set
Type	DT		Definite time	Set
	INV		Inverse time (Equation 5.1)	
K1		s	Delay multiplier (Type =INV)	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There is detailed information available of the eight latest faults: Time stamp, unbalance current, elapsed delay and setting group.

Table 5.10: Recorded values of the current unbalance stage (8 latest faults) I_2> (46) in motor mode

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		% Imot	Maximum unbalance current
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1		Active setting group during the fault
	2		

5.9 Phase reversal/incorrect phase sequence protection I_2>> (47)

The phase sequence stage prevents the motor from being started in to wrong direction, thus protecting the load.

When the ratio between negative and positive sequence current exceeds 80% and the average of three phase currents exceeds 0.2 x I_{MOT} in the start-up situation, the phase sequence stage starts and trips after 100 ms after start-up.

Table 5.11: Parameters of the incorrect phase sequence stage I_2>> (47)

	Parameter	Value/unit	Description
Measured value	I2/I1	%	Neg. phase seq. current/pos. phase seq. current
Recorded values	SCntr		Start counter (Start) reading
	TCntr		Trip counter (Trip) reading
	Flt	%	Max. value of fault current
	EDly	%	Elapsed time as compared to the set operate time, 100% = tripping

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5.10 Stall protection I_{ST}> (48)

The stall protection unit I_{ST}> measures the fundamental frequency component of the phase currents.

Stage I_{st}> can be configured for definite time or inverse time operation characteristic.

The stall protection stage protects the motor against prolonged direct-on-line (DOL) starts caused by e.g. a stalled rotor, too high inertia of the load or too low voltage. This function is sensitive to the fundamental frequency component of the phase currents.

The I_{ST}> stage can be configured for definite operation time or inverse time operation characteristic. For a weak voltage supply the inverse characteristics is useful allowing more start time when a voltage drop decreases the start current and increases the start time. Equation 5.2 defines the inverse operation time. Figure 5.13 shows an example of the inverse characteristics.

Equation 5.2:

$$T = \left(\frac{I_{start}}{I_{meas}}\right)^2 T_{start}$$

T = Inverse operation time.

I_{START} = Rated start current of the motor "Nom motor start current" I_{MOTST}. The default setting is 6.00xI_{MOT}.

I_{MEAS} = Measured current

T_{START} = Maximum allowed start time "Inv. time coefficient" k> for the motor at rated voltage.

The pick-up setting "Motor start detection current" I_{ST}> is the start detection level of the start current. While the current has been less than 10% of Imot and then within 200 milliseconds exceeds the setting I_{ST}>, the stall protection stage starts to count the operation time T_{START}. When current drops below 120 % x I_{MOT} the stall protection stage releases. Stall protection is active only during the starting of the motor.

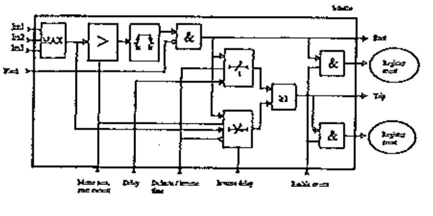


Figure 5.12: Block diagram of the stall protection stage I_{ST}>.

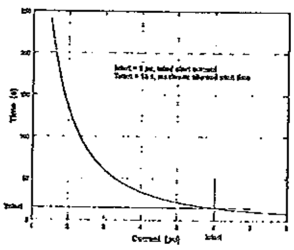


Figure 5.13: Example of an inverse operation time delay of the stall protection stage. If the measured current is less than the specified start current I_{START} the operation time will be longer than the specified start time T_{START} and vice versa.

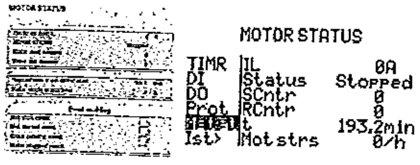
Table 5.12: Parameters of the stall protection stage I_{ST}> (48)

	Parameter	Value/unit	Description
Status	Status		Status of the stage
	SCntr		Cumulative start counter
	TCntr		Cumulative trip counter
	Force	ON/Off	Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. This flag is automatically reset 5 minutes after the last front panel push button pressing.
Parameters	IL	A	Phase current IL, not settable
	Status		Status of stage
	Ist>	A	Motor start detection current scaled to primary value, calculated by relay
	Ist>	xImot	Motor start detection current. Must be less than initial motor starting current.
	ImotSt	A	Nominal motor starting current scaled to primary value, calculated by relay
	ImotSt	xImot	Nominal motor starting current
	Type	DT	Operation charact./ definite time
		Inv	Operation charact./ inverse time
	t>	S	Operation time [s]
	tInv>	S	Time multiplier at inverse time
Recorded values	Log		Start and trip time
	Flt	xImot	Maximum fault current.
	EDly	%	Elapsed time of the operating time setting. 100% = trip

5.10.1 Motor status

There are three possible status for a motor: stopped, starting or running.

- Motor stopped: Motor average current is less than 10% of the motor nominal current.
- Motor starting: To reach the starting position motor has to be stopped for least 500ms before starting. Motor average current has to increase above the motor start detection current (setting value) within 200ms. Motor will remain starting as long as the terms for turning into running condition are not filled.
- Motor running: Motor is able to turn into a running position from both stopped and starting position. Low limit for motor running is 20% of the motors nominal and the high limit for motor running is 120% of the motors nominal current.



```
MOTOR STATUS
TIMR |IL           0A
DI   |Status  Stopped
DO   |SCntr        0
Prot |RCntr        0
     |t      193.2min
Ist> |Mot strs   0/h
```

Figure 5.14: Motor status via VAMPSET and local panel.

The status of the motor can be viewed via VAMPSET -software or by looking from the local panel of the relay (Mstat). Statuses Starting and running can be found from the output –and block matrix. Therefore it is possible to use these signals for tripping or indication and for blocking purposes.

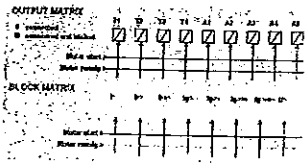


Figure 5.15: Motor status in output –and block matrix.

Softstart

Frequency converter drives and soft starter applications will not initiate motor start signal due to the low current while starting motor. Motor will change directly from stopped to running position when the current increases into a certain level.

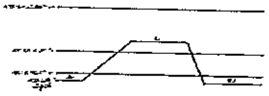


Figure 5.16: The terms of soft start.

Normal starting sequence

As a default for the motor start detection, relay uses value of 6 times motor nominal. This value is editable.

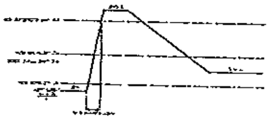


Figure 5.17: The terms of normal starting sequence.

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5.11 Frequent start protection N> (66)

The simplest way to start an asynchronous motor is just to switch the stator windings to the supply voltages. However every such start will heat up the motor considerably because the initial currents are significantly above the rated current.

If the motor manufacturer has defined the maximum number of starts within an hour or/and the minimum time between two consecutive starts this stage is easy to apply to prevent too frequent starts.

When current has been less than 10% of the motor nominal current and then exceeds the value Motor start detection current of I_{ST}> (Stall protection stage), situation is recognized as a motor start. After the recognition of the motor start if current drops to a less than 10 % of the motor nominal current, stage considers motor to be stopped.

Frequent start protection stage will provide N> alarm signal when the second last start has been done and remains active until the maximum amount of motor starts are reached or one hour of time is passed.

The N> motor start inhibit signal activates after starting the motor and remains active a period of time that is defined for parameter Min time between motor starts. After the given time has passed, inhibit signal returns to inactive state.

When start counter of stage reaches the value defined for Max. motor starts/hour, N> motor start inhibit signal activates and remains active until one hour has passed.

Frequent start protection stage correlation to output contacts is defined in output matrix menu. See Chapter 4.4.1 Output matrix. Figure 5.18 shows an application.

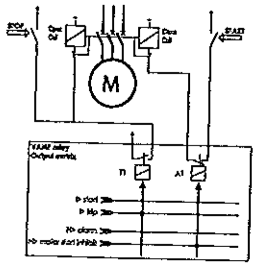

Figure 5.18: Application for preventing too frequent starting using the N> stage. The signal relay A1 has been configured to normal closed (NC) in device "relays" menu and is controlled by N> motor start inhibit signal. Whenever N> motor start inhibit signal becomes active, it prevents circuit breaker to be closed.

Table 5.13: Parameters of the frequent start protection N> (66)

	Parameter	Value/unit	Description
Measured value	Status	Disabled/ Enabled	Stage status
	SCntr		Start counter
	Mot strs		Motor starts in last hour
	T	Min	Elapsed time from motor start
	Force	On / Off	Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. This flag is automatically reset 5 minutes after the last front panel push button pressing
Setting values	Mot strs		Max. starts in one hour
	t	Min	Elapsed time from motor start
	Status		Stage status
	SCntr		Start counter
	Sts/h		Max. motor start per hour
	Interval	Min	Min. Interval between two consecutive starts
Recorded values	LOG1		Date and time of trip
	N.st / h		Motor starts / hour
	TimeFromSt		Elapsed time from motor start
	Tot Mot Strs		Number of total motor starts
	Type		Fault type
Event Enabling	Alr_on		Alarm on event
	Alr_off		Alarm off Event
	MoStrt_dis		Motor start disabled
	MotStrt_En		Motor start enabled

5.12 Undercurrent protection I< (37)

The undercurrent unit measures the fundamental frequency component of the phase currents.

The stage I< can be configured for definite time characteristic.

The undercurrent stage is protecting rather the device driven by the motor e.g. a submersible pump, than the motor itself.

Table 5.14: Parameters of the undercurrent stage I< (37)

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
SCntr			Start counter (Start) reading	C
TCntr			Trip counter (Trip) reading	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
ILmin		A	Min. value of phase currents IL1, IL2, IL3 in primary value	
Status			Status of protection stage	
I<		A	Start detection current scaled to primary value, calculated by relay	
I<		% Imode	Setting value in percentage of Imode	
t<		s	Operation time delay [s]	
NoCmp		% Imode	Block limit	
NoCmp		60A	Block limit scaled to primary value, calculated by relay	
Log			Start and trip time	
Type	1-N, 2-N, 3-N		Fault type/single-phase fault e.g.: 1-N = fault on phase L1	
	1-2, 2-3, 1-3		Fault type/two-phase fault e.g.: 2-3 = fault between L2 and L3	
	1-2-3		Fault type/three-phase fault	
Flt		x Imode	Min. value of fault current as per times Imot	
Load		x Imode	1s mean value of pre-fault currents IL1—IL3	
EDly		%	Elapsed time as compared to the set operate time, 100% = tripping	

5.13 Directional earth fault protection $I_{0\varphi}$> (67N)

The directional earth fault protection is used for earth faults in networks or motors where a selective and sensitive earth fault protection is needed and in applications with varying network structure and length.

The device consists of versatile protection functions for earth fault protection in various network types.

The function is sensitive to the fundamental frequency component of the residual current and zero sequence voltage and the phase angle between them. The attenuation of the third harmonic is more than 60 dB. Whenever the size of I_0 and U_0 and the phase angle between I_0 and U_0 fulfils the pick-up criteria, the stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation time delay setting, a trip signal is issued.

Polarization

The negative zero sequence voltage U_0 is used for polarization i.e. the angle reference for I_0. The U_0 voltage is measured via energizing input U_0 or it is calculated from the phase voltages internally depending on the selected voltage measurement mode (see Chapter 3.8 Voltage measurement modes):

- 3LN/LL$_Y$ and 3LN/LN$_Y$: the zero sequence voltage is calculated from the phase voltages and therefore any separate zero sequence voltage transformers are not needed. The setting values are relative to the configured voltage transformer (VT) voltage/$\sqrt{3}$.
- 3LN+U_0, 2LL+U_0, 2LL+U_0+LLy, 2LL+U_0+LNy, LL+U_0+LLy+LLz, and LN+U_0+LNy+LNz: the zero sequence voltage is measured with voltage transformer(s) for example using a broken delta connection. The setting values are relative to the VT_0 secondary voltage defined in configuration.

Modes for different network types

The available modes are:

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- ResCap
  This mode consists of two sub modes, Res and Cap. A digital signal can be used to dynamically switch between these two sub modes. This feature can be used with compensated networks, when the Petersen coil is temporarily switched off.
  - Res
    The stage is sensitive to the resistive component of the selected I_0 signal. This mode is used with compensated networks (resonant grounding) and networks earthed with a high resistance. Compensation is usually done with a Petersen coil between the neutral point of the main transformer and earth. In this context "high resistance" means, that the fault current is limited to be less than the rated phase current. The trip area is a half plane as drawn in Figure 5.20. The base angle is usually set to zero degrees.
  - Cap
    The stage is sensitive to the capacitive component of the selected I_0 signal. This mode is used with unearthed networks. The trip area is a half plane as drawn in Figure 5.20. The base angle is usually set to zero degrees.
- Sector
  This mode is used with networks earthed with a small resistance. In this context "small" means, that a fault current may be more than the rated phase currents. The trip area has a shape of a sector as drawn in Figure 5.21. The base angle is usually set to zero degrees or slightly on the lagging inductive side (i.e. negative angle).
- Undir
  This mode makes the stage equal to the undirectional stage I_0>. The phase angle and U_0 amplitude setting are discarded. Only the amplitude of the selected I_0 input is supervised.

Input signal selection

Each stage can be connected to supervise any of the following inputs and signals:

- Input I_0 for all networks other than rigidly earthed.
- Calculated signal I_{0Calc} for rigidly and low impedance earthed networks. $I_{0Calc} = I_{L1} + I_{L2} + I_{L3} = 3I_0$.

Intermittent earth fault detection

Short earth faults make the protection to start (to pick up), but will not cause a trip. (Here a short fault means one cycle or more. For shorter than 1 ms transient type of intermittent earth faults in compensated networks there is a dedicated stage I_{0INT}> 67NI.) When starting happens often enough, such intermittent faults can be cleared using the intermittent time setting.

When a new start happens within the set intermittent time, the operation delay counter is not cleared between adjacent faults and finally the stage will trip.

Two independent stages

There are two separately adjustable stages: $I_{0\varphi}$> and $I_{0\varphi}$>>. Both the stages can be configured for definite time delay (DT) or inverse time delay operation time.

Inverse operation time

Inverse delay means that the operation time depends on the amount the measured current exceeds the pick-up setting. The bigger the fault current is the faster will be the operation. Accomplished inverse delays are available for both stages $I_{0\varphi}$> and $I_{0\varphi}$>>. The inverse delay types are described in Chapter 5.29 Inverse time operation. The device will show a scaleable graph of the configured delay on the local panel display.

Inverse time limitation

The maximum measured secondary residual current is 10 x I_{0N} and maximum measured phase current is 50 x I_N. This limits the scope of inverse curves with high pick-up settings. See Chapter 5.29 Inverse time operation for more information.

Setting groups

There are two settings groups available for each stage. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

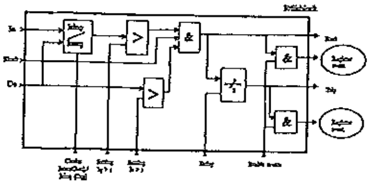

Figure 5.19: Block diagram of the directional earth fault stages $I_{0\varphi}$> and $I_{0\varphi}$>>

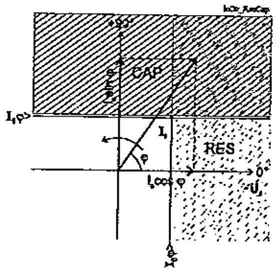

Figure 5.20: Operation characteristic of the directional earth fault protection in Res or Cap mode. Res mode can be used with compensated networks and Cap mode is used with ungrounded networks.

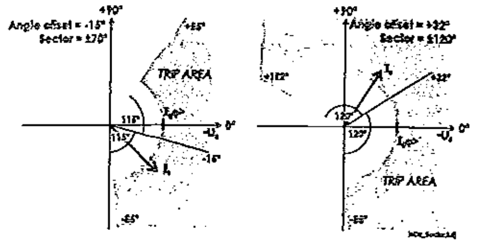

Figure 5.21: Two example of operation characteristics of the directional earth fault stages in sector mode. The drawn I0 phasor in both figures is inside the trip area. The angle offset and half sector size are user's parameters.

Table 5.15: Parameters of the directional earth fault stages $I_{0\varphi}$>, $I_{0\varphi}$>> (67N)

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
TripTime		s	Estimated time to trip	
SCntr			Cumulative start counter	Clr
TCntr			Cumulative trip counter	Clr
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Io IoCalc IoPeak		pu	The supervised value according the parameter "input" below. ($I_{0\varphi}$> only)	
IoRes		pu	Resistive part of I_0 (only when "InUse"=Res)	
IoCap		pu	Capacitive part of I_0 (only when "InUse"=Cap)	
Ioφ>		A	Pick-up value scaled to primary value	

Parameter	Value	Unit	Description	Note
Ioφ>		pu	Pick-up setting relative to the parameter "Input" and the corresponding CT value	Set
Uo>		%	Pick-up setting for U_0	Set
Uo		%	Measured U_0	
Curve			Delay curve family:	Set
	DT		Definite time	
	IEC, IEEE, IEEE2, RI, PrgN		Inverse time. Chapter 5.29 Inverse time operation.	
Type			Delay type.	Set
	DT		Definite time	
	NI, VI, EI, LTI, Parameters		Inverse time. Chapter 5.29 Inverse time operation.	
t>		s	Definite operation time (for definite time only)	Set
k>			Inverse delay multiplier (for inverse time only)	Set
Mode	ResCap		High impedance earthed nets	Set
	Sector		Low impedance earthed nets	
	Undir		Undirectional mode	
Offset		°	Angle offset (MTA) for ResCap and Sector modes	Set
Sector	Default = 88	±°	Half sector size of the trip area on both sides of the offset angle	Set
ChCtrl			Res/Cap control in mode ResCap	Set
	Res		Fixed to Resistive characteristic	
	Cap		Fixed to Capacitive characteristic	
	DIx		Controlled by digital input	
	VIx		Controlled by virtual input	
InUse			Selected submode in mode ResCap.	
	-		Mode is not ResCap	
	Res		Submode = resistive	
	Cap		Submode = capacitive	
Input	Io		X1:7, 8, 9. See Chapter 9 Connections.	Set
	IoCalc		IL1 + IL2 + IL3	
	IoPeak		X1:7, 8, 9 peak mode ($I_{0\varphi}$> only)	
Intrmt		s	Intermittent time	Set
Dly20x		s	Delay at 20xI_{0N}	
Dly4x		s	Delay at 4xI_{0N}	
Dly2x		s	Delay at 2xI_{0N}	
Dly1x		s	Delay at 1xI_{0N}	
A, B, C, D, E			User's constants for standard equations. Type=Parameters. See Chapter 5.29 Inverse time operation.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There is detailed information available of the eight latest earth faults: Time stamp, fault current, elapsed delay and setting group.

Table 5.16: Recorded values of the directional earth fault stages (8 latest faults) $I_{0\varphi}$>, $I_{0\varphi}$>> (67N)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		pu	Maximum earth fault current Resistive part of I_0 (only when "InUse"=Res) Capacitive part of I_0 (only when "InUse"=Cap)
EDly		%	Elapsed time of the operating time setting. 100% = trip
Angle	°		Fault angle of I_0 $-U_0$ = 0°
Uo		%	Max. U_0 voltage during the fault
SetGrp	1, 2		Active setting group during fault

5.14 Earth fault protection I_0> (50N/51N)

The undirectional earth fault protection is to detect earth faults in low impedance earthed networks. In high impedance earthed networks, compensated networks and isolated networks undirectional earth fault can be used as back-up protection.

The undirectional earth fault function is sensitive to the fundamental frequency component of the residual current $3I_0$. The attenuation of the third harmonic is more than 60 dB. Whenever this fundamental value exceeds the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation time delay setting, a trip signal is issued.

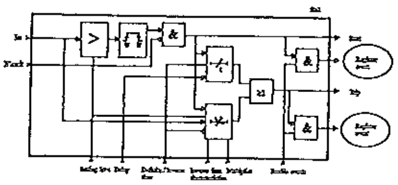

Figure 5.22: Block diagram of the earth fault stage I_0>

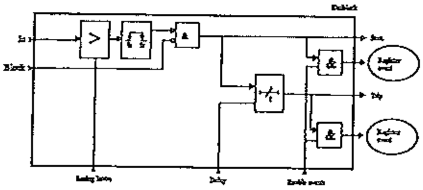

Figure 5.23: Block diagram of the earth fault stages I_0>>, I_0>>> and I_0>>>>

Figure 5.22 shows a functional block diagram of the I_0> earth overcurrent stage with definite time and inverse time operation time. Figure 5.23 shows a functional block diagram of the I_0>>, I_0>>> and I_0>>>> earth fault steges with definite time operation delay.

Input signal selection

Each stage can be connected to supervise any of the following inputs and signals:

- Input I_0 for all networks other than rigidly earthed.
- Calculated signal I_{0Calc} for rigidly and low impedance earthed networks. $I_{0Calc} = I_{L1} + I_{L2} + I_{L3}$.

Intermittent earth fault detection

Short earth faults make the protection to start (to pick up), but will not cause a trip. (Here a short fault means one cycle or more. For shorter than 1 ms transient type of intermittent earth faults in compensated networks there is a dedicated stage I_{0INT}> 67NI.) When starting happens often enough, such intermittent faults can be cleared using the intermittent time setting.

When a new start happens within the set intermittent time, the operation delay counter is not cleared between adjacent faults and finally the stage will trip.

Four or six independent undirectional earth fault overcurrent stages

There are four separately adjustable earth fault stages: I_0>, I_0>>, I_0>>>, and I_0>>>>. The first stage I_0> can be configured for definite time (DT) or inverse time operation characteristic (IDMT). The other stages have definite time operation characteristic. By using the definite delay type and setting the delay to its minimum, an instantaneous (ANSI 50N) operation is obtained.

Using the directional earth fault stages (Chapter 5.13 Directional earth fault protection $I_{0\varphi}$> (67N)) in undirectional mode, two more stages with inverse operation time delay are available for undirectional earth fault protection.

Inverse operation time (I_0> stage only)

Inverse delay means that the operation time depends on the amount the measured current exceeds the pick-up setting. The bigger the fault current is the faster will be the operation. Accomplished inverse delays are available for the I_0> stage. The inverse delay types are described in Chapter 5.29 Inverse time operation. The device will show a scaleable graph of the configured delay on the local panel display.

Inverse time limitation

The maximum measured secondary residual current is 10 x I_{0N} and maximum measured phase current is 50 x I_N. This limits the scope of inverse curves with high pick-up settings. See Chapter 5.29 Inverse time operation for more information.

Setting groups

There are two settings groups available for each stage. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

Table 5.17: Parameters of the undirectional earth fault stage I_0> (50N/51N)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
TripTime		s	Estimated time to trip	
SCntr			Cumulative start counter	Clr
TCntr			Cumulative trip counter	Clr
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Io, IoCalc, IoPeak		pu	The supervised value according the parameter "input" below.	
Io>		A	Pick-up value scaled to primary value	
Io>		pu	Pick-up setting relative to the parameter "input" and the corresponding CT value	Set
Curve	 DT IEC, IEEE, IEEE2, RI, PrgN		Delay curve family: Definite time Inverse time. Chapter 5.29 Inverse time operation.	Set
Type	 DT NI, VI, EI, LTI, Parameters		Delay type. Definite time Inverse time. Chapter 5.29 Inverse time operation.	Set
t>		s	Definite operation time (for definite time only)	Set
k>			Inverse delay multiplier (for inverse time only)	Set
Input	Io		X1:7, 8, 9. See Chapter 9 Connections.	Set
	IoCalc		IL1 + IL2 + IL3	
	IoPeak		X1:7, 8, 9. peak mode ($I_{0\varphi}$> only).	
Intrmt		s	Intermittent time	Set

Parameter	Value	Unit	Description	Note
Dly20x		s	Delay at 20 x I_{0N}	
Dly4x		s	Delay at 4 x I_{0N}	
Dly2x	-	s	Delay at 2 x I_{0N}	
Dly1x			Delay at 1 x I_{0N}	
A, B, C, D, E			User's constants for standard equations. Type=Parameters. See Chapter 5.29 Inverse time operation.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Table 5.18: Parameters of the undirectional earth fault stage I_0>>, I_0>>>, I_0>>>> (50N/51N)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
TripTime		s	Estimated time to trip	
SCntr			Cumulative start counter	Clr
TCntr			Cumulative trip counter	Clr
SetGrp	1 or 2		Active setting group	Set
SgrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Io IoCalc		pu	The supervised value according the parameter "input" below.	
Io>>, Io>>>, Io>>>>		A	Pick-up value scaled to primary value	
Io>>, Io>>>, Io>>>>		pu	Pick-up setting relative to the parameter "input" and the corresponding CT value	Set
t>		s	Definite operation time (for definite time only)	Set
Input	Io		X1:7, 8, 9. See Chapter 9 Connections.	Set
	IoCalc		IL1 + IL2 + IL3	

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There is detailed information available of the eight latest earth faults: Time stamp, fault current, elapsed delay and setting group.

Table 5.19: Recorded values of the undirectional earth fault stages (8 latest faults) I_0>, I_0>>, I_0>>>, I_0>>>> (50N/51N)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		pu	Maximum earth fault current
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1, 2		Active setting group during fault

5.14.1 Earth fault faulty phase detection algorithm

Phase recognition:

A zero sequence overcurrent has been detected.

Faulted phase/ phases are detected in 2 stage system.

1. Algorithm is using delta principle to detect the faulty phase/ phases.
2. Algorithm confirms the faulty phase with neutral current angle comparison to the suspected faulted phase.

Ideal grounded network:

When there is forward earth fault in phase L1, its current will increase creating calculated or measured zero sequence current in phase angle of 0 degrees. If there is reverse earth fault in phase L1, its current will degrease creating calculated or measured zero sequence current in phase angle of 180 degrees.

When there is forward earth fault in phase L2, its current will increase creating calculated or measured zero sequence current in phase angle of -120 degrees. If there is reverse earth fault in phase L2, its current will degrease creating calculated or measured zero sequence current in phase angle of 60 degrees.

When there is forward earth fault in phase L3, its current will increase creating calculated or measured zero sequence current in phase angle of 120 degrees. If there is reverse earth fault in phase L3 its current will degrease creating calculated or measured zero sequence current in phase angle of -60 degrees.

Implementation:

When faulty phase is recognized, it will be recorded in 50N protection fault log (also in event list and alarm screen). This faulted phase and direction recording function has a tick box for enabling/disabling in protection stage settings. For compensated network, this is not a 100% reliable algorithm because it depends on the network compensation degree. So for compensated networks this feature can be turned off so it will not cause confusion. For high impedance earthed networks, there will be drop down menu in both setting groups to choose between RES/CAP. RES is default and it is for earthed networks. When CAP is chosen, the Io angle will be corrected to inductive direction 90 degrees and after that faulty phase detection is made.

Possible outcomes and conditions for those detections:

- FWD L1
  Phase L1 increases above the set limit and two other phases remain inside the set (delta) limit. Io current angle is +/- 60 degrees from L1 phase angle.
- FDW L2
  Phase L2 increases above the set limit and two other phases remain inside the set (delta) limit. Io current angle is +/- 60 degrees from L2 phase angle.
- FDW L3
  Phase L3 increases above the set limit and two other phases remain inside the set (delta) limit. Io current angle is +/- 60 degrees from L3 phase angle.
- FWD L1-L2
  Phase L1 and L2 increase above the set limit and phase L3 remains inside the set (delta) limit. Io current angle is between L1 and L2 phase angles.
- FWD L2-L3
  Phase L2 and L3 increase above the set limit and phase L1 remains inside the set (delta) limit. Io current angle is between L2 and L3 phase angles.
- FWD L3-L1
  Phase L3 and L1 increase above the set limit and phase L2 remains inside the set (delta) limit. Io current angle is between L3 and L3 phase angles.
- FWD L1-L2-L3
  All three phase currents increase above the set delta limit.
- REV 1 (any one phase)
  One phase decreases below the set delta limit and other two phases remain inside the delta limit.
- REV 2 (any two phase)
  Two phases decrease below the set delta limit and third phase remains inside the delta limit.
- REV 3 (all three phases)
  All three phase currents decrease below the set delta limit.

Below are simulated different fault scenarios:

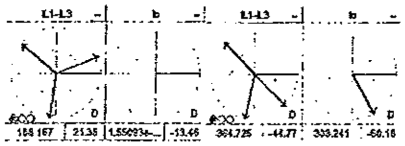

Figure 5.24: Phase L1 forward

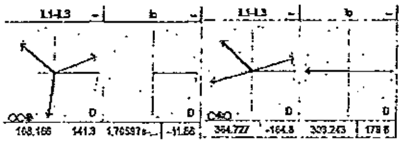

Figure 5.25: Phase L2 forward

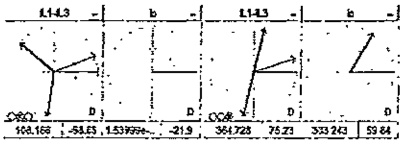

Figure 5.26: Phase L3 forward

5.15 Intermittent transient earth fault protection I_{0INT}> (67NI)

NOTE: Voltage measurement mode contains direct U_0 measurement.

The directional intermittent transient earth fault protection is used to detect short intermittent transient faults in compensated cable networks. The transient faults are self extinguished at some zero crossing of the transient part of the fault current I_{Fault} and the fault duration is typically only 0.1 ms – 1 ms. Such short intermittent faults can not be correctly recognized by normal directional earth fault function using only the fundamental frequency components of I_0 and U_0.

Although a single transient fault usually self extinguishes within less than one millisecond, in most cases a new fault happens when the phase-to-earth voltage of the faulty phase has recovered (Figure 5.27).

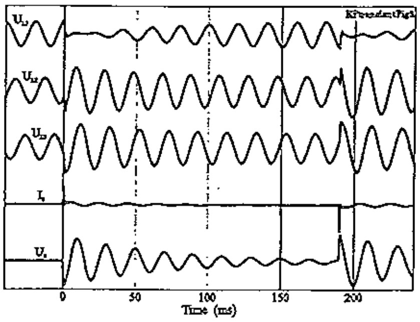

Figure 5.27: Typical phase to earth voltages, residual current of the faulty feeder and the zero sequence voltage U_0 during two transient earth faults in phase L1. In this case the network is compensated.

Direction algorithm

The function is sensitive to the instantaneous sampled values of the residual current and zero sequence voltage. The selected voltage measurement mode has to include a direct U_0 measurement.

I_0 pick-up sensitivity

The sampling time interval of the relay is 625 μs at 50 Hz (32 samples/cycle). The I_0 current spikes can be quite short compared to this sampling interval. Fortunately the current spikes in cable networks are high and while the anti-alias filter of the relay is attenuates the amplitude, the filter also makes the pulses wider. Thus, when the current pulses are high enough, it is possible to detect pulses, which have duration of less than twenty per cent of the sampling interval. Although the measured amplitude can be only a fraction of the actual peak amplitude it doesn't disturb the direction detection, because the algorithm is more sensitive to the sign and timing of the I_0 transient than sensitive to the absolute amplitude of the transient. Thus a fixed value is used as a pick up level for the I_0.

Co-ordination with $U_0>$ back up protection

Especially in a fully compensated situation, the zero sequence voltage back up protection stage $U_0>$ for the bus may not release between consecutive faults and the $U_0>$ might finally do an unselective trip if the intermittent transient stage $I_{0INT}>$ doesn't operate fast enough. The actual operation time of the $I_{0INT}>$ stage is very dependent on the behaviour of the fault and the intermittent time setting. To make the co-ordination between $U_0>$ and $I_{0INT}>$ more simple, the start signal of the transient stage $I_{0INT}>$ in an outgoing feeder can be used to block the $U_0>$ backup protection.

Co-ordination with the normal directional earth fault protection based on fundamental frequency signals

The intermittent transient earth fault protection stage $I_{0INT}>$ should always be used together with the normal directional earth fault protection stages $I_{0φ}>$, $I_{0φ}>>$. The transient stage $I_{0INT}>$ may in worst case detect the start of a steady earth fault in wrong direction, but will not trip because the peak value of a steady state sine wave I_0 signal must also exceed the corresponding base frequency component's peak value in order to make the $I_{0INT}>$ to trip.

The operation time of the transient stage $I_{0INT}>$ should be lower than the settings of any directional earth fault stage to avoid any unnecessary trip from the $I_{0φ}>$, $I_{0φ}>>$ stages .The start signal of the $I_{0INT}>$ stage can be also used to block $I_{0φ}>$, $I_{0φ}>>$ stages of all paralell feeders.

Auto reclosing

The start signal of any $I_{0φ}>$ stage initiating auto reclosing (AR) can be used to block the $I_{0INT}>$ stage to avoid the $I_{0INT}>$ stage with a long intermittent setting to interfere with the AR cycle in the middle of discrimination time.

Usually the $I_{0INT}>$ stage itself is not used to initiate any AR. For transient faults the AR will not help, because the fault phenomena itself already includes repeating self extinguishing.

Operation time, peak amount counter and intermittent time co-ordination

Algorithm has three independently settable parameters: operation delay, required amount of peaks and intermittent time. All requirements need to be satisfied before stage issues trip signal. There is also settable reset delay: to ensure that stage does not release before circuit breaker has operated. Setting range for required amount of peaks is 1 – 20 and the setting range for operational delay is 0.02 – 300s. Reset delay setting range is 0.06 – 300s. Intermittent time setting is 0.01 – 300s. If in example setting for peaks is set to 2 and setting for operation delay is set to 160ms and intermittent time is set to 200ms then function starts calculating operation delay from first peak and after second peak in 80ms peak amount criteria is satisfied and when 160ms comes full operation time criteria is satisfied and the stage issues trip (Figure 5.28). If second peak does not come before operational delay comes full the stage is released after intermittent time has come full. But if the second peak comes after operation time has come full but still inside intermittent time then trip is issued instantly (Figure 5.29). If intermittent time comes full before operation delay comes full the stage is released (Figure 5.30). There is a of couple limitations to avoid completely incorrect settings. Algorithm assumes that peaks can't come more often than 10ms so if peak amount is set to 10 then operation delay will not accept smaller value than 100ms and also if operational delay is set to 40ms then it's not possible to set higher peak amount setting than 4. This is not fail proof but prohibits usage of that kind of settings that can never be satisfied.

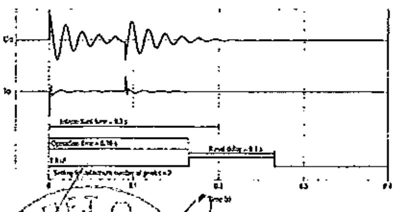

Figure 5.28: Set peak amount is satisfied and operation time comes full inside intermittent time setting. Stage issues a trip.

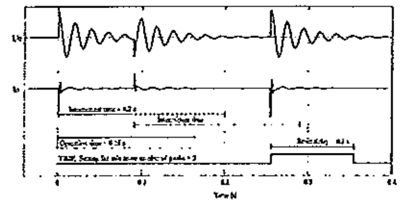

Figure 5.29: Peak amount is not satisfied when operation delay comes full but last required peak comes during intermittent time. Stage issues instant trip when peak amount comes satisfied.

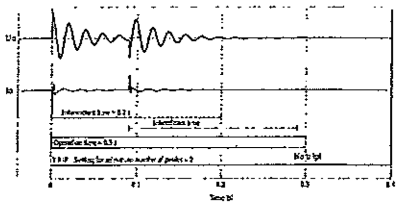

Figure 5.30: Peak amount is satisfied but intermittent time comes full before operation time comes full. Stage is released.

Setting groups

There are two settings groups available. Switching between setting groups can be controlled by digital inputs, virtual inputs (mimic display, communication, logic) and manually.

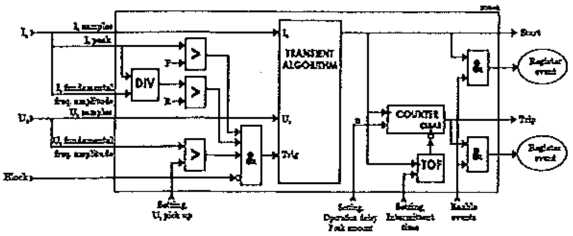

Figure 5.31: Block diagram of the directional intermittent transient earth fault stage $I_{0INT}>$.

Table 5.20: Parameters of the directional intermittent transient earth fault stage $I_{0INT}>$ (67NI)

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
SCntr			Cumulative start counter	Clr
TCntr			Cumulative trip counter	Clr
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Io input	IoPeak		I_0 Connectors X1-7, 8, 9	Set
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset after a five minute timeout.	Set
Io peak		pu	The detected I_0 value according the parameter "input" below.	
Uo		%	The measured U_0 value. U_{0N} = 100 %	
Direction mode	Forward Reverse		Setting between direction towards line or bus	Set
Uo>		%	U_0 pick up level. U_{0N} = 100 %	Set

Parameter	Value	Unit	Description	Note
t>	0.04 – 300	s	Operation delay setting	Set
Min. peaks	1 – 20		Minimum number of peaks required	Set
Reset	0.06 – 300	s	Reset delay setting	Set
Intrmt		s	Intermittent time. When the next fault occurs within this time, the delay counting continues from the previous value.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There is detailed information available of the eight latest detected faults: Time stamp, U_0 voltage, elapsed delay and setting group.

Table 5.21: Recorded values of the directional intermittent transient earth fault stage (8 latest faults) I_{0INT}> (67NI)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		pu	Maximum detected earth fault current
EDly		%	Elapsed time of the operating time setting. 100% = trip
Uo		%	Max. U_0 voltage during the fault
SetGrp	1, 2		Active setting group during fault
FWD peaks		pcs	Amount of detected peaks to forward direction
REV peaks		pcs	Amount of detected peaks to reverse direction

5.16 Capacitor bank unbalance protection

The device enables capacitor, filter and reactor bank protection, with its five current measurement inputs. The fifth input is typically useful for unbalance current measurement of a double-wye connected unearthed bank.

Furthermore, the unbalance protection is highly sensitive to internal faults of a bank because of the sophisticated natural unbalance compensation. However, the location method gives the protection a new dimension and enables easy maintenance monitoring for a bank.

This protection scheme is specially used in double wye connected capacitor banks. The unbalance current is measured with a dedicated current transformer (could be like 5A/5A) between two starpoints of the bank. The unbalance current is not affected by system unbalance. However, due to manufacturing tolerances, some amount of natural unbalance current exists between the starpoints. This natural unbalance current affects the settings, thus, the setting has to be increased.

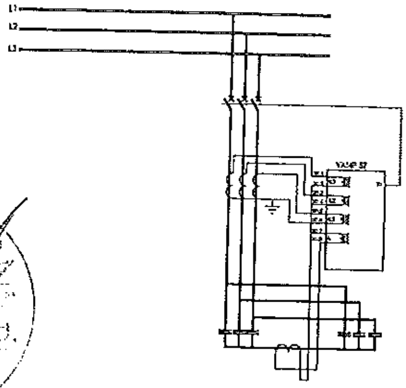

Figure 5.32: Typical capacitor bank protection application with VAMP devices.

Compensation method

The method for unbalance protection is to compensate the natural unbalance current. The compensation is triggered manually when commissioning.

The phasors of the unbalance current and one phase current are recorded.

This is because one polarizing measurement is needed. When the phasor of the unbalance current is always related to I_{L1}, the frequency changes or deviations have no effect on the protection.

After recording the measured unbalance current corresponds the zero-level and therefore, the setting of the stage can be very sensitive.

Compensation and location

The most sophisticated method is to use the same compensation method as mentioned above, but the add-on feature is to locate the branch of each faulty element or to be more precise, the broken fuse.

This feature is implemented to the stage I_0>>>>, while the other stage I_0>>> can still function as normal unbalance protection stage with compensation method. Normally, the I_0>>>> could be set as an alarming stage while stage I_0>>> will trip the circuit-breaker.

The stage I_0>>>> should be set based on the calculated unbalance current change of one faulty element. This can be easily calculated. However, the setting must be, say 10% smaller than the calculated value, since there are some tolerances in the primary equipment as well as in the relay measurement circuit. Then, the time setting of I_0>>>> is not used for tripping purposes. The time setting specifies, how long the device must wait until it is certain that there is a faulty element in the bank. After this time has elapsed, the stage I_0>>>> makes a new compensation automatically, and the measured unbalance current for this stage is now zero. Note, the automatic compensation does not effect on the measured unbalance current of stage I_0>>>.

If there is an element failure in the bank, the algorithm checks the phase angle of the unbalance current related to the phase angle of the phase current I_{L1}. Based on this angle, the algorithm can increase the corresponding faulty elements counter (there are six counters).

The user can set for the stage I_0>>>> the allowed number of faulty elements, e.g. if set to three elements, the fourth fault element will issue the trip signal.

The fault location is used with internal fused capacitor and filter banks. There is no need to use it with fuseless or external fused capacitor and filter banks, nor with the reactor banks.

Table 5.22: Setting parameters of capacitor bank unbalance protection I_0>>>, I_0>>>> (50N/51N):

Parameter	Value	Unit	Default	Description
Input	Io1; Io2; IoCalc	-	Io2	Current measurement input. NOTE! Do not use the calculated value which is only for earth fault protection purposes
Io>>>	0.01 – 20.00	pu	0.10	Setting value
Io>>>>	0.01 – 20.00	pu	0.20	Setting value
t>	0.08 – 300.00	s	0.50 (Io>>>), 1.00 (Io>>>>)	Definite operating time
CMode	Off; On (Io>>>); Off; Normal; Location(Io>>>>)	-	Off	Compensation selection
SaveBa	-; Get	-	-	Trigg the phasor recording
SetBal	0.010 – 3.000	pu	0.050	Compensation level
S_On	On; Off	-	On	Start on event
S_Off	On; Off	-	On	Start off event
T_On	On; Off	-	On	Trip on event
T_Off	On; Off	-	On	Trip off event
DIoSav	On; Off	-	Off	Recording trigged event
DIoSav	On; Off	-	Off	Recording ended event

Table 5.23: Measured and recorded values of capacitor bank unbalance protection I_0>>>, I_0>>>> (50N/51N):

	Parameter	Value	Unit	Description
Measured values	Io		pu	Unbalance current (including the natural unbalance current)
	dIo		A	Compensated unbalance current
Display	Io>>>, Io>>>>		A	Setting value
Recorded values	SCntr		-	Cumulative start counter
	TCntr		-	Cumulative trip counter
	Flt		pu	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping
	Isaved		A	Recorded natural unbalance current
	SavedA		deg	Recorded phase angle of natural unbalance current
	Faults (Io>>>>only)		-	Allowed number of element failures
	Total (Io>>>>only)		-	Actual number of element failures in the bank
	Clear (Io>>>>only)	-; Clear	-	Clear the element counters
	L1-B1 (Io>>>>only)		-	Number of element failures in phase L1 in brach 1 (left side)
	L1-B2 (Io>>>>only)		-	Number of element failures in phase L1 in brach 2 (right side)
	L2-B1 (Io>>>>only)		-	Number of element failures in phase L2 in brach 1 (left side)
	L2-B2 (Io>>>>only)		-	Number of element failures in phase L2 in brach 2 (right side)
	L3-B1 (Io>>>>only)		-	Number of element failures in phase L3 in brach 1 (left side)
	L3-B2 (Io>>>>only)		-	Number of element failures in phase L3 in brach 2 (right side)
	Locat (Io>>>>only)		-	Changed unbalance current (after automatic compensation)
	LocAng (Io>>>>only)		-	Changed phase angle of the unbalance current (after automatic compensation)

5.17 Zero sequence voltage protection U_0> (59N)

The zero sequence voltage protection is used as unselective backup for earth faults and also for selective earth fault protections for motors having a unit transformer between the motor and the busbar.

This function is sensitive to the fundamental frequency component of the zero sequence voltage. The attenuation of the third harmonic is more than 60 dB. This is essential, because 3n harmonics exist between the neutral point and earth also when there is no earth fault.

Whenever the measured value exceeds the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation time delay setting, a trip signal is issued.

Measuring the zero sequence voltage

The zero sequence voltage is either measured with three voltage transformers (e.g. broken delta connection), one voltage transformer between the motor's neutral point and earth or calculated from the measured phase-to-neutral voltages according to the selected voltage measurement mode (see Chapter 3.8 Voltage measurement modes):

- When the voltage measurement mode is 3LN: the zero sequence voltage is calculated from the phase voltages and therefore a separate zero sequence voltage transformer is not needed. The setting values are relative to the configured voltage transformer (VT) voltage/$\sqrt{3}$.
- When the voltage measurement mode contains "+U_0": The zero sequence voltage is measured with voltage transformer(s) for example using a broken delta connection. The setting values are relative to the VT_0 secondary voltage defined in configuration.

NOTE: The U_0 signal must be connected according the connection diagram in order to get a correct polarization. Please note that actually the negative U_0, $-U_0$, is to be connected to the relay.

Two independent stages

There are two separately adjustable stages: U_0> and U_0>>. Both stages can be configured for definite time (DT) operation characteristic.

The zero sequence voltage function comprises two separately adjustable zero sequence voltage stages (stage U_0> and U_0>>).

Setting groups

There are two settings groups available for both stages. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

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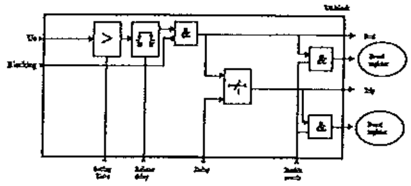


Figure 5.33: Block diagram of the zero sequence voltage stages U_0>, U_0>>

Table 5.24: Parameters of the residual overvoltage stages U_0>, U_0>>

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Uo		%	The supervised value relative to Un/$\sqrt{3}$	
Uo>, Uo>>		%	Pick-up value relative to Un/$\sqrt{3}$	Set
t>, t>>		s	Definite operation time.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There are detailed information available of the eight latest faults: Time stamp, fault voltage, elapsed delay and setting group.

Table 5.25: Recorded values of the residual overvoltage stages U_0>, U_0>>

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		%	Fault voltage relative to Un/$\sqrt{3}$
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1 2		Active setting group during fault

5.18 Thermal overload protection T> (49)

The thermal overload function protects the motor in the motor mode or cables in the feeder mode against excessive heating.

Thermal model

The temperature is calculated using rms values of phase currents and a thermal model according IEC 60255-8. The rms values are calculated using harmonic components up to the 15th.

Trip time: $t = \tau \cdot \ln \frac{I^2 - I_P{}^2}{I^2 - a^2}$, τ unit: second

Alarm: $a = k \cdot k_\Theta \cdot I_{MODE} \cdot \sqrt{alarm}$ (Alarm 60% = 0,6)

Trip: $a = k \cdot k_\Theta \cdot I_{MODE}$

Release time: $t = \tau \cdot C_\tau \cdot \ln \frac{I_P{}^2}{a^2 - I^2}$, τ unit: second

Trip release: $a = \sqrt{0.95} \times k \times I_{MODE}$

Start release: $a = \sqrt{0.95} \times k \times I_{MODE} \times \sqrt{alarm}$ (Alarm 60% = 0.6)

T =	Operation time
τ =	Thermal time constant tau (Setting value)
ln =	Natural logarithm function
I =	Measured rms phase current (the max. value of three phase currents)
Ip =	Preload current, $I_P = \sqrt{\theta} \times k \times I_{MODE}$ (if temperature rise is 120% -> θ = 1.2). This parameter is the memory of the algorithm and corresponds to the actual temperature rise.
k =	Overload factor (Maximum continuous current), i.e. service factor.(Setting value)
kΘ =	Ambient temperature factor (Permitted current due to tamb).
I_{MODE} =	The rated current (I_N or I_{MOT})
C_τ =	Relay cooling time constant (Setting value)

Time constant for cooling situation

If the motor's fan is stopped, the cooling will be slower than with an active fan. Therefore there is a coefficient C_τ for thermal constant available to be used as cooling time constant, when current is less than 0.3 x I_{MOT}.

Heat capacitance, service factor and ambient temperature

The trip level is determined by the maximum allowed continuous current I_{MAX} corresponding to the 100 % temperature rise Θ_{TRIP} i.e. the heat capacitance of the motor or cable. I_{MAX} depends of the given service factor k and ambient temperature Θ_{AMB} and settings I_{MAX40} and I_{MAX70} according the following equation.

$$I_{MAX} = k \cdot k_\Theta \cdot I_{MODE}$$

The value of ambient temperature compensation factor kΘ depends on the ambient temperature Θ_{AMB} and settings I_{MAX40} and I_{MAX70}. See Figure 5.34. Ambient temperature is not in use when kΘ = 1. This is true when

- I_{MAX40} is 1.0
- Samb is "n/a" (no ambient temperature sensor)
- TAMB is +40 °C.

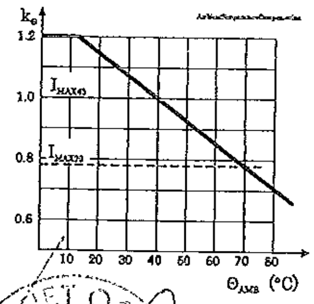


Figure 5.34: Ambient temperature correction of the overload stage T>.

Example of a behaviour of the thermal model

Figure 5.34 shows an example of the thermal model behaviour. In this example τ = 30 minutes, k = 1.06 and kΘ = 1 and the current has been zero for a long time and thus the initial temperature rise is 0 %. At time = 50 minutes the current changes to 0.85 x I_{MODE} and the temperature rise starts to approach value $(0.85/1.06)^2$ = 64 % according the time constant. At time = 300 min, the temperature is about stable, and the current increases to 5 % over the maximum defined by the rated current and the service factor k. The temperature rise starts to approach value 110 %. At about 340 minutes the temperature rise is 100 % and a trip follows.

Initial temperature rise after restart

When the device is switched on, an initial temperature rise of 70 % is used. Depending of the actual current, the calculated temperature rise then starts to approach the final value.

Alarm function

The thermal overload stage is provided with a separately settable alarm function. When the alarm limit is reached the stage activates its start signal.

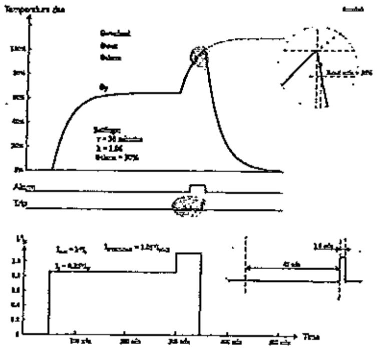


Figure 5.35: Example of the thermal model behaviour.

Table 5.26: Parameters of the thermal overload stage T> (49)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
Time	hh:mm:ss		Estimated time to trip	
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
T		%	Calculated temperature rise. Trip limit is 100 %.	F
MaxRMS		Arms	Measured current. Highest of the three phases.	
Imax		A	k x I_{MODE}. Current corresponding to the 100 % temperature rise.	
k>		xI_{MODE}	Allowed overload (service factor)	Set
Alarm		%	Alarm level	Set
tau		min	Thermal time constant	Set
ctau		xtau	Coefficient for cooling time constant. Default = 1.0	Set
kTamb		xI_{MODE}	Ambient temperature corrected max. allowed continuous current	
Imax40		$\%I_{MODE}$	Allowed load at Tamb +40 °C. Default = 100 %.	Set
Imax70		$\%I_{MODE}$	Allowed load at Tamb +70 °C.	Set
Tamb		°C	Ambient temperature. Editable Samb=n/a. Default = +40 °C	Set
Samb			Sensor for ambient temperature	Set
	n/a		No sensor in use for Tamb	
	ExtAI1 – 16		External Analogue Input 1 – 16	

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

5.19 Overvoltage protection U> (59)

The overvoltage function measures the fundamental frequency component of the line-to-line voltages regardless of the voltage measurement mode (Chapter 3.8 Voltage measurement modes). By using line-to-line voltages any phase-to-ground over-voltages during earth faults have no effect. (The earth fault protection functions will take care of earth faults.) Whenever any of these three line-to-line voltages exceeds the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation time delay setting, a trip signal is issued.

In rigidly earthed 4-wire networks with loads between phase and neutral overvoltage protection may be needed for phase-to-ground voltages, too. In such applications the programmable stages can be used. Chapter 5.28 Programmable stages (99)

Three independent stages

There are three separately adjustable stages: U>, U>> and U>>>. All the stages can be configured for definite time (DT) operation characteristic.

Configurable release delay

The U> stage has a settable release delay, which enables detecting intermittent faults. This means that the time counter of the protection function does not reset immediately after the fault is cleared, but resets after the release delay has elapsed. If the fault appears again before the release delay time has elapsed, the delay counter continues from the previous value. This means that the function will eventually trip if faults are occurring often enough.

Configurable hysteresis

The dead band is 3 % by default. It means that an overvoltage fault is regarded as a fault until the voltage drops below 97 % of the pick up setting. In a sensitive alarm application a smaller hysteresis is needed. For example if the pick up setting is about only 2 % above the normal voltage level, hysteresis must be less than 2 %. Otherwise the stage will not release after fault.

Setting groups

There are two settings groups available for each stage. Switching between setting groups can be controlled by digital inputs, virtual inputs (communication, logic) and manually.

Figure 5.36 shows the functional block diagram of the overvoltage function stages U>, U>> and U>>>.

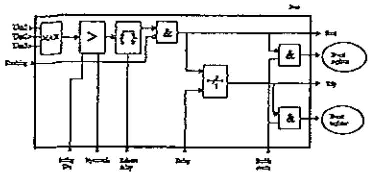


Figure 5.36: Block diagram of the three-phase overvoltage stages U>, U>> and U>>>

Table 5.27: Parameters of the overvoltage stages U>, U>>, U>>>

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Umax		V	The supervised value. Max. of U12, U23 and U31	
U>, U>>, U>>>		V	Pick-up value scaled to primary value	
U>, U>>, U>>>		% Un	Pick-up setting relative to U_N	Set
t>, t>>, t>>>		s	Definite operation time.	Set
RlsDly		s	Release delay (U> stage only)	Set
Hyster	3 (default)	%	Dead band size i.e. hysteresis	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There are detailed information available of the eight latest faults: Time stamp, fault voltage, elapsed delay and setting group.

Table 5.28: Recorded values of the overvoltage stages (8 latest faults) U>, U>>, U>>>

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		% Un	Maximum fault voltage
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1		Active setting group during fault
	2		

5.20 Undervoltage protection U< (27)

This is a basic undervoltage protection. The function measures the three line-to-line voltages and whenever the smallest of them drops below the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation time delay setting, a trip signal is issued.

Blocking during VT fuse failure

As all the protection stages the undervoltage function can be blocked with any internal or external signal using the block matrix. For example if the secondary voltage of one of the measuring transformers disappears because of a fuse failure (See VT supervision function in Chapter 6.9 Voltage transformer supervision). The blocking signal can also be a signal from the user's logic (see Chapter 4.7 Logic functions).

Self blocking at very low voltage

The stages can be blocked with a separate low limit setting. With this setting, the particular stage will be blocked, when the biggest of the three line-to-line voltages drops below the given limit. The idea is to avoid purposeless tripping, when voltage is switched off. If the operating time is less than 0.08 s, the blocking level setting should not be less than 15 % to the blocking action to be enough fast. The self blocking can be disabled by setting the low voltage block limit equal to zero.

Figure 5.37 shows an example of low voltage self blocking.

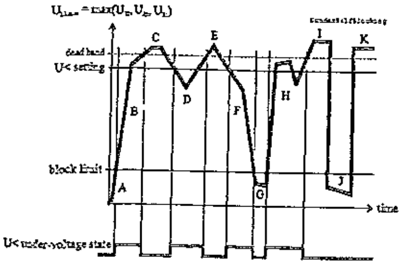


Figure 5.37: Under voltage state and block limit.

A	The maximum of the three line-to-line voltages U_{LLmax} is below the block limit. This is not regarded as an under voltage situation.
B	The voltage U_{LLmin} is above the block limit but below the pick-up level. This is an undervoltage situation.
C	Voltage is OK, because it is above the pick-up limit.
D	This is an under voltage situation.
E	Voltage is OK.
F	This is an under voltage situation.
G	The voltage U_{LLmin} is under block limit and this is not regarded as an under voltage situation.
H	This is an under voltage situation.
I	Voltage is OK.
J	Same as G
K	Voltage is OK.

Three independent stages

There are three separately adjustable stages: U<, U<< and U<<<. All these stages can be configured for definite time (DT) operation characteristic.

Setting groups

There are two settings groups available for all stages. Switching between setting groups can be controlled by digital inputs, virtual inputs (mimic display, communication, logic) and manually.

Table 5.29: Parameters of the under voltage stages U<, U<<, U<<<

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
MinU		V	The supervised minimum of line-to-line voltages in primary volts	
U<, U<<, U<<<		V	Pick-up value scaled to primary value	
U<, U<<, U<<<		% Un	Pick-up setting	Set
t<, t<<, t<<<		S	Definite operation time.	Set
LVBlk		% Un	Low limit for self blocking	Set
RlsDly		S	Release delay (U< stage only)	Set
Hyster	Default 3.0 %	%	Dead band setting	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There are detailed information available of the eight latest faults for each of the stages: Time stamp, fault voltage, elapsed delay, voltage before the fault and setting group.

Table 5.30: Recorded values of the undervoltage stages (8 latest faults) U<, U<<, U<<<

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		% Un	Minimum fault voltage
EDly		%	Elapsed time of the operating time setting. 100% = trip
PreFlt		% Un	Supervised value before fault, 1 s average value.
SetGrp	1, 2		Active setting group during fault

5.21 Directional power protection P< (32)

Directional power function can be used for example to disconnect a motor in case the supply voltage is lost and thus prevent power generation by the motor. It can also be used to detect loss of load of a motor.

Directional power function is sensitive to active power. For reverse power function the pick-up value is negative. For underpower function a positive pick-up value is used. Whenever the active power goes under the pick-up value, the stage picks up and issues a start signal. If the fault situation stays on longer than the delay setting, a trip signal is issued.

The pick-up setting range is from -200 % to +200 % of the nominal apparent power S_N. The nominal apparent power is determined by the configured voltage and current transformer values.

Equation 5.3:

$$S_n = VT_{Rated Primary} \cdot CT_{Rated Primary} \cdot \sqrt{3}$$

There are two identical stages available with independent setting parameters.

Table 5.31: Setting parameters of P< and P<< stages

Parameter	Value	Unit	Default	Description
P<, P<<	-200.0 ~ +200.0	%Sn	-4.0 (P<), -20.0(P<<)	P<, P<< pick-up setting
t<	0.3 ~ 300.0	s	1.0	P<, P<< operational delay
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Table 5.32: Measured and recorded values of P< and P<< stages

	Parameter	value	Unit	Description
Measured value	P		kW	Active power
Recorded values	SCntr		-	Start counter (Start) reading
	TCntr		-	Trip counter (Trip) reading
	Flt		%Sn	Max value of fault
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

---

5.22 Frequency Protection f><, f>><< (81)

Frequency protection is used for load sharing, loss of mains detection and as a backup protection for over-speeding.

The frequency function measures the frequency from the two first voltage inputs. At least one of these two inputs must have a voltage connected to be able to measure the frequency. Whenever the frequency crosses the user's pick-up setting of a particular stage, this stage picks up and a start signal is issued. If the fault situation remains on longer than the user's operation delay setting, a trip signal is issued. For situations, where no voltage is present an adapted frequency is used.

Protection mode for f>< and f>>< stages

These two stages can be configured either for overfrequency or for underfrequency.

Under voltage self blocking of underfrequency stages

The underfrequency stages are blocked when biggest of the three line-to-line voltages is below the low voltage block limit setting. With this common setting, LVBlk, all stages in underfrequency mode are blocked, when the voltage drops below the given limit. The idea is to avoid purposeless alarms, when the voltage is off.

Initial self blocking of underfrequency stages

When the biggest of the three line-to-line voltages has been below the block limit, the under frequency stages will be blocked until the pick-up setting has been reached.

Four independent frequency stages

There are four separately adjustable frequency stages: f><, f>><<, f<, f<<. The two first stages can be configured for either overfrequency or underfrequency usage. So totally four underfrequency stages can be in use simultaneously. Using the programmable stages even more can be implemented (chapter Chapter 5.28 Programmable stages (99)). All the stages have definite operation time delay (DT).

Setting groups

There are two settings groups available for each stage. Switching between setting groups can be controlled by digital inputs, virtual inputs (mimic display, communication, logic) and manually.

Table 5.33: Parameters of the over & underfrequency stages

Parameter	Value	Unit	Description	Note
Status	-		Current status of the stage	
	Blocked			
	Start			F
	Trip			F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	Vix		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
f		Hz	The supervised value.	
		Hz	Pick-up value	Set
fX			Over/under stage f><. See row "Mode".	
fXX			Over/under stage f>><<.	
f<			Under stage f<	
f<<			Under stage f<<	
		s	Definite operation time.	Set
tX			f>< stage	
tXX			f>><< stage	
t<			f< stage	
t<<			f<< stage	
Mode			Operation mode. (only for f>< and f>><<)	Set
	>		Overfrequency mode	
	<		Underfrequency mode	
LVblck		% Un	Low limit for self blocking. This is a common setting for all four stages.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There are detailed information available of the eight latest faults: Time stamp, frequency during fault, elapsed delay and setting group.

Table 5.34: Recorded values of the over & under frequency stages (8 latest faults) f><, f>><<, f<, f<<

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		Hz	Faulty frequency
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1, 2		Active setting group during fault

5.23 Rate of change of frequency (ROCOF) (81R)

Rate of change of frequency (ROCOF or df/dt) function is used for fast load shedding, to speed up operation time in over- and under-frequency situations and to detect loss of grid. For example a centralized dedicated load shedding relay can be omitted and replaced with distributed load shedding, if all outgoing feeders are equipped with VAMP devices.

A special application for ROCOF is to detect loss of grid (loss of mains, islanding). The more the remaining load differs from the load before the loss of grid, the better the ROCOF function detects the situation.

Frequency behaviour during load switching

Load switching and fault situations may generate change in frequency. A load drop may increase the frequency and increasing load may decrease the frequency, at least for a while. The frequency may also oscillate after the initial change. After a while the control system of any local generator may drive the frequency back to the original value. However, in case of a heavy short circuit fault or in case the new load exceeds the generating capacity, the average frequency keeps on decreasing.

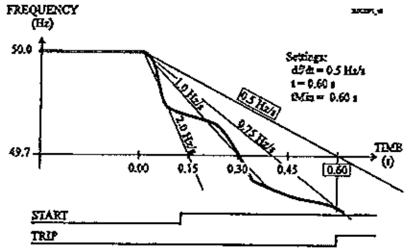


Figure 5.38: An example of definite time df/dt operation time. At 0.6 s, which is the delay setting, the average slope exceeds the setting 0.5 Hz/s and a trip signal is generated.

Setting groups

There are two settings groups available. Switching between setting groups can be controlled by digital inputs, virtual inputs (mimic display, communication, logic) and manually.

Description of ROCOF implementation

The ROCOF function is sensitive to the absolute average value of the time derivate of the measured frequency |df/dt|. Whenever the measured frequency slope |df/dt| exceeds the setting value for 80 ms time, the ROCOF stage picks up and issues a start signal after an additional 60 ms delay. If the average |df/dt|, since the pick-up moment, still exceeds the setting, when the operation delay time has elapsed, a trip signal is issued. In this definite time mode the second delay parameter "minimum delay, t_{MIN}" must be equal to the operation delay parameter "t".

If the frequency is stable for about 80 ms and the time t has already elapsed without a trip, the stage will release.

ROCOF and frequency over and under stages

One difference between over-/under-frequency and df/dt function is the speed. In many cases a df/dt function can predict an overfrequency or underfrequency situation and is thus faster than a simple overfrequency or underfrequency function. However, in most cases a standard overfrequency and underfrequency stages must be used together with ROCOF to ensure tripping also in case the frequency drift is slower than the slope setting of ROCOF.

Definite operation time characteristics

Figure 5.38 shows an example where the df/dt pick-up value is 0.5 Hz/s and the delay settings are t = 0.60 s and t_{MIN} = 0.60 s. Equal times t = t_{MIN} will give a definite time delay characteristics. Although the frequency slope fluctuates the stage will not release but continues to calculate the average slope since the initial pick-up. At the defined operation time, t = 0.6 s, the average slope is 0.75 Hz/s. This exceeds the setting, and the stage will trip.

At slope settings less than 0.7 Hz/s the fastest possible operation time is limited according the Figure 5.39

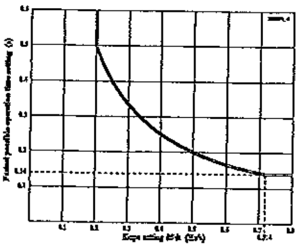


Figure 5.39: At very sensitive slope settings the fastest possible operation time is limited according the figure.

Inverse operation time characteristics

By setting the second delay parameter t_{MIN} smaller than the operational delay t, an inverse type of operation time characteristics is achieved.

Figure 5.41 shows one example, where the frequency behaviour is the same as in the first figure, but the t_{MIN} setting is 0.15 s instead of being equal with t. The operation time depends of the measured average slope according the following equation.

Equation 5.4:

$$t_{TRIP} = \frac{s_{SET} \cdot t_{SET}}{|s|}$$

t_{TRIP} = Resulting operation time (seconds).

s_{SET} = df/dt i.e. slope setting (hertz/seconds).

t_{SET} = Operation time setting t (seconds).

s = Measured average frequency slope (hertz/seconds).

The minimum operation time is always limited by the setting parameter t_{MIN}. In the example of the fastest operation time, 0.15 s, is achieved when the slope is 2 Hz/s or more. The leftmost curve in

Figure 5.40 shows the inverse characteristics with the same settings as in Figure 5.41.

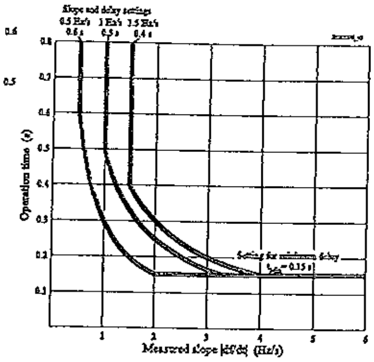


Figure 5.40: Three examples of possible inverse df/dt operation time characteristics. The slope and operation delay settings define the knee points on the left. A common setting for tMin has been used in these three examples. This minimum delay parameter defines the knee point positions on the right.

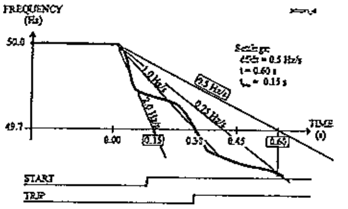


Figure 5.41: An example of inverse df/dt operation time. The time to trip will be 0.3 s, although the setting is 0.6 s, because the average slope 1 Hz/s is steeper than the setting value 0.5 Hz/s.

Table 5.35: Setting parameters of df/dt stage

Parameter	Value	Unit	Default	Description
df/dt	0.2 – 10.0	Hz/s	5.0	df/dt pick-up setting
t>	0.14 – 10.0	s	0.50	df/dt operational delay
tMin>	0.14 – 10.0	s	0.50	df/dt minimum delay
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Table 5.36: Measured and recorded values of df/dt stage

	Parameter	Value	Unit	Description
Measured value	f		Hz	Frequency
	df/dt		Hz/s	Frequency rate of change
Recorded values	SCntr		-	Start counter (Start) reading
	TCntr		-	Trip counter (Trip) reading
	Flt		%Hz/s	Max rate of change fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

5.24 Synchrocheck (25)

The device includes a function that will check synchronism when the circuit-breaker is closed. The function will monitor voltage amplitude, frequency and phase angle difference between two voltages. Since there are two stages available, it is possible to monitor three voltages. The voltages can be busbar and line or busbar and busbar (bus coupler).

Synchrocheck function is available when one of the following analog measurement module and suitable measuring mode is in use:

Analog measurement card	Voltage measuring mode	No. of synchrocheck stages
3L+4U+I$_0$ (5/1A)	3LN+LLy	1
	3LN+LNy	1
	2LL+Uo+LLy	1
	2LL+Uo+LNy	1
	LL+Uo+LLy+LLz	2
	LN+Uo+LNy+LNz	2

5.24.1 Connections for synchrocheck

The voltage used for sychrochecking is always phase-to-phase voltage U12. The sychrocheck stage 1 always compares U12 with U12y. The compared voltages for the stage 2 can be selected (U12 / U12y, U12 / U12z, U12y / U12z). See Chapter 3.8 Voltage measurement modes.

Table 5.37: Setting parameters of synchrocheck stages SyC1, SyC2 (25)

Parameter	Values	Unit	Default	Description
Side	U12/U12y; U12/U12z; U12y/U12z	-	U12/U12z	Voltage selection. The stage 1 has fixed voltages U12/U12y.
CBObj	Obj1 – Obj6	-	Obj1	The selected object for CB control. The synchrocheck closing command will use the closing command of the selected object.
CBObj2	Obj1 – Obj6	-	Obj2	The selected object for CB control. The synchrocheck closing command will use the closing command of the selected object.
ObjSel	Digital inputs	-	-	Input for selecting between CBObj1 and CBObj2. When active CBObj2 is in use
Smode	Async; Sync; Off	-	Sync	Synchrocheck mode. Off = only voltage check Async = the function checks dU, df and dangle. Furthermore, the frequency slip, df, determines the remaining time for closing. This time must be longer than "CB time". Sync mode = Synchronization is tried to make exactly when angle difference is zero. In this mode df-setting should be enough small (<0.3Hz).
Umode	-, DD, DL, LD, DD/DL, DD/LD, DL/LD, DD/DL/LD	-	-	Voltage check mode: The first letter refers to the reference voltage and the second letter refers to the comparison voltage. D means that the side must be "dead" when closing (dead = The voltage below the dead voltage limit setting) L means that the side must be "live" when closing (live = The voltage higher than the live voltage limit setting) Example: DL mode for stage 1: The U12 side must be "dead" and the U12y side must be "live".
Cbtime	0.04 – 0.6	s	0.1	Typical closing time of the circuit-breaker.
Dibypass	Digital inputs	-	-	Bypass input. If the input is active, the function is bypassed.
Bypass	0; 1	-	0	The bypass status. "1" means that the function is bypassed. This parameter can also be used for manual bypass.
CBCtrl	Open;Close	-	-	Circuit-breaker control
ShowInfo	Off; On	-	On	Additional information display about the sychrocheck status to the mimic dispaly.
SGrpDI	Digital inputs	-	-	The input for changing the setting group.
SetGrp	1; 2	-	1	The active setting group.

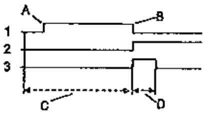
Table 5.38: Measured and recorded values of synchrocheck stages SyC1, SyC2 (25)

	Parameter	Values	Unit	Description
Measured values	df	-	Hz	Measured frequency difference
	dU	-	% Un / deg	Measured voltage amplitude and phase angle difference
	UState	-	-	Voltage status (e.g. DD)
	SState	-	-	Synchrocheck status
	ReqTime	-	-	Request time status
	f1)	-	Hz	Measured frequency (reference side)
	fy1)	-	Hz	Measured frequency (comparison side)
	U121)	-	% Un	Measured voltage (reference side)
	U12y1)	-	% Un	Measured voltage (comparison side)

	Parameter	Values	Unit	Description
Recorded values	ReqCntr	-	-	Request counter
	SyncCntr	-	-	Synchronising counter
	FailCntr	-	-	Fail counter
	f$^{1)}$	-	Hz	Recorded frequency (reference side)
	fy$^{1)}$	-	Hz	Recorded frequency (comparison side)
	U12$^{1)}$	-	% Un	Recorded voltage (reference side)
	U12y$^{1)}$	-	% Un	Recorded voltage (comparison side)
	dAng	-	Deg	Recorded phase angle difference, when close command is given from the function
	dAngC	-	Deg	Recorded phase angle difference, when the circuit-breaker actually closes.
	EDly	-	%	The elapsed time compared to the set request timeout setting, 100% = timeout

1) Please note that the labels (parameter names) change according to the voltage selection.

The following signals of the stage are available in the output matrix and the logic: "Request", "OK" and "Fail". The "request"-signal is active, when a request has received but the breaker is not yet closed. The "OK"-signal is active, when the synchronising conditions are met, or the voltage check criterion is met. The "fail"-signal is activated, if the function fails to close the breaker within the request timeout setting. See below the figure.

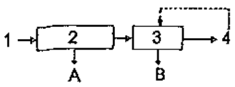


1. Sync request
2. Sync OK
3. Object close command

A. Object close command gived (mimic or bus) actually make only sync request
B. Request going down when "real" object close being requested
C. Synchronizing time if timeout happens, Sync_Fail signal activates Timeout defined in synchrocheck
D. Normal object close operation

Figure 5.42: The principle of the synchrocheck function

Please note that the control pulse of the selected object should be long enough. For example, if the voltages are in opposite direction, the synchronising conditions are met after several seconds.



1. Object close command
2. Synchrocheck
3. Object
4. CB

A. Sync_Fail signal if sync timeout happen
B. Object_Fail signal if "real" object control fail.

Time settings:

- Synchrocheck: Max synchronize time (~seconds)
- Object: Max object control pulse len (~200 ms)

Figure 5.43: The block diagram of the synchrocheck and the controlling object

Please note that the wiring of the secondary circuits of voltage transformers to the device terminal depends on the selected voltage measuring mode.

See synchrocheck stages connection diagrams in Chapter 3.8 Voltage measurement modes

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5.25 Magnetishing inrush I_{f2} > (68F2)

This stage is mainly used to block other stages. The ratio between the second harmonic component and the fundamental frequency component is measured on all the phase currents. When the ratio in any phase exceeds the setting value, the stage gives a start signal. After a settable delay, the stage gives a trip signal.

The start and trip signals can be used for blocking the other stages.

The trip delay is irrelevant if only the start signal is used for blocking.

The trip delay of the stages to be blocked must be more than 60 ms to ensure a proper blocking.

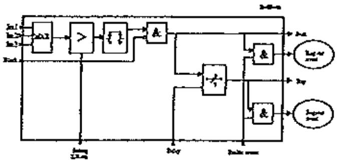

Figure 5.44: Block diagram of the magnetishing inrush stage.

Table 5.39: Setting parameters of magnetishing inrush blocking (68F2)

Parameter	Value	Unit	Default	Description
If2>	10 – 100	%	10	Setting value If2/Ifund
t_f2	0.05 – 300.0	s	0.05	Definite operating time
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Table 5.40: Measured and recorded values of magnetishing inrush blocking (68F2)

	Parameter	Value	Unit	Description
Measured values	IL1H2.		%	2. harmonic of IL1, proportional to the fundamental value of IL1
	IL2H2.		%	2. harmonic of IL2
	IL3H2.		%	2. harmonic of IL3
Recorded values	Flt		%	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

---

5.26 Transformer over exicitation I_{f5}> (68F5)

Overexiting for example a transformer creates odd harmonics. This over excitation stage can be used detect overexcitation. This stage can also be used to block some other stages.

The ratio between the over excitation component and the fundamental frequency component is measured on all the phase currents. When the ratio in any phase exceeds the setting value, the stage gives a start signal. After a settable delay, the stage gives a trip signal.

The trip delay of the stages to be blocked must be more than 60 ms to ensure a proper blocking.

Table 5.41: Setting parameters of over excitation blocking (68F5)

Parameter	Value	Unit	Default	Description
If5>	10 – 100	%	10	Setting value If2/Ifund
t_f5	0.05 – 300.0	s	0.05	Definite operating time
S_On	Enabled; Disabled	-	Enabled	Start on event
S_Off	Enabled; Disabled	-	Enabled	Start off event
T_On	Enabled; Disabled	-	Enabled	Trip on event
T_Off	Enabled; Disabled	-	Enabled	Trip off event

Table 5.42: Measured and recorded values of over exicitation blocking (68F5)

	Parameter	Value	Unit	Description
Measured values	IL1H5.		%	5. harmonic of IL1, proportional to the fundamental value of IL1
	IL2H5.		%	5. harmonic of IL2
	IL3H5.		%	5. harmonic of IL3
Recorded values	Flt		%	The max. fault value
	EDly		%	Elapsed time as compared to the set operating time; 100% = tripping

5.27 Circuit breaker failure protection CBFP (50BF)

The circuit breaker failure protection can be used to trip any upstream circuit breaker (CB), if the fault has not disappeared within a given time after the initial trip command. A different output contact of the device must be used for this backup trip.

The operation of the circuit-breaker failure protection (CBFP) is based on the supervision of the signal to the selected trip relay and the time the fault remains on after the trip command.

If this time is longer than the operating time of the CBFP stage, the CBFP stage activates another output relay, which will remain activated until the primary trip relay resets.

The CBFP stage is supervising all the protection stages using the same selected trip relay, since it supervises the control signal of this device. See Chapter 4.4.1 Output matrix

Table 5.43: Parameters of the circuit breaker failure stage CBFP (50BF)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Cbrelay			The supervised output relay*).	Set
	1		Relay T1	
	2		Relay T2	
t>		s	Definite operation time.	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

For details of setting ranges, see Chapter 10.3 Protection functions.

Recorded values of the latest eight faults

There are detailed information available of the eight latest faults: Time stamp and elapsed delay.

Table 5.44: Recorded values of the circuit breaker failure stage (8 latest faults) CBFP (50BF)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
EDly		%	Elapsed time of the operating time setting. 100% = trip

5.28 Programmable stages (99)

For special applications the user can built own protection stages by selecting the supervised signal and the comparison mode.

The following parameters are available:

- **Priority**
  If operation times less than 80 milliseconds are needed select 10 ms. For operation times under one second 20 ms is recommended. For longer operation times and THD signals 100 ms is recommended.
- **Coupling A**
  The name of the supervised signal in ">" and "<" modes (see table below). Also the name of the supervised signal 1 in "Diff" and "AbsDiff" modes.
- **Coupling B**
  The name of the supervised signal 2 in "Diff" and "AbsDiff" modes.
- **Compare condition**
  Compare mode. '>' for over or '<' for under comparison, "Diff" and "AbsDiff" for comparing Coupling A and Coupling B.
- **Pick-up**
  Limit of the stage. The available setting range and the unit depend on the selected signal.
- **Operation delay**
  Definite time operation delay
- **Hysteresis**
  Dead band (hysteresis)
- **No Compare limit for mode <**
  Only used with compare mode under ('<'). This is the limit to start the comparison. Signal values under NoCmp are not regarded as fault.

Table 5.45: Available signals to be supervised by the programmable stages

IL1, IL2, IL3	Phase currents
Io	Residual current input
U12, U23, U31	Line-to-line voltages
UL1, UL2, UL3	Phase-to-ground voltages
Uo	Zero sequence voltage
f	Frequency
P	Active power
Q	Reactive power
S	Apparent power
Cos Fii	Cosine φ
IoCalc	Phasor sum $I_{L1} + I_{L2} + I_{L3}$
I1	Positive sequence current
I2	Negative sequence current
I2/I1	Relative negative sequence current
I2/In	Negative sequence current in pu
U1	Positive sequence voltage
U2	Negative sequence voltage
U2/U1	Relative negative sequence voltage
IL	Average $(I_{L1} + I_{L2} + I_{L3}) / 3$
TanFii	Tangent φ [= tan(arccosφ)]
Prms	Active power rms value
Qrms	Reactive power rms value
Srms	Apparent powre rms value
THDIL1	Total harmonic distortion of I_{L1}
THDIL2	Total harmonic distortion of I_{L2}
THDIL3	Total harmonic distortion of I_{L3}
THDUa	Total harmonic distortion of input U_A
THDUb	Total harmonic distortion of input U_B
THDUc	Total harmonic distortion of input U_C
fy	Frequency behind circuit breaker
fz	Frequency behind 2nd circuit breaker
IL1RMS	IL1 RMS for average sampling
IL2RMS	IL2 RMS for average sampling
IL3RMS	IL3 RMS for average sampling
ILmin, ILmax	Minimum and maximum of phase currents
ULLmin, ULLmax	Minimum and maximum of line voltages
ULNmin, ULNmax	Minimum and maximum of phase voltages
VAI1, VAI2, VAI3, VAI4, VAI5	Virtual analog inputs 1, 2, 3, 4, 5 (GOOSE)

Eight independent stages

The device has eight independent programmable stages. Each programmable stage can be enabled or disabled to fit the intended application.

Setting groups

There are two settings groups available. Switching between setting groups can be controlled by digital inputs, virtual inputs (mimic display, communication, logic) and manually.

There are two identical stages available with independent setting parameters.

Table 5.46: Parameters of the programmable stages PrgN (99)

Parameter	Value	Unit	Description	Note
Status	- Blocked Start Trip		Current status of the stage	 F F
SCntr			Cumulative start counter	C
TCntr			Cumulative trip counter	C
SetGrp	1 or 2		Active setting group	Set
SGrpDI			Digital signal to select the active setting group	Set
	-		None	
	DIx		Digital input	
	VIx		Virtual input	
	LEDx		LED indicator signal	
	VOx		Virtual output	
	Fx		Function key	
Force	Off On		Force flag for status forcing for test purposes. This is a common flag for all stages and output relays, too. Automatically reset by a 5-minute timeout.	Set
Link	See Table 5.45		Name for the supervised signal	Set
See Table 5.45			Value of the supervised signal	
Cmp			Mode of comparison	Set
	>		Over protection	
	<		Under protection	
	Diff		Difference	
	AbsDiff		Absolut difference	
Pickup			Pick up value scaled to primary level	
Pickup		pu	Pick up setting in pu	Set
t		s	Definite operation time.	Set
Hyster		%	Dead band setting	Set
NoCmp		pu	Minimum value to start under comparison. (Mode='<')	Set

Set = An editable parameter (password needed). C = Can be cleared to zero. F = Editable when force flag is on.

Recorded values of the latest eight faults

There is detailed information available of the eight latest faults: Time stamp, fault value and elapsed delay.

Table 5.47: Recorded values of the programmable stages PrgN (99)

Parameter	Value	Unit	Description
	yyyy-mm-dd		Time stamp of the recording, date
	hh:mm:ss.ms		Time stamp, time of day
Flt		pu	Fault value
EDly		%	Elapsed time of the operating time setting. 100% = trip
SetGrp	1, 2		Active setting group during fault

5.29 Inverse time operation

The inverse time operation - i.e. inverse delay minimum time (IDMT) type of operation - is available for several protection functions. The common principle, formulae and graphic representations of the available inverse delay types are described in this chapter.

Inverse delay means that the operation time depends on the measured real time process values during a fault. For example with an overcurrent stage using inverse delay a bigger a fault current gives faster operation. The alternative to inverse delay is definite delay. With definite delay a preset time is used and the operation time does not depend on the size of a fault.

Stage specific inverse delay

Some protection functions have their own specific type of inverse delay. Details of these dedicated inverse delays are described with the appropriate protection function.

Operation modes

There are three operation modes to use the inverse time characteristics:

- Standard delays
  Using standard delay characteristics by selecting a curve family (IEC, IEEE, IEEE2, RI) and a delay type (Normal inverse, Very inverse etc). See Chapter 5.29.1 Standard inverse delays IEC, IEEE, IEEE2, RI.
- Standard delay formulae with free parameters
  selecting a curve family (IEC, IEEE, IEEE2) and defining one's own parameters for the selected delay formula. This mode is activated by setting delay type to 'Parameters', and then editing the delay function parameters A – E. See Chapter 5.29.2 Free parameterization using IEC, IEEE and IEEE2 equations.
- Fully programmable inverse delay characteristics
  Building the characteristics by setting 16 [current, time] points. The relay interpolates the values between given points with 2nd degree polynomials. This mode is activated by setting curve family to 'PrgN". There are maximum three different programmable curves available at the same time. Each programmed curve can be used by any number of protection stages. See Chapter 5.29.3 Programmable inverse time curves.

Local panel graph

The device will show a graph of the currently used inverse delay on the local panel display. Up and down keys can be used for zooming. Also the delays at 20 x I_{SET}, 4 x I_{SET} and 2 x I_{SET} are shown.

Inverse time setting error signal

If there are any errors in the inverse delay configuration the appropriate protection stage will use definite time delay.

There is a signal 'Setting Error' available in output matrix, which indicates three different situations:

1. Settings are currently changed with VAMPSET or local panel, and there is temporarily an illegal combination of curve/delay/points. For example if previous settings were IEC/NI and then curve family is changed to IEEE, the setting error will active, because there is no NI type available for IEEE curves. After changing valid delay type for IEEE mode (for example MI), the 'Setting Error' signal will release.
2. There are errors in formula parameters A – E, and the device is not able to build the delay curve
3. There are errors in the programmable curve configuration and the device is not able to interpolate values between the given points.

Limitations

The maximum measured secondary phase current is 50 x I_N and the maximum directly measured earth fault current is 10 x I_{0N} for residual current input. The full scope of inverse delay curves goes up to 20 times the setting. At high setting the maximum measurement capability limits the scope of inverse curves according the following table.

Current input	Maximum measured secondary current	Maximum secondary scaled setting enabling inverse delay times up to full 20x setting
I_{L1}, I_{L2}, I_{L3} and I_{0Calc}	250 A	12.5 A
I_0 = 5 A	50 A	2.5 A
I_0 = 1 A	10 A	0.5 A

1. Example of limitation

   CT = 750 / 5

   CT_0= 100 / 1 (cable CT is used for residual current)

   For overcurrent stage I> the table above gives 12.5 A. Thus the maximum setting for I> stage giving full inverse delay range is 12.5 A / 5 A = 2.5 xI_N = 1875 $A_{Primary}$.

   For earth fault stage I_0> the table above gives 0.5 A. Thus the maximum setting for I_0> stage giving full inverse delay range is 0.5 A / 1 A = 0.5 xI_{0N} = 50 $A_{Primary}$.

---

2. Example of limitation

   CT = 750 / 5

   Application mode is Motor

   Rated current of the motor = 600 A

   I_{0Calc} (= I_{L1} + I_{L2} + I_{L3}) is used for residual current

   At secondary level the rated motor current is 600 / 750*5 = 4 A

   For overcurrent stage I> the table above gives 12.5 A. Thus the maximum setting giving full inverse delay range is 12.5 A / 4 A = 3.13 x I_{MOT} = 1875 $A_{Primary}$.

   For earth fault stage I_0> the table above gives 12.5 A. Thus the maximum setting for I_0> stage giving full inverse delay range is 12.5 A / 5 A = 2.5 x I_{0N} = 1875 $A_{Primary}$.

5.29.1 Standard inverse delays IEC, IEEE, IEEE2, RI

The available standard inverse delays are divided in four categories IEC, IEEE, IEEE2 and RI called delay curve families. Each category of family contains a set of different delay types according the following table.

Inverse time setting error signal

The inverse time setting error signal will be activated, if the delay category is changed and the old delay type doesn't exist in the new category. See Chapter 5.29 Inverse time operation for more details.

Limitations

The minimum definite time delay start latest, when the measured value is twenty times the setting. However, there are limitations at high setting values due to the measurement range. Chapter 5.29 Inverse time operation for more details.

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Table 5.48: Available standard delay families and the available delay types within each family.

Delay type		Curve family				
		DT	IEC	IEEE	IEEE2	RI
DT	Definite time	X				
NI	Normal inverse		X		X	
VI	Very inverse		X	X	X	
EI	Extremely inverse		X	X	X	
LTI	Long time inverse		X	X		
LTEI	Long time extremely inverse			X		
LTVI	Long time very inverse			X		
MI	Moderately inverse			X	X	
STI	Short time inverse			X		
STEI	Short time extremely inverse			X		
RI	Old ASEA type					X
RXIDG	Old ASEA type					X

IEC inverse time operation

The operation time depends on the measured value and other parameters according Equation 5.5. Actually this equation can only be used to draw graphs or when the measured value I is constant during the fault. A modified version is implemented in the relay for real time usage.

Equation 5.5:

$$t = \frac{k\,A}{\left(\frac{I}{I_{PICKUP}}\right)^{B} - 1}$$

t = Operation delay in seconds

k = User's multiplier

I = Measured value

I_{PICKUP} = User's pick up setting

A, B = Constants parameters according Table 5.49.

There are three different delay types according IEC 60255-3, Normal inverse (NI), Extremely inverse (EI), Very inverse (VI) and a VI extension. Additional there is a de facto standard Long time inverse (LTI).

Table 5.49: Constants for IEC inverse delay equation

Delay type		Parameter	
		A	B
NI	Normal inverse	0.14	0.02
EI	Extremely inverse	80	2
VI	Very inverse	13.5	1
LTI	Long time inverse	120	1

Example for Delay type "Normal inverse (NI)":

k = 0.50

I = 4 pu (constant current)

I_{PICKUP} = 2 pu

A = 0.14

B = 0.02

$$t = \frac{0.50 \cdot 0.14}{\left(\frac{4}{2}\right)^{0.02} - 1} = 5.0$$

The operation time in this example will be 5 seconds. The same result can be read from Figure 5.45.

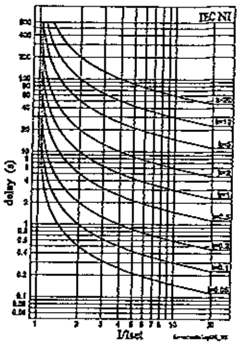

Figure 5.45: IEC normal inverse delay.

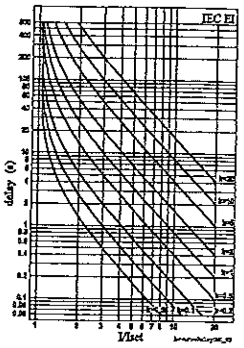

Figure 5.46: IEC extremely inverse delay.

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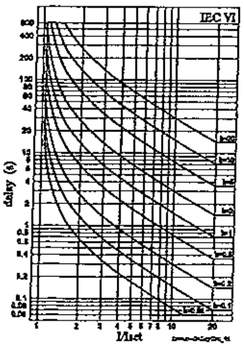

Figure 5.47: IEC very inverse delay.

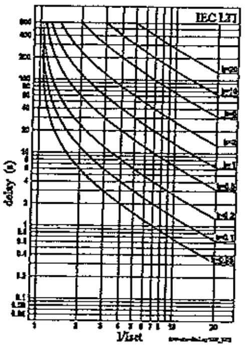

Figure 5.48: IEC long time inverse delay.

IEEE/ANSI inverse time operation

There are three different delay types according IEEE Std C37.112-1996 (MI, VI, EI) and many de facto versions according Table 5.50. The IEEE standard defines inverse delay for both trip and release operations. However, in the VAMP relay only the trip time is inverse according the standard but the release time is constant.

The operation delay depends on the measured value and other parameters according Equation 5.6. Actually this equation can only be used to draw graphs or when the measured value I is constant during the fault. A modified version is implemented in the relay for real time usage.

Equation 5.6:

$$t = k\left[\frac{A}{\left(\frac{I}{I_{PICKUP}}\right)^{C} - 1} + B\right]$$

t = Operation delay in seconds

k = User's multiplier

I = Measured value

I_{PICKUP} = User's pick up setting

A,B,C = Constant parameter according Table 5.50.

Table 5.50: Constants for IEEE/ANSI inverse delay equation

Delay type		Parameter		
		A	B	C
LTI	Long time inverse	0.086	0.185	0.02
LTVI	Long time very inverse	28.55	0.712	2
LTEI	Long time extremely inverse	64.07	0.250	2
MI	Moderately inverse	0.0515	0.1140	0.02
VI	Very inverse	19.61	0.491	2
EI	Extremely inverse	28.2	0.1217	2
STI	Short time inverse	0.16758	0.11858	0.02
STEI	Short time extremely inverse	1.281	0.005	2

Example for Delay type "Moderately inverse (MI)":

k = 0.50

I = 4 pu

I_{PICKUP} = 2 pu

A = 0.0515

B = 0.114

C = 0.02

$$t = 0.50 \cdot \left[\frac{0.0515}{\left(\frac{4}{2}\right)^{0.02} - 1} + 0.1140\right] = 1.9$$

The operation time in this example will be 1.9 seconds. The same result can be read from Figure 5.52.

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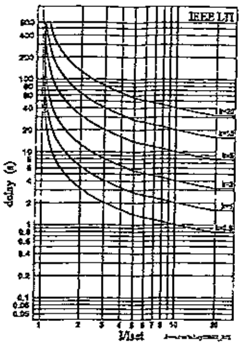


Figure 5.49: ANSI/IEEE long time inverse delay

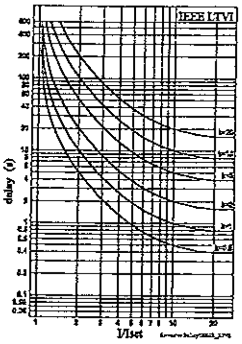


Figure 5.50: ANSI/IEEE long time very inverse delay

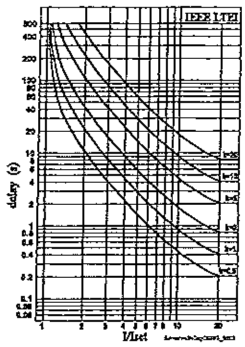


Figure 5.51: ANSI/IEEE long time extremely inverse delay

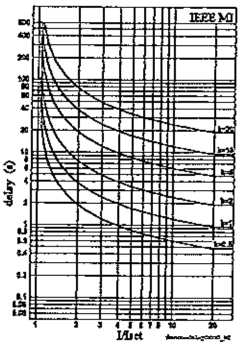


Figure 5.52: ANSI/IEEE moderately inverse delay

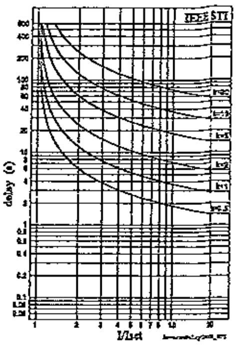


Figure 5.53: ANSI/IEEE short time inverse delay

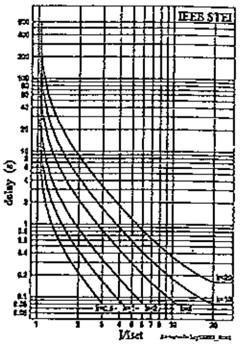


Figure 5.54: ANSI/IEEE short time extremely inverse delay

IEEE2 inverse time operation

Before the year 1996 and ANSI standard C37.112 microprocessor relays were using equations approximating the behaviour of various induction disc type relays. A quite popular approximation is Equation 5.7, which in VAMP relays is called IEEE2. Another name could be IAC, because the old General Electric IAC relays have been modeled using the same equation.

There are four different delay types according Table 5.51. The old electromechanical induction disc relays have inverse delay for both trip and release operations. However, in VAMP relays only the trip time is inverse the release time being constant.

The operation delay depends on the measured value and other parameters according Equation 5.7. Actually this equation can only be used to draw graphs or when the measured value I is constant during the fault. A modified version is implemented in the relay for real time usage.

ВЯРНО С ОРИГИНАЛА

Equation 5.7:

$$t = k\left[A + \frac{B}{\left(\frac{I}{I_{PICKUP}} - C\right)} + \frac{D}{\left(\frac{I}{I_{PICKUP}} - C\right)^2} + \frac{E}{\left(\frac{I}{I_{PICKUP}} - C\right)^3}\right]$$

t = Operation delay in seconds

k = User's multiplier

I = Measured value

I_{PICKUP} = User's pick up setting

A, B, C, D = Constant parameter according Table 5.51.

Table 5.51: Constants for IEEE2 inverse delay equation

Delay type		Parameter				
		A	B	C	D	E
MI	Moderately inverse	0.1735	0.6791	0.8	-0.08	0.1271
NI	Normally inverse	0.0274	2.2614	0.3	-0.1899	9.1272
VI	Very inverse	0.0615	0.7989	0.34	-0.284	4.0505
EI	Extremely inverse	0.0399	0.2294	0.5	3.0094	0.7222

Example for Delay type "Moderately inverse (MI)":

k = 0.50

I = 4 pu

I_{PICKUP} = 2 pu

A = 0.1735

B = 0.6791

C = 0.8

D = -0.08

E = 0.127

$$t = 0.5\cdot\left[0.1735 + \frac{0.6791}{\left(\frac{4}{2} - 0.8\right)} + \frac{-0.08}{\left(\frac{4}{2} - 0.8\right)^2} + \frac{0.127}{\left(\frac{4}{2} - 0.8\right)^3}\right] = 0.38$$

The operation time in this example will be 0.38 seconds. The same result can be read from Figure 5.55.

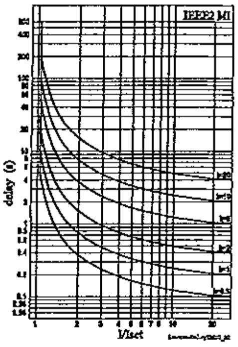


Figure 5.55: IEEE2 moderately inverse delay

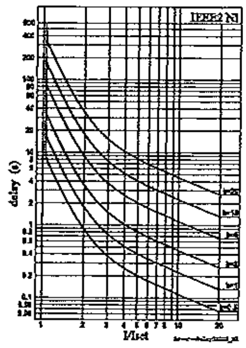


Figure 5.56: IEEE2 normal inverse delay

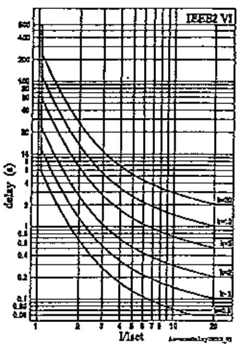


Figure 5.57: IEEE2 very inverse delay

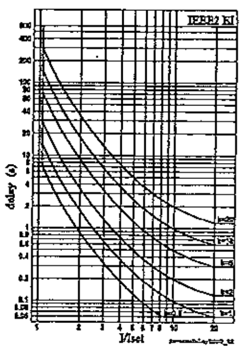


Figure 5.58: IEEE2 extremely inverse delay

RI and RXIDG type inverse time operation

These two inverse delay types have their origin in old ASEA (nowadays ABB) earth fault relays.

The operation delay of types RI and RXIDG depends on the measured value and other parameters according Equation 5.8 and Equation 5.9. Actually these equations can only be used to draw graphs or when the measured value I is constant during the fault. Modified versions are implemented in the relay for real time usage.

Equation 5.8: RI

$$t_{RI} = \frac{k}{0.339 - \frac{0.236}{\left(\frac{I}{I_{PICKUP}}\right)}}$$

Equation 5.9: RXIDG

$$t_{RXIDG} = 5.8 - 1.35 \ln \frac{I}{k I_{PICKUP}}$$

t = Operation delay in seconds

k = User's multiplier

I = Measured value

I_{PICKUP} = User's pick up setting

Example for Delay type RI

k = 0.50

I = 4 pu

I_{PICKUP} = 2 pu

$$t_{RI} = \frac{0.5}{0.339 - \frac{0.236}{\left(\frac{4}{2}\right)}} = 2.3$$

The operation time in this example will be 2.3 seconds. The same result can be read from Equation 5.8.

Example for Delay type RXIDG

k = 0.50

I = 4 pu

I_{PICKUP} = 2 pu

$$t_{RXIDG} = 5.8 - 1.35 \ln \frac{4}{0.5 \cdot 2} = 3.9$$

The operation time in this example will be 3.9 seconds. The same result can be read from Figure 5.60.

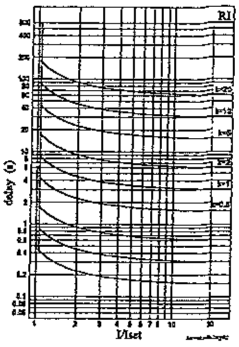


Figure 5.59: Inverse delay of type RI.

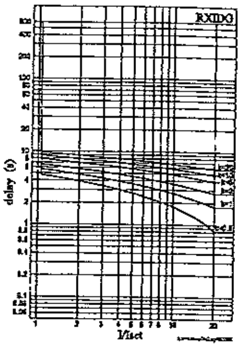


Figure 5.60: Inverse delay of type RXIDG.

5.29.2 Free parameterization using IEC, IEEE and IEEE2 equations

This mode is activated by setting delay type to 'Parameters', and then editing the delay function constants, i.e. the parameters A – E. The idea is to use the standard equations with one's own constants instead of the standardized constants as in the previous chapter.

Example for GE-IAC51 delay type inverse:

k = 0.50

I = 4 pu

I_{PICKUP} = 2 pu

A = 0.2078

B = 0.8630

C = 0.8000

D = - 0.4180

E = 0.1947

$$t = 0.5 \cdot \left[0.2078 + \frac{0.8630}{\left(\frac{4}{2} - 0.8\right)} + \frac{-0.4180}{\left(\frac{4}{2} - 0.8\right)^2} + \frac{0.1947}{\left(\frac{4}{2} - 0.8\right)^3} \right] = 0.37$$

The operation time in this example will be 0.37 seconds.

The resulting time/current characteristic of this example matches quite well with the characteristic of the old electromechanical IAC51 induction disc relay.

Inverse time setting error signal

The inverse time setting error signal will become active, if interpolation with the given parameters is not possible. See Chapter 5.29 Inverse time operation for more details.

Limitations

The minimum definite time delay start latest, when the measured value is twenty times the setting. However, there are limitations at high setting values due to the measurement range. See Chapter 5.29 Inverse time operation for more details.

5.29.3 Programmable inverse time curves

Only with VAMPSET, requires rebooting.

The [current, time] curve points are programmed using VAMPSET PC program. There are some rules for defining the curve points:

- configuration must begin from the topmost line
- line order must be as follows: the smallest current (longest operation time) on the top and the largest current (shortest operation time) on the bottom
- all unused lines (on the bottom) should be filled with [1.00 0.00s]

Here is an example configuration of curve points:

Point	Current I/I_{PICKUP}	Operation delay
1	1.00	10.00 s
2	2.00	6.50 s
3	5.00	4.00 s
4	10.00	3.00 s
5	20.00	2.00 s
6	40.00	1.00 s
7	1.00	0.00 s
8	1.00	0.00 s
9	1.00	0.00 s
10	1.00	0.00 s
11	1.00	0.00 s
12	1.00	0.00 s
13	1.00	0.00 s
14	1.00	0.00 s
15	1.00	0.00 s
16	1.00	0.00 s

Inverse time setting error signal

The inverse time setting error signal will be activated, if interpolation with the given points fails. See Chapter 5.29 Inverse time operation for more details.

Limitations

The minimum definite time delay start latest, when the measured value is twenty times the setting. However, there are limitations at high setting values due to the measurement range. See Chapter 5.29 Inverse time operation for more details.

6 Supporting functions

6.1 Event log

Event log is a buffer of event codes and time stamps including date and time. For example each start-on, start-off, trip-on or trip-off of any protection stage has a unique event number code. Such a code and the corresponding time stamp is called an event.

As an example of information included with a typical event a programmable stage trip event is shown in the following table.

EVENT	Description	Local panel	Communication protocols
Code: 01E02	Channel 1, event 2	Yes	Yes
Prg1 trip on	Event text	Yes	No
2.7 x In	Fault value	Yes	No
2007-01-31	Date	Yes	Yes
08:35:13.413	Time	Yes	Yes
Type: U12, U23, U31	Fault type	Yes	No

Events are the major data for a SCADA system. SCADA systems are reading events using any of the available communication protocols. Event log can also be scanned using the front panel or using VAMPSET. With VAMPSET the events can be stored to a file especially in case the relay is not connected to any SCADA system.

Only the latest event can be read when using communication protocols or VAMPSET. Every reading increments the internal read pointer to the event buffer. (In case of communication interruptions, the latest event can be reread any number of times using another parameter.) On the local panel scanning the event buffer back and forth is possible.

Event enabling/masking

In case of an uninteresting event, it can be masked, which prevents the particular event(s) to be written in the event buffer. As a default there is room for 200 latest events in the buffer. Event buffer size can be modified from 50 to 2000.

Modification can be done in "Local panel conf" –menu.

Indication screen (popup screen) can also be enabled in this same menu when VAMPSET –setting tool is used. The oldest one will be overwritten, when a new event does occur. The shown resolution of a time stamp is one millisecond, but the actual resolution depends of the particular function creating the event. For example most protection stages create events with 5ms, 10 ms or 20 ms resolution. The absolute accuracy of all time stamps depends on the time

synchronizing of the relay. See Chapter 6.4 System clock and synchronization for system clock synchronizing.

Event buffer overflow

The normal procedure is to poll events from the device all the time. If this is not done then the event buffer could reach its limits. In such case the oldest event is deleted and the newest displayed with OVF code in HMI.

Table 6.1: Setting parameters for events

Parameter	Value	Description	Note
Count		Number of events	
ClrEn	- Clear	Clear event buffer	Set
Order	Old-New New-Old	Order of the event buffer for local display	Set
FVSca		Scaling of event fault value	Set
	PU	Per unit scaling	
	Pri	Primary scaling	
Display Alarms	On Off	Indication dispaly is enabled No indication display	Set
FORMAT OF EVENTS ON THE LOCAL DISPLAY			
Code: CHENN		CH = event channel, NN=event code	
Event description		Event channel and code in plain text	
yyyy-mm-dd		Date (for available date formats, see Chapter 6.4 System clock and synchronization)	
hh:mm:ss.nnn		Time	

ВЯРНО С
ОРИГИНАЛА

ГЕОПЕТ ООД

6.2 Disturbance recorder

The disturbance recorder can be used to record all the measured signals, that is, currents, voltage and the status information of digital inputs (DI) and digital outputs (DO).

Triggering the recorder

The recorder can be triggered by any start or trip signal from any protection stage or by a digital input. The triggering signal is selected in the output matrix (vertical signal DR). The recording can also be triggered manually. All recordings are time stamped.

Reading recordings

The recordings can be uploaded, viewed and analysed with the VAMPSET program. The recording is in COMTRADE format. This also means that other programs can be used to view and analyse the recordings made by the relay.

For more details, please see a separate VAMPSET manual.

Number of channels

At the maximum, there can be 12 recordings, and the maximum selection of channels in one recording 12 (limited in wave form) and digital inputs reserve one channel (includes all the inputs). Also the digital outputs reserve one channel (includes all the outputs). If digital inputs and outputs are recorded, there will be still 10 channels left for analogue waveforms.

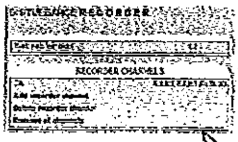


Table 6.2: Disturbance recorder parameters

Parameter	Value	Unit	Description	Note
Mode			Behavior in memory full situation:	Set
	Saturated		No more recordings are accepted	
	Overflow		The oldest recorder will be overwritten	
SR			Sample rate	Set
	32/cycle		Waveform	
	16/cycle		Waveform	
	8/cycle		Waveform	
	1/10ms		One cycle value *)	
	1/20ms		One cycle value **)	
	1/200ms		Average	
	1/1s		Average	
	1/5s		Average	
	1/10s		Average	
	1/15s		Average	
	1/30s		Average	
	1/1min		Average	
Time		s	Recording length	Set
PreTrig		%	Amount of recording data before the trig moment	Set
MaxLen		s	Maximum time setting. This value depends on sample rate, number and type of the selected channels and the configured recording length.	
Status			Status of recording	
	-		Not active	
	Run		Waiting a triggering	
	Trig		Recording	
	FULL		Memory is full in saturated mode	
ManTrig	-, Trig		Manual triggering	Set
ReadyRec	n/m		n = Available recordings / m = maximum number of recordings The value of 'm' depends on sample rate, number and type of the selected channels and the configured recording length.	

Parameter	Value	Unit	Description	Note
AddCh			Add one channel. Maximum simultaneous number of channels is 12.	Set
	IL1, IL2, IL3		Phase current	
	Io		Measured residual current	
	U12, U23, U31		Line-to-line voltage	
	UL1, UL2, UL3		Phase-to-neutral voltage	
	Uo		Zero sequence voltage	
	f		Frequency	
	P, Q, S		Active, reactive, apparent power	
	P.F.		Power factor	
	CosFii		cosφ	
	IoCalc		Phasor sum Io = (IL1+IL2+IL3)/3	
	I1		Positive sequence current	
	I2		Negative sequence current	
	I2/I1		Relative current unbalance	
	I2/In		Current unbalance [x I_{MOT}]	
	U1		Positive sequence voltage	
	U2		Negative sequence voltage	
	U2/U1		Relative negative sequence voltage	
	IL		Average (IL1 + IL2 + IL3) / 3	
	Uphase		Average phase voltage	
	Uline		Average line-to-lines voltages	
	DI, DO		Digital inputs, Digital outputs	
	TanFii		tanφ	
	THDIL1, THDIL2, THDIL3		Total harmonic distortion of IL1, IL2 or IL3	
	THDUa, THDUb, THDUc		Total harmonic distortion of Ua, Ub or Uc	
	Qrms		Reactive power rms value	
	Srms		Apparent power rms value	
	fy		Frequency behind circuit breaker	
	fz		Frequency behind 2nd circuit breaker	
	U12y		Voltage behind circuit breaker	
	U12z		Voltage behind 2nd circuit breaker	
	IL1RMS, IL2MRS, IL3RMS		IL1, IL2, IL3 RMS for average sampling	
	Starts		Protection stage start signals	
	Trips		Protection stage trip signals	
Delete recorder channel			Delete selected channel	
ClrCh	-, Clear		Remove all channels	Set
(Ch)			List of selected channels	

Set = An editable parameter (password needed).

*) This is the fundamental frequency rms value of one cycle updated every 10 ms.

**) This is the fundamental frequency rms value of one cycle updated every 20 ms.

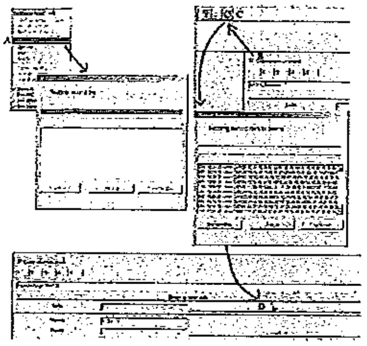
For details of setting ranges, see Chapter 10.4 Supporting functions.

6.2.1 Running virtual comtrade files

Virtual comtrade files can be run with the device. Device behaviour can be analysed by playing the recorder data over and over again in the relay memory.

Steps of opening the VAMPSET setting tool:

1. Go to "Disturbance record" and select Open... (A).
2. Select the comtrade file from you hard disc or equivalent. VAMPSET is now ready to read the recording.
3. The virtual measurement has to be enabled (B) in order to send record data to the relay (C).
4. Sending the file to the device's memory takes a few seconds. Initiate playback of the file by pressing the Go! button (D). The "Change to control mode" button takes you back to the virtual measurement.



NOTE: The sample rate of the comtrade file has to be 32/cycle (625 micro seconds when 50 Hz is used). The channel names have to correspond to the channel names in VAMP relays: I_{L1}, I_{L2}, I_{L3}, I_0, U_{12}, U_{23}, U_{L1}, U_{L2}, U_{L3} and U_0.

6.3 Cold load pick-up and magnetising inrush

Cold load pick-up

A situation is regarded as cold load when all the three phase currents have been less than a given idle value and then at least one of the currents exceeds a given pick-up level within 80 ms. In such case the cold load detection signal is activated for a given time. This signal is available for output matrix and blocking matrix. Using virtual outputs of the output matrix setting group control is possible.

Application for cold load detection

Right after closing a circuit breaker a given amount of overload can be allowed for a given limited time to take care of concurrent thermostat controlled loads. Cold load pick-up function does this for example by selecting a more coarse setting group for over-current stage(s). It is also possible to use the cold load detection signal to block any set of protection stages for a given time.

Magnetising inrush detection

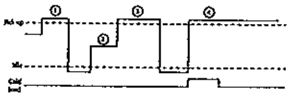
Magnetising inrush detection is quite similar with the cold load detection but it does also include a condition for second harmonic relative content of the currents. When all phase currents have been less than a given idle value and then at least one of them exceeds a given pick-up level within 80 ms and the ratio 2nd harmonic ratio to fundamental frequency, I_{f2}/I_{f1}, of at least one phase exceeds the given setting, the inrush detection signal is activated. This signal is available for output matrix and blocking matrix. Using virtual outputs of the output matrix setting group control is possible.

By setting the 2nd harmonic pickup parameter for I_{f2}/I_{f1} to zero, the inrush signal will behave equally with the cold load pick-up signal.

Application for inrush current detection

The inrush current of transformers usually exceeds the pick-up setting of sensitive overcurrent stages and contains a lot of even harmonics. Right after closing a circuit breaker the pick-up and tripping of sensitive overcurrent stages can be avoided by selecting a more coarse setting group for the appropriate over-current stage with inrush detect signal. It is also possible to use the detection signal to block any set of protection stages for a given time.

NOTE: Inrush detection is based on FFT - calculation which recuires full cycle of data for analyzing the harmonic content. Therefore when using inrush blocking function the cold load pick up starting conditions are used for activating the inrush blocking when the current rise is noticed. If in the signal is found second harmonic component after 1st cycle the blocking is continued, otherwise 2nd harmonic based blocking signal is released. Inrush blocking is recommended to be used into time delayed overcurrent stages while non blocked instant overcurrent stage is set to 20 % higher than expected inrush current. By this scheme fast reaction time in short circuit faults during the energization can be achieved while time delayed stages are blocked by inrush function.



1. No activation because the current has not been under the set I_{DLE} current.
2. Current dropped under the I_{DLE} current level but now it stays between the I_{DLE} current and the pick-up current for over 80ms.
3. No activation because the phase two lasted longer than 80ms.
4. Now we have a cold load activation which lasts as long as the operation time was set or as long as the current stays above the pick-up setting.

Figure 6.1: Functionality of cold load / inrush current feature.

Table 6.3: Parameters of the cold load & inrush detection function

Parameter	Value	Unit	Description	Note
ColdLd	- Start Trip		Status of cold load detection: Cold load situation is active Timeout	
Inrush	- Start Trip		Status of inrush detection: Inrush is detected Timeout	
ILmax		A	The supervised value. Max. of IL1, IL2 and IL3	
Pickup		A	Primary scaled pick-up value	
Idle		A	Primary scaled upper limit for idle current	
MaxTime		s		Set
Idle		xImode	Current limit setting for idle situation	Set
Pickup		xImode	Pick-up setting for minimum start current	Set
	80	ms	Maximum transition time for start recognition	
Pickupf2		%	Pick-up value for relative amount of 2nd harmonic, I_{f2}/I_{f1}	Set

Set = An editable parameter (password needed).

6.4 System clock and synchronization

The internal clock of the relay is used to time stamp events and disturbance recordings.

The system clock should be externally synchronised to get comparable event time stamps for all the relays in the system.

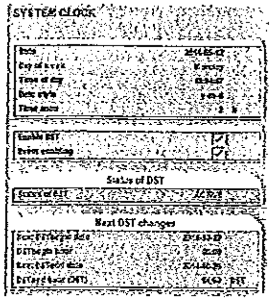
The synchronizing is based on the difference of the internal time and the synchronising message or pulse. This deviation is filtered and the internal time is corrected softly towards a zero deviation.

Time zone offsets

Time zone offset (or bias) can be provided to adjust the local time for IED. The Offset can be set as a Positive (+) or Negative (-) value within a range of -15.00 to +15.00 hours and a resolution of 0.01/h. Basically quarter hour resolution is enough.

Daylight saving time (DST)

IED provides automatic daylight saving adjustments when configured. A daylight savings time (summer time) adjustment can be configured separately and in addition to a time zone offset.

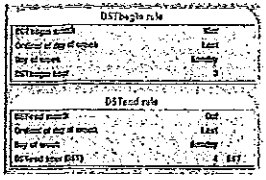


Daylight time standards vary widely throughout the world. Traditional daylight/summer time is configured as one (1) hour positive bias. The new US/Canada DST standard, adopted in the spring of 2007 is: one (1) hour positive bias, starting at 2:00am on the second Sunday in March, and ending at 2:00am on the first Sunday in November. In the European Union, daylight change times are defined relative to the UTC time of day instead of local time of day (as in U.S.) European customers, please carefully find out local country rules for DST.

The daylight saving rules for Finland are the IED defaults (24-hour clock):

- Daylight saving time start: Last Sunday of March at 03.00

- Daylight saving time end: Last Sunday of October at 04.00



To ensure proper hands-free year-around operation, automatic daylight time adjustments must be configured using the "Enable DST" and not with the time zone offset option.

Adapting auto adjust

During tens of hours of synchronizing the device will learn its average deviation and starts to make small corrections by itself. The target is that when the next synchronizing message is received, the deviation is already near zero. Parameters "AAIntv" and "AvDrft" will show the adapted correction time interval of this ±1 ms auto-adjust function.

Time drift correction without external sync

If any external synchronizing source is not available and the system clock has a known steady drift, it is possible to roughly correct the clock deviation by editing the parameters "AAIntv" and "AvDrft". The following equation can be used if the previous "AAIntv" value has been zero.

$$AAIntv = \frac{604.8}{DriftInOneWeek}$$

If the auto-adjust interval "AAIntv" has not been zero, but further trimming is still needed, the following equation can be used to calculate a new auto-adjust interval.

$$AAIntv_{NEW} = \frac{1}{\frac{1}{AAIntv_{PREVIOUS}} + \frac{DriftInOneWeek}{604.8}}$$

The term *DriftInOneWeek*/604.8 may be replaced with the relative drift multiplied by 1000, if some other period than one week has been used. For example if the drift has been 37 seconds in 14 days, the relative drift is 37*1000/(14*24*3600) = 0.0306 ms/s.

Example 1

If there has been no external sync and the relay's clock is leading sixty-one seconds a week and the parameter AAIntv has been zero, the parameters are set as

$$AvDrft = Lead$$

$$AAIntv = \frac{604.8}{61} = 9.9s$$

With these parameter values the system clock corrects itself with –1 ms every 9.9 seconds which equals –61.091 s/week.

Example 2

If there is no external sync and the relay's clock has been lagging five seconds in nine days and the AAIntv has been 9.9 s, leading, then the parameters are set as

$$AAIntv_{NEW} = \frac{1}{\frac{1}{9.9} - \frac{5000}{9 \cdot 24 \cdot 3600}} = 10.6$$

$$AvDrft = Lead$$

When the internal time is roughly correct – deviation is less than four seconds – any synchronizing or auto-adjust will never turn the clock backwards. Instead, in case the clock is leading, it is softly slowed down to maintain causality.

Table 6.4: System clock parameters

Parameter	Value	Unit	Description	Note
Date			Current date	Set
Time			Current time	Set
Style			Date format	Set
	y-d-m		Year-Month-Day	
	d.m.y		Day.Month.Year	
	m/d/y		Month/Day/Year	
SyncDI	Possible values depends on the types of I/O cards		The digital input used for clock synchronisation.	***)
	-		DI not used for synchronizing	
	DI1 – DI6		Minute pulse input	
TZone	-15.00 – +15.00 *)		UTC time zone for SNTP synchronization. Note: This is a decimal number. For example for state of Nepal the time zone 5:45 is given as 5.75	Set
DST	No; Yes		Daylight saving time for SNTP	Set
SySrc			Clock synchronisation source	
	Internal		No sync recognized since 200s	
	DI		Digital input	
	SNTP		Protocol sync	
	SpaBus		Protocol sync	
	ModBus		Protocol sync	
	ModBus TCP		Protocol sync	
	IEC101		Protocol sync	
	IEC103		Protocol sync	
	DNP3		Protocol sync	
MsgCnt	0 – 65535, 0 – etc.		The number of received synchronisation messages or pulses	
Dev	±32767	ms	Latest time deviation between the system clock and the received synchronization	
SyOS	±10000.000	s	Synchronisation correction for any constant deviation in the synchronizing source	Set
AAIntv	±1000	s	Adapted auto adjust interval for 1 ms correction	Set**)
AvDrft	Lead; Lag		Adapted average clock drift sign	Set**)
FilDev	±125	ms	Filtered synchronisation deviation	

Set = An editable parameter (password needed).

*) A range of -11 h – +12 h would cover the whole Earth but because the International Date Line does not follow the 180° meridian, a more wide range is needed.

**) If external synchronization is used this parameter will be set automatically.

***) Set the DI delay to its minimum and the polarity such that the leading edge is the synchronizing edge.

Synchronisation with DI

Clock can be synchronized by reading minute pulses from digital inputs, virtual inputs or virtual outputs. Sync source is selected with SyncDI setting. When rising edge is detected from the selected input, system clock is adjusted to the nearest minute. Length of digital input pulse should be at least 50 ms. Delay of the selected digital input should be set to zero.

Synchronisation correction

If the sync source has a known offset delay, it can be compensated with SyOS setting. This is useful for compensating hardware delays or transfer delays of communication protocols. A positive value will compensate a lagging external sync and communication delays. A negative value will compensate any leading offset of the external synch source.

Sync source

When the device receives new sync message, the sync source display is updated. If no new sync messages are received within next 1.5 minutes, the device will change to internal sync mode.

Deviation

The time deviation means how much system clock time differs from sync source time. Time deviation is calculated after receiving new sync message. The filtered deviation means how much the system clock was really adjusted. Filtering takes care of small deviation in sync messages.

Auto-lag/lead

The device synchronizes to the sync source, meaning it starts automatically leading or lagging to stay in perfect sync with the master. The learning process takes few days.

6.5 Self-supervision

The functions of the microcontroller and the associated circuitry, as well as the program execution are supervised by means of a separate watchdog circuit. Besides supervising the relay, the watchdog circuit attempts to restart the micro controller in an inoperable situation. If the micro controller does not resart, the watchdog issues a self-supervision signal indicating a permanent internal condition.

When the watchdog circuit detects a permanent fault, it always blocks any control of other output relays (except for the self-supervision output relay). In addition, the internal supply voltages are supervised. Should the auxiliary supply of the IED disappear, an indication is

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automatically given because the IED status inoperative (SF) output relay functions on a working current principle. This means that the SF relay is energized when the auxiliary supply is on. The Service LED and SF contact are assigned to work together. Manufacturer recommends that SF output is hardwired into the substation's automation system for alarm purposes.

6.5.1 Diagnostics

The device runs self-diagnostic tests for hardware and software in boot sequence and also performs runtime checking.

Permanent inoperative state

If permanent inoperative state has been detected, the device releases SF relay contact and status LED is set on. Local panel will also display a detected fault message. Permanet inoperative state is entered when the device is not able to handle main functions.

Temporal inoperative state

When self-diagnostic function detects a temporal inoperative state, Selfdiag matrix signal is set and an event (E56) is generated. In case the inoperative state was only temporary, an off event is generated (E57). Self diagnostic state can be reset via local HMI.

Diagnostic registers

There are four 16-bit diagnostic registers which are readable through remote protocols. The following table shows the meaning of each diagnostic register and their bits.

Register	Bit	Code	Description
SelfDiag1	0 (LSB)	(Reserved)	(Reserved)
	1	(Reserved)	(Reserved)
	2	T1	Detected output relay fault
	3	T2	
	4	T3	
	5	T4	
	6	T5	
	7	T6	
	8	T7	
	10	A1	
SelfDiag4	0 (LSB)	+12V	Detected internal voltage fault
	1	ComBuff	BUS: detected buffer error
	2	Order Code	Detected order code error
	3	Slot card	Detected option card error

The code is displayed in self diagnostic events and on the diagnostic menu on local panel and VAMPSET.

6.6 Voltage sags and swells

The power quality of electrical networks has become increasingly important. The sophisticated loads (e.g. computers etc.) require uninterruptible supply of "clean" electricity. VAMP protection platform provides many power quality functions that can be used to evaluate, monitor and alarm on the basis of the quality. One of the most important power quality functions are voltage sag and swell monitoring.

VAMP provides separate monitoring logs for sags and swells. The voltage log is trigged, if any voltage input either goes under the sag limit (U<) or exceeds the swell limit (U>). There are four registers for both sags and swells in the fault log. Each register will have start time, phase information, duration, minimum, average, maximum voltage values of each sag and swell event. Furthermore, there are total number of sags and swells counters as well as total timers for sags and swells.

The voltage power quality functions are located under the submenu "U".

Table 6.5: Setting parameters of sags and swells monitoring

Parameter	Value	Unit	Default	Description
U>	20 – 150	%	110	Setting value of swell limit
U<	10 – 120	%	90	Setting value of sag limit
Delay	0.04 – 1.00	s	0.06	Delay for sag and swell detection
SagOn	On; Off	-	On	Sag on event
SagOff	On; Off	-	On	Sag off event
SwelOn	On; Off	-	On	Swell on event
SwelOf	On; Off	-	On	Swell off event

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Table 6.6: Recorded values of sags and swells monitoring

	Parameter	Value	Unit	Description
Recorded values	Count		-	Cumulative sag counter
	Total		-	Cumulative sag time counter
	Count		-	Cumulative swell counter
	Total		-	Cumulative swell time counter
Sag / swell logs 1 – 4	Date		-	Date of the sag/swell
	Time		-	Time stamp of the sag/swell
	Type		-	Voltage inputs that had the sag/swell
	Time		s	Duration of the sag/swell
	Min1		% Un	Minimum voltage value during the sag/swell in the input 1
	Min2		% Un	Minimum voltage value during the sag/swell in the input 2
	Min3		% Un	Minimum voltage value during the sag/swell in the input 3
	Ave1		% Un	Average voltage value during the sag/swell in the input 1
	Ave2		% Un	Average voltage value during the sag/swell in the input 2
	Ave3		% Un	Average voltage value during the sag/swell in the input 3
	Max1		% Un	Maximum voltage value during the sag/swell in the input 1
	Max2		% Un	Maximum voltage value during the sag/swell in the input 2
	Max3		% Un	Maximum voltage value during the sag/swell in the input 3

For details of setting ranges, see Chapter 10.4 Supporting functions. -

6.7 Voltage interruptions

The device includes a simple function to detect voltage interruptions. The function calculates the number of voltage interruptions and the total time of the voltage-off time within a given calendar period. The period is based on the real time clock of the device. The available periods are:

- 8 hours, 00:00 – 08:00, 08:00 – 16:00, 16:00 – 24:00
- one day, 00:00 – 24:00
- one week, Monday 00:00 – Sunday 24:00
- one month, the first day 00:00 – the last day 24:00
- one year, 1st January 00:00 – 31st December 24:00

After each period, the number of interruptions and the total interruption time are stored as previous values. The interruption counter and the total time are cleared for a new period. The old previous values are overwritten.

The voltage interruption is based on the value of the positive sequence voltage U_1 and a user given limit value. Whenever the measured U_1 goes below the limit, the interruption counter is increased, and the total time counter starts increasing.

Shortest recognized interruption time is 40 ms. If the voltage-off time is shorter it may be recognized depending on the relative depth of the voltage dip.

If the voltage has been significantly over the limit U_1< and then there is a small and short under-swing, it will not be recognized (Figure 6.2).

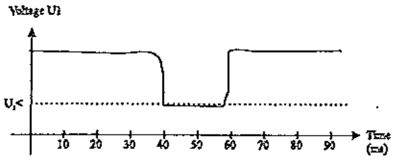

Figure 6.2: A short voltage interruption which is probably not recognized

On the other hand, if the limit U_1< is high and the voltage has been near this limit, and then there is a short but very deep dip, it will be recognized (Figure 6.3).

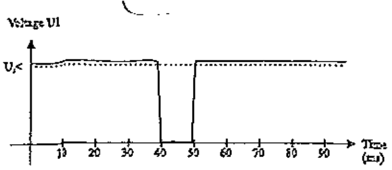

Figure 6.3: A short voltage interrupt that will be recognized

Table 6.7: Setting parameters of the voltage sag measurement function:

Parameter	Value	Unit	Default	Description
U1<	10.0 – 120.0	%	64	Setting value
Period	8h Day Week Month	-	Month	Length of the observation period
Date		-	-	Date
Time		-	-	Time

Table 6.8: Measured and recorded values of voltage sag measurement function:

	Parameter	Value	Unit	Description
Measured value	Voltage	LOW; OK	-	Current voltage status
	U1		%	Measured positive sequence voltage
Recorded values	Count		-	Number of voltage sags during the current observation period
	Prev		-	Number of voltage sags during the previous observation period
	Total		s	Total (summed) time of voltage sags during the current observation period
	Prev		s	Total (summed) time of voltage sags during the previous observation period

For details of setting ranges, see Chapter 10.4 Supporting functions.

6.8 Current transformer supervision

The relay supervise the external wiring between the relay terminals and current transformers (CT) and the CT themselves. Furthermore, this is a safety function as well, since an open secondary of a CT, causes dangerous voltages.

The CT supervisor function measures phase currents. If one of the three phase currents drops below I_{MIN}< setting, while another phase current is exceeding the I_{MAX}> setting, the function will issue an alarm after the operation delay has elapsed.

Table 6.9: Setting parameters of CT supervisor CTSV

Parameter	Value	Unit	Default	Description
Imax>	0.0 – 10.0	xIn	2.0	Upper setting for CT supervisor current scaled to primary value, calculated by relay
Imin<	0.0 – 10.0	xIn	0.2	Lower setting for CT supervisor current scaled to primary value, calculated by relay
t>	0.02 – 600.0	s	0.10	Operation delay
CT on	On; Off	-	On	CT supervisor on event
CT off	On; Off	-	On	CT supervisor off event

Table 6.10: Measured and recorded values of CT supervisor CTSV

	Parameter	Value	Unit	Description
Measured value	ILmax		A	Maximum of phase currents
	ILmin		A	Minimum of phase currents
Display	Imax>, Imin<		A	Setting values as primary values
Recorded values	Date		-	Date of CT supervision alarm
	Time		-	Time of CT supervision alarm
	Imax		A	Maximum phase current
	Imin		A	Minimum phase current

For details of setting ranges, see Chapter 10.4 Supporting functions.

6.9 Voltage transformer supervision

The device supervises the VTs and VT wiring between the device terminals and the VTs. If there is a fuse in the voltage transformer circuitry, the blown fuse prevents or distorts the voltage measurement. Therefore, an alarm should be issued. Furthermore, in some applications, protection functions using voltage signals, should be blocked to avoid false tripping.

The VT supervisor function measures the three phase voltages and currents. The negative sequence voltage U_2 and the negative sequence currentI_2 are calculated. If U_2 exceed the U_2> setting and at the same time, I_2 is less than the I_2< setting, the function will issue an alarm after the operation delay has elapsed.

Table 6.11: Setting parameters of VT supervisor VTSV ()

Parameter	Value	Unit	Default	Description
U2>	0.0 – 200.0	% Un	34.6	Upper setting for VT supervisor
I2<	0.0 – 200.0	% In	100.0	Lower setting for VT supervisor
t>	0.02 – 600.0	s	0.10	Operation delay
VT on	On; Off	-	On	VT supervisor on event
VT off	On; Off	-	On	VT supervisor off event

Table 6.12: Measured and recorded values of VT supervisor VTSV ()

	Parameter	Value	Unit	Description
Measured value	U2		% Un	Measured negative sequence voltage
	I2		% In	Measured negative sequence current
Recorded Values	Date		-	Date of VT supervision alarm
	Time		-	Time of VT supervision alarm
	U2		% Un	Recorded negative sequence voltage
	I2		% In	Recorded negative sequence current

For details of setting ranges, see Chapter 10.4 Supporting functions.

6.10 Circuit breaker condition monitoring

The relay has a condition monitoring function that supervises the wearing of the circuit-breaker. The condition monitoring can give alarm for the need of CB maintenance well before the CB condition is critical.

The CB wear function measures the breaking current of each CB pole separately and then estimates the wearing of the CB accordingly the permissible cycle diagram. The breaking current is registered when the trip relay supervised by the circuit breaker failure protection (CBFP) is activated. (See Chapter 5.27 Circuit breaker failure protection CBFP (50BF) for CBFP and the setting parameter "CBrelay".)

Breaker curve and its approximation

The permissible cycle diagram is usually available in the documentation of the CB manufacturer (Figure 6.4). The diagram specifies the permissible number of cycles for every level of the breaking current. This diagram is parameterised to the condition monitoring function with maximum eight [current, cycles] points. See Table 6.13. If less than eight points needed, the unused points are set to [I_{BIG}, 1], where I_{BIG} is more than the maximum breaking capacity.

If the CB wearing characteristics or part of it is a straight line on a log/log graph, the two end points are enough to define that part of the characteristics. This is because the relay is using logarithmic interpolation for any current values falling in between the given current points 2 – 8.

The points 4 – 8 are not needed for the CB in Figure 6.4. Thus they are set to 100 kA and one operation in the table to be discarded by the algorithm.

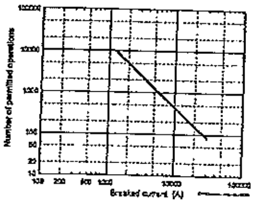

Figure 6.4: An example of a circuit breaker wearing characteristic graph.

Table 6.13: An example of circuit breaker wearing characteristics in a table format. The values are taken from the figure above. The table is edited with VAMPSET under menu "BREAKER CURVE".

Point	Interrupted current (kA)	Number of permitted operations
1	0 (mechanical age)	10000
2	1.25 (rated current)	10000
3	31.0 (maximum breaking current)	80
4	100	1
5	100	1
6	100	1
7	100	1
8	100	1

Setting alarm points

There are two alarm points available having two setting parameters each.

- Current
  The first alarm can be set for example to nominal current of the CB or any application typical current. The second alarm can be set for example according a typical fault current.
- Operations left alarm limit
  An alarm is activated when there are less operation left at the given current level than this limit.

Any actual interrupted current will be logarithmically weighted for the two given alarm current levels and the number of operations left at the alarm points is decreased accordingly. When the "operations left" i.e. the number of remaining operations, goes under the given alarm limit, an alarm signal is issued to the output matrix. Also an event is generated depending on the event enabling.

Clearing "operations left" counters

After the breaker curve table is filled and the alarm currents are defined, the wearing function can be initialised by clearing the decreasing operation counters with parameter "Clear" (Clear oper. left cntrs). After clearing the relay will show the maximum allowed operations for the defined alarm current levels.

Operation counters to monitor the wearing

The operations left can be read from the counters "Al1Ln" (Alarm 1) and "Al2Ln" (Alarm2). There are three values for both alarms, one for each phase. The smallest of three is supervised by the two alarm functions.

Logarithmic interpolation

The permitted number of operations for currents in between the defined points are logarithmically interpolated using equation

Equation 6.1:

$$C = \frac{a}{I^n}$$

C = permitted operations

I = interrupted current

a = constant according Equation 6.2

n = constant according Equation 6.3

Equation 6.2:

$$n = \frac{\ln \frac{C_k}{C_{k+1}}}{\ln \frac{I_{k+1}}{I_k}}$$

Equation 6.3:

$$a = C_k I_k^n$$

ln = natural logarithm function

C_k = permitted operations. k = row 2 – 7 in Table 6.13.

I_k = corresponding current. k = row 2 – 7 in Table 6.13.

C_{k+1} = permitted operations. k = row 2 – 7 in Table 6.13.

I_{k+1} = corresponding current. k = row 2 – 7 in Table 6.13.

Example of the logarithmic interpolation

Alarm 2 current is set to 6 kA. What is the maximum number of operations according Table 6.13.

The current 6 kA lies between points 2 and 3 in the table. That gives value for the index k. Using

k = 2

C_k = 10000

C_{k+1} = 80

I_{k+1} = 31 kA

I_k = 1.25 kA

and the Equation 6.2 and Equation 6.3, the relay calculates

$$n = \frac{\ln \frac{10000}{80}}{\ln \frac{31000}{1250}} = 1.5038$$

$$a = 10000 \cdot 1250^{1.5038} = 454 \cdot 10^6$$

Using Equation 6.1 the relay gets the number of permitted operations for current 6 kA.

$$C = \frac{454 \cdot 10^6}{6000^{1.5038}} = 945$$

Thus the maximum number of current breaking at 6 kA is 945. This can be verified with the original breaker curve in Figure 6.4. Indeed, the figure shows that at 6 kA the operation count is between 900 and 1000. A useful alarm level for operation-left, could be in this case for example 50 being about five per cent of the maximum.

Example of operation counter decrementing when the CB is breaking a current

Alarm2 is set to 6 kA. CBFP is supervising trip relay T1 and trip signal of an overcurrent stage detecting a two phase fault is connected to this trip relay T1. The interrupted phase currents are 12.5 kA, 12.5 kA and 1.5 kA. How many are Alarm2 counters decremented?

Using Equation 6.1 and values n and a from the previous example, the relay gets the number of permitted operation at 10 kA.

$$C_{10kA} = \frac{454 \cdot 10^6}{12500^{1.5038}} = 313$$

At alarm level 2, 6 kA, the corresponding number of operations is calculated according

Equation 6.4:

$$\Delta = \frac{C_{AlarmMax}}{C}$$

$$\Delta_{L1} = \Delta_{L2} = \frac{945}{313} = 3$$

Thus Alarm2 counters for phases L1 and L2 are decremented by 3. In phase L1 the currents is less than the alarm limit current 6 kA. For such currents the decrement is one.

Δ_{L3} = 1

Table 6.14: Local panel parameters of CBWEAR function

Parameter	Value	Unit	Description	Set
CBWEAR STATUS				
			Operations left for	
Al1L1			- Alarm 1, phase L1	
Al1L2			- Alarm 1, phase L2	
Al1L3			- Alarm 1, phase L3	
Al2L1			- Alarm 2, phase L1	
Al2L2			- Alarm 2, phase L2	
Al2L3			- Alarm 2, phase L3	
Latest trip				
Date			Time stamp of the latest trip operation	
time				
IL1		A	Broken current of phase L1	
IL2		A	Broken current of phase L2	
IL3		A	Broken current of phase L3	
CBWEAR SET				
Alarm1				
Current	0.00 – 100.00	kA	Alarm1 current level	Set
Cycles	100000 – 1		Alarm1 limit for operations left	Set
Alarm2				
Current	0.00 – 100.00	kA	Alarm2 current level	Set
Cycles	100000 – 1		Alarm2 limit for operations left	Set
CBWEAR SET2				
Al1On	On ; Off		'Alarm1 on' event enabling	Set
Al1Off	On ; Off		'Alarm1 off' event enabling	Set
Al2On	On ; Off		'Alarm2 on' event enabling	Set
Al2Off	On ; Off		'Alarm2 off' event enabling	Set
Clear	-; Clear		Clearing of cycle counters	Set

Set = An editable parameter (password needed).

The breaker curve table is edited with VAMPSET.

6.11 Energy pulse outputs

The device can be configured to send a pulse whenever certain amount of energy has been imported or exported. The principle is presented in Figure 6.5. Each time the energy level reaches the pulse size, an output relay is activated and the relay will be active as long as defined by a pulse duration setting.

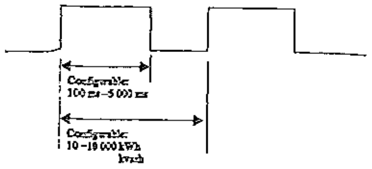

Figure 6.5: Principle of energy pulses

The relay has four energy pulse outputs. The output channels are:

- Active exported energy
- Reactive exported energy
- Active imported energy
- Reactive imported energy

Each channel can be connected to any combination of the output relays using output matrix. The parameters for the energy pulses can be found in the E menu under the submenus E-PULSE SIZES and E-PULSE DURATION.

Table 6.15: Energy pulse output parameters

	Parameter	Value	Unit	Description
E-PULSE SIZES	E+	10 – 10 000	kWh	Pulse size of active exported energy
	Eq+	10 – 10 000	kvarh	Pulse size of reactive exported energy
	E-	10 – 10 000	kWh	Pulse size of active imported energy
	Eq-	10 – 10 000	kvarh	Pulse size of reactive imported energy
E-PULSE DURATION	E+	100 – 5000	ms	Pulse length of active exported energy
	Eq+	100 – 5000	ms	Pulse length of reactive exported energy
	E-	100 – 5000	ms	Pulse length of active imported energy
	Eq-	100 – 5000	ms	Pulse length of reactive imported energy

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Scaling examples

1. Average active exported power is 250 MW.
   Peak active exported power is 400 MW.
   Pulse size is 250 kWh.
   The average pulse frequency will be 250/0.250 = 1000 pulses/h.
   The peak pulse frequency will be 400/0.250 = 1600 pulses/h.
   Set pulse length to 3600/1600 - 0.2 = 2.0 s or less.
   The lifetime of the mechanical output relay will be
   $50x10^6/1000$ h = 6 a.
   This is not a practical scaling example unless an output relay lifetime of about six years is accepted.
2. Average active exported power is 100 MW.
   Peak active exported power is 800 MW.
   Pulse size is 400 kWh.
   The average pulse frequency will be 100/0.400 = 250 pulses/h.
   The peak pulse frequency will be 800/0.400 = 2000 pulses/h.
   Set pulse length to 3600/2000 - 0.2 = 1.6 s or less.
   The lifetime of the mechanical output relay will be
   $50x10^6/250$ h = 23 a.
3. Average active exported power is 20 MW.
   Peak active exported power is 70 MW.
   Pulse size is 60 kWh.
   The average pulse frequency will be 25/0.060 = 416.7 pulses/h.
   The peak pulse frequency will be 70/0.060 = 1166.7 pulses/h.
   Set pulse length to 3600/1167 - 0.2 = 2.8 s or less.
   The lifetime of the mechanical output relay will be
   $50x10^6/417$ h = 14 a.
4. Average active exported power is 1900 kW.
   Peak active exported power is 50 MW.
   Pulse size is 10 kWh.
   The average pulse frequency will be 1900/10 = 190 pulses/h.
   The peak pulse frequency will be 50000/10 = 5000 pulses/h.
   Set pulse length to 3600/5000 - 0.2 = 0.5 s or less.
   The lifetime of the mechanical output relay will be
   $50x10^6/190$ h = 30 a.

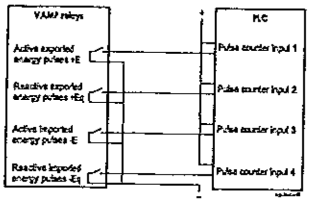

Figure 6.6: Application example of wiring the energy pulse outputs to a PLC having common plus and using an external wetting voltage

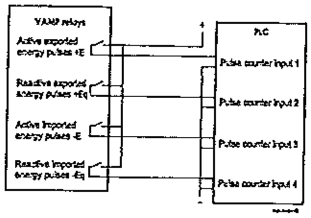

Figure 6.7: Application example of wiring the energy pulse outputs to a PLC having common minus and using an external wetting voltage

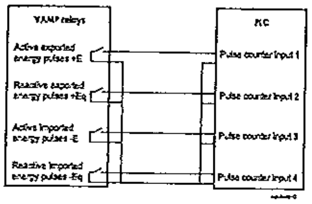

Figure 6.8: Application example of wiring the energy pulse outputs to a PLC having common minus and an internal wetting voltage.

6.12 Running hour counter

This function calculates the total active time of the selected digital input, virtual I/O or output matrix output signal. The resolution is ten seconds.

Table 6.16: Running hour counter parameters

Parameter	Value	Unit	Description	Note
Runh	0 – 876000	h	Total active time, hours Note: The label text "Runh" can be edited with VAMPSET.	(Set)
Runs	0 – 3599	s	Total active time, seconds	(Set)
Starts	0 – 65535		Activation counter	(Set)
Status	Stop Run		Current status of the selected digital signal	
DI			Select the supervised signal	Set
	-		None	
	DI1 – DIn,		Physical inputs	
	VI1 – VIn,		Virtual inputs	
	LedA,		Output matrix out signal LA	
	LedB,		Output matrix out signal LB	
	LedC,		Output matrix out signal LC	
	LedD,		Output matrix out signal LD	
	LedE,		Output matrix out signal LE	
	LedF,		Output matrix out signal LF	
	LedG,		Output matrix out signal LG	
	LedDR,		Output matrix out signal DR	
	VO1 – VO6		Virtual outputs	
Started at			Date and time of the last activation	
Stopped at			Date and time of the last inactivation	

Set = An editable parameter (password needed).

(Set) = An informative value which can be edited as well.

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6.13 Timers

The VAMP protection platform includes four settable timers that can be used together with the user's programmable logic or to control setting groups and other applications that require actions based on calendar time. Each timer has its own settings. The selected on-time and off-time is set and then the activation of the timer can be set to be as daily or according the day of week (See the setting parameters for details). The timer outputs are available for logic functions and for the block and output matrix.

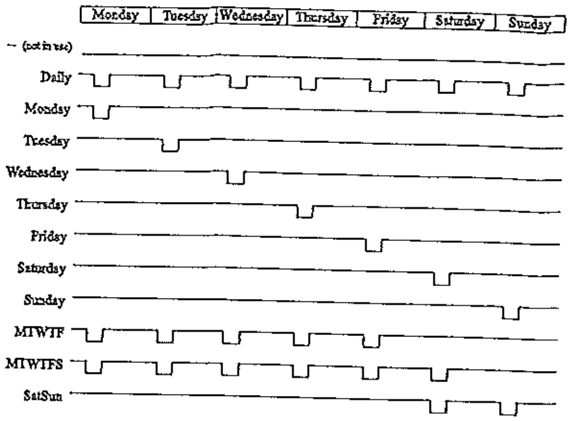


Figure 6.9: Timer output sequence in different modes.

The user can force any timer, which is in use, on or off. The forcing is done by writing a new status value. No forcing flag is needed as in forcing i.e. the output relays.

The forced time is valid until the next forcing or until the next reversing timed act from the timer itself.

The status of each timer is stored in non-volatile memory when the auxiliary power is switched off. At start up, the status of each timer is recovered.

Table 6.17: Setting parameters of timers

Parameter	Value	Description
TimerN		Timer status
	-	Not in use
	0	Output is inactive
	1	Output is active
On	hh:mm:ss	Activation time of the timer
Off	hh:mm:ss	De-activation time of the timer
Mode		For each four timers there are 12 different modes available:
	-	The timer is off and not running. The output is off i.e. 0 all the time.
	Daily	The timer switches on and off once every day.
	Monday	The timer switches on and off every Monday.
	Tuesday	The timer switches on and off every Tuesday.
	Wednesday	The timer switches on and off every Wednesday.
	Thursday	The timer switches on and off every Thursday.
	Friday	The timer switches on and off every Friday.
	Saturday	The timer switches on and off every Saturday.
	Sunday	The timer switches on and off every Sunday.
	MTWTF	The timer switches on and off every day except Saturdays and Sundays
	MTWTFS	The timer switches on and off every day except Sundays.
	SatSun	The timer switches on and off every Saturday and Sunday.

6.14 Combined overcurrent status

This function is collecting faults, fault types and registered fault currents of all enabled overcurrent stages.

Table 6.18: Line fault parameters

Parameter	Value	Unit	Description	Note
IFltLas		xImode	Current of the latest overcurrent fault	(Set)
LINE ALARM				
AlrL1 AlrL2 AlrL3	 0 1		Start (=alarm) status for each phase. 0 = No start since alarm ClrDly 1 = Start is on	
OCs	 0 1		Combined overcurrent start status. AlrL1 = AlrL2 = AlrL3 = 0 AlrL1 = 1 or AlrL2 = 1 or AlrL3 = 1	
LxAlarm	On / Off		'On' Event enabling for AlrL1 – 3 Events are enabled / Events are disabled	Set
LxAlarmOff	On / Off		'Off' Event enabling for AlrL1 – 3 Events are enabled / Events are disabled	Set
OCAlarm	On / Off		'On' Event enabling for combined o/c starts Events are enabled / Events are disabled	Set
OCAlarmOff	On / Off		'Off' Event enabling for combined o/c starts Events are enabled / Events are disabled	Set
IncFltEvnt	 On Off		Disabling several start and trip events of the same fault Several events are enabled *) Several events of an increasing fault is disabled *)	Set
ClrDly	0 – 65535	s	Duration for active alarm status AlrL1, Alr2, AlrL3 and OCs	Set
LINE FAULT				
FltL1 FltL2 FltL3	 0 1		Fault (=trip) status for each phase. 0 = No fault since fault ClrDly 1 = Fault is on	
OCt	 0 1		Combined overcurrent trip status. FltL1 = FltL2 = FltL3 = 0 FltL1 = 1 or FltL2 = 1 or FltL3 = 1	
LxTrip	On / Off		'On' Event enabling for FltL1 – 3 Events are enabled / Events are disabled	Set
LxTripOff	On / Off		'Off' Event enabling for FltL1 – 3 Events are enabled / Events are disabled	Set
OCTrip	On / Off		'On' Event enabling for combined o/c trips Events are enabled / Events are disabled	Set

Parameter	Value	Unit	Description	Note
OCTripOff			'Off' Event enabling for combined o/c starts	Set
	On / Off		Events are enabled / Events are disabled	
IncFltEvnt			Disabling several events of the same fault	Set
	On		Several events are enabled *)	
	Off		Several events of an increasing fault is disabled **)	
ClrDly	0 – 65535	s	Duration for active alarm status FltL1, Flt2, FltL3 and OCt	Set

Set = An editable parameter (password needed).

*) Used with IEC 60870-105-103 communication protocol. The alarm screen will show the latest if it's the biggest registered fault current, too. Not used with Spabus, because Spabus masters usually don't like to have unpaired On/Off events.

**) Used with SPA-bus protocol, because most SPA-bus masters do need an off-event for each corresponding on-event.

6.15 Incomer short circuit fault locator

The device includes a stand-alone fault locator algorithm. The algorithm can locate a short circuit in radial operated networks provided that the relay located in the incoming feeder is connected CT & VT polarity wise for forward (positive) power direction In case the incoming feeder's power flow direction is configured negative the short circuit fault locator function does not work. The fault location is given as in reactance (ohms) and kilometres. Fault value can then be exported, for example, with event to a DMS (Distribution Management System). The system can then localize the fault. If a DMS is not available, the distance to the fault is displayed as kilometres, as well as a reactance value. However, the distance value is valid only if the line reactance is set correctly. Furthermore, the line should be homogenous, that is, the wire type of the line should be the same for the whole length. If there are several wire types on the same line, an average line reactance value can be used to get an approximate distance value to the fault (examples of line reactance values: Overhead wire Sparrow: 0.408 ohms/km and Raven: 0.378 ohms/km).

The fault locator is normally used in the incoming bay of the substation. Therefore, the fault location is obtained for the whole network with just one device. This is very cost-effective upgrade of an existing system.

The algorithm functions in the following order:

1. The needed measurements (phase currents and voltages) are continuously available.
2. The fault distance calculation can be triggered in two ways: by opening a feeder circuit-breaker due to a fault and sudden increase in phase currents (Enable Xfault calc1 + Triggering digital input). Other option is to use only the sudden increase in the phase currents (Enable Xfault calc1).
3. Phase currents and voltages are registered in three stages: before the fault, during the fault and after the faulty feeder circuit-breaker was opened.
4. The fault distance quantities are calculated.
5. Two phases with the biggest fault current are selected.
6. The load currents are compensated.
7. The faulty line length reactance is calculated.

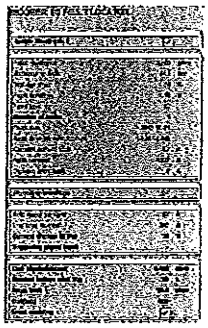
Table 6.19: Setting parameters of incomer short circuit fault locator

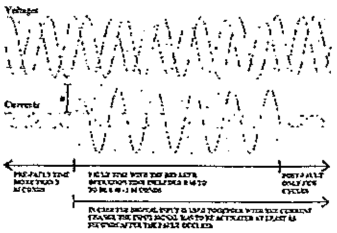
Parameter	Value	Unit	Default	Description
Triggering digital input	-; Di1 – Di16 Vi1 – Vi4 VO1 – VO5 NI1 – NI64 POC1 – POC16	-	-	Trigger mode (-= triggering based on sudden increase of phase current, otherwise sudden increase of phase current + Dix/Vix)
Line reactance	0.010 – 10.000	Ohms/km	0.389	Line reactance of the line. This is used only to convert the fault reactance to kilometers.
dI/g	10 – 800	% Imode	50	Trig current (sudden increase of phase current)
Blocked before next trig	10 – 600	s	70	Blocks function for this et time after trigger. This is used for blocking calculation in autoreclose.
Xmax limit	0.5 – 500.0	Ohm	11.0	Limit for maximum reactance. If reactance value is above set limit calculation result will not be shown.
Event	Disabled; Enabled	-	Enabled	Event mask

Table 6.20: Measured and recorded values of incomer short circuit fault locator

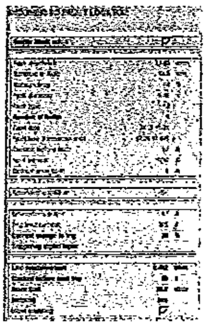
	Parameter	Value	Unit	Description
Measured values/ recorded values	Distance		km	Distance to the fault
	Xfault		ohm	Fault reactance
	Date		-	Fault date
	Time		-	Fault time
	Time		ms	Fault time
	Cntr		-	Number of faults
	Pre		A	Pre-fault current (=load current)
	Fault		A	Current during the fault
	Post		A	Post-fault current
	Udrop		% Un	Voltage dip during the fault
	Durati		s	Fault duration
	Type		-	Fault type (1-2,2-3,1-3,1-2-3)

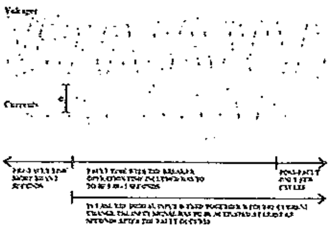
Below is presented an application example where the fault location algorithm is used at the incomer side. Notice following things while commissioning the relay:





Below is presented an application example where the fault location algorithm is used at the feeder side. Notice following things while commissioning the relay:





6.16 Feeder fault locator

The device includes a stand-alone fault locator algorithm. The algorithm can locate a short circuit and earth fault in radial operated networks. The fault location is given as in reactance (ohms) and kilometres. Fault value can then be exported, for example, with event to a DMS (Distribution Management System). The system can then localize the fault. If a DMS is not available, the distance to the fault is displayed as kilometres, as well as a reactance value.

However, the distance value is valid only if the line reactance is set correctly.

Furthermore, the line should be homogenous, that is, the wire type of the line should be the same for the whole length. If there are several wire types on the same line, an average line reactance value can be used to get an approximate distance value to the fault (examples of line reactance values: Overhead wire Sparrow: 0.408 ohms/km and Raven: 0.378 ohms/km).

This fault locator cannot be used in incomer because this locator has not ability to compensate healthy feeders away.

When feeder fault locator is calculating short circuit impedance following formula is used:

$$Z_{AB} = \frac{\overline{U_A} - \overline{U_B}}{\overline{I_A} - \overline{I_B}}$$

U_A = Vector between the voltage and the ground

U_B = Vector between the voltage and the ground

I_A = Vector between the current and the ground

I_B = Vector between the current and the ground

When feeder fault locator is calculating ground fault impedance following formula is used:

$$Z_A = \frac{\overline{U_A}}{\overline{I_A} + k \times 3I_0}$$

U_A = Vector between the voltage and the ground

I_A = Vector between the current and the ground

k = Earth factor k, needs to be set by user

$3I_0$ = Residual current, calculated from phase currents (I_{0Calc})

Earth factor k is calculated with following formula:

K_0 = $(Z_{0L}-Z_{1L}) / (3 \times Z_{1L})$

Z_{0L} = Zero sequence line imedance

Z_{1L} = Positive sequence line impedance

Triggering of the fault reactance calculation happens when "Pick-up setting" -value is exceeded OR if user wants, both "Pick-up setting"

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and "Triggering digital input" terms are fulfilled. When used, "Triggering digital input" can be either digital or virtual input.

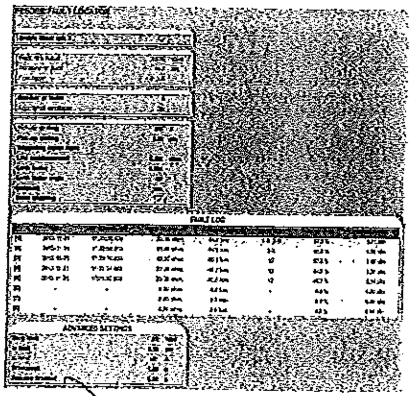
Table 6.21: Setting parameters of feeder fault locator

Parameter	Value	Unit	Default	Description
Pick-up setting	0.10 – 5.00	xIn	1.2	Current limit for triggering.
Triggering digital input	- DI1 – DI16 VI1 – VI4 VO1 – VO6 NI1 – NI64 POC1 – POC16	-	-	Trigger mode (= triggering based on sudden increase of phase current, otherwise sudden increase of phase current + DIx/VIx/VOx/NIx/POCx)
Line reactance	0.010 – 10.000	Ohms/km	0.491	Line reactance of the line. This is used only to convert the fault reactance to kilometers.
Earth factor	0.000 – 10.000	-	0.678	Calculated earth factor from line specifications.
Earth factor angle	-60 – +60	°	10	Angle of calculated earth factor from line specifications.
Event enabling	Off; On	-	On	Event mask

Table 6.22: Measured and recorded values of feeder fault locator

	Parameter	Value	Unit	Description
Measured values/recorded values	Distance		km	Distance to the fault
	Xfault		ohm	Fault reactance
	Date		-	Fault date
	Time		-	Fault time
	Cntr		-	Number of faults
	Fault		A	Current during the fault
	Udrop		% Un	Voltage dip during the fault
	Type		-	Fault type (1-2, 2-3, 1-3, 1-2-3, 1-N, 2-N, 3-N, 1-N-2-N, 2-N-3-N, 3-N-1-N, 1-N-2-N-3-N)

ВЯРНО С
ОРИГИНАЛА



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7 Communication and protocols

7.1 Communication ports

In the front there is USB port for connection to VAMPSET setting and configuration tool.

At the back, there is either RS-485 connection for serial protocols (Remote port) or 2 x RJ-45 connection for Ethernet protocols (Ethernet port).

7.1.1 Remote port

Remote port is used for serial protocols like Modbus or IEC 103. The physical interface is described in Chapter 9 Connections.

The parameters for the port can be set from the local HMI or using VAMPSET (see Table 7.1).

Table 7.1: Parameters

Parameter	Value	Unit	Description	Note
Protocol	None SPA-bus ModbusSlv IEC-103 ExternalIO DNP3 IEC-101 GetSet		Protocol selection for the port. (ExternalIO is the protocol used to connect to VIO 12A module. GetSet is the protocol used by VAMPSET.)	Set
Message counter	0 – 4200000000		Message counter since the device has restarted or since last clearing	Clr
Error counter	0 – 64000		Protocol interruption since the device has restarted or since last clearing	Clr
Timeout counter	0 – 64000		Timeout interruption since the device has restarted or since last clearing	Clr
speed/DPS			Display of current communication parameters. speed = bit/s D = number of data bits P = parity: none, even, odd S = number of stop bits	1.

Set = An editable parameter (password needed)

Clr = Clearing to zero is possible

1. The communication parameters are set in the protocol specific menus. For the local port command line interface the parameters are set in configuration menu.

7.1.2 Ethernet port

Ethernet port is used for Ethernet protocols like IEC61850 and Modbus TCP.

The physical interface is described in Chapter 9 Connections.

The parameters for the port can be set from the local HMI or using VAMPSET (see Table 7.2). Two different protocols can be used simultaneously - both protocols use the same IP address and MAC address (but different IP port number).

Table 7.2: Parameters of the Ethernet port

Parameter	Value	Unit	Description	Note
MAC address	001ADnnnnnnn		MAC address	
Enable DHCP service	Yes / No		If enabled the IP address of the device is defined by the DHCP server of the network.	
Enable IP verification service	Yes / No		If this option is enabled, device will send ARP packet to verify that the IP address given by the DHCP server is not duplicated in the network.	
NetMask	n.n.n.n		Net mask (set with VAMPSET)	Set
Gateway	default = 0.0.0.0		Gateway IP address	Set
NTP Server	n.n.n.n		Network time protocol server	Set
NTP server (BackUp)	n.n.n.n		Network time protocol server to be used if NPT server does not respond.	Set
IP port for setting tool	0 – 64000		IP port number to be used by VAMPSET (default = 23)	Set
TCP keepalive interval	0 – 20	s	TCP keepalive interval	Set 1)
Eth Port 1 status			Status of the physical Ethernet port 1	
Eth Port 2 status			Status of the physical Ethernet port 2	
Enable FTP server	Yes / No		Enable / Disable FTP	Set
FTP password	String		Password for FTP communication	Set
FTP max speek	1 – 10	KB/s	Max. amouth of data sent with FTP (this limited to give more time to other communications)	Set
Enable HTTP server	Yes / No		Enable / Disable HTTP (Web) connection	Set
Storm protection limit	0.01 – 20	%	Percentage of broadcast messages, which is accepted	Set
Storm protection on port 1	Yes / No		Storm protection on/off on port 1	Set
Storm protection on port 2	Yes / No		Storm protection on/off on port 2	Set
Sniffer mode	Yes / No		Sniffer mode on/off.	Set
Sniffer port			Port which can be used to "sniff" the network traffic	
Disable Port 1 AugoNegotiation	Yes / No		Disable/enable automatic speed negotiation of the Ethernet port	Set

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Parameter	Value	Unit	Description	Note
Disable Port 2 AugoNegotiation	Yes / No		Disable/enable automatic speed negotiation of the Ethernet port	Set
Send Gratuitous ARP	Yes / No		ARP Reply sent when no one requested. Vamp will send such reply in two cases: - when ethernet link goes up - when RSTP topology change occurs	Set
Ethernet Protocol 1				
Ethernet port protocol 1	None ModbusTCP DNP 3 IEC-101 IEC-61850 EthernetIP		Protocol 1 for Ethernet port	Set
IP port for protocol	0 – 64000		IP port number to be used by protocol 1	Set
Message counter	0 – 4200000000		Message counter since the device has restarted or since last clearing	
Error counter	0 – 64000		Protocol errors since the device has restarted or since last clearing	
Timeout counter	0 – 64000		Timeout errors since the device has restarted or since last clearing	
Ethernet Protocol 2				
Ethernet port protocol 2	None ModbusTCP DNP 3 IEC-101 IEC-61850 EthernetIP		Protocol 2 for Ethernet port	Set
IP port for protocol	0 – 64000		IP port number to be used by protocol 2	Set
Message counter	0 – 4200000000		Message counter since the device has restarted or since last clearing	
Error counter	0 – 64000		Protocol errors since the device has restarted or since last clearing	
Timeout counter	0 – 64000		Timeout errors since the device has restarted or since last clearing	
RSTP protocol for Ethernet				
Enable for RSTP	Yes / No		Enable / disable use of RSTP protocol on the Ethernet port	Set
Brige priority	Selection between 0 – 61440		Parameter used to define the RSTP root device for the network. If priorities of two or more devices are equal then the device with lowest MAC address is chosen as a root.	Set
Hello time	2 – 10	s	Setting defines how often RSTP frames (Hello BPDU) are sent	Set

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Parameter	Value	Unit	Description	Note
Forward delay	4 – 30	s	Time needed for the port to change its state from blocking to forwarding	Set
Max Age	6 – 40	s	Time that every RSTP device should wait before starting to change the topology in case of not receiving Hello BPDU	Set
Bridge role			Role of the device in the RSTP network	
Migrate time				
Protocol version			Version of the RSTP protocol	
Port 1				
Port priority				Set
Admin edge			Yes = port is connected to a device with single connection to the network and without RSTP protocol support	Set
Auto edge			Yes = enables automatic discovering of edge device	Set
Current state			State of the port	
Current role			Role of the port	
Root Path Cost			Port Cost is related to transfer speed. This is determined automatically according to RSTP specification.	
Port 2				
Port priority	Selection between 0 – 160			Set
Admin edge	Yes / No		Yes = port is connected to a device with single connection to the network and without RSTP protocol support	Set
Auto edge	Yes / No		Yes = enables automatic discovering of edge device	Set
Current state	Link down, blocked, listening, learning, forwarding		State of the port	
Current role	Root, designated, backup, alternate		Role of the port	
Root Path Cost			Port Cost is related to transfer speed. This is determined automatically according to RSTP specification.	

Set = An editable parameter (password needed)

1) KeepAlive: The KeepAlive parameter sets in seconds the time between two keepalive packets are sent from the IED. The setting range for this parameter is between zero (0) and 20 seconds; with the exception that zero (0) means actually 120 seconds (2 minutes). A keep alive's packet purpose is for the VAMP IED to send a probe packet to a connected client for checking the status of the TCP-connection when no other packet is being sent e.g. client does not poll data from the IED. If the keepalive packet is not acknowledged, the IED will close the TCP connection. Connection must be resumed on the client side.

7.2 Communication protocols

The protocols enable the transfer of the following type of data:

- events
- status information
- measurements
- control commands
- clock synchronizing
- Settings (SPA-bus and embedded SPA-bus only)

7.2.1 GetSet

This is and ASCII protocol used by VAMPSET. This protocol is the protocol used on the USB port. This can also be used on the COM ports, if VAMPSET interface via these ports is required.

7.2.2 Modbus TCP and Modbus RTU

These Modbus protocols are often used in power plants and in industrial applications. The difference between these two protocols is the media. Modbus TCP uses Ethernet and Modbus RTU uses asynchronous communication (RS-485).

VAMPSET will show the list of all available data items for Modbus.

The Modbus communication is activated via a menu selection with parameter "Protocol". See Chapter 7.1 Communication ports.

For Ethernet interface configuration, see Chapter 7.1.2 Ethernet port.

Table 7.3: Parameters

Parameter	Value	Unit	Description	Note
Addr	1 – 247		Modbus address for the device. Broadcast address 0 can be used for clock synchronizing. Modbus TCP uses also the TCP port settings.	Set
bit/s	1200 2400 4800 9600 19200	bps	Communication speed for Modbus RTU	Set
Parity	None Even Odd		Parity for Modbus RTU	Set

Set = An editable parameter (password needed)

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7.2.3 SPA-bus

The device has full support for the SPA-bus protocol including reading and writing the setting values. Also reading of multiple consecutive status data bits, measurement values or setting values with one message is supported.

Several simultaneous instances of this protocol, using different physical ports, are possible, but the events can be read by one single instance only.

There is a separate document "Spabus parameters.pdf" of SPA-bus data items available.

Table 7.4: Parameters

Parameter	Value	Unit	Description	Note
Addr	1 – 899		SPA-bus address. Must be unique in the system.	Set
bit/s	1200 2400 4800 9600 (default) 19200	bps	Communication speed	Set
Emode			Event numbering style.	(Set)
	Channel		Use this for new installations.	
	(Limit60) (NoLimit)		(The other modes are for compatibility with old systems.)	

Set = An editable parameter (password needed)

7.2.4 IEC 60870-5-103

The IEC standard 60870-5-103 "*Companion standard for the informative interface of protection equipment*" provides standardized communication interface to a primary system (master system).

The unbalanced transmission mode of the protocol is used, and the device functions as a secondary station (slave) in the communication. Data is transferred to the primary system using "data acquisition by polling"-principle.

The IEC functionality includes application functions:

- station initialization
- general interrogation
- clock synchronization and
- command transmission.

It is not possible to transfer parameter data or disturbance recordings via the IEC 103 protocol interface.

The following ASDU (Application Service Data Unit) types will be used in communication from the device:

- ASDU 1: time tagged message
- ASDU 3: Measurands I
- ASDU 5: Identification message
- ASDU 6: Time synchronization and
- ASDU 8: Termination of general interrogation.

The device will accept:

- ASDU 6: Time synchronization
- ASDU 7: Initiation of general interrogation and
- ASDU 20: General command.

The data in a message frame is identified by:

- type identification
- function type and
- information number.

These are fixed for data items in the compatible range of the protocol, for example, the trip of I> function is identified by: type identification = 1, function type = 160 and information number = 90. "Private range" function types are used for such data items, which are not defined by the standard (e.g. the status of the digital inputs and the control of the objects).

The function type and information number used in private range messages is configurable. This enables flexible interfacing to different master systems.

For more information on IEC 60870-5-103 in VAMP devices refer to the "IEC103 Interoperability List" document.

Table 7.5: Parameters

Parameter	Value	Unit	Description	Note
Addr	1 – 254		An unique address within the system	Set
bit/s	9600 19200	bps	Communication speed	Set
MeasInt	200 – 10000	ms	Minimum measurement response interval	Set
SyncRe	Sync Sync+Proc Msg Msg+Proc		ASDU6 response time mode	Set

Set = An editable parameter (password needed)

Table 7.6: Parameters for disturbance record reading

Parameter	Value	Unit	Description	Note
ASDU23	On Off		Enable record info message	Set
Smpls/msg	1 – 25		Record samples in one message	Set
Timeout	10 – 10000	s	Record reading timeout	Set
Fault			Fault identifier number for IEC-103. Starts + trips of all stages.	
TagPos			Position of read pointer	
Chn			Active channel	
ChnPos			Channel read position	
Fault numbering				
Faults			Total number of faults	
GridFlts			Fault burst identifier number	
Grid			Time window to classify faults together to the same burst.	Set

Set = An editable parameter (password needed)

7.2.5 DNP 3.0

The relay supports communication using DNP 3.0 protocol. The following DNP 3.0 data types are supported:

- binary input
- binary input change
- double-bit input
- binary output
- analog input
- counters

Additional information can be obtained from the "DNP 3.0 Device Profile Document" and "DNP 3.0 Parameters.pdf". DNP 3.0 communication is activated via menu selection.

Table 7.7: Parameters

Parameter	Value	Unit	Description	Set
bit/s	4800 9600 (default) 19200 38400	bps	Communication speed	Set
Parity	None (default) Even Odd		Parity	Set
SlvAddr	1 – 65519		An unique address for the device within the system	Set
MstrAddr	1 – 65519 255 = default		Address of master	Set
LLTout	0 – 65535	ms	Link layer confirmation timeout	Set
LLRetry	1 – 255 1 = default		Link layer retry count	Set
APLTout	0 – 65535 5000 = default	ms	Application layer confirmation timeout	Set
CnfMode	EvOnly (default); All		Application layer confirmation mode	Set
DBISup	No (default); Yes		Double-bit input support	Set
SyncMode	0 – 65535	s	Clock synchronization request interval. 0 = only at boot	Set

Set = An editable parameter (password needed)

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7.2.6 IEC 60870-5-101

The IEC 60870-5-101 standard is derived from the IEC 60870-5 protocol standard definition. In VAMP devices, IEC 60870-5-101 communication protocol is available via menu selection. The VAMP unit works as a controlled outstation (slave) unit in unbalanced mode.

Supported application functions include process data transmission, event transmission, command transmission, general interrogation, clock synchronization, transmission of integrated totals, and acquisition of transmission delay.

For more information on IEC 60870-5-101 in VAMP devices, refer to the "IEC 101 Profile checklist & datalist.pdf" document.

Table 7.8: Parameters

Parameter	Value	Unit	Description	Note
bit/s	1200 2400 4800 9600	bps	Bitrate used for serial communication.	Set
Parity	None Even Odd		Parity used for serial communication	Set
LLAddr	1 – 65534		Link layer address	Set
LLAddrSize	1 – 2	Bytes	Size of Link layer address	Set
ALAddr	1 – 65534		ASDU address	Set
ALAddrSize	1 – 2	Bytes	Size of ASDU address	Set
IOAddrSize	2 – 3	Bytes	Information object address size. (3-octet addresses are created from 2-octet addresses by adding MSB with value 0.)	Set
COTsize	1	Bytes	Cause of transmission size	
TTFormat	Short Full		The parameter determines time tag format: 3-octet time tag or 7-octet time tag.	Set
MeasFormat	Scaled Normalized		The parameter determines measurement data format: normalized value or scaled value.	Set
DbandEna	No Yes		Dead-band calculation enable flag	Set
DbandCy	100 – 10000	ms	Dead-band calculation interval	Set

Set = An editable parameter (password needed)

7.2.7 IEC 61850

IEC 61850 protocol is available with the optional communication module. IEC 61850 protocol can be used to read / write static data from the relay to receive events and to receive / send GOOSE messages to other relays.

IEC 61850 server interface is capable of

- Configurable data model: selection of logical nodes corresponding to active application functions
- Configurable pre-defined data sets
- Supported dynamic data sets created by clients
- Supported reporting function with buffered and unbuffered Report Control Blocks
- Sending analogue values over GOOSE
- Supported control modes:
  - direct with normal security
  - direct with enhanced security
  - select before operation with normal security
  - select before operation with enhanced security
- Supported horizontal communication with GOOSE: configurable GOOSE publisher data sets, configurable filters for GOOSE subscriber inputs, GOOSE inputs available in the application logic matrix

Additional information can be obtained from the separate documents "IEC 61850 conformance statement.pdf", "IEC 61850 Protocol data.pdf" and "Configuration of IEC 61850 interface.pdf".

7.2.8 EtherNet/IP

The device supports communication using EtherNet/IP protocol which is a part of CIP (Common Industrial Protocol) family. EtherNet/IP protocol is available with the optional inbuilt Ethernet port. The protocol can be used to read / write data from the device using request / response communication or via cyclic messages transporting data assigned to assemblies (sets of data).

For more detailed information and parameter lists for EtherNet/IP, refer to a separate application note "Application Note EtherNet/IP.pdf".

For the complete data model of EtherNet/IP, refer to the document "Application Note DeviceNet and EtherNet/IP Data Model.pdf".

7.2.9 HTTP server – Webset

The Webset HTTP configuration interface provides the option to configure the device with a standard web browser such as Internet Explorer, Mozilla Firefox, or Google Chrome. The feature is available when communication option is 2 x RJ45 Ethernet.

A subset of the features of Vampset is available in the Webset interface. The group list and group view from Vampset are provided, and most groups, except the LOGIC and the MIMIC groups are configurable.

Parameter	Value	Description	Note
Enable HTTP srvr	Yes No	Enable or disable the HTTP server.	Set

---

8 Applications and configuration examples

The following chapters illustrate the functions in different protection applications.

The relays can be used for line/feeder protection of medium voltage networks with grounded, low-resistance grounded, isolated or a compensated neutral point. The relays have all the required functions to be applied as a backup relay in high voltage networks or to a transformer differential relay. In addition VAMP 57 includes all the required functions to be applied as motor protection relay for rotating machines in industrial protection applications.

The relays provide circuit-breaker control functionality, additional primary switching devices (earthing switches and disconnector switches) can also be controlled from the relay HMI or the control or SCADA/automation system. Programmable logic functionality is also implemented in the relay for various applications e.g interlockings schemes.

8.1 Substation feeder protection

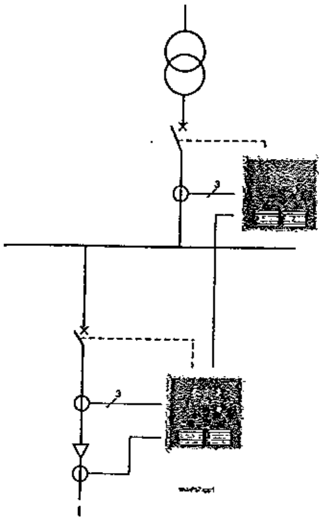

Figure 8.1: VAMP 57 used in substation feeder protection.

The device includes three-phase overcurrent protection and earth fault protection. At the incoming feeder, the instantaneous stage I>>> of the VAMP feeder device is blocked with the start signal of the overcurrent stage. This prevents the trip signal if the fault occurs on the outgoing feeder.

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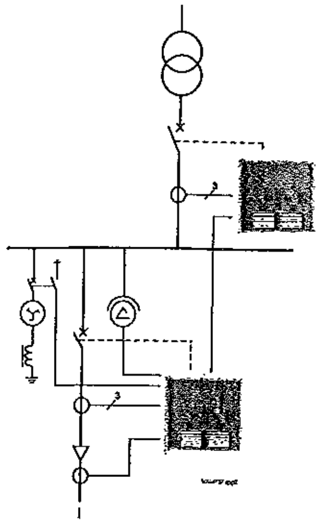

Figure 8.2: VAMP 57 used in substation feeder protection in compensated network.

For the directional function of earth fault function, the status information (on/off) of the Petersen coil is routed to one of the digital inputs of the feeder device so that either $I_{0\sin\varphi}$ or $I_{0\cos\varphi}$ function is obtained.

The function $I_{0\sin\varphi}$ is used in isolated networks, and the function $I_{0\cos\varphi}$ is used in resistance or resonant earthed networks.

Stara Zagora

8.2 Industrial feeder / motor protection

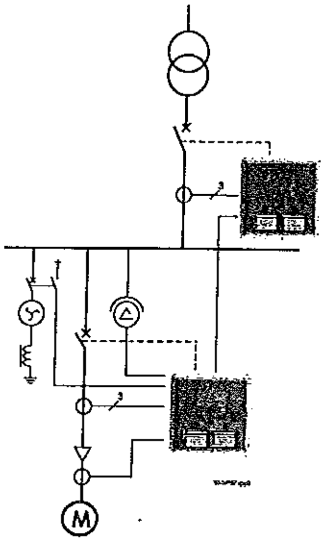

Figure 8.3: VAMP 57 used in cable protection of an industry plant network.

The device supports directional earth fault protection and three-phase overcurrent protection which is required in a cable feeder. Furthermore, the thermal stage can be used to protect the cable against overloading. All necessary motor protection functions are supported when using motor application mode.

8.3 Trip circuit supervision

Trip circuit supervision is used to ensure that the wiring from the protective device to a circuit-breaker is in order. This circuit is unused most of the time, but when a protection device detects a fault in the network, it is too late to notice that the circuit-breaker cannot be tripped because of a broken trip circuitry.

Also the closing circuit can be supervised, using the same principle.

8.3.1 Trip circuit supervision with one digital input

The benefits of this scheme is that only one digital inputs is needed and no extra wiring from the relay to the circuit breaker (CB) is needed. Also supervising a 24 Vdc trip circuit is possible.

The drawback is that an external resistor is needed to supervise the trip circuit on both CB positions. If supervising during the closed position only is enough, the resistor is not needed.

- The digital input is connected parallel with the trip contacts (Figure 8.4).
- The digital input is configured as Normal Closed (NC).
- The digital input delay is configured longer than maximum fault time to inhibit any superfluous trip circuit fault alarm when the trip contact is closed.
- The digital input is connected to a relay in the output matrix giving out any trip circuit alarm.
- The trip relay should be configured as non-latched. Otherwise, a superfluous trip circuit fault alarm will follow after the trip contact operates, and the relay remains closed because of latching.
- By utilizing an auxiliary contact of the CB for the external resistor, also the auxiliary contact in the trip circuit can be supervised.

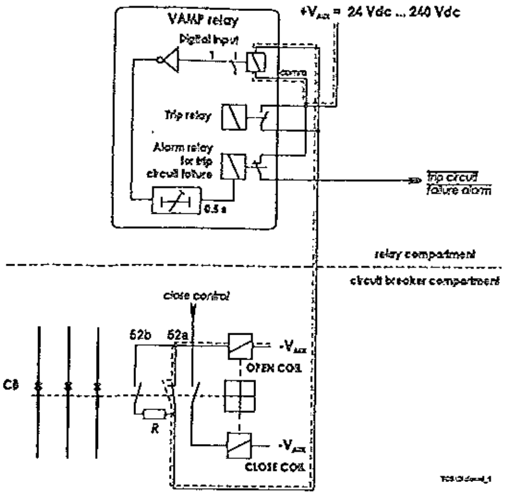

Figure 8.4: Trip circuit supervision using a single digital input and an external resistor R. The circuit-breaker is in the closed position. The supervised circuitry in this CB position is double-lined. The digital input is in active state when the trip circuit is complete. This is applicable for any digital inputs.

NOTE: The need for the external resistor R depends on the application and circuit breaker manufacturer's specifications.

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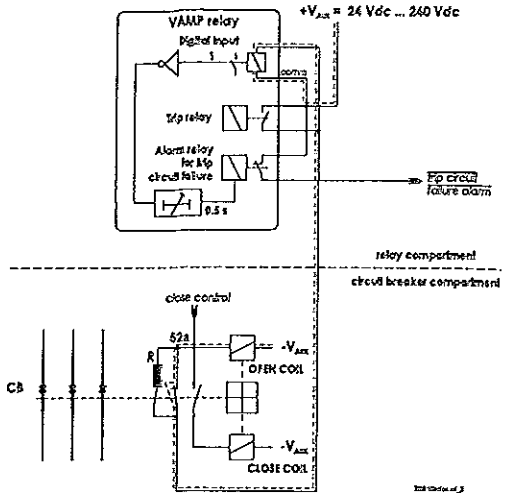


Figure 8.5: Alternative connection without using circuit breaker 52b auxiliary contacts. Trip circuit supervision using a single digital input and an external resistor R. The circuit-breaker is in the closed position. The supervised circuitry in this CB position is double-lined. The digital input is in active state when the trip circuit is complete. Alternative connection without using circuit breaker 52b auxiliary contacts. This is applicable for any digital inputs.

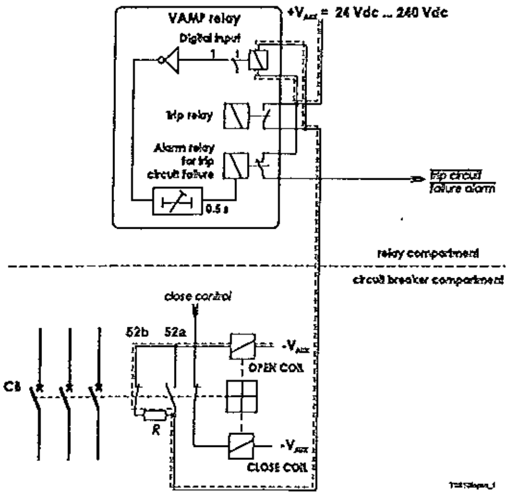


Figure 8.6: Trip circuit supervision using a single digital input, when the circuit breaker is in open position.

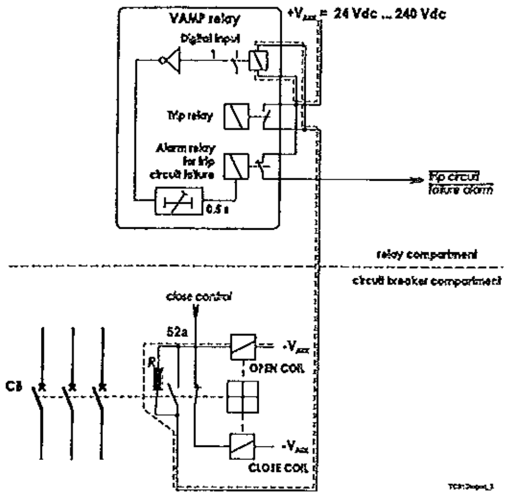
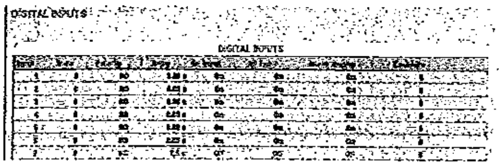


Figure 8.7: Alternative connection without using circuit breaker 52b auxiliary contacts. Trip circuit supervision using a single digital input, when the circuit breaker is in open position.


DIGITAL INPUTS

DIGITAL INPUTS

Figure 8.8: An example of digital input DI7 configuration for trip circuit supervision with one digital input.

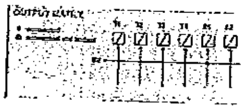


Figure 8.9: An example of output matrix configuration for trip circuit supervision with one digital input.

Example of dimensioning the external resistor R:

U_{AUX} = 110 Vdc - 20 % + 10%, Auxiliary voltage with tolerance

U_{DI} = 18 Vdc, Threshold voltage of the digital input

I_{DI} = 3 mA, Typical current needed to activate the digital input including a 1 mA safety margin.

P_{COIL} = 50 W, Rated power of the open coil of the circuit breaker. If this value is not known, 0 Ω can be used for the R_{COIL}.

U_{MIN} = U_{AUX} - 20 % = 88 V

U_{MAX} = U_{AUX} + 10 % = 121 V

R_{COIL} = U^2_{AUX} / P_{COIL} = 242 Ω.

The external resistance value is calculated using Equation 8.1.

Equation 8.1:

$$R = \frac{U_{MIN} - U_{DI} - I_{DI} \cdot R_{Coil}}{I_{DI}}$$

R = (88 – 18 – 0.003*242)/0.003 = 23.1 kΩ

(In practice the coil resistance has no effect.)

By selecting the next smaller standard size we get 22 kΩ.

The power rating for the external resistor is estimated using Equation 8.2 and Equation 8.3. The Equation 8.2 is for the CB open situation including a 100 % safety margin to limit the maximum temperature of the resistor.

Equation 8.2:

$$P = 2 \cdot I_{DI}^2 \cdot R$$

P = 2*0.003^2 x 22000 = 0.40 W

Select the next bigger standard size, for example 0.5 W.

When the trip contacts are still closed and the CB is already open, the resistor has to withstand much higher power (Equation 8.3) for this short time.

Equation 8.3:

$$P = \frac{U_{MAX}^2}{R}$$

P = 121^2 / 22000 = 0.67 W

A 0.5 W resistor will be enough for this short time peak power, too. However, if the trip relay is closed for longer time than a few seconds, a 1 W resistor should be used.

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8.3.2 Trip circuit supervision with two digital inputs

The benefits of this scheme is that no external resistor is needed.

The drawbacks are, that two digital inputs from two separate groups are needed and two extra wires from the relay to the CB compartment is needed. Additionally the minimum allowed auxiliary voltage is 48 Vdc, which is more than twice the threshold voltage of the dry digital input, because when the CB is in open position, the two digital inputs are in series.

- The first digital input is connected parallel with the auxiliary contact of the open coil of the circuit breaker.
- Another auxiliary contact is connected in series with the circuitry of the first digital input. This makes it possible to supervise also the auxiliary contact in the trip circuit.
- The second digital input is connected in parallel with the trip contacts.
- Both inputs are configured as normal closed (NC).
- The user's programmable logic is used to combine the digital input signals with an AND port. The delay is configured longer than maximum fault time to inhibit any superfluous trip circuit fault alarm when the trip contact is closed.
- The output from the logic is connected to a relay in the output matrix giving out any trip circuit alarm.
- The trip relay should be configured as non-latched. Otherwise, a superfluous trip circuit fault alarm will follow after the trip contact operates, and the relay remains closed because of latching.
- Both digital inputs must have their own common potential. Using the other digital inputs in the same group as the upper DI in the Figure 8.10 is not possible in most applications. Using the other digital inputs in the same group as the lower DI in the Figure 8.10 is limited, because the whole group will be tied to the auxiliary voltage V_{AUX}.

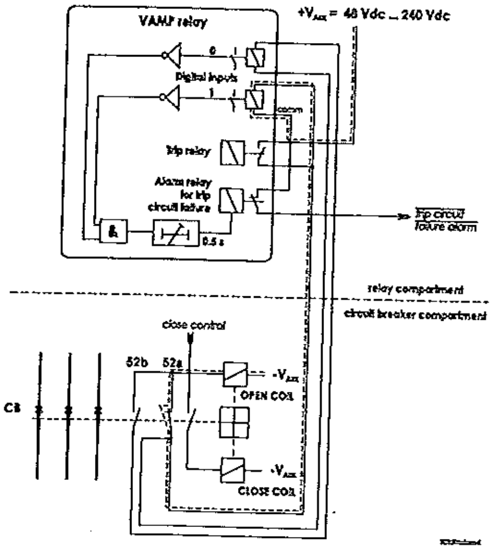

Figure 8.10: Trip circuit supervision with two digital inputs. The CB is closed. The supervised circuitry in this CB position is double-lined. The digital input is in active state when the trip circuit is complete.

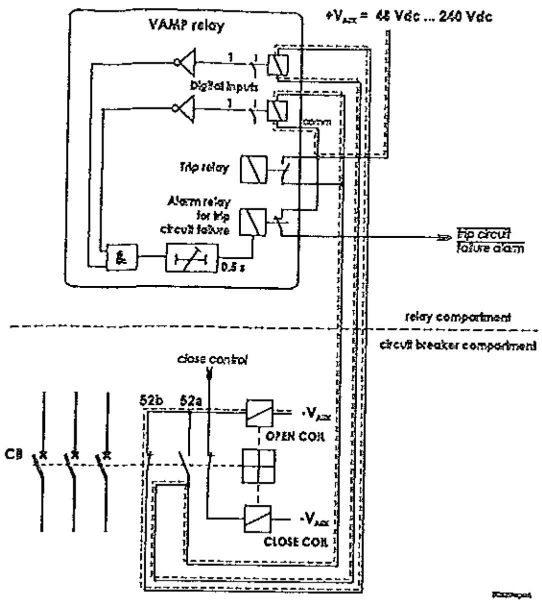

Figure 8.11: Trip circuit supervision with two digital inputs. The CB is in the open position. The two digital inputs are now in series.

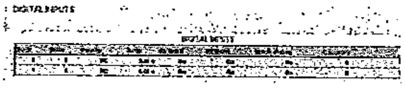

Figure 8.12: An example of digital input configuration for trip circuit supervision with two dry digital inputs DI1 and DI2. If DI3 – DI16 are used, the minimum voltage has to be 96 Vdc.

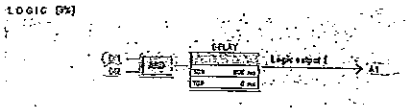

Figure 8.13: An example of logic configuration for trip circuit supervision with two digital inputs DI1 and DI2.

Figure 8.14: An example of output matrix configuration for trip circuit supervision with two digital inputs.

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9 Connections

9.1 Rear panel

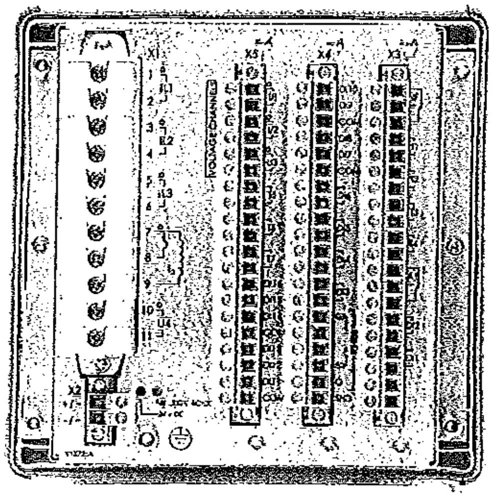

Figure 9.1: Connections on the rear panel of the V57F-3AAA1BBA with screw clamp connectors

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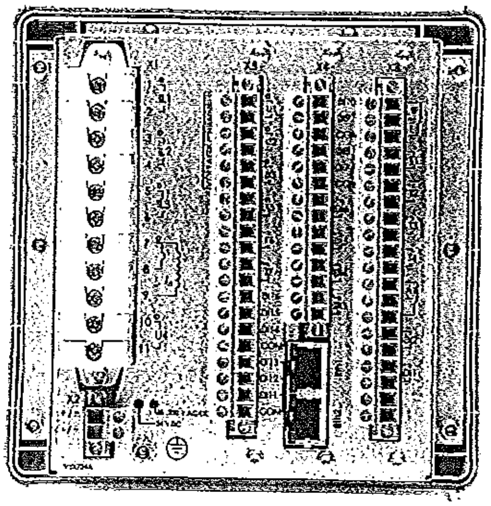

Figure 9.2: Connections on the rear panel of the V57F-3AAA1BCA with screw clamp connector

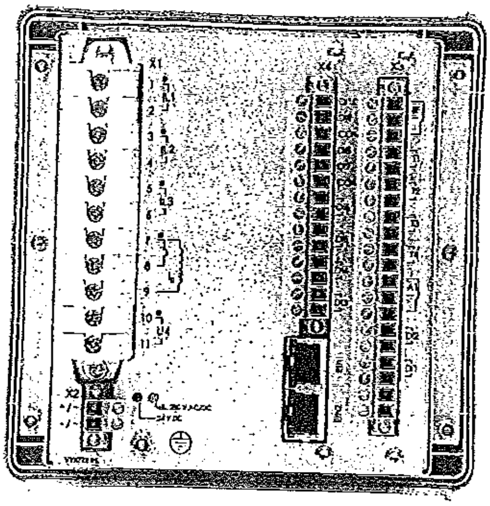

Figure 9.3: Connections on the rear panel of the V57F-3AAA1ACA with screw clamp connector. This model does not have X5 module hence the device has 3 x IL, 1xIo, 1xU, 10xDI, 4xDO (trip), 1 x Alarm, 1 x SF only.

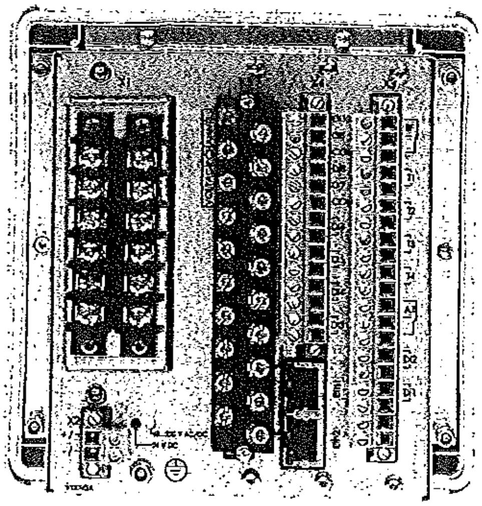

Figure 9.4: Connections on the rear panel of the V57F-4AAA1BCA with ring-lug connector

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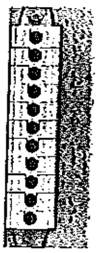
Table 9.1: Voltage measurement modes

Terminal	X5						X1	
	20	19	18	17	16	15	10	11
Voltage channel	*U1*		*U2*		*U3*		*U4*	
Mode / Used voltage								
3LN	UL1		UL2		UL3		-	
3LN+U$_0$							U$_0$	
3LN+LLy					LLy		UL3	
3LN+LNy					LNy			
2LL+U$_0$	U12		U23		U$_0$		-	
2LL+U$_0$+LLy					LLy		U$_0$	
2LL+U$_0$+LNy					LNy			
LL+U$_0$+LLy+LLz			U12y		U12z			
LN+U$_0$+LNy+LNz	UL1		UL1y		UL1z			

Terminal X1



No	Symbol	Description
1	IL1(S1)	Phase current L1 (S1)
2	IL1(S2)	Phase current L1 (S2)
3	IL2(S1)	Phase current L2 (S1)
4	IL2(S2)	Phase current L2 (S2)
5	IL3(S1)	Phase current L3 (S1)
6	IL3(S2)	Phase current L3 (S2)
7	Io1	Residual current Io1 common for 1 A and 5 A (S1)
8	Io1/5A	Residual current Io1 5A (S2)
9	Io1/1A	Residual current Io1 1A (S2)
10	U4	Uo/ULN/ULL (da/a/a)
11	U4	Uo/ULN/ULL (dn/n/b)

NOTE: Terminal X1 can be ring-lug type, too. See Chapter 12 Order information.

Terminal X2

No	Symbol	Description
1	U$_{AUX}$	Auxiliary voltage
2	U$_{AUX}$	Auxiliary voltage

Terminal X3

No	Symbol	Description
20	SF NO	Self-diagnostic relay, normal close
19	SF NC	Self-diagnostic relay, normal open
18	SF COM	Self-diagnostic relay, common terminal
17	T1	Trip relay 1
16	T1	Trip relay 1
15	T2	Trip relay 2
14	T2	Trip relay 2
13	T3	Trip relay 3
12	T3	Trip relay 3
11	T4	Trip relay 4
10	T4	Trip relay 4
9	A1 NC	Alarm relay 1, normal closed terminal
8	A1 NO	Alarm relay 1, normal open terminal
7	A1 COM	Alarm relay 1, common terminal
6	DI2 +	Digital input 2
5	DI2 -	Digital input 2
4	DI1 +	Digital input 1
3	DI1 -	Digital input 1
2	-	No connection
1	-	No connection

NOTE: Digital inputs are polarity free.

Terminal X5

No	Symbol	Description
20	U1	ULN/ULL (a/a)
19	U1	ULN/ULL (n/b)
18	U2	ULN/ULL (a/b)
17	U2	ULN/ULL (n/b)
16	U3	Uo/ULN/ULL (da/a/a)
15	U3	Uo/ULN/ULL (dn/n/b)
14	T5	Trip relay 5
13	T5	Trip relay 5
12	T6	Trip relay 6
11	T6	Trip relay 6
10	T7	Trip relay 7
9	T7	Trip relay 7
8	DI16	Digital input 16
7	DI15	Digital input 15
6	DI14	Digital input 14
5	COM	Common potential of digital inputs 14 – 16
4	DI13	Digital input 13
3	DI12	Digital input 12
2	DI11	Digital input 11
1	COM	Common potential of digital inputs 11 – 13

NOTE: Terminal X5 can be ring-lug type, too.

See Chapter 12 Order information.

When the option A in the slot of "Voltage measurements + I/O, X5" is selected, Terminal X5's inputs and outputs are not available.

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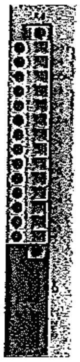
Terminal X4 (model V57-3AAA1BBA)

No	Symbol	Description
20	DI10	Digital input 10
19	DI9	Digital input 9
18	COM	Common potential of digital inputs 9 – 10
17	DI8	Digital input 8
16	DI7	Digital input 7
15	COM	Common potential of digital inputs 7 – 8
14	DI6	Digital input 6
13	DI6	Digital input 6
12	DI5	Digital input 5
11	DI5	Digital input 5
10	DI4	Digital input 4
9	DI4	Digital input 4
8	DI3	Digital input 3
7	DI3	Digital input 3
6*	RS-485 term	RS-485 interface termination resistor for "-" connection
5*	RS-485 -	RS-485 interface "-" connection
4*	RS-485 +	RS-485 interface "+" connection
3*	RS-485 term	RS-485 interface termination resistor for "+" connection
2	RS-485 G	RS-485 interface ground terminal
1	RS-485 SHD	RS-485 interface cable shield connection

NOTE: * interconnect 3&4 and 5&6 when termination is needed.

Terminal X4 (model V57-3AAA1BCA)



No	Symbol	Description
14	DI10	Digital input 10
13	DI9	Digital input 9
12	COM	Common potential of digital inputs 9 – 10
11	DI8	Digital input 8
10	DI7	Digital input 7
9	COM	Common potential of digital inputs 7 – 8
8	DI6	Digital input 6
7	DI6	Digital input 6
6	DI5	Digital input 5
5	DI5	Digital input 5
4	DI4	Digital input 4
3	DI4	Digital input 4
2	DI3	Digital input 3
1	DI3	Digital input 3

9.2 Auxiliary voltage

The external auxiliary voltage U_{AUX} (40 – 265 V ac or V dc, or optionally 18 – 36V dc) for the relay is connected to the pins X2: 1 – 2.

NOTE: When optional 18 – 36 Vdc power module is used the polarity is as follows: X2:1 positive (+), X2:2 negative (-).

9.3 Communication interfaces

9.3.1 RS-485 interface (model V57-3AAA1BBA)

Vamp 57 model V57-3AAA1BBA has one RS-485 interface for serial protocols (like Modbus or IEC 103). The connection is in terminal X4 pins 1 – 6.

9.3.2 Ethernet interface (model V57-3AAA1BCA)

Vamp 57 model V57-3AAA1BCA has two RJ-45 connectors for Ethernet communications. These connectors makes it possible to daisy-chain many devices or build a loop configuration using RSTP protocol.

9.4 Local port (Front panel)

The relay has a USB-connector in the front panel

Protocol for the USB port

The front panel USB port is always using the command line protocol for VAMPSET.

The protocol is an ASCII character protocol called "GetSet". The speed of the interface is defined in CONF/DEVICE SETUP menu from the local HMI. The default settings for the relay are 38400/8N1.

Connecting a cable between the PC and the relay will create a virtual com-port. The default settings for the relay are 38400/8N1. The communication parameter display on the local display will show the active parameter values for the local port.

Physical interface

The physical interface of this port is USB.

Figure 9.5: Pin numbering of the front panel USB type B connector

Pin	Signal name
1	VBUS
2	D-
3	D+
4	GND
Shell	Shield

It is possible to change the bit rate of front USB port. This setting is visible only on local display of the IED. Bit rate can be set between 1200 - 187500. This changes the bit rate of the IED, Vampset bit rate has to be set separately. If bit rate in setting tool is incorrect it takes longer time to establish the communication.

NOTE: Use same bit rate in the IED and Vampset -setting tool.

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9.5 External option modules

9.5.1 VIO 12A RTD input / output modules

VIO 12A I/O modules can be connected to VAMP 57 using RS 485 connection in V57 3AAA1BBA interface modules.

A separate product manual for VIO 12A (VVIO12A/EN M/xxxx) can be found from our website.

9.5.2 External input / output module

The device supports also external input / output modules used to extend the number of digital inputs and outputs. Other modules have analogue inputs and outputs.

The following types of devices are supported:

- Analog input modules (RTD)
- Analog output modules (mA-output)
- Binary input/output modules

NOTE: Only available when the order code is V57 3AAA1BBA. When external input/output module is used, RS 485 can not be used for any other communication protocols.

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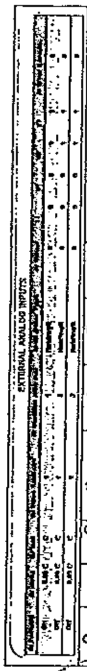
External analog inputs configuration (VAMPSET only)



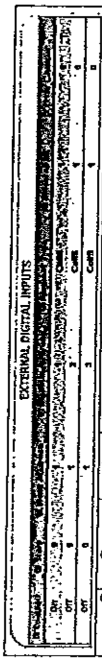
Range	Description			
	Communication read errors			
X: -32000 – 32000 Y: -1000 – 1000	Scaling	Y2	Scaled value	Point 2
		X2	Modbus value	
		Y1	Scaled value	Point 1
		X1	Modbus value	
-32000 – 32000		Offset	Subtracted from Modbus value, before running XY scaling	
InputR or HoldingR	Modbus register type			
1 – 9999	Modbus register for the measurement			
1 – 247	Modbus address of the I/O device			
C, F, K, mA, Ohm or V/A	Unit selection			
	Active value			
On / Off	Enabling for measurement			

Alarms for external analog inputs

Range	Description	
0 – 10000	Hysteresis for alarm limits	
-21x107 – +21x107	Alarm >>	Limit setting
- / Alarm		Active state
-21x107 – +21x107	Alarm >	Limit setting
- / Alarm		Active state
	Active value	
1 – 9999	Modbus register for the measurement	
1 – 247	Modbus address of the I/O device	
On / Off	Enabling for measurement	

Analog input alarms have also matrix signals, "Ext. Alx Alarm1" and "Ext. Alx Alarm2".

External digital inputs configuration (VAMPSET only)



Range	Description
	Communication read errors
1 – 16	Bit number of Modbus register value
CoilS, InputS, InputR or HoldingR	Modbus register type
1 – 9999	Modbus register for the measurement
1 – 247	Modbus address of the I/O device
0 / 1	Active state
On / Off	Enabling for measurement

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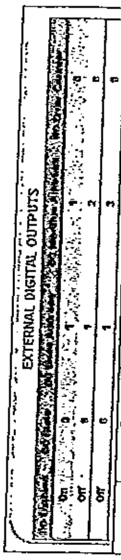
External digital outputs configuration (VAMPSET only)



Range	Description
	Communication errors
1 – 9999	Modbus register for the measurement
1 – 247	Modbus address of the I/O device
0 / 1	Output state
	Enabling for measurement

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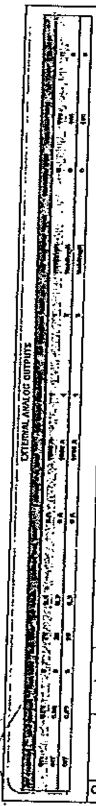
External analog outputs configuration (VAMPSET only)



Range	Description
	Communication errors
-32768 – +32767 (0 – 65535)	Modbus value corresponding Linked Val. Max
	Modbus value corresponding Linked Val. Min
InputR or HoldingR	Modbus register type
1 – 9999	Modbus register for the output
1 – 247	Modbus address of the I/O device
0 – 42x106, -21x106 – +21x106	Maximum limit for lined value, corresponding to "Modbus Max"
	Minimum limit for lined value, corresponding to "Modbus Min"
	Link selection
-21x107 – +21x107	Minimum & maximum output values
	Active value
On / Off	Enabling for measurement

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9.6 Block diagram

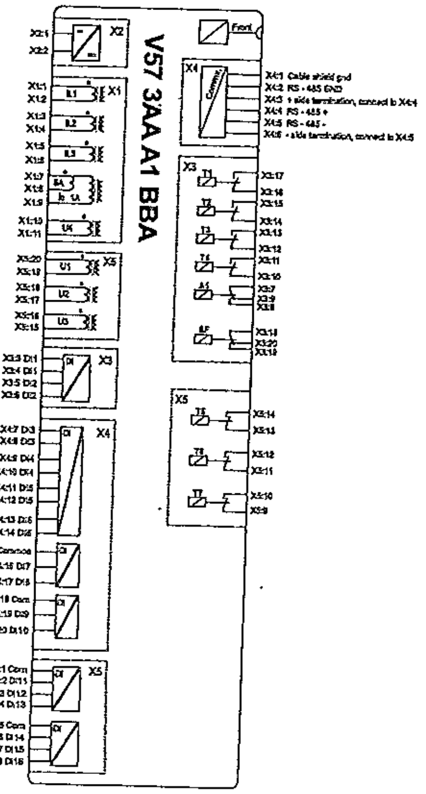

Figure 9.6: VAMP 57 3AA A1 BBA block diagram

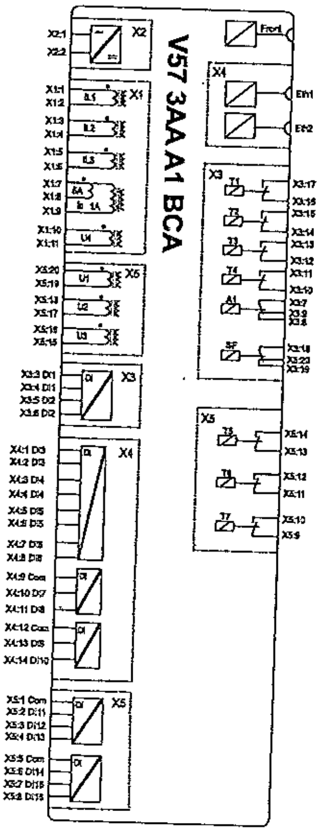

Figure 9.7: VAMP 57 3AA A1 BCA block diagram

000327

9.7 Connection examples

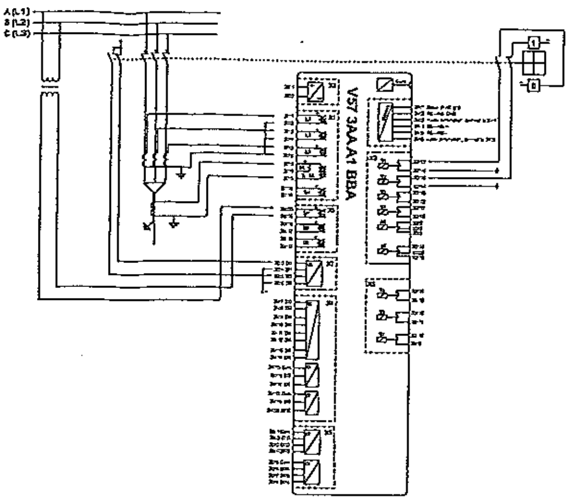

Figure 9.8: Feeder and motor protection connection when one line-to-line voltage is sufficient.

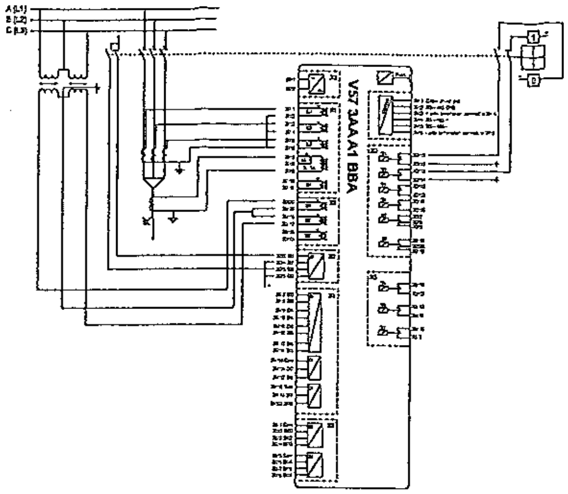

Figure 9.9: Feeder and motor feeder protection connection where two line-to-line voltage transformers are available.

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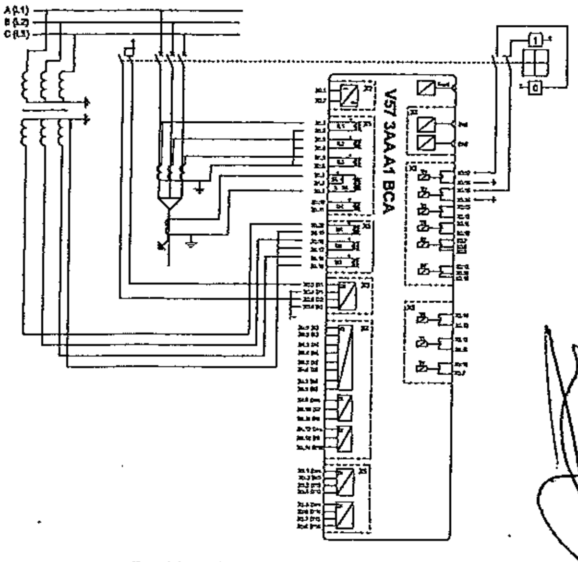

Figure 9.10: Feeder and motor protection connection where line-to-neutral connection is used. When the voltage measurement mode in set to 3LN the relay calculates line-to-line and zero sequence voltage thus directional over current and earth fault protection stages could be used.

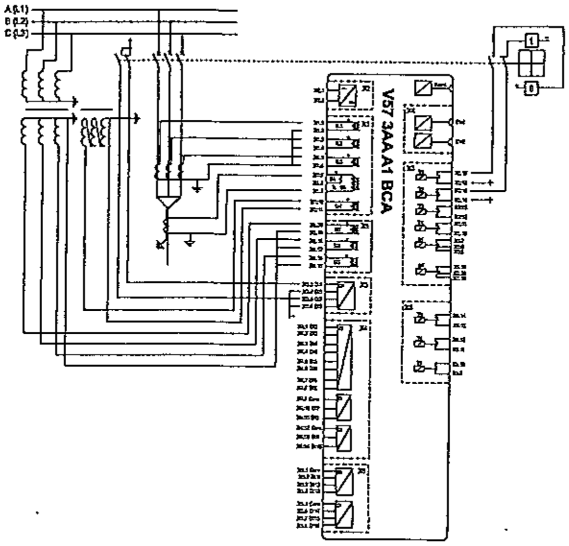

Figure 9.11: Feeder and motor protection connection where line-to-neutral connection is used. When the voltage measurement mode in set to 3LN+Uo the relay calculates line-to-line voltages thus directional over current and earth fault protection stages could be used.

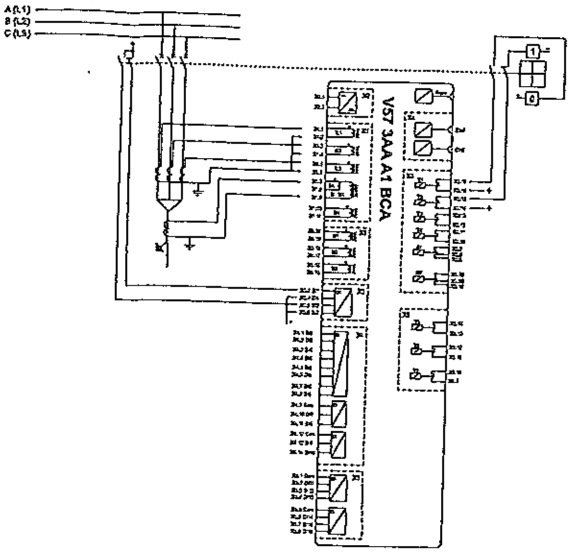

Figure 9.12: Feeder and motor protection connection without system voltages.

ВЯРНО С ОРИГИНАЛА

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10 Technical data

10.1 Connections

Table 10.1: Measuring circuits

Phase currents	
Rated phase current	5 A (configurable for CT secondaries 1 – 10 A)
- Current measuring range	0.05 – 250 A
- Thermal withstand	20 A (continuously) 100 A (for 10 s) 500 A (for 1 s)
- Burden	0.075 VA
- Impedance	0.003 Ohm
I_0 Input (5 A)	
Rated residual current	5 A (configurable for CT secondaries 0.1 – 10 A)
- Current measuring range	0.025 – 50 A
- Thermal withstand	20 A (continuously) 100 A (for 10 s) 500 A (for 1 s)
- Burden	0.075 VA
- Impedance	0.003 Ohm
I_0 Input (1 A)	
Rated residual current	1 A (configurable for CT secondaries 0.1 – 10.0 A)
- Current measuring range	0.003 – 10 A
- Thermal withstand	4 A (continuously) 20 A (for 10 s) 100 A (for 1 s)
- Burden	0.02 VA
- Impedance	0.02 Ohm

Voltages	
Rated voltage U_N	100 V (configurable for VT secondaries 50 – 400 V)
- Voltage measuring range	0 – 185 V (100 V / 110 V)
- Continuous voltage withstand	250 V
- Burden	< 0.5 VA
Rated voltage U	100 V (configurable for VT secondaries 50 – 120 V)
- Voltage measuring range	0 – 175 V
- Continuous voltage withstand	250 V
- Burden	< 0.5 VA
Frequency	
Rated frequency f_N	45 – 65 Hz (protection operates accurately)
Measuring range	16 – 95 Hz < 40Hz / > 65Hz (other protection is not steady except frequency protection)

Table 10.2: Auxiliary voltage

	Type A (standard)	Type B (option)
Rated voltage U_{AUX}	40 – 265 V ac/dc	18 – 36 V dc Note! Polarity X2:1= positive (+) X2:2= negative (-)
Start-up peak (DC) 110 V (Type A) 220 V (Type A)	25 A with time constant of 1000 µs 15 A with time constant of 500 µs 25 A with time constant of 750 µs	
Power consumption	< 15 W (normal conditions) < 25 W (output relays activated)	
Max. permitted interruption time	< 50 ms (110 V dc)	

Table 10.3: Digital inputs internal operating voltage

Number of inputs	As per ordering code Model: V57F-xxxxxBxx: 16 Model: V57F-xxxxxAxx: 10
Voltage withstand	265 V ac/dc
Nominal operation voltage DI1 – DI16	1: 24 – 230 V ac/dc (max. 265 V ac/dc) 2: 110 – 230 V ac/dc (max. 265 V ac/dc) 3: 220 – 230 V ac/dc (max. 265 V ac/dc)
Typical switching treshold	1: 12 V dc 2: 75 V dc 3: 155 V dc
Current drain	approx. 3 mA
Activation time dc/ac	< 11 ms / < 15 ms
Reset time dc/ac	< 11 ms / < 15 ms

1 set dc/ac mode according to the used voltage in VAMPSET.

Table 10.4: Trip contact, Tx

Number of contacts	Model V57F-xxxxxBxx: 7 Model V57F-xxxxxAxx: 4
Rated voltage	250 V ac/dc
Continuous carry	5 A
Minimum making current	100 mA @ 24 Vdc
Typical operation time	7 ms
Make and carry, 0.5 s	30 A
Make and carry, 3s	15 A
Breaking capacity, AC	2 000 VA
Breaking capacity, DC (L/R=40ms)	
at 48 V dc	1.15 A
at 110 V dc	0.5 A
at 220 V dc	0.25 A
Contact material	AgNi 90/10

Table 10.5: Signal contact, A1

Number of contacts:	1
Rated voltage	250 V ac/dc
Max. make current, 4s at duty cycle 10%	15 A
Continuous carry	5 A
Breaking capacity, AC	2 000 VA
Minimum making current	100 mA @ 24 V ac/dc
Breaking capacity, DC (L/R=40ms)	
at 48 V dc:	1.15 A
at 110 V dc:	0.5 A
at 220 V dc	0.25 A
Contact material	AgNi 0.15 gold plated

Table 10.6: Signal contact, SF

Number of contacts:	1
Rated voltage	250 V ac/dc
Continuous carry	5 A
Breaking capacity, AC	2 000 VA
Minimum making current	100 mA @ 24 V ac/dc
Breaking capacity, DC (L/R=40ms)	
at 48 V dc:	1.15 A
at 110 V dc:	0.5 A
Contact material	AgNi 0.15 gold plated

Table 10.7: Terminal characteristics

Terminal characteristics	X1	X2	X3	X4	X5
Screw clamp:					
Maximum wire dimension, mm² (AWG)	4.0 (11 – 12)	2.5 (13 – 14)	2.5 (13 – 14)	2.5 (13 – 14)	2.5 (13 – 14)
Terminal type	Fixed	MSTB2.5 – 5.08	MSTB2.5 – 5.08	MSTB2.5 – 5.08	MSTB2.5 – 5.08
Maximum wiring screw tightening torque Nm (lb-in)	1.2 (10.6)	0.5 – 0.6 (4.4 – 5.3)	0.5 – 0.6 (4.4 – 5.3)	0.5 – 0.6 (4.4 – 5.3)	0.5 – 0.6 (4.4 – 5.3)
Maximum connector retention screw tightening torque Nm (lb-in)		0.34 (3)	0.34 (3)	0.34 (3)	0.34 (3)
Wire type	Solid or stranded				
Ring-lug:					
Ring lug width (mm) and screw size	8.0, M3.5				7.0, M3.5
Maximum wiring screw tightening torque Nm (lb-in)	0.79 (7)				0.79 (3)
Maximum connector retention screw tightening torque Nm (lb-in)					0.34 (3)

Table 10.8: RS 485 communication port

Number of physical ports	0 - 1 on rear panel (option)
Electrical connection	RS-485 (option)
Protocols	Modbus, RTU slave Spabus, slave IEC 60870-5-103 IEC 61870-5-101 * DNP 3.0

Table 10.9: Ethernet communication port

Number of ports	0 or 2 on rear panel (option)
Electrical connection	RJ-45 100Mbps (option)
Protocols	IEC 61850 Modbus TCP DNP 3.0 Ethernet IP IEC 61870-5-101

10.2 Test and environmental conditions

Table 10.10: Disturbance tests

Test	Standard & Test class / level	Test value
Emission	IEC/EN 60255-26 (ed3)	
- Conducted	EN 55022, Class A, IEC 60255-25, CISPR 22	0.15 – 30 MHz
- Emitted	EN 55011, Class A / IEC 60255-25 / CISPR 11	30 – 1000 MHz
Immunity	IEC/EN 60255-26 (ed3)	
- 1Mhz damped oscillatory wave	IEC/EN 61000-4-18, IEC 60255-22-1	±2.5kVp CM, ±2.5kVp DM
- Static discharge (ESD)	IEC/EN 61000-4-2 Level 4, IEC 60255-22-2	±8 kV contact, ±15 kV air
- Emitted HF field	IEC/EN 61000-4-3 Level 3, IEC 60255-22-3	80 - 2700 MHz, 10 V/m
- Fast transients (EFT)	IEC/EN 61000-4-4 Level 4, IEC 60255-22-4	±4 kV, 5/50 ns, 5 kHz
- Surge	IEC/EN 61000-4-5 Level 3, IEC 60255-22-5	±2 kV, 1.2/50 µs, CM ±1 kV, 1.2/50 µs, DM
- Conducted HF field	IEC/EN 61000-4-6 Level 3, IEC 60255-22-6	0.15 - 80 MHz, 10 Vemf
- Power-frequency magnetic field	IEC/EN 61000-4-8	300A/m (continuous), 1000A/m 1-3s
- Pulse magnetic field	IEC/EN 61000-4-9 Level 5	1000A/m, 1.2/50 µs
- Voltage dips	IEC/EN 61000-4-29, IEC/EN 61000-4-11	30%/1s, 60%/0.2s, 100%/0.05s
- Voltage alternative component	IEC/EN 61000-4-17	15% of operating voltage (DC) / 10min
- Voltage short interruptions	IEC/EN 61000-4-29, IEC/EN 61000-4-11	30%/10ms, 100%/10ms, 60%/100ms, 100%/5000ms

Table 10.11: Electrical safety tests

Test	Standard & Test class / level	Test value
- Impulse voltage withstand	IEC/EN 60255-27, EN 60255-5, Class III	5 kV, 1.2/50 ms, 0.5 J 1 kV, 1.2/50 ms, 0.5 J Communication
- Dielectric test	IEC/EN 60255-27, EN 60255-5, Class III	2 kV, 50 Hz 0.5 kV, 50 Hz Communication
- Insulation resistance	IEC/EN 60255-27, EN 60255-5	
- Protective bonding resistance	IEC/EN 60255-27	
- Power supply burden	IEC 60255-1	

Table 10.12: Mechanical tests

Test	Standard & Test class / level	Test value
Device in operation		
- Vibrations	IEC 60255-21-1, Class II / IEC 60068-2-6, Fc	1Gn, 10Hz – 150 HZ
- Shocks	IEC 60255-21-2, Class II / IEC 60068-2-27, Ea	10Gn/11ms
- Seismic	IEC 60255-21-3 Method A, Class II	2G horizontal / 1G vertical, 1Hz-35Hz
Device de-energized		
- Vibrations	IEC 60255-21-1, Class II / IEC 60068-2-6, Fc	2Gn, 10Hz – 150 HZ
- Shocks	IEC 60255-21-2, Class II / IEC 60068-2-27, Ea	30Gn/11ms
- Bump	IEC 60255-21-2, Class II / IEC 60068-2-27, Ea	20Gn/16ms

Table 10.13: Environmental tests

Test	Standard & Test class / level	Test value
Device in operation		
- Dry heat	EN / IEC 60068-2-2, Bd	65°C (149°F)
- Cold	EN / IEC 60068-2-1, Ad	-40°C (-40°F)
- Damp heat, cyclic	EN / IEC 60068-2-30, Db	• From 25°C (77°F) to 55°C (131°F) • From 93% RH to 98% RH • Testing duration: 6 days
- Damp heat, static	EN / IEC 60068-2-78, Cab	• 40°C (104°F) • 93% RH • Testing duration: 10 days
Device in storage		
- Dry heat	EN / IEC 60068-2-2, Bb	70°C (158°F)
- Cold	EN / IEC 60068-2-1, Ab	-40°C (-40°F)

Table 10.14: Environmental conditions

Ambient temperature, in-service	-40 – 65°C (-40 – 149°F)
Ambient temperature, storage	-40 – 70°C (-40 – 158°F)
Relative air humidity	< 95%

Table 10.15: Casing

Degree of protection (IEC 60529)	IP54 Front panel, IP20 rear side
Dimensions (w x h x d):	170 x 170 x 205 mm / 6.69 x 6.69 x 8.07 in
Weight	2.5 kg (5.519 lb)

10.3 Protection functions

*) EI = Extremely Inverse, NI = Normal Inverse, VI = Very Inverse, LTI = Long Time Inverse, MI= Moderately Inverse

**) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

10.3.1 Non-directional current protection

Table 10.16: Overcurrent stage I> (50/51)

Pick-up current	0.10 – 5.00 x I_{MODE} (step 0.01)
Definite time function:	DT**
- Operating time	0.04 – 300.00 s (step 0.01 s)
IDMT function:	
- Delay curve family	(DT), IEC, IEEE, RI Prg
- Curve type	EI, VI, NI, LTI, MI..., depends on the family*
- Time multiplier k	0.05 – 20.0, except
	0.50 – 20.0 for RXIDG, IEEE and IEEE2
Start time	Typically 30 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio:	0.97
Transient over-reach, any τ	< 10 %
Inaccuracy:	
- Starting	±3% of the set value or 5 mA secondary
- Operating time at definite time function	±1% or ±25 ms
- Operating time at IDMT function	±5% or at least ±25 ms**

Table 10.17: Overcurrent stage I>> (50/51)

Pick-up current	0.10 – 20.00 x I_{MODE} (step 0.01)
Definite time function:	DT**
Operating time	0.04 – 1800.00 s (step 0.01 s)
Start time	Typically 30 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio:	0.97
Transient over-reach, any τ	< 10 %
Inaccuracy:	
- Starting	±3% of the set value or 5 mA secondary
- Operation time	±1% or ±25 ms

Table 10.18: Overcurrent stages I>>> (50/51)

Pick-up current	0.10 – 40.00 x I_{MODE} (step 0.01)
Definite time function:	DT**
Operating time	0.03 – 300.00 s (step 0.01 s)
Instant operation time:	
I_M / I_{SET} ratio > 1.5	<30 ms
I_M / I_{SET} ratio 1.03 – 1.5	< 50 ms
Start time	Typically 20 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio:	0.97
Inaccuracy:	
- Starting	±3% of the set value or 5 mA secondary
- Operation time DT (I_M/I_{SET} ratio > 1.5)	±1% or ±15 ms
- Operation time DT (I_M/I_{SET} ratio 1.03 – 1.5)	±1% or ±25 ms

Table 10.19: Stall protection stage (48) in motor mode

Setting range:	
- Motor start detection current	1.30 – 10.00 x I_{MOT} (step 0.01)
- Nominal motor start current	1.50 – 10.00 x I_{MOT} (step 0.01)
Delay type:	DT, INV
Definite time characteristic (DT):	
- Operating time	1.0 – 300.0 s (step 0.1)**)
Inverse time characteristic (INV):	
- operation delay	1.0 – 300.0 s (step 0.1)
- Inverse time coefficient, k	1.0 – 200.0 s (step 0.1)
Minimum motor stop time to activate stall protection	500 ms
Maximum current raise time from motor stop to start	200 ms
Motor stopped limit	0.10 x I_{MOT}
Motor running lower limit	0.20 x I_{MOT}
Motor running limit after starting	1.20 x I_{MOT}
Start time	Typically 60 ms
Reset time	< 95 ms
Reset ratio:	0.95
Inaccuracy:	
- Starting	±3% of the set value or 5 mA secondary
- Operating time at definite time function	±1% or at ±30 ms
- Operating time at IDMT function	±5% or at least ±30 ms

NOTE: Motor stopped and running limits are based on the average of three phase currents.

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Table 10.20: Thermal overload stage T> (49)

Maximum continuous current:	0.1 – 2.40 x I_{MODE} (step 0.01)
Alarm setting range:	60 – 99 % (step 1%)
Time constant Tau:	2 – 180 min (step 1)
Cooling time coefficient:	1.0 – 10.0 x Tau (step 0.1)
Max. overload at +40°C	70 – 120 %I_{MODE} (step 1)
Max. overload at +70°C	50 – 100 %I_{MODE} (step 1)
Ambient temperature	-55 – 125°C (step 1°)
Resetting ratio (Start & trip)	0.95
Accuracy:	
- Operating time	±5% or ±1 s

Table 10.21: Undercurrent protection stage I< (37)

Current setting range:	20 – 70 %I_{MODE} (step 1%)
Definite time characteristic:	
- Operating time	0.3 – 300.0 s (step 0.1)
Block limit	15 % (fixed)
Start time	Typically 200 ms
Reset time	< 450 ms
Reset ratio:	1.05
Accuracy:	
- Starting	±2% of set value or ±0.5% of the rated value
- Operating time	±1 % or ±150 ms

NOTE: Stage Blocking is functional when all phase currents are below the block limit.

Table 10.22: Current unbalance stage I_2> (46) in motor mode

Setting range:	2 – 70% (step 1%)
Definite time characteristic:	
- Operating time	1.0 – 600.0 s (step 0.1 s)
Inverse time characteristic:	
- 1 characteristic curve	Inv
- time multiplier	1 – 50 s (step 1)
- upper limit for inverse time	1000 s
Start time	Typically 300 ms
Reset time	< 450 ms
Reset ratio:	0.95
Inaccuracy:	
- Starting	±1% - unit
- Operate time	±5% or ±200 ms

NOTE: Stage is operational when all secondary currents are above 250 mA.

Table 10.23: Current unbalance stage I_2/I_1> (46) in feeder mode

Settings:	
- Setting range I_2 / I_1>	2 – 70% (step 1%)
Definite time function:	
- Operating time	1.0 – 600.0 s (step 0.1 s)
Start time	Typically 300 ms
Reset time	< 450 ms
Reset ratio:	0.95
Inaccuracy:	
- Starting	±1% - unit
- Operate time	±5% or ±200 ms

Table 10.24: Incorrect phase sequence I_2>> (47)

Setting:	80 % (fixed)
Operating time	<120 ms
Reset time	< 105 ms

NOTE: Stage is blocked when motor has been running for 2 seconds.

Stage is operational only when least one of the currents is above 0.2 x I_{MOT}

Table 10.25: Earth fault stage I_0> (50N/51N)

Input signal	I_0 (input X1:7 – 8 or input X1:7 – 9)
	I_{0Calc} (= I_{L1} + I_{L2} + I_{L3})
Setting range I_0>	0.005 – 8.00 pu (when I_0) (step 0.01)
	0.05 – 20.0 pu (when I_{0Calc})
Definite time function:	DT**
- Operating time	0.04** – 300.00 s (step 0.01 s)
IDMT function:	
- Delay curve family	(DT), IEC, IEEE, RI Prg
- Curve type	EI, VI, NI, LTI, MI..., depends on the family*
- Time multiplier k	0.05 – 20.0, except
	0.50 – 20.0 for RXIDG, IEEE and IEEE2
Start time	Typically 30 ms
Reset time	< 95 ms
Reset ratio:	0.95
Inaccuracy:	
- Starting	±2% of the set value or ±0.3% of the rated value
- Starting (Peak mode)	±5% of the set value or ±2% of the rated value (Sine wave <65 Hz)
- Operating time at definite time function	±1% or ±25 ms
- Operating time at IDMT function	±5% or at least ±25 ms**

Table 10.26: Earth fault stages $I_0>>$, $I_0>>>$, $I_0>>>>$ (50N/51N)

Input signal	I_0 (input X1:7 – 8 or input X1:7 – 9) I_{0Calc} (= I_{L1} + I_{L2} + I_{L3})
Setting range	0.01 – 8.00 pu (When I_0) (step 0.01) 0.05 – 20.0 pu (When I_{0Calc}) (step 0.01)
Definite time function: - Operating time	 0.04** – 300.00 s (step 0.01 s)
Start time	Typically 30 ms
Reset time	< 95 ms
Reset ratio:	0.95
Inaccuracy:	
- Starting	±2% of the set value or ±0.3% of the rated value
- Starting (Peak mode)	±5% of the set value or ±2% of the rated value (Sine wave <65 Hz)
- Operate time	±1% or ±25 ms

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10.3.2 Directional current protection

Table 10.27: Directional overcurrent stages $I_\varphi>$, $I_\varphi>>$ (67)

Pick-up current	0.10 – 4.00 x I_{MODE} (step 0.01)
Mode	Directional/Directional+BackUp
Minimum voltage for the direction solving	2 $V_{SECONDARY}$
Base angle setting range	-180° – +179°
Operation angle	±88°
Definite time function: - Operating time	DT** 0.04 – 300.00 s (step 0.01)
IDMT function: - Delay curve family - Curve type - Time multiplier k	 (DT), IEC, IEEE, RI Prg EI, VI, NI, LTI, MI…depends on the family* 0.05 – 20.0, except 0.50 – 20.0 for RXIDG, IEEE and IEEE2
Start time	Typically 30 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio:	0.95
Reset ratio (angle)	2°
Transient over-reach, any τ	< 10 %
Adjustable voltage memory length	0.2 – 3.2 s
Inaccuracy:	
- Starting (rated value I_N= 1–5A)	±3% of the set value or ±0.5% of the rated value
- Angle	±2° U>5 V ±30° U= 0.1 – 5.0 V
- Operate time at definite time function	±1% or ±25 ms
- Operate time at IDMT function	±5% or at least ±30 ms**

Table 10.28: Directional overcurrent stages $I_\varphi>>>$, $I_\varphi>>>>$ (67)

Pick-up current	0.10 – 20.00 x I_{MODE} (step 0.01)
Mode	Directional/Directional+BackUp
Minimum voltage for the direction solving	2 $V_{SECONDARY}$
Base angle setting range	-180° – +179°
Operation angle	±88°
Definite time function: - Operating time	DT** 0.04 – 300.00 s (step 0.01)
Start time	Typically 30 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio:	0.95
Reset ratio (angle)	2°
Transient over-reach, any τ	< 10 %
Adjustable voltage memory length	0.2 – 3.2 s
Inaccuracy:	
- Starting (rated value I_N= 1 – 5A)	±3% of the set value or ±0.5% of the rated value
- Angle	±2° U> 5 V ±30° U= 0.1 – 5.0 V
- Operate time at definite time function	±1% or ±25 ms

Table 10.29: Directional earth fault stages $I_{0\varphi}>$, $I_{0\varphi}>>$ (67N)

Pick-up current	0.005 – 20.00 x I_{0N} (up to 8.00 for inputs other than I_{0Calc})
Start voltage	1 – 50 %U_{0N} (step 1%)
Input signal	I_{0Calc} (= I_{L1} + I_{L2} + I_{L3})
Mode	Non-directional/Sector/ResCap
Base angle setting range	-180° – 179°
Operation angle	±88°
Definite time function: - Operating time	 0.10** – 300.00 s (step 0.02 s)
IDMT function:	
- Delay curve family	(DT), IEC, IEEE, RI Prg
- Curve type	EI, VI, NI, LTI, MI..., depends on the family*
- Time multiplier k	0.05 – 20.0, except 0.50 – 20.0 for RI, IEEE and IEEE2
Start time	Typically 60 ms
Reset time	< 95 ms
Reset ratio:	0.95
Reset ratio (angle)	2°
Inaccuracy:	
- Starting U_0 & I_0 (rated value In= 1 – 5A)	±3% of the set value or ±0.3% of the rated value
- Starting U_0 & I_0 (Peak Mode when, rated value I_{0n}= 1 – 10A)	±5% of the set value or ±2% of the rated value (Sine wave <65 Hz)
- Starting U_0 & I_0 (I_{0Calc})	±3% of the set value or ±0.5% of the rated value
- Angle	±2° when U> 1V and I_0> 5% of I_{0N} or > 50 mA else ±20°
- Operate time at definite time function	±1% or ±30 ms
- Operate time at IDMT function	±5% or at least ±30 ms**

000332

Table 10.30: Directional intermittent transient earth fault stage $I_{0INT}>$ (67NI)

Input selection for I_0 peak signal	I_0 Connectors X1:7 – 8 or X1:7 – 9
Direction selection	Forward Reverse
I_0 peak pick up level (fixed)	0.1 pu @ 50 Hz
U_0 pickup level	1 – 60 %U_{0N} (step 1%)
Definite operating time	0.02 – 300.00 s (step 0.02)
Intermittent time	0.01 – 300.00 s (step 0.01)
Start time	Typically 30 ms
Reset time	0.06 – 300 s
Reset ratio (hysteresis) for U_0	0.97
Inaccuracy:	
- Starting	±3% for U_0. No inaccuracy defined for I_0 transients
- time	±1% or ±30 ms (The actual operation time depends of the intermittent behaviour of the fault and the intermittent time setting.)

10.3.3 Frequent start protection

Table 10.31: Frequent start protection N> (66)

Settings:	
- Max motor starts	1 – 20
- Min time between motor starts	0.0 – 100 min. (step 0.1 min)

10.3.4 Voltage protection

Table 10.32: Overvoltage stage U> (59)

Overvoltage setting range:	50 – 150 %U_N (step 1%)
Definite time characteristic:	
- Operating time	0.08** – 300.00 s (step 0.02)
Hysteresis	0.99 – 0.800 (0.1 – 20.0 %, step 0.1 %)
Start time	Typically 60 ms
Release delay	0.06 – 300.00 s (step 0.02)
Reset time	< 95 ms
Retardation time	< 50 ms
Inaccuracy:	
- Starting	±3% of the set value
- operate time	±1% or ±30 ms

Table 10.33: Overvoltage stage U>> (59)

Overvoltage setting range:	50 – 150 %U_N (step 1%)
Definite time characteristic:	
- Operating time	0.06** – 300.00 s (step 0.02)
Hysteresis	0.99 – 0.800 (0.1 – 20.0 %, step 0.1 %)
Start time	Typically 60 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Inaccuracy:	
- Starting	±3% of the set value
- operate time	±1% or ±30 ms

Table 10.34: Overvoltage stage U>>> (59)

Overvoltage setting range:	50 – 180 %U_N (step 1%)
Definite time characteristic:	
- Operating time	0.04 – 300.00 s (step 0.01)
Hysteresis	0.99 – 0.800 (0.1 – 20.0 %, step 0.1 %)
Start time	Typically 30 ms
Reset time	< 95 ms
Retardation time	< 60 ms
Inaccuracy:	
- Starting	±3% of the set value
- operate time	±1% or ±25 ms

Table 10.35: Undervoltage stage U< (27)

Undervoltage setting range	20 – 120 %U_N (step 1%)
Definite time characteristic:	
- Operating time	0.08** – 300.00 s (step 0.02)
Hysteresis	1.001 – 1.200 (0.1 – 20.0 %, step 0.1 %)
Self-blocking value of the undervoltage	0 – 80 %U_N
Start time	Typically 60 ms
Release delay	0.06 – 300.00 s (step 0.02 s)
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio (Block limit)	0.5 V or 1.03 (3 %)
Reset ratio:	1.03 (depends on the hysteresis setting)
Inaccuracy:	
- Starting	±3% of the set value
- blocking	±3% of set value or ±0.5 V
- operate time	±1% or ±30 ms

Table 10.36: Undervoltage stage U<< (27)

Undervoltage setting range	20 – 120 %U_N (step 1%)
Definite time characteristic:	
- Operating time	0.06** – 300.00 s (step 0.02)
Hysteresis	1.001 – 1.200 (0.1 – 20.0 %, step 0.1 %)
Self-blocking value of the undervoltage	0 – 80 %U_N
Start time	Typically 60 ms
Reset time	< 95 ms
Retardation time	< 60 ms
Reset ratio (Block limit)	0.5 V or 1.03 (3 %)
Reset ratio:	1.03 (depends on the hysteresis setting)
Inaccuracy:	
- Starting	±3% of the set value
- blocking	±3% of set value or ±0.5 V
- operate time	±1% or ±30 ms

Table 10.37: Undervoltage stage U<<< (27)

Undervoltage setting range	20 – 120 %U_N (step 1%)
Definite time characteristic:	
- Operating time	0.04 – 300.00 s (step 0.01)
Hysteresis	1.001 – 1.200 (0.1 – 20.0 %, step 0.1 %)
Self-blocking value of the undervoltage	0 - 80 %U_N
Start time	Typically 30 ms
Reset time	< 95 ms
Retardation time	< 50 ms
Reset ratio (Block limit)	0.5 V or 1.03 (3 %)
Reset ratio:	1.03 (depends on the hysteresis setting)
Inaccuracy:	
- Starting	±3% of the set value
- blocking	±3% of set value or ±0.5 V
- operate time	±1% or ±25 ms

Table 10.38: Zero sequence voltage stage $U_0>$ (59N)

Zero sequence voltage setting range	1 – 60 %U_{0N} (step 1%)
Definite time function:	
- Operating time	0.3 – 300.0 s (step 0.1 s)
Start time	Typically 200 ms
Reset time	< 450 ms
Reset ratio:	0.97
Inaccuracy:	
- Starting	±2% of the set value or ±0.3% of the rated value
- Starting UoCalc (3LN mode)	±1 V
- Operate time	±1 % or ±150 ms

Table 10.39: Zero sequence voltage stage $U_0>>$ (59N)

Zero sequence voltage setting range	1 – 60 %U_{0N} (step 1%)
Definite time function:	
- Operating time	0.08 – 300.0 s (step 0.02 s)
Start time	Typically 60 ms
Reset time	< 95 ms
Reset ratio:	0.97
Inaccuracy:	
- Starting	±2% of the set value or ±0.3% of the rated value
- Starting U_{0Calc} (3LN mode)	±1 V
- Operate time	±1% or ±30 ms

.10.3.5 Circuit-breaker failure protection CBFP (50BF)

Table 10.40: Circuit-breaker failure protection CBFP (50BF)

Relay to be supervised	T1 – T7 (depending the ordering code)
Definite time function:	
- Operating time	0.1** – 10.0 s (step 0.1 s)
Inaccuracy	
- Operating time	±20 ms

10.3.6 Magnetising inrush 68F2

Table 10.41: Magnetising Inrush 68F2

Settings:	
- Setting range magnetising inrush	10 – 100 % (step 1%)
- Operating time	0.03 – 300.00 s (step 0.01 s)
Inaccuracy:	
- Starting	±1% - unit

NOTE: The amplitude of second harmonic content has to be at least 2% of the nominal of CT. If the nominal current is 5 A, the 100 Hz component needs to exceed 100 mA.

10.3.7 Over exicitation 68F5

Table 10.42: Over exicitation 68F5

Settings:	
- Setting range over excitation	10 – 100 % (step 1%)
- Operating time	0.03 – 300.00 s (step 0.01 s)
Inaccuracy:	
- Starting	±2%- unit

NOTE: The amplitude of fifth harmonic content has to be at least 2% of the nominal of CT. If the nominal current is 5 A, the 250 Hz component needs to exceed 100 mA.

10.3.8 Frequency protection

Table 10.43: Overfrequency and underfrequency stages f><, f>><< (81H/81L)

Frequency measuring area	16.0 – 75.0 Hz
Current and voltage meas. range	45.0 – 65.0 Hz
Frequency stage setting range	40.0 – 70.0 Hz (step 0.01)
Low voltage blocking	10 – 100 %U_N Suitable frequency area for low voltage blocking is 45 – 65 Hz. Low voltage blocking is checking the maximum of line to line voltages.
Definite time function:	
- Operating time	0.10** – 300.0 s (step 0.02 s)
Start time	< 100 ms
Reset time	<120 ms
Reset ratio (f> and f>>)	0.998
Reset ratio (f< and f<<)	1.002
Reset ratio (LV block)	Instant (no hysteresis)
Inaccuracy:	
- Starting	±20 mHz
- starting (LV block)	3% of the set value or ±0.5 V
- Operating time	±1% or ±30 ms

NOTE: If device restarts for some reason there will be no trip even if the frequency is below the set limit during the start up (Start and trip is blocked). To cancel this block, frequency has to rise above the set limit.

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Table 10.44: Underfrequency stages f<, f<< (81L)

Frequency measuring area	16.0 – 75.0 Hz
Current and voltage meas. range	45.0 – 65.0 Hz
Frequency stage setting range	40.0 – 64.0 Hz
Low voltage blocking	10 – 100 %U_N Suitable frequency area for low voltage blocking is 45 – 65 Hz. Low voltage blocking is checking the maximum of line to line voltages.
Definite time function:	
- Operating time	0.10** – 300.0 s (step 0.02 s)
Undervoltage blocking	2 – 100 %
Start time	< 100 ms
Reset time	<120 ms
Reset ratio:	1.002
Reset ratio (LV block)	Instant (no hysteresis)
Inaccuracy:	
- Starting	±20 mHz
- starting (LV block)	3% of the set value or ±0.5 V
- Operating time	±1% or ±30 ms

Table 10.45: Rate of change of frequency (ROCOF) stage df/dt> (81R)

Pick-up setting df/dt	0.2 – 10.0 Hz/s (step 0.1 Hz/s)
Definite time delay (t> and t_{Min}> are equal):	
- operating time t>	0.14** – 10.00 s (step 0.02 s)
Inverse time delay (t> is more than t_{Min}>):	
- minimum operating time t_{Min}>	0.14** – 10.00 s (step 0.02 s)
Start time	Typically 140 ms
Reset time	150 ms
Retardation time	< 90 ms
Reset ratio:	1
Inaccuracy:	
- Starting	10% of set value or ±0.1 Hz/s
- operating time (overshoot ≥ 0.2 Hz/s)	±35 ms, when area is 0.2 – 1.0 Hz/s

NOTE: ROCOF stage is using the same low voltage blocking limit as the frequency stages.

10.3.9 Power protection

Table 10.46: Directional power stages P<, P<< (32)

Pick-up setting range	-200.0 – +200.0 %P_N (step 0.5)
Definite time function:	
- Operating time *	0.3 – 300.0 s (step 0.1)
Start time	Typically 200 ms
Reset time	<500 ms
Reset ratio:	1.05
Inaccuracy:	
- Starting	±3 % of set value or ±0.5 % of rated value
- Operating time at definite time function	±1 % or ±150 ms

NOTE: When pick-up setting is +1 – +200% an internal block will be activated if max. voltage of all phases drops below 5% of rated.

10.3.10 Synchrocheck function

Table 10.47: Synchrocheck function Δf, ΔU, Δφ (25)

Sync mode	Off; Async; Sync;
Voltage check mode	DD; DL; LD; DD/DL; DD/LD; DL/LD; DD/DL/LD
CB closing time	0.04 – 0.6 s
U_{DEAD} limit setting	10 – 120 %U_N
U_{LIVE} limit setting	10 – 120 %U_N
Frequency difference	0.01 – 1.00 Hz
Voltage difference	1 – 60 %U_N
Phase angle difference	2° – 90°
Request timeout	0.1 – 600.0 s
Stage operation range	46.0 – 64.0 Hz
Reset ratio (U)	0.97
Inaccuracy:	
- voltage	±3 %U_N
- frequency	±20 mHz
- phase angle	±2° (when Δf < 0.2 Hz, else ±5°)
- Operating time	±1% or ±30 ms

NOTE: When "sync" mode is used, Δf should be less < 0.2 Hz.

10.4 Supporting functions

*) This is the instantaneous time i.e. the minimum total operational time including the fault detection time and operation time of the trip contacts.

Table 10.48: Disturbance recorder (DR)

Mode of recording	Saturated / Overflow
Sample rate:	
- Waveform recording	32/cycle, 16/cycle, 8/cycle
- Trend curve recording	10, 20, 200 ms 1, 5, 10, 15, 30 s 1 min
Recording time (one record)	0.1 s – 12 000 min (According recorder setting)
Pre-trigger rate	0 – 100%
Number of selected channels	0 – 12

The recording time and the number of records depend on the time setting and the number of selected channels.

Table 10.49: Inrush current detection

Cold load settings:	
- Idle current	0.01 – 0.50 x I_N
- Pickup current	0.30 – 10.00 x I_N
- Maximum time	0.01*) – 300.00 s (step 0.01 s)
Inrush settings:	
- Pickup for 2nd harmonic	0 – 99 %

Table 10.50: Current transformer supervision

I_{MAX}> setting	0.00 – 10.00 x I_N (step 0.01)
I_{MIN}< setting	0.00 – 10.00 x I_N (step 0.01)
Definite time function:	DT
- Operating time	0.04 – 600.00 s (step 0.02 s)
Reset time	< 60 ms
Reset ratio I_{MAX}>	0.97
Reset ratio I_{MIN}<	1.03
Inaccuracy:	
- Activation	±3% of the set value
- Operating time at definite time function	±1% or ±30 ms

Table 10.51: Voltage transformer supervision

U_2> setting	0.0 – 200.0 % (step 0.1%)
I_2< setting	0.0 – 200.0 % (step 0.1%)
Definite time function:	DT
- Operating time	0.04 – 600.00 (step 0.02s)
Reset time	< 60 ms
Reset ratio:	3% of the pick-up value
Inaccuracy:	
- Activation U_2>	±1% - unit
- Activation I_2<	±1% - unit
- Operating time at definite time function	±1% or ±30 ms

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11 Mounting

PANEL MOUNTING VAMP 57

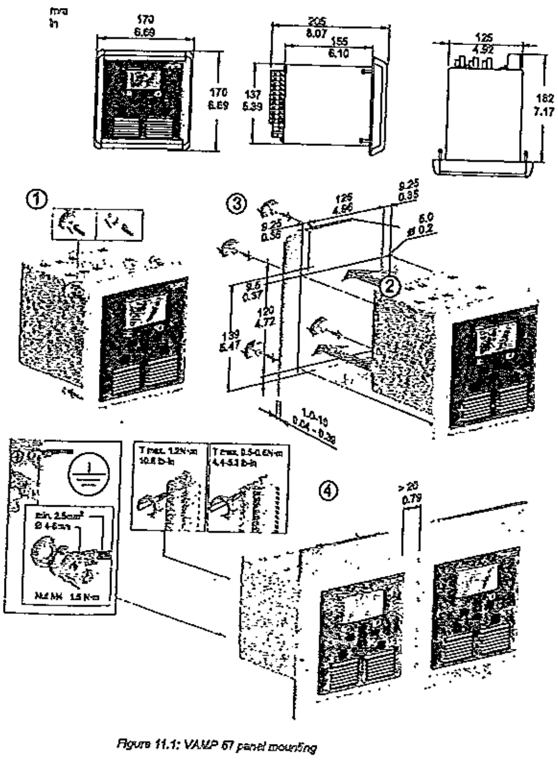

Figure 11.1: VAMP 57 panel mounting

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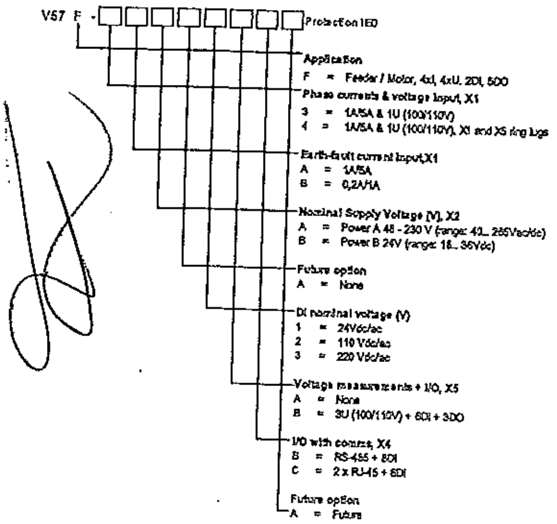
12 Order information

When ordering, please state:

- Type designation:
- Quantity:
- Options (see respective ordering code):


V57 F - ☐☐☐☐☐☐☐☐ Protection IED

Application
F = Feeder / Motor, 4xI, 4xU, 2DI, 5DO

Phase currents & voltage input, X1
3 = 1A/5A & 1U (100/110V)
4 = 1A/5A & 1U (100/110V), X1 and X5 ring lugs

Earth-fault current input,X1
A = 1A/5A
B = 0,2A/1A

Nominal Supply Voltage (V), X2
A = Power A 48 - 230 V (range: 40...265Vac/dc)
B = Power B 24V (range: 18...36Vdc)

Future option
A = None

DI nominal voltage (V)
1 = 24Vdc/ac
2 = 110 Vdc/ac
3 = 220 Vdc/ac

Voltage measurements + I/O, X5
A = None
B = 3U (100/110V) + 6DI + 3DO

I/O with comms, X4
B = RS-485 + 6DI
C = 2 x RJ-45 + 6DI

Future option
A = Future

000335

EC DECLARATION OF CONFORMITY

We

Manufacturer's name: Vamp Ltd

Manufacturer's address:
P.O.Box 810,
Yrittäjänkatu 15,
65101 Vaasa,
Finland

Hereby declare the products

Product types: VAMP 57 Feeder and motor protection relay

Conforms to the requirements of the following European Directives:
Low voltage directive 2006/95/EC
EMC directive 2004/108/EC

The following standards were used for reference and to establish conformity:

EN / IEC 60255-26:2013, Measuring relays and protection equipment: Electromagnetic compatibility requirements
EN 60255-27:2014 / IEC 60255-27:2013, Measuring relays and protection equipment: Product safety requirements

ВЯРНО С ОРИГИНАЛА

Stara Zagora Ltd.

Reference No: VDEC159

Vaasa 22.06.2015

Marko Kuokkanen
Managing Director

The last two digits of the year the CE marking was affixed 15

Schneider Electric

Type Test Certificate

Products: Protection IED: **VAMP 57**

Manufacturer Vamp Oy, Yrittäjänkatu 15, (P.O. Box 810), 65101 Vaasa, Finland

References:
- User Manual: V57/en M/E002

Result: We SCHNEIDER ELECTRIC / Vamp Oy hereby declare that the following products have been fully tested and the products have not shown to be non-conforming the following tests:
- Disturbance tests
- Electrical safety tests
- Mechanical tests
- Environmental tests
- Environmental conditions
- Energizing quantities

Function: VAMP 57 can be used as a feeder / motor protection relay

ВЯРНО С
ОРИГИНАЛА

Pekka Hämäläinen
Offer Manager - Vamp range
SCHNEIDER ELECTRIC VAMP

Petri Hakamäki
Type Approval & Design Engineer
SCHNEIDER ELECTRIC VAMP

Reference Number : VDEC 178
Date of Issue : 13 October 2015
Issue : A

VAMP 57

Disturbance tests :

Test	Standard & Test class / level	Test value
Emission	IEC/EN 60255-26 (ed3)	
- Conducted	EN 55022, Class A, IEC 60255-25, CISPR 22	0.15 – 30 MHz
- Emitted	EN 55011, Class A / IEC 60255-25 / CISPR	30 – 1000 MHz
Immunity	IEC/EN 60255-26 (ed3)	
- 1Mhz damped oscillatory wave	IEC/EN 61000-4-18, IEC 60255-22-1	±2.5kVp CM, ±2.5kVp DM
- Static discharge (ESD)	IEC/EN 61000-4-2 Level 4, IEC 60255-22-2	±8 kV contact, ±15 kV air
- Emitted HF field	IEC/EN 61000-4-3 Level 3, IEC 60255-22-3	80 - 2700 MHz, 10 V/m
- Fast transients (EFT)	IEC/EN 61000-4-4 Level 4, IEC 60255-22-4	±4 kV, 5/50 ns, 5 kHz
- Surge	IEC/EN 61000-4-5 Level 3, IEC 60255-22-5	±2 kV, 1.2/50 µs, CM ±1 kV, 1.2/50 µs, DM
- Conducted HF field	IEC/EN 61000-4-6 Level 3, IEC 60255-22-6	0.15 - 80 MHz, 10 Vemf
- Power-frequency magnetic field	IEC/EN 61000-4-8	300A/m (continuous), 1000A/m 1-3s
- Pulse magnetic field	IEC/EN 61000-4-9 Level 5	1000A/m, 1.2/50 µs
- Voltage dips	IEC/EN 61000-4-29, IEC/EN 61000-4-11	30%/1s, 60%/0.1s, 100%/0.05s
- Voltage alternative component	IEC/EN 61000-4-17	15% of operating voltage (DC) / 10min
- Voltage short interruptions	IEC/EN 61000-4-29, IEC/EN 61000-4-11	30%/10ms, 100%/10ms, 60%/100ms, 100%/5000ms

Electrical safety tests :

Test	Standard & Test class / level	Test value
- Impulse voltage withstand	IEC/EN 60255-27, EN 60255-5, Class III	5 kV, 1.2/50 µs 1 kV, 1.2/50 µs Communication
- Dielectric test	IEC/EN 60255-27, EN 60255-5, Class III	2 kV, 50 Hz 0.5 kV, 50 Hz Communication
- Insulation resistance	IEC/EN 60255-27, EN 60255-5	>100Mohm, 500V / 100V
- Protective bonding resistance	EN 60255-27	< 0,1 ohm
- Power supply burden	IEC 60255-1	

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Mechanical tests :

Test	Standard & Test class / level	Test value
Device in operation		
- Vibrations	IEC 60255-21-1, Class II / IEC 60068-2-6, Fc	1Gn, 10Hz – 150 Hz
- Shocks	IEC 60255-21-2, Class II / IEC 60068-2-27, Ea	10Gn/11ms
- Seismic	IEC 60255-21-3 Method A, Class II	2G horizontal / 1G vertical , 1Hz-35Hz
Device de-energized		
- Vibrations	IEC 60255-21-1, Class II / IEC 60068-2-6, Fc	2Gn, 10Hz – 150 Hz
- Shocks	IEC 60255-21-2, Class II / IEC 60068-2-27, Ea	30Gn/11ms
- Bump	IEC 60255-21-2, Class II / IEC 60068-2-27, Ea	20Gn/16ms

Environmental tests :

Test	Standard & Test class / level	Test value
Device in operation		
- Dry heat	EN / IEC 60068-2-2, Bd	65°C (149°F)
- Cold	EN / IEC 60068-2-1, Ad	-40°C (-40°F)
- Damp heat, cyclic	EN / IEC 60068-2-30, Db	• From 25°C (77°F) to 55°C (131°F) • From 93% RH to 98% RH • Testing duration: 6 days
- Damp heat, static	EN / IEC 60068-2-78, Cab	• 40°C (104°F) • 93% RH • Testing duration: 10 days
Device in storage		
- Dry heat	EN / IEC 60068-2-2, Bb	70°C (158°F)
- Cold	EN / IEC 60068-2-1, Ab	-40°C (-40°F)

Environmental conditions :

Ambient temperature, in-service	-40 – 65°C (-40 – 149°F)
Ambient temperature, storage	-40 – 70°C (-40 – 158°F)
Relative air humidity	< 95%
Maximum operating altitude	2000 m (6561.68 ft)
Degree of protection (IEC 60529)	IP54 front panel, IP 20 rear panel

ВЯРНО С
ОРИГИНАЛА

Energizing quantities:

Contact performance: Trip contact, Tx

Test (IEC 60255-1)	Test value
Rated voltage	250V ac/dc
Continuous carry	5A
Make and carry, 0.5s	30A
Make and carry, 3s	15A
Breaking capacity, AC	2 000 VA
Breaking capacity, DC (L/R=40ms)	
at 48 V dc:	1.15 A
at 110 V dc:	0.5 A
at 220 V dc	0.25 A

Contact performance: Signal contact, A1,SF

Test (IEC 60255-1)	Test value
Rated voltage	250V ac/dc
Continuous carry	5A
Breaking capacity, AC	2 000 VA
Breaking capacity, DC (L/R=40ms)	
at 48 V dc:	1.15 A
at 110 V dc:	0.5 A
at 220 V dc	0.25 A

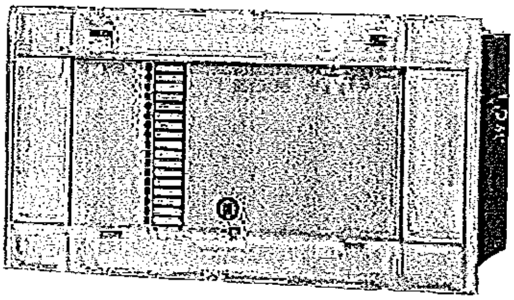
Thermal withstand

Test (IEC 60255-1)	Test value
AC current thermal withstand	4 x In continuously 100 x In for 1 s

ВЯРНО С
ОРИГИНАЛА

C264-R Application

Modular Remote Terminal Unit



Sophisticated remote terminal unit for substation control, monitoring, distributed IEDs data concentration and gateway communication with SCADAs.

The MiCOM C264-R combines the usual RTUs features with the benefits of fast Ethernet communication. Its intrinsic high-performance is further expanded through the modular I/Os acquisition racks. This up to date design helps the user to simplify the engineering and installation, improve reliability and quality as well as increase efficiency through space and cost reductions in wiring, testing, maintenance and management. The MiCOM C264-R offers natively an on-board 100Mb Ethernet communication for SCADA communication, simple maintenance access and the connection of many I/Os acquisition racks. This is in addition of the serial ports for every application using multiple standard protocols. Each port is able to communicate with a protocol including IEC60870-5-103, IEC 60870-5-101, MODBUS, DNP3.0, or with a SOE serial printer. The MiCOM C264-R with high-performance, large capacity, expandable is well adapted for turnkey applications as well as retrofit installations. MiCOM C264-R is also to be considered as a step on the way of Digital Control Systems.

FIELD OF APPLICATION

The MiCOM C264-R modular Remote Terminal Unit (RTU) provides a powerful solution for SCADA communication, Sequence of Event Recorder (SER), and can be integrated to digital substation control systems. It is designed for a wide range of applications:

Electrical utility

- Transmission and distribution substations
- Power Plant substations

Industry

- Process control, including manufacturing, transit, telecommunications, testing, etc...
- Oil and gas, including pipelines
- Water and wastewater

Transportation electrical supervision and control

- Railways
- Airport

Customer Benefits

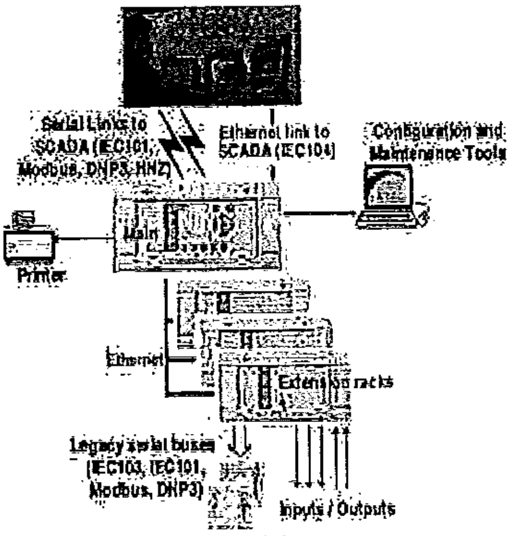
- Modular RTU for electrical substations requiring large capacities
- IEDs and Sub-RTUs concentrator
- SCADA interfaces with serial and Ethernet protocols
- A step for a smooth transition to Digital Control Systems
- LCD graphical display for user-friendly local control, monitoring, and maintenance
- Expandable design with single or multiple racks architectures
- High availability and reliability with redundant communication facilities

APPLICATION PROFILE

- Stand-alone RTU (Single or Multiple I/Os racks)
- Sequence of Event Recorder (SER) – SOE printing
- IEDs and remote sub-RTU's data concentrator
- Substation Gateway and protocol converter
- Integrated into the Schneider Electric DCS and SCADA solutions

GENERAL FUNCTIONS

- Data acquisition and processes for digital, analogue values inputs and outputs
- Control and monitoring of switching devices
- Configurable indications on local LCD screen, graphical Mimics and LEDs
- Standardised and proprietary communication protocols
- Local storage of events, counters and measurement values
- Download of the configuration thru Ethernet or from SCADA (IEC101 serial communication)
- Maintenance facilities over Ethernet (I/O values visualisation, hardware status, software and database download), with convivial software tool, on standard PC.



MiCOM C264-R architecture

TECHNICAL DATA

Hardware

Case

- MiCOM C264C
  WxHxD 40T(206 mm) x 4U(177 mm) x 168 mm
  Slots 6 free assignment
- MiCOM C264
  WxHxD 80T(405 mm) x 4U(177 mm) x 168 mm
  Slots 15 free assignment

Control panel

- Large graphical LCD (optional)
- Display 72 x 72 mm (optional)
- Buttons (12) : 7 for operations
  5 for control (optional)
- LEDs 17, 12 free configurable

Power supply board

- U_N $24V_{DC}$, $48/60V_{DC}$, $110>125V_{DC}$,
  $220/250\ V_{DC}$,
  $100 - 250\ V_{AC}$ 50/60 Hz
- Watchdog, Digital Input and Output relays for redundancy management

Processor board

- 32-bit Power PC-based processor
- Internal Watchdog
- Clock 80 Mhz
- RAM 64 Mbytes
- Flash 16 Mbytes
- Ethernet-Based 10/100Base-FX or 10/100Base-TX
- up to 4 serial interfaces RS232/485/optical fibre on each rack
- IRIG-B interface, BNC plug, Amplitude modulated. Standard : NF- 5 85-500, May 1987

Digital input board (16 DI)

- 16 optically insulated inputs with one common for 2 DI.
  U_N 24, 48/60, 110/125, 220/250 V_{DC}
  with DIU200 board
  or
  U_N $24V_{DC}$, 250 V_{DC}
  with multi-voltage DIU210 board

Digital output board (10 DO)

- 8 outputs NO + 2 outputs NO/NC
  $U_N \leq 250\ V_{DC} / 230\ V_{AC}$
- Continuous current : 2,5A
  Short duration current : 30A for 500ms,
  100A for 30ms.
  Breaking capacity:
  DC: 50W resistive
  15 W inductive
  (L/R = 20ms)

Mixed board (8 DI / 4 DO)
Circuit breaker control board (CCU200)

- 8 optically insulated inputs with one common for 2 DI.
  U_N 24, 48/60, 110/125, and 220/250 V_{DC}
- 4 power outputs relay (2 NO contacts)
  $U_N \leq 250\ V_{DC} / 230\ V_{AC}$
  Continuous current : 5A
  short duration current : 250A for 30ms
  Breaking capacity:
  (double pole contacts wired in serial)
  DC: 100W resistive
  30W inductive

Analogue input board (4 AI / 8 AI)

- 4 isolated analogue inputs for measuring transducer connection (AIU201).
  Current: ± 1 / 2 / 5 / 10 / 20 mA / 4-20 mA
  Voltage: ± 1.25 / 2.5 / 5 / 10 V
- 8 analogue inputs for measuring transducer connection (AIU210).
  Current: ± 1 / 2 / 5 / 10 / 20 mA / 4-20 mA

Analogue output board (4 AO)

- 4 analogue outputs with 4 read inhibit output relays (AOU200).
  Current: ± 5 / 10 / 20 mA / 4-20mA
  External power supply (48V ±5%)
  Output maintained in case of C264 power supply failure

MiCOM C264 : a compact, powerful and innovative RTU for electrical applications

COMMUNICATIONS

Standard ethernet SCADA protocols
IEC 60870-5-104, DNP3/IP (option)
Ethernet 10/100Base-FX or 10/100Base-TX

Standard serial SCADA protocols
IEC 60870-5-101, MODBUS, HNZ, DNP3 (option)

Interfaces
Optical / RS232 / RS422 / RS485

Standard IEDs protocols
IEC 60870-5-103, MODBUS,
IEC 60870-5-101, DNP3 (option)

Synchronisation
External synchronisation using IRIG-B

RTU CAPACITY

- Multiple acquisition racks over Ethernet
- Up to 240 Digital Input signals per rack (15 slots)
- Up to 4 serial links on a rack (RS232/RS485/ optical)
- Up to 2 SCADAs simultaneous connections
- Double lines management over IEC60870-5-101 SCADA connections
- Up to 16 IEDs on the RS485 legacy buses
- Global data management of up to 5012 digital datapoints, 1024 Analog values, 1024 Digital outputs, 100 Setpoints, 100 Tap Position Indication on the C264-R
- Redundancy of SCADA interface (option)

SOE RECORDS

- 1ms time tagging
  - Chronological order
  - 1 standard serial printer
- 2000 events recorded in non volatile memory (Flash disk)
- The 200 most recent events readable on optional LCD screen

STANDARD COMPLIANCE

Superior construction : environment, EMC, isolations in accordance with IEC Standards.

Stara Zagora

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RCS Nanterre 954 503 439
Capital social 896 313 776 €
www.schneider-electric.com

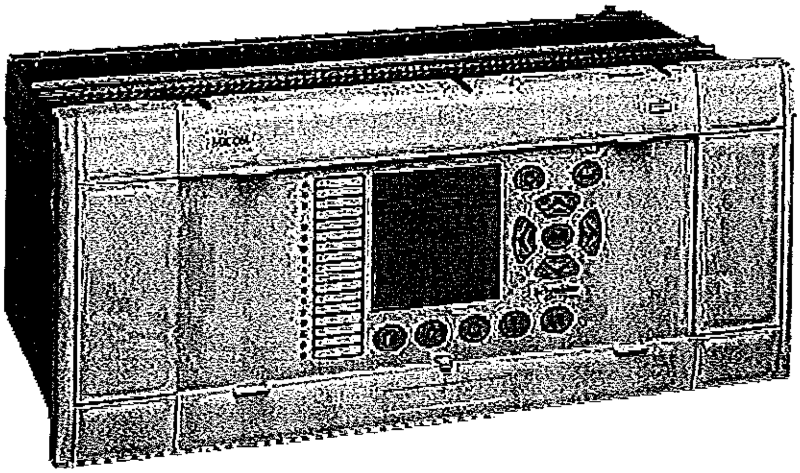
Publishing: Schneider Electric
Design: Schneider Electric
Printing:

EnergyAutomation-DS-C264RTU-1287b-EN

10-2010

Product Environmental Profile

C264 – 80TE
Modular substation computer



Schneider Electric

Product Environmental Profile

Product overview

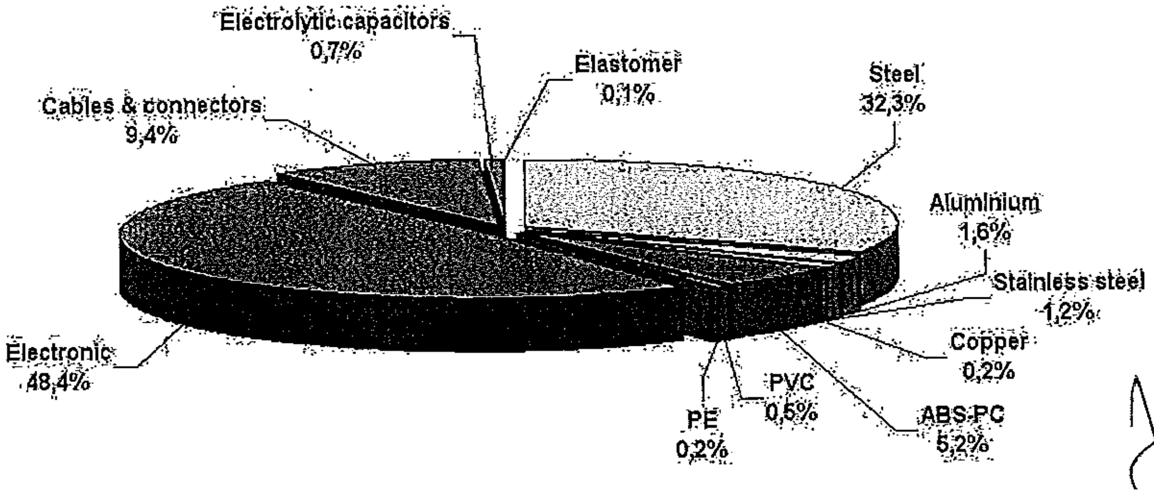
MiCOM C264 is a modular substation computer that can, in addition to traditional input/output management, act as a IEC61850 computer, an Ethernet gateway, a measurement centre and a fast automation processor.

As a remote terminal unit (RTU), a bay controller, a data concentrator, a protocol converter or a voltage regulator, MiCOM C264 is the solution to applications installed in demanding electromagnetic conditions.

The representative product used for the analysis is an 80TE version of the C264. The environmental impacts of this referenced product are representative of the impacts of the other products of the range which are developed with a similar technology.

Constituent materials

The mass of the MICOM C264 is between 4 kg and 12 kg (it's 11.5kg for the 80TE under study).
The constituent materials are distributed as follows:



Substance assessment

This product contains lead (0.02%) and hexavalent chromium (0.002%). These percentages are relative to the total mass of the product.

Manufacturing

The MICOM products are manufactured at a Schneider Electric production sites on which ISO14001 certified environmental management systems have been established.

Distribution

MiCOM C264 are highly configurable products that are used in conjunction with other equipments. Whenever possible, they are integrated into cubicles on the very same site they have been assembled, and shipped directly to the final location where they will be in use, saving unnecessary transportation.

Use

The products of the MICOM range do not generate environmental pollution (noise, emissions) requiring special precautionary measures in standard use.
The electrical power consumption depends on the conditions under which the product is implemented and used. The electrical power consumed by a MICOM C264 is between 20W and 40W. Most of the time, C264 will run at its nominal burden, which is 30W.

ВЯРНО С
ОРИГИНАЛА

Product Environmental Profile

End of life

At end of life, products in the MiCOM range have been optimized to decrease the amount of waste and allow recovery of the product components and materials.

This product range contains leaded electronic boards & electrolytic capacitors that should be separated from the stream of waste so as to optimize end-of-life treatment by special treatments. The location of these components and other recommendations are given in the End of Life Instruction document which is available for this product range.

The recyclability potential of the products has been evaluated using the "ECO-DEEE recyclability and recoverability calculation method" (version V1, 20 Sep. 2008 presented to the French Agency for Environment and Energy Management: ADEME).

According to this method, the potential recyclability ratio is: 49%.

As described in the recyclability calculation method this ratio includes only metals and plastics which have proven industrial recycling processes.

Environmental impacts

Life cycle assessment has been performed on the following life cycle phases: Materials and Manufacturing (M), Distribution (D), Use (U), and End of life (E).

Modelling hypothesis and method:

- The calculation was performed on a MiCOM C264 with an 80TE case with a detachable front panel, powered at 220V.
- Scenario for the Use phase: This product range is included in the "energy using products" category.

MiCOM C264 is designed for a maintenance-free 20 years service-life, and is considered to run 100% of the time at it's nominal consumption of 30W, corresponding to half of the outputs activated and detachable HMI unplugged (*i.e.* no maintenance operation ongoing)

The electrical power model used for calculation is the European model.

- End of life impacts are based on a worst case transport distance to the recycling plant (1000km)

Presentation of the product environmental impacts

Environmental Indicators	Unit	MiCOM C264				
		S=M+D+U+E	M	D	U	E
Raw Material Depletion	Y-1	3,28E-12	3,21E-12	6,64E-17	6,83E-14	2,05E-17
Energy Depletion	MJ	6,45E+04	4,26E+03	4,87E+01	6,02E+04	1,50E+01
Water depletion	dm^3	1,13E+04	2,61E+03	4,62E+00	8,70E+03	1,43E+00
Global Warming	$g{\approx}CO_2$	3,29E+06	2,46E+05	3,86E+03	3,04E+06	1,19E+03
Ozone Depletion	g≈CFC-11	1,97E-01	2,84E-02	2,73E-03	1,65E-01	8,41E-04
Air Toxicity	m^3	5,87E+08	8,26E+07	7,27E+05	5,04E+08	2,24E+05
Photochemical Ozone Creation	$g{\approx}C_2H_4$	1,09E+03	5,96E+01	3,30E+00	1,03E+03	1,02E+00
Air acidification	$g{\approx}H^+$	4,63E+02	5,19E+01	4,91E-01	4,10E+02	1,52E-01
Water Toxicity	dm^3	8,99E+05	3,22E+04	4,82E+02	8,67E+05	1,49E+02
Water Eutrophication	$g{\approx}PO_4$	1,60E+01	8,82E+00	6,41E-02	7,14E+00	1,98E-02
Hazardous waste production	kg	6,22E+01	1,18E+01	1,43E-03	5,04E+01	4,42E-04

Life cycle assessment has been performed with the EIME software (Environmental Impact and Management Explorer), version 4, with its database version 11.

The Use phase is the life cycle phase which has the greatest impact on the majority of environmental indicators.

System approach

Please note that the values given above are only valid within the context specified and cannot be used directly to draw up the environmental assessment of an installation.

Glossary

Raw Material Depletion (RMD)	This indicator quantifies the consumption of raw materials during the life cycle of the product. It is expressed as the fraction of natural resources that disappear each year, with respect to all the annual reserves of the material.
Energy Depletion (ED)	This indicator gives the quantity of energy consumed, whether it be from fossil, hydroelectric, nuclear or other sources. This indicator takes into account the energy from the material produced during combustion. It is expressed in MJ.
Water Depletion (WD)	This indicator calculates the volume of water consumed, including drinking water and water from industrial sources. It is expressed in dm^3.
Global Warming (GW)	The global warming of the planet is the result of the increase in the greenhouse effect due to the sunlight reflected by the earth's surface being absorbed by certain gases known as "greenhouse-effect" gases. The effect is quantified in gram equivalent of CO_2.
Ozone Depletion (OD)	This indicator defines the contribution to the phenomenon of the disappearance of the stratospheric ozone layer due to the emission of certain specific gases. The effect is expressed in gram equivalent of CFC-11.
Air Toxicity (AT)	This indicator represents the air toxicity in a human environment. It takes into account the usually accepted concentrations for several gases in the air and the quantity of gas released over the life cycle. The indication given corresponds to the air volume needed to dilute these gases down to acceptable concentrations.
Photochemical Ozone Creation (POC)	This indicator quantifies the contribution to the "smog" phenomenon (the photochemical oxidation of certain gases which generates ozone) and is expressed in gram equivalent of ethylene (C_2H_4).
Air Acidification (AA)	The acid substances present in the atmosphere are carried by rain. A high level of acidity in the rain can cause damage to forests. The contribution of acidification is calculated using the acidification potentials of the substances concerned and is expressed in mode equivalent of H^+.
Water Toxicity (WT)	This indicator represents the water toxicity. It takes into account the usually accepted concentrations for several substances in water and the quantity of substances released over the life cycle. The indication given corresponds to the water volume needed to dilute these substances down to acceptable concentrations.
Hazardous Waste Production (HWP)	This indicator calculates the quantity of specially treated waste created during all the life cycle phases (manufacturing, distribution and utilization). For example, special industrial waste in the manufacturing phase, waste associated with the production of electrical power, etc. It is expressed in kg.

PEP in compliance with Schneider-Electric TT01 V4.9 and TT02 V15 procedures

PEP established according to PCR PEPecopassport PEP- PCR-ed 2-EN-2011 12 09

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Published by: Schneider Electric

IEC 61850 Certificate Level A[1]

Page 1/2

No. 74101852-MOC/INC 13-1306

Issued to:
Schneider Electric
Avenue de Figuieres
34975 Lattes
France

For the server product:
MiCOM C264
Firmware: B8.16G

Issued by: KEMA

The server product has not shown to be non-conforming to:

IEC 61850 First Edition Parts 6, 7-1, 7-2, 7-3, 7-4 and 8-1

Communication networks and systems in substations

The conformance test has been performed according to IEC 61850-10, the UCA International Users Group Device Test Procedures version 2.3 with TPCL[2] version 1.5, the product's protocol, model and technical issue implementation conformance statements: "MiCOM C264 version B8.16G - PICS - Issue A", "MiCOM C264 version B8.16G - MICS - Issue A" and "MiCOM C264 version B8.16G - TICS - Issue A" and the extra information for testing: "MiCOM C264 version B8.16G - PIXIT - Issue A".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases):

1	Basic Exchange (16/24)	9b	GOOSE Subscribe (11/11)
2	Data Sets (3/6)	12a	Direct Control (5/12)
5	Unbuffered Reporting (13/19)	12c	Enhanced Direct Control (5/13)
6	Buffered Reporting (16/21)	12d	Enhanced SBO Control (10/19)
9a	GOOSE Publish (8/13)	13	Time Synchronization (4/5)

This certificate includes a summary of the test results as carried out at Schneider Electric in France with UniCA 61850 Client simulator 4.26.04 with test suite 3.26.00 and UniCA 61850 Analyzer 4.26.04. This document has been issued for information purposes only, and the original paper copy of the KEMA report: No. 74101852-MOC/INC 13-1307 will prevail.

The test has been carried out on one single specimen of the product as referred above and submitted to KEMA by Schneider Electric. The manufacturer's production process has not been assessed. This attestation does not imply that KEMA has approved any product other than the specimen tested.

Arnhem, March 29, 2013

M. Adriaensen
Director Intelligent Networks & Communication

R. Schimmel
Certification Manager

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[1] Level A - Independent test lab with certified ISO 9001 quality system.
[2] TPCL - Test procedures change list

ПИС
ОРИГИНАЛА

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T +31 26 356 20 25 F +31 26 351 36 83 sales@kema.com www.kema.com

Applicable Test Procedures from the UCA International Users Group Device Test Procedures version 2.3 with TPCL version 1.5

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Ass1, Ass2, Ass3, AssN2, AssN3, AssN4, AssN5 Srv1, Srv2, Srv3, Srv4, Srv5, SrvN1abcd, SrvN4	Srv8, SrvN1f
2: Data Sets	Dset1, Dset10a, DsetN1ae	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7, Rp10, Rp12 RpN1, RpN2, RpN3, RpN4	Rp5, Rp8
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9, Br12, Br14 BrN1, BrN2, BrN3, BrN4, BrN5	Br5, Br10
9a: GOOSE publish	Gop2, Gop3, Gop4, Gop7, Gop10a	Gop1, Gop6, GopN1
9b: GOOSE subscdbe	Gos1a, Gos2, Gos3, GosN1, GosN2, GosN3, GosN4, GosN5, GosN6	Gos1b, Gos4
12a: Direct control	CtlN3, CtlN8 DOns1, DOns3	Ctl7
12c: Enhanced Direct Control	CtlN3, CtlN8 DOes2, DOes5	Ctl7
12d: Enhanced SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, CtlN9 SBOes1, SBOes2, SBOes3	Ctl7
13: Time sync	Tm1, Tm2, TmN1	Tm3

ВЯРНО С
ОРИГИНАЛА

НЕОДЕТ ООД
NEODET Ltd

ВЯРНО С
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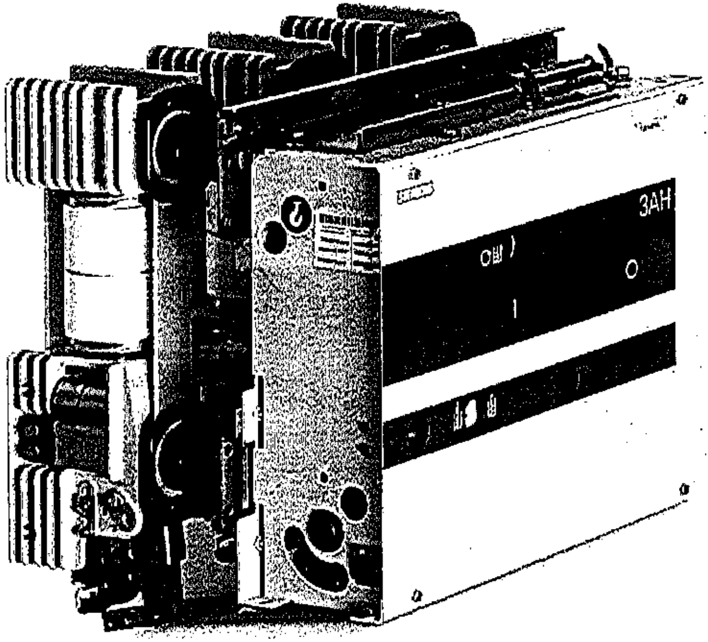
SIEMENS

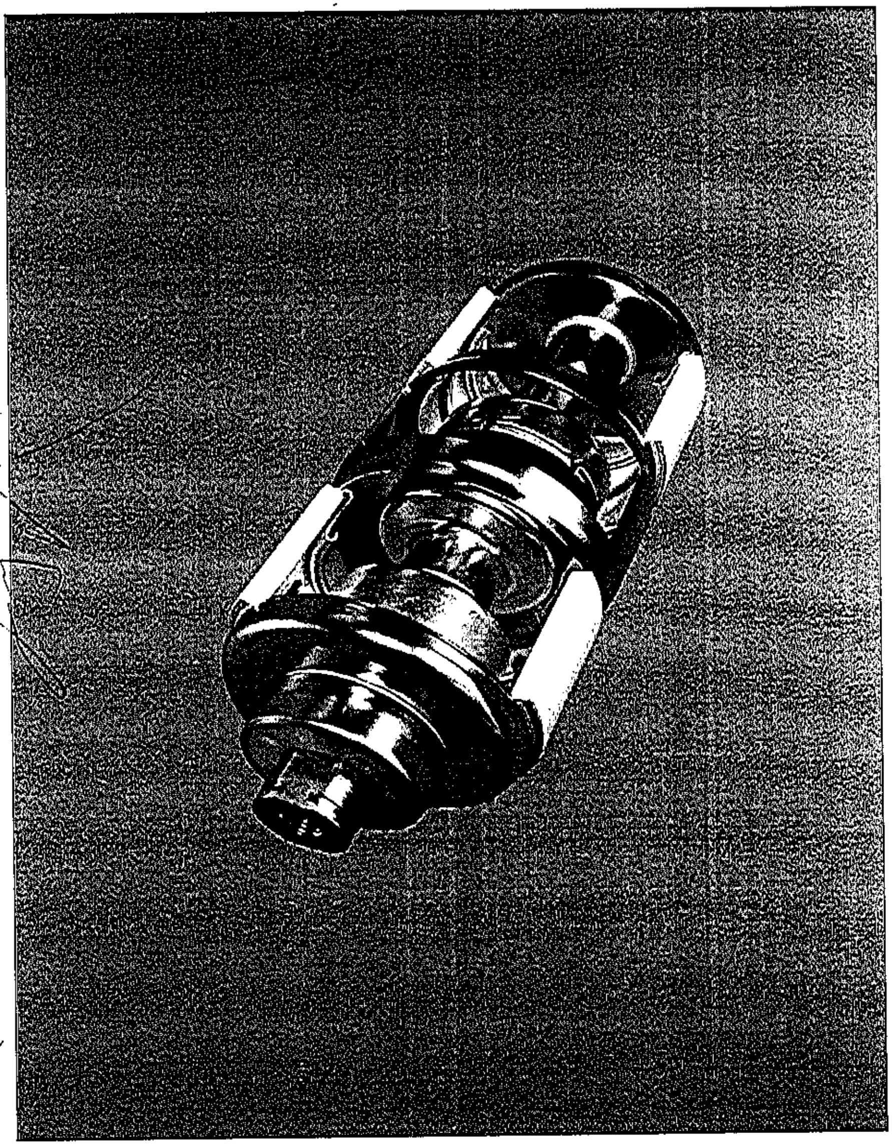


Catalog
HG 11.05 ·
Edition 2017

3AH5 Vacuum Circuit-Breakers

Medium-Voltage Equipment

siemens.com/3AH5



3AH5 Vacuum Circuit-Breakers

Medium-Voltage Equipment
Catalog HG 11.05 · 2017

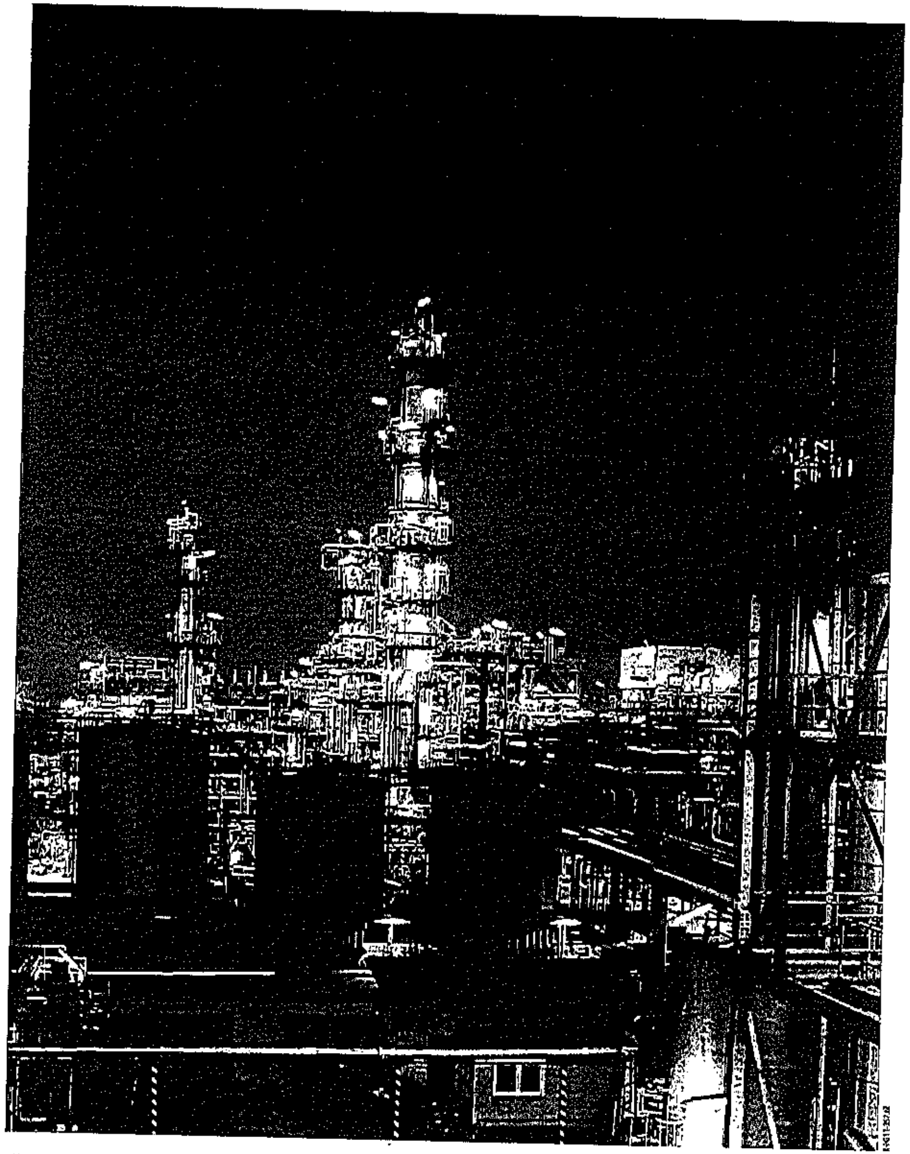
Invalid:
Catalog HG 11.05 · 2010

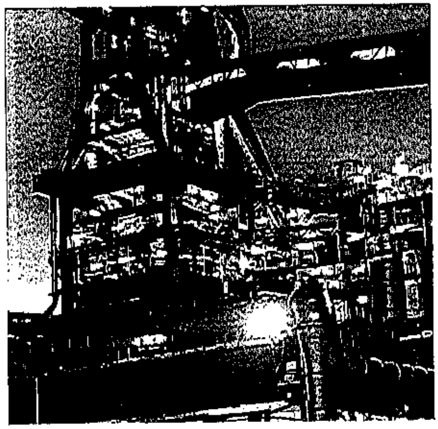
Contents

MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 = ISO 14001
OHSAS 18001

The products and systems described in this catalog are manufactured and sold according to a certified management system (acc. to ISO 9001, ISO 14001 and BS OHSAS 18001).

000353





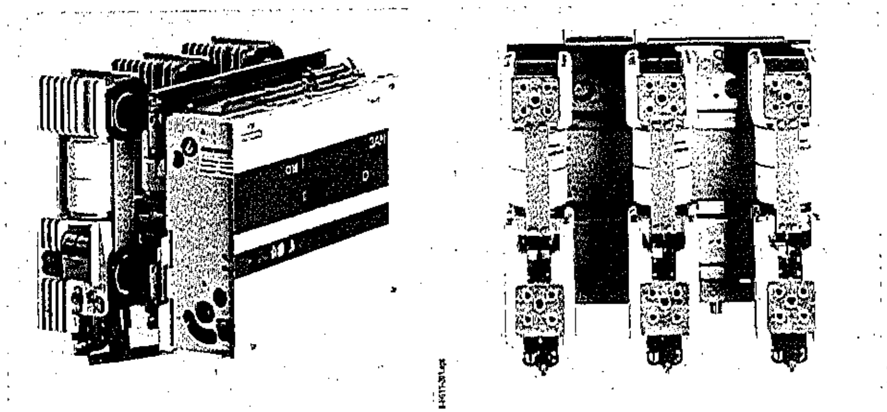
Industrial application: Refinery

000354

1 3AH5 standard circuit-breaker from 12 to 36 kV – The Economical

3AH5 vacuum circuit-breakers control all switching duties in medium-voltage systems. They are applicable for operation of e.g. overhead lines, cables, transformers, generators, capacitors, filter circuits, motors and reactors. Here, small short-circuit ratings in distribution systems face high breaking currents in industrial systems.

3AH5 – the universal circuit-breaker in the product range



The 3AH5 vacuum circuit-breaker is a real all-round device in its field of application. With its compact dimensions, it fits in all customary switchgear types. The comprehensive variety of types with different normal currents and short-circuit currents as well as various pole-centre distances for voltage levels from 12 kV to 36 kV enables its universal application for all medium-voltage requirements.

The 3AH5 vacuum circuit-breaker consists of the pole assemblies (1) and the operating mechanism box (2). The pole assemblies are fixed to the operating mechanism box via post insulators (3). The switching movement is transferred by means of operating rods (4) and levers.

Pole assemblies

The pole assemblies consist of the vacuum interrupters (5) and the interrupter supports. The vacuum interrupters are air-insulated and freely accessible. This makes it possible to clean the insulating parts easily in adverse ambient conditions. The vacuum interrupter is rigidly fixed to the upper interrupter support (6). The lower part of the interrupter is guided in the lower interrupter support (7), allowing axial movement. The braces (8) absorb the external forces resulting from switching operations and the contact pressure.

Operating mechanism box

The whole operating mechanism with releases, auxiliary switches, indicators and actuating devices is accommodated in the operating mechanism box. The extent of the secondary equipment depends on the case of application and offers a multiple variety of options in order to meet almost every requirement.

Operating mechanism

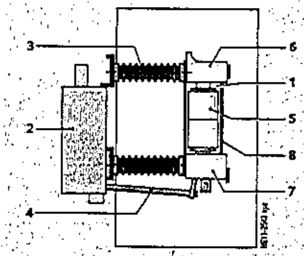
For circuit-breaker operation, both spring-operated and stored-energy mechanisms are available. With manual spring-operated mechanisms, the closing process takes place automatically after manual charging of the closing spring. The opening or contact springs are charged simultaneously during the closing operation, which means that a stored energy mechanism is available for the opening operation.

With motor or manual operating stored-energy mechanisms, the closing spring is either charged electrically or manually. It latches tight at the end of the charging process and serves as an energy store.

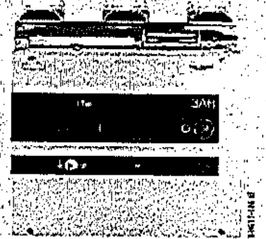
To close the breaker, the closing spring can be unlatched either mechanically by means of the local "ON" pushbutton or electrically by remote control. The closing spring charges the opening or contact pressure springs as the breaker closes. The now discharged closing spring will be charged again automatically by the mechanism motor or manually. Then the operating sequence OPEN-CLOSE-OPEN is stored in the springs.

Trip-free mechanism

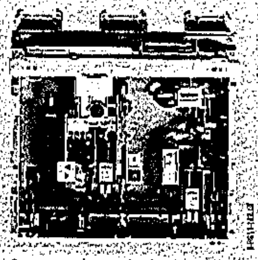
3AH5 vacuum circuit-breakers have a trip-free mechanism according to IEC 62271-100. In the event of an opening command being given after a closing operation has been initiated, the moving contacts return to the open position and remain there even if the closing command is sustained. This means that the contacts of the vacuum circuit-breakers are momentarily in the closed position, which is permissible according to IEC 62271-100.



Circuit-breaker structure
1 Pole assembly
2 Operating mechanism box
3 Post insulator
4 Operating rod
5 Vacuum interrupter
6 Upper interrupter support
7 Lower interrupter support
8 Brace



Front view



Open operating mechanism box

Releases

A release is a device which transfers electrical commands from an external source, such as a control room, to the latching mechanism of the vacuum circuit-breaker so that it can be opened or closed. Apart from the closing solenoid, the maximum possible equipment is one shunt release and another release to be selected at will. For release combinations, refer to page 15.

- The closing solenoid unlatches the charged closing spring of the vacuum circuit-breaker, closing it by electrical means. It is suitable for DC or AC voltage.

- Shunt releases are used for automatic tripping of vacuum circuit-breakers by suitable protection relays and for deliberate tripping by electrical means. They are intended for connection to an external power supply (DC or AC voltage) but, in special cases, may also be connected to a voltage transformer for manual operation.

- Current-transformer operated releases comprise a stored energy mechanism, an unlatching mechanism and an electromagnetic system. They are used when there is no external source of auxiliary power (e.g. a battery). Tripping is effected by means of a protection relay (e.g. overcurrent time protection) acting on the current-transformer operated release. When the tripping current is exceeded (≈ 90 % of the rated normal current of the c.t.-operated release), the latch of the energy store, and thus opening of the circuit-breaker, is released.

- Undervoltage releases comprise a stored-energy mechanism, an unlatching mechanism and an electromagnetic system which is permanently connected to the secondary or auxiliary voltage while the vacuum circuit-breaker is closed. If the voltage falls below a predetermined value, unlatching of the release is enabled and the circuit-breaker is opened via the stored-energy mechanism.

The deliberate tripping of the undervoltage release generally takes place via an NC contact in the tripping circuit or via an NO contact by short-circuiting the magnet coil. With this type of tripping, the short-circuit current is limited by the built-in resistors. Undervoltage releases can also be connected to voltage transformers. When the operating voltage drops to impermissibly low levels, the circuit-breaker is tripped automatically.

For delayed tripping, the undervoltage release can be combined with energy stores.

Closing

In the standard version of the stored-energy mechanisms, 3AH5 vacuum circuit-breakers can be remote-closed electrically. They can also be closed locally by mechanical unlatching of the closing spring via pushbutton. With spring operated mechanisms, closing obligatory takes place after the charging process.

An electrical closing lock-out prevents unpermissible closing of the circuit-breaker. The closing lock-out releases the operation of the circuit-breaker when auxiliary voltage is available, and blocks both local manual closing and remote electrical closing mechanically when there is no auxiliary voltage available.

The operating voltage of the electrical closing lock-out is the same as that of the closing solenoid. If constant CLOSE and OPEN commands are present at the vacuum circuit-breaker at the same time, the vacuum circuit-breaker will return to the open position after closing. It remains in this position until a new CLOSE command is given. In this manner, continuous closing and opening (= "pumping") is prevented.

Interlocking

Mechanical interlocking for stored-energy mechanisms

To interlock circuit-breaker trucks, withdrawable parts or disconnectors according to the switch position, the stored energy mechanisms of 3AH5 circuit-breakers can be equipped with a mechanical interlocking. A sensor at the switchgear checks the position of the circuit-breaker and prevents the open circuit-breaker in a reliable way from being closed mechanically and electrically.

Electrical interlocking

The vacuum circuit-breakers can be integrated in electromagnetic feeder or switchgear interlocks. In case of electrical interlocking, the disconnector or its operating mechanism is equipped with a magnetic lock-out mechanism. This mechanism is controlled by an auxiliary contact of the circuit-breaker, so that the disconnector can only be operated when the circuit-breaker is open. On the other hand, the vacuum circuit-breaker is also controlled by the disconnector or its operating mechanism, so that it can only be closed when the disconnector is in an end position. For this purpose, the circuit-breaker operating mechanism must be equipped with a closing lock-out (see "Closing").

Standards

3AH5 vacuum circuit-breakers conform to the following standards:
- IEC 62271-100 (former IEC 60056)
- IEC 62271-1 (former IEC 60694)
- VDE 0671 (former VDE 0670 Part 100 and VDE 0670 Part 1000)

All 3AH5 vacuum circuit-breakers fulfil the endurance classes E2, M2 and C2 according to IEC 62271-100.

Description
Maintenance-free design, ambient conditions, current carrying capacity and dielectric strength

Maintenance-free design

The 3AH5 vacuum circuit-breakers are maintenance-free:

- Under normal ambient conditions according to IEC 62271-1 (former IEC 60694).
- Up to 10,000 operating cycles,
  - no relubrication, no readjustment required
  - and within their tolerances, the characteristics are independent of the switching rate or of standing times without switching operations.

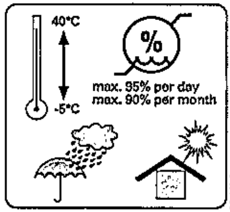
Ambient conditions

The vacuum circuit-breakers are designed for the normal operating conditions defined in IEC 62271-100.

Condensation can occasionally occur under the ambient conditions shown opposite. 3AH5 vacuum circuit-breakers are suitable for use in the following climatic classes according to IEC 60721, Part 3-3:

Climatic ambient conditions:	Class 3K4 [1]
Biological ambient conditions:	Class 3B1
Mechanical ambient conditions:	Class 3M2
Chemically-active substances:	Class 3C2 [2]
Mechanically-active substances:	Class 3S2 [3]

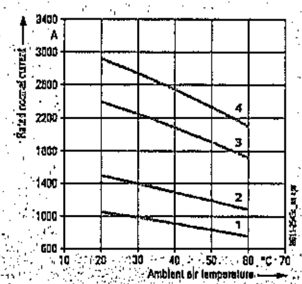
[1] Low temperature limit: – 5 °C
[2] Without icing and wind-driven precipitation
[3] Restriction: Clean insulation parts



Current carrying capacity (see diagram)

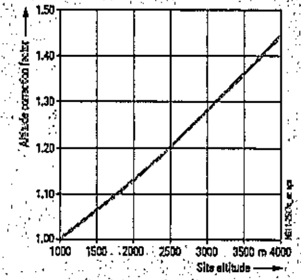
The rated normal currents specified in the opposite diagram have been defined according to IEC 62271-100 for an ambient air temperature of + 40 °C and apply to open switchgear. For enclosed switchgear the data of the switchgear manufacturer applies. At ambient air temperatures below + 40 °C, higher normal currents can be carried.

Characteristics curve 1 = Rated normal current 800 A
Characteristics curve 2 = Rated normal current 1250 A
Characteristics curve 3 = Rated normal current 2000 A
Characteristics curve 4 = Rated normal current 2500 A



Dielectric strength

The dielectric strength of air insulation decreases with increasing altitude due to low air density. According to IEC 62271-1, the values of the rated lightning impulse withstand voltage and the rated short-duration power frequency withstand voltage specified in the chapter "Technical Data" apply to a site altitude of 1000 m above sea level. For an altitude above 1000 m, the insulation level must be corrected according to the opposite diagram. The characteristic shown applies to both rated withstand voltages.



To select the devices, the following applies: $U \geq U_0 \times K_a$

U Rated withstand voltage under reference atmosphere
U_0 Rated withstand voltage requested for the place of installation
K_a Altitude correction factor according to the opposite diagram

Example

For a requested rated lightning impulse withstand voltage of 75 kV at an altitude of 2500 m, an insulation level of 90 kV under reference atmosphere is required as a minimum:

90 kV ≥ 75 kV x 1.2

Description
Product range overview and basic equipment

Product range overview 3AH5

Rated voltage	Rated short-circuit breaking current	Rated normal current (A)												
		800			1250				2000			2500	
		Pole-centre distance (mm)											
kV	kA	160	210	275	160	210	275	350	210	275	350	210	275
12	13.1	■	■										
	16	■	■		■	■							
	20	■	■		■	■			■				
	25	■	■		■	■			■			■	
	31.5				■	■			■			■	
17.5	25	■	■		■	■						■	
	31.5				■	■			■			■	
24	16		■	■		■	■						
	20					■	■		■	■		■	■
	25					■	■					■	■
36	16						■	■					
	25						■	■			■		

■ Available design

For the endurance class C2, all circuit-breakers fulfil the following values according to IEC 62271-100

	Line	Cable	Single capacitor bank	Back-to-back capacitor bank [1]	
Rated voltage	Rated line-charging breaking current	Rated cable-charging breaking current	Rated single capacitor bank breaking current [2]	Rated back-to-back capacitor bank breaking current	Frequency of the inrush current
U_r	I_l	I_c	I_{sb}	I_{bb}	f_{bi}
kV, r.m.s.	A, r.m.s.	A, r.m.s.	A, r.m.s.	A, r.m.s.	Hz
12	10	25	400	400	4250
17.5	10	31.5	400	400	4250
24	10	31.5	400	400	4250
36	10	50	400	400	4250

[1] Rated back-to-back capacitor bank making current for a back-to-back capacitor bank – see chapter 3: Technical data
[2] The capacitive switching capacity of the circuit-breaker is 0.7xI, above the standard specification.

Basic equipment

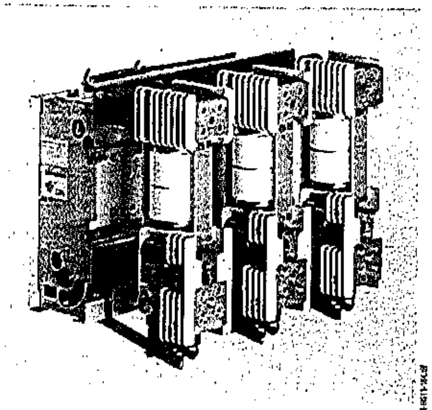
In the basic version, the 3AH5 is equipped with a manual spring-operated mechanism. The following overview shows the alternatively selectable or additional equipment, as well as the possibility of designing the switching device with stored-energy mechanisms.

Equipment features for the different types of operating mechanisms

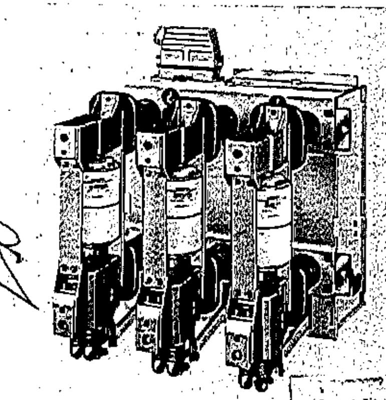
Type of operating mechanism	Closing solenoid	Electrical closing lock-out [3]	1st shunt release	2nd release	Counter	Circuit-breaker tripping signal	Auxiliary switch 2NO+2NC	Auxiliary switch 6NO+6NC	Auxiliary switch 12NO+12NC	Without terminal strip	24-pole terminal strip	24-pole plug connection	64-pole plug connection	Mechanical interlocking
Manual spring operated mechanism [1]	–	–	■	O	■	O	X	X	–	X	X	X	–	O
Manual operating stored-energy mechanism [1]	O	O	■	O	■	O	X	X	–	X	X	X	–	O
Motor operating stored-energy mechanism [2]	■	O	■	O	■	O	–	X	X [4]	–	X	X	X	O

■ Basic equipment X Optionally selectable basic equipment O Selectable additional equipment – Not available

[1] With manual operating mechanism, always with hand crank
[2] With anti-pumping device
[3] From pole-centre distance ≥ 210mm
[4] Only with 64-pole plug



3AH5 135-6 vacuum circuit-breaker



3AH5 204-1 vacuum circuit-breaker

2

000357

2

Order number structure

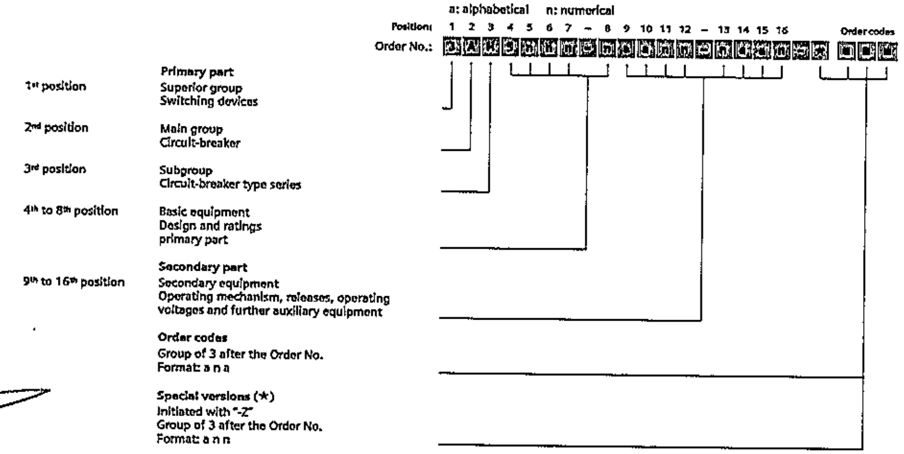
The 3AH5 vacuum circuit-breakers consist of a primary and a secondary part. The relevant data make up the 16-digit order number. The primary part covers the main electrical data of the circuit-breaker poles. The secondary part covers the auxiliary devices which are necessary for operating and controlling the vacuum circuit-breaker.

Order codes

Individual equipment versions, marked with "9" or "Z" in the 9th to 16th position, are explained more in detail by a 3-digit order code. Several order codes can be added to the order number in succession and in any sequence.

Special versions (★)

In case of special versions, "-Z" is added to the order number and a descriptive order code follows. If several special versions are required, the suffix "-Z" is listed only once. If a requested special version is not in the catalog and can therefore not be ordered via order code, it has to be identified with Y 9 9 after consultation. The agreement here to is made directly between your responsible sales partner and the order processing department in the Switchgear Factory Berlin.



1st position	**Primary part** Superior group Switching devices
2nd position	Main group Circuit-breaker
3rd position	Subgroup Circuit-breaker type series
4th to 8th position	Basic equipment Design and ratings primary part
9th to 16th position	**Secondary part** Secondary equipment Operating mechanism, releases, operating voltages and further auxiliary equipment
	Order codes Group of 3 after the Order No. Format: a n a
	Special versions (★) Initiated with "-Z" Group of 3 after the Order No. Format: a n n

Configuration example

In order to simplify the selection of the correct order number for the requested circuit-breaker type, you will find a configuration example on each page of the chapter "Equipment Selection". For the selection of the secondary part, always the last example of the primary part was taken over and continued, so that at the end of the equipment selection (page 20) a completely configured circuit-breaker results as an example.

On the foldout page we offer a configuring aid. Here you can fill in the order number you have determined for your circuit-breaker.

Example for Order No.:
Order codes:

Equipment Selection

Selection of basic types, circuit-breakers

12 kV

50/60 Hz

Rated voltage U_r kV	Rated lightning impulse withstand voltage U_p kV	Rated short-duration power-frequency withstand voltage U_d kV	Rated short-circuit breaking current at 36 % DC component I_{sc} kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Pole-centre distance mm	Rated normal current I_r A	Order No.: Position 1 2 3 4 5 6 7 – 8
12	75	28	13.1	33/34	160	800	3 A H 5 1 2 1 – 1
					210	800	3 A H 5 1 3 1 – 1
			16	40/42	160	800	3 A H 5 1 2 2 – 1
						1250	3 A H 5 1 2 2 – 2
					210	800	3 A H 5 1 3 2 – 1
						1250	3 A H 5 1 3 2 – 2
			20	50/52	160	800	3 A H 5 1 2 3 – 1
						1250	3 A H 5 1 2 3 – 2
					210	800	3 A H 5 1 3 3 – 1
						1250	3 A H 5 1 3 3 – 2
						2000	3 A H 5 1 3 3 – 4
			25	63/65	160	800	3 A H 5 1 4 4 – 1
						1250	3 A H 5 1 4 4 – 2
					210	800	3 A H 5 1 5 4 – 1
						1250	3 A H 5 1 5 4 – 2
						2000	3 A H 5 1 3 4 – 4
						2500	3 A H 5 1 3 4 – 6
			31.5	80/82	160	1250	3 A H 5 1 2 5 – 2
					210	1250	3 A H 5 1 3 5 – 2
						2000	3 A H 5 1 3 5 – 4
						2500	3 A H 5 1 3 5 – 6

Position 9 10 11 12 – 13 14 15 16: See page 15, See page 16, See page 16, See page 17, See page 18, See page 18, See page 19, See page 19; Order codes: See page 20

Special version U_d = 42 kV (available for all 12 kV ≥ 25 kA circuit-breakers)

17.5 kV

50/60 Hz

U_r kV	U_p kV	U_d kV	I_{sc} kA	I_{ma} kA	mm	I_r A	Order No.
17.5	95	38	25	63/65	160	800	3 A H 5 2 0 4 – 1
						1250	3 A H 5 2 0 4 – 2
					210	800	3 A H 5 2 1 4 – 1
						1250	3 A H 5 2 1 4 – 2
						2500	3 A H 5 2 1 4 – 6
			31.5	80/82	160	1250	3 A H 5 2 0 5 – 2
					210	1250	3 A H 5 2 1 5 – 2
						2000	3 A H 5 2 1 5 – 4
						2500	3 A H 5 2 1 5 – 6

Special version U_d = 42 kV (available for all 17.5 kV circuit-breakers)

Configuration example
3AHS vacuum circuit-breaker
Rated voltage U_r = 17.5 kV
Rated short-circuit breaking current I_{sc} = 25 kA
Rated normal current I_r = 2500 A
Pole-centre distance = 210 mm
Special version U_d = 42 kV

Example for Order No.: [illegible]
Order codes: [illegible]

000358

Equipment Selection

Selection of basic types, circuit-breakers

24 kV

50/60 Hz

Rated voltage U_r kV	Rated lightning impulse withstand voltage U_p kV	Rated short-duration power-frequency withstand voltage U_d kV	Rated short-circuit breaking current at 36 % DC component I_{sc} kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Pole-centre distance mm	Rated normal current I_r A	Order No.: Position 1 2 3 4 5 6 7 – 8
24	125	50	16	40/42	210	800	3 A H 5 2 7 2 – 1
						1250	3 A H 5 2 7 2 – 2
					275	800	3 A H 5 2 8 2 – 1
						1250	3 A H 5 2 8 2 – 2
			20	50/52	210	1250	3 A H 5 2 7 3 – 2
						2000	3 A H 5 2 7 3 – 4
						2500	3 A H 5 2 7 3 – 6
					275	1250	3 A H 5 2 8 3 – 2
						2000	3 A H 5 2 8 3 – 4
						2500	3 A H 5 2 8 3 – 6
			25	63/65	210	1250	3 A H 5 2 7 4 – 2
						2500	3 A H 5 2 7 4 – 6
					275	1250	3 A H 5 2 8 4 – 2
						2500	3 A H 5 2 8 4 – 6

Position 9 10 11 12 – 13 14 15 16: See page 15, See page 16, See page 16, See page 17, See page 18, See page 18, See page 19, See page 19; Order codes: See page 20

36 kV

50/60 Hz

U_r kV	U_p kV	U_d kV	I_{sc} kA	I_{ma} kA	mm	I_r A	Order No.
36	170	70	16	40/42	275	1250	3 A H 5 3 2 2 – 2
					350	1250	3 A H 5 3 3 2 – 2
			25	63/65	275	1250	3 A H 5 3 2 4 – 2
					350	1250	3 A H 5 3 1 4 – 2
						2000	3 A H 5 3 1 4 – 4

Configuration example
3AHS vacuum circuit-breaker
Rated voltage U_r = 36 kV
Rated short-circuit breaking current I_{sc} = 25 kA
Rated normal current I_r = 2000 A
Pole-centre distance = 350 mm

Example for Order No.: [illegible]
Order codes: [illegible]

Equipment Selection

Selection of secondary equipment

9th position
Release combination

Position: 1 2 3 4 5 6 7 – 8 9 10 11 12 13 14 15 16 Order codes

Order No.:

1st shunt release	2nd shunt release	Undervoltage release	C.t.-operated release 0.5 A	C.t.-operated release 1.0 A	C.t.-operated release with tripping pulse ≥ 0.1 Ws (10 Ω)	C.t.-operated release with tripping pulse ≥ 0.1 Ws (20 Ω)	9	Order codes
■							M	
■	■						N	
■		■					R	
■			■				U	
■				■			U	– Z A 4 6
■					■		V	
■						■	V	– Z A 4 5

See page 16 · See page 16 · See page 17 · See page 18 · See page 18 · See page 19 · See page 19 · See page 20

Configuration example

3AH5 vacuum circuit-breaker

(U_r = 36 kV, I_{sc} = 25 kA, I_r = 2000 A, pole-centre distance = 350 mm)

1st shunt release; c.t.-operated release with a rated normal current of 1.0 A

Example for Order No.: 3AH5 ... U ... Z A 4 6

Order codes:

Equipment Selection

Selection of secondary equipment

10th position
Operating voltage of the closing solenoid

Position: 1 2 3 4 5 6 7 – 8 9 10 11 12 – 13 14 15 16 Order codes

Order No.:

See page 17 · See page 18 · See page 18 · See page 19 · See page 19 · See page 20

To be observed for selection!

- Manual spring-operat.mechan. generally without closing solenoid (A)
- Man. operat. stored-energy mechan. option. with closing solenoid (A – Z)
- Motor op. stored-energy mech. generally with closing solenoid (B – Z)

Standard voltages		Special voltages		10		Order codes
Without closing solenoid				A		
24 V DC				B		
48 V DC				C		
60 V DC				D		
110 V DC				E		
220 V DC				F		
100 V AC	50/60 Hz 1)			H		
110 V AC	50/60 Hz 1)			J		
230 V AC	50/60 Hz 1)			K		
		30 V DC		Z	With order code	K 1 A
		32 V DC		Z	With order code	K 1 B
		120 V DC		Z	With order code	K 1 C
		125 V DC		Z	With order code	K 1 D
		127 V DC		Z	With order code	K 1 E
		240 V DC		Z	With order code	K 1 F
		120 V AC	50/60 Hz 1)	Z	With order code	K 1 K
		125 V AC	50/60 Hz 1)	Z	With order code	K 1 L
		240 V AC	50/60 Hz 1)	Z	With order code	K 1 M

11th position
Operating voltage of the 1st shunt release

Standard voltages		Special voltages		11		Order codes
24 V DC				1		
48 V DC				2		
60 V DC				3		
110 V DC				4		
220 V DC				5		
100 V AC	50/60 Hz 1)			6		
110 V AC	50/60 Hz 1)			7		
230 V AC	50/60 Hz 1)			8		
		30 V DC		9	With order code	L 1 F
		32 V DC		9	With order code	L 1 B
		120 V DC		9	With order code	L 1 C
		125 V DC		9	With order code	L 1 D
		127 V DC		9	With order code	L 1 E
		240 V DC		9	With order code	L 1 F
		120 V AC	50/60 Hz 1)	9	With order code	L 1 K
		125 V AC	50/60 Hz 1)	9	With order code	L 1 L
		240 V AC	50/60 Hz 1)	9	With order code	L 1 M

1) The AC frequency 50 or 60 Hz is selected at the 16th position of the order number together with the language (see page 19)

Configuration example

3AH5 vacuum circuit-breaker

(U_r = 36 kV, I_{sc} = 25 kA, I_r = 2000 A, pole-centre distance = 350 mm)

Operating voltage of the closing solenoid 48 V DC (manual operating stored-energy mechanism)

Operating voltage of the 1st shunt release 48 V DC

Example for Order No.: 3AH5 ... U C 2 ... Z

Order codes:

Equipment Selection

Selection of secondary equipment

12th position
Operating voltage of the 2nd release

Positions: 1 2 3 4 5 6 7 – 8 9 10 11 12 – 13 14 15 16 · Order codes

Order No.:

13, 14: See page 18 · 15: See page 19 · 16: See page 19 · See page 20

Standard voltages		Special voltages		12		Order codes
Without, or c.t.-operated release				0		
24 V DC				1		
48 V DC				2		
60 V DC				3		
110 V DC				4		
220 V DC				5		
100 V AC	50/60 Hz 1)			6		
110 V AC	50/60 Hz 1)			7		
230 V AC	50/60 Hz 1)			8		
		30 V DC		9	With order code	M 1 A
		32 V DC		9	With order code	M 1 B
		120 V DC		9	With order code	M 1 C
		125 V DC		9	With order code	M 1 D
		127 V DC		9	With order code	M 1 E
		240 V DC		9	With order code	M 1 F
		120 V AC	50/60 Hz 1)	9	With order code	M 1 K
		125 V AC	50/60 Hz 1)	9	With order code	M 1 L
		240 V AC	50/60 Hz 1)	9	With order code	M 1 M

Special version

To operate the 2nd release as an undervoltage release on an energy store type AN1902- (for DC) or AN1901-2 (for AC), both make Bender, the operating voltage must be defined – and whether the energy store will be provided by the customer or included in the scope of supply.

	Energy store Type	In the scope of supply	12		Order codes
60 V DC	AN 1902-	no	9	With order code	M 2 D
110 V DC	AN 1902-	no	9	With order code	M 2 E
220 V DC	AN 1902-	no	9	With order code	M 2 F
100 V/110 V/230 V AC	AN 1901-2	no	9	With order code	M 2 G
60 V DC	AN 1902-	yes	9	With order code	M 3 D
110 V DC	AN 1902-	yes	9	With order code	M 3 E
220 V DC	AN 1902-	yes	9	With order code	M 3 F
100 V/110 V/230 V AC	AN 1901-2	yes	9	With order code	M 3 G

---

1) The AC frequency 50 or 60 Hz is selected at the 16th position of the order number together with the language (see page 19)

Configuration example

3AH5 vacuum circuit-breaker

(U_r = 36 kV, I_{sc} = 25 kA, I_r = 2000 A, pole-centre distance = 350 mm)

2nd release as c.t.-operated release with a rated normal current of 1.0 A

Example for Order No.: [illegible]

Order codes: [illegible]

Equipment Selection

Selection of secondary equipment

13th position
Counter and circuit-breaker tripping signal

Positions: 1 2 3 4 5 6 7 – 8 9 10 11 12 – 13 14 15 16 · Order codes

Order No.:

15: See page 19 · 16: See page 19 · See page 20

Attention! Selection of the counter and the circuit-breaker tripping signal depends on the selection of the secondary connection.

Counter	Circuit-breaker tripping signal	Without terminal strip/plug	24-pole terminal strip/plug	64-pole plug	Definition 15th position ■ (See page 19)	13	15
■		O			A, B	1	■
■			O		E, F, G, and H	1	■
■	■		O		E, F, G and H	2	■
■	■			O	J, K, L, 1) and M	2	■

■ Equipment to be selected   O Dependent equipment

1) Equipment only possible in combination with motor operating stored-energy mechanism

14th position
Operating voltage of the operating mechanism/ type of operating mechanism

Type of operating mechanism/ standard voltages		Special voltages		13	14		Order codes
Manual operat. stored-energy mechan. (hand crank incl. in the scope of supply)					A		
Manual spring-operated mechan. (hand crank incl. in the scope of supply)					X		
Motor operating stored-energy mechan. (selection of an operating voltage)							
24 V DC					B		
48 V DC					C		
60 V DC					D		
110 V DC					E		
220 V DC					F		
100 V AC	50/60 Hz 2)				H		
110 V AC	50/60 Hz 2)				J		
230 V AC	50/60 Hz 2)				K		
		30 V DC			Z	With order code	P 1 A
		32 V DC			Z	With order code	P 1 B
		120 V DC			Z	With order code	P 1 C
		125 V DC			Z	With order code	P 1 D
		127 V DC			Z	With order code	P 1 E
		240 V DC			Z	With order code	P 1 F
		120 V AC	50/60 Hz 2)		Z	With order code	P 1 K
		125 V AC	50/60 Hz 2)		Z	With order code	P 1 L
		240 V AC	50/60 Hz 2)		Z	With order code	P 1 M

---

2) The AC frequency 50 or 60 Hz is selected at the 16th position of the order number together with the language (see page 19)

Configuration example

3AH5 vacuum circuit-breaker

(U_r = 36 kV, I_{sc} = 25 kA, I_r = 2000 A, pole-centre distance = 350 mm)

With counter and circuit-breaker tripping signal

Manual operating stored-energy mechanism

Example for Order No.: [illegible]

Order codes: [illegible]

Equipment Selection

Selection of secondary equipment

15th position

Auxiliary switch, secondary connection, interlocking

Positions: 1 2 3 4 5 6 7 – 8 9 10 11 12 – 13 14 15 16 Order codes

Order No.:

Attention! The selection of these options depends on the already selected counter and circuit-breaker tripping signal (13th position).

Definition 13th position ■ (see page 18)	Auxiliary switch 2 NO + 2 NC 1)	Auxiliary switch 6 NO + 6 NC	Auxiliary switch 12 NO + 12 NC 2)	Without terminal strip 1)	24-pole terminal strip	24-pole plug	64-pole plug 2)	Mechanical interlocking	See page 18	15	See page 20
1	■			■					■	A[1]	
1	■			■				■	■	B[5]	
1 or 2		■			■				■	E[3]	
1 or 2		■			■			■	■	F[3]	
1 or 2		■				■			■	G[3]	
1 or 2		■				■		■	■	H[3]	
5		■					■		■	J[4]	
5		■					■	■	■	K[4]	
5			■				■		■	L[4]	
5			■				■	■	■	M[4]	

Special versions gold-plated contacts and pins

Auxiliary switch 6 NO + 6 NC and 64-pole plug connector (J or K) – Z A 2 0

Auxiliary switch 12 NO + 12 NC and 64-pole plug connector (L or M) – Z A 2 1

---

1) Not possible with motor operating stored-energy mechanism

2) Only possible with motor operating stored-energy mechanism

3) Electrical components are wired to the lower part of the plug. The free auxiliary switch connections are not wired

4) Electrical components are wired to the lower part of the plug. The auxiliary switches are wired to the lower part of the plug according to the circuit diagrams

5) Electrical components and HIS are not wired

16th position

AC frequency of operating voltages

Languages of operating instructions and rating plate

Language selection				Frequency selection					
German	English	French	Spanish	DC	50 Hz	50 Hz and DC	60 Hz	60 Hz and DC	16
■				■	■	■			0
■							■	■	1
	■			■	■	■			2
	■						■	■	3
		■		■	■	■			4
		■					■	■	5
			■	■	■	■			6
			■				■	■	7

Other languages on request

Special versions

Additional information on the rating plate (only after consultation with the order processing department of the Switchgear Factory Berlin). Information in clear text. – Z Y 1 2

Configuration example

3AH5 vacuum circuit-breaker

(U_r = 36 kV, I_{SC} = 25 kA, I_r = 2000 A, pole-centre distance = 350 mm)

Auxiliary switch 6 NO + 6 NC, 24-pole plug and mechanical interlocking

Frequency DC, operating instructions and rating plate in English

Example for Order No.: 3 A H 5 3 1 4 – 4 U C 2 0 – 2 A H 2

Order codes:

Equipment Selection

Selection of additional equipment

Additional equipment

Positions: 1 2 3 4 5 6 7 – 8 9 10 11 12 13 14 15 16 Order codes

Order No.: 3 A H 5

Options	Order codes
Wiring cables, halogen-free and flame-retardant	– Z A 1 0
Condensation protection, heating for 230 V AC, 50 W	– Z A 2 0
Silicone-free design	– Z A 3 1
With electrical closing lock-out 1)	– Z A 4 7
Additional rating plate, loose delivery	– Z B 0 0
Routine test certificate enclosed	– Z F 2 0
Hand crank (also with motor operating mechanism) for manual charging of the closing spring	– Z F 3 0
Warranty 24 months	– Z W 7 0
Warranty 36 months	– Z W 7 1
Warranty 60 months	– Z W 7 2
Further, non-listed special versions (only after consultation with the order processing department of the Switchgear Factory Berlin). Information additionally in clear text.	– Z Y 9 9

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1) The operating voltage of the closing lock-out is the same as that of the closing solenoid. The closing lock-out is not available for manual spring-operated mechanisms or manual operating stored-energy mechanisms without closing solenoid (10th position: A) and generally not for 3AH512, 3AH513, 3AH514, 3AH520.

Configuration example

3AH5 vacuum circuit-breaker	3 A H 5
Rated voltage U_r = 36 kV	
Rated short-circuit breaking current I_{SC} = 25 kA	
Rated normal current I_r = 2000 A	
Pole-centre distance = 350 mm	3 1 4 – 4
1st shunt release, c.t.-operated release with a rated normal current of 1.0 A	U / – Z A 4 6
Operating voltage of the closing solenoid 48 V DC	C
Operating voltage of the 1st shunt release 48 V DC	2
2nd release as c.t.-operated release with a rated normal current of 1.0 A	0 –
With counter and breaker tripping signal	2
Manual operating stored-energy mechanism	A
Auxiliary switch 6 NO + 6 NC, 24-pole plug and mechanical interlocking	H
Frequency DC, operating instructions and rating plate in English	2
Routine test certificate enclosed	– Z F 2 0

Example for Order No.: 3 A H 5 3 1 4 – 4 U C 2 0 – 2 A H 2 – Z

Order codes: A 4 6 + F 2 0

Equipment Selection

Accessories and spare parts

On request, we will be pleased to send you an overview of accessories and spare parts, as well as the spare circuit-breaker poles available. Please consider the following information for your purchase order.

Remark for orders

The order numbers are applicable to vacuum circuit-breakers of current manufacture. When mounting parts or spare parts are being ordered for an existing vacuum circuit-breaker, always quote the type designation, serial number and the year of manufacture of the circuit-breaker to be sure to get the correct delivery.

Retrofitting

When releases/solenoids are retrofitted, the order numbers of the mounting parts must also be specified. For other additional equipment, the required mounting parts are included in the delivery.

Spare parts

As spare parts, the vacuum interrupters are always supplied as a complete pole including post insulator.

To select the correct spare interrupter, please specify the type designation, serial number and year of manufacture of the circuit-breaker. All data is given on the rating plate.

Vacuum interrupters and other spare parts must only be replaced by instructed personnel.

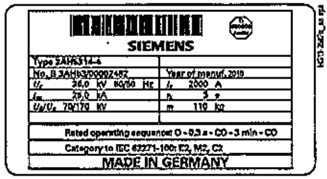
Accessories for the plug connector

Included in the scope of supply of the basic equipment for 3AH5 vacuum circuit-breakers:

For 24-pole plug connector
- Lower part of plug
- Crimp sockets according to number of contacts
- Upper part of plug with screwed contacts
  (no crimp sockets required)

For 64-pole plug connector
- Lower part of plug
- Upper part of plug
- Crimp sockets according to number of contacts

Data on the rating plate



SIEMENS

Type 3AH5314-4
No. B 3AH53/00002487 | Year of manuf. 2019
U_r 36,0 kV 50/60 Hz | I_r 2000 A
I_{sc} 25,0 kA | t_k 3 s
U_d/U_p 70/170 kV | m 110 kg

Rated operating sequence: O - 0,3 s - CO - 3 min - CO

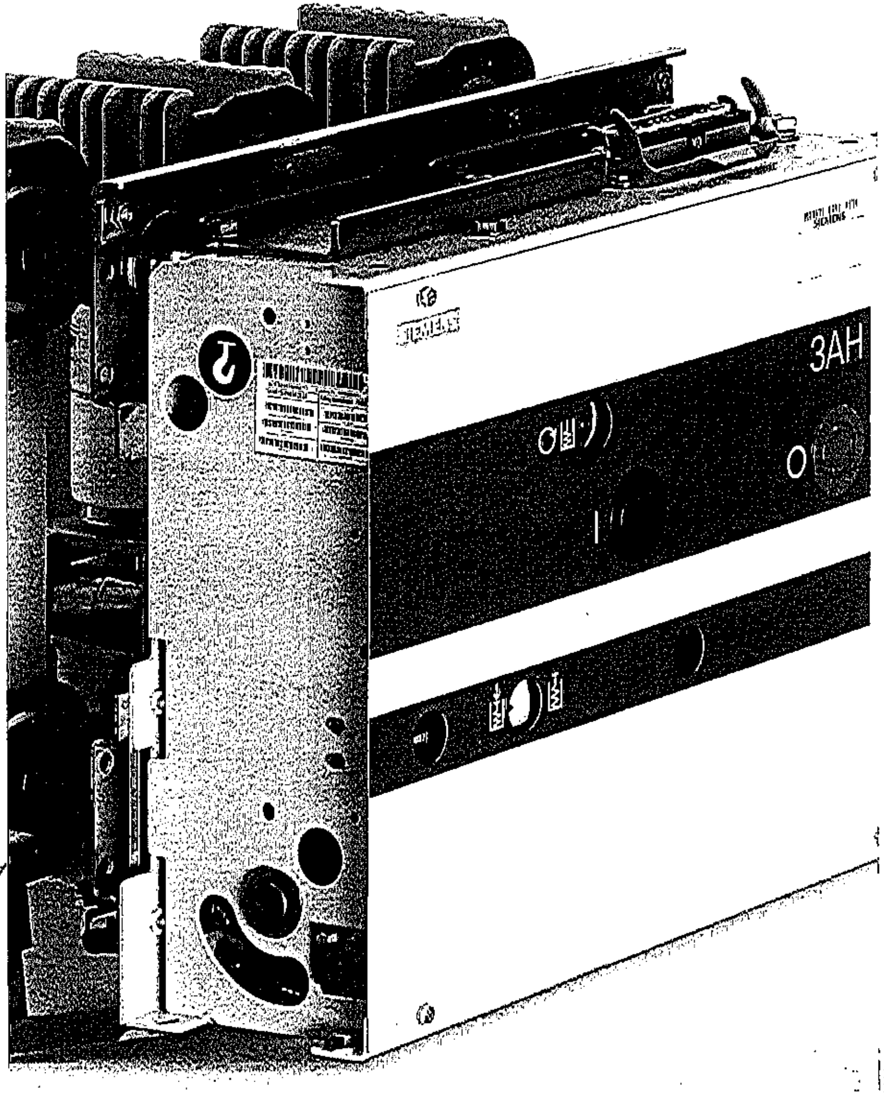
Category to IEC 62271-100: E2, M2, C2

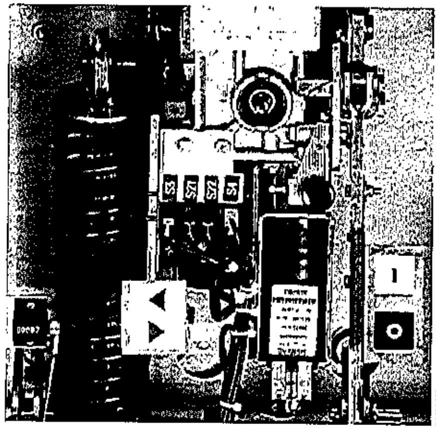
MADE IN GERMANY

Note:
For any query regarding spare parts, subsequent deliveries, etc. the following three details are necessary:
- Type designation
- Serial No.
- Year of manufacture

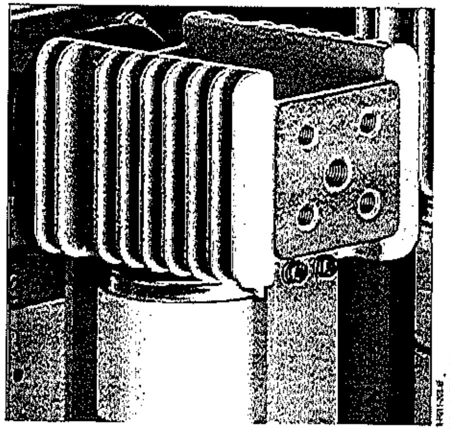
Accessories

Designation	Remarks	Operating voltage	Order No.
Hand crank for charging the closing spring	Short design		3AX15 30-4A
	Standard design		3AX15 30-4B
	Long design		3AX15 30-4C
	Bit for battery screwdriver		3AX15 30-3D
Wire bundle	With 10 wires for connection of auxiliary switch to		
	– 64-pole plug connector		3AX11 34-2D
	– 24-pole plug connector		3AX11 34-2B
	– 24-pole terminal strip		3AX11 34-2C
64-pole plug connector	Upper part of plug incl. sockets		3AX11 34-5A
	Lower part of plug incl. pins		3AX11 34-5B
	Complete plug connector		3AX11 34-6A
24-pole plug connector	Upper part of plug incl. socket insert		3AX11 34-5C
	Lower part of plug incl. pins		3AX11 34-5D
	Complete plug connector		3AX11 34-7A
Accessories for plug connector	(for wire cross-section 1.5 mm²)		
	Crimp pins for lower part of plug	24-pole	3AX11 34-3A
		64-pole	3AX11 34-4B
	Crimp sockets for upper part of plug	64-pole	3AX11 34-4C
	Crimping pliers		3AX11 34-4D
	Disassembly tool		3AX11 34-4G





Motor operating mechanism with energy store and closing solenoid



Upper pole support with conductor bar connection

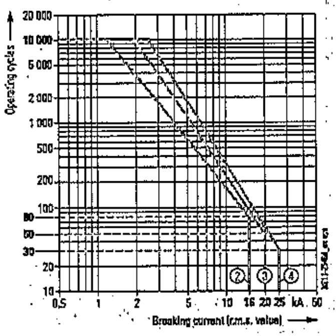
Technical Data

Electrical data, dimensions, weights and dimension drawings

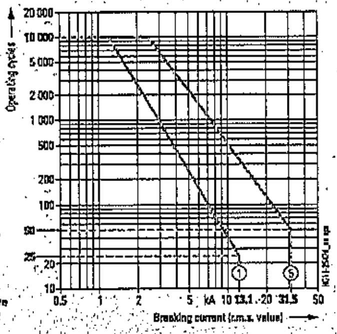
12 kV 50/60 Hz Order No.	Rated normal current I_r A	Pole-centre distance mm	Rated operating sequence: O – 3 min – CO – 3 min – CO	O – 0.3 s – CO – 3 min – CO	O – 0.3 s – CO – 15 s – CO	Rated duration of short-circuit t_k s	Rated short-circuit breaking current I_{sc} kA	DC component in % of the rated short-circuit breaking current %	Asymmetrical breaking current kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Rated back-to-back capacitor bank making current I_{bi} kA Peak	Rated lightning impulse withstand voltage U_p kV	Rated short-duration power-frequency withstand voltage U_d kV	Voltage drop ΔU between connections (according to IEC 62271-1 at DC 100 A) mV	Minimum creepage distance, interrupter mm	Minimum creepage distance, phase-to-earth mm	Minimum clearance, phase-to-phase mm	Minimum clearance, phase-to-earth mm	Weights kg	Detailed dimension drawing (can be ordered)	Operating cycle diagram no. (see page 25)	Catalog dimension drawing no. (see page 25)
3AH5 121-1...	800	160	☐	■	○	3	13.1	36	14.7	33/34	–*)	75	28	6.0	90	135	88	95	35	S_441 00641	1	1.1
3AH5 122-1...	800	160	☐	■	○	3	16	36	17.9	40/42	10	75	28	3.4	120	135	71	95	40	S_441 00643	2	1.3
3AH5 122-2...	1250	160	☐	■	○	3	16	36	17.9	40/42	10	75	28	3.4	120	135	71	95	40	S_441 00643	2	1.3
3AH5 123-1...	800	160	☐	■	○	3	20	36	22.4	50/52	10	75	28	3.4	120	135	71	95	40	S_441 00643	3	1.3
3AH5 123-2...	1250	160	☐	■	○	3	20	36	22.4	50/52	10	75	28	3.4	120	135	71	95	40	S_441 00643	3	1.3
3AH5 125-2...	1250	160	☐	■	○	3	31.5	36	35.4	80/82	20	75	28	3.0	129	135	60	95	40	S_441 00651	5	1.5
3AH5 131-1...	800	210	☐	■	○	3	13.1	36	14.7	33/34	–*)	75	28	6.0	90	135	138	95	35	S_441 00642	1	1.2
3AH5 132-1...	800	210	☐	■	○	3	16	36	17.9	40/42	10	75	28	3.4	120	135	121	95	40	S_441 00644	2	1.4
3AH5 132-2...	1250	210	☐	■	○	3	16	36	17.9	40/42	10	75	28	3.4	120	135	121	95	40	S_441 00644	2	1.4
3AH5 133-1...	800	210	☐	■	○	3	20	36	22.4	50/52	10	75	28	3.4	120	135	121	95	40	S_441 00644	3	1.4
3AH5 133-2...	1250	210	☐	■	○	3	20	36	22.4	50/52	10	75	28	3.4	120	135	121	95	40	S_441 00644	3	1.4
3AH5 133-4...	2000	210	☐	■	○	3	20	36	22.4	50/52	20	75	28	1.8	129	135	91	95	55	S_441 00646	3	1.6
3AH5 134-4...	2000	210	☐	■	○	3	25	36	28	63/65	20	75	28	1.8	129	135	91	95	55	S_441 00646	4	1.6
3AH5 134-6...	2500	210	☐	■	○	3	25	36	28	63/65	20	75	28	1.8	129	135	91	95	55	S_441 00646	4	1.6
3AH5 135-2...	1250	210	☐	■	○	3	31.5	36	35.4	80/82	20	75	28	3.0	129	135	110	95	45	S_441 00645	5	1.6
3AH5 135-4...	2000	210	☐	■	○	3	31.5	36	35.4	80/82	20	75	28	1.8	129	135	91	95	55	S_441 00646	5	1.7
3AH5 135-6...	2500	210	☐	■	○	3	31.5	36	35.4	80/82	20	75	28	1.8	129	135	91	95	55	S_441 00646	5	1.6
3AH5 144-1...	800	160	☐	■	○	3	25	36	28	63/65	–*)	75	28	3.8	90	135	75	95	40	S_441 01301	4	1.8
3AH5 144-2...	1250	160	☐	■	○	3	25	36	28	63/65	–*)	75	28	3.8	90	135	75	95	40	S_441 01301	4	1.8
3AH5 154-1...	800	210	☐	■	○	3	25	36	28	63/65	–*)	75	28	3.8	90	135	125	95	45	S_441 01302	4	1.9
3AH5 154-2...	1250	210	☐	■	○	3	25	36	28	63/65	–*)	75	28	3.8	90	135	125	95	45	S_441 01302	4	1.9

■ Standard information on the rating plate
☐ Possible with order number suffix Z and order code F27, or standard for manual operating mechanism (14th position A or X)
○ Possible with order number suffix Z and order code F28
*) Not available for this application

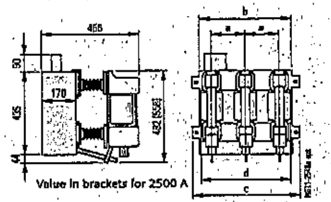
Operating cycle diagrams for 12 kV



The permissible number of electrical operating cycles is shown as a function of the breaking current (r.m.s. value). All vacuum circuit-breakers fulfil the endurance classes E2, M2 and C2 according to IEC 62271-100. The curve shape beyond the parameters defined in IEC 62271-100 is based on average experience data. The number of operating cycles that can actually be reached can be different depending on the respective application.



Dimension drawing for 12 kV



Value in brackets for 2500 A

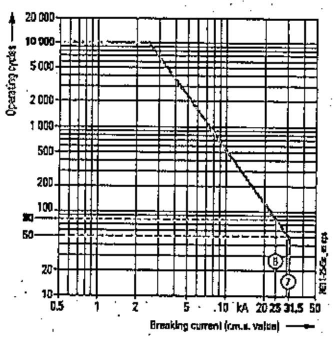
Dimension drawing	a mm	b mm	c mm	d mm
1.1	160	432	490	392
1.2	210	534	592	492
1.3	160	432	490	409
1.4	210	534	592	509
1.5	160	432	490	422
1.6	210	534	592	539
1.7	210	534	592	522
1.8	160	432	490	405
1.9	210	534	592	505

a – Pole-centre distance
b – Width of cross member
c – Width of cross member incl. lugs
d – Largest energized width

17.5 kV 50/60 Hz Order No.	Rated normal current I_r A	Pole-centre distance mm	Rated operating sequence: O – 3 min – CO – 3 min – CO	O – 0.3 s – CO – 3 min – CO	O – 0.3 s – CO – 15 s – CO	Rated duration of short-circuit t_k s	Rated short-circuit breaking current I_{sc} kA	DC component in % of the rated short-circuit breaking current %	Asymmetrical breaking current kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Rated back-to-back capacitor bank making current I_{bi} kA Peak	Rated lightning impulse withstand voltage U_p kV	Rated short-duration power-frequency withstand voltage U_d kV	Voltage drop ΔU between connections (according to IEC 62271-1 at DC 100 A) mV	Minimum creepage distance, Interrupter mm	Minimum creepage distance, phase-to-earth mm	Minimum clearance, phase-to-phase mm	Minimum clearance, phase-to-earth mm	Weights kg	Detailed dimension drawing (can be ordered)	Operating cycle diagram no. (see page 27)	Catalog dimension drawing no. (see page 27)
3AH5 204-1…	800	160	☐	■	○	3	25	36	28	63/65	20	95	38	3.4	129	170	176	130	40	S_441 00705	6	2.1
3AH5 204-2…	1250	160	☐	■	○	3	25	36	28	63/65	20	95	38	3.4	129	170	176	130	40	S_441 00705	6	2.1
3AH5 205-2…	1250	160	☐	■	○	3	31.5	36	35.4	80/82	20	95	38	2.7	129	170	140	130	40	S_441 00652	7	2.1
3AH5 214-1…	800	210	☐	■	○	3	25	36	28	63/65	20	95	38	3.4	129	170	108	130	45	S_441 00706	6	2.2
3AH5 214-2…	1250	210	☐	■	○	3	25	36	28	63/65	20	95	38	3.4	129	170	108	130	45	S_441 00706	6	2.2
3AH5 214-6…	2500	210	☐	■	○	3	25	36	28	63/65	20	95	38	1.6	129	170	163	130	55	S_441 00649	6	2.3
3AH5 215-2…	1250	210	☐	■	○	3	31.5	36	35.4	80/82	20	95	38	2.7	129	170	108	130	45	S_441 00648	7	2.2
3AH5 215-4…	2000	210	☐	■	○	3	31.5	36	35.4	80/82	20	95	38	1.6	129	170	163	130	55	S_441 00649	7	2.3
3AH5 215-6…	2500	210	☐	■	○	3	31.5	36	35.4	80/82	20	95	38	1.6	129	170	163	130	55	S_441 00649	7	2.3

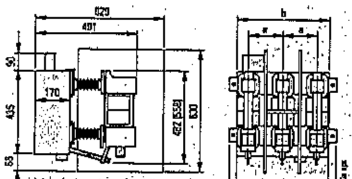
■ Standard information on the rating plate
☐ Possible with order number suffix Z and order code F27, or standard for manual operating mechanism (14th position A or X)
○ Possible with order number suffix Z and order code F28

Operating cycle diagram for 17.5 kV



The permissible number of electrical operating cycles is shown as a function of the breaking current (r.m.s. value). All vacuum circuit-breakers fulfil the endurance classes E2, M2 and C2 according to IEC 62271-100. The curve shape beyond the parameters defined in IEC 62271-100 is based on average experience data. The number of operating cycles that can actually be reached can be different depending on the respective application.

Dimension drawing for 17.5 kV



Value in brackets for 2500 A
Barrier for pole-centre distance of 160 mm

Dimension drawing	a mm	b mm	c mm	d mm
2.1	160	432	490	422
2.2	210	534	592	522
2.3	210	534	592	534

a – Pole-centre distance
b – Width of cross member
c – Width of cross member incl. lugs
d – Largest energized width

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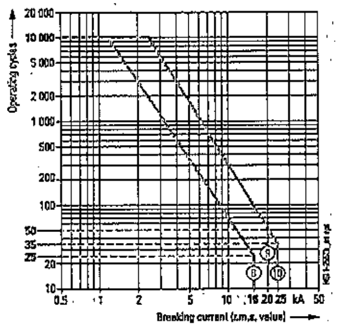
24 kV 50/60 Hz Order No.	Rated normal current I_r A	Pole-centre distance mm	Rated operating sequence: O – 3 min – CO – 3 min – CO	O – 0.3 s – CO – 3 min – CO	O – 0.3 s – CO – 15 s – CO	Rated duration of short-circuit t_k s	Rated short-circuit breaking current I_{sc} kA	DC component in % of the rated short-circuit breaking current %	Asymmetrical breaking current kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Rated back-to-back capacitor bank making current I_{bi} kA Peak	Rated lightning impulse withstand voltage U_p kV	Rated short-duration power-frequency withstand voltage U_d kV	Voltage drop ΔU between connections (according to IEC 62271-1 at DC 100 A) mV	Minimum creepage distance, interrupter mm	Minimum creepage distance, phase-to-earth mm	Minimum clearance, phase-to-phase mm	Minimum clearance, phase-to-earth mm	Weights kg	Detailed dimension drawing (can be ordered)	Operating cycle diagram no. (see page 29)	Catalog dimension drawing no. (see page 29)
3AH5 272-1…	800	210	☐	■	○	3	16	36	17.9	40/42	10	125	50	3.8	200	190	215	175	55	S_441 00660	8	3.1
3AH5 272-2…	1250	210	☐	■	○	3	16	36	17.9	40/42	10	125	50	3.8	200	190	215	175	55	S_441 00660	8	3.1
3AH5 273-2…	1250	210	☐	■	○	3	20	36	22.4	50/52	20	125	50	3.8	200	190	215	175	55	S_441 00662	9	3.2
3AH5 273-4…	2000	210	☐	■	○	3	20	36	22.4	50/52	20	125	50	2.2	200	190	227	175	80	S_441 00663	9	3.3
3AH5 273-6…	2500	210	☐	■	○	3	20	36	22.4	50/52	20	125	50	2.2	200	190	227	175	80	S_441 00663	9	3.3
3AH5 274-2…	1250	210	☐	■	○	3	25	36	28	63/65	20	125	50	3.8	200	190	260	175	55	S_441 00662	10	3.2
3AH5 274-6…	2500	210	☐	■	○	3	25	36	28	63/65	20	125	50	2.2	200	190	227	175	80	S_441 00663	10	3.3
3AH5 282-1…	800	275	☐	■	○	3	16	36	17.9	40/42	10	125	50	3.8	200	190	180	175	55	S_441 00661	8	3.4
3AH5 282-2…	1250	275	☐	■	○	3	16	36	17.9	40/42	10	125	50	3.8	200	190	180	175	55	S_441 00661	8	3.4
3AH5 283-2…	1250	275	☐	■	○	3	20	36	22.4	50/52	20	125	50	3.8	200	190	165	175	55	S_441 00664	9	3.5
3AH5 283-4…	2000	275	☐	■	○	3	20	36	22.4	50/52	20	125	50	2.2	200	190	135	175	80	S_441 00668	9	3.6
3AH5 283-6…	2500	275	☐	■	○	3	20	36	22.4	50/52	20	125	50	2.2	200	190	135	175	80	S_441 00668	9	3.6
3AH5 284-2…	1250	275	☐	■	○	3	25	36	28	63/65	20	125	50	3.8	200	190	165	175	55	S_441 00664	10	3.5
3AH5 284-6…	2500	275	☐	■	○	3	25	36	28	63/65	20	125	50	2.2	200	190	135	175	80	S_441 00668	10	3.6

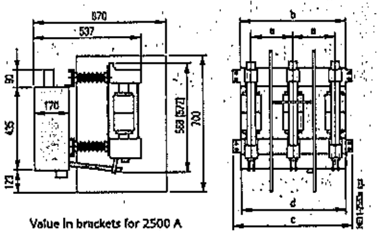
■ Standard information on the rating plate
☐ Possible with order number suffix Z and order code F27, or standard for manual operating mechanism (14th position A or X)
○ Possible with order number suffix Z and order code F28

Operating cycle diagram for 24 kV



The permissible number of electrical operating cycles is shown as a function of the breaking current (r.m.s. value). All vacuum circuit-breakers fulfil the endurance classes E2, M2 and C2 according to IEC 62271-100. The curve shape beyond the parameters defined in IEC 62271-100 is based on average experience data. The number of operating cycles that can actually be reached can be different depending on the respective application.

Dimension drawing for 24 kV



Value in brackets for 2500 A
Barrier for pole-centre distance of 160 mm

Dimension drawing	a mm	b mm	c mm	d mm
3.1	210	534	592	516
3.2	210	534	592	530
3.3	210	534	592	541
3.4	275	650	708	645
3.5	275	650	708	660
3.6	275	650	708	690

a = Pole-centre distance
b = Width of cross member
c = Width of cross member incl. lugs
d = Largest energized width

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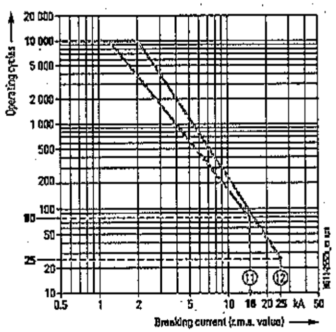
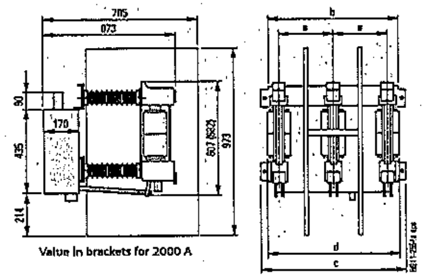
36 kV 50/60 Hz Order No.	Rated normal current I_r A	Pole-centre distance mm	Rated operating sequence: O – 3 min – CO – 3 min – CO	O – 0.3 s – CO – 3 min – CO	O – 0.3 s – CO – 15 s – CO	Rated duration of short-circuit t_k s	Rated short-circuit breaking current I_{sc} kA	DC component in % of the rated short-circuit breaking current %	Asymmetrical breaking current kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Rated back-to-back capacitor bank making current I_{bi} kA Peak	Rated lightning impulse withstand voltage U_p kV	Rated short-duration power-frequency withstand voltage U_d kV	Voltage drop ΔU between connections (according to IEC 62271-1 at DC 100 A) mV	Minimum creepage distance, interrupter mm	Minimum creepage distance, phase-to-earth mm	Minimum clearance, phase-to-phase mm	Minimum clearance, phase-to-earth mm	Weights kg	Detailed dimension drawing (can be ordered)	Operating cycle diagram no. (see below)	Catalog dimension drawing no. (see below)
3AH5 312-2...	1250	350	□	■	○	3	16	36	28	40/42	20	170	70	3.0	240	310	256	300	85	S_441 00910	11	4.2
3AH5 314-2...	1250	350	□	■	○	3	25	36	28	63/65	20	170	70	3.0	240	310	256	300	85	S_441 00910	12	4.2
3AH5 314-4...	2000	350	□	■	○	3	25	36	28	63/65	20	170	70	2.5	240	310	256	300	110	S_441 00676	12	4.2
3AH5 322-2...	1250	275	□	■	○	3	16	36	28	40/42	20	170	70	3.0	240	310	256	300	75	S_441 00990	11	4.1
3AH5 324-2...	1250	275	□	■	○	3	25	36	28	63/65	20	170	70	3.2	240	310	256	300	75	S_441 00990	12	4.1

■ Standard information on the rating plate
□ Possible with order number suffix Z and order code F27, or standard for manual operating mechanism (14th position A or X)
○ Possible with order number suffix Z and order code F28

Operating cycle diagram and dimension drawing for 36 kV





Value in brackets for 2000 A

The permissible number of electrical operating cycles is shown as a function of the breaking current (r.m.s. value). All vacuum circuit-breakers fulfil the endurance classes E2, M2 and C2 according to IEC 62271-100. The curve shape beyond the parameters defined in IEC 62271-100 is based on average experience data. The number of operating cycles that can actually be reached can be different depending on the respective application.

Dimension drawing	a mm	b mm	c mm	d mm
4.1	275	650	708	668
4.2	350	810	868	818

a = Pole-centre distance
b = Width of cross member
c = Width of cross member incl. lugs
d = Largest energized width

Technical Data

Operating times, short-circuit protection of motors and consumption data of releases

Operating times

Operating times at rated voltage of the secondary circuit	Equipment of circuit-breaker	Operating time of circuit-breaker
Closing time	–	< 65 ms 1)
Opening time	1st shunt release	< 55 ms 1)
	2nd release	< 45 ms
Arcing time	–	< 15 ms
Break time	1st shunt release	< 70 ms
	2nd release	< 60 ms
Dead time	–	300 ms
CLOSE/OPEN contact time	1st shunt release	< 75 ms
	2nd release	< 60 ms
Minimum command duration	Closing solenoid	45 ms
	1st shunt release	40 ms
	2nd release	20 ms
Pulse time for circuit-breaker tripping signal	1st shunt release	> 15 ms
	2nd release	> 10 ms
Charging time for electrical operation	–	< 15 s
Synchronism error between the poles	–	≤ 2 ms

1) Shorter operating times on request.

Short-circuit protection of motors (fuse protection of drive motors)

Rated voltage of the motor	Operating voltage		Power consumption of the motor		Smallest possible rated current 2) of the m.c.b. (miniature circuit-breaker) with C-characteristic
V	max. V	min. V	W (at DC)	VA (at AC)	A
DC 24	26	20	650	–	10
DC 48	53	41	650	–	8
DC 60	66	51	650	–	6
DC 110	121	93	650	–	4
DC 220	242	187	650	–	3
AC 110	121	93	–	650	3
AC 230	244	187	–	650	2

2) The current inrush in the drive motor can be neglected due to its very short presence.

Consumption data of releases

Release	Power consumption		Tripping ranges	
	Operation at		Tripping voltage	Tripping voltage or tripping current
	DC approx. W	AC 50/60 Hz approx. VA	at DC	at AC 50/60 Hz
Closing solenoid 3AY15 10 ~	140 – 210	140 – 210	85 to 110 % U	85 to 110 % U
1st shunt release (without energy store) 3AY15 10	140	140	70 to 110 % U	85 to 110 % U
2nd shunt release (with energy store) 3AX11 01	70	50	70 to 110 % U	85 to 110 % U
Undervoltage release 3AY11 03	20	20	35 to 0 % U	35 to 0 % U
Current-transformer operated release 3AX11 02 (rated normal current 0.5 A or 1 A)	–	10 3)	–	90 to 110 % I_n
Current-transformer operated release 3AX11 04 (tripping pulse ≥ 0.1 Ws)	–	–	–	–

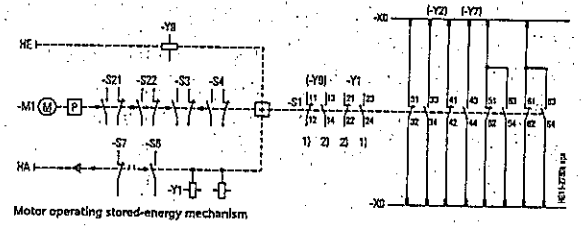
3) Consumption at pickup current (90 % of the rated normal current) and open armature.

Technical Data

Circuit diagrams

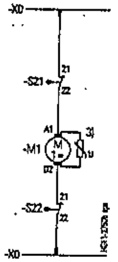
Circuit diagrams

The circuit diagrams shown here are examples from the manifold possibilities of circuit-breaker wiring.

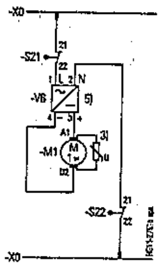


Motor operating stored-energy mechanism

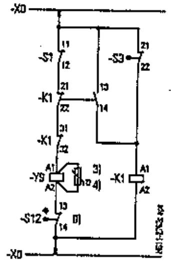
The available possible combinations are described in the chapter "Selection of secondary equipment".



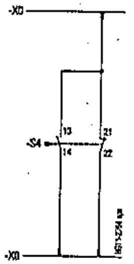
Motor charging for DC



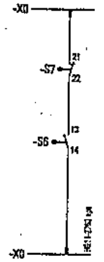
Motor charging with rectifier for AC



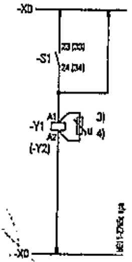
Closing and anti-pumping



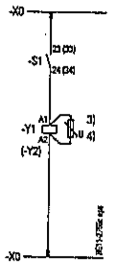
Signal: Spring charged with 24-pole plug connector



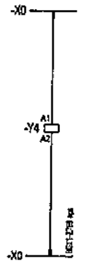
Circuit-breaker tripping for 24/64-pole plug connector



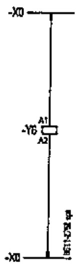
1st shunt release (2nd shunt release) with 64-pole plug connector



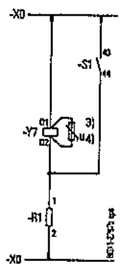
1st shunt release (2nd shunt release) with 24-pole plug connector



1st current-transformer operated release



Low-energy current-transformer operated release



Undervoltage release

1) Internally wired
2) Not wired
3) Integrated varistor for ≥ 60 V DC
4) Integrated varistor for ≥ 100 V AC/DC
5) Additional rectifier only required for AC
6) Only in connection with mechanical interlocking

Legend

HA	Manual opening	S1	Auxiliary switch	S12	Mechanical interlocking	Y2	2nd shunt release
HE	Manual closing	S3	Position switch (opens when closing spring is charged)	S21, S22	Position switches (to de-energize the motor operating mechanism after charging)	Y4	Current-transformer operated release
K1	Contactor (anti-pumping)	S4	Position switch (indicates the charging state)	V6	Rectifier	Y6	Low-energy current-transformer operated release
M1	Motor operating mechanism	S6	Circuit-breaker tripping signal	X0	Lower part of plug	Y7	Undervoltage release
P	Energy store	S7	Cutout switch for circuit-breaker tripping signal	Y1	1st shunt release	Y9	Closing solenoid
R1	Resistance						

Brandenburg Gate, Berlin, Germany

Switchgear Factory, Berlin, Germany

4

Please copy, fill in and return to your Siemens partner.

Inquiry concerning

☐ 3AH5 circuit-breaker

Please

☐ Submit an offer
☐ Call us
☐ Visit us

Your address

Company

Dept.

Name

Street

Postal code/city

Country

Phone

Fax

E-mail

4

Siemens AG

Dept.

Name

Street

Postal code/city

Country

Fax

Technical data

				Other values
Rated voltage	☐ 12 kV ☐ 24 kV	☐ 17.5 kV ☐ 36 kV		☐ ___ kV
Rated lightning impulse withstand voltage	☐ 75 kV ☐ 125 kV	☐ 95 kV ☐ 170 kV		☐ ___ kV
Rated short-duration power-frequency withstand voltage	☐ 28 kV ☐ 50 kV	☐ 38 kV ☐ 70 kV	☐ 42 kV	☐ ___ kV
Rated short-circuit breaking current	☐ 13.1 kA ☐ 25 kA	☐ 16 kA ☐ 31.5 kA	☐ 20 kA	☐ ___ kA
Rated normal current	☐ 800 A ☐ 2000 A	☐ 1250 A ☐ 2500 A		☐ ___ A
Pole-centre distance	☐ 160 mm	☐ 210 mm	☐ 275 mm	☐ 350 mm

Secondary equipment

For possible combinations see pages 15 to 19

Circuit-breaker equipment	☐ Manual spring-operated mechanism ☐ Manual operating stored-energy mechanism ☐ Motor operating stored-energy mechanism			
Motor operating mechanism	☐ ___ V DC		☐ ___ V AC, ___ Hz	
Closing solenoid	☐ ___ V DC		☐ ___ V AC, ___ Hz	
1st shunt release	☐ ___ V DC		☐ ___ V AC, ___ Hz	
2nd shunt release	☐ ___ V DC		☐ ___ V AC, ___ Hz	
Current-transformer operated release	☐ 0.5 A	☐ 1 A	☐ ≥ 0.1 Ws 10 Ω	☐ ≥ 0.1 Ws 20 Ω
Undervoltage release	☐ ___ V DC		☐ ___ V AC, ___ Hz	
Auxiliary switch	☐ 2 NO + 2 NC	☐ 6 NO + 6 NC	☐ 12 NO + 12 NC	
Low-voltage connection	☐ without	☐ 24-pole terminal strip	☐ 24-pole plug	☐ 64-pole plug
☐ Mechanical interlocking				
☐ Counter				
☐ Circuit-breaker tripping signal				
☐ Electrical closing lock-out				
Operating instructions	☐ English	☐ German	☐ French	☐ Spanish

Application and other requirements

☐ Please check off ___ Please fill in

You prefer to configure your 3AH5 vacuum circuit-breaker on your own?

Follow the steps to the configuration and enter the order number in the configuration aid.

Instruction for configuration of the 3AH5 vacuum circuit-breaker

1st step: Definition of the primary part (see page 13 to 14)

Please specify the following ratings:	Possible options:
Rated voltage (U_r)	U_r: 12 kV, 17.5 kV, 24 kV, 36 kV
Rated lightning impulse withstand voltage (U_p)	U_p: 75 kV, 95 kV, 125 kV, 170 kV
Rated short-duration power-frequency withstand voltage (U_d)	U_d: 28 kV, 38 kV, 42 kV, 50 kV, 70 kV
Rated short-circuit breaking current (I_{sc})	I_{sc}: 13.1 kA, 16 kA, 20 kA, 25 kA, 31.5 kA
Rated normal current (I_r)	160 mm, 210 mm, 275 mm, 350 mm
Pole-centre distance	I_r: 800 A, 1250 A, 2000 A, 2500 A

These ratings define the positions 5 to 8 of the order number.

2nd step: Definition of the secondary equipment (see pages 15 to 19)

Please specify the following equipment features:	Possible options:
Release combination (position 9)	Shunt release, current-transformer operated release and undervoltage release
Closing solenoid (position 10)	Operating voltages from 24 V DC to 240 V AC
Operating voltage of the releases (positions 11/12)	Operating voltages from 24 V DC to 240 V AC
Equipment with circuit-breaker tripping signal (position 13)	Equipment depends on the selection of the secondary connection
Type of operating mechanism and operating voltage of a motor, if available (position 14)	Manual spring-operated mechanism, manual operating stored-energy mechanism, motor operating stored-energy mechanism with operating voltages from 24 V DC to 240 V AC
Number of auxiliary contacts (position 15)	2 NO + 2 NC, 6 NO + 6 NC, 12 NO + 12 NC
Design of the secondary connection (position 15)	24-pole terminal strip, 24-pole plug connector, 64-pole plug connector, without plug connector
Language of the documentation (position 16)	English, German, French, Spanish, other languages on request
Frequency of the operating voltage of the secondary equipment at AC (position 16)	50 Hz/60 Hz

These equipment features define the positions 9 to 16 of the order number.

3rd step: Do you have any further requirements concerning the equipment? (see page 20)

Your Siemens sales partner will be pleased to support you.

For configuration of your
3AH5 vacuum circuit-breaker

1	2	3	4	5	6	7	–	8	9	10	11	12	–	13	14	15	16		
3	A	H	5	☐	☐	☐	–	☐	☐	☐	☐	☐	–	☐	☐	☐	☐	–	Z
					See page 13 and page 14				See page 15	See page 16	See page 16	See page 17		See page 18	See page 18	See page 19	See page 19		See page 20

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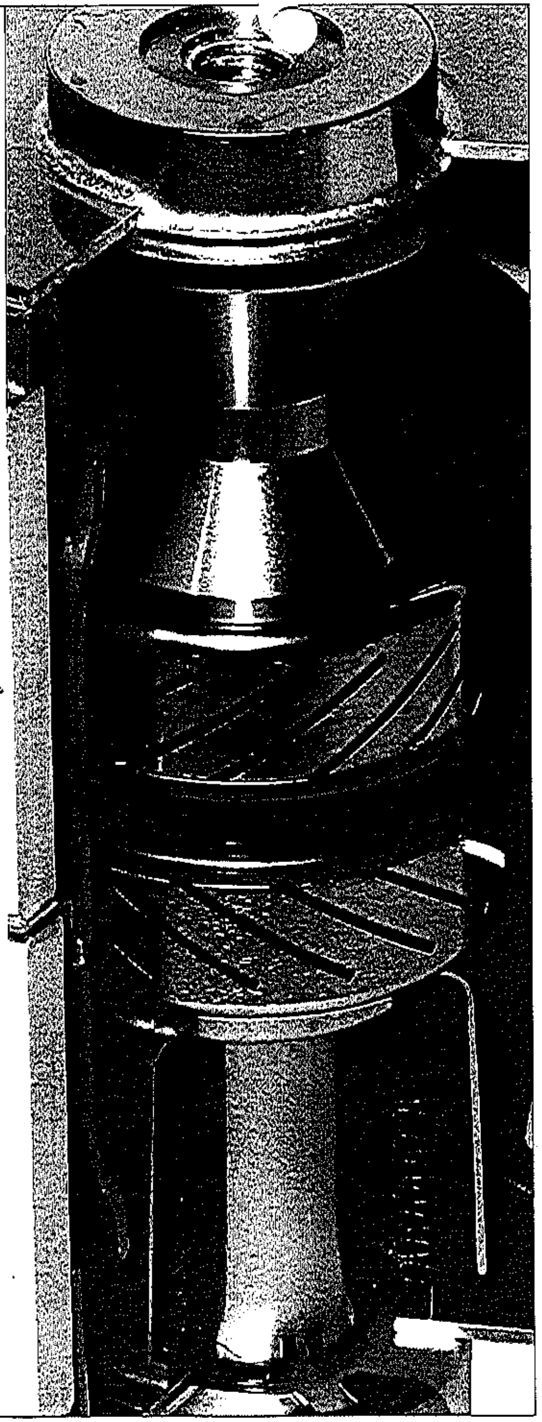

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13623 Berlin, Germany

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E-mail: support.energy@siemens.com

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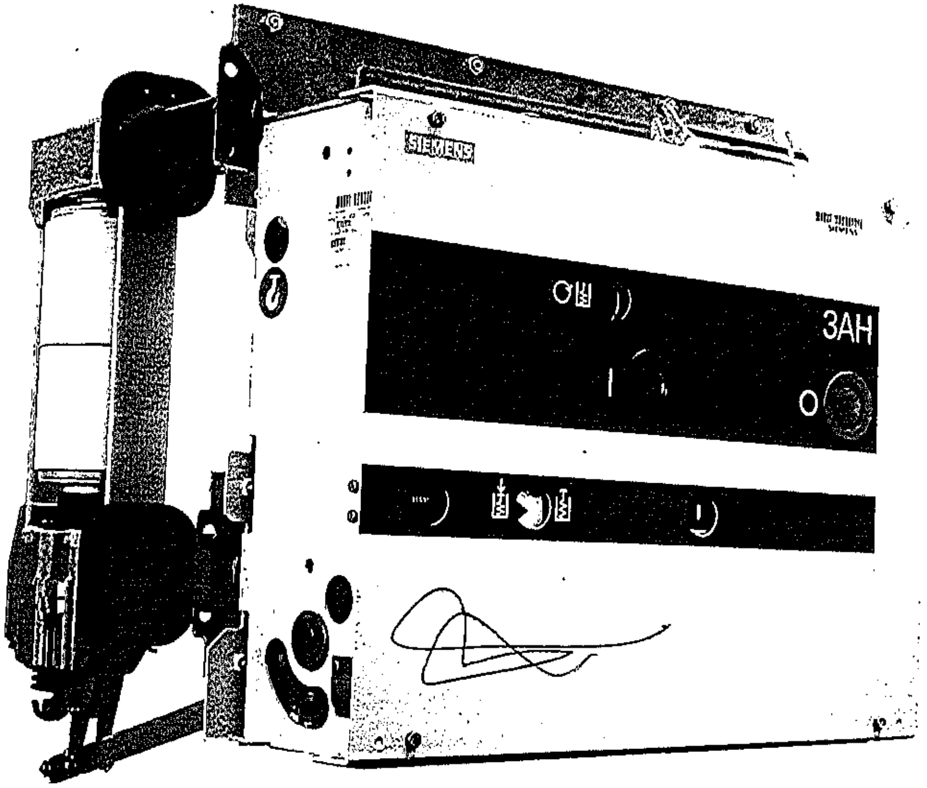
2017

Schaltungsunterlagen Übersicht Stromlaufpläne / Overview circuit diagrams



000371

Vakuum-Leistungsschalter 3AH5 mit 24 poligen Stecker oder Klemme
3AH5 Vacuum circuit-breaker with 24 pole plug connector or terminal strip

0A		20.04.12	Bro	Datum	26.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C	s. Blatt 19	11.09.12	Hähn.	Gepr.	
Zustand	Änderung	Datum	Name	Norm	

Deckblatt
Cover sheet

Urspr./Ers.f./Ers.d.

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connrctor
24 pol.Klemme / 24 pole terminal strip

=KZ01
S +
I ME1
3S_S_A7E_449_99004_002-0C
M1
Blatt 1+
19 Bl.

Archiv =KZ01/S1M12/

Blatt / Side	24 poliger Stecker oder Klemme / 24 pole plug or pole terminal strip
1	Deckblatt / Cover sheet
2	Inhaltsverzeichnis / Table of contents
3	Inhaltsverzeichnis / Table of contents
4	Inhaltsverzeichnis / Table of contents
5	Lageplan / Layout
6	Motoraufzug / Motor charging
	S_A7E_449_33001_101 für DC mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33001_201 für DC mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33002_101 für AC mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33002_201 für AC mit 24 pol.Klemme / with 24 pole terminal strip
7	Einschaltung und Pumpverhinderung / Closing and anti pumping
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33010_531 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33011_531 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33010_581 mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33011_581 mit 24 pol.Klemme / with 24 pole terminal strip
	mit mechanische Verriegelung / with mechanical interlocking
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33010_532 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33011_532 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33010_582 mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33011_582 mit 24 pol.Klemme / with 24 pole terminal strip
	mit Einschaltsperre / with electrical closing lock-out
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33010_533 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33011_533 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33010_583 mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33011_583 mit 24 pol.Klemme / with 24 pole terminal strip
	mit mechanische Verriegelung und Einschaltsperre
	with mechanical interlocking and electrical closing lock-out
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33010_534 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33011_534 mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33010_584 mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33011_584 mit 24 pol.Klemme / with 24 pole terminal strip
8	Auslöser / release
	S_A7E_449_33020_101 1.Arbeitsstromauslöser / 1st shunt release
	mit 24 pol.Stecker / with 24 pole plug connector
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33020_201 1.Arbeitsstromauslöser / 1st shunt release
	mit 24 pol.Klemme / with 24 pole terminal strip
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

Blatt / Side	24 poliger Stecker oder Klemme / 24 pole plug or pole terminal strip
8	S_A7E_449_33021_101 2.Arbeitsstromauslöser / 2nd shunt release
	mit 24 pol.Stecker / with 24 pole plug connector
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33021_201 2.Arbeitsstromauslöser / 2nd shunt release
	mit 24 pol.Klemme / with 24 pole terminal strip
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33023_101 Energiearmer Wandlerstromauslöser /
	Low energy C.T.operated release
	mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33023_201 Energiearmer Wandlerstromauslöser /
	Low energy C.T.operated release
	S_A7E_449_33024_101 1.Wandlerstromauslöser .DC / 1st C.T.operated release .DC
	mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33024_201 1.Wandlerstromauslöser .DC / 1st C.T.operated release .DC
	mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33024_102 1.Wandlerstromauslöser .AC/ 1st C.T.operated release. AC
	mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33024_202 1.Wandlerstromauslöser .AC/ 1st C.T.operated release. AC
	mit 24 pol.Klemme / with 24 pole terminal strip
9	S_A7E_449_33026_101 Unterspannungsauslöser / Undervoltage release
	mit 24 pol.Stecker / with 24 pole plug connector
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33026_201 Unterspannungsauslöser / Undervoltage release
	mit 24 pol.Klemme / with 24 pole terminal strip
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33026_102 Unterspannungsauslöser mit elektrische Einschaltsperre DC /
	Undervoltage release with elektrical closing lock-out
	mit 24 pol.Stecker / with 24 pole plug connector
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33026_202 Unterspannungsauslöser mit elektrische Einschaltsperre DC /
	Undervoltage release with elektrical closing lock-out
	mit 24 pol.Klemme / with 24 pole terminal strip
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33026_103 Unterspannungsauslöser mit elektrische Einschaltsperre AC /
	Undervoltage release with elektrical closing lock-out
	mit 24 pol.Stecker / with 24 pole plug connector
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
	S_A7E_449_33026_203 Unterspannungsauslöser mit elektrische Einschaltsperre AC /
	Undervoltage release with Elektrical Closing lock-out
	mit 24 pol.Klemme / with 24 pole terminal strip
	Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

000372

FB_D_01.03.97

449_99004_002

Zustand	Änderung	Datum	Name	Norm	
0A		20.04.12	Bro	Datum	26.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C	s. Blatt 19	12.09.12	Hähn.	Gepr.	

Inhaltsverzeichnis
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Urspr./Ers.f./Ers.d.

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole.plug connector
24 pol.Klemme / 24 pole terminal strip
Stromlaufplan

1 ME1
3S_S_A7E_449_99004_002–0C
=KZ01
S +
M2
Blatt 2+
19 Bl.

000373

FB_0_01.08.97

449_99004_002

0A		20.04.12	Bro	Datum	26.04.2011	Inhaltsverzeichnis Table of contents	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole,plug connector 24 pol.Klemme / 24 pole terminal strip Stromlaufplan	=KZ01
0B		24.05.12	Bro	Bearb.	Bronsch				S +
0C	s. Blatt 19	12.09.12	Hähn.	Gepr.				I ME1	3S_S_A7E_449_99004_002–0C
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.			M3 Blatt 3+ 19 Bl.

Archiv: =KZ01 / S / M / 4 /

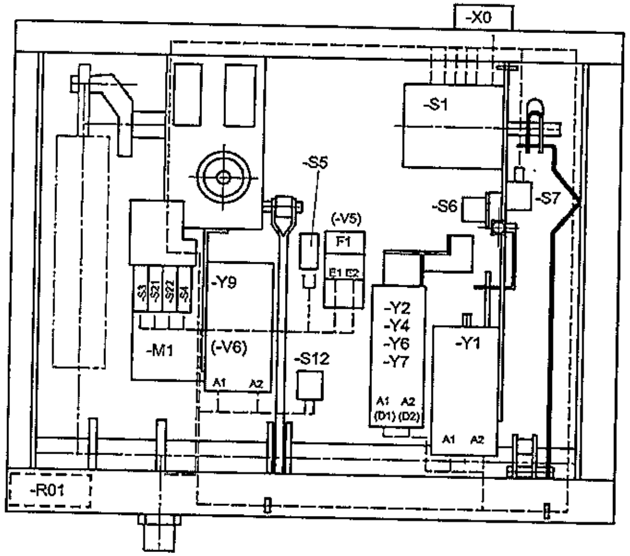
Blatt / Side	24 poliger Stecker oder Klemme / 24 pole plug or pole terminal strip
15	S_A7E_449_33061_124 (-Y1,-Y2) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_224 (-Y1,-Y2) mit 24pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33061_123 (-Y1,-Y2) mit 24 pol.Stecker / with 24 pole plug connector für Einschaltsperre /for electrical closing lock-out
	S_A7E_449_33061_223 (-Y1,-Y2) mit 24pol.Klemme / with 24 pole terminal strip für Einschaltsperre /for electrical closing lock-out
16	S_A7E_449_33061_125 (-Y1,-Y7) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_225 (-Y1,-Y7) mit 24 pol.Klemme / with 24 pole terminal strip
17	Hilfsschalter 6S/6Ö -S1 unverdrahtet / Auxiliary switch 6NO/6NC -S1 unwired
	S_A7E_449_33061_116 (-Y9,-Y1) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_216 (-Y9,-Y1) mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33061_115 (-Y9,-Y1,-Y2) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_215 (-Y9,-Y1,-Y2) mit 24pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33061_110 (-Y9,-Y1,-Y7) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_210 (-Y9,-Y1,-Y7) mit 24 pol.Klemme / with 24 pole terminal strip
	Hilfsschalter 6S/6Ö -S1 unverdrahtet / Auxiliary switch 6NO/6NC -S1 unwired
	S_A7E_449_33061_113(-Y1) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_223 (-Y1) mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33061_114 (-Y1,-Y2) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_214 (-Y1,-Y2) mit 24 pol.Klemme / with 24 pole terminal strip
	S_A7E_449_33061_112 (-Y1,-Y7) mit 24 pol.Stecker / with 24 pole plug connector
	S_A7E_449_33061_212 (-Y1,-Y7) mit 24 pol.Klemme / with 24 pole terminal strip
18	Anschlussplan / Terminal diagram
19	Indexerläuterung / Index indication

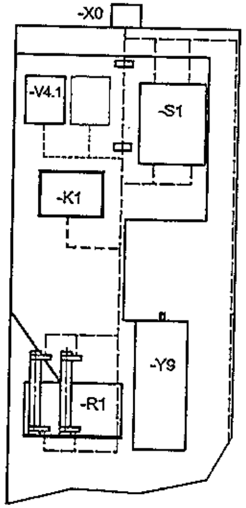
000374

FB_D_01.08.97

449_99004_002

0A		20.04.12	Bro	Datum	26.04.2011	Inhaltsverzeichnis Table of contents	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole,plug connector 24 pol.Klemme / 24 pole terminal strip Stromlaufplan		=KZ01 S + 3S_S_A7E_449_99004_002-0C	M4
0B		24.05.12	Bro	Bearb.	Bronsch						Blatt 4+
0C	s. Blatt 19	12.09.12	Hähn.	Gepr.					I ME1		19 Bl.
Zustand	Änderung	Datum	Name	Norm	-	Urspr./Ers.f./Ers.d.					





000375

Betriebsmittel-Kennzeichen / Operating supplies characteristic

-K1	Schütz / Contactor	Abschaltung -Y9 und Pumpverhinderung / cut-oft -Y9 and anti-pumping
-M1	Motor / Motor	
-R1	Widerstand / Resistor	für R-Auslöser / for Undervoltage release
-R01	Widerstand / Resistor	Heizung / Heating
-S1	Hilfsschalter / Auxiliary switch	
-S3	Positionsschalter / Position switch	Steuerung für-K1 / Control for -K1
-S4	Positionsschalter / Position switch	Meldung Spannzustand der Einschaltfeder / signal changing dat of closing spring
-S5	Positionsschalter / Position switch	Enschaltsperre / OElectrical Closing lock-out
-S6,S7	Positionsschalter / Position switch	Schalterfallmeldung / circuit breaker tripping signal
-S12	Positionsschalter / Position switch	verhindert elektrische Einschaltung bei mech. Verriegelung prevents electrical cloping with mech. interlocking
-S21,S22	Positionsschalter / Position switch	Motorabsteuerung / switch off the motor after charging
-V4.1	Gleichrichterbaustein mit Varistor Rectifier modul with varistor	für Wandlerstromauslöser 5A for 1.C.T.operated release 5A
-V5	Gleichrichterbaustein mit Varistor Rectifier modul with varistor	für elektrische Einschaltsperre for electrical Closing lock-out
-V6	Gleichrichterbaustein mit Varistor Rectifier modul with varistor	für Motor for motor
-X0	64 pol.Stecker / 64 pole plug	
-Y1	1. F- Auslöser / 1st shunt release	"Aus" / "Off"
-Y2	2. F- Auslöser / 2nd shunt release	"Aus" / "Off"
-Y4	1. Wandlerstromauslöser 1st CT-operated release	"Aus" "Off"
-Y6	Energiearmer Wandlerstromauslöser Low energy C.T.operated release	"Aus" "Off"
-Y7	Unterspannungsauslöser Undervoltage release	"Aus" "Off"
-Y9	Betätigungsmagnet / Closing solenoid Closing and anti pumping	"Ein" / "On"
-F1	Elektrische Einschaltsperre Electrical Closing lock-out	

Auslöserkombination / Release
F = Arbeitsstromauslöser / shunt release
R=Unterspannungsauslöser / Undervoltage release
E= Energiearmer Wandlerstromauslöser / Low energy C.T.operated release
W=Wandlerstromauslöser / C.T.operated release

Auslöserkombination Release combination	F	2F	F,W	F,R	F,E

Allgemeine Angaben:
General datas:

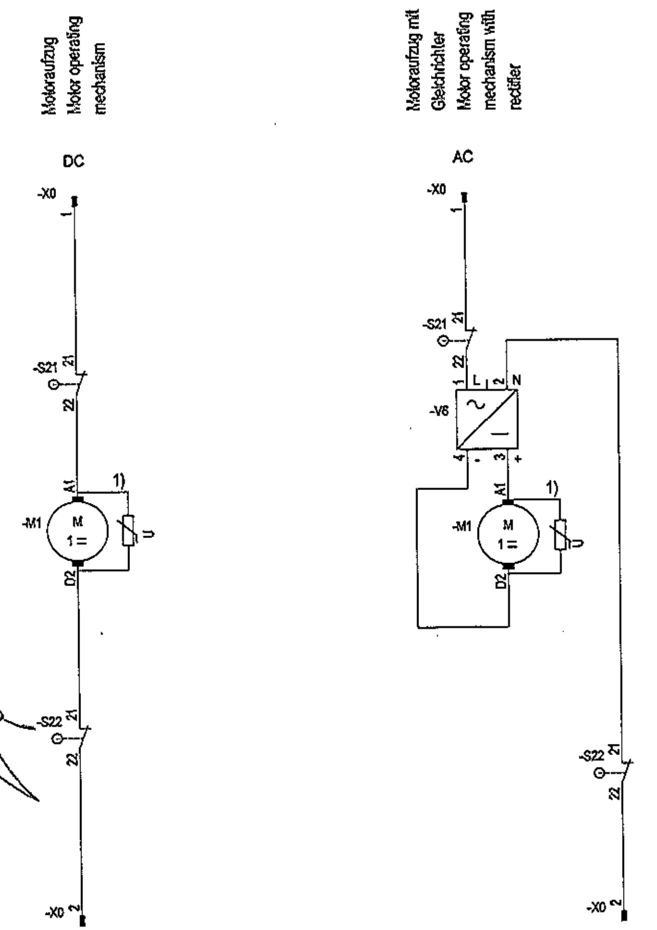
1. Geräteliste: (3) S 447 24 400 002
   Device list: (3) S 447 24 400 002

0A		20.04.12	Bro	Datum	26.04.2011	Lageplan Layout
0B		24.05.12	Bro	Bearb.	Bronsch	
0C		12.09.12	Bro	Gepr.		
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connector
24 pol.Klemme / 24 pole terminal strip

=KZ01
S +
I ME1
3S_S_A7E_449_99004_002--0C



S_A7E_449_33001_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33001_201
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33002_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33002_201
mit 24 pol.Klemme / with 24 pole terminal strip

Angaben mit Bezug:
1) Integrierter Varistor für DC>=60V
Integrated varistor for voltages DC>=60V

Alle nicht bezeichnolon Leitungen DIN 47727-H07V-K1x1.5sw

0A		20.04.12	Bro	Datum	26.04.2011	Motoraufzug Motor charging	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole plug connector 24 pol.Klemme / 24 pole terminal strip Stromlaufplan		=KZ01 S +	M6
0B		24.05.12	Bro	Bearb.	Bronsch						Blatt 6+
0C		12.09.12	Hähne	Gepr.					I ME1	3S_S_A7E_449_99004_002–0C	19 Bl.
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.					

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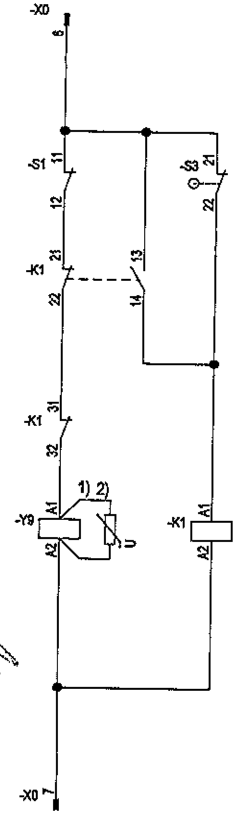
449_99004_002

000376

Einschaltung und Pumpverhinderung
Closing and anti pumping device



mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_531
Zusatz S98 / Order code S98

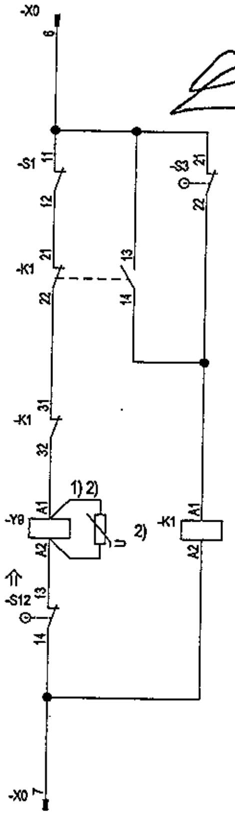
S_A7E_449_33011_531

mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_581
Zusatz S98 / Order code S98

S_A7E_449_33011_581

Einschaltung und Pumpverhinderung mit mechanischer Verriegelung
Closing and anti pumping with mechanical interlocking



mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_532
Zusatz S98 / Order code S98

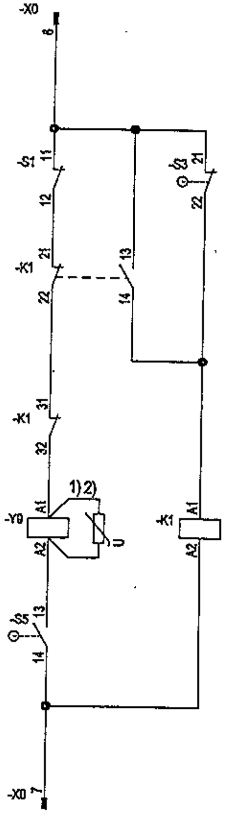
S_A7E_449_33011_532

mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_582
Zusatz S98 / Order code S98

S_A7E_449_33011_582

Einschaltung und Pumpverhinderung mit Einschaltsperre
Closing and anti pumping with electrical closing lock-out



mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_533
Zusatz S98 / Order code S98

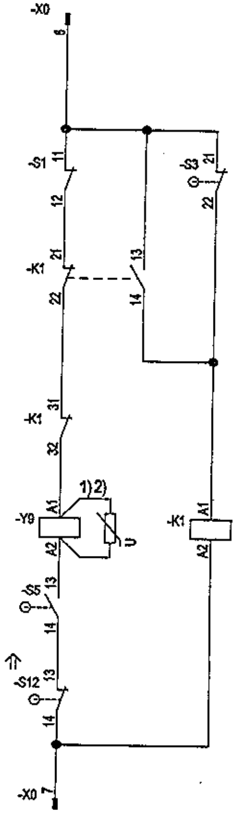
S_A7E_449_33011_533

mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_583
Zusatz S98 / Order code S98

S_A7E_449_33011_583

Einschaltung und Pumpverhinderung mit mechanischer Verriegelung mit Einschaltsperre
Closing and anti pumping with mechanical interlocking and electrical closing lock out



mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_534
Zusatz S98 / Order code S98

S_A7E_449_33011_534

mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö Auxiliary switch 6NO/6NC

S_A7E_449_33010_584
Zusatz S98 / Order code S98

S_A7E_449_33011_584

Angaben mit Bezug/Footnotes:
1) Integrierter Varistor für DC>=60V
Integrated varistor for voltages DC>=60V
2) Integrierter Gleichrichter für AC/DC>=100V
Integrated rectifier for voltages AC/DC>=100V

0A		20.04.12	Bro	Datum	26.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C		12.09.12	Hähne	Gepr.	
Zustand	Änderung	Datum	Name	Norm	

Einschaltung und Pumpverhinderung
Closing and anti pumping
Urspr./Ers.f./Ers.d.

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connector
24 pol.Klemme / 24 pole terminal strip

I ME1

3S_S_A7E_449_99004_002–0C

=KZ01
S +
M7
Blatt 7+
19 Bl.

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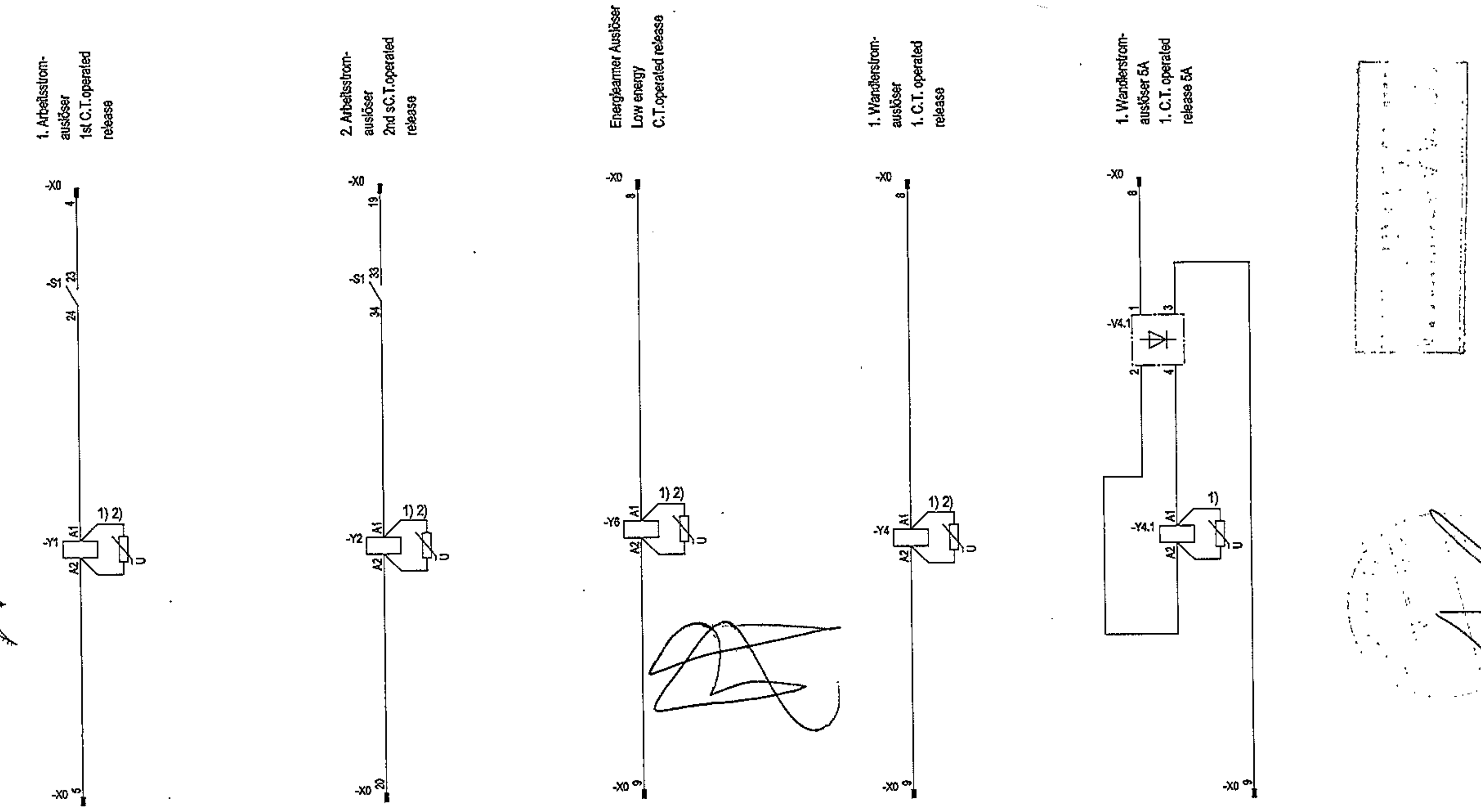
449_99004_002

000377



S_A7E_449_33020_101
mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

S_A7E_449_33020_201
mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

S_A7E_449_33021_101
mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

S_A7E_449_33021_201
mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

S_A7E_449_33023_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33023_201
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33024_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33024_201
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33024_102 ·
mit 24 pol.Stecker / with 24 pole plug connector
Zusatz / Order code A49

S_A7E_449_33024_202
mit 24 pol.Klemme / with 24 pole terminal strip
Zusatz / Order code A49

Angaben mit Bezug/Footnotes:
1) Integrierter Varistor für DC>=60V
Integrated varistor for voltages DC>=60V
2) Integrierter Gleichrichter für AC/DC>=100V
Integrated rectifier for voltages AC/DC>=100V

000378

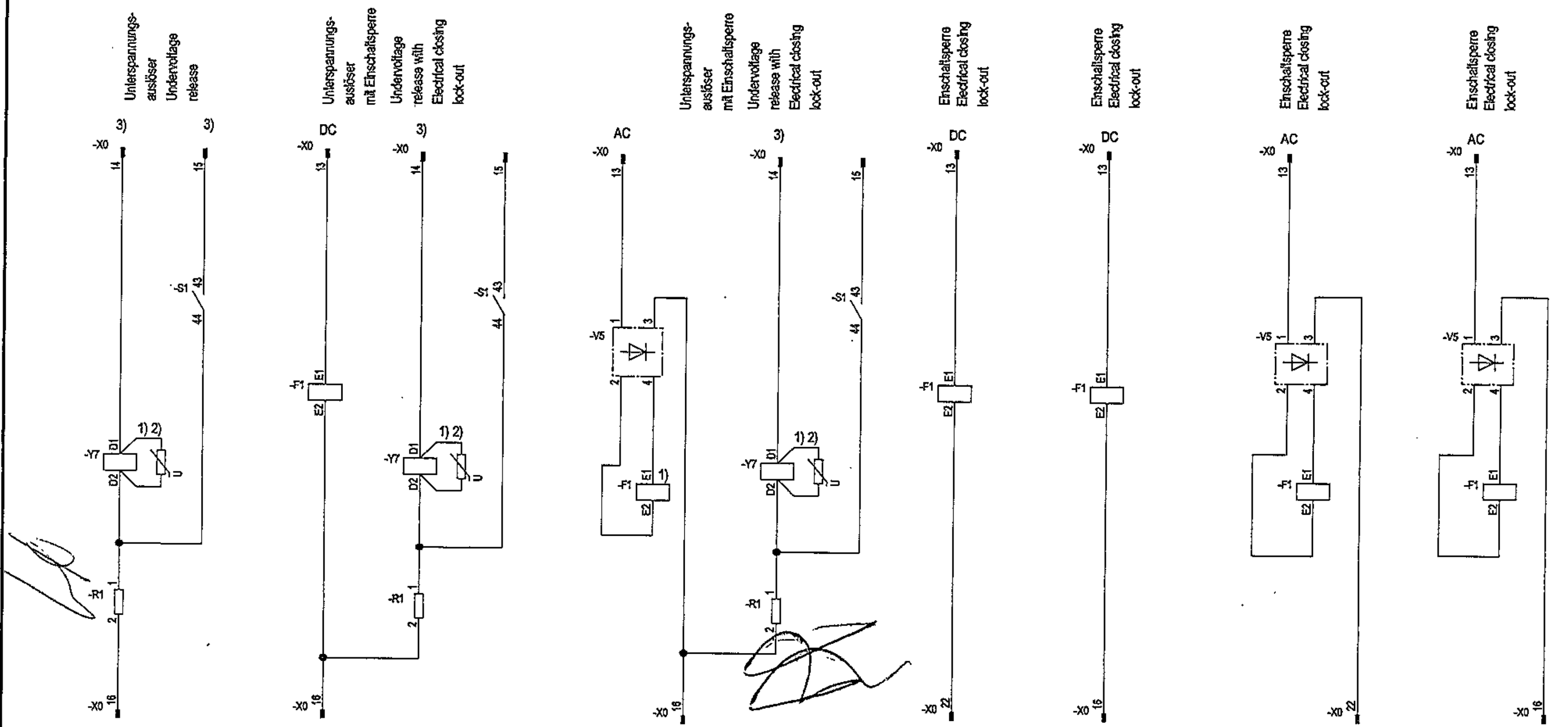
FB_D, 01.08.97

449_99004_002

0A		20.04.12	Bro	Datum	26.04.2011	Auslöser Releases	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole plug connector 24 pol.Klemme / 24 pole terminal strip		=KZ01 S +	M8
0B		24.05.12	Bro	Bearb.	Bronsch						Blatt 8+
0C	s. Blatt 19	12.09.12	Hähn.	Gepr.					I ME1	3S_S_A7E_449_99004_002–0C	19 Bl.
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.					

Archiv: =KZ01 / S / M / 9 /

F8_0_01.08.97



S_A7E_449_33026_101
mit 24 pol. Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

S_A7E_449_33026_201
mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC

S_A7E_449_33026_102
mit 24 pol. Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
Zusatz / Order code A48

S_A7E_449_33026_202
mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
Zusatz / Order code A48

S_A7E_449_33026_103
mit 24 pol.Stecker / with 24 pole plug connector
Hilfsschalter 6S/6Ö / Auxiliary switch 6NMO/6NC
Zusatz / Order code A48

S_A7E_449_33026_203
mit 24 pol.Klemme / with 24 pole terminal strip
Hilfsschalter 6S/6Ö / Auxiliary switch 6NO/6NC
Zusatz / Order code A48

S_A7E_449_33030_101
mit 24 pol.Stecker /
with 24 pole plug connector
Zusatz / Order code A47

S_A7E_449_33030_201
mit 24 pol.Klemme /
with 24 pole terminal strip
Zusatz / Order codes A47

S_A7E_449_33030_102
mit 24 pol.Stecker /
with 24 pole plug connector
Zusatz / Order code A47

S_A7E_449_33030_202
mit 24 pol.Klemme /
with 24 pole terminal strip
Zusatz / Order codes A47

S_A7E_449_33030_103
mit 24 pol.Stecker /
with 24 pole plug connector
Zusatz / Order codes A47

S_A7E_449_33030_203
mit 24 pol.Klemme /
with 24 pole terminal strip
Zusatz / Order codes A47

S_A7E_449_33030_104
mit 24 pol.Stecker /
with 24 pole plug connector
Zusatz / Order codes A47

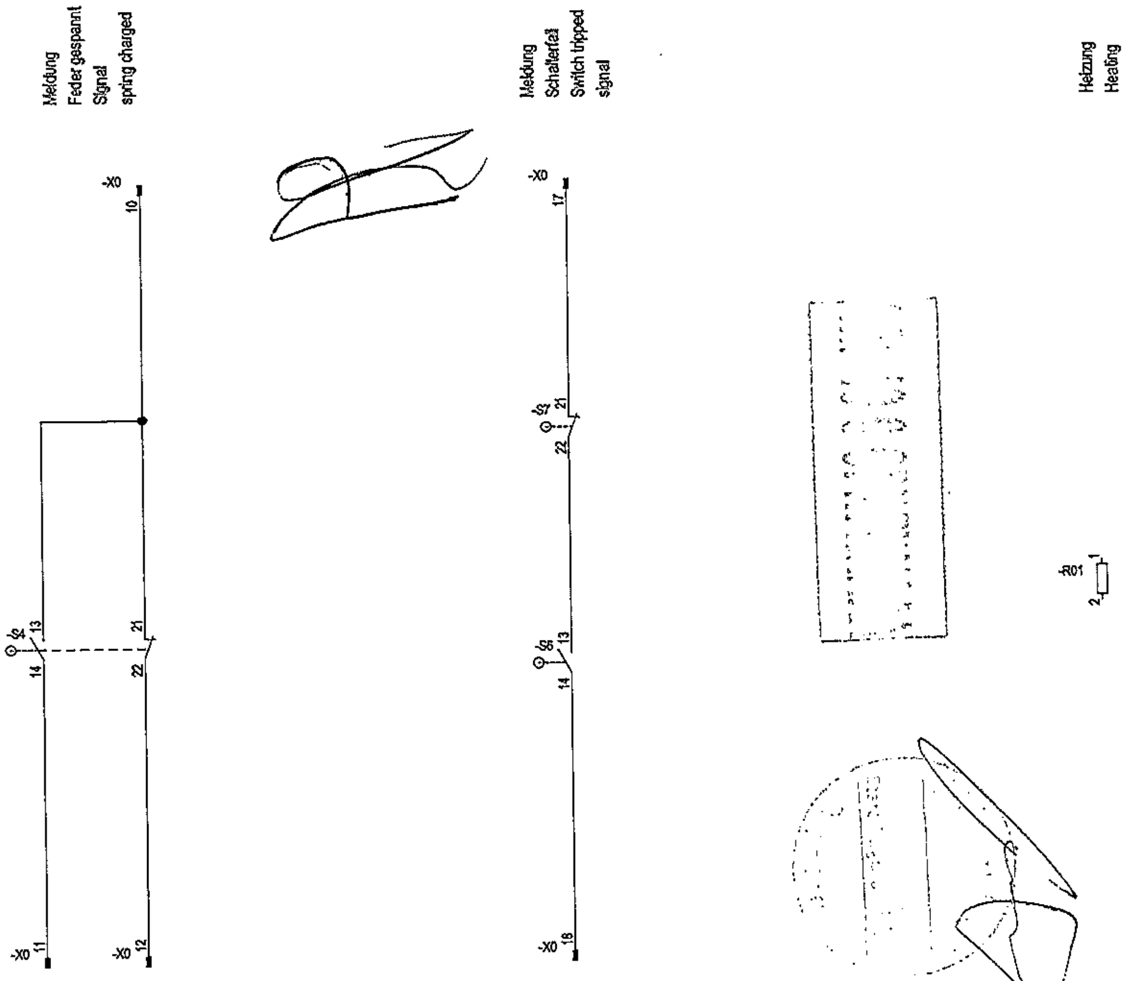
S_A7E_449_33030_204
mit 24 pol.Klemme /
with 24 pole terminal strip
Zusatz / Order codes A47

Angaben mit Bezug/Footnotes:
1) Integrierter Varistor für DC>=60V
Integrated varistor for voltages DC>=60V
2) Integrierter Gleichrichter für AC/DC>=100V
Integrated rectifier for voltages AC/DC>=100V
3) Achtung:Bei DC L+ anschliessen
Attention:For DC connect L+

000379

449_99004_002

0A		20.04.12	Bro	Datum	26.04.2011	Auslöser Releases	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole plug breaker 24 pol.Klemme / 24 pole terminal strip		=KZ01
0B		24.05.12	Bro	Bearb.	Bronsch				S	+
0C		12.09.12	Hähn.	Gepr.						M9
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.			I ME1	3S_S_A7E_449_99004_002–0C	Blatt 9+ 19 Bl.



S_A7E_449_33042_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33042_201
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33043_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33043_201
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33050_101
Zusatz / Order code A30
ohne 24 pol.Stecker / without 24 pole plug connector
ohne 24 pol.Klemme / without 24 pole terminal strip

0A		20.04.12	Bro	Datum	26.04.2011	Meldungen / Helzung Signal /Heating	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole plug connector 24 pol. Klemme / 24 pole terminal strip		=KZ01 S | +	M10
0B		24.05.12	Bro	Bearb.	Bronsch						Blatt 10+
0C		12.09.12	Hähnel	Gepr.					I ME1	3S_S_A7E_449_99004_002–0C	19 Bl.
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.					

Arch.Nr. =KZ01 / S / M / 10 /

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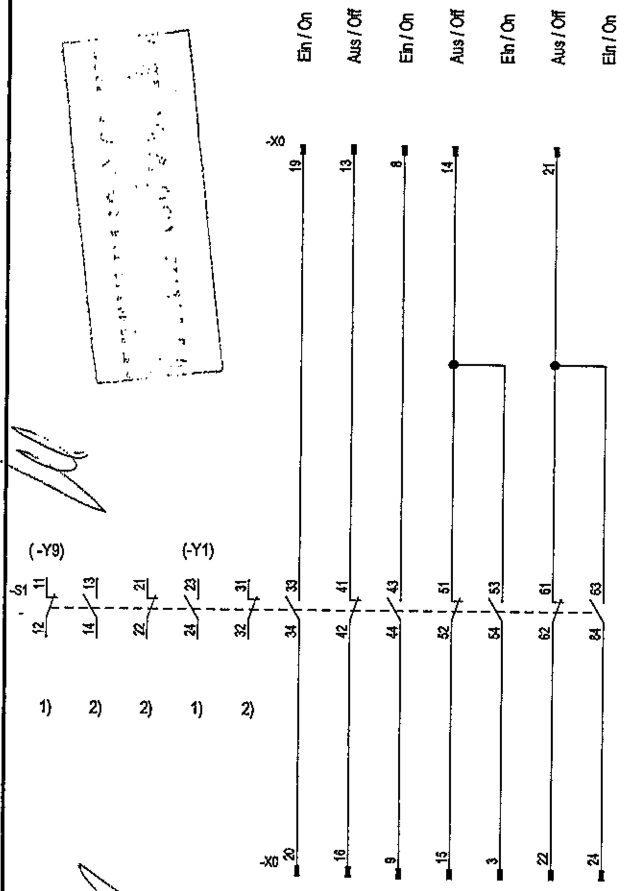
449_99004_002

FB_D_01.08.97

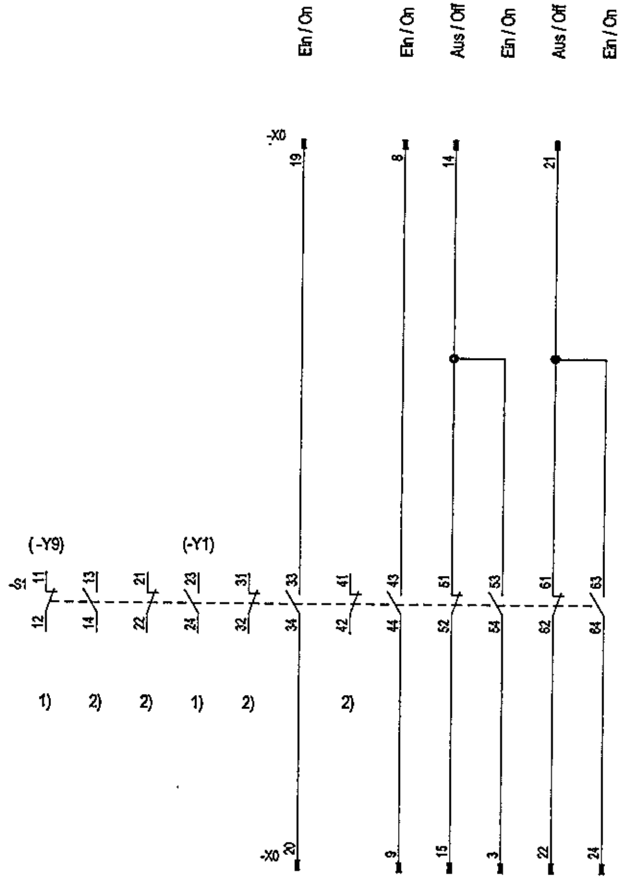
449_99004_002

000381



S_A7E_449_33061_102
mit 24 pol.Stecker / with 24 pole plug connector

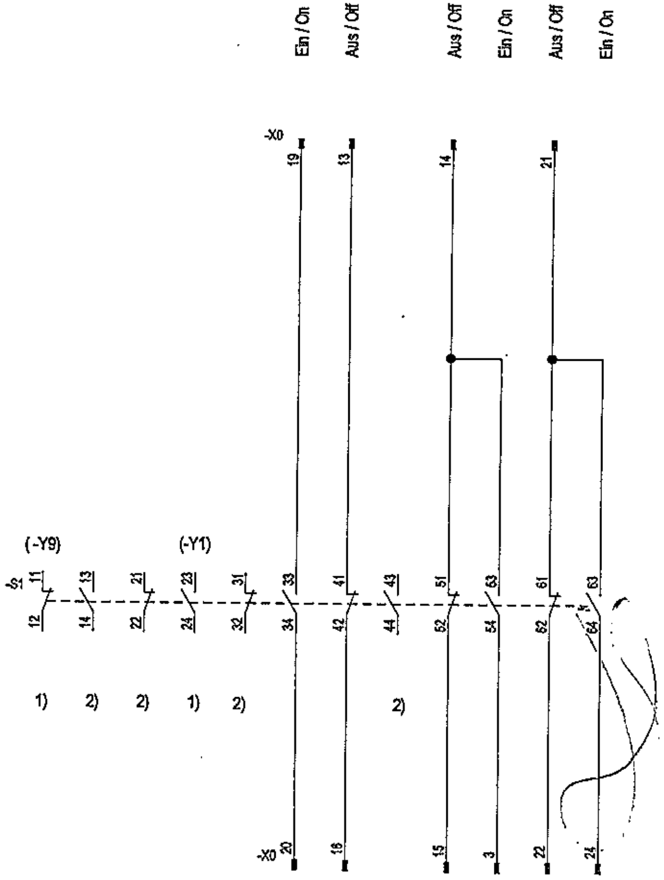
S_A7E_449_33061_202
mit 24 pol.Klemme / with 24 pole terminal strip



für Einschaltsperre / for Electrical closing lock-out

S_A7E_449_33061_101
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_201
mit 24 pol.Klemme / with 24 pole terminal strip



für Wandlerstromauslöser / for c.t. operated release

S_A7E_449_33061_127
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_227
mit 24 pol.Klemme / with 24 pole terminal strip

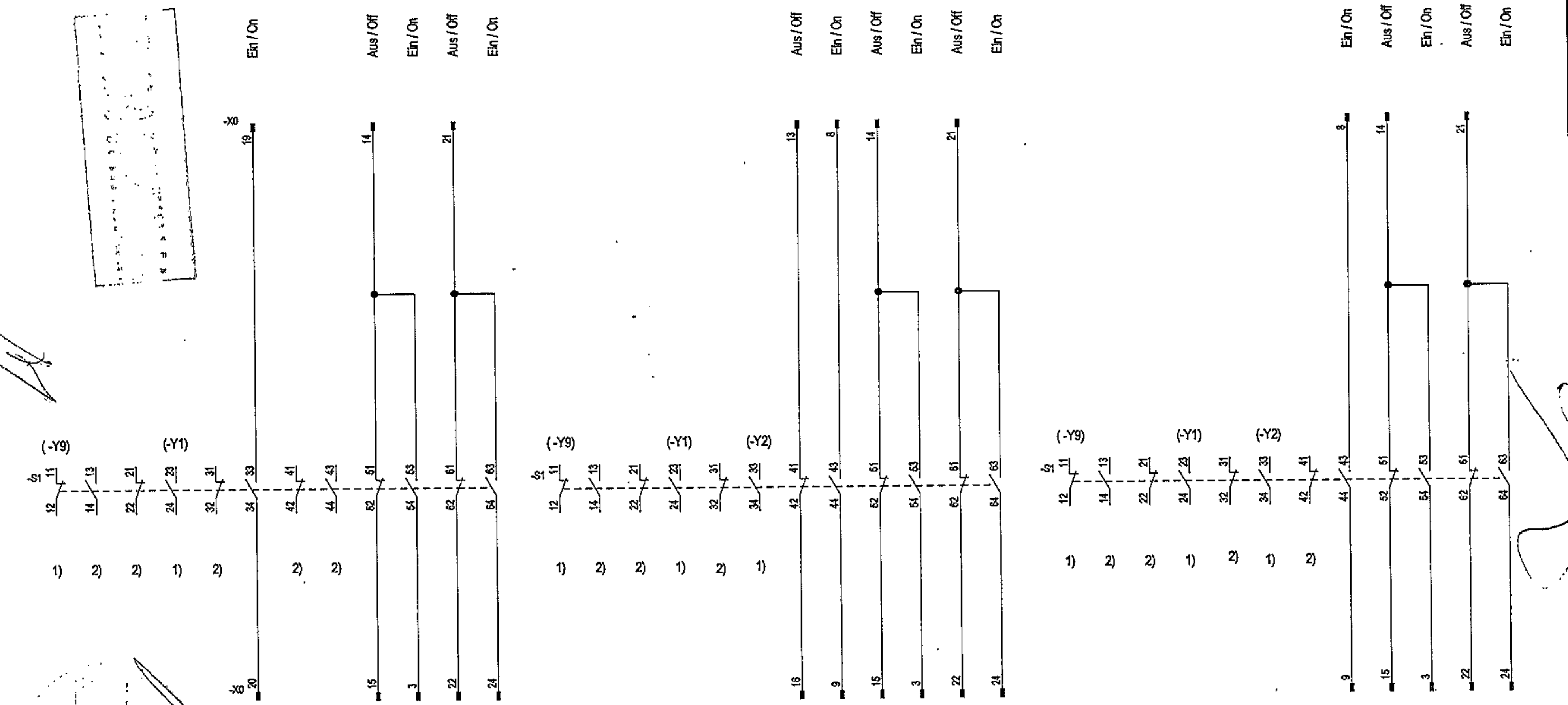
Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

0A		20.04.12	Bro	Datum	26.04.2011	Hilfsschalter 6S/6O
0B		24.05.12	Bro	Bearb.	Bronsch	Auxiliary switch 6NO/6NC
0C		12.09.12	Hähne	Gepr.		
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connector
24 pol.Klemme / 24 pole terminal strip

=KZ01
S +
M11
I ME1
3S_S_A7E_449_99004_002–0C
Blatt 11+
19 Bl.



für Einschaltsperre und Wandlerstromauslöser
for Electrical closing lock-out and c.t. operated release

S_A7E_449_33061_103
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_203
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33061_107
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_207
mit 24 pol.Klemme / with 24 pole terminal strip

für Einschaltsperre / for Electrical closing lock-out

S_A7E_449_33061_106
mit 24 pol.Stecker / with 24 pole plug connector

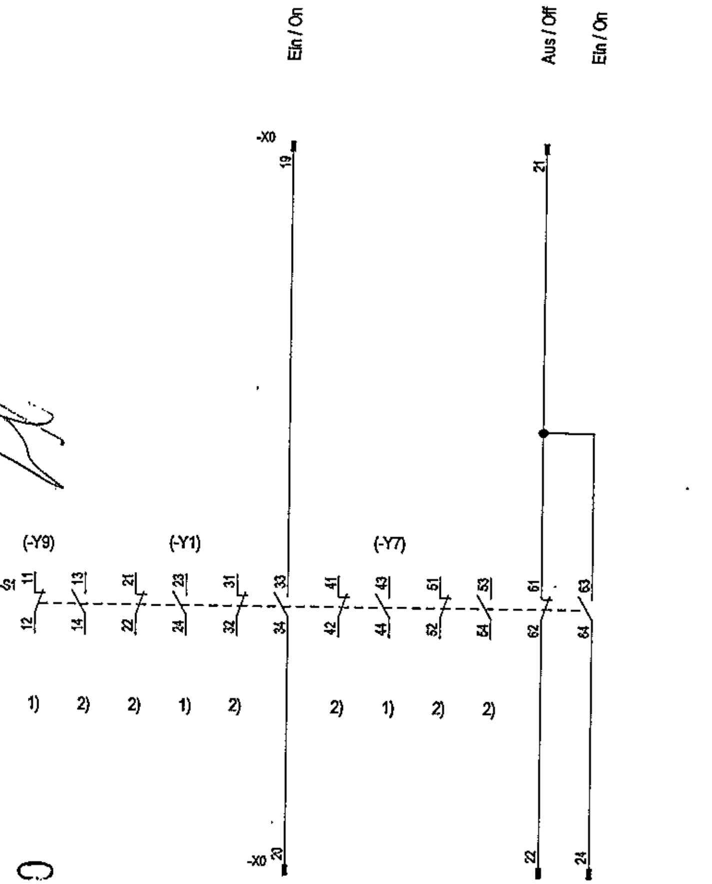
S_A7E_449_33061_206
mit 24 pol.Klemme / with 24 pole terminal strip

Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

0A		20.04.12	Bro	Datum	26.04.2011	Hilfsschalter 6S/6O Auxiliary switch 6NO/6NC	SIEMENS	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole plug connector 24 pol.Klemme / 24 pole terminal strip	=KZ01 S + M12
0B		24.05.12	Bro	Bearb.	Bronsch				Blatt 12+
0C	s. Blatt 19	12.09.12	Hähne	Gepr.				I ME1	3S_S_A7E_449_99004_002-0C
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.			19 Bl.

FB_D_01.08.97

449_99004_002



000383

mit / ohne Einschaltsperre / with / without Electrical closing lock-out

S_A7E_449_33061_108
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_208
mit 24 pol.Klemme / with 24 pole terminal strip

Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

0A		20.04.12	Bro	Datum	26.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C		12.09.12	Hähn.	Gepr.	
Zustand	Änderung	Datum	Name	Norm	

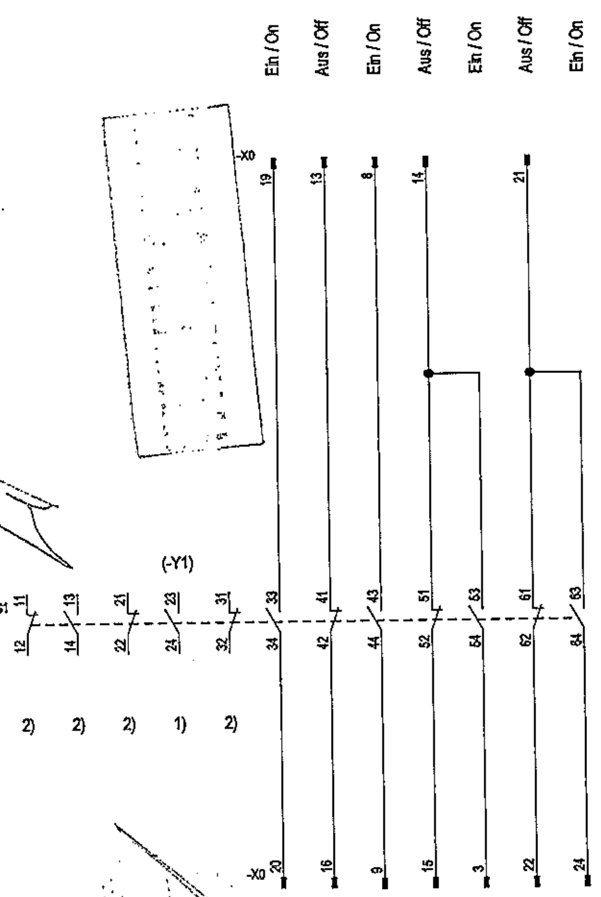
Hilfsschalter 6S/6Ö
Auxiliary switch 6NO/6NC

Urspr./Ers.f./Ers.d.

SIEMENS

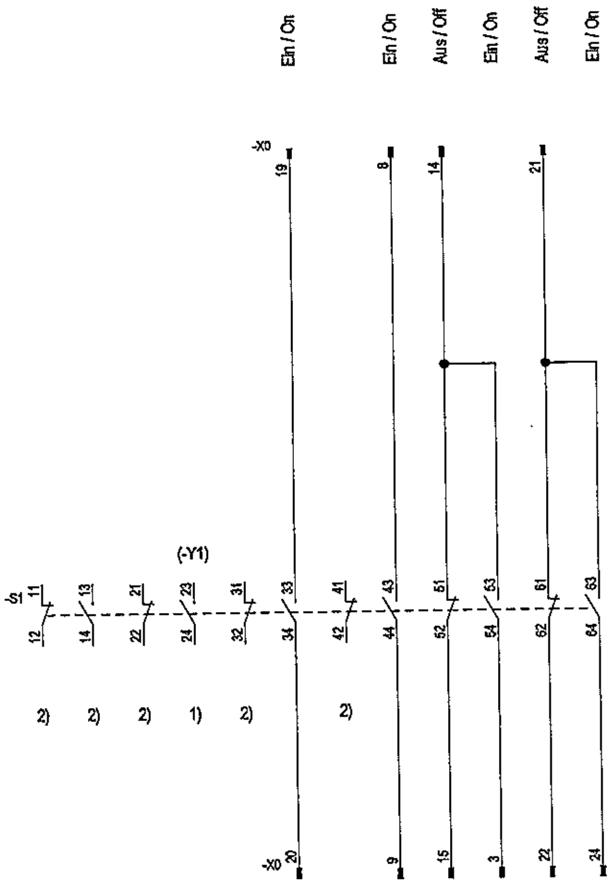
3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connector
24 pol.Klemme / 24 pole terminal strip

=KZ01
S +
M13
I ME1
3S_S_A7E_449_99004_002–0C
Blatt 13+
19 Bl.



S_A7E_449_33061_117
mit 24 pol.Stecker / with 24 pole plug connector

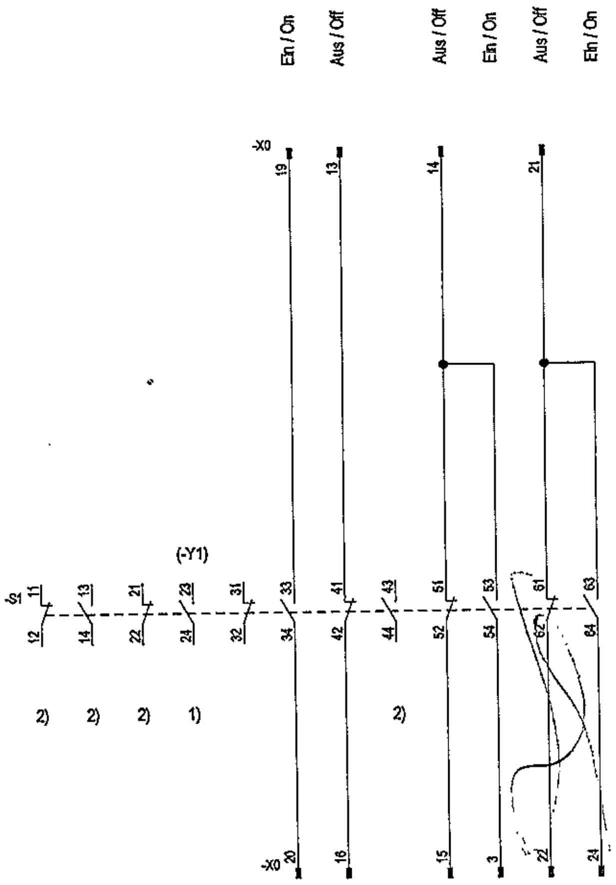
S_A7E_449_33061_217
mit 24 pol.Klemme / with 24 pole terminal strip



für Einschaltsperre / for Eletrical closing lock-out

S_A7E_449_33061_120
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_220
mit 24 pol.Klemme / with 24 pole terminal strip



für Wandlerstromauslöser / for c.t. operated release

S_A7E_449_33061_118
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_218
mit 24 pol.Klemme / with 24 pole terminal strip

Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

Alle nicht bezeichneten Leitungen

Zustand	Änderung	Datum	Name	Norm
0A		20.04.12	Bro	
0B		24.05.12	Bro	
0C		12.09.12	Hähn.	

Datum 26.04.2011
Bearb. Bronsch
Gepr.

Hilfsschalter 6S/6Ö
Auxiliary switch 6NO/6NC

Urspr./Ers.f./Ers.d.

Siemens AG

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker/ 24 pole plug connector
24 pol.Klemme/ 24 pole terminal strip
Stromlaufplan

I ME1

3S_S:A7E_449_99004_002–0C

=KZ01
S +

M14
Blatt 14+
19 Bl.

Archiv: =KZ01 / S / M / 14 /

F8_D_01.08.97

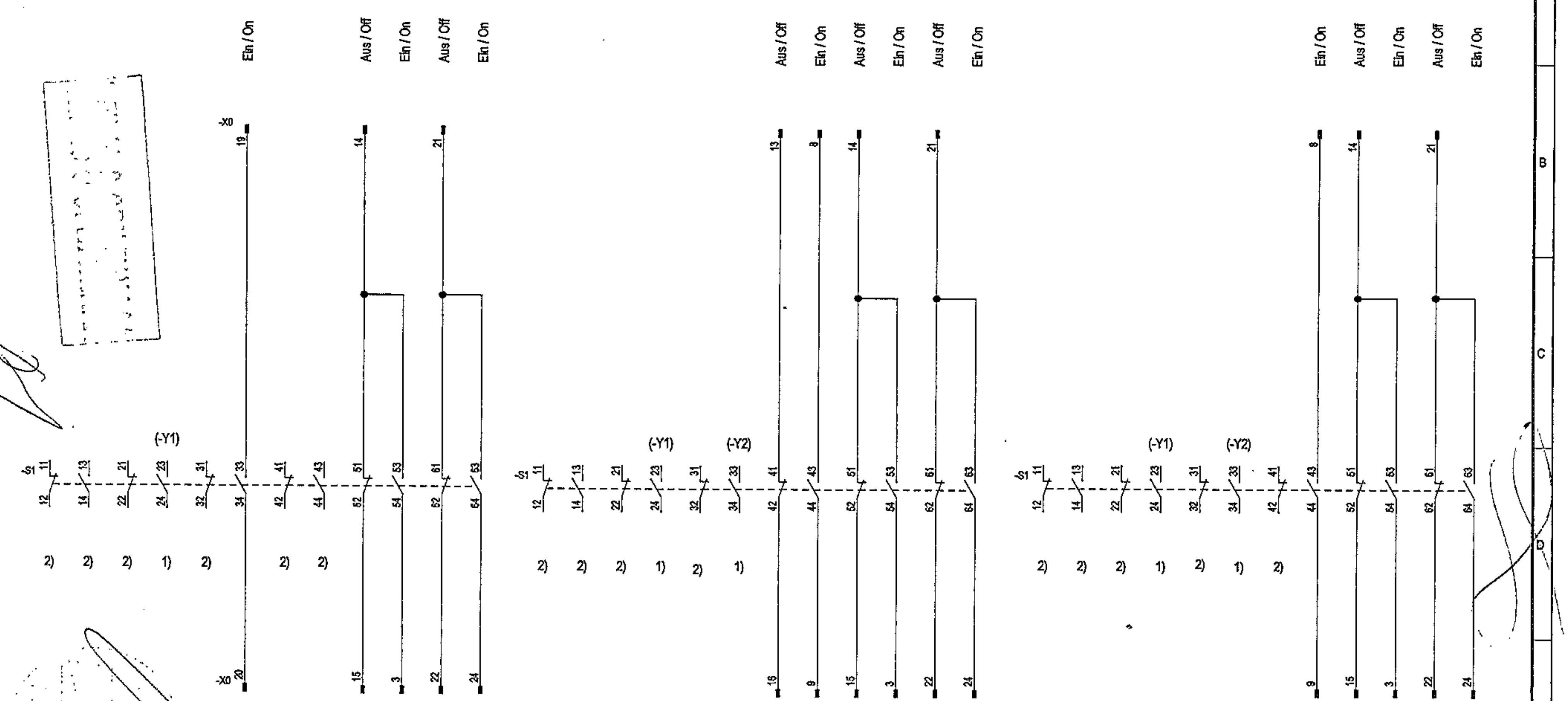
449_99004_002

000384

FB_0_01.08.97

449_99004_002

000385



für Einschaltsperre und Wandlerstromauslöser
for Electrical Closing lock-out and c.t. operated release

S_A7E_449_33061_121
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_221
mit 24 pol.Klemme / with 24 pole terminal strip

S_A7E_449_33061_124
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_224
mit 24 pol.Klemme / with 24 pole terminal strip

für Einschaltsperre / for Eletrical closing lock-out

S_A7E_449_33061_123
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_223
mit 24 pol.Klemme / with 24 pole terminal strip

Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

Alle nicht bezeichneten Leitungen

0A		20.04.12	Bro	Datum	16.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C	s. Blatt 19	12.09.12	Hähn.	Gepr.	
Zustand	Änderung	Datum	Name	Norm	

Hilfsschalter 6S/6Ö
Auxiliary switch 6NO/6NC
Urspr./Ers.f./Ers.d.

Siemens AG

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker/ 24pole plug connector
24 pol.Klemme/ 24 pole terminal strip
Stromlaufplan

I ME1

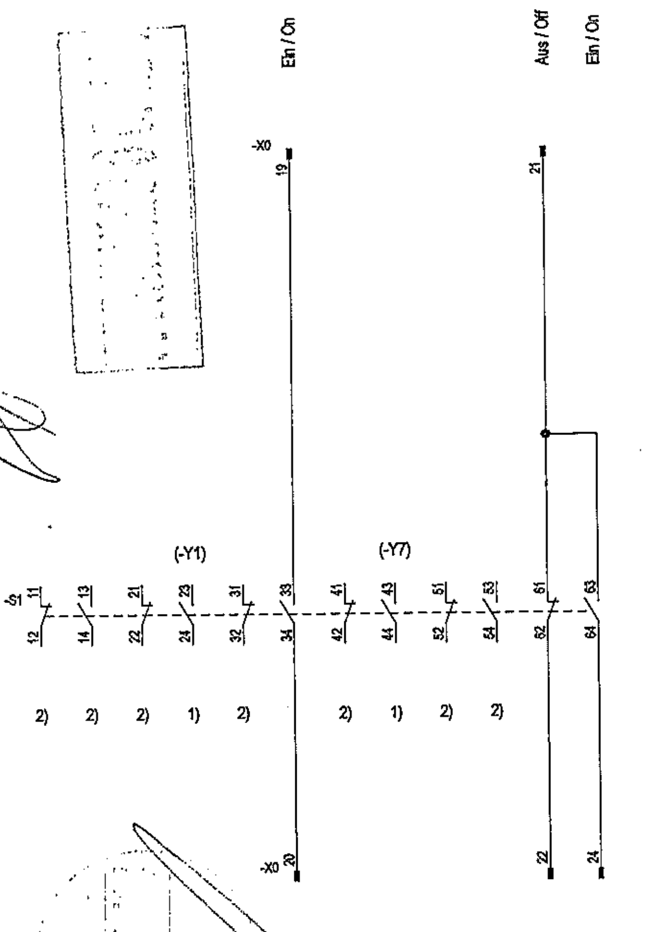
3S_S_A7E_449_99004_002_--0C

	=KZ01	
S	+	M15
		Blatt 15+
		19 Bl.

Arch.Nr.:=KZ01 / S / M / 16 /

FB_0_01.08.97

449_99004_002



mit / ohne Einschaltsperre / with / without Eletrical closing lock-out

S_A7E_449_33061_125
mit 24 pol.Stecker / with 24 pole plug connector

S_A7E_449_33061_225
mit 24 pol.Klemme / with 24 pole terminal strip
für Einschaltsperre / for eletrical Closing lock-out

Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

Alle nicht bezeichneten Leitungen

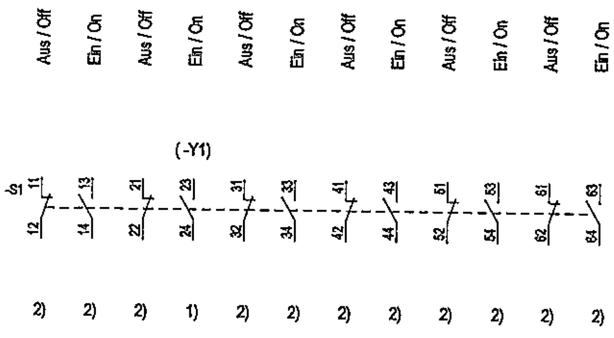
0A		20.04.12	Bro	Datum	26.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C		12.09.12	Hähn.	Gepr.	
Zustand	Änderung	Datum	Name	Norm	

Hilfsschalter 6S/6Ö
Auxillary switch 6NO/6NC
Urspr./Ers.f./Ers.d.

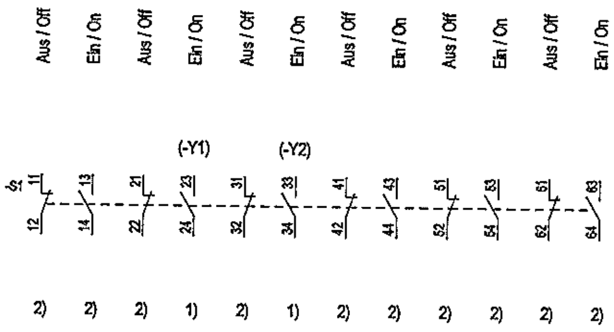
Siemens AG

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker/ 24 pole plug connector
24 pol.Klemme/ 24 pole terminal strip
Stromlaufplan

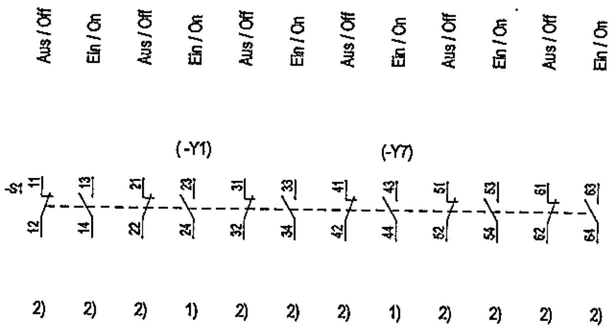
=KZ01
S +
I ME1
3S_S_A7E_449_99004_002–0C
M16
Blatt 16+
19 Bl.



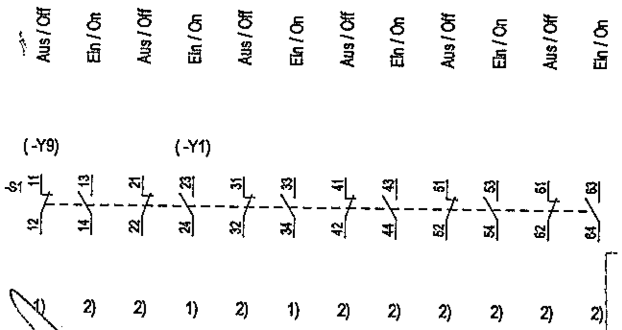
S_A7E_449_33061_113
mit 24 pol.Stecker / with 24 pole plug connector
S_A7E_449_33061_213
mit 24 pol.Klemme / with 24 pole terminal strip



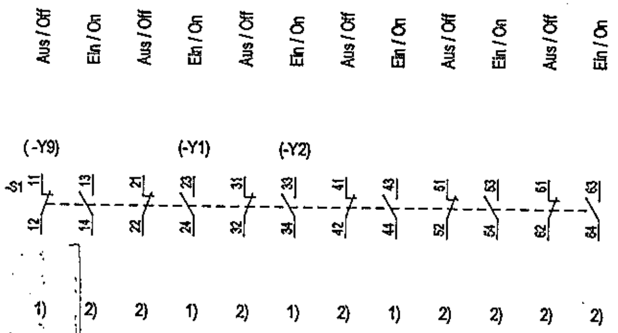
S_A7E_449_33061_114
mit 24 pol.Stecker / with 24 pole plug connector
S_A7E_449_33061_214
mit 24 pol.Klemme / with 24 pole terminal strip



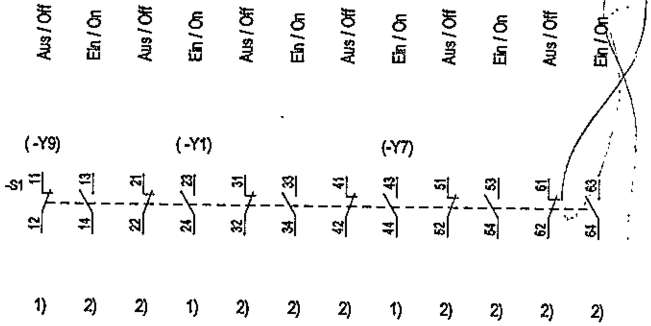
S_A7E_449_33061_112
mit 24 pol.Stecker / with 24 pole plug connector
S_A7E_449_33061_212
mit 24 pol.Klemme / with 24 pole terminal strip



S_A7E_449_33061_116
mit 24 pol.Stecker / with 24 pole plug connector
S_A7E_449_33061_216
mit 24 pol.Klemme / with 24 pole terminal strip



S_A7E_449_33061_115
mit 24 pol.Stecker / with 24 pole plug connector
S_A7E_449_33061_215
mit 24 pol.Klemme / with 24 pole terminal strip



S_A7E_449_33061_110
mit 24 pol.Stecker / with 24 pole plug connector
S_A7E_449_33061_210
mit 24 pol.Klemme / with 24 pole terminal strip

Angaben mit Bezug / Footnotes:
1) Intern verdrahtet / Intern wired
2) Nicht verdrahtet / Not wired

0A		20.04.12	Bro	Datum	26.04.2011	Hilfsschalter 6S/6O Auxiliary switch 6NO/6NC	
0B		24.05.12	Bro	Bearb.	Bronsch		
0C		12.09.12	Hähn.	Gepr.			
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.	

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connector
24 pol.Klemme / 24 pole terminal strip

	S	=KZ01	
		+	M17
I ME1	3S_S_A7E_449_99004_002–0C		Blatt 17+ 19 Bl.

Anschlussleiste/ Terminal strip	Stecker-Nr./ Connector No.	Ziel/ Destination Kennzeich.-Anschlussbez./ Designation-Connection No
-X0	1	-S21:21
	2	-S22:22
	3	-S1:54
	4	-S1:23 (Y1)
	5	-Y1:A2
	6	-S1:11 (-Y9)
	7	-K1:A2 (-Y9)
	8	-Y4/-Y6:A1 / -S1:43 / -V4.1:1
	9	-Y4/-Y6:A2 / -S1:44 / -V4.1:3
	10	-S4:21
	11	-S4:14
	12	-S4:22
	13	-F1:E1 / -V5:1 / -S1:41
	14	-Y7:D1 / -S1:51
	15	-S1:43 (Y7) / -S1:52
	16	-R1:2 (Y7) / -F01:E2 / -S1:42
	17	-S7:13
	18	-S6:22
	19	-S1:33 (Y2) / -S1:33
	20	-Y2:A2 / -S1:34
	21	-Y6:A1 / -S1:61
	22	-V5:3 / -S1:62
	23	-S1:63
	24	-S1:64
	⏚	

FB_D, 01.03.97

449_99004_002

000388

0A		20.04.12	Bro	Datum	26.04.2011
0B		24.05.12	Bro	Bearb.	Bronsch
0C		12.09.12	Hähn.	Gepr.	
Zustand	Änderung	Datum	Name	Norm	

Anschlussplan
Terminal connection diagram

Urspr./Ers.f./Ers.d.

SIEMENS

3AH5 Leistungsschalter/Circuit breaker
24 pol.Stecker / 24 pole plug connector
24 pol.Klemme / 24 pole terminal strip

=KZ01
S +

1 ME1

3S_S_A7E_449_99004_002-0C

M18
Blatt 18+
19 Bl.

Indexerläuterungen/ index indication	0B) 24.05.2012	Erstfreigabe / First release
	0C) 12.09.2012	Blatt 3,4: div. Makro-Nummer korrigiert / severel no. of macro corrected: (449 27... in 449 33...) Blatt 12: Verdrahtung -S1:31/32 bei Makro 449 33061 106/107/206/207 gelöscht Blatt 15: Verdrahtung -S1:31/32 bei Makro 449 33061 124/123/224/223 gelöscht Blatt 19: hinzu. Alle Blätter erhalten Index "0C"/added. All pages get index"0C"

000389

0A		20.04.12	Bro	Datum	26.04.2011	Indexerläuterung Index indication	**SIEMENS**	3AH5 Leistungsschalter/Circuit breaker 24 pol.Stecker / 24 pole plug connector 24 pol.Klemme / 24 pole terminal strip	=KZ01 S + M19
0B		24.05.12	Bro	Bearb.	Bronsch				
0C	s. Blatt 19	12.09.12	Hähn.	Gepr.				I ME1	Blatt 19-
Zustand	Änderung	Datum	Name	Norm		Urspr./Ers.f./Ers.d.		3S_S_A7E_449_99004_002-0C	19 Bl.

SIEMENS

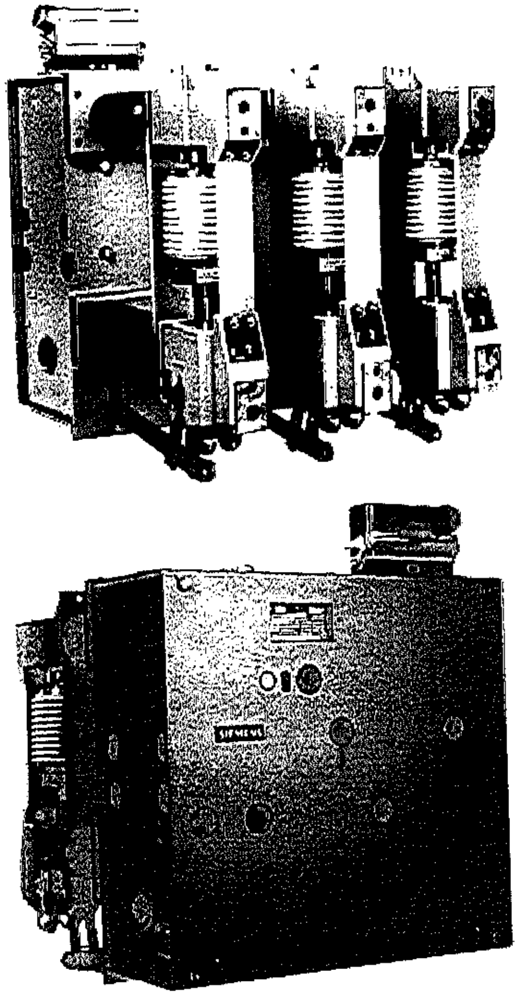
Вакуумен мощностен прекъсвач 3AH51 ... 54

12 kV до 36 kV

Vacuum Circuit-Breaker 3AH51 ... 54

12 kV to 36 kV

Инструкции за експлоатация/Operating Instructions Кат.-Nr./Order-No.: 3ZX1812-0AH50-0AN0/9229 9665 174



Кат.-Nr./Order No.: 3ZX1812-0AH50-0AN0 / 9229 9665 174
Място за поръчка/Place of order: EV GW P1 Log Berlin
Printed in the Federal Republic of Germany
AG 11.07 Kb De-En

Съдържание

Когато поръчвате инструкциите за експлоатация цитирайте Nr. 3ZX1812-0AH50-0AN0 / 9229 9665 174 .

Contents

When ordering the Operating Instructions please quote the Order No. 3ZX1812-0AH50-0AN0 / 9229 9665 174.

⚠ ПРЕДУПРЕЖДЕНИЕ

Това оборудване съдържа опасни напрежения и механични части, които се движат с висока скорост и могат да бъдат управлявани дистанционно.

Несъобразяването с инструкциите за безопасност може да причини тежки увреждания на хората или повреда на имущество.

Само квалифициран персонал трябва да работи на или около това оборудване след подробно запознаване със всички предупреждения, бележки по безопасността и процедури по поддръжката, съдържащи се в този документ.

Успешното и безопасно действие на това оборудване зависи от подходящото съхранение, монтиране, действие и поддръжка.

⚠ WARNING

This equipment contains hazardous voltages and mechanical parts which move at high speed and may be controlled remotely.

Non-observance of the safety instructions can result in severe personal injury or property damage.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, and maintenance procedures contained herein.

The successful and safe operation of this equipment is dependent on proper handling, installation, operation and maintenance.

Внимание

В основния вариант и всички стандартно представени възможности за до-оборудване, мощностните вакуумни прекъсвачи 3AH5 са типово изпитани компоненти по условията на IEC.В случай, че някакви допълнителни устройства - напр. блокиращи елементи в механичната част - се монтират на прекъсвача в по-късен етап, трябва да се осигурят такива условия, че бързо-движещи се части да не бъдат натоварвани с допълнителни маси или усилия, както и подходящи разстояния между новомонтираните и наличните елементи - особено подвижните и тези под напрежение.

В случай, че клиентът реши да преустрои прекъсвача за допълнителни функции, ние препоръчваме първо да се консултира с нашата фабрика, където в повечето случаи се намират доказани и изпитани решения.

Attention

In their basic design and with all standard listed equipment options, 3AH5 V breakers are type-tested components in accordance with IEC.
If any attachments or installations, e.g. interlocking components in connection with switchgear, are made to the breakers at a later stage, it must be ensured that quickly moving parts are not loaded additionally by masses or forces and that any added parts have an adequate clearance particularly to moving and live parts.

If the customer intends to fit the breakers with additional functions, we recommend that he should first consult our factory as in most cases proven and tested solutions are already available.

Обща информация:

Вакуумните мощностни прекъсвачи на Siemens 3AH5 са триполюсен закрит вид за номинално напрежение между 12 и 36 kV.

Вакуумния мощностен прекъсвач се състои от корпус на механизма, комплектован с пружина и управляващи елементи, трите полюса с вакуумни прекъсвачи, изолатори, отляти от смола и работни пръти.

При нормални оперативни условия, вакуумният мощностен прекъсвач не се нуждае от поддръжка.

General :

Siemens 3AH5 vacuum circuit-breakers (V-breaker) are of the triple-pole indoor type for rated voltages between 12 and 36 kV.

The vacuum circuit-breaker consists of the mechanism housing complete with stored-energy spring mechanism and control elements, the three poles with vacuum interrupters, cast-resin insulators and operating rods.

Under normal operating conditions, the vacuum circuit-breaker is maintenance-free.

Технически данни

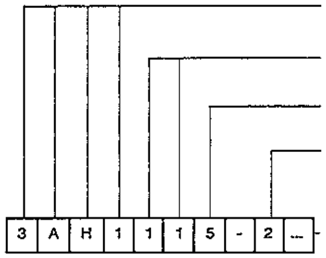
Обозначение за тип

Вакуумните прекъсвачи 3AH5 се идентифицират с код, който може да се чете от машина и който се състои от серии от цифри и букви, чийто първи 8 места могат да бъдат намерени на табелката с имената на мощностните прекъсвачи. Във връзка с кода на проекта, указан на табелката с имената, обозначението за тип осигурява пълно описание на мощностния прекъсвач. Фигурата по-долу показва какво означават отделните места на основния идентификационен код на продукта.

Technical data

Type designation

3AH5 vacuum circuit-breakers are identified by a machine-readable product designation made up of a series of figures and letters, whose first 8 places can be found on the name plate of the circuit-breakers. In connection with the design code stated on the name plate, the machine-readable product designation provides a full description of the circuit-breaker. The figure below shows what the individual places of the basic machine-readable product designation stand for:



Основен тип
Basic type

Код за номинално напрежение, код на проекта
Rated voltage code, design code

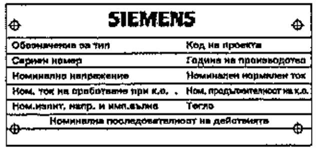
Код за номинален ток на прекъсване при късо съединение
Rated short circuit breaking current code

Код за номинален нормален ток
Rated normal current code

Вторично оборудване в съответствие с документите по доставката
Secondary equipment in acc. w. delivery documents

Табелка с номиналните данни

Табелката, която може да бъде прочетена в работно състояние, съдържа следната информация:



Фиг. 1/1
Табелка с номиналните данни

Rating plate

The rating plate which can be read in the operating position, contains the following information :

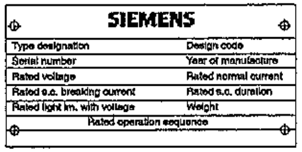


Fig. 1/1
Rating plate

Бележка! В случай на някакви въпроси посочете обозначението за тип, кода на проекта и серийния номер.

Note: In the event of any queries state the type designation, design code and the serial number.

Стандартни спецификации

Вакуумните мощностни прекъсвачи 3AH5 съответстват на стандартите IEC 56, IEC 694, BS 5311 и DIN VDE 0670.

Standard specifications

The 3AH5 vacuum circuit-breakers comply with the standards of IEC 56, IEC 694, BS 5311 and DIN VDE 0670.

Околна температура/влажност и товароносимост

Вакуумните прекъсвачи 3AH2 са проектирани за нормални условия на работа, посочени в стандартите. Допустимите околни температури са следните:

Максимална стойност	= +40 °C
Средна за период от 24 часа	= +35 °C
Минимална стойност	= - 5 °C

Допустима относителна влажност на въздуха:

Отн. влажност, средна за 24 часа	95%
Относителна влажност, средна за 1 месец	90%

При тези условия случайно може да се получи кондензация. Освен това, прекъсвачът е също подходящ за използване при следните климатични категории по IEC 721, Част3-3:

Климатични условия на околната среда:	Категория3K4¹
Биологични условия на околната среда:	Категория3B1
Механични условия на околната среда:	Категория3M2
Химически активни материали:	Категория3C2²
Механически активни материали:	Категория3S2³

Използването при условия, различни от нормалните е възможно с определени мерки, които могат да бъдат изпълнени по заявка. Обърнете се към вашият местен офис на Сименс за необходимите мерки.

Номиналните нормални токове, показани на Фиг.1/4 са определени за околна температура 40°C, в съответствие с DIN VDE/IEC. Температурата на околната среда за вакуумния мощностен прекъсвач е представена на фиг. 1/2. Посочените работни токове са приложими за открити разпределителни(превключвателни) уредби.За капсулованите уредби токовете се намаляват по указание на производителя превключвателните уредби.

Ambient temperature/humidity and loadability

The 3AH5 V-breakors are designed for the normal operating conditions laid down in the standards. Permissible ambient temperatures:

Maximum value	= +40 °C
Average over a period of 24 hours	= +35 °C
Minimum value	= - 5 °C

Permissible relative atmospheric humidity:

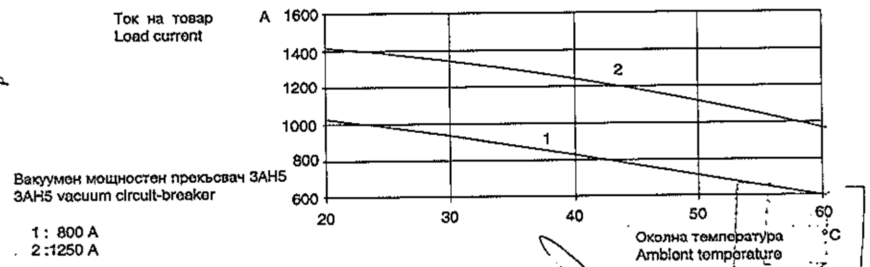
Maximum value, 24 hour mean	95%
Maximum value, 1 month mean	90%

Under these conditions condensation may occasionally occur. Furthermore, the breaker is also suitable for use in the following climatic categories per IEC 721, Part3-3:

Climatic environmental conditions:	Category 3K4¹
Biological environmental conditions:	Category 3B1
Mechanical environmental conditions:	Category 3M2
Chemically active materials:	Category 3C2²
Mechanically active materials:	Category 3C2³

Use of the breaker under conditions other than normal is possible when certain measures are implemented. Please ask your local Siemens office about the necessary measures.

The rated normal currents listed in Fig. 1/4 were laid down for an ambient temperature of 40°C in accordance with DIN VDE/IEC. V-breaker ambient temperature has been plotted in Fig. 1/2. The load currents indicated apply to open-type switchgear. Metal-enclosed switchgear must be derated as specified by the switchgear manufacturer.



Фиг 1/2 Максимален допустим работен ток като функция на околната температура на превключвателя.
Maximum permissible load current as a function of the switch ambient temperature

1 Долна температурна граница: -5°C
2 Без заледяване и влага, носена от вятъра
3 Предпоставка: чисти изолиращи части

1 Lower temerature limit: -5°C
2 Without ice formation and wind-driven precipitation
3 Prerequisite: clean insulating parts

Монтажна височина

Стойностите на номиналния изолиращ капацитет (номинално изпитателно напрежение с импулсна вълна, номинално изпитателно напрежение с промишлена честота за една минута) ¹) определени за оборудване Siemens са базирани, съгласно условията на VDE Стандарт 0111 и IEC Публикация 71, на стандартни атмосферни условия (19013 hPa, 20°C и 11 g/m³ водно съдържание), т.е. морско равнище. Изолиращият капацитет във въздух се намалява с увеличаване на височината поради разликите в плътността на въздуха. Стандартите, публикувани от DIN VDE, IEC и други не отчитат това намаление на изолиращия капацитет за височина от до 1000 метра, т.е. намаление от около 9% за тази височина е допустимо.

Стандартите не дават насоки за височини над 1000 метра по отношение на изолационните нива, те оставят това на споразумение между производителя и потребителя.

Нашите препоръки са както следва:Тъй като този метод, използван за оценяване на изолация до височини от 1000 метра е доказан за достатъчен, той също трябва да се използва и за по-големи височини. Следователно корекционният фактор за височина трябва с да се базира на изолиращия капацитет при 1000 метра, който е по-малък с 9% (съответстващо на 0,91 или $\frac{1}{1,1}$) спрямо капацитета на морското равнище.

Следният израз се прилага за избор на оборудване:

Номинално изпитателно напрежение, което се избира ²)

$$\geq \frac{\text{Необходимо изпитателно напрежение}^{2)}}{1{,}1 \cdot a}$$

Пример:

Височина на площадката над морското равнище . . . . 3000 m

Необходимо номинално импулсно изпитателно напрежение 95 kV (за 15kV система съгласно ANSI)

Корекционен фактор a . . . . .0,73 (съгласно фиг.1/3)

Номинално импулсно изпитателно напрежение, което се избира: $\frac{95\ \text{kV}}{1{,}1 \times 0{,}73} = 118\ \text{kV}$

На тези изисквания отговаря превключвателна уредба с номинално напрежение от 24 kV, списък 2 (номинално моментно импулсно изпитателно напрежение - 125 kV).

Действителният изолиращ капацитет при работа на на тази площадка е:

Изпитателно напрежение³) = a · номинално изпитателно напрежение ²) за избраната превключвателна уредба.

Site altitude

The rated insulating capacity values (rated impulse withstand voltage, rated power frequency withstand voltage) ¹) specified for the Siemens equipment are, in accordance with the provisions of VDE Standard 0111 and IEC Publication 71, based on standard atmospheric conditions (19013 h Pa, 20°C and 11 g/m³ water content), i. e. sea level. The insulating capacity of an insulation in air decreases with increasing altitude as a result of changes in the air density. Standards promulgated by DIN VDE, IEC and other disregard this decrease in insulating capacity for altitude of up to 1000 m, i.e. the decrease of approximately 9 % at this altitude is still permissible.

The standards provide no guideline for altitudes of more than 1000 m with respect to insulation ratings; they leave this up to an agreement between manufacturer and user.

Our own recommendation is as follows:
Since this method used for rating insulation up to altitudes of 1000 m has proved to be satisfactory, it should also be applied to higher altitudes. The altitude correction factor a should therefore be based on the insulating capacity at 1000 m, which is lower by 9 % (corresponding to 0.91 or $\frac{1}{1.1}$) than the capacity at sea level.

The following expression thus applies for the selection of the equipment:

Rated withstand voltage to be selected ²)

$$\geq \frac{\text{Required rated withstand voltage}^{2)}}{1.1 \cdot a}$$

Example:

Site altitude above sea level . . . . 3000 m

Required rated impulse withstand voltage . . . . 95 kV (for a 15 kV system according to ANSI)

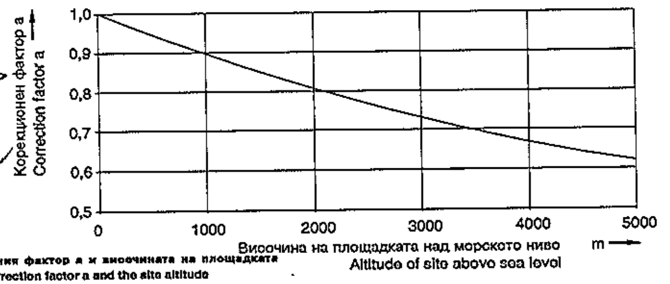
Correction factor a . . . . .0,73 (according to Fig. 1/3)

Rated impulse withstand voltage to be selected $\frac{95\ \text{kV}}{1.1 \times 0.73} = 118\ \text{kV}$

Switchgear with a rated voltage of 24 kV, List 2 (rated lightning impulse withstand voltage of 125 kV) meet this requirement.

The actual insulating capacity at the site is then

withstand voltage ³) = a · rated withstand voltage ²) of the selected switchgear unit.



Фиг. 1/3
Връзка между корекционния фактор a и височината на площадката
Relationship between the correction factor a and the site altitude

Използват се следните определения:
¹) Номинално изпитателно напрежение²) - по условията на DIN VDE, IEC за морско равнище. Изпитателно напрежение³) = действителната стойност за дадената височина.
²) Номинално моментно импулсно изпитателно напрежение.
Номинално изпитателно напрежение с промишлена честота за 1 минута.
³) Моментно импулсно изпитателно напрежение.
Изпитателно напрежение с промишлена честота за 1 минута.

The following definitions apply:
¹) Rated withstand voltage²) = required value corresponding to the provisions of VDE, IEC etc. for sea level.
Withstand voltage³) = actual value for the given altitude
²) Rated lighlning impulse withstand voltage
Rated power frequency withstand voltage
³) Lightning impulse withstand voltage
Power frequency withstand voltage

Номинални данни

Вакуумен мощностен прекъсвач 3AH5

Rated data

3AH5 vacuum circuit-breaker

12	75	28	13,1	3	800	32,5	160	70	2	3AH5 101-1
					800		210			3AH5 111-1
			16	3	800	40	160	70	3	3AH5 102-1
					1250		160			3AH5 102-2
					800		210			3AH5 112-1
					1250		210			3AH5 112-2
		28*	20	3	800	50	160	70	5	3AH5 103-1
					1250		160			3AH5 103-2
					800		210			3AH5 113-1
					1250		210			3AH5 113-2
			25	3	800	63	160	70	6	3AH5 104-1
					1250		160			3AH5 104-2
					800		210			3AH5 114-1
					1250		210			3AH5 114-2
17,5	95	38*	25	3	800	63	160	70	1	3AH5 204-1
					1250		160			3AH5 204-2
					800		210			3AH5 214-1
					1250		210			3AH5 214-2
24	125	50	16	3	800	40	210	70	4	3AH5 252-1
					1250		210			3AH5 252-2
					800		275			3AH5 262-1
					1250		275			3AH5 262-2
36	170	70	16	3	1250	40	350	85	4	3AH5 302-2
12	75	42	25	4	800	63	210	70	1	3AH5 404-1
					1250				1	3AH5 404-2
					800				5	3AH5 414-1
					1250				5	3AH5 414-2
17,5	110	38*	25	3	800	63	210	70	1	3AH5 424-1
					1250					3AH5 424-2

*) 42 kV при поискване
42 kV on demand

1 Номинално напрежение U в kV
2 Номинално моментно импулсно изпитателно напрежение в kV
3 Ном. изпит. напрож. с пром. честота за 1 минута U_w в kV
4 Номинален ток на късо съединение I_{sc} в kA
5 Номинална продължителност на късо съединение t_k in s
6 Номинален нормален ток в kA
7 Номинален ток на възникване на късо съединение I_{ma} in kA
8 Разстояние между центровете на полюсите в mm
9 Тегло* в kg
10 Електрическа издръжливост (номер на товарова характ., виж фиг.5/2)
11 Обозначение за тип

* Основна версия, теглото може да бъде до 10 кг повече в зависимост от степента на оборудване.

Фиг.1/4 Електрически данни за вакуумен мощностен прекъсвач 3AH5

1 Rated voltage U in kV
2 Rated lightning impulse withstand voltage in kV
3 Rated power frequency withstand voltage U_w in kV
4 Rated short-circuit breaking current I_{sc} in kA
5 Rated short-circuit duration t_k in s
6 Rated normal current in kA
7 Rated short-circuit making current I_{ma} in kA
8 Pole centre distance in mm
9 Weight* in kg
10 Electrical endurance (load characteristics number, see Fig. 5/2)
11 Type designation

* Basic version; the weight can be up to 10 kg higher depending on the equipment level

Fig. 1/4 Electrical data for 3AH5 vacuum circuit-breakers

Работни времена

Operating times

Време на затваряне с пружинния механизъм/Closing time with stored energy mech.			ms	< 75
Време за натягане на пружината/Spring charging time		(M1)	s	< 10
Време за отваряне/ Opening time	1. 1-ва Изключваща бобина/1st shunt release		ms	< 65
	2. 2-ра Изключваща бобина/2nd shunt release		ms	< 50
Време на искрене/Arcing time			ms	< 15
Време на прекъсване/Break time	1. Hilfsauslöser/1st shunt release		ms	< 80
	2. Hilfsauslöser/2nd shunt release		ms	< 65
Мъртво време /Dead time			ms	300
време за Затваряне-отваряне/Close-open-time	1. 1ва изключваща бобина/1st shunt release		ms	< 75
	2. 2ра изключваща бобина/2nd shunt release		ms	< 60
Синхронизираща грешка между полюсите/Synchronizing error between the poles			ms	< 2
Минимална продължителност на импулса/Minimum pulse duration				
	Затварящ електромагнит/Closing solenoid	(Y9)	ms	60
	Изключваща бобина/Shunt release	(Y1)	ms	60
	Допълнително разединение 3AX 110 / Supplementary release 3AX 110	(Y2)	ms	20
		(Y4)	ms	20
		(Y6)	ms	20
		(Y7)	ms	20
мин. продължителност на импулса на изключващия сигнал на прекъсвача / min. pulse duration of breaker tripping signal			ms	10

Фиг. 1/5 Работни времена/Operating times

Време на затваряне = интервала от време между началото на действието затваряне и момента когато контактите се допират във всички полюси.

Време на отваряне = интервала от време между началото на действието отваряне и момента, когато контактите се отделят във всички полюси.

Време на искрене = интервала от време между момента на възникване на дъга и момента на окончателно гасене на дъгата във всички полюси.

Време на прекъсване = интервала от време между започването на операцията отваряне и момента на окончателно гасене на дъгата в последния полюс на прекъсвача (време на отваряне + време на искрене).

Време затваряне/отваряне = интервала от време (в работен цикъл възникване - гасене) между момента когато контактите се допират в първия полюс в процеса на затваряне и момента когато искрящите контакти се отделят във всички полюси при последващия процес на отваряне.

Мъртво време = интервала от време между на окончателно гасене на дъгата във всички полюси в процеса на отваряне и първото възстановяване на тока във всеки полюс в следващата операция затваряне.

Closing time = the interval of time between the initiation of the closing operation and the instant when the contact touch in all poles.

Opening time = the interval of time between the initiation of the opening operation and the instant when the contacts separate in all poles.

Arcing time = the interval of time between the instant of the first initiation of an arc and the instant of final arc extinction in all poles.

Break time = the interval of time between the initiation of the opening operation and the instant of final arc extinction in thelast circuit-breaker pole extinguished (= opening time + arcing time).

Close-open time = the interval of time (in a make-break operating cycle) between the instant when the contacts touch in the first pole in the closing process and the instant when the arcing contacts separate in all poles in the subsequent opening process.

Deadtime = The interval of time between final arc extinction in all poles in the opening operation and the first re-establishment of current in any pole in the subsequent closing operation.

Спомагателен превключвател (S1) 3SV92

Могат да се поддържат две версии спомагателни превключватели. Стандартната версия е снабдена ▪ с 6 нормално отворени (NO) контакта и с 6 нормално затворени (NC) контакта. Разширената версия е ▪ снабдена с 12 NO контакта и 12 NC контакта.

Номинално изолиращо напрежение: AC/DC 250 V
Клас на изолацията: C по DIN VDE 0110
Ток: 10 A
Капацитет на възникване: 50 A

Auxiliary switch (S1) 3SV92

Two versions of the auxiliary switch can be supplied. The standard version is fitted with 2 NO contacts and 2 NC contacts. The extended version is fitted with 6 NO contacts and 6 NC contacts.

Rated insulation voltage : AC/DC 250 V
Insulation class : C to DIN VDE 0110
Current : 10 A
Making capacity : 50 A

Напрежение Voltage U (V)	Капацитет на прекъсване (A) Breaking capacity	
	Реактивен товар Resistive load	Индуктивен товар Inductive load
до/up to 230 AC	10	10
24 DC	10	10
48 DC	10	9
60 DC	9	7
110 DC	5	4
220 DC	2.5	2

Фиг.1/7 Капацитет на прекъсване на спомагателен превключвател 3SV92
Breaking capacity of 3SV92 auxiliary switch

Включваща бобина (Y9) 3AY1510
(допълнително)

Затварящият електромагнит отключва напрегнатата затваряща пружина и по този начин затваря мощностния прекъсвач електрически. Това е възможно както за работа с променлив ток, така и с прав ток. Затварящият електромагнит не е проектиран за продължителна работа и няма вътрешно автоматично разреждане. Проверете затварящата команда от устройството да не превишава 1 минута. Захранващото напрежение на затварящия електромагнит може да се отклонява от номиналното значение ӧ-15% до +10%. При работа с променлив ток в прекъсвача се монтира изправящ модул 3AX1525.

Консумирана мощност приблизително 140 W / VA

Изключваща бобина (Y1) 3AY1510

Изключващата бобина 3AY1510 се използва като стандарт в основния вариант на мощностния прекъсвач. В този проект, електрически задействащ импулс минава към отключващ механизъм "отворено" посредством електромагнитна арматура с директно действие и отваря мощностния прекъсвач. Отварящият електромагнит не е проектиран за продължителна работа и няма вътрешно автоматично разреждане. Проверете отварящата команда от устройството да не превишава 1 минута. Захранващото напрежение на затварящия електромагнит може да се отклонява от номиналното с 30% до +10% за правотоково и -15% до +10% за променливотоково напрежение. При работа с променлив ток в прекъсвача се монтира изправящ модул 3AX1525.

Консумирана мощност приблизително 140 W / VA

Изключваща бобина (Y2) 3AX1101
(Допълнителна)

Изключващата бобина 3AX1101 е пригодена за случаи когато са необходими повече от една изключваща бобина. С това устройство, електрическата команда за отваряне се предава в усилена форма на включващия "отворено" механизъм и отваря мощностния прекъсвач чрез освобождаване на пружината. Отварящият електромагнит не е проектиран за продължителна работа и няма вътрешно автоматично разреждане. Проверете отварящата команда от устройството да не превишава 1 минута.

Консумирана мощност приблизително 60 W / VA

Shunt closing release (Y9) 3AY1510
(additional feature)

The closing solenoid unlatches the charged closing spring and thus closes the circuit-breaker electrically. It is available for both AC and DC operation. The closing solenoid is not designed for continuous operation and it is not automatically de-energized internally. Make sure that the closing command from the installation is limited to max. 1 min. The supply voltage of the closing solenoid may deviate from the rated value by -15% to +10%. In operation with AC voltage, a rectifier module 3AX1525 is installed in the circuit-breaker.

Power consumption approx. 140 W / VA

Shunt release (Y1) 3AY1510

The 3AY1510 shunt release is used as standard in the basic circuit-breaker version. With this design, the electrically supplied tripping pulse is passed to the "Open" latching mechanism by means of a direct-action solenoid armature and the circuit-breaker is thus opened. This opening solenoid is not designed for continuous operation and it is not automatically de-energized internally. Make sure that the opening command from the installation is limited to max. 1 min. The supply voltage of the shunt release may deviate from the rated value by -30% to +10% with DC voltage, by -15% to +10% with AC voltage. In operation with AC voltage, a rectifier module 3AX1525 is installed in the circuit-breaker. In operation with AC voltage, a rectifier module 3AX1525 is installed in the circuit-breaker.

Power consumption approx. 140 W / VA

Shunt release (Y2) 3AX1101
(additional feature)

The 3AX1101 shunt release is fitted if more than one shunt release is required. With its design, the electrical opening command is transferred in boosted form to the ăOpenÒ latching mechanism via a solenoid armature through unlatching of a energy store and thus the circuit-breaker is opened. This opening solenoid is not designed for continuous operation and it is not automatically de-energized internally. Make sure that the opening command from the installation is limited to max. 1 min.

Power consumption approx. 60 W / VA

Разединител по ниско напрежение (Y7) 3AX1103
(Допълнително)

Разединителите по ниско напрежение се състоят от пружина, отключващ механизъм и електромагнитна система, която е свързана постоянно към захранването когато прекъсвачът е в затворено състояние. Ако напрежението падне под определена стойност, отключващият механизъм освобождава пружината и тя отваря прекъсвача.

Преднамереното задействане на разединителя по ниско напрежение обикновено се извършва чрез нормално затворен (NC) контакт в схемата на задействане, но може да бъде извършено и чрез нормално отворен (NO) контакт чрез късо съединение на магнитната намотка. При този вид задействане, тока на късо съединение е ограничен от вградените съпротивления (виж схемата на Фиг. 3/4), но се уверете, че късото съединение на електромагните не продължава повече от 1 минута.

Разединителите по ниско напрежение могат също да бъдат свързани към напреженови трансформатори. Когато работното напрежение падне до недопустимо ниски нива, прекъсвачът се задейства автоматично.

Консумирана мощност приблизително 27 VA или 18 W.

Разединител по прагов ток (Y4) 3AX1102
(допълнително)

Разединителите по прагов ток се състоят от пружинен механизъм, отключващ механизъм и електромагнитна система. Когато е надвишен праговия ток (90 % от номиналния ток на разединителя по прагов ток) отключващото устройство на пружинния механизъм се освобождава и отваря прекъсвача. За използване на разединителите по прагов ток освен трансформатори на първичен ток са необходими и измервателни трансформатори.

Консумирана мощност приблизително 20 VA за разединители с номинален задействащ ток = 0.5 A и 1 A при 90 % от номиналния ток и при отворена арматура.

Сигнал за задействане на прекъсвача, изолиращи ключове(S6 und S7)
(допълнително)

Когато вакуумните мощностни прекъсвачи са задействани посредством разединение, позиционния превключвател S6 за кратко прави контакт. Това създаване на контакт може да бъде да бъде използвано за сигнализация. В случай на преднамерено механично задействане, изолиращият ключ S7 не позволява да се направи този контакт.

Варисторен модул (V1 до V3) 3AX1526
(допълнително)

Прекъсването на индуктивните товари в правотоковите вериги може да причини превключващи наднапрежения които създават риск за електронните управляващи единици. С цел да се предотврати това, индуктивностите на механизмите на мощностния прекъсвач и управляващите (двигател, затварящ електромагнит, изключваща бобина и спомагателен контактор) могат да бъдат свързани към варистори (с правотоково действие). За номинални работни напрежения от 60 V до 220 V прав ток, варисторният модул 3AX1526 се доставя като допълнение, което ограничава наднапрежението до приблизително 500V. Модулът съдържа 2 отделни варисторни схеми.

Undervoltage release (Y7) 3AX1103
(additional feature)

Undervoltage releases consist of a stored-energy mechanism, an unlatching mechanism and an electromagnet system which is connected continuously to the supply when the circuit-breaker is in the close state. If this voltage drops to below a certain value the unlatching mechanism is released and opening of the circuit-breaker is thus initiated via the stored-energy mechanism.

The deliberate tripping of the undervoltage release generally takes place via an NC contact in the tripping circuit. But it can also be carried out via an NO contact by short-circuiting of the magnet coil. With this type of tripping, the short-circuit current is limited by the built-in resistors (see circuit diagram Fig. 3/3), but make sure that short-circuiting of the solenoid does not last for longer than 1 minute.

Undervoltage releases can also be connected to voltage transformers. When the operating voltage drops to impermissibly low levels, the circuit-breaker is tripped automatically.

Power consumption approx. 27 VA or 18 W

CT-Operated release (Y4) 3AX1102
(additional feature)

CT-operated releases consist of a stored-energy mechanism, an unlatching mechanism and an electromagnet system. When the tripping current is exceeded (90 % of the CT-operated release rated current) the unlatching device of the stored-energy mechanism is released and thus opening of the circuit-breaker is initiated. In addition to the primary current transformers, matching transformers are required for application of the CT-operated releases.

Power consumption for releases with 0.5 A and 1 A rated tripping current = approx. 20 VA at 90 % of the release rated current and with open armature.

Breaker tripping signal, cut-out switches (S6 and S7)
(additional feature)

When the vacuum circuit-breaker is tripped by means of a release, the position switch S6 briefly makes contact. This contact making can be used for signalling. In the event of intentional mechanical tripping, the cut-out switch S7 prevents this contact from being made.

Varistor module (V1 to V3) 3AX1526
(additional feature)

The disconnection of inductive loads in DC circuits may cause switching overvoltages which pose a risk to electronic control units. In order to prevent this, the inductances of the circuit-breaker mechanism (motor, closing solenoid, shunt release and auxiliary contactor) can be connected to varistors (with DC operation). For rated operating voltages of 60 V to 220 V DC the varistor module 3AX1526 is available as an additional feature which limits the overvoltage to approx. 500 V. The module contains 2 separate varistor circuits.

Механично блокиране
(допълнение с пружинен механизъм)

Пружинният механизъм на вакуумния мощностен прекъсвач 3AH5 може да бъде оборудван с устройство за механично блокиране, което блокира подвижните платформи, изваждаемите части на прекъсвача или разединителите в определено положение.

Един датчик, осигурен от клиента, следи позицията на прекъсвача и така предотвратява механичното или електрическо затваряне на вакуумния мощностен прекъсвач, когато той е отворен.

Датчикът трябва да бъде проектиран така, че да не може да управлява подвижните платформи, изваждаемите части на прекъсвача или разединителите когато вакуумния мощностен прекъсвач е затворен.

Окабеляване
(допълнително)

В базовия вариант контролните изводи са свързани електрически направо към вграденото оборудване. За тази цел, превключващите вериги са предварително окабелени в съответствие с разположението на оборудването, показано на Фиг. 3/2. При "допълнително окабеляване", оборудването[1] е окабелено в завода до терминална лента или до конектор в съответствие с Фиг. 3/2.

Когато се извършват следващи кабелни работи, ние ви препоръчваме да използвате примерните схеми на веригите, показани на Фиг. 3/2.

Размери и тегла

Размерите и теглата на вакуумния мощностен прекъсвач са показани на съответните графики. За целите на планирането могат да бъдат поръчани чрез съответната агенция на Siemens чертежи, показващи подробни пълни размери.
Теглото също е показано на табелката с номинални данни на прекъсвача, на Фиг.1/4 или на съответната схема/чертеж.

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[1]) изключение: Спомагателен ключ S1 -S1

Mechanical Interlocking
(additional feature with stored-energy mechanism)

The stored-energy mechanisms of the 3AH5 circuit-breakers can be equipped with a mechanical interlocking facility to interlock breaker trucks, withdrawable breaker parts or disconnectors in a certain position.

A sensing component provided by the customer senses the switch position of the circuit-breaker and in this way prevents mechanical and electrical closing of the circuit-breaker when the circuit-breaker is open.

The sensing component must be designed in such a way that is not possible to operate the disconnector, withdrawable part or truck when the circuit-breaker is closed.

Wiring
(additional feature)

In the basic version, the control leads are connected electrically directly to the built-in equipment. For this purpose, the switching circuits are prewired in accordance with the equipmentplan shown in Fig. 3/2. In the case of the additional feature "wiring", the equipment[1] is wired at the factory to a terminal strip or to a connector in accordance with Fig. 3/2.

When carrying out subsequent wiring work, we recommend that you use the circuitry examples of the circuit diagram illustrated in Fig. 3/2.

Dimensions and weights

The dimensions of the vacuum circuit-breaker are shown in the relevant drawings, which can be ordered through your Siemens office.

The weight can be found on the breaker rating plate, in Fig. 1/4 or in the relevant drawing.

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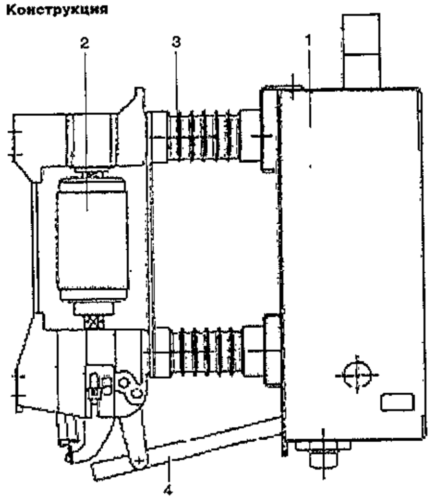
[1]) Exception: Auxiliary switch S1

Описание

Конструкция



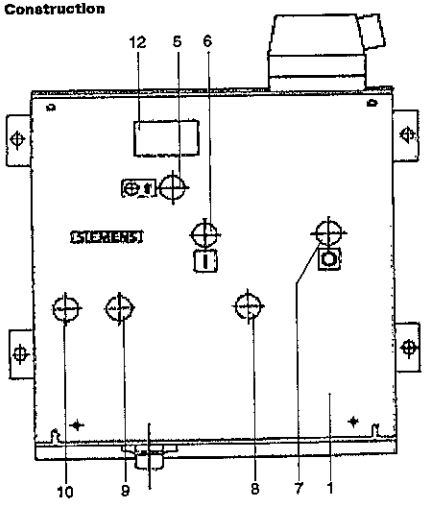
1	Корпус на механизма	7	Бутон "Отваряне"
2	Вакуумен прекъсвач	8	Индикатор "Затв./Отв"
3	Опорен изолатор	9	Индикатор за съст. на пруж.
4	Работен прът	10	Брояч
5	Отвор за манивела	11	Капак
6	Бутон "Затваряне"	12	Табелка с ном. данни

Фиг. 2/1 Вакуумен мощностен прекъсвач 3АН5, изглед на корпуса на механизма

Вакуумният мощностен прекъсвач се състои от корпус на механизма (1), 3-полюсни възли с вакуумни прекъсвачи(2), стълбови изолатори отлети от смола (3), подпори, и работни пръти (4). Всички механични и електрически елементи, необходими за отваряне и затваряне на вакуумния мощностен прекъсвач, са поместени в корпуса на механизма. Корпуса има подвижен капак, с отвори за задействащите и индикаторни устройства. В зависимост от нивото на оборудване на мощностния прекъсвач, някои от тези отвори не се използват и в този случай са затворени с тапи.

Description

Construction



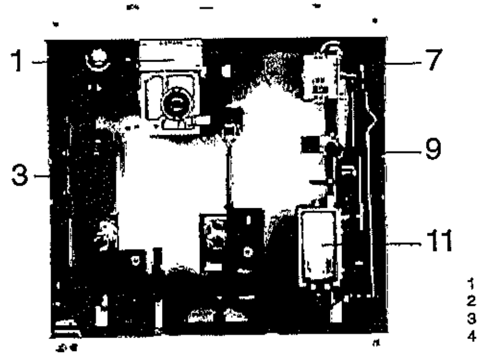
1	Mechanism housing	7	"OPEN" pushbutton
2	Vacuum interrupter	8	"CLOSED/OPEN" indicator
3	Post insulator	9	Spring state indicator
4	Operating rod	10	Counter
5	Opening for hand crank	11	Cover plate
6	"CLOSE" pushbutton	12	Rating plate

Fig. 2/2 Vacuum-Leistungsschalter 3AH5, Ansicht auf Antriebskasten 3AH5 vacuum circuit - breaker, view to mechanism housing

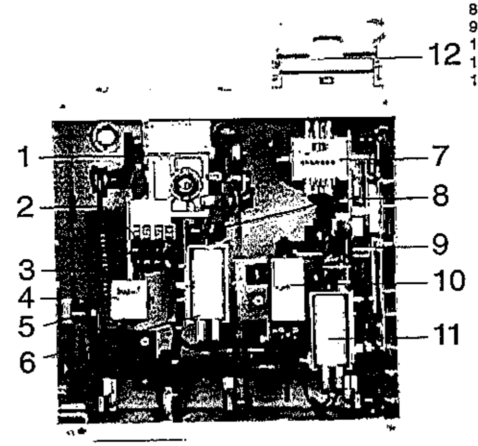
The vacuum circuit-breaker consists of the mechanism housing (1), the 3-pole assemblies with vacuum interrupters (2), cast-resin post insulators (3), struts and of the operating rods (4). The mechanism housing accommodates all electrical and mechanical elements required for opening and closing the vacuum circuit-breaker. The mechanism housing has a detachable cover which has cut-outs for the actuating and indicating devices. Depending on the equipment level of the circuit-breaker, some of these cut-outs are not used and are in this case sealed with blanking plugs.

На Фиг.2/3 е показан корпуса на вакуумния мощностен прекъсвач 3АН5, като механизъм с ударно действие, оборудван с основно оборудване, а на Фиг 2/4 - пружинен механизъм с пълно оборудване, и разположение на възлите от комплектования механизъм в кутията.

Fig. 2/3 depicts the mechanism housing of the 3AH5 vacuum circuit-breaker, as a snap-action mechanism equipped with the basic equipment and Fig. 2/4 a stored-energy mechanism equipped with full equipment; it also shows the layout of the full individual mechanism subassemblies in the mechanism housing.



Фиг.2/3 Корпус на механизма без капак, основно оборудване Mechanism housing without cover, basic equipment



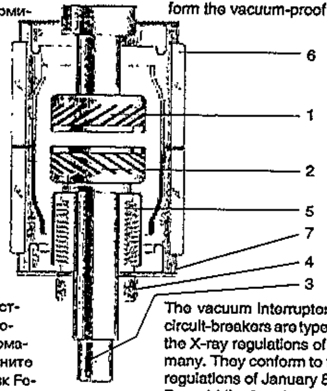
Фиг.2/4 Корпус на механизма без капак, пълно оборудване Mechanism housing without cover, full cpmplement

1	Предавателна кутия	1	Gearbox
2	Позиционен превкл.	2	Position switch
3	Затваряща пружина	3	Closing spring
4	Сигнал "затваряща пружина напрегната"	4	"Closing spring charged" signal
5	Брояч на опер. цикли	5	Operating cycle counter
6	Затварящ ел.магнит	6	Closing solenoid
7	Спом. превключвател	7	Auxiliary switch
8	Бутон "затваряне"	8	Pushbutton "CLOSED"
9	Бутон "отваряне"	9	Pushbutton "OPEN"
10	2-ра изкл. бобина	10	2nd shunt release
11	1-ва изкл. бобина	11	1st shunt release
12	Конектор за ниско напрежение	12	Low-voltage plug connector

Вакуумни прекъсвачи

Основната конструкция на вакуумните прекъсвачи за вакуумен мощностен прекъсвач 3AH5 е показана в разрез на Фиг. 2/5.

Фиксираният контактен детайл (1) е свързан директно към корпуса. Движещият се контактен детайл (2) е прикрепен към терминалния болт (3) и е разположен централно във водача (4). Металните гофрирани калъфи (5) заедно с изолаторите (6) направени от високо алуминиева керамика и крайните фланци (7) формират херметичния корпус на прекъсвача.



Фиг.2/5 Вакуумен прекъсвач
Vacuum Interrupter

Вакуумните прекъсвачи използвани във мощностните прекъсвачи 3AH5 съответстват на рентгеновите предписания на Федерална Република Германия. Те отговарят на изискванията на нормативните документи за рентген от 8 Януари 1987 (Вестник Federal Law стр.144)) § 8 и Приложение III Раздел 5 до номиналното краткотрайно променливо напрежение определено в съотвествие с DIN VDE/IEC.

Екипировка

Основният вариант на вакуумния мощностен прекъсвач включва:

Ръчно управляем ударен механизъм за затваряне.	
Пружинен механизъм "отваряне" с изкл. бобина	(Y1)
Спомагателен превключвател 2NO/2NC	(S1)

Всеки вакуумен мощностен прекъсвач може да бъде екипиран със следните спомагателни устройства:

Пружинен затварящ механизъм с ръчно задействане	
Електрически работен механизъм	(M1)
с устройство за поддръжка на вакуума и изкл. бобина	(Y9)
Удължен спомагателен ключ 6NO/6NC	(S1)
Позиционен превключвател за сигнализиране	
"Затварящата пружина напрегната"	(S4)
Задействащ прекъсвача сигнал, изолиращ ключ	(S6, S7)
Брояч на оперативните цикли	
Изключваща бобина 3AX 1101 1)	(Y2)
Разединител упр. от токов трансформатор 3AX1102 1)	(Y4)
Разединител по ниско напрежение 3AX 1103 1)	(Y7)
Разединител упр. от токов трансформатор 3AX1104 1)	(Y6)
Варисторни схеми	
Механична блокировка	
Окабеляване на електро-оборудването до 24-полюсна терминална лента или 24-полюсен конектор.	

1) Вакуумният мощностен прекъсвач 3AH5 може да бъде снабден с максимално 1 разединител от типа 3AX 11 ... в допълнение към или вместо стандартната изключваща бобина Y1.

Допустимите комбинации от спомагателно оборудване и специални варианти са показани в Каталог HG 11.

Vacuum Interrupters

The basic construction of the vacuum interrupters for the 3AH5 vacuum circuit-breaker is shown in the sectional view in Fig. 2/5.

The fixed contact piece (1) is connected directly to the housing. The moving contact piece (2) is fixed to the terminal bolt (3) and is located centrally in the guide (4). The metal bellows (5) together with insulators (6) made of high alumina ceramics and the end flanges (7) form the vacuum-proof interrupter housing.

The vacuum interrupters fitted in the 3AH5 vacuum circuit-breakers are type-approved in accordance with the X-ray regulations of the Federal Republic of Germany. They conform to the requirements of the X-ray regulations of January 8, 1987 (Federal Law Gazette Page 144) ¤ 8 and Annex III Section 5 up to respective rated short-time AC voltage stipulated in accordance with DIN VDE/IEC (rated power frequency withstand voltage).

Complement

The basic version of the 3AH5 vacuum circuit-breaker comprises:

Manually operated snap-action mechanism for closing	
Stored energy "open" with shunt release	(Y1)
Auxiliary switch 2NO/2NC	(S1)

Each 3AH5 vacuum circuit-breaker can be equipped with the following supplementary devices:

Manually operated stored-energy mechanism for closing	
Electrical operating mechanism	(M1)
with pump antipumping feature and shunt closing release	(Y9)
Extended auxiliary switch 6NO/6NC	(S1)
Position switch for signalling	
"Closing spring charged"	(S4)
Breaker tripping signal, cut-out switch	(S6, S7)
Operating cycle counter	
Shunt release 3AX 1101 1)	(Y2)
Current transformer-operated release 3AX 1102 1)	(Y4)
Undervoltage release 3AX 1103 1)	(Y7)
Current transformer-operated release 3AX 1104 1)	(Y6)
Varistor circuitry	
Mechanical interlock	
Wiring of the electrical equipment to 24-pole terminal strip or 24-pole connector.	

1) The 3AH5 vacuum circuit-breaker can be fitted with a maximum of 1 release of type 3AX 11.. in addition to or instead of the standard shunt release Y1.

The permissible combinations of supplementary equipment and special versions are stated in relevant HG catalog.

Монтаж

Монтиране в килия или на платформа

Вакуумните мощносни прекъсвачи са монтирани перпендикулярно на вакуумните прекъсвачи. За други позиции на монтаж се обърнете към местния офис на Siemens.

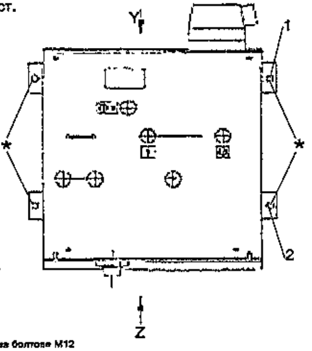
Вакуумните мощностни прекъсвачи 3AH5 се доставят в отворено състояние, с видима индикация "затваряща пружина освободена". Преди монтирането на прекъсвача 3AH5, махнете транспортните устройства (плъзгачи и разделители). Монтирайте отделно доставените фазови бариери в съответствие със осигурените схеми.

Преди монтирането на вакуумния мощностен прекъсвач 3AH5 в килия или на платформа, проверете неговите данни на табелката с номиналните данни (за да се избегне недоразумение) и сравнете номиналното напрежение от придружаващата документация с напрежението на захранването, налично на площадката.

На вакуумният мощностен прекъсвач с разединител по ниско напрежение (Y7) 3AX1103, спиращият винт на чука трябва да се премести от позиция A в позиция B (виж картата с инструкции за освобождаване или бележката в кутията на механизма на вакуумния мощностен прекъсвач).

На 2-те траверси (1) и (2) и върху кутията на механизма има 12 фиксиращи отвора (*) за удобство при различни видове монтаж (Фиг.3/1). Използвайте фиксиращи болтове M12 от клас на якост 8.8, като следите чертежите със задължителни размери.

Стойката или рамката трябва да бъде приспособена към работните условия и да има подходяща товароносимост и стабилност.



* Отвори за болтове M12
Holes for M12 bolts

Фиг.3/1 Средства за фиксиране на вакуумен прекъсвач 3AH5
Means of fixing 3AH5 vacuum circuit-breaker

Плоски контактни повърхности

Преди да монтирате проводниците прикрепете ги така че да осигурите гладък контакт с техните свързващи части и с отворите в пълно изравняване.

Изтрийте контактните повърхности които ще бъдат скрепени с болтове с телена четка - с движения на кръст - докато се покаже чист метал и ги избършете с чист парцал. Смажете тънко металните контактни мовърхности с не киселинен Вазелин (напр. Shell Vaseline 8420¹) и ги скрепете с болтове веднага.

Installation

Installing in cubicle or on truck

The vacuum circuit-breaker is installed perpendicular to the vacuum interrupters. Please contact your local Siemens agency about other installation positions.

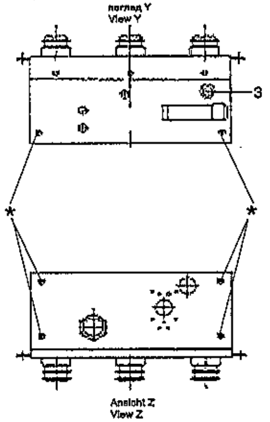
The 3AH5 vacuum circuit-breakers are supplied in the open (Off) state with the closing spring discharged. Before installing the 3AH5 V-breaker, remove the transport devices (skids and spacers). Mount phase barriers supplied loose with the breakers in accordance with the drawings supplied.

Before installing the 3AH5 vacuum circuit-breaker in a cubicle or a truck check its rating plate data (to avoid confusion) and compare the rated voltage indicated in the delivery documents with the power supply voltage available at the site.

On the vacuum circuit-breaker with undervoltage release (Y7) 3AX1103, the arresting screw of the hammer must be moved from position A to B (see instruction card for release or note card in the mechanism housing of vacuum circuit-breaker).

On the 2 traverses (1) and (2) and on the mechanism housing has, there are a total of 10 fixing holes (*) to suit the various types of installation (Fig. 3/1). Use M12 fixing bolts of strength Class 8.8, making reference to the mandatory dimension drawings.

The rack or frame must be adapted to the operating conditions and have adequate load bearing capacity and stability.



Flat bar connection

Prior to fitting the conductors fix them so as to ensure smooth contact with their connecting parts and with the holes in full alignment.

Rub the contact faces to be bolted together with crisscrossing strokes using a wire brush or emery cloth (for metal grain size 150) until bright metal shows and wipe then with a clean rag. Thinly grease the bright contact faces with acid-free Vaseline (e. g. Shell Vaseline 8420¹) and bolt them together immediately).

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¹) Shell-Vaseline 8420, Deutsche Shell-AG Abt. VSM Überseering 35, D-22 297 Hamburg Postfach 60 05 55

Внимание! Повърхностите с медно и сребърно покритие трябва да бъдат почиствани с парцал и да не бъдат четкани. Различните контактни материали (Al/CU) не трябва да се обработват с един и същ почистващ инструмент.
Използвайте подходящи гайки и болтове M12 от клас на якост 8.8 и съответни пружинни елементи и обикновени шайби.
Внимание! Когато стягате болтовете на терминала противодействайте на въртящият момент (70 Nm ˜ 7mkp) чрез подходящ гаечен или френски ключ.

Изводи за управление

Ние препоръчваме използването на управляващи изводи с номинално сечение 1.5 mm2. Използваните електрически компоненти са проектирани за 6.3 АМП конектори. Окабеляването трябва да се извърши в съответствие с примерните планове за разположение на Фиг. 4/1.

Когато прекъсвачът е допълнително оборудван с 24-полюсен ниско-волтов конектор или терминална лента, подходящите външни контролни изводи са със сечение 2,5 mm². Окабеляването и схемите на вакуумните мощностни прекъсвачи зависят от варианта и степента на оборудване; за справка ползвайте примерните планове на Фиг. 3/2.

Заземяване

Свържете вакуумният мощностен прекъсвач за подходящо високоволтово защитно заземяване посредством подходящо маркиран M12 (3,Фиг.3/1) терминал върху кутията на механизма като използвате медна пластина, меден кабел или горещо галванизирана стоманена лента.

Ако мощностният прекъсвач и корпуса на механизма са монтирани в заземена метална рамка, така че има сигурен електрически контакт, корпуса на механизма не е необходимо да бъде заземяван отделно. Когато монтирате прекъсвача външно, трябва да бъдат поставени назъбени шайби (DIN 6798) под главите на болтовете.

Note! Copper-sprayed and spray silver-plated surfaces should be cleaned with a rag and not rubbed (brushed). Differing contact materials (Al/CU) must not be worked with the same cleaning tool.

Use the appropriate M12 nuts and bolts of strength class 8.8 and corresponding spring elements and plain washers.

Note! When tightening the terminal screws, counteract the torque (70 Nm) by resisting it with a suitable spanner or socket wrench.

Control leads

We recommend the use of a control lead with a nominal sectional area of 1.5 mm². The electrical components used are designed for connecting 6.3 AMP tab connectors. Wiring must be carried out in accordance with equipment plan examples in Fig. 4/1.

If the breaker is equipped as an additional feature with a 24-pole low voltage plug connector or a terminal strip, the external for control leads with a nominal sectional area of up to 2.5 mm² is suitable. The wiring and circuitry of the vacuum circuit-breakers depend on the particular version and level eqipment; refer to the equipment plan examples in Fig. 3/2.

Earthing

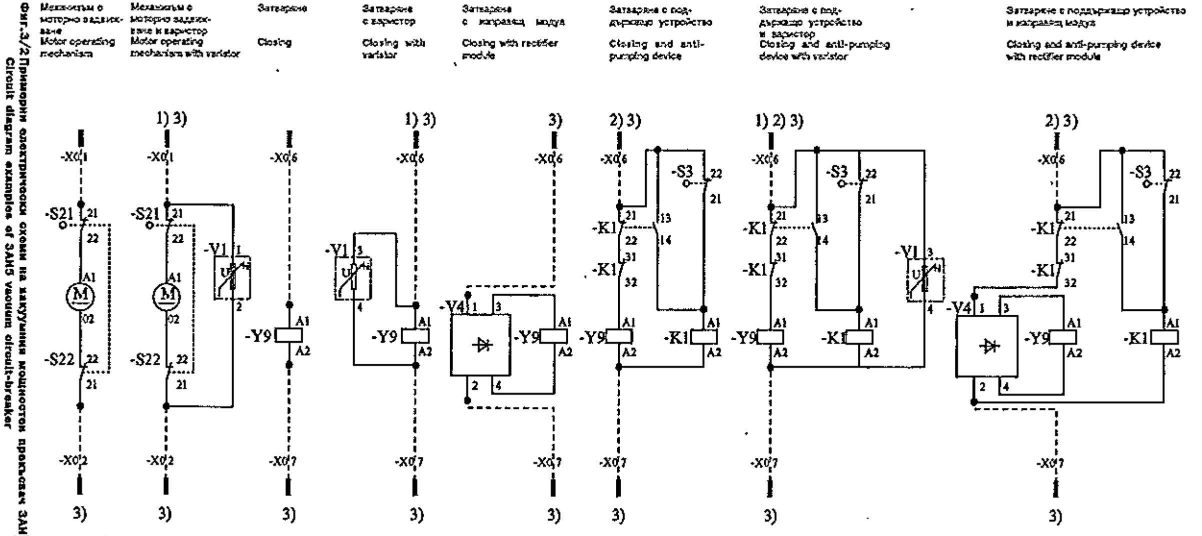
Connect the vacuum circuit-breaker to the appropriate high voltage protective earth by means of the suitable marked M12 (3, Fig. 3/1) terminal on the top of the mechanism housing using flat copper, copper cable or hot-galvanized steel strip.

If the vacuum circuit-breaker and mechanism housing are installed in an earthed metal rack so that firm electrical contact is established, the mechanism housing need not to be earthed separately. When installing the breaker externally, toothed serrated washers (DIN 6798) must be placed under the bolt heads.

Фиг.3/2 Примерни електрически схеми на вакуумни мощностни прекъсвачи 3AH5
Circuit diagram examples of 3AH5 vacuum circuit-breaker

Електрическа схема

Circuit diagrams



Общи спецификации

Представените схеми включват всички възможни комбинации, като изборът зависи от поръчката за вакуумен прекъсвач

------ Кабели, които се поставят само за поръчани контакти/терминали

Спецификации за справка:

1) Само ако е поръчан за DC 60 V

2) Само в комбинация с двигател (-M1)

3) Ако е поръчан без контакт/терминал има 200 мм свободен кабел за връзка на клиента

General specifications:

Wiring diagrams includes all possible circuit arrangements, selection dependend on order of circuit breaker

------ Wiring only if ordered, plug/terminal

Specifications with reference:

1) Only if ordered DC 60 V

2) Only in combination with motor (-M1)

3) If ordered without plug/terminal there is a 200 mm free wire for customer connection

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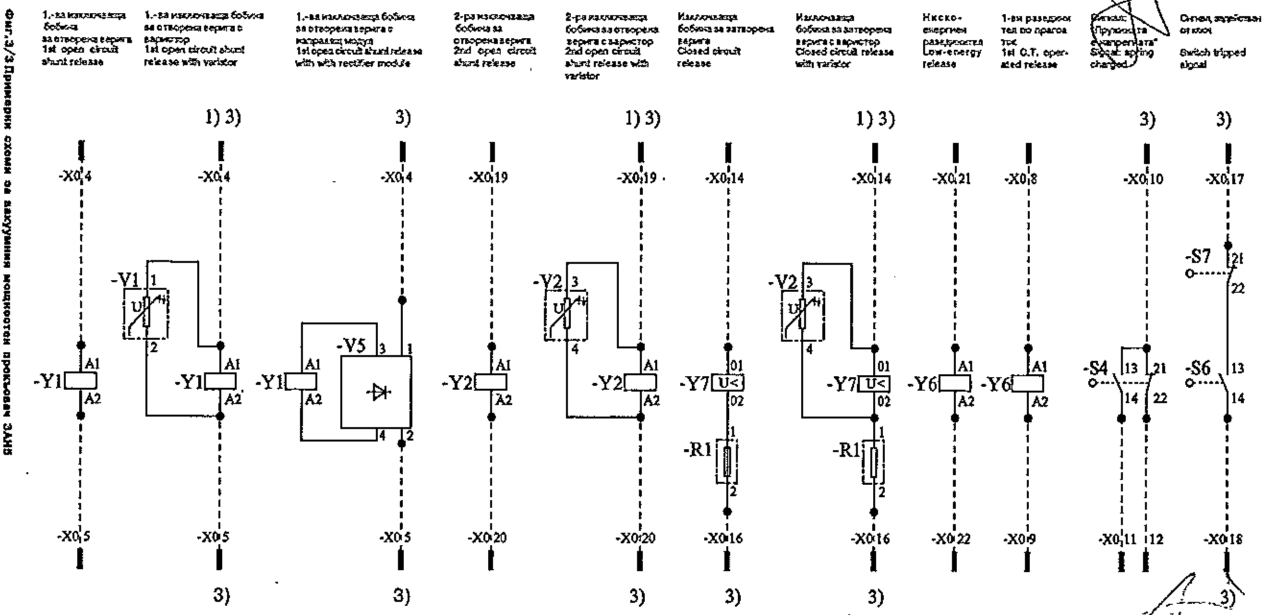
Фиг.3/3 Примерни схеми за вакуумни мощностни прекъсвачи 3AH5
Circuit diagram examples of 3AH5 vacuum circuit-breaker



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General specifications:

Wiring diagrams includes all possible circuit arrangements, selection dependend on order of circuit breaker

------ Wiring only if ordered, plug/terminal

Specifications with reference:

1) Only if ordered DC 60 V

2) Only in combination with motor (-M1)

3) If ordered without plug/terminal there is a 200 mm free wire for customer connection

000399

Работа

⚠ ОПАСНОСТ

Високо напрежение!

Докосването да части под напрежение ще предизвика смърт или тежко увреждано.

С това оборудване може да работи само квалифициран персонал след подробно изучаване на ръководството с инструкции и особено на инструкциите по безопасност.

⚠ ПРЕДУПРЕЖДЕНИЕ

Това оборудване съдържа опасни напрежения и бързо-движещи се части, които може да се управляват дистанционно.

Неспазването на правилата за безопасност може да доведе до тежки увреждания на персонала и техниката.

В частност:
Не отваряйте капака на кутията на механизма. Не бъркайте в отворите на действащия механизъм. Не пипайте полюсите и работните пръти.

Въвеждане в експлоатация

Преди да въведете вакуумния мощностен прекъсвач в експлоатация, проверете следните неща:

1. Почистете добре вакуумния мощностен прекъсвач (за подробности вижте "почистване" - стр. 5/1)
2. Проверете дали всички фиксиращи и терминални болтове са добре затегнати.
3. Проверете за прекъсвача за евентуални външни повреди, особено по контролните изводи, стълбовите изолатори и вакуумните прекъсвачи.

⚠ ВНИМАНИЕ

Вакуумния мощностен прекъсвач може да се ползва само с оригиналната ръчна манивела, за да се избегнат наранявания в случай, че моторът (ако е доставен допълнително) стартира внезапно.

Operation

⚠ DANGER

High voltage!

Touching of live parts will result in death or severe personal injury.

This equipment shall be operated only by qualified personnel after becoming thoroughly familiar with the respective instruction manual and in particular all safety instructions.

⚠ WARNING

This equipment contains hazardous voltages and mechanical parts which move at high speed and may be controlled remotely.

Non - observance of the safety instructions can result in severe personal injury or property damage.

In particular:
Do not remove the cover of the mechanim housing. Do not reach inside any openings in the operating mechanism. Do not touch pole assemblies and operating rods.

Commissioning

Prior to commissioning, check the V-breaker in accordance with the following points:

1. Clean the circuit-breaker as applicable (for details, refer to "Cleaning" page 5/1).
2. Check all fixing and terminal screws for tightness.
3. Examine the circuit-breaker for any external damage, especially to the control leads, post insulators and vacuum interrupters.

⚠ CAUTION

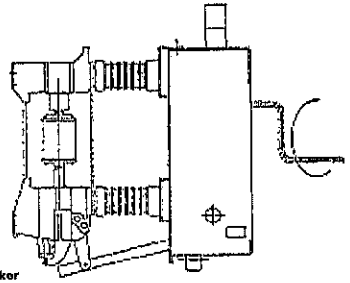
The V-breaker may be operated only with the original hand crank, in order to avoid injuries that may occur if the motor (if fitted as an additional feature) starts up suddenly.

⚠ ВНИМАНИЕ

При подаване на захранващо напрежение, моторът веднага напряга затварящата пружина.

4. За да изпитате ръчно задвижвания ударен механизъм, напрегнете затварящата пружина с манивелата (около 20 оборота) докато прекъсвачът се затвори (Виж Фиг. 4/1). Когато е монтиран пружинен механизъм (допълнително), натиснете бутона "затваряне" (6, Фиг. 3/1) след напрягане на затварящата пружина (символът "затварящата пружина напрегната" се появява в индикаторния отвор (9, Фиг. 3/1). След като прекъсвачът е затворил, отворете го чрез натискане на бутона "отваряне" (7, Фиг. 3/1). Проверете индикаторите за механично и електрическо състояние

   На мощностния вакуумен прекъсвач 3АН5 с разединител по ниско напрежение (Y7) 3АХ1103, задържащият винт на чука трябва да се премести от позиция А към В (виж картат с инструкции в кутията на механизма на мощностния вакуумен прекъсвач 3АН5.



Фиг.4/1 Затваряне на вакуумен прекъсвач 3АН5
Closing the 3AH5 vacuum circuit-breaker

5. Когато прекъсвачът е снабден с моторно задвижван пружинен механизъм, моторът стартира автоматично при подаване на напрежение и напряга затварящата пружина. Затворете и отворете прекъсвача, както е описано по-горо.
6. Проверете спомагателния ключ S1 и ако може - позиционните превключватели - електрически - в двете крайни позиции чрез задействане на прекъсвача 3АН5.
7. Проверете също (чрез електрическо задействано) дали монтираните изключващи отварящи и затварящи бобини работят нормално

След като правилното функциониране на вакуумния прекъсвач е доказано, той може да бъде въведен в работа.

Затваряне

Ударно действие с ръчно задвижване

Затварящата пружина на мощностния прекъсвач се напряга чрез доставената манивела, докато прекъсвачът се затвори. След това задействането на прекъсвача може да бъде ръчно или електрическо. Прекъсвачите с ударен механизъм не са подходящи за автоматично повторно затваряне

Ръчно задвижван пружинен механизъм
(допълнителен)

Затварящата пружина с енапряга ръчно чрез доставената манивела, докато се появи индикация "пружина напрегната" и се чуе щракането на затварящата лапа. След това задтварянето на прекъсвача може да бъде ръчно или електрическо. След затваляне, пружината може отново да бъдо напрегната ръчно.

⚠ CAUTION

When the supply voltage is applied, the motor immediately recharges the closing spring.

4. To test switching with the manually operated snap-action mechanism, charge the closing spring using the hand crank (approx. 20 rotations) until the breakers closes (see Fig. 4/1). When the stored-energy mechanism is fitted (additonal feature), press the "CLOSE" pushbutton (6, Fig. 3/1) after the closing spring is charged (the symbol "Closing spring charged" appears in the indicator opening (9, Fig. 3/1)): Once the circuit-breaker has closed, open it again by pressing the "OPEN" pushbutton (7, Fig. 3/1). Check the mechanical and electrical state indication.

   On the 3AH5 V-breaker with undervoltage release (Y7) 3AX1103, the arresting screw of the hammer must be moved from position A to B (see instruction card in the mechanism housing of the 3AH5 vacuum circuit-breaker).

5. With circuit-breakers equipped with a motor-operated, stored-energy mechanism, the motor starts up automatically when the supply voltage is applied and charges the closing spring. Close and open the circuit-breaker as described above.
6. Check the auxiliary switch S1 and if applicable the position switches electrically in both end positions by actuating the 3AH5 vacuum breaker.
7. Also check (by electrical actuation) whether the shunt closing and opening releases fitted operate properly.

Once correct functioning of the 3AH5 V-breaker has been ascertained, it can be put into service.

Closing

Manually operated snap-action

The closing spring of the circuit-breaker is charged by means of the hand crank supplied until the circuit-breaker closes. It is then possible to trip the breaker either manually or electrically. Breakers equipped with a snap-action mechanism are not suitable for auto-reclosing.

Manually operated stored-energy mechanism
(additional feature)

The closing spring is charged by means of the hand crank supplied until the "spring charged" indication appears and an audible clicking noise indicates that the closing pawl has latched. It is then possible to close the breaker either manually or electrically. After closing, the spring can be recharged manually.

Механизъм с моторно задвижване (M1) и пружина (допълнителен)

Пружинният механизъм може да бъде доставен също и с моторно задвижване, заедно с изключващата затваряща бобина, вместо ръчно задвижвания механизъм. Моторното задвижване стартира веднага при подаване на захранване, затварящата пружина се отпуска и автоматично вътрешно се разтоварва след напрягане. Ръчното задвижване, както е описано в предната глава, също е възможно по всяко време. Манивелата трябва да се поръча отделно.

Максималната входна право-токова мощност е 300 W. Максималната входна променливо-токова мощност е приблизително 350 VA. През част от късото време за напрягане на пружината, моторите работят с претоварване. Препоръчителните категории на моторните защитни устройства са показани на Фиг. 4/2 (защитните устройства не се доставят в комплекта на прекъсвача и трябва да бъдат поръчани отделно).

Motor operating mechanism (M1) with stored-energy mechanism (additional feature)

The stored-energy mechanism of the circuit-breakers is also available with a motor-operated mechanism, including shunt closing release, instead of the manually operated mechanism. The motor-operated mechanism starts operating immediately once the power supply has been connected and the closing spring is discharged and is automatically de-energized internally after charging. Manual operation as described under the chapter above can still be performed at any time. A hand crank has to be ordered separately.

The maximum DC power input is 300 W (approx.). The maximum AC power input is 350 VA (approx.). During part of the short spring charging time, the motors operate in the overload range. The recommended ratings for motion protection devices are shown in Fig. 4/2 (the protection devices are not supplied with the vacuum circuit-breakers and must be ordered separately).

Номинално захранващо напрежение Rated supply voltage	DC 24 V	DC 48 V	DC 60 V	DC/AC 110 V 50 / 60 Hz	DC 220 V/AC 230 V 50 / 60 Hz
Empfohlener Nennstrom der Schutzeinrichtung Препоръчителни токове на моторните защитни устройства	8 A	6 A	4 A	2 A	1,6 A

Фиг4/2Препоръч. токове на моторните защитни устройства

Fig. 4/2 Rated currents of motor protection devices

За защита на моторите, ние препоръчваме MCB с G-характеристика.

Захранващото напрежение на механизма с моторно задвижване може да се отклонява от номиналното с -15% до +10%.

To protect the motors, we recommend an MCB with G characteristics.

The supply voltage of the motor-operated mechanism may deviate from the rated value by -15% to +10%.

Поддръжка

Мерки за безопасност

⚠ ОПАСНОСТ

Поддържката, ремонтът и свързаните с тях работи може да се извършват само от специално обучен пеоонал в съответствие с инструкциите за експлоатация и/или други специални инструкции. Обучение и информация могат д абъдат осигурени от компетентния отдел на Сименс.

Преди започването на всяка работа по вакуумните мощностни прекъсвачи, трябва да се направи справка с местните правила за безопасност по високо-волтови превключватели, например петте правила за безопасност (DIN VDE 0105 Part 100, Item 6.2). Изключете захранването. След това затворете и отворете вакуумния мощностен прекъсвач ръчно (при отворено състояние не се вижда индикацията "затваряща пружина напрегната"), за да сте сигурни, че затварящата пружина е отпусната.

Не-спазването може да предизвика смърт, тежко лично уреждане или значителни материални загуби.

Обслужване

При нормални работни условия вакуумният прекъсвач 3AH5 не се нуждае от поддръжка. Все пак, ние препоръчваме редовен външен оглед за евентуално замърсяване (напр. прах, солена мъгла, губички и др.) по прекъсвача.

Почистване

За да осигурят изолиращия капацитет, изолиращите елементи трябва да бъдат чисти. Изолиращите елементи и външните части на прекъсвача трябва да се бършат с влажен парцал. Използвайте само топла вода с добавка на мек домакински миещ препарат.

⚠ ПРЕДУПРЕЖДЕНИЕ

Намотките и терминалите не бива да се докосват преди да е изключено захранването.

Не-спазването може да предизвика смърт или сериозни лични увреждания.

⚠ ВНИМАНИЕ

Всички пружини на работния механизъм трябва да бъдат отпуснати и вакуумния мощностен прекъсвач да бъде приведен в отворено състояние - индикацията "затваряща пружина напрегната" да не се вижда.
Не-спазването може да предизвика лични увреждания.

Maintenance

Safety measures

⚠ DANGER

Maintenance, repair and subsequent conversion work may be carried out only by specially trained personnel in accordance with the operating instructions and/or special conversion instructions. Training and information sessions for personnel can be provided by the competent Siemens department.

Before starting any work on vacuum circuit-breakers, reference must be made to the local safety regulations for high-voltage switchgear, e. g. the five safety rules (DIN VDE 0105 Part 100, Item 6.2). Switch off the power supply and then close and open the vacuum circuit-breaker by hand (V-breaker in open state, "closing spring charged" indication not visible), to ensure that the closing spring is discharged.

Non-observance can result in death, severe personal injury or substantial property damage.

Servicing

Under normal operating conditions, the 3AH5 vacuum circuit-breaker is maintenance-free. We recommend nonetheless a regular visual inspection to check for soiling (e.g. dust, saline fog, fungus etc.) of the circuit-breaker.

Cleaning

To assure the insulating capacity, it is necessary that the insulating components are clean. Insulating components and external breaker parts must be wiped with a damp cloth. Use only warm water with the addition of a mild liquid household detergent as cleaning agent.

⚠ WARNING

Windings and terminals must not be touched if the power supply has not been disconnected.

Non-observance can result in death or serious personal injury.

⚠ CAUTION

All springs of the operating mechanism must be discharged and the vacuum circuit-breaker be brought into the open state, "Closing spring charged" indication not visible.

Non-observance can result in personal injury.

Ненормални работни условия

Ако вакуумният мощностен прекъсвач 3AH5 се използва при ненормални неблагоприятни външни условия (напр. честа голяма кондензация, запрашен въздух и др.), ние препоръчваме често почистване на външните компоненти на прекъсвача и, ако е необходимо, подмяна на анти-корозионната защита. За съответните работни части на прекъсвача могат да бъдат използвани само следните продукти:

Лагери, триещи се повърхности:
Isoflex Topas L 32
Klueber - Lubrication KG
Geisenhausener Strasse 7
Postfach 70 10 47
D-81379 Muenchen

Лагери, недостъпни за смазване и лагери на спомагателния превключвател S1

SHELL Tellus oel 32
SHELL Mineralšlhandel GmbH
Zitadellenstrasse 5
Postfach 90 09 15
D-21079 Hamburg

Връзките и лагерите, които не могат да бъдат демонтирани **не трябва** да бъдат третирани с почистващ агент преди да се обработят с антикорозиони.

След подмяна на анти-корозионната защита, трябва да се извършат няколко механични тестови операции за превключване на вакуумния мощностен прекъсвач.

Смазките (за специални условия) може да се намерят в съответния отговорен офис на Siemens:

	Каталожен №
180 g Klueber-Isoflex Topas L32 und 50 g SHELL Tellus Oel 32	3AX11 33-3A
180 g Klueber -Isoflex Topas L32	3AX11 33-3H
50 g SHELL Tellus Oel 32	3AX11 33-2G
1 kg SHELL Tellus Oel 32	3AX11 33-2D
1 kg Klueber -Isoflex Topas L32	3AX11 33-3E

Проверка на контактната система

Контактната система се износва както от контактна ерозия, така и от притискането между контактните детайли и водещите болтове. За проверка на износването на контакта в долната опора на прекъсвача е поставен маркер (Фиг. 5/1). Позицията на индикатора (1.) по отношение на ивицата (2.) в затворено състояние показва измененията в контактната система. Прекъсвачът може да се използва само когато индикаторът е в границите на ивицата.

Abnormal operating conditions

If the 3AH5 vacuum circuit-breaker is used in abnormally unfavourable indoor conditions (e.g. frequent heavy condensation, dust-ridden air etc.), we recommend regular cleaning of the breaker external components and, if necessary, renewal of the anti-corrosion protection. Only the following products may be used for the respective working parts of the VCB.

Bearings, sliding surfaces:
Isoflex Topas L 32
Klueber - Lubrication KG
Geisenhausener Strasse 7
Postfach 70 10 47
D-81379 Munich
Federal Republic of Germany

Bearings inaccessible to grease and bearings of the auxiliary switch S1:

SHELL Tellus Oil 32
SHELL Oil trade company GmbH
Zitadellenstraße 5
P.O. Box 900915
D-21079 Hamburg
Federal Republic of Germany

Joints and bearings which cannot be dismantled **must not** be treated with a cleaning agent prior to reapplication of anticorrosives.

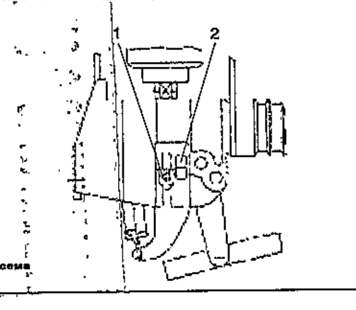
After renewal of the anti-corrosion protection, several mechanical test-switching operations should be performed on the vacuum circuit-breaker.

Lubricants (for special conditions) are available from the Siemens agency responsible:

	Order No
180 g Klueber-Isoflex Topas L32 and 50 g SHELL Tellus Oil 32	3AX11 33-3A
180 g Klueber -Isoflex Topas L32	3AX11 33-3H
50 g SHELL Tellus Oil 32	3AX11 33-2G
1 kg SHELL Tellus Oil 32	3AX11 33-2D
1 kg Klueber -Isoflex Topas L32	3AX11 33-3E

Checking the contact system

The contact system is subject to wear both by contact erosion and by compression of the contact pieces and the guide bolts. To check the contact wear, a marking is provided on the lower interrupter support (Fig. 5/1). The position of the indicator (1) relative to the stripe (2) in closed state indicates changes in the contact system. The breaker may be operated only when the indicator is within the range of the stripe.



Фиг.5/1 Проверка на контактната система
Checking the contact system

Проверка на вакуума

Такава проверка трябва да бъде направена ако съществува риск да се появи изтичане от прекъсвача. Шините и кабелните връзки трябва да бъдат отделени. Проверката се извършва с тестов инструмент HV. Ако е необходимо, може да бъде осигурена допълнителна информация от съответния регионален офис на Siemens.

Проектен работен ресурс

При нормални работни условия, мощностните прекъсвачи са проектирани за 10 000 оперативни цикъла. Поради оптимизация на проектния ресурс на всички части нивото на надеждност пада ако прекъсвачите се използват за по-голям брой цикли на отваряне. Производителят не препоръчва да се продължи използването на мощностните прекъсвачи, дори ако определени части са подновени.

Допустимият брой оперативни цикли като функция на праговия ток е показан на фиг.5/2. Когато този допустим максимум се достигне, полюсите трябва да бъдат подменени. Подробни инструкции са дадени заедно с заместващите прекъсвачи/полюси.

Когато поръчвате заместващи прекъсвачи или полюси, укажете вида на мощностния прекъсвач, кода на проекта и серийния номер (виж табелката с имената).

Checking the vacuum

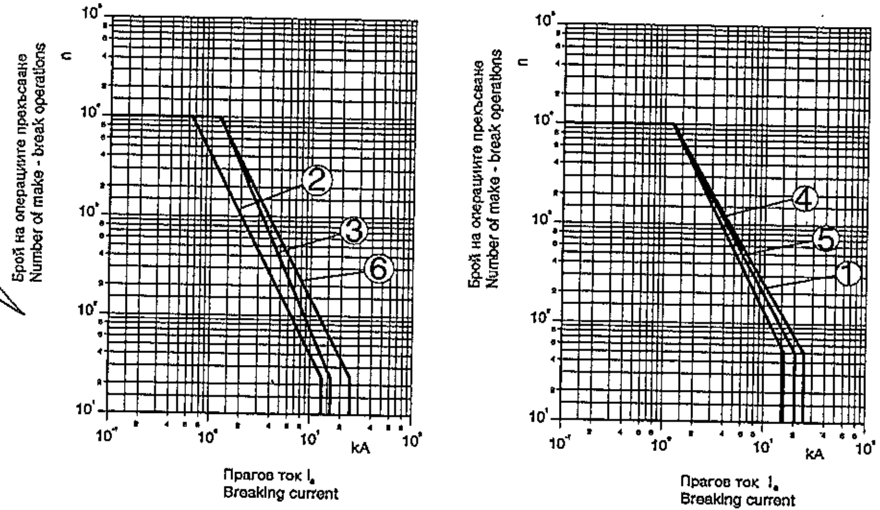
Such a check should be made if there is any risk of an interrupter having developed a leak. Busbar and cable connections must be split. The check is performed with an HV test unit. If necessary, further information may be obtained from the appropriate Siemens Regional Office.

Service life

Under normal operating conditions, the circuit-breakers are designed for 10,000 operating cycles. Due to the optimization of the service life of all parts, the level of reliability falls if the breakers are used for a greater number of opening cycles. The manufacturer can therefore not recommend continued use of the circuit-breakers, even if certain subassemblies are renewed.

The permissible number of electrical operating cycles as a function of the breaking current is shown in Fig. 5/2. When this permissible maximum has been attained, the complete pole assemblies must be renewed. Detailed instructions are supplied with the replacement pole assemblies.

When ordering replacement pole assemblies, state the circuit-breaker type, design code and serial number (see name plate).



Фиг. 5/2 Допустим брой оперативни цикли като функция напраговия ток Ia
Permissible number of operating cycles as a function of breaking current Ia

Принадлежности и резервни части

Поради факта, че всички части от този вид прекъсвач са оптимизирани да издържат номинален проектен ресурс, не е възможно да се препоръча да се държат в резерв определени резервни части. Въпреки това, ако се нуждаете от резервни части, посочете следните данни при поръчването им:

1 Обозначение за тип, код на проекта и сериен номер на вакуумния мощностен прекъсвач 3AH5 (виж. табелката с ном. данни)
2 Обозначението и номера на частта, като направите справка с илюстрациите в тези работни инструкции или на снимка или схема както е възможно. Друга възможност е да се представи образец.

Accessories and spare parts

Owing to the fact that all parts of this breaker type have been optimized to last the normal service life, it is no need to recommend any particular spare parts for keeping in stock. Nevertheless, if you require further spare parts, state the following data when ordering them:

1 Type designation, design code and serial number of the 3AH5 vacuum circuit-breaker (see rating plate).
2 For components not listed as spare parts, state the designation and part number, making reference to illustrations in these Operating Instructions or to a photograph or sketch as applicable. Alternatively, a sample may be submitted.

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Подлежи на промяна

Published by the
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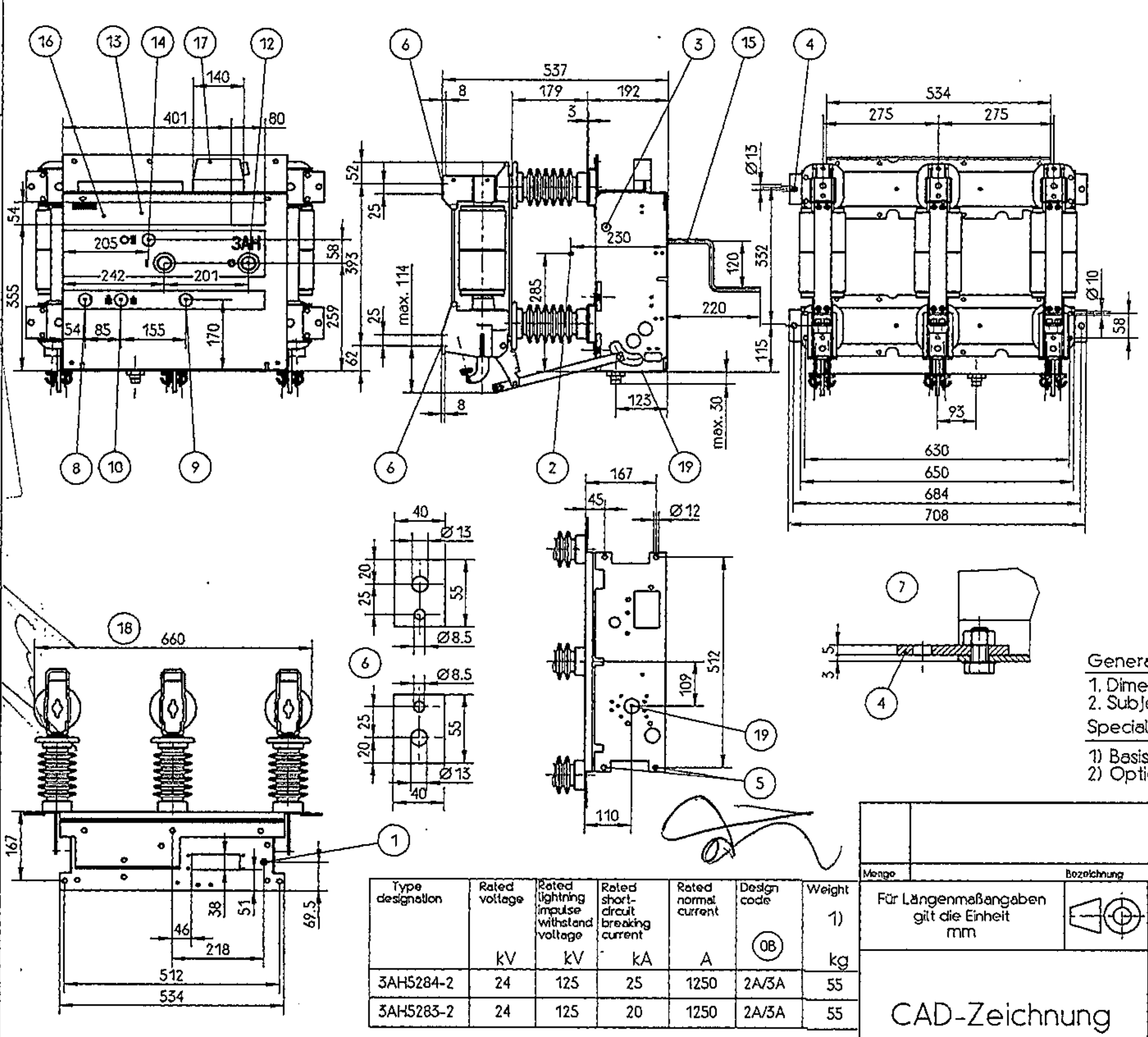
Schaltwerk Berlin

13623 Berlin
Federal Republic of Germany

Subject to change



Type designation	Rated voltage	Rated lightning impulse withstand voltage	Rated short-circuit breaking current	Rated normal current	Design code	Weight 1)
	kV	kV	kA	A	⓪B	kg
3AH5284-2	24	125	25	1250	2A/3A	55
3AH5283-2	24	125	20	1250	2A/3A	55

Legend to drawing 3 M 441 00664 002:

① Earth terminal, M12 screw
② Centre of gravity
③ 2 holes Ø 30 mm for crane hooks
④ Connection pieces for breaker fastening
⑤ Alternative fixing points
⑥ Terminal flanges
⑦ Fitting of connection pieces from loose parts
⑧ Operation counter (optional)
⑨ ON / OFF indicator
⑩ "Spring charged" indicator } (with stored energy mech.)
⑪ Pushbutton "ON"
⑫ Pushbutton "OFF"
⑬ Rating plate
⑭ Aperture for insertable hand crank
⑮ Handcrank (optional)
⑯ Removable mechanism-cover
⑰ 24 way plug connector / terminal block 2)
⑱ Maximum width of live parts
⑲ 7 holes Ø5mm (M6 thread core-hole)
and 1 hole Ø 25 mm
for mech. interlocking device

General information

1. Dimension of bus - bars according to DIN 43 670/671
2. Subjekt to minor deviations from dimensions shown

Special information

1) Basis - Version ; up to 57 kg with accessories
2) Optional

Menge
Bezeichnung
Lfd.Nr.
Sach-Nr.
Bemerkungen

Für Längenmaßangaben
gilt die Einheit
mm

Gepr.. Planung
Maßstab im Original
Masse
Oberfläche

Erst. 15.05.2002
Bearb. Wonneberger
Gepr. u. Freig. n. SV 724-1:
VCB 13 / 24117
Siemens AG
Bereich Energieübertragung und -verteilung Schaltwerk

CAD-Zeichnung

SW-Bezeichnung
V - Circuit - Breaker
Für Typ
Sach-Nr.
3 M 441 00664 002
Blatt

0B | B | Wonneberger 23.10.03 | Vo.
Index (Zust.) | Mitteilung Schlüssel | Änderer Name | Datum Freigabe

Ersatz f.
Ersetzt d.

СИМЕНС

Пренос и разпределение на електроенергия
TVM-A2015

Документи за изпитания
на вакуумен прекъсвач
3AH5135-6
(12 kV, 31.5 kA, 2500 A)

Вакуумните прекъсвачи от тип 3AH5 бяха типово изпитани съгласно

IEC 60694, версия 2.2, 2002-01,
IEC 62271-100, 1-во издание, 2001-05 и
релевантните документи по хармонизацията.

За вакуумния прекъсвач 3AH5135-6 са валидни следните документи за изпитания:

Типови изпитания	Номинални стойности	Документи за изпитания
Диелектрични изпитания	Up = 75 kV Ud = 42 kV	03-029-MH/E
Изпитания с повишаване на температурата	Ir 2500 A	32-016-ME/E
Изпитание за механично сработване при различна околна температура; изпитания при долна и горна граница на температурата	10 000 раб. цикъла	03-015-MM/E 03-038-MM/E
Изпитания при номинален краткотраен ток на термична устойчивост и ток на динамична	Isc = 31.5 kA/3s Ima = 80 kA	03-020-MS/E
Изпитания при ток на включване и ток на изключване при к.с	Isc = 31.5 kA Ima = 80 kA	03-020-MS/E

Средно напрежение
Направление Изпитване
(Подпис не се чете)

Средно напрежение
Направление Проектиране
(Подпис не се чете)

(кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ“)

Берлин, 4 юли, 2003

Средно напрежение
Компоненти
Ръководител: Др. Хърълд Фиен
Пренос и разпределение на електроенергия
Ръководство: Др. Х.Хизингер, Председател, Др. Х.Й-Шлосс

Адрес за
кореспонденция:
Сименс АГ
PTD M C R&D
13623 Берлин

Адрес: Нонендамалее 104
Сименсщат
16329 Берлин
Тел.: (030) 386-24510

Акционерно дружество Сименс: Председатели на Надзорния съвет: Хайнрих ф. Пийрер; Управителен съвет: Клаус Клайнфелд, председател; Йоханес Фелдмайер, Джо Кезер, Руди Лампрехт, Едуардо Монтес, Юрген Радомски, Ерих Р. Райндарт, Херман Реквaрт, Уриел Дж. Шареф, Клаус Вухерер
Седалище на дружеството: Берлин и Мюнхен, регистрация: Берлин Шарлотенбург, HRB 12300, Мюнхен, HRB 6684

ВЯРНО С
ОРИГИНАЛА

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Пренос и разпределение на електроенергия
TVM-A2015

Документи за изпитания
на вакуумен прекъсвач
3AH5135-6
(12 kV, 31.5 kA, 2500 A)

Ако дадено изпитание е проведено с вакуумен прекъсвач с различен номер за поръчки, валидността на документа от изпитанието се задава от следните декларации:

Посочените документи от изпитания за гореспоменатия вакуумен прекъсвач са валидни по отношение на познатата конструкция на вакуумните прекъсвачи, тъй като структурата на главната токова верига и механичния задвижващ механизъм са почти идентични.

Средно напрежение Направление Изпитване (Подпис не се чете)	Средно напрежение Направление Проектиране (Подпис не се чете)

(кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ“)

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Пренос и разпределение на електроенергия
TVM-A2015

Документи за изпитания
на вакуумен прекъсвач
3AH5135-6
(12 kV, 31.5 kA, 2500 A)

В допълнение към типовите изпитания съгласно IEC 60694 и IEC 62271-100 бяха проведени следните изпитания:

Типови изпитания	**Документи от изпитанията**
Изпитания с еднофазно и двойно земно к.с.	03-020-MS/E
Изпитания за комутация на капацитивни токове: -изпитания с ток на изключване на зарядни токове -изпитания за комутация с единична кондензаторна батерия	03-024-MS/E
Изпитания за включване и изключване в условия на дефазиране	03-039-MS/E

Средно напрежение
Направление Изпитване
(Подпис не се чете)

Средно напрежение
Направление Проектиране
(Подпис не се чете)

(кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ")

Берлин, 4 юли, 2003

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Компоненти
Ръководител: Др. Хърълд Фиен
Пренос и разпределение на електроенергия
Ръководство: Др. Х.Хизингер, Председател, Др. Х.Й-Шлосс

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ВЯРНО С
ОРИГИНАЛА

NEOTERA Ltd.

СИМЕНС

Пренос и разпределение на електроенергия
TVM 2032а

Документи за изпитания
на вакуумен прекъсвач
3AH5283-2
(24 kV, 20 kA, 1250 A)

Вакуумните прекъсвачи от тип 3AH5 бяха типово изпитани съгласно

IEC 60694, версия 2.2, 2002-01,
IEC 62271-100, 1-во издание, 2001-05 и
релевантните документи по хармонизацията.

За вакуумния прекъсвач 3AH5283-2 са валидни следните документи за изпитания:

Типови изпитания	**Номинални стойности**	**Документи за изпитания**
Диелектрични изпитания	Up = 125 kV Ud = 50 kV	02-021-MH/E
Изпитания с повишаване на температурата	Ir = 1250 A	02-014-ME/E
Изпитание за механично сработване при различна околна температура; изпитания при долна и горна граница на температурата	10 000 раб. цикъла	02-012-MM/E
Изпитания при номинален краткотраен ток на термична устойчивост и ток на динамична	Isc = 20 kA/3s Ima = 50 kA	03-021-MS/E
Изпитания при ток на включване и ток на изключване при к.с.	Isc = 20 kA Ima = 50 kA	03-021-MS/E

(подпис – не се чете) (кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ")

Ангер
Ръководител отдел Изследвания, разработване и изпитване на компоненти за средно напрежение

Берлин, 28 ноември 2006

Сименс АГ
Направление: Средно напрежение
Ръководител: Волфганг Хойринг, Ръководител: Норберт Райнхард Отдел: Пренос и разпределение на електроенергия
Ръководство: Удо Нийхаге, председател; Памела Кнап, Кристиан Урбанке

Адрес за кореспонденция:
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Адрес: Ноненедамалее 104
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Тел.: +49 (30) 386-0

Акционерно дружество Сименс: Председатели на Надзорния съвет: Хайнрих ф. Пийрер; Управителен съвет: Клаус Клайнфелд, председател; Йоханес Фелдмайер, Джо Кезер, Руди Лампрехт, Едуардо Монтес, Юрген Радомски, Ерих Р. Райндарт, Херман Рекварт, Уриел Дж. Шареф, Клаус Вухерер
Седалище на дружеството: Берлин и Мюнхен, регистрация: Берлин Шарлотенбург, HRB 12300, Мюнхен, HRB 6684
Данъчен рег. No. DE 23691322

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Пренос и разпределение на електроенергия
TVM 2032a

Документи за изпитания
на вакуумен прекъсвач
3AH5283-2
(24 kV, 20 kA, 1250 A)

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(подпис – не се чете) (кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ")

Ангер
Ръководител отдел Изследвания, разработване и изпитване на компоненти за средно напрежение

Берлин, 28 ноември 2006

Сименс АГ
Направление: Средно напрежение
Ръководител: Волфганг Хойринг, Ръководител: Норберт Райнхард Отдел:
Пренос и разпределение на електроенергия
Ръководство: Удо Нийхаге, председател; Памела Кнап, Кристиан Урбанке

Адрес за кореспонденция:
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Акционерно дружество Сименс: Председатели на Надзорния съвет: Хайнрих ф. Пийрер; Управителен съвет: Клаус Клайнфелд, председател; Йоханес Фелдмайер, Джо Кезер, Руди Лампрехт, Едуардо Монтес, Юрген Радомски, Ерих Р. Райндарт, Херман Реквaрт, Уриел Дж. Шареф, Клаус Вухерер
Седалище на дружеството: Берлин и Мюнхен, регистрация: Берлин Шарлотенбург, HRB 12300, Мюнхен, HRB 6684
Данъчен рег. No. DE 23691322

ВЯРНО С
ОРИГИНАЛА

Стара Загора

СИМЕНС

Пренос и разпределение на електроенергия
TVM 2032a

Документи за изпитания
на вакуумен прекъсвач
3AH5283-2
(24 kV, 20 kA, 1250 A)

В допълнение към типовите изпитания съгласно IEC 60694 и IEC 62271-100 бяха проведени следните изпитания:

Типови изпитания	**Документи от изпитанията**
Изпитания с еднофазно и двойно земно к.с.	03-021-MS/E
Изпитания за комутация на капацитивни токове: -изпитания с ток на изключване на зарядни токове -изпитания за комутация с единична кондензаторна батерия	03-032-MS/E
Изпитания за включване и изключване в условия на дефазиране	03-045-MS/E

(подпис – не се чете) (кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ“)

Ангер
Ръководител отдел Изследвания, разработване и изпитване на компоненти за средно напрежение

Берлин, 28 ноември 2006

Сименс АГ
Направление: Средно напрежение
Ръководител: Волфганг Хойринг, Ръководител: Норберт Райнхард Отдел: Пренос и разпределение на електроенергия
Ръководство: Удо Нийхаге, председател; Памела Кнап, Кристиан Урбанке

Адрес за кореспонденция:
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13623 Берлин

Адрес: Нонендамалее 104
Сименсщат
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Акционерно дружество Сименс: Председатели на Надзорния съвет: Хайнрих ф. Пийрер; Управителен съвет: Клаус Клайнфелд, председател; Йоханес Фелдмайер, Джо Кезер, Руди Ламппрехт, Едуардо Монтес, Юрген Радомски, Ерих Р. Райндарт, Херман Рекварт, Уриел Дж. Шареф, Клаус Вухерер
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Данъчен рег. No. DE 23691322

ВЯРНО С
ОРИГИНАЛА

СИМЕНС

Пренос и разпределение на електроенергия
TVM-A2014

Документи за изпитания
на вакуумен прекъсвач
3AH5135-2
(12 kV, 31.5 kA, 1250 A)

Вакуумните прекъсвачи от тип 3AH5 бяха типово изпитани съгласно

IEC 60694, версия 2.2, 2002-01,
IEC 62271-100, 1-во издание, 2001-05 и
релевантните документи по хармонизацията.

За вакуумния прекъсвач 3AH5135-2 са валидни следните документи за изпитания:

Типови изпитания	**Номинални стойности**	**Документи за изпитания**
Диелектрични изпитания	Up = 75 kV Ud = 42 kV	03-030-MH/E
Изпитания с повишаване на температурата	Ir = 1250 A	94-002-ME/E
Изпитание за механично сработване при различна околна температура; изпитания при долна и горна граница на температурата	10 000 раб. цикъла	03-015-MM/E 03-038-MM/E
Изпитания при номинален краткотраен ток на термична устойчивост и ток на динамична	Isc = 31.5 kA/3s Ima = 80 kA	03-033-MS/E
Изпитания при ток на включване и ток на изключване при к.с.	Isc = 31.5 kA Ima = 80 kA	03-020-MS/E

Средно напрежение
Направление Изпитване
(Подпис не се чете)

Средно напрежение
Направление Проектиране
(Подпис не се чете)

(кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ")

Берлин, 4 юли, 2003

Средно напрежение
Компоненти
Ръководител: Др. Хърълд Фиен
Пренос и разпределение на електроенергия
Ръководство: Др. Х.Хизингер, Председател, Др. Х.Й-Шлосс

Адрес за
кореспонденция:
Сименс АГ
PTD M C R&D
13623 Берлин

Адрес: Нонендамалее 104
Сименсщат
16329 Берлин
Тел.: (030) 386-24510

Акционерно дружество Сименс: Председатели на Надзорния съвет: Хайнрих ф. Пийрер; Управителен съвет: Клаус Клайнфелд, председател; Йоханес Фелдмайер, Джо Кезер, Руди Лампрехт, Едуардо Монтес, Юрген Радомски, Ерих Р. Райндарт, Херман Рекварт, Уриел Дж. Шареф, Клаус Вухерер
Седалище на дружеството: Берлин и Мюнхен, регистрация: Берлин Шарлотенбург, HRB 12300, Мюнхен, HRB 6684

ВЯРНО С ОРИГИНАЛА

СИМЕНС

Пренос и разпределение на електроенергия
TVM-A2014

Документи за изпитания
на вакуумен прекъсвач
3AH5135-2
(12 kV, 31.5 kA, 1250 A)

Ако дадено изпитание е проведено с вакуумен прекъсвач с различен номер за поръчки, валидността на документа от изпитанието се задава от следните декларации:

Посочените документи от изпитания за гореспоменатия вакуумен прекъсвач са валидни по отношение на познатата конструкция на вакуумните прекъсвачи, тъй като структурата на главната токова верига и механичния задвижващ механизъм са почти идентични.

Средно напрежение
Направление Изпитване
(Подпис не се чете)

Средно напрежение
Направление Проектиране
(Подпис не се чете)

(кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ")

Берлин, 4 юли, 2003

Средно напрежение
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Пренос и разпределение на електроенергия
Ръководство: Др. Х.Хизингер, Председател, Др. Х.Й-Шлосс

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16329 Берлин
Тел.: (030) 386-24510

Акционерно дружество Сименс: Председатели на Надзорния съвет: Хайнрих ф. Пийрер; Управителен съвет: Клаус Клайнфелд, председател; Йоханес Фелдмайер, Джо Кезер, Руди Лампрехт, Едуардо Монтес, Юрген Радомски, Ерих Р. Райндарт, Херман Рекварт, Уриел Дж. Шареф, Клаус Вухерер
Седалище на дружеството: Берлин и Мюнхен, регистрация: Берлин Шарлотенбург, HRB 12300, Мюнхен, HRB 6684

ВЯРНО С
ОРИГИНАЛА

СИМЕНС

Пренос и разпределение на електроенергия
TVM-A2014

Документи за изпитания на вакуумен прекъсвач 3AH5135-2 (12 kV, 31.5 kA, 1250 A)

В допълнение към типовите изпитания съгласно IEC 60694 и IEC 62271-100 бяха проведени следните изпитания:

Типови изпитания	**Документи от изпитанията**
Изпитания с еднофазно и двойно земно к.с.	03-020-MS/E
Изпитания за комутация на капацитивни токове: -изпитания с ток на изключване на зарядни токове -изпитания за комутация с единична кондензаторна батерия	03-024-MS/E
Изпитания за включване и изключване в условия на дефазиране	03-039-MS/E

Средно напрежение Направление Изпитване (Подпис не се чете)	Средно напрежение Направление Проектиране (Подпис не се чете)

(кръгъл печат „Изпитателна станция за комутационно оборудване за средно напрежение на Сименс АГ")

Берлин, 4 юли, 2003

Средно напрежение
Компоненти
Ръководител: Др. Хърълд Фиен
Пренос и разпределение на електроенергия
Ръководство: Др. Х.Хизингер, Председател, Др. Х.Й-Шлосс

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ВЯРНО С
ОРИГИНАЛА

SIEMENS

Power Transmission and Distribution

TVM 2032a

Test Documents for Vacuum Circuit-Breaker 3AH5283-2 (24 kV, 20 kA, 1250 A)

The vacuum circuit-breakers of type 3AH5 were type tested in accordance with

IEC 60694, edition 2.2, 2002-01,
IEC 62271-100, 1st edition, 2001-05 and the relevant harmonisation documents.

For vacuum circuit-breaker 3AH5283-2 the following test documents are valid:

Type Tests	**Rated Values**	**Test Documents**
Dielectric tests	U_P = 125 kV U_d = 50 kV	02-021-MH/E
Temperature-rise tests	I_r = 1250 A	02-014-ME/E
Mechanical operation test at ambient temperature, Low and high temperature tests	10.000 op. Cycles	02-012-MM/E
Short-time withstand current and peak withstand current tests	I_{sc} = 20 kA/3s I_{ma} = 50 kA	03-021-MS/E
Short-circuit making and breaking tests	I_{sc} = 20 kA I_{ma} = 50 kA	03-021-MS/E

Anger
Head of Medium Voltage Components
Research, Development & Testing Department

Prüffeld der Schaltwerke
Siemens AG
Berlin
Bereich Mittelspannung

Berlin, November 28, 2006

Siemens AG
Geschäftsgebiet: Medium Voltage
Leitung: Wolfgang Heuring, Kfm. Leitung: Norbert Reinhard
Bereich: Power Transmission and Distribution
Vorstand: Udo Niehage, Vorsitzender; Pamela Knapp, Christian Urbanke

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Siemens Aktiengesellschaft: Vorsitzender des Aufsichtsrats: Heinrich v. Pierer; Vorstand: Klaus Kleinfeld, Vorsitzender; Johannes Feldmayer, Joe Kaeser, Rudi Lamprecht, Eduardo Montes, Jürgen Radomski, Erich R. Reinhardt, Hermann Requardt, Uriel J. Sharef, Klaus Wucherer
Sitz der Gesellschaft: Berlin und München, Registergericht: Berlin Charlottenburg, HRB 12300, München, HRB 6684
WEEE-Reg.-Nr. DE 23691322

SIEMENS

Power Transmission and Distribution

TVM 2032a

Test Documents
for Vacuum Circuit-Breaker
3AH5283-2
(24 kV, 20 kA, 1250 A)

If a test is carried out with a vacuum circuit-breaker with different order number, the validity of the test document is given by the following statements:

The listed test documents for the mentioned vacuum circuit-breaker are valid in respect to familiar design of the vacuum circuit-breakers, as the construction of the main current path and mechanical driving mechanism is nearly identical.

Prüffeld der Schaltwerke Siemens AG Berlin Bereich Mittelspannung

Anger
Head of Medium Voltage Components
Research, Development & Testing Department

Berlin, November 28, 2006

Siemens AG
Geschäftsgebiet: Medium Voltage
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Sitz der Gesellschaft: Berlin und München, Registergericht: Berlin Charlottenburg, HRB 12300, München, HRB 6684
WEEE-Reg.-Nr. DE 23691322

SIEMENS

Power Transmission and Distribution

TVM 2032a

Test Documents
for Vacuum Circuit-Breaker
3AH5283-2
(24 kV, 20 kA, 1250 A)

In addition to the type tests in accordance with IEC 60694 and IEC 62271-100 the following tests were carried out:

Type Tests	Test Documents
Single-phase and double earth fault tests	03-021-MS/E
Capacitive current switching tests: -cable-charging current breaking tests -single capacitor bank switching tests	03-032-MS/E
Out-of-phase making and breaking tests	03-045-MS/E

Anger
Head of Medium Voltage Components
Research, Development & Testing Department

Prüffeld der Schaltwerke
Siemens AG
Berlin
Bereich Mittelspannung

Berlin, November 28, 2006

Siemens AG
Geschäftsgebiet: Medium Voltage
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Sitz der Gesellschaft: Berlin und München, Registergericht: Berlin Charlottenburg, HRB 12300, München, HRB 6684
WEEE-Reg.-Nr. DE 23691322

SIEMENS

Test Document

Report No.: 03-021-MS/E **Copy No.:** 0 **Contents:** 119 sheets

Equipment under test: Three-pole vacuum circuit-breaker 3AH5273-2 (24 kV, 20 kA, 1250 A) with vacuum interrupters VS 25005.

Manufacturer: Siemens AG, PTD M C PB1, 13623 Berlin

Client: Siemens AG, PTD M C R&D VCB 13, 13623 Berlin

Testing station: Siemens AG, Prüffeld der Schaltwerke, Berlin

Date of test: February 07 till 20-2003

Applied test specifications:

IEC Publication 60694, edition 2.2, 2002-01
IEC Publication 62271-100, 1st edition, 2001-05
DIN EN 60694 (VDE 0670, Teil 1000), 2002-09

Tests performed:

Short-time and peak withstand current tests:
Peak current: 53.7 kA and 65.6 kA
Short-time current: 20.9 kA and 25.5 kA - 3 s
Short-circuit making and breaking tests in test duties:

T100s:	54.7 kA up to 60.5 kA	at	26.3 kV up to 28.0 kV
	21.0 kA up to 21.2 kA	at	26.3 kV up to 26.8 kV
T100a:	20.3 kA up to 21.3 kA	at	24.5 kV up to 26.2 kV, 43% ≤ dc ≤ 47%
T60:	11.3 kA up to 12.0 kA	at	24.2 kV up to 25.5 kV
T30:	6.0 kA up to 6.1 kA	at	24.6 kV up to 25.3 kV
T10:	1.9 kA up to 2.0 kA	at	24.1 kV up to 24.2 kV

Double-earth fault: 17.3 kA at 26.5 kV
Single-phase: 20.2 kA at 15.8 kV

Test results: The apparatus tested has passed the above indicated tests for a rated short-circuit current of 20 kA at a rated voltage of 24 kV without any objection. The results obtained and the proved performance comply with the requirements mentioned above.

Siemens Aktiengesellschaft
Prüffeld der Schaltwerke, Berlin

i.V. Anger
Manager of Prüffeld der Schaltwerke
Medium Voltage Division

Siemens AG
Berlin

i.V. Jäger
Manager of High-Power/High Voltage
Testing Department
Medium Voltage Division

Berlin, May 31-2003

The test results exclusively relate to the items tested.

Deutscher Akkreditierungs Rat
DAR
DAT-P-017/92-02

Technical Data of Test Object

Switching Device

Ratings assigned by the manufacturer

Test object: Three-pole vacuum circuit-breaker with vacuum interrupters VS 25005
Type: 3AH5273-2
Manufacturer: Siemens AG, PTD M C PB1
Serial No.: 3AH5/00012873 **Year of manufacture:** 2003
Drawing No.: Drawings and part lists - see sheet 6

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated short-duration power-frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	50	kA
Rated short-time withstand current	20	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	20	kA
D.C. component	36	%
Rated short-circuit making current	50	kA
Rated transient recovery voltage		
Peak value	41	kV
Rate of rise	0.47	kV/μs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	vacuum	
Rated pressure (20 °C) (absolute)	< 0.01	Pa
Insulating medium	air	
Rated pressure / Minimum pressure (20 °C)	-	MPa
Driving mechanism		
Type of drive	spring/motor	
Rated voltage	110	V DC
Number of poles	3	
Number of units per pole	1	
Rated opening time	< 65	ms
Rated closing time	< 75	ms
Rated voltage of opening release	110	V DC
Rated voltage of closing release	110	V DC
Rated supply voltage	-	V DC
Rated frequency of supply voltage	-	Hz
Further specifications:		

Tube in pole R	S.-No.:	44236
Tube in pole S	S.-No.:	44234
Tube in pole T	S.-No.:	44232

Essential characteristics: -

Remarks: -

SIEMENS

Test Document

Report No.: 03-032-MS/E **Copy No.:** 0 **Contents:** 121 sheets

Equipment under test: Three-pole vacuum circuit-breaker 3AH5273-2 (24 kV, 20 kA, 1250 A) with vacuum interrupters VS 25005.

Manufacturer: Siemens AG, PTD M C PB1, 13623 Berlin

Client: Siemens AG, PTD M C R&D VCB 13, 13623 Berlin

Testing station: Siemens AG, Prüffeld der Schaltwerke, Berlin

Date of test: April 09 till May 05-2003

Applied test specifications:

IEC Publication 60694, edition 2.2, 2002-01
DIN EN 60694 (VDE 0670, Teil 1000), 2002-09
IEC Publication 62271-100, 1st edition, 2001-05

Tests performed:
Test-duty T60: 14.8 kA up to 14.9 kA at 17.7 kV
Cable-charging current switching tests in test-duties:
CC2: 32.9 A up to 33.3 A at 24.8 kV up to 25.1 kV
CC1: 7.1 A at 25.0 kV up to 25.1 kV
Single capacitor bank current switching tests in test-duties:
BC2: 408.7 A up to 419.3 A at 24.8 kV up to 25.2 kV
BC1: 93.7 A up to 94.7 A at 24.9 kV up to 25.0 kV

Test results: The apparatus tested has passed the above indicated tests for a rated voltage of 24 kV without any objection. The results obtained and the proved performance comply with the requirements mentioned above.

Siemens Aktiengesellschaft
Prüffeld der Schaltwerke, Berlin

i.V.
Anger
Manager of Prüffeld der Schaltwerke
Medium Voltage Division

Prüffeld der Schaltwerke
Siemens AG
Berlin
Bereich Mittelspannung

i.V. Jäger
Jäger
Manager of High-Power/High Voltage
Testing Department
Medium Voltage Division

Berlin, June 13-2003

The test results exclusively relate to the items tested.

Deutscher
Akkreditierungs
Rat
DAR

DAT-P-017/92-02

Technical Data of Test Object

Switching Device

Ratings assigned by the manufacturer

Test object: Three-pole vacuum circuit-breaker with vacuum interrupters VS 25005
Type: 3AH5273-2
Manufacturer: Siemens AG, PTD M C PB1
Serial No.: 3AH5/00012873 **Year of manufacture:** 2003
Drawing No.: Drawings and part lists - see sheet 6

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated short-duration power-frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	50	kA
Rated short-time withstand current	20	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	20	kA
D.C. component	36	%
Rated short-circuit making current	50	kA
Rated transient recovery voltage		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	vacuum	
Rated pressure (20 °C) (absolute)	< 0.01	Pa
Insulating medium	air	
Rated pressure / Minimum pressure (20 °C)	-	MPa
Driving mechanism		
Type of drive	spring/motor	
Rated voltage	110	V DC
Number of poles	3	
Number of units per pole	1	
Rated opening time	< 65	ms
Rated closing time	< 75	ms
Rated voltage of opening release	110	V DC
Rated voltage of closing release	110	V DC
Rated supply voltage	-	V DC
Rated frequency of supply voltage	-	Hz

Further specifications:

Tube in pole R	S.-No.:	44842
Tube in pole S	S.-No.:	44841
Tube in pole T	S.-No.:	44843

Essential characteristics: -

Remarks: -

SIEMENS

Test Document

Report No.: 02-021-MH/E **Copy No.:** 0 **Contents:** 14 sheets

Equipment under test: Three-pole vacuum circuit-breaker 3AH5284-2 (24 kV, 25 kA, 1250 A) with vacuum interrupters VS25005

Manufacturer: Siemens AG, PTD M C PB1, 13623 Berlin

Client: Siemens AG, PTD M C R&D VCB 13, 13623 Berlin

Testing station: Siemens AG, Prüffeld der Schaltwerke, Berlin

Date of test: June 12, 2002

Applied test specifications:

IEC Publication 60694, edition 2.2, 2002-01 DIN EN 60694 (VDE 670, Teil 1000), Oktober 1998

Tests performed:

Dielectric tests, including:

Short-duration power-frequency withstand voltage:	50 kV
Lightning impulse withstand voltage:	125 kV

Test results:

The apparatus tested has passed the above indicated tests without any objection. The results obtained and the proved performance comply with the requirements mentioned above.

Siemens Aktiengesellschaft
Prüffeld der Schaltwerke, Berlin

i.V.
Manager of Prüffeld der Schaltwerke
Medium Voltage Division
Anger

SIEMENS
Berlin

i.V.
Manager of High Voltage Testing Department
Medium Voltage Division
Jäger

Berlin, July 26, 2002

The test results exclusively relate to the items tested.

Deutscher
Akkreditierungs
Rat
DAR

DAT-P-017/92-01

Technical Data of Test Object

Switching Device

Ratings assigned by the manufacturer

Test object: Three-pole vacuum-circuit breaker with vacuum interrupters type VS25005
Type: 3AH5284-2
Manufacturer: Siemens AG
Serial No.: 3AH5/00011497 **Year of manufacture:** 2002
Drawing No.: Drawings and part lists - see sheet 6

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated short-duration power-frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	25	kA
D.C. component	36	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage		
Peak value	41	kV
Rate of rise	0.47	kV/μs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	vacuum	
Rated pressure (20 °C) (absolute)	< 0.01	Pa
Insulating medium	air	
Rated pressure / Minimal pressure (20 °C)	-	MPa
Driving mechanism		
Type of drive	spring/ motor	
Rated voltage	110	V DC
Number of poles	3	
Number of units per pole	1	
Rated opening time	< 65	ms
Rated closing time	< 75	ms
Rated voltage of opening release	110	V DC
Rated voltage of closing release	110	V DC
Rated supply voltage	-	V DC
Rated frequency of supply voltage	-	Hz

Further specifications:

Tube in pole R	S.-No.:	37886
Tube in pole S	S.-No.:	37889
Tube in pole T	S.-No.:	37885

Essential characteristics: -

Remarks: -

SIEMENS

Test Document

Report No.: 02-014-ME/E **Copy No.:** 0 **Contents:** 12 sheets

Equipment under test: Three-pole vacuum circuit-breaker 3AH5 272-2, (24 kV, 16 kA, 1250 A) with vacuum interrupters VS 24016

Manufacturer: Siemens AG, PTD M C PB1, 13623 Berlin

Client: Siemens AG, PTD M C R&D VCB 1, 13623 Berlin

Testing station: Siemens AG, Prüffeld der Schaltwerke, Berlin

Date of test: July 31-2002

Applied test specifications:

IEC Publication 60694, edition 2.2, 2002-01
DIN EN 60694 (VDE 670, Teil 1000), Oktober 1998
IEC Publication 62271-100, 1st edition, 2001-05

Tests performed: Temperature rise test

Test results:

The apparatus tested has passed the above indicated tests without any objection. The results obtained and the proved performance comply with the requirements mentioned above.

Siemens Aktiengesellschaft
Prüffeld der Schaltwerke, Berlin

i.V.
Manager of Prüffeld der Schaltwerke
Medium Voltage Division
Jäger

Siemens AG
Berlin

i.V.
Manager of Mechanical Testing Department
Medium Voltage Division
Stelzer

Berlin, August 02-2002

The test results exclusively relate to the items tested.

Deutscher Akkreditierungs Rat
DAR
DAT-P-017/92-01

Technical Data of Test Object

Switching Device

Ratings assigned by the manufacturer

Test object:	Vacuum circuit breaker
Type:	3AH5 272-2; VS 24016
Manufacturer:	Siemens AG, PTD M C PB1
Serial No.:	3AH5/ 0001 1577
Drawing No.:	Drawings and part lists - see sheet 6

Year of manufacture: 2002

Rated voltage	24	kV
Rated lightning impulse withstand voltage	125	kV
Rated switching impulse withstand voltage	-	kV
Rated short-duration power-frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	40	kA
Rated short-time withstand current	16	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	16	kA
D.C. component	36	%
Rated short-circuit making current	40	kA
Rated transient recovery voltage		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	Vacuum	
Rated pressure (20 °C) (absolute)	<0.01	Pa
Insulating medium	Air	
Rated pressure / Minimum pressure (20 °C)	-	MPa
Driving mechanism		
Type of drive	Motor / Spring	
Rated voltage	110	V DC
Number of poles	3	
Number of units per pole	1	
Rated opening time	< 65	ms
Rated closing time	< 75	ms
Rated voltage of opening release	110	V DC
Rated voltage of closing release	110	V DC
Rated supply voltage	110	V DC
Rated frequency of supply voltage	-	Hz
Further specifications:		

Tube in pole R	S.-No.:	8828
Tube in pole S	S.-No.:	8813
Tube in pole T	S.-No.:	8821

Essential characteristics: -

Remarks: -

SIEMENS

Test Document

Report No.: 02-012-MM/E **Copy No.:** 0 **Contents:** 16 sheets

Equipment under test: Three-pole vacuum circuit-breaker 3AH5284-2, (24 kV, 25 kA, 1250 A) with vacuum interrupters VS 25005
Manufacturer: Siemens AG, PTD M C PB1, 13623 Berlin
Client: Siemens AG, PTD M C R&D VCB 1, 13623 Berlin
Testing station: Siemens AG, Prüffeld der Schaltwerke, Berlin
Date of test: April 25-2002 – July 01-2002

Applied test specifications:

IEC Publication 60694, edition 2.2, 2002-01
IEC Publication 62271-100, 1st edition, 2001-05
DIN EN 60694 (VDE 670, Teil 1000), Oktober 1998

Tests performed:
Mechanical type test
10.000 operation cycles
Low and high temperature test

Test results:

The apparatus tested has passed the above indicated tests without any objection. The results obtained and the proved performance comply with the requirements mentioned above.

Siemens Aktiengesellschaft
Prüffeld der Schaltwerke, Berlin

Siemens AG
Berlin

i.V. Anger
Manager of Prüffeld der Schaltwerke
Medium Voltage Division

i.V. Stelzer
Manager of Mechanical Testing Department
Medium Voltage Division

Berlin, August 12-2002

The test results exclusively relate to the items tested.

Deutscher Akkreditierungs Rat
DAR
DAT-P-017/92-01

Technical Data of Test Object

Switching Device

Ratings assigned by the manufacturer

Test object: Vacuum circuit breaker
Type: 3AH5284-2
Manufacturer: Siemens AG
Serial No.: 3AH5/00011497 **Year of manufacture:** 2002
Drawing No.: Drawings and part lists - see sheet 6

Rated voltage	24	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated short-duration power-frequency withstand voltage	50	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	63	kA
Rated short-time withstand current	25	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	25	kA
D.C. component	36	%
Rated short-circuit making current	63	kA
Rated transient recovery voltage		
Peak value	41	kV
Rate of rise	0.47	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	Vacuum	
Rated pressure (20 °C) (absolute)	< 0.01	Pa
Insulating medium	Air	
Rated pressure / Minimum pressure (20 °C)	-	MPa
Driving mechanism		
Type of drive	Motor/Spring	
Rated voltage	110	V DC
Number of poles	3	
Number of units per pole	1	
Rated opening time	< 75	ms
Rated closing time	< 65	ms
Rated voltage of opening release	110	V DC
Rated voltage of closing release	110	V DC
Rated supply voltage	110	V DC
Rated frequency of supply voltage	-	Hz
Further specifications:		

Tube in pole R	S.-No.:	37885
Tube in pole S	S.-No.:	37889
Tube in pole T	S.-No.:	37886

Essential characteristics: -

Remarks: -

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

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von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

Siemens Aktiengesellschaft
Wittelsbacher Platz 2, 80333 München

Standort:
Siemens Aktiengesellschaft
PSW (Prüffeld der Schaltwerke)
EM HP BSS LAB
Nonnendammallee 104, 13629 Berlin

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Hochspannungsschaltgeräte und -anlagen sowie
Geräte der elektrischen Energietechnik

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 26.02.2016 mit der Akkreditierungsnummer D-PL-11055-10 und ist gültig bis 25.02.2021. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 12 Seiten.

Registrierungsnummer der Urkunde: **D-PL-11055-10-00**

Frankfurt, 26.02.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Deutsche Akkreditierungsstelle GmbH

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Spittelmarkt 10
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Europa-Allee 52
60327 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

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Deutsche Akkreditierungsstelle GmbH

Anlage zur Akkreditierungsurkunde D-PL-11055-10-00 nach DIN EN ISO/IEC 17025:2005

Gültigkeitsdauer: 26.02.2016 bis 25.02.2021 Ausstellungsdatum: 26.02.2016

Urkundeninhaber:

Siemens Aktiengesellschaft
Wittelsbacher Platz 2, 80333 München

Standort:
Siemens Aktiengesellschaft
PSW (Prüffeld der Schaltwerke)
EM HP BSS LAB
Nonnendammallee 104, 13629 Berlin

Prüfungen in den Bereichen:

Hochspannungsschaltgeräte und -anlagen sowie Geräte der elektrischen Energietechnik

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Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Allgemein			
Elektrotechnik	DIN EN 62271-1:2012 VDE 0671-1:2012 EN 62271-1:2011 IEC 62271-1:2011	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 1: Gemeinsame Bestimmungen	
Elektrotechnik	IEEE 4:2013	IEEE Standard Techniques for High-Voltage Testing	
Elektrotechnik	IEEE Std C37.20.2:1999	IEEE Standard for Metal-Clad Switchgear	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	IEEE Std C37.20.3:2013	IEEE Standard for Metal-Enclosed Interrupter Switchgear	
Elektrotechnik	IEEE Std C37.100:1992	IEEE Standard Definitions for Power Switchgear	
Elektrotechnik	IEEE Std C37.100.1:2007	Common requirements for high voltage power switchgear rated above 1000 V	
Elektrotechnik	GOST 1516.3-96	Electrical equipment for a.c. voltages from 1 to 750 kV – Requirements for electric strength of insulation	
Leistungsschalter			
Elektrotechnik	DIN EN 62271-100:2013 VDE 0671-100:2013 EN 62271-100:2012 IEC 62271-100:2012 STL Guide:2013	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 100: Hochspannungs-Wechselstrom-Leistungsschalter	
Elektrotechnik	DIN EN 62271-101:2013 VDE 0671-101:2013 EN 62271-101:2013 IEC 62271-101:2012 STL Guide:2013	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 101: Synthetische Prüfung	
Elektrotechnik	DIN EN 62271-108:2006 VDE 0671-108:2006 EN 62271-108:2006 IEC 62271-108:2005	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 108: Hochspannungs-Wechselstrom-Leistungsschalter mit Trennfunktion für Bemessungsspannungen größer oder gleich 72,5 kV	
Elektrotechnik	DIN EN 62271-109:2014 VDE 0671-109:2014 EN 62271-109:2013 IEC 62271-109:2013	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 109: Wechselstrom-Überbrückungsschalter für Reihenkondensatoren	
Elektrotechnik	DIN EN 62271-110:2013 VDE 0671-110:2013 EN 62271-110:2012 IEC 62271-110:2012	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 110: Schalten induktiver Lasten	
Elektrotechnik	DIN IEC 62271-111:2014 VDE 0671-111:2014 IEC 62271-111:2012 IEEE Std C37.60:2012	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 111: Automatische Wiedereinschalter (Recloser) und Fehlerunterbrecher für Wechselspannungssysteme bis 38 kV	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Ein-schränkung
Elektrotechnik	DIN EN 50152-1:2014 VDE 0115-320-1:2014 EN 50152-1:2013	Bahnanwendungen – Ortsfeste Anlagen – Besondere Anforderungen an Wechselstrom-Schalteinrichtungen – Teil 1: Einphasen-Leistungsschalter mit Un über 1 kV	
Elektrotechnik	DIN EN 50152-2:2013 VDE 0115-320-2:2013 EN 50152-2:2012	Bahnanwendungen – Ortsfeste Anlagen – Besondere Anforderungen an Wechselstrom-Schaltanlagen – Teil 2: Einphasige Trennschalter, Erdungsschalter und Lastschalter mit Un über 1 kV	
Elektrotechnik	DIN EN 60077-1:2003 VDE 0115-460-1:2003 EN 60077-1:2002 IEC 60077-1:1999	Bahnanwendungen – Elektrische Betriebsmittel auf Bahnfahrzeugen – Teil 1: Allgemeine Betriebsbedingungen und allgemeine Regeln	
Elektrotechnik	DIN EN 60077-2:2003 VDE 0115-460-2:2003 EN 60077-2:2002 IEC 60077-2:1999	Bahnanwendungen – Elektrische Betriebsmittel auf Bahnfahrzeugen – Teil 2: Elektrotechnische Bauteile – Allgemeine Regeln	
Elektrotechnik	DIN EN 60077-4:2004 VDE 0115-460-4:2004 EN 60077-4:2003 IEC 60077-4:2003	Bahnanwendungen – Elektrische Geräte auf Bahnfahrzeugen – Teil 4: Elektrotechnische Bauteile; Regeln für AC-Leistungsschalter	
Elektrotechnik	DIN EN 61166:1994 VDE 0670-111:1994 EN 61166:1993	Hochspannungs-Wechselstrom-Leistungsschalter – Leitfaden für die Erdbeben-Qualifikation von Hochspannungs-Wechselstrom-Leistungsschaltern	
Elektrotechnik	IEC/TR 62271-300:2006	High-voltage switchgear and controlgear – Part 300: Seismic qualification of alternating current circuit-breakers	
Elektrotechnik	IEC/TR 62271-302:2010	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 302: Wechselstrom-Leistungsschalter mit beabsichtigt ungleichzeitigen Schaltzeiten der Schalterpole	
Elektrotechnik	IEC/TR 62271-310:2008	High-voltage switchgear and controlgear – Part 310: Electrical endurance testing for circuit-breakers of rated voltage 72,5 kV and above	
Elektrotechnik	IEEE Std C37.04:2009 IEEE Std C37.04A:2003 IEEE Std C37.04B:2008	IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	IEEE C37.06:2009	AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities	
Elektrotechnik	IEEE Std C37.09:2007 IEEE Std C37.09A:2005 IEEE Std C37.09B:2010	IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis	
Elektrotechnik	IEEE Std C37.010:1999	IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis	
Elektrotechnik	IEEE Std C37.011:2011	IEEE Application Guide for Transient Recovery Voltage for AC High-Voltage Circuit Breakers	
Elektrotechnik	IEEE Std C37.012:2014	IEEE Application Guide for Capacitance Current Switching for AC High-Voltage Circuit Breakers	
Elektrotechnik	IEEE Std C37.013:1997 IEEE Std C37.013A:2007	IEEE Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis	
Elektrotechnik	IEEE Std C37.015:2009	IEEE Application Guide for Shunt Reactor Switching	
Elektrotechnik	IEEE Std C37.016:2006	AC high-voltage circuit switchers rated 15.5 kV through 245 kV	
Elektrotechnik	IEEE Std C37.081:1981 IEEE Std C37.081A:1997	IEEE Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis	
Elektrotechnik	IEEE Std C37.083:1999	IEEE Guide for Synthetic Capacitive Current Switching Tests of AC High-Voltage Circuit Breakers	
Elektrotechnik	IEEE Std C37.11:2014	IEEE Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis	
Elektrotechnik	ANSI C37.54:2003	Conformance Test Procedures for Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear Assemblies	
Elektrotechnik	CSA C22.2 No. 31-10:2010	Switchgear assemblies	
Elektrotechnik	GOST 52565-2006	Alternating-Current Circuit-Breakers for Voltage from 3 to 750 kV	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Lastschalter			
Elektrotechnik	DIN EN 62271-103:2012 VDE 0671-103:2012 EN 62271-103:2011 IEC 62271-103:2013 STL-Guide:2004	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 103: Lastschalter für Bemessungsspannungen über 1 kV bis einschließlich 52 kV	
Elektrotechnik	DIN EN 62271-104:2010 VDE 0671-104:2010 EN 62271-104:2009 IEC 62271-104:2015	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 104: Wechselstrom-Lastschalter für Bemessungsspannungen über 52 kV	
Elektrotechnik	DIN EN 62271-105:2013 VDE 0671-105:2013 EN 62271-105:2012 IEC 62271-105:2012	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 105: Hochspannungs-Lastschalter-Sicherungs-Kombinationen	
Schütze und Motorstarter			
Elektrotechnik	DIN IEC 62271-106:2012 VDE 0671-106:2012 EN 62271-106:2011 IEC 62271-106:2011	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 106: Wechselstrom-Schütze, Kombinationsstarter und Motorstarter mit Schützen	
Trenn- und Erdungsschalter			
Elektrotechnik	DIN EN 62271-102:2013 VDE 0671-102:2013 EN 62271-102:2013 IEC 62271-102:2013 STL Guide:2011	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter	
Elektrotechnik	IEEE C37.30.1:2011	IEEE Standard Requirements for High-Voltage Switches	
Elektrotechnik	IEEE C37.41:2008	IEEE Standard Requirements for High-Voltage Switches	
Elektrotechnik	GOST 52726-2007	Disconnectors and Earthing Switches for AC Voltage above 1 kV and their Drive Units	
Schaltanlagen			
Elektrotechnik	DIN EN 62271-200:2012 VDE 0671-200:2012 EN 62271-200:2012 IEC 62271-200:2011 STL Guide:2013	Hochspannungs-Schaltgeräte und Schaltanlagen – Teil 200: Metallgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 62271-201:2015 VDE 0671-201:2015 EN 62271-201:2015 IEC 62271-201:2015	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 201: Isolierstoffgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV	
Elektrotechnik	DIN EN 62271-203:2012 VDE 0671-203:2012 EN 62271-203:2012 IEC 62271-203:2013 STL Guide:2013	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 203: Gasisolierte metallgekapselte Schaltanlagen für Bemessungsspannungen über 52 kV	
Elektrotechnik	DIN EN 62271-205:2008 VDE 0671-205:2008 EN 62271-205:2008 IEC 62271-205:2008	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 205: Hochspannungs-Schaltanlagenanordnungen für Bemessungsspannungen über 52 kV	
Elektrotechnik	DIN EN 62271-209:2008 VDE 0671-209:2008 EN 62271-209:2007 IEC 62271-209:2007	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 209: Kabelanschlüsse für gasisolierte metallgekapselte Schaltanlagen für Bemessungsspannungen über 52 kV – Kabel mit fluidgefüllter und extrudierter Isolierung – Fluidgefüllte und feststoffisolierte Kabelendverschlüsse	
Elektrotechnik	DIN EN 62271-211:2014 VDE 0671-211:2014 EN 62271-211:2014 IEC 62271-211:2014	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 211: Direkte Verbindungen zwischen Leistungstransformatoren und gasisolierten metallgekapselten Schaltanlagen für Bemessungsspannungen über 52 kV	
Elektrotechnik	DIN EN 62271-4:2014 VDE 0671-4:2014 EN 62271-4:2013 IEC 62271-4:2013	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 4: Handhabungsmethoden im Umgang mit Schwefelhexafluorid (SF6) und seinen Mischgasen	
Elektrotechnik	IEEE Std C37.122:2011 IEEE Std C37.122.1:2014	IEEE Standard for Gas-Insulated Substations	
Elektrotechnik	GOST 54828-2011	Gas-insulated metal-enclosed switchgear for nominal voltages above 110 kV. General technical specification	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Überspannungsschutzgeräte			
Elektrotechnik	DIN EN 50526-1:2012 VDE 0115-526-1:2012 EN 50526-1:2012	Bahnanwendungen – Ortsfeste Anlagen – Überspannungsableiter und Spannungsbegrenzungseinrichtung – Teil 1: Überspannungsableiter	
Elektrotechnik	DIN EN 60099-1:2000 VDE 0675-1:2000 EN 60099-1:1999	Überspannungsableiter – Teil 1: Überspannungsableiter mit nichtlinearen Widerständen und Funkenstrecken für Wechselspannungsnetze	
Elektrotechnik	DIN EN 60099-4:2010 VDE 0675-4:2010 EN 60099-4:2014 IEC 60099-4:2014 GB11032-2000	Überspannungsableiter – Teil 4: Metalloxidableiter ohne Funkenstrecken für Wechselspannungsnetze	
Elektrotechnik	DIN EN 60099-8:2011 VDE 0675-8:2011 EN 60099-8:2011 IEC 60099-8:2011	Überspannungsableiter – Teil 8: Metalloxid-Überspannungsableiter mit externer Serienfunkenstrecke (EGLA) für Übertragungs- und Verteilungsleitungen von Wechselstromsystemen über 1 kV	
Elektrotechnik	DIN EN 60099-9:E2013 EN 60099-9:2014 IEC 60099-9:2014	Überspannungsableiter – Teil 9: Metalloxidableiter ohne Funkenstrecken für HGÜ Konverter Stationen	
Elektrotechnik	DIN EN 61643-11:2013 VDE 0675-6-11:2013 EN 61643-11:2012 IEC 61643-11:2011	Überspannungsschutzgeräte für Niederspannung – Teil 11: Überspannungsschutzgeräte für den Einsatz in Niederspannungsanlagen – Anforderungen und Prüfungen	
Elektrotechnik	IEC 61992-5:2006	Bahnanwendungen – Ortsfeste Anlagen – Gleichstrom-Schalteinrichtungen – Teil 5: Überspannungsableiter und Niederspannungsbegrenzer für spezielle Verwendung in Gleichstromsystemen	
Elektrotechnik	IEEE Std C62.11:2012	IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV)	
Elektrotechnik	CIGRE WG 33/14-05:1989	Application Guide for Metal oxide Arresters without gaps for HVDC Converter Stations	
Elektrotechnik	GOST R 52725-2007	Surge arresters for AC electrical installations for voltage from 3 kV to 750 kV	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Übertragungsleitungen			
Elektrotechnik	DIN EN 62271-204:2012 VDE 0671-204:2012 EN 62271-204:2011 IEC 62271-204:2011	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 204: Starre gasisolierte Übertragungsleitungen für Bemessungsspannungen über 52 kV	
Elektrotechnik	DIN VDE 0851:1993 VDE 0851:1993 IEC 60353:2002	TFH-Sperre für Wechselstrom-Energieversorgungssysteme	
Elektrotechnik	DIN EN 60358-1:2013 VDE 0560-2:2013 EN 60358-1:2012 IEC 60358-1:2013	Kopplungskondensatoren und kapazitive Teiler – Teil 1: Allgemeine Bestimmungen	
Transformatoren, Drosselspulen			
Elektrotechnik	DIN EN 60076-6:2009 VDE 0532-76-6:2009 EN 60076-6:2008 IEC 60076-6:2007	Leistungstransformatoren – Teil 6: Drosselspulen	
Strom- und Spannungswandler			
Elektrotechnik	DIN EN 61869-1:2010 VDE 0414-9-1:2010 EN 61869-1:2009 IEC 61869-1:2007 STL-Guide:2008	Messwandler – Teil 1: Allgemeine Anforderungen	
Elektrotechnik	DIN EN 61869-2:2014 VDE 0414-9-2:2014 EN 61869-2:2012 IEC 61869-2:2012 STL-Guide:1998	Messwandler – Teil 2: Zusätzliche Anforderungen für Stromwandler	
Elektrotechnik	DIN EN 60044-7:2000 VDE 0414-44-7:2000 EN 60044-7:2000 IEC 60044-7:1999	Messwandler – Teil 7: Elektronische Spannungswandler	
Elektrotechnik	DIN EN 60044-8:2003 VDE 0414-44-8:2003 EN 60044-8:2002 IEC 60044-8:2002	Messwandler – Teil 8: Elektronische Stromwandler	
Elektrotechnik	IEEE Std C57.13:2008	Requirements for instrument transformers	

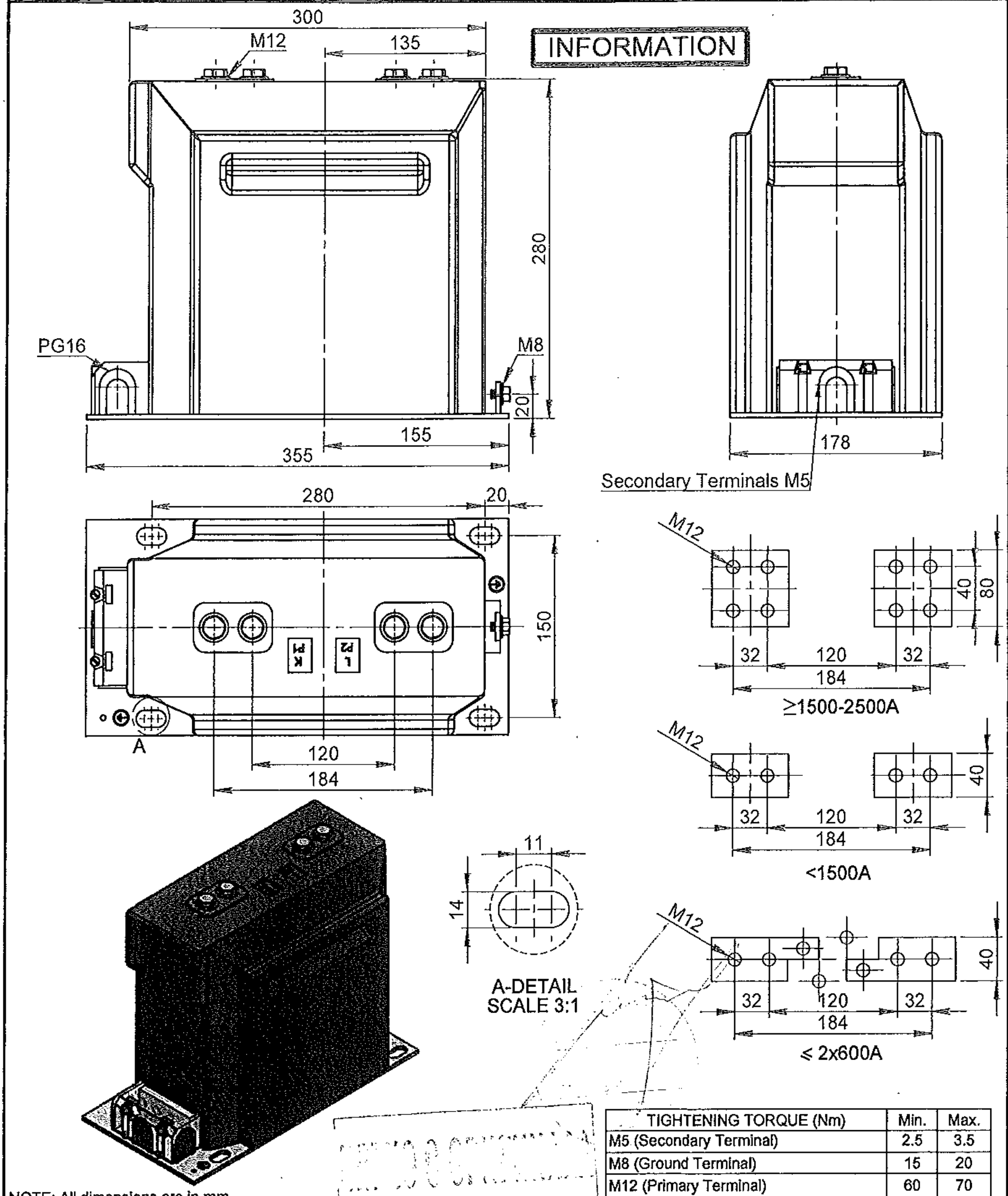
Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Isolierkörper, Durchführungen			
Elektrotechnik	DIN EN 60383-1:2001 VDE 0446-1:2001 EN 60383-1:1999 IEC 60383-1:1993	Isolatoren für Freileitungen mit einer Nennspannung über 1 kV – Teil 1: Keramik- oder Glas-Isolatoren für Wechselspannungssysteme; Begriffe, Prüfverfahren und Annahmekriterien	
Elektrotechnik	DIN EN 60383-2:1995 VDE 0446-4:1995 EN 60383-2:1995 IEC 60383-2:1993	Isolatoren für Freileitungen mit einer Nennspannung über 1000 V – Teil 2: Isolatorstränge und Isolatorketten für Wechselspannungssysteme; Begriffe, Prüfverfahren und Annahmekriterien	
Elektrotechnik	DIN EN 60137:2009 VDE 0674-5:2009 EN 60137:2008 IEC 60137:2008	Isolierte Durchführungen für Wechselspannungen über 1000 V	
Elektrotechnik	DIN EN 60168:2001 VDE 0674-1:2001 EN 60168:2000 IEC 60168:2001	Prüfungen an Innenraum- und Freiluft-Stützisolatoren aus keramischem Werkstoff oder Glas für Systeme mit Nennspannungen über 1 kV	
Elektrotechnik	DIN EN 61109:2009 VDE 0441-100:2009 EN 61109:2008 IEC 61109:2008	Isolatoren für Freileitungen – Verbund-Hänge- und -Abspannisolatoren für Wechselstromsysteme mit einer Nennspannung über 1000 V – Begriffe, Prüfverfahren und Annahmekriterien	
Elektrotechnik	DIN EN 62155:2004 VDE 0674-200:2004 EN 62155:2003 IEC 62155:2003	Druckbeanspruchte und drucklose Hohlisolatoren aus keramischem Werkstoff und Glas für Anwendungen in elektrischen Betriebsmitteln mit Nennspannungen über 1000 V	
Elektrotechnik	IEC/TS 60815-1:2008	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles	
Elektrotechnik	IEC/TS 60815-2:2008	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Ein-schränkung
Elektrotechnik	DIN 48113:1973	Stützisolatoren für Schaltgeräte und Schaltanlagen für Spannungen über 1 kV; Zuordnung der Begriffe für Biegefestigkeit	
Elektrotechnik	DIN EN 61462:2008 VDE 0441-102:2008 EN 61462:2007 IEC 61462:2007	Verbundhohlisolatoren – Druckbeanspruchte und drucklose Isolatoren für den Einsatz in elektrischen Betriebsmitteln mit Bemessungsspannungen über 1000 V – Begriffe, Prüfverfahren, Annahmekriterien und Konstruktionsempfehlungen	
Elektrotechnik	ANSI C29.1:1988	Electrical Power Insulators – Test Methods	
Elektrotechnik	ANSI C29.2A:2013 ANSI C29.2B:2013	Insulators – Wet-Process Porcelain and Toughened Glass – Suspension Type .	Teilweise zurück-gezogen, C29.2:2012
Elektrotechnik	ANSI C29.11:2012	Composite Insulators – Test Methods	
Elektrotechnik	ANSI C29.12:2013	Insulators – Composite-Suspension Type	
		Hochspannungsprüftechnik	
Elektrotechnik	DIN IEC 60060-1:2011 VDE 0432-1:2011 EN 60060-1:2010 IEC 60060-1,2010 STL-Guide:2013	Hochspannungs-Prüftechnik; Teil 1: Allgemeine Festlegungen und Prüfbedingungen	
Elektrotechnik	DIN EN 60060-2:2011 VDE 0432-2:2011 EN 60060-2:2011 IEC 60060-2:2010 STL-Guide:2001	Hochspannungs-Prüftechnik – Teil 2: Messsysteme	
Elektrotechnik	DIN EN 60052:2003 VDE 0432-9:2003 EN 60052:2002 IEC 60052:2002	Spannungsmessungen mit Standard-Luftfunkenstrecken	
Elektrotechnik	DIN EN 60270:2002 VDE 0434:2002 EN 60270:2001 IEC 60270:2001	Hochspannungs-Prüftechnik – Teilentladungsmessungen	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Mechanische Prüfungen, Umwelt- und Schutzprüfungen			
Elektrotechnik	DIN EN 60068-2-1:2008 VDE 0468-2-1:2008 EN 60068-2-1:2007 IEC 60068-2-1:2007	Umgebungseinflüsse – Teil 2-1: Prüfverfahren – Prüfung A: Kälte	
Elektrotechnik	DIN EN 60068-2-2:2008 VDE 0468-2-2:2008 EN 60068-2-2:2007 IEC 60068-2-2:2007	Umgebungseinflüsse – Teil 2-2: Prüfverfahren – Prüfung B: Trockene Wärme	
Elektrotechnik	DIN EN 60068-2-6:2008 VDE 0468-2-6:2008 EN 60068-2-6:2008 IEC 60068-2-6:2007	Umgebungseinflüsse – Teil 2-6: Prüfverfahren – Prüfung Fc: Schwingen (sinusförmig)	
Elektrotechnik	DIN EN 60068-2-14:2010 VDE 0468-2-14:2010 EN 60068-2-14:2009 IEC 60068-2-14:2009	Umgebungseinflüsse – Teil 2-14: Prüfverfahren – Prüfung N: Temperaturwechsel	
Elektrotechnik	DIN EN 60068-2-17:1995 EN 60068-2-17:1994 IEC 60068-2-17:1994	Umweltprüfungen – Teil 2: Prüfungen – Prüfung Q: Dichtheit	
Elektrotechnik	DIN EN 60068-2-27:2010 VDE 0468-2-27:2010 EN 60068-2-27:2009 IEC 60068-2-27:2008	Umgebungseinflüsse – Teil 2-27: Prüfverfahren – Prüfung Ea und Leitfaden: Schocken	
Elektrotechnik	DIN EN 60529:2014 VDE 0470-1:2014 EN 60529:2013 IEC 60529:2013	Schutzarten durch Gehäuse (IP-Code)	
Elektrotechnik	IEEE Std 693:2005	IEEE Recommended Practice for Seismic Design of Substations	
Elektrotechnik	DIN EN ISO 3744:2011 ISO 3744:2010	Akustik – Bestimmung der Schallleistungspegel von Geräuschquellen aus Schalldruckmessungen – Hüllflächenverfahren der Genauigkeitsklasse 2 für ein im wesentlichen freies Schallfeld über einer reflektierenden Ebene (ISO 3744:1994)	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN 45635-1:1984	Geräuschmessung an Maschinen; Luftschallemission, Hüllflächen-Verfahren; Rahmenverfahren für 3 Genauigkeitsklassen	
Elektrotechnik	DIN 45635-12:1978	Geräuschmessungen an Maschinen; Luftschallmessung, Hüllflächen-Verfahren, Elektrische Schaltgeräte	
Elektrotechnik	DIN EN ISO 11201:2010 EN ISO 11201:2010 ISO 11201:2010	Akustik – Geräuschabstrahlung von Maschinen und Geräten – Messung von Emissions-Schalldruckpegeln am Arbeitsplatz und an anderen festgelegten Orten; Verfahren der Genauigkeitsklasse 2 für ein im wesentlichen freies Schallfeld über einer reflektierenden Ebene	
Elektrotechnik	DIN EN ISO 11202:2010 EN ISO 11202:2010 ISO 11202:2010	Akustik – Geräuschabstrahlung von Maschinen und Geräten – Messung von Emissions-Schalldruckpegeln am Arbeitsplatz und an anderen festgelegten Orten – Verfahren der Genauigkeitsklasse 3 für Messungen unter Einsatzbedingungen	
Elektrotechnik	IEC/IEEE 62271-37-082:2012 IEEE 62271-37-082:2012	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 37-082: Normverfahren für die Messung von Schalldruckpegeln an Wechselstrom-Leistungsschaltern	

REV 1	M8 earthing terminal has been revised.	01/07/2011
REV 2		
REV 3		



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Esitas reserves the right to change the specifications and the dimensions of the goods.

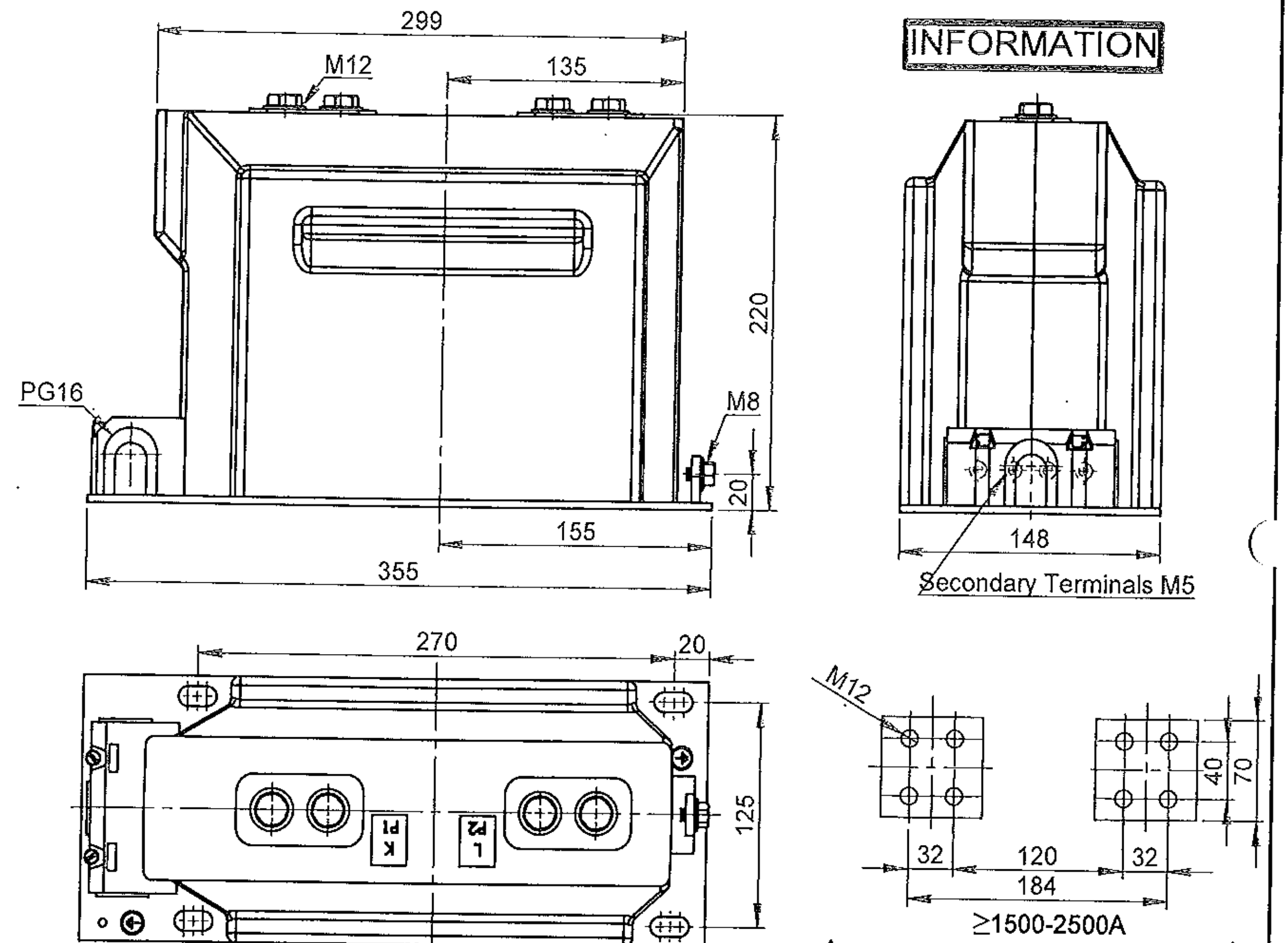
TIGHTENING TORQUE (Nm)	Min.	Max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

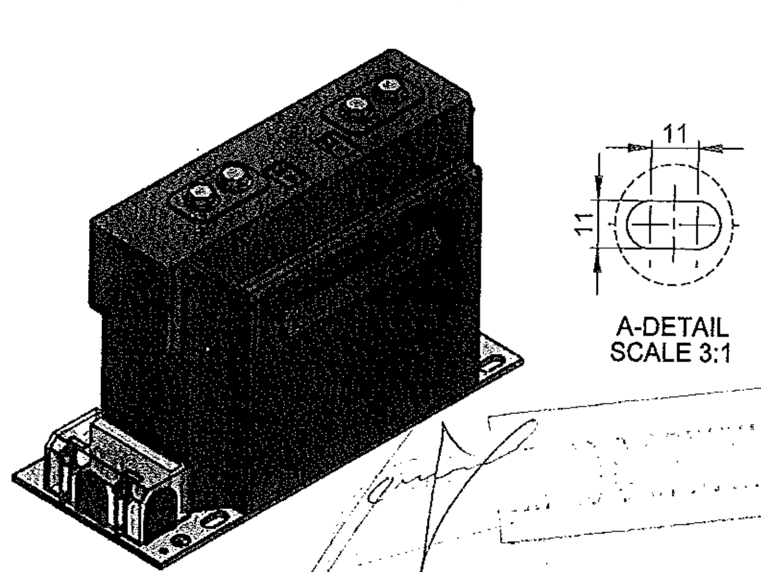
NOTE: All dimensions are in mm.
Secondary terminals are at P1 (at P2 according to request).
Small deviations in dimensions and construction possible.

						CAST RESIN
UNIT	PARTNAME	ITEM	MTRL.DIMEN.	MTRL.COD.	DRAWING NO.	MTRL.TYPE

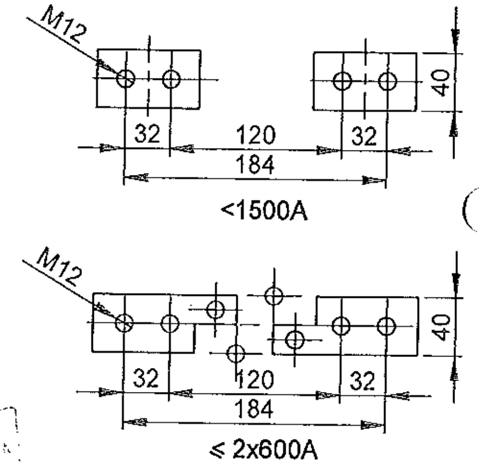
		DATE	NAME	SIGNATURE	
REV.	DRW.BY	01/07/2011	M.AKSU		ESITAS Instrument Transformers
TOLERANCE	CONTROL	01/07/2011	T.DEMİRCAN		
DIN 7168-g	PREPARED BY		CHECK BY		RAW.MTRL.CODE: ALT SAC 3935
SCALE --------	ATB 20-BS CURRENT TRANSFORMER				SEMI FINISHED MTRL.: C0C441 5383-00

REV 1	M8 earthing termial has been revised.	01/07/2011
REV 2	300mm has been revised as 299mm	31/05/2012
REV 3		





A-DETAIL
SCALE 3:1



TIGHTENING TORQUE (Nm)	Min.	Max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

NOTE: All dimensions are in mm.
Secondary terminals are at P1 (at P2 according to request).
Small deviations in dimensions and construction possible.

UNIT	PARTNAME	ITEM	MTRL.DIMEN.	MTRL.COD.	DRAWING NO.	CAST RESIN MTRL.TYPE

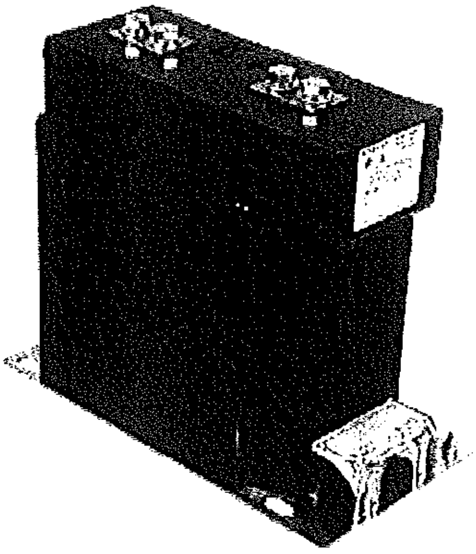
		DATE	NAME	SIGNATURE
REV.	DRW.BY	31/05/2012	M.AKSU	
TOLERANCE DIN 7168-g	CONTROL	31/05/2012	T.DEMİRCAN	
	PREPARED BY		CHECK BY	
SCALE --------	ATB 10-BS CURRENT TRANSFORMER			

ESİTAŞ
Instrument Transformers

RAW.MTRL.CODE: ALT SAC 3713
SEMI FINISHED MTRL.: 006442
5150-00

CURRENT TRANSFORMERS

INDOOR SUPPORT TYPE CAST RESIN INSULATED CURRENT TRANSFORMERS
(Um=3,6kV ...... 12kV, 17,5 ...... 24kV NEW BLOCK TYPES)



Types: ATB 10-BS
ATB 20-BS

- Up to 3 cores*
- On request with capacitive layer.
- On request with barrier.

Technical Data

TYPES	ATB 10-BS			ATB 20-BS	
Operating voltage, Um (kV)	3,6	7,2	12 **	17,5	24
Rated power-frequency withstand voltage (1 minute) (kV)	10	20	28	38	50
Rated impulse test voltage (1,2/50 µs) full wave (kV)	40	60	75	95	125
Rated frequency (Hz)	50-60				
Primary rated current (A)	5 - 2500 (On request 3000A 1.0xIn / Cont. & Insulation class B)				
Primary reconnection (A)	2 x 5 - 2 x 600				
Secondary rated current (A)	1-5				
Metering classes	0,2 - 0,2S - 0,5 - 0,5S - 1 - 3 - 5 Acc. to IEC 60044-1				
Protection classes	5P- 10P: Cl:PX Acc. to IEC 60044-1				
Rated short-time thermal current (Ith) (1s) (kA)	max. 1000 x In				
Rated dynamic current (Idyn) (kA)	2,5 x Ith				
Short-time load (mechanical) (N)	5000				
Insulation class	E				
Ambient temperature (°C)	-25 .... +40***				
Altitude (m)	1000				
Standard	According to the customer requirements				
Weight (approx.) (kg)	20 - 25			30	

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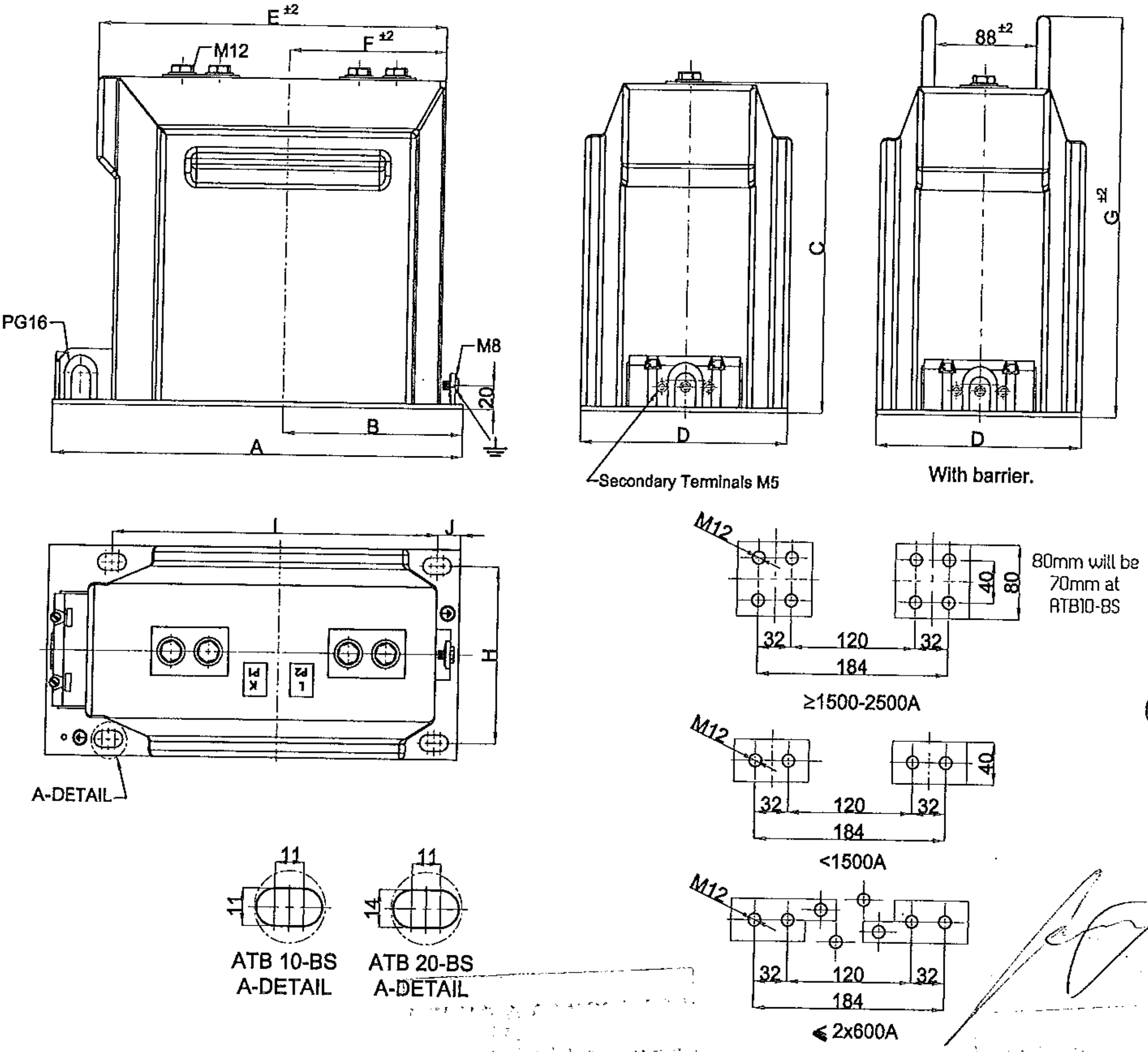
* For more cores please contact with ESITAS for feasibility.
** On request ATB 10-BS operating voltage of 17,5kV is available.
*** It can be produced according to customer's specified ambient temperature.Please contact with ESITAS for feasibility.

INDOOR SUPPORT TYPE CAST RESIN INSULATED C.T.'S TECHNICAL DRAWING
(Um=3,6kV ...... 12kV, 17,5 ...... 24kV NEW BLOCK TYPES)



TYPES	A	B	C	D	E	F	G	H	I	J
ATB 10-BS	355	155	220	148	299	135	-	125	270	20
ATB 20-BS	355	155	280	178	300	135	340	150	280	20

TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2,5	3,5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

- All dimensions are in mm.
- Tolerances are according to DIN 7168-g when not specified.
- Esitas reserves the right to change the specifications and the dimensions of the goods. Please ask for updated information.
- Customer designed products are also available.

00C444

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ESİTAŞ
Elektrik Sanayi ve Ticaret A.Ş.

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Tel: +90 216 304 32 70 Pbx
Faks: +90 216 304 32 82
E-mail:info@esitas.com
Sultanbeyli V.D. 380 034 3395

ИНСТРУКЦИЯ ЗА ТРАНСПОРТ,СЪХРАНЕНИЕ,МОНТАЖ И ЕКСПЛОАТАЦИЯ НА ТОКОВИ ТРАНСФОРМАТОРИ ЗА ЗАКРИТ МОНТАЖ

Съхранение:

- Тип за закрит монтаж, трябва да се съхранява в затворени помещения;
- Съхранявайте при температурни нива, отбелязани на етикета на дървената опаковка.

Транспорт:

- Транспортна опаковка съгласно международните стандарти и практики;
- За по следващ транспорт не изваждайте от оригиналната опаковка или обезопасете внимателно;
- Следвайте инструкциите за товарене върху етикетите на дървените каси.

Товарене:

- Тежки обекти- използвайте транспалетни колички или мотокар за товарене;
- Не поставяйте върху по-крехки обекти;
- Не поставяйте повече от два сандъка един върху друг;
- Следвайте инструкциите за товарене, върху етикетите на дървените каси

Инсталиране:

- Следвайте инструкциите на Esitas доставени с Вашия трансформатор;
- Инсталацията трябва да се извърши само от обучен персонал;
- Винаги заземявайте стоманената основна плоча;
- Винаги заземявайте края на вторичните клеми;
- Никога не оставяйте вторичните намотки отворени.

Поддръжка:

- Животът на продукта се удължава, ако се използва при нормални условия на системата без проблеми;
- Почиствайте всяка година, ако съществува натрупване на прах върху изолираните части на трансформатора. (Не забравяйте да изключите захранването преди почистване).

БЪЛГАРСКИ ИНСТИТУТ ПО МЕТРОЛОГИЯ

Главна дирекция МЕРКИ И ИЗМЕРВАТЕЛНИ УРЕДИ

БЪЛГАРСКИ ИНСТИТУТ ПО МЕТРОЛОГИЯ
София 1040, бул. "Г. М. Димитров" №52Б
АУ-ОТСИ № 33
София 05.06.2013 г.

ДО
"Контрагент 35" ЕООД,
6000 – гр. Стара Загора,
ул. „Индустриална", ПК 177

<u>ОТНОСНО:</u> Одобряване на тип АТВ 10/20/30 на токови измервателни трансформатори, *(по Заявление, вх. № АУ-ОТСИ-33/30.04.2013 г.)*

УВАЖАЕМИ ГОСПОДА,

Уведомяваме Ви, че в регистъра на одобрените за използване типове средства за измерване под ***№ 5007*** са вписани ***токови измервателни трансформатори тип АТВ 10/20/30,*** с метрологични характеристики съгласно Удостоверение № 13.06.5007.

Фирма – производител: ESITAS Elektrik Sanayi ve Ticaret A.S., Турция

Срокът на валидност на одобряване на типа е: ***03.06.2023 г.***

Измервателните трансформатори, подлежат на задължителна първоначална проверка.

Производителят/вносителят на средството за измерване от одобрен тип се задължава да постави знак за одобрен тип в съответствие с чл. 35 от Закона за измерванията (ДВ, бр. 46 от 2002 г.).

С уважение:
СТЕФКА ХРИСТОВА
/Гл. директор/

000446

Приложение към удостоверение за одобрен тип № 13.06.5007

Издадено на производител: ESITAS Elektrik Sanayi ve Ticaret A.S., Турция

Относно: токови измервателни трансформатори тип ATB 10/20/30

1. Описание на типа:

Токовите измервателни трансформатори тип ATB 10/20/30 са предназначени за измерване и релейна защита в комплектни разпределителни устройства за средно напрежение. Максималното работно напрежение е 3,6; 7,2; 12; 17,5; 24 и 36 kV.

Първичните и вторичните намотки са положени върху лентови магнитопроводи и след това заляти с епоксидна смола. Вторичните изводи са изведени навън като изолирани съединителни проводници през формованото тяло на трансформатора и фабрично са присъединени към вторичните клеми. Вторичните клеми на трансформатора са разположени в отделна изолирана клемна кутия и са обозначени със стандартни маркировки на изводите.

Външната изолация е от епоксидна смола, с което се постига необходимата изолационна и механична здравина.

2. Технически и метрологични характеристики:

Тип на трансформатора	**ATB 10/20/30**
Максимално работно напрежение, kV	3,6; 7,2; 12; 17,5; 24; 36
Номинален първичен ток, A	5 - 3000
Превключване на първичната намотка	2x5 – 2x600
Номинален вторичен ток, A	1; 5
Номинална честота, Hz	50 - 60
Клас на точност - намотки за измерване - намотки за защита	0,2 S; 0,2; 0,5 S; 0,5; 1; 3; 5 5P, 10P, PX

3. Типово означение: тип **ATB 10/20/30**

4. Описание на местата, предназначени за поставяне на знаци от метрологичен контрол:

- Знакът за одобрен тип се нанася до табелката с технически данни.
- Знакът за първоначална проверка (марка за залепване) се поставя до знака за одобрен тип.

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология
REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ
Measuring Instrument Type-approval Certificate

№ 13.06.5007

Издадено на производител: *Issued to manufacturer:* ESITAS Elektrik Sanayl ve Tlcaret A.S., Турция

На основание на: *In Accordance with:* чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)

Относно: *In Respect of:* токови измервателни трансформатори тип АТВ 10/20/30

Знак за одобрен тип: *Type Approval Mark:*
BG 13
5007

Технически и метрологични характеристики: *Technical and metrological characteristics:* приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване

Срок на валидност: *Valid until:* 03.06.2023 г.

Вписва се в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:* 5007

Дата на издаване на удостоверението за одобрен тип: *Date:* 03.06.2013 г.

И.Д. ПРЕДСЕДАТЕЛ:
Димка Иванова

страница 1 от 2

БЪЛГАРСКИ ИНСТИТУТ ПО МЕТРОЛОГИЯ

Главна дирекция МЕРКИ И ИЗМЕРВАТЕЛНИ УРЕДИ

[illegible]
АУ.000029 № 16902
София 07 07 2015 г.

ДО
„КОНТРАГЕНТ 35" ЕООД
6000 ГР. СТАРА ЗАГОРА
УЛ. „ИНДУСТРИАЛНА" П.К. № 177
ТЕЛ.: 042/600 032, ФАКС: 042/600 129

Относно: Издаване на допълнение № 15.07.5007.1 към удостоверение за одобрен тип № 13.06.5007 на токов измервателн трансформатор тип АТВ 10/20/30.
(по Заявление, вх. № АУ-000029-16902/26.06.2015 г.)

УВАЖАЕМИ ГОСПОДА,

Уведомяваме Ви, че е издадено допълнение **№ 15.07.5007.1** към удостоверение № 13.06.5007 за одобрен и вписан под **№ 5007** в регистъра на одобрените за използване типове средства за измерване – **токов измервателн трансформатор тип АТВ 10/20/30** с метрологични характеристики съгласно горепосоченото допълнение.

- Фирма-производител: ESITAŞ Elektrik Sanayi ve Ticaret A.Ş., Турция
  Hilal Mahallesi Paşaköy Caddesi No: 31 Sancaktepe
  İSTANBUL / TÜRKİYE;
- Срокът на валидност на одобряване на типа е: **03.06.2023 г.**

Измервателните трансформатори подлежат на задължителна първоначална проверка.

Производителят/вносителят на средството за измерване от одобрен тип се задължава да постави знак за одобрен тип в съответствие с чл. 35 от Закона за измерванията (ДВ, бр. 46 от 2002 г.).

С УВАЖЕНИЕ,
ВАЛЕНТИН СТАРЕВ
Главен директор на ГД МИУ

1040-София
бул."д-р. Г. М. Димитров" № 52Б
e-mail: GD_MIU@bim.government.bg

телефон: 02/ 970 27 39
факс: 02/ 873 52 72
www.bim.government.bg

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РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология
REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.07.5007.1

КЪМ УДОСТОВЕРЕНИЕ ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 13.06.5007

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител: *Issued to manufacturer:*	ESITAŞ Elektrik Sanayi ve Ticaret A.Ş., Турция Hilal Mahallesi Paşaköy Caddesi No:31 Sancaktepe İSTANBUL / TÜRKİYE
На основание на: *In Accordance with:*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)
Относно: *In Respect of:*	токов измервателен трансформатор тип АТВ 10/20/30
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	03.06.2023 г.
Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	5007
Дата на издаване на допълнението към удостоверението за одобрен тип: *Date:*	06.07.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

Приложение към Допълнение № 15.07.5007.1 към удостоверение № 13.06.5007

Издадено на производител: ESITAŞ Elektrik Sanayi ve Ticaret A.Ş., Турция
Hilal Mahallesi Paşaköy Caddesi No: 31 Sancaktepe
İSTANBUL / TÜRKİYE

Относно: токов измервателен трансформатор тип АТВ 10/20/30

Описание на допълнението към удостоверение за одобрен тип № 13.06.5007

- В т. 2. **Технически и метрологични характеристики:**

Номинален първичен ток, А „5-3000" да се промени на: „от 5 до 3000";
Превключване на първичната намотка, А „2x5 - 2x600" да се промени на „от 2x5 до 2x600";

- Към т.3. **Типово означение да се допълни:**

„XX" към типовото означение АТВ 10/20/30: АТВ 10-XX/20-XX/30-XX, където:

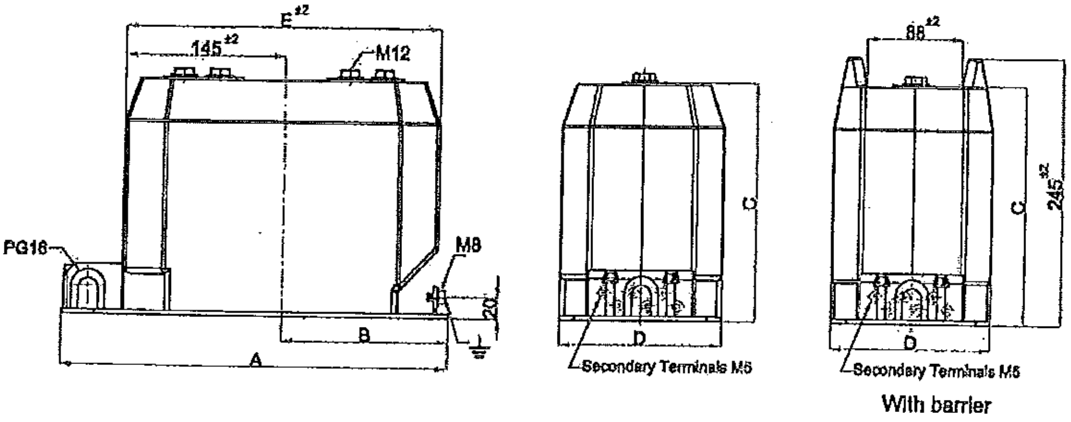
XX е цифрово-буквена комбинация, състояща се от една цифра и/или буква или от две цифри и/или букви, обозначаваща следното значение:

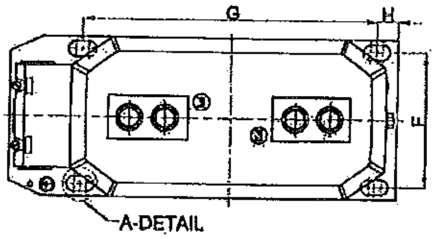
B	-	размер на корпус АТВ10-B	(Чертеж № 1)
	-	размер на корпус АТВ20-B	(Чертеж № 4)
B2	-	размер на корпус АТВ10-B2	(Чертеж № 1)
	-	размер на корпус АТВ20-B2	(Чертеж №4)
B3	-	размер на корпус АТВ10-B3	(Чертеж № 1)
B4	-	размер на корпус АТВ20-B4	(Чертеж № 4)
BS	-	размер на корпус АТВ10-BS	(Чертеж № 2)
	-	размер на корпус АТВ20-BS	(Чертеж № 2)
S	-	размер на корпус АТВ30-S	(Чертеж № 7)
S1	-	размер на корпус АТВ30-S1	(Чертеж № 7)
1	-	размер на корпус АТВ30-1	(Чертеж № 7)
2	-	размер на корпус АТВ10-2	(Чертеж № 1)
	-	размер на корпус АТВ30-2	(Чертеж № 7)
3	-	размер на корпус АТВ20-3	(Чертеж № 4)
	-	размер на корпус АТВ30-3	(Чертеж № 7)
4	-	размер на корпус АТВ30-4	(Чертеж № 8)
5	-	размер на корпус АТВ30-5	(Чертеж № 8)
10	-	размер на корпус АТВ10-10	(Чертеж № 3)
	-	размер на корпус АТВ20-10	(Чертеж № 6)
	-	размер на корпус АТВ30-10	(Чертеж № 8)
15	-	размер на корпус АТВ10-15	(Чертеж № 3)
	-	размер на корпус АТВ20-15	(Чертеж № 6)
	-	размер на корпус АТВ30-15	(Чертеж № 8)
3A	-	размер на корпус АТВ20-3A	(Чертеж № 5)
3B	-	размер на корпус АТВ20-3B	(Чертеж № 5)
3K	-	размер на корпус АТВ20-3K	(Чертеж № 4)

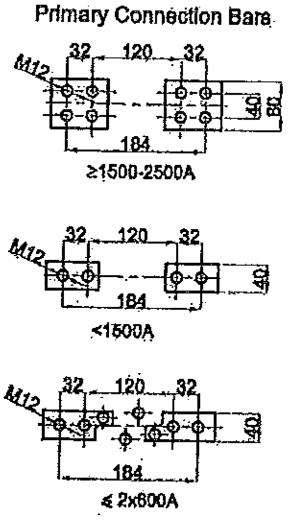
Приложение към Допълнение № 15.07.5007.1 към удостоверение № 13.06.5007

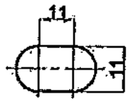
ЧЕРТЕЖ № 1

ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=3,6kV, 12kV BLOCK TYPES)









TYPES	A	B	C	D	E	F	G	H
ATB 10-B	355	155	220	148	290	125	270	20
ATB 10-B2	395	195	220	148	330	125	310	20
ATB 10-B3	455	255	220	148	390	125	370	20
ATB 10-2	355	155	220	175	290	150	270	20

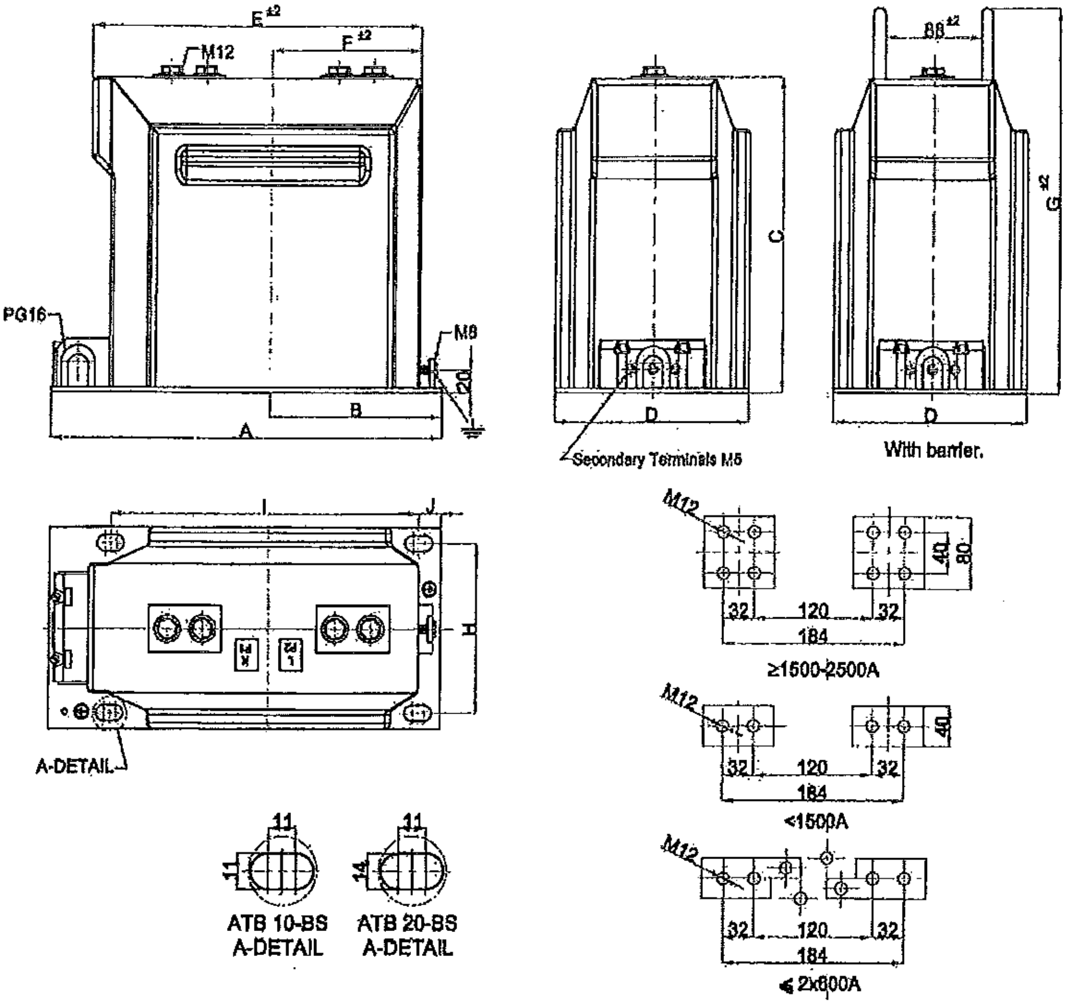
TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

Приложение към Допълнение № 15.07.5007.1 към удостоверение № 13.06.5007

ЧЕРТЕЖ No 2

ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=3,6kV; 12kV; 17,5....24kV NEW BLOCK TYPES)



TYPES	A	B	C	D	E	F	G	H	I	J
ATB 10-BS	355	155	220	148	299	135	-	125	270	20
ATB 20-BS	355	155	280	178	300	135	340	150	280	20

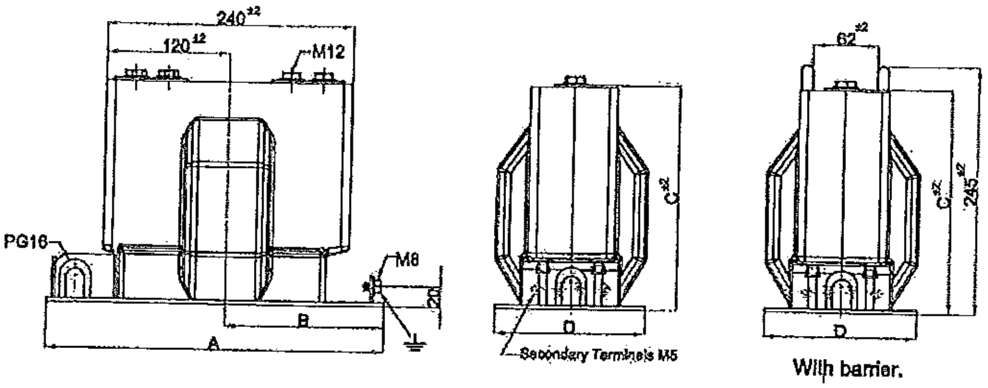
TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

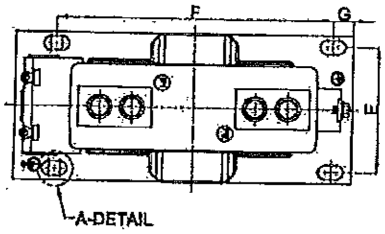
Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

Приложение към Допълнение № 15.07.5007.1 към удостоверение № 13.06.5007

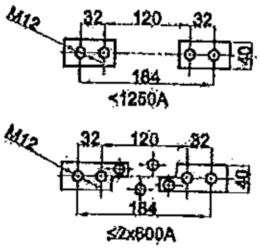
ЧЕРТЕЖ № 3

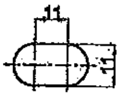
ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=3,6kV 12kV NARROW BLOCK TYPES)





Primary Connection Bars





A-DETAIL

TYPES	A	B	C	D	E	F	G
ATB 10-10	330	155	220	148	125	270	20
ATB 10-15	330	155	220	148	125	270	20

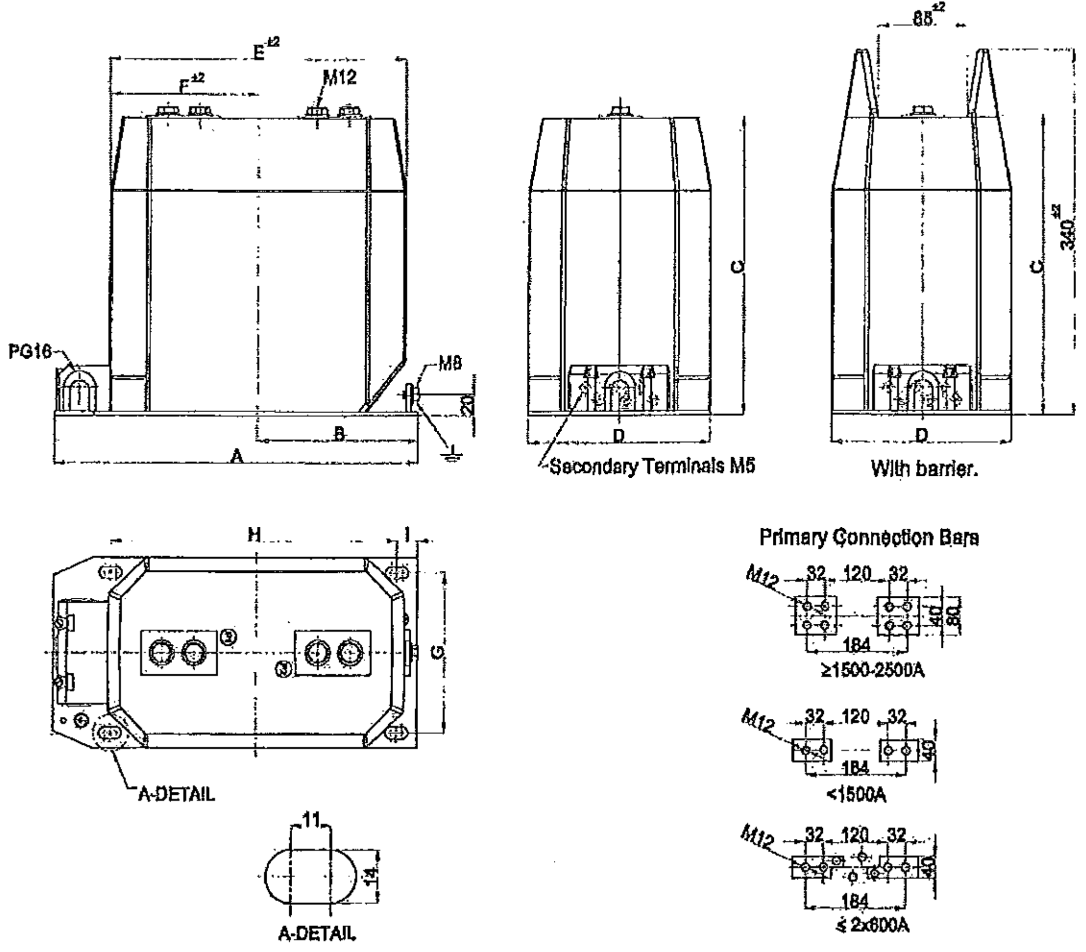
TIGHTENING TORQUE (Nm)	min	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

Всички размери са в милиметри. Допустимите отклонения са фъгласно DIN 7168-g.

000454

ЧЕРТЕЖ № 4

ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=17,5kV...24kV BLOCK TYPES)

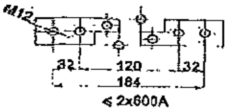


TYPES	A	B	C	D	E	F	G	H	I
ATB 20-B	355	155	280	178	290	145	150	280	20
ATB 20-B2	355	155	280	205	290	145	180	280	17
ATB 20-B4	355	155	280	218	290	145	190	280	17
ATB 20-3	455	197	280	178	390	195	150	375	22
ATB 20-3B	455	197	280	205	390	195	180	375	22
ATB 20-3K	455	197	280	218	390	195	190	375	22

TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

A-DETAIL

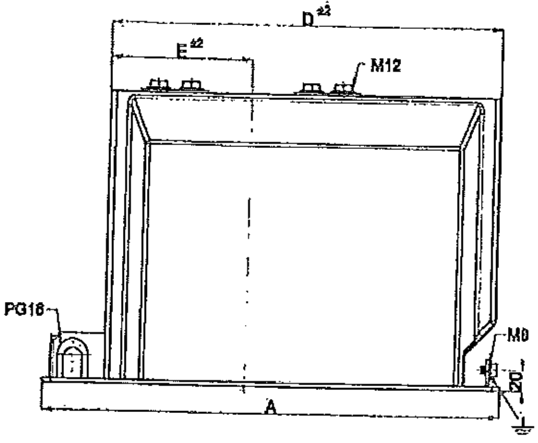


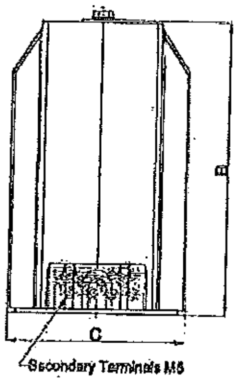
≤ 2x600A

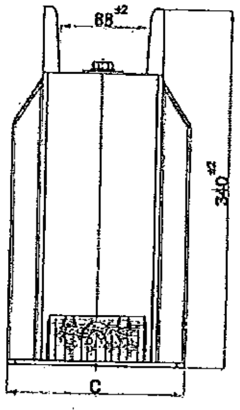
17

TYPES	A	B	C	D	E	F	G	H
ATB 20-3A	455	280	178	390	140	150	375	20
ATB 20-3B	455	280	205	390	140	180	375	20

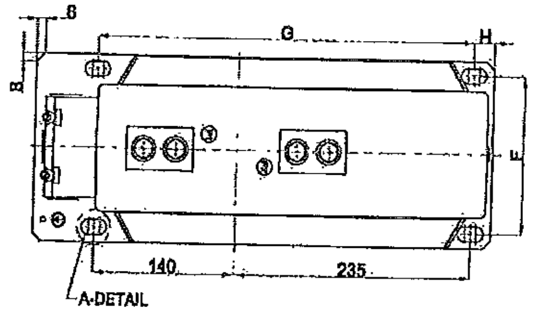
TIGHTENING TORQUE (Nm)	min	max
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

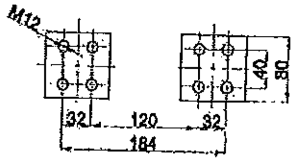




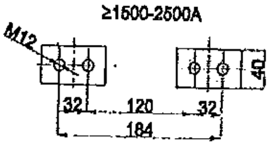


With barrier.





≥1500-2500A



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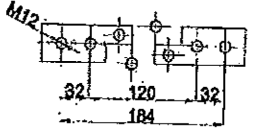
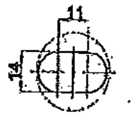


≤ 2x600A



A-DETAIL

TYPES	A	B	C	D	E	F	G	H
ATB 20-3A	455	280	178	390	140	150	375	20
ATB 20-3B	455	280	205	390	140	180	375	20

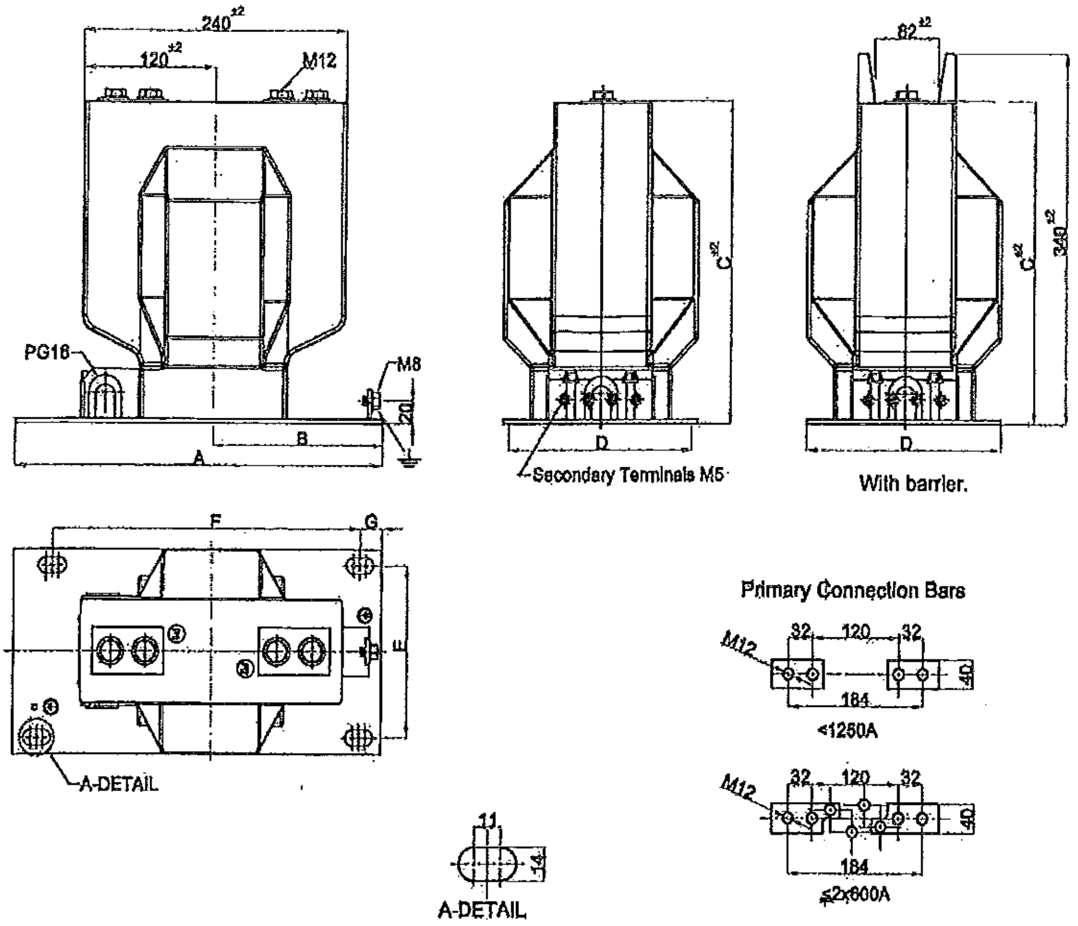
TIGHTENING TORQUE (Nm)	min.	max
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

Приложение към Допълнение № 15.07.5007.1 към удостоверение № 13.06.5007

ЧЕРТЕЖ № 6

ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=17,5kV 24kV NARROW BLOCK TYPES)



TYPES	A	B	C	D	E	F	G
ATB 20-10	335	155	280	178	150	280	20
ATB 20-15	335	155	280	178	150	280	20

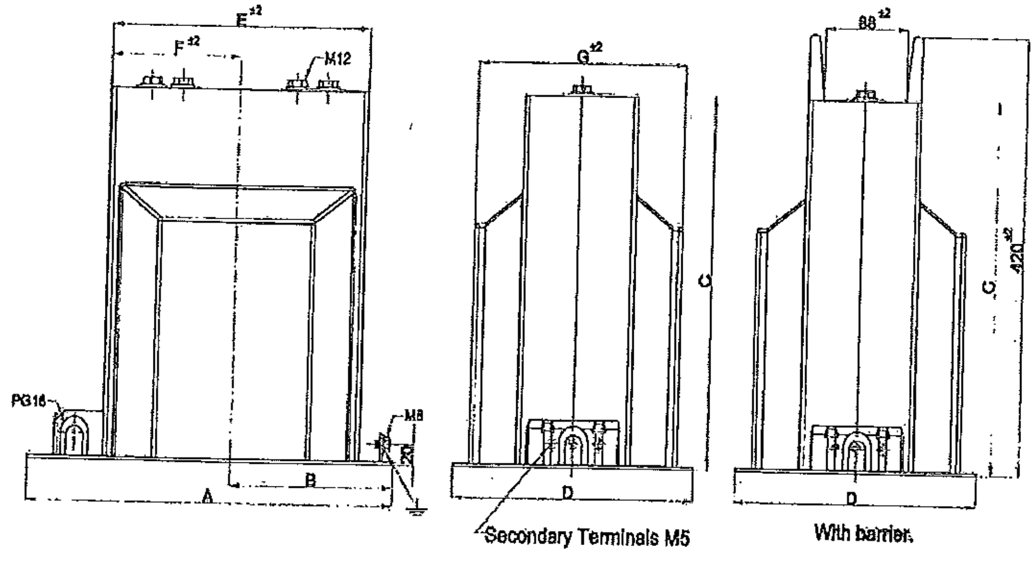
TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

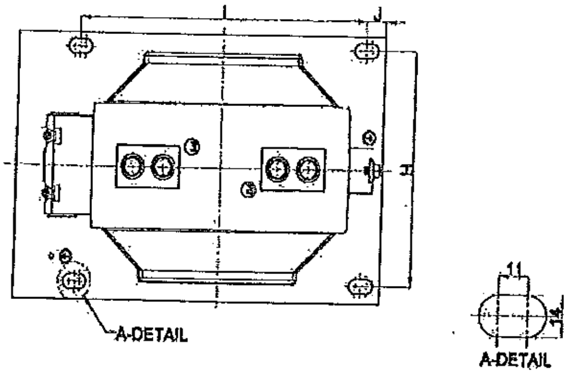
Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

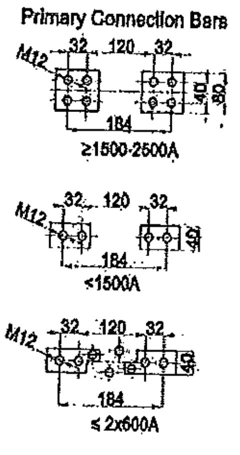
Приложение към Допълнение № 15.07.5007.1 към удостоверение № 13.06.5007

ЧЕРТЕЖ № 7

ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=36kV BLOCK TYPES)







TYPES	A	B	C	D	E	F	G	H	I	J
ATB 30-S	385	170	360	255	250	125	210	225	300	20
ATB 30-S1	385	170	360	255	270	135	220	225	300	20
ATB 30-1	385	170	360	255	270	135	220	225	300	20
ATB 30-2	385	170	360	255	310	155	240	225	300	20
ATB 30-3	455	210	360	255	389	195	249	225	375	20

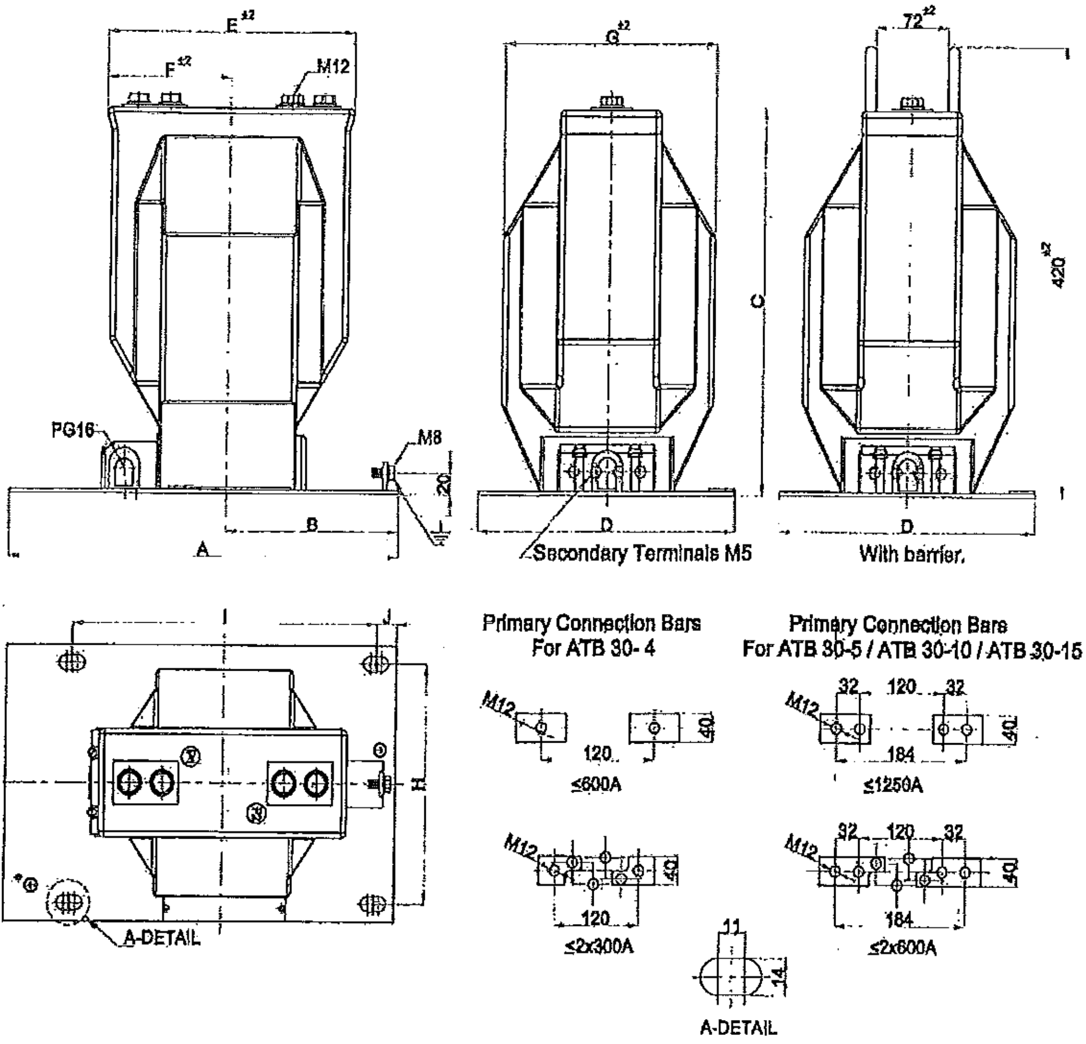
TIGHTENING TORQUE (Nm)	min	max
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M12 (Primary Terminal)	60	70

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

000458

ЧЕРТЕЖ № 8

ТРАНСФОРМАТОР ТОКОВ, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА,
ЗА ЗАКРИТ МОНТАЖ (Um=36kV NARROW BLOCK TYPES)



TYPES	A	B	C	D	E	F	G	H	I	J	TIGHTENING TORQUE (Nm)	min.	max.
ATB 30-4	385	170	360	255	200	100	180	225	300	20	M5 (Secondary Terminal)	2.5	3.5
ATB 30-5	385	170	360	255	250	125	210	225	300	20	M8 (Ground Terminal)	15	20
ATB 30-10	385	170	360	255	250	125	210	225	300	20	M 12 (Primary Terminal)	60	70
ATB 30-15	385	170	360	255	250	125	210	225	300	20			

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

ВЯРНО С ОРИГИНАЛА

Este documento es una versión bilingüe español-inglés, realizada por TECNALIA, del anexo técnico original emitido en español (Rev. 22, 24/04/2015) de la acreditación 4/LE148.
This document is an English-Spanish version, prepared by TECNALIA, of the original technical annex issued in Spanish (Rev. 22, 2015/04/24) of the accreditation 4/LE148.

ANEXO TÉCNICO
TECHNICAL ANNEX

ACREDITACIÓN Nº 4/LE148
ACCREDITATION No. 4/LE 148

Entidad / *Organization*: FUNDACIÓN TECNALIA RESEARCH & INNOVATION

Sede / *Address* Derio: Parque Científico y Tecnológico de Bizkaia, C/ Geldo, Edificio 700;
48160 Derio (Vizcaya)
Sede / *Address* Zamudio: Parque Científico y Tecnológico de Bizkaia, Laida Bidea, Edificio 413;
48170 Zamudio (Vizcaya)

Norma de referencia / *Standard Reference*: UNE-EN ISO/IEC 17025: 2005 (CGA-ENAC-LEC)

Ensayos en las siguientes áreas / *Tests in the following areas:*

Sede / *Address* Derio

Ensayos ambientales / *Environmental testing*

Categoría 0 (Ensayos en el laboratorio permanente) / *Category 0 (Tests in the permanent laboratory)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Ensayos ambientales en equipos eléctricos y electrónicos / *Environmental testing in electric and electronic equipment*		
Equipos y componentes eléctrico-electrónicos / *Electrical and electronic equipment and components*	Frío: Ensayos Ab, Ad y Ae. Temperatura mínima: -40°C Volumen máximo del espécimen: 0,6 m³ *Cold: Tests Ab, Ad and Ae* *Minimum temperature: -40ºC* *Maximum volume of the specimen:0.6 m3*	UNE-EN 60068-2-1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Calor seco: Ensayos Bb, Bd y Be. Temperatura máxima: 85°C Volumen máximo del espécimen: 0,6 m³ *Dry heat: Tests Bb, Bd and Be* *Maximum temperature: 85ºC* *Maximum volume of the specimen:0.6 m³*	UNE-EN 60068-2-2:2008
	Ensayo cíclico de calor húmedo (ciclos de 12+12 h). Ensayo Db. Volumen máximo del espécimen: 0,6 m³ *Damp heat, cyclic (12 h + 12 h cycle). Test Db* *Maximum volume of the specimen:0.6 m³*	UNE-EN 60068-2-30:2006
	Calor húmedo, ensayo continuo. Ensayo Cab Volumen máximo del espécimen: 0,2 m³ *Damp heat, steady state: Test Cab* *Maximum volume of the specimen:0.2 m³*	UNE-EN 60068-2-78:2013
	Variación de temperatura, Ensayo Na. Rango de temperaturas: -40°C a 85°C Volumen máximo del espécimen: 0,2 m³ *Change of temperature Test Na.* *Temperature range: -40°C a 85°C* *Maximum volume of the specimen: 0.2 m³*	UNE-EN 60068-2-14:2011
	Vibración sinusoidal. Ensayo Fc. Dimensiones del espécimen inferiores a: 0,6x0,6x0,3 m. Peso inferior a 25 kg Aceleraciones hasta 30 g Frecuencias de 1 a 2000 Hz *Vibration (sinusoidal): Test Fc* *Dimensions of the specimen less than 0.6x0.6x0.3 m* *Weight less than 25 kg* *Accelerations up to 30 g* *Frequencies from 1 to 2000 Hz*	UNE-EN 60068-2-6:2008
	Choques. Ensayo Ea Dimensiones del espécimen inferiores a: 0,6x0,6x0,3 m. Peso inferior a 25 kg *Shock: Test Ea* *Dimensions of the specimen less tan 0.6x0.6x0.3 m* *Weight less than 25 kg*	UNE-EN 60068-2-27:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Vibración aleatoria de banda ancha. Ensayo Fh Dimensiones del espécimen inferiores a: 0,6x0,6x0,3 m. Peso inferior a 25 kg Aceleraciones RMS hasta 10 m/s² Frecuencias de 1 a 2000 Hz *Vibration, broadband random. Test Fh* *Dimensions of the specimen less than 0.6x0.6x0.3 m* *Weight less than 25 kg* *RMS accelerations up to 10 m/s²* *Frequencies from 1 to 2000 Hz*	UNE-EN 60068-2-64:2009 ETSI EN 300 019-2-2:2013, random vibration
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 50470-1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 50470-3:2007
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos o electromecánicos destinados a la medida de energía eléctrica en sistemas de 50Hz y tensión hasta 600V *Electricity metering equipment (a.c.)* *Static or electromechanics meters and intended to the measuring of electrical energy in 50 Hz systems and voltage up to 600 V.*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 62052-11:2004

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PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contedores estáticos de energía activa (clases 1 y 2) *Electricity metering equipment (a.c.) Static meters for active energy (classes 1 and 2)*	Ensayos climáticos - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 62053-21:2003
Equipos de medida de la energía eléctrica (c.a). Contadores estáticos de energía reactiva (clases 2 y 3) *Electricity metering equipment (a.c.) Static meters for reactive energy (classes 2 and 3)*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 62053-23:2003

Ensayos de compatibilidad electromagnética (EMC) y evaluación de la exposición humana a campos electromagnéticos / *Electromagnetic Compatibility*

Categoría 0 (Ensayos en el laboratorio permanente) / *Category 0 (Tests in the permanent laboratory)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos industriales, científicos y médicos (ICM) *Industrial, scientific and medical equipment (ISM)*	Emisión: Medida de las perturbaciones radioeléctricas *Equipos del grupo 1* *Rango de frecuencias hasta 1 GHz* *Emission:* *Measurements of the radioelectric disturbances* *Group 1 equipment* *Frequency range up to 1 GHz*	UNE-EN 55011:2011 UNE-EN 55011/A1:2011
Electrodomésticos, herramientas eléctricas y aparatos análogos *Household appliances, electric tools and similar apparatus*	Emisión: Medida de las perturbaciones radioeléctricas Rango de frecuencias hasta 1GHz *Emission:* *Measurements of the radioelectric disturbances* *Frequency range up to 1 GHz*	UNE-EN 55014-1:2008 UNE-EN 55014-1/A1:2009 UNE-EN 55014-1/A2:2012 UNE-EN 55014-1:ERRATUM:2009
Equipos de la tecnología de la información *Information technology equipment*	Emisión: Medida de las perturbaciones radioeléctricas *Rango de frecuencias hasta 1GHz* *Emission:* *Measurements of the radioelectric disturbances* *Frequency range up to 1 GHz*	UNE-EN 55022: 2011 UNE-EN 55022:AC:2012
Equipos eléctricos y electrónicos con corriente de entrada ≤ 16 A por fase *Electric and electronic products with current input ≤ 16 A per phase*	Emisión: Medida de armónicos de corriente *Emission:* *Measurements of voltage fluctuations and flicker*	UNE-EN 61000-3-2: 2006 UNE-EN 61000-3-2/A1: 2010 UNE-EN 61000-3-2/A2: 2010
Equipos eléctricos y electrónicos con corriente de entrada ≤ 16 A por fase *Electric and electronic products with current input ≤ 16 A per phase*	Emisión: Medida de flicker y fluctuaciones de tensión *Emission:* *Measurements of voltage fluctuations and flicker*	UNE-EN 61000-3-3: 2013

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos eléctricos y electrónicos de entorno residencial, comercial e industria ligera	Emisión: Medida de las perturbaciones radioeléctricas	UNE-EN 61000-6-3:2007 UNE-EN 61000-6-3/A1 : 2012
Equipos eléctricos y electrónicos de entorno industrial *Residential, commercial and light industry environments electric and electronic products*	Emisión: Medida de las perturbaciones radioeléctricas *Emission:* *Measurements of the radioelectric disturbances*	UNE-EN 61000-6-4:2007 UNE-EN 61000-6-4/A1 : 2011 UNE-EN 61000-6-4:ERRATUM:2008
Equipos eléctricos y electrónicos *Industrial environments electric and electronic products*	Inmunidad a descargas electrostáticas *Immunity to electrostatic discharges*	UNE-EN 61000-4-2:2010
	Inmunidad a campos electromagnéticos radiados *Frecuencias entre 80 MHz y 3 GHz* *Intensidad de campo hasta 10 V/m* *Immunity to radiated electromagnetic fields* *Frequencies between 80 MHz and 3 GHz* *Field intensity up to 10 V/m*	UNE-EN 61000-4-3:2007 UNE-EN 61000-4-3/A1:2008 UNE-EN 61000-4-3/A2:2011
	Inmunidad a ráfagas de transitorios rápidos *Immunity to electrical fast transients*	UNE-EN 61000-4-4:2013
	Inmunidad a ondas de choque (surges) *Immunity to surge*	UNE-EN 61000-4-5:2007 UNE-EN 61000-4-5:CORR:2010
	Inmunidad a las perturbaciones conducidas inducidas por los campos de radiofrecuencia *Immunity to conducted disturbances induced by radiofrequency fields*	UNE-EN 61000-4-6:2009
	Inmunidad a campos magnéticos amortiguados *Volumen efectivo 0,6 m x 0,6 m x 0,5 m* *Immunity to damped magnetic fields* *Effective volume: 0.6 m x 0.6 m x 0.5 m*	UNE-EN 61000-4-10:1996 UNE-EN 61000-4-10/A1:2001

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Inmunidad a campos magnéticos de frecuencia industrial *Volumen efectivo 0,6 m x 0,6 m x 0,5 m* *Immunity to power frequency magnetic fields* *Effective volume: 0,6 m x 0,6 m x 0,5 m*	UNE-EN 61000-4-8:2011
	Inmunidad a huecos de tensión, interrupciones breves y variaciones de tensión DC *Immunity to DC voltage dips, short interruptions and voltage variations*	UNE-EN 61000-4-29:2002
	Inmunidad a ondas oscilatorias amortiguadas *Frecuencias de 100 kHz y 1 MHz* *Immunity to damped oscillatory waves* *Frequencies of 100 kHz and 1 MHz*	UNE-EN 61000-4-18:2008 UNE-EN 61000-4-18/A1:2011
	Inmunidad a huecos de tensión, interrupciones breves y variaciones de tensión *Immunity to voltage dips, short interruptions and voltage variations*	UNE-EN 61000-4-11:2005
Dispositivos eléctricos y electrónicos para formar esquemas para la protección destinados a funcionar en sistemas eléctricos *Electrical and electronic devices manufactured for configuring schemes for the protection destined to operate in electrical systems*	Medidas de resistencia de aislamiento, rigidez dieléctrica e impulso de tensión *Measurements of insulation resistance, dielectric test and voltage impulse test*	IEC 60255-5:2000 IEC 60255-27:2013 Apto. 10.6.4.2; 10.6.4.3 y 10.6.4.4
Equipos eléctricos y electrónicos de entorno residencial, comercial e industria ligera *Residential, commercial and light industry environments electric and electronic products*	Inmunidad a las perturbaciones electromagnéticas *Immunity to electromagnetic disturbances*	UNE-EN 61000-6-1:2007
Equipos eléctricos y electrónicos de entorno industrial *Industrial environments electric and electronic products*	Inmunidad a las perturbaciones electromagnéticas *Immunity to electromagnetic disturbances*	UNE-EN 61000-6-2:2006 UNE-EN 61000-6-2:ERRATUM:2009

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz *Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz*	Requisitos generales, bandas de frecuencia y perturbaciones electromagnéticas *General requirements, frequency bands and electromagnetic disturbances*	UNE-EN 50065-1:2012 Capítulo 6 Tensión de salida del transmisor
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz destinados para uso en entornos residenciales, comerciales y de industria ligera *Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz and intended to residential, commercial and light industry*	Requisitos de Inmunidad *Immunity requisites*	UNE-EN 50065-2-1:2004 UNE-EN 50065-2-1:2004+A1:2006
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz destinados para uso en entornos industriales *Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz destined to industry*	Requisitos de Inmunidad *Immunity requisites*	UNE-EN 50065-2-2:2004 UNE-EN 50065-2-2:2004+A1:2006 UNE-EN 50065-2-2:2004/A1:2006/CORR A1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz destinados para uso por los suministradores y distribuidores de electricidad *Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz and intended for use by electricity suppliers and distributors*	Requisitos de Inmunidad *Immunity requisites*	UNE-EN 50065-2-3:2004 UNE-EN 50065-2-3:2004/A1: 2006
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz *Signaling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz*	Medidas de Impedancia *Immunity requisites*	UNE-EN 50065-7:2002
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 50470-1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Ensayos de inmunidad a: - Huecos e Interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas Inmunidad Campo Magnético continuo y externo *Immunity test:* - *Dips and Interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave* *Constant and external Magnetic-Field Immunity*	
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 50470-3:2007
	Ensayos de inmunidad a: - Huecos e Interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas Inmunidad Campo Magnético continuo y externo *Immunity test:* - *Dips and Interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave* *Constant and external Magnetic-Field Immunity*	

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos o electromecánicos destinados a la medida de energía eléctrica en sistemas de 50Hz y tensión hasta 600V *Electricity metering equipment (a.c.) Static or electromechanics meters and intended to the measuring of electrical energy in 50 Hz systems and voltage up to 600 V.*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 62052-11:2004
	Ensayos de inmunidad a: - Huecos e interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas *Immunity test:* - *Dips and interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave*	
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos de energía activa (clases 1 y 2) *Electricity metering equipment (a.c.) Static meters for active energy (classes 1 and 2)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission* Ensayos de inmunidad a: - Huecos e interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas *Immunity test:* - *Dips and interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave*	UNE-EN 62053-21:2003

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a). Contadores estáticos de energía reactiva (clases 2 y 3) *Electricity metering equipment (a.c.)* *Static meters for reactive energy (classes 2 and 3)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 62053-23:2003

Sede / *Address* Zamudio

Equipos de generación, transporte, distribución y uso de la energía eléctrica, en media y alta tensión /
Equipment for Generation, Transmission, Distribution and use of Electric Power, high and medium voltage

Categoría 0 (Ensayos en el laboratorio permanente) / *Category 0 (Tests in the permanent laboratory)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transformadores de distribución y transformadores de media potencia *Distribution transformers and medium power transformers*	Ensayos tipo, ensayos individuales y ensayos especiales, excepto: - Medida de las características de transmisión de tensiones - Medida de gases disueltos - Medida del calentamiento del punto caliente - Verificación del recubrimiento externo Límites: - Dieléctricos: hasta 145 kV de tensión más elevada para el material - Determinación del nivel de ruido: método de presión acústica *Type tests, routine tests and special tests, except:* - *Determination of transient voltage transfer characteristics* - *Measurement of dissolved gases* - *Winding hot-spot temperature-rise measurements* - *Check of external coating* *Limits:* - *Dielectric tests: up to 145 kV higher voltage for the material* - *Determination of sound levels: sound pressure method*	UNE-EN 60076-1:1998 UNE-EN 60076-1/A1:2001 UNE-EN 60076-1/A12:2002 IEC 60076-1:2011 UNE-EN 60076-2:1998 UNE-EN 60076-2:2006 ERRATUM IEC 60076-2:2011 UNE-EN 60076-3: 2002 UNE-EN 60076-3: 2006 ERRATUM IEC 60076-3:2000 IEC 60076-3:2000 CORRIGENDUM 1 UNE-EN 60076-5:2008 IEC 60076-5:2006 UNE-EN 60076-10:2002 IEC 60076-10:2001 UNE-EN 60076-16:2012 IEC 60076-16:2011
Transformadores de distribución sumergidos en aceite, de 25 kVA a 2500 kVA *Oil-immersed distribution transformers, from 25 up to 2500 kVA*	Todos los de la norma excepto: - Ensayo de fatiga de las cubas de llenado integral - Características de la pintura *All the tests of the standard, except:* - *Endurance test on corrugated tanks of completely oil filled and hermetically sealed distribution transformers* - *Tests of painting characteristics*	UNE 21428-1:2011 UNE 21428-1-1:2011 UNE 21428-1-2:2011 UNE-EN 50464-1:2010 UNE-EN 50464-2-1:2010 UNE-EN 50464-2-2:2010 UNE-EN 50464-2-3:2010 UNE-EN 50464-3:2010
Transformadores de potencia tipo seco *Dry-type power transformers*	Todos los de la norma sobre transformadores de distribución y transformadores de media potencia, excepto: - Ensayos de choque térmico, ambientales y de fuego *All the tests of the standard on distribution and medium power transformers, except:* - *Thermal shock, fire behaviour and environmental tests*	UNE-EN 60076-11:2005 IEC 60076-11:2004 UNE 21538-1: 2007 UNE-EN 50541-1:2012 UNE-EN 60076-16:2012 IEC 60076-16:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transformadores autoprotegidos sumergidos en líquido *Self-protected liquid-filled transformers*	- Todos los de la norma realizados por referencia a la serie de normas 60076 - Ensayo de descargas parciales (cap. 12) - *All the tests of the standard performed by reference to 60076 series* - *Partial discharges test (chap. 12)*	UNE-EN 60076-13:2008 IEC 60076-13:2006
Transformadores de medida y protección *Instrument transformers*	Todos los de la norma Límites: - Precisión: hasta 5 kA hasta 10 kV; 40 kV desde 10 VA - Dieléctricos: hasta Um ≤ 145 kV *All the tests of the standard* *Limits:* - *Accuracy: up to 5 kA* *up to 10 kV; 40 kV* *from 10 VA* - *Dielectric tests: up to Um ≤ 145 kV*	UNE-EN 60044-1:2000 UNE-EN 60044-1/A1:2001 UNE-EN 60044-1/A2:2004 UNE-EN 60044-2:1999 UNE-EN 60044-2/A1:2001 UNE-EN 60044-2/A2:2004 UNE-EN 60044-3:2004 IEC 60044-3:2002
Transformadores de tensión electrónicos Electronic voltage transformers	Ensayos de tipo: - Dieléctricos: hasta Um ≤ 145 kV - Ensayo de impulso tipo rayo - Ensayo bajo lluvia para tipo exterior - Ensayo de resistencia a la tensión de impulso para componentes de baja tensión - Precisión: hasta 10 kV; 40 kV; 50 Hz desde 10 VA Ensayos individuales y ensayos especiales *Type tests:* - *Dielectric tests: up to Um ≤ 145 kV* - *Lightning impulse test* - *Wet test for outdoor type* - *Impulse voltage withstand test for low-voltage components.* - *Accuracy: up to 10 kV, 40 kV, 50 Hz from 10 VA* *Routine tests and special tests*	UNE-EN 60044-7: 2001 IEC 60044-7:1999

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transformadores de medida y protección *Instrument transformers*	Todos los de la norma para transformadores de tensión, transformadores de intensidad para medida y transformadores de intensidad para protección de clase P, excepto: - Ensayo de estanquidad de la envolvente en sistemas de gas, a temperatura ambiente (Apdos. 7.2.8 y 7.3.7) y a alta y baja temperatura (Apdo. 7.4.7) - Ensayo de presión sobre la envolvente (Apdos. 7.2.9 y 7.3.8) - Ensayo de impulsos cortados múltiples (Apdo. 7.4.2) - Ensayos mecánicos (Apdo. 7.4.5) - Ensayo de defecto por arco interno (Apdo. 7.4.6) - Ensayo de punto de rocío del gas (Apdo. 7.4.8) - Ensayo de corrosión (Apdo. 7.4.9) - Ensayo de riesgo de incendio (Apdo. 7.4.10) Límites: - Ensayos dieléctricos: hasta: Um ≤ 145 kV - Transformadores de tensión: Precisión: Potencia de precisión rango II. Tensiones primarias asignadas hasta 40 kV *All the tests of the standard for voltage transformers, measuring current transformers and class P current transformers for protection, except:* - *Enclosure tightness test in gas systems, at ambient temperature (7.2.8 and 7.3.7) and at low and high temperatures (7.4.7)* - *Pressure test for the enclosure (7.2.9 and 7.3.8)* - *Multiple chopped impulse test (7.4.2)* - *Mechanical tests (7.4.5)* - *Internal arc fault test (7.4.6)* - *Gas dew point test (7.4.8)* - *Corrosion test (7.4.9)* - *Fire hazard test (7.4.10)* *Limits:* - *Dielectric tests: up to Um ≤ 145 kV* - *Voltage transformers:* *Accuracy: burden range II. Rated primary voltages up to 40 kV*	UNE-EN 61869-1:2010 UNE EN 61869-1:2011 ERRATUM IEC 61869-1:2007 IEC 61869-2:2012 UNE-EN 61869-3:2012 IEC 61869-3:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aisladores pasantes (pasatapas) *Insulated bushings*	Todos los de la norma, excepto: - Ensayo de presión interna - Ensayo de estanquidad en pasatapas con gas o sumergidos en gas Límites: Um ≤ 145 kV *All the tests of the standard, except:* - *Internal pressure test* - *Tightness test on gas-filled and gas-insulated bushings* *Limits: Um ≤ 145 kV*	UNE-EN 50180:1997 UNE-EN 50180:1999 CORRIGENDUM UNE-EN 50180:2011 UNE-EN 50181:1997 UNE-EN 50181:2011 UNE EN 60137:2011 IEC 60137:2008
Aisladores de apoyo de interior de materia orgánica para instalaciones de tensión nominal superiores a 1 kV e inferiores a 300 kV *Indoor post insulators of organic material for systems with nominal voltages greater than 1kV and below 300 kV*	Todos los de la norma Límites: Um ≤ 145 kV *All the tests of the standard* *Limits: Um ≤ 145 kV*	UNE-EN 60660:2001 IEC 60660:1999
Centros de transformación prefabricados *High voltage/low voltage prefabricated substations*	Todos los de la norma, excepto: Apdo 6.9, Ensayos CEM Límites: Arco interno: 1000 V *All the tests of the standard,* *except:* *- EMC tests (6.9)* *Limits:* *Arcing due to an internal fault: 1000V*	UNE-EN 62271-202:2007 IEC 62271-202:2006

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos compactos de aparamenta para centros de transformación (CEADS) *Compact equipment assemblies for distribution substations (CEADS)*	Todos los de la norma, excepto: - Ensayos CEM (apdo. 6.9) - Ensayos de robustez mecánica de cubas herméticas de llenado integral (incluidos en el apdo. 6.201) - Ensayo de estanquidad de la unidad funcional de alta tensión (apdo. 7.4) Límites: Arco interno: 1000 V *All the tests of the standard, except:* *- EMC tests (6.9)* *- Mechanical strength tests of hermetically sealed tanks (included in 6.201)* *- Tightness tests of high voltage functional unit (7.4)* *Limits:* *Arcing due to an internal fault: 1000V*	UNE-EN 50532:2011
Materiales aislantes *Insulating materials*	Rigidez dieléctrica, ensayos a frecuencias industriales, tensión continua e impulsos 1,2/50 sobre materiales en placas y planchas y tubos rígidos Límites: Tensión alterna < 200 kV Tensión continua - 70 kV, sólo polaridad negativa Impulsos hasta 500 kV *Electric strength, tests at power frequencies, direct voltage and 1,2/50 µs impulse tests on boards and sheets materials, and rigid tubes* *Limits:* *Power frequency voltage < 200 kV* *Direct voltage -70 kV, only negative polarity* *Impulses up to 500 kV*	UNE-EN 60243-1:1999 UNE-EN 60243-2:2001 UNE-EN 60243-3:2002 IEC 60243-1:1998 IEC 60243-2:2001 IEC 60243-3:2001

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Materiales aislantes sólidos plásticos *Electrical insulating plastic materials*	Ensayo del hilo incandescente *Glow wire test*	UNE-EN 60695-2-10:2002 UNE-EN 60695-2-11:2001 UNE-EN 60695-2-12:2001 UNE-EN 60695-2-12 :2011 UNE-EN 60695-2-13:2002 UNE-EN 60695-2-13 :2011 IEC 60695-2-10:2000 IEC 60695-2-11:2000 IEC60695-2-11:2001 CORRIGENDUM 1 IEC 60695-2-12:2010 IEC 60695-2-13:2010 IEC 60695-2-13:2012 CORRIGENDUM 1
Alfombras de material aislante para trabajos eléctricos *Electrical insulating matting for live working*	Todos los ensayos de la norma, excepto - Ensayos mecánicos (apdos. 5.5, 5.9 y - 5.10) - Ensayo de envejecimiento (Aptdo. 5.7) - Ensayo de llama (apdo. 5.8.1) - Resistencia al ácido (apdo. 5.9) - Resistencia al aceite (apdo. 5.10) *All the tests of the standard, except:* *- Mechanical tests (5.5, 5.9 y 5.10)* *- Aging test (5.7)* *- Flame retardance test (5.8.1)* *- Acid resistance (5.9)* *- Oil resistance (5.10)*	UNE-EN 61111 :2010 IEC 61111:2009
Mantas eléctricas aislantes *Electrical insulating matting for live working*	- Inspección visual y mediciones (apdo. 5.2) - Marcado (apdo. 5.3) - Embalaje e instrucciones de uso (apdo. 5.4) - Ensayos dieléctricos (apdo 5.6) - Ensayo de plegado a baja temperatura (apdo. - 5.8.2) - Categoría A. Resistencia al ácido. Parte eléctrica (apdo. 6.2) - Categoría C: Ensayo de doblado a temperaturas - extremadamente bajas (apdo. 6.6) *- Visual Inspection and measurements (5.2)* *- Marking (5.3)* *- Packaging and instructions for use (5.4)* *- Dielectric tests (5.6)* *- Low temperature folding test (5.8.2)* *- Category A: Acid resistance. Electrical part (6.2)* *- Category C: Extremely low temperature folding test (6.6)*	UNE-EN 61112:2010 IEC 61112:2009

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Envolventes de materiales eléctricos *Enclosures for electric material*	Clasificación de los grados de protección proporcionados por las envolventes, códigos IP e IK (excepto IK01) *Degrees of protection provided by enclosures. Code IP and IK (except IK01)*	UNE 20324:1993 UNE 20324/1M:2000 UNE 20324:2004 ERRATUM IEC 60529:1989 IEC 60529/A1:1999 UNE-EN 50102:1996 UNE-EN 50102:2002 CORRIGENDUM UNE-EN 50102/A1:1999 UNE-EN 50102/A1:2002 CORRIGENDUM IEC 62262:2002
Envolventes destinadas a los conjuntos de aparamenta de baja tensión *Empty enclosures for low-voltage switchgear and controlgear assemblies*	Ensayos para las envolventes vacías, todos los de la norma excepto: - Ensayo de resistencia a la radiación ultravioleta (UV) *Tests for empty enclosures, all the tests of the standard except:* *- Resistance to ultra-violet(UV) radiation*	UNE-EN 62208: 2004 UNE-EN 62208:2012 IEC 62208:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aparamenta de alta tension *High-voltage switchgear and controlgear*	Ensayos de tipo: Todos los de la norma excepto: - Ensayos CEM sobre circuitos auxiliares y de mando (Apdos. 6.9.1.2 , 6.9.2 y 6.9.3) - Aparamenta en gas: estanquidad (Apdo. - 6.8) - Ensayos sísmicos sobre circuitos auxiliares - (Apdo. 6.10.5.6) - Ensayo de rayos X para botellas de vacío - (Apdo. 6.11) - Aparamenta de Um > 245 kV: impulso tipo maniobra - - Aparamenta exterior: contaminación - artificial Límites: Ensayos dieléctricos: Frecuencia Industrial hasta 550 kV Impulso tipo rayo hasta 750 kV Tensión de perturbaciones radioeléctricas hasta 300 kV Ensayos individuales: Todos los de la norma excepto estanquidad de aparamenta en gas (Apdo. 7.4) *Type tests:* *All the tests of the standard, except:* *- EMC tests on auxiliary and control circuits (6.9.1.2, 6.9.2 and 6.9.3)* *- Gas insulated switchgear and controlgear: tightness test (6.8)* *- Seismic tests on auxiliary circuits (6.10.5.6)* *- X-radiation test procedure for vacuum interrupters (6.11)* *- Switchgear and controlgear of Um>245 kV: switching impulse voltage test* *- Outdoor switchgear and controlgear: Artificial pollution test* *Limits:* *Dielectric tests:* *Power frequency up to 550 kV* *Lightning impulse up to 750 kV* *Radio interference voltage up to 300 kV* *Routine tests:* *All the tests of the standard, except tightness test in gas insulated switchgear and controlgear (7.4)*	UNE-EN 62271-1:2009 UNE-EN 62271-1/A1:2011 IEC 62271-1:2007 IEC 62271-1/A1:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aparamenta bajo envolvente metálica para corriente alterna de tensiones asignadas superiores a 1 kV e inferiores o iguales a 52 kV *AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*	Ensayos de tipo: Todos los de la norma, excepto: - Ensayos CEM (Apdo. 6.9.) - Aparamenta en gas: estanquidad (Apdo. 6.8) - Ensayos sísmicos sobre circuitos auxiliares (Apdo. 6.10.5.6) - Ensayo de rayos X para botellas de vacío (Apdo. 6.11) - Aparamenta exterior: contaminación artificial sobre aisladores (Apdo. 6.2.8) Límites: - Ensayos de establecimiento y corte: 200 MVA, 36 kV - Arco interno: 1000 V Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests (6.9)* *- Gas insulated switchgear and controlgear: tightness test (6.8)* *- Seismic tests on auxiliary circuits (6.10.5.6)* *- X-radiation test procedure for vacuum interrupters (6.11)* *- Outdoor switchgear and controlgear: artificial pollution test on insulators (6.2.8)* *Limits:* *- Making and breaking tests: 200 MVA, 35 kV* *- Arcing due to an internal fault: 1000V* *Routine tests:* *All the tests of the standard, except tightness test on gas insulated switchgear and controlgear*	UNE-EN 62271-200:2012 (Vcorr:2013) UNE-EN 62271-200:2006 IEC 62271-200: 2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aparamenta bajo envolvente aislante para corriente alterna de tensiones asignadas superiores a 1 kV e inferiores o iguales a 52kV *AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*	Ensayos de tipo: Todos los de la norma excepto - Ensayos CEM (Apdo.6.9.) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares Límites: Ensayos de establecimiento y corte: 200 MVA, 36 kV Arco interno: 1000 V Ensayos individuales: Todos los de la norma excepto estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests (6.9)* *- Gas insulated switchgear and controlgear: tightness test* *- Seismic tests on auxiliary circuits* *Limits:* *- Making and breaking tests: 200 MVA, 35 kV* *- Arcing due to an internal fault: 1000V* *Routine tests:* *All the tests of the standard, except tightness test on gas insulated switchgear and controlgear*	UNE-EN 62271-201:2007 IEC 62271-201:2006
Aparamenta de interior bajo envolvente de tensiones asignadas superiores a 1 kV e inferiores o iguales a 52 kV para ser utilizada en condiciones climáticas severas *Indoor enclosed switchgear and controlgear for rated voltages above 1 kV up to and including 52 kV to be used in severe climatic conditions*	Todos los de la norma *All the tests of the standard*	IEC/TS 62271-304:2008 IEC/TS 62271-304:2010 CORRIGENDUM 1
Aparamenta bajo envolvente metálica aislada en SF6 hasta 36 Kv *SF6 insulated metal-enclosed switchgear and controlgear up to 35 kV*	Ensayo de inmersión *Immersion test*	Procedimiento Interno PE.EE-27-E Apdo. E.1. *Internal procedure PE.EE-27-E Section E.1.*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Seccionadores y seccionadores de puesta a tierra de corriente alterna para alta tensión *High-voltage alternating current disconnectors and earthing switches*	Ensayos de tipo: Todos los de la norma excepto - Ensayos CEM sobre circuitos auxiliares y de mando (Apdos. 6.9.1.2, 6.9.2 y 6.9.3) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares - Aparamenta de Um > 245 kV: impulso tipo maniobra - Aparamenta exterior: contaminación artificial operación bajo condiciones severas de hielo Límites: - Ensayos dieléctricos: - Frecuencia industrial hasta 550 kV - Impulso tipo rayo hasta 750 kV - Tensión de perturbaciones radioeléctricas - hasta 300 kV - Ensayos de conexión: 200 MVA, 36 kV Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests on auxiliary and control circuits (6.9.1.2, 6.9.2 and 6.9.3)* *- Gas insulated switchgear and controlgear: tightness test* *- Seismic tests on auxiliary circuits* *- Switchgear and controlgear of Um > 245 kV: Switching impulse voltage test* *- Outdoor switchgear and controlgear: Artificial pollution test and operation under severe ice conditions* *Limits:* *Dielectric tests:* *- Power frequency up to 550 kV* *- Lightning impulse up to 750 kV* *- Radio interference voltage up to 300 kV* *- Making tests: 200 MVA, 36 kV* *Routine tests:* *All the tests of the standard, except:* *- Gas insulated switchgear and controlgear: tightness test*	UNE-EN 62271-102:2005 UNE-EN 62271-102:2011 ERRATUM UNE-EN 62271-102/A1:2012 IEC 62271-102:2001 IEC 62271-102:2002 CORRIGENDUM 1 IEC 62271-102:2003 CORRIGENDUM 2 IEC 62271-102:2005 CORRIGENDUM 3 IEC 62271-102/A1:2011 IEC 62271-102/A1:2012 CORRIGENDUM 1 IEC 62271-102/A2:2013

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Interruptores automáticos de corriente alterna para alta tensión *High-voltage alternating-current circuit-breakers*	Ensayos de tipo: Todos los de la norma, excepto: - Ensayos CEM sobre circuitos auxiliares y de mando - (Apdos. 6.9.1.2, 6.9.2 y 6.9.3) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares - Ensayos de corte - Aparamenta de Um > 245 kV: Impulso tipo maniobra - Aparamenta exterior: contaminación artificial y operación bajo condiciones severas de hielo Límites: - Ensayos dieléctricos: - Frecuencia industrial hasta 550 kV - Impulso tipo rayo hasta 750 kV - Tensión de perturbaciones radioeléctricas hasta 300 kV - Ensayos de conexión: 200 MVA, 36 kV Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests on auxiliary and control circuits (6.9.1.2, 6.9.2 and 6.9.3)* *- Gas insulated switchgear and controlgear: Tightness test* *- Seismic tests on auxiliary circuits* *- Breaking tests* *- Switchgear and controlgear of Um > 245 kV: Switching impulse voltage test* *- Outdoor switchgear and controlgear: Artificial pollution test and operation under severe ice conditions* *Limits:* *Dielectric tests:* *- Power frequency up to 550 kV* *- Lightning impulse up to 750 kV* *- Radio interference voltage up to 300 kV* *- Making tests: 200 MVA, 36 kV* *Routine tests:* *All the tests of the standard, except:* *- Gas insulated switchgear and controlgear: tightness test*	UNE-EN 62271-100:2011 IEC 62271-100:2008 IEC 62271-100/A1:2012 IEC 62271-100/A1:2012 CORRIGENDUM 1

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Interruptores de alta tensión para tensiones asignadas superiores a 1 kV e inferiores a 52 kV *High voltage switches for rated voltages above 1 kV and less than 52 kV*	Ensayos de tipo: Todos los de la norma, excepto: - Ensayos CEM (Apdo. 6.9) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares - Aparamenta exterior: contaminación - artificial y operación bajo condiciones severas de hielo Límites: - Ensayos de establecimiento y corte: 200 - MVA, 36 kV Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests (6.9)* *- Gas insulated switchgear and controlgear: Tightness test* *- Seismic tests on auxiliary circuits* *- Outdoor switchgear and controlgear: Artificial pollution test and operation under severe ice conditions.* *Limits:* *Making and breaking tests: 200 MVA, 36 kV* *Routine tests:* *All the tests of the standard, except:* *- Gas insulated switchgear and controlgear: Tightness test*	UNE-EN 60265-1:1999 UNE-EN 60265-1:2005 CORRIGENDUM UNE-EN 62271-103:2012 IEC 62271-103:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos y materiales de alta tensión *High voltage equipment and materials*	Ensayos de alta tensión: Ensayos en seco y bajo lluvia Ensayos con tensión alterna Ensayos con tensión continua Ensayos con impulsos tipo rayo Límites: - Tensión alterna hasta 550 kV - Tensión continua hasta 100 Kv - Impulsos tipo rayo hasta 750 kV *High voltage tests:* *Dry and Wet tests* *Tests with Alternating Voltage* *Tests with Direct Voltage* *Lightning Impulse voltage tests* *Limits:* *- Alternating voltage up to 550 kV* *- Direct voltage up to 100 kV* *- Lightning impulse voltage up to 750 kV*	UNE 21308-1:1994 UNE-EN 60060-1:2012 IEC 60060-1:2010
	Medida de las descargas parciales Límite : Tensión de ensayo ≤ 550 kV *Partial discharges measurement* *Limit: Test voltage ≤ 550 kV*	UNE-EN 60270:2002 IEC 60270:2000 IEC 60270:2001 CORRIGENDUM 1
Pértigas aislantes de maniobra para alta tensión *Insulating poles (insulating sticks) for electrical purposes on high-voltage installations*	Ensayos eléctricos: corriente de fugas (Apdo. 8.2.2) Ensayos mecánicos: ensayo de flexión (Adpo. 8.4.1) *Dielectric tests: leakage current (8.2.2)* *Mechanical tests : bending test (8.4.1)*	UNE 204003:2003 UNE 204003:2004 ERRATUM
Detectores de tipo capacitivo para utilización con tensiones superiores a 1 kV en corriente alterna *Capacitive type detectors to be used for voltages exceeding 1 kV a.c.*	Ensayos funcionales (apdo. 6.2) Ensayos dieléctricos (apdo. 6.3) Ensayos mecánicos (apdo. 6.4) Ensayos específicos (cap. 7) Límites: Vdc ≤ 100 kV Vac ≤ 550 kV *Function tests (6.2)* *Dielectric tests (6.3)* *Mechanical tests (6.4)* *Specific tests (7)* *Limits:* *Vdc ≤ 100 kV* *Vac ≤ 550 kV*	UNE-EN 61243-1:2006 UNE-EN 61243-1/A1:2011 IEC 61243-1:2003 IEC 61243-1:2005 CORRIGENDUM 1 IEC 61243-1/A1:2009

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Detectores de tensión tipo bipolar para baja tensión *Two-pole low-voltage type voltage detectors*	Ensayos para requisitos funcionales (apdo. 5.3), excepto: Dependencia de la frecuencia (apdo 5.3.5) Dependencia del rizado para detectores de tensión con CC (apdo. 5.3.6) Ensayos de requisitos eléctricos (apdo. 5.4), excepto: Protección contra sobretensiones transitorias (apdo. 5.4.5.1) Ensayos de requisitos mecánicos (apdo. 5.5), excepto: Ensayo de vibraciones (apdo. 5.5.4) Resistencia al calor (apdo. 5.5.9) Buena adherencia del aislamiento de la parte aislada del electrodo de contacto (apdo. 5.5.10.3) Ensayos del cable (apdo. 5.5.11) Marcas (apdo. 5.6) Mal uso de la tensión CA/CC (apdo. 5.8.1) *Tests for general requirements (5.3), except:* *Frequency dependency (5.3.5)* *Ripple dependency for d.c. voltage detector (5.3.6)* *Tests for electrical requirements (5.4), except:* *Protection against transient overvoltages (5.4.5.1)* *Tests for mechanical requirements (5.5), except:* *Vibration resistance (5.5.4)* *Heat resistance (5.5.9)* *Close adhesion of insulation of the insulated part of the contact electrode (5.5.10.3)* *Lead tests (5.5.11)* *Marking (5.6)* *AC/DC voltage misuse (5.8.1)*	UNE-EN 61243-3:2011 IEC 61243-3:2009
Aparamenta de baja tensión *Low voltage switchgear and controlgear*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 8.4) *All the tests of the standard, except:* *- Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* *- EMC tests (8.4)*	UNE-EN 60947-1:2008 UNE-EN 60947-1/A1:2011 IEC 60947-1:2007 IEC 60947-1/A1:2010

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PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Interruptores automáticos de baja tensión *Low voltage circuit-breakers*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos del anexo B - Anexo J: CEM *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *Tests of annex B* - *Annex J: EMC*	UNE-EN 60947-2:2007 UNE-EN 60947-2/A1:2011 IEC 60947-2:2006 IEC 60947-2/A1:2009 IEC 60947-2/A2 :2013
Interruptores, seccionadores, interruptores-seccionadores y combinados fusibles de baja tensión *Low voltage switches, disconnectors, switch-disconnectors and fuse-combination units*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 8.4) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (8.4)*	UNE-EN 60947-3:2000 UNE-EN 60947-3/A1:2002 UNE-EN 60947-3/A2:2006 UNE-EN 60947-3:2009 UNE-EN 60947-3:2010 ERRATUM IEC 60947-3:2008 IEC 60947-3/A1:2012 IEC 60947-3/Corr1:2012
Contactores y arrancadores electromecánicos de baja tensión *Low voltage electromechanical contactors and motor starters*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 9.4) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (9.4)*	UNE-EN 60947-4-1:2002 UNE-EN 60947-4-1:2002 ERRATUM UNE-EN 60947-4-1/A1:2003 UNE-EN 60947-4-1/A2:2006 IEC 60947-4-1:2009 IEC 61947-4-1/A1:2012
Controladores y arrancadores semiconductores de motores de corriente alterna de baja tensión *Low voltage contactors and motor starters – AC semiconductor motor controllers and starters*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 9.3.5) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (9.3.5)*	UNE-EN 60947-4-2:2002 UNE-EN 60947-4-2:2008 ERRATUM UNE-EN 60947-4-2/A1:2003 UNE-EN 60947-4-2/A2:2007 IEC 60947-4-2:2011 IEC 60947-4-2/CORR1:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de serie y conjuntos derivados de serie de aparamenta de baja tensión *Low voltage switchgear and controlgear assemblies. Type-tested and partially type-tested assemblies*	Todos los de la norma, excepto: - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *EMC tests (8.2.8)*	UNE-EN 60439-1:2001 UNE-EN 60439-1/A1:2005
Conjuntos de aparamenta de baja tensión *Low voltage switchgear and controlgear assemblies*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y anexo J) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2 and annex J)*	IEC 61439-1:2011 UNE-EN 61439-1:2011 UNE-EN 61439-1:2012 IEC/TR 61439-0:2010
Conjuntos de aparamenta de potencia de baja tensión *Low voltage power switchgear and controlgear assemblies*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y Anexo J) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (Apdo. 10.6.2. y anexo J)*	IEC 61439-2:2011 UNE-EN 61439-2:2011 UNE-EN 61439-2:2012
Canalizaciones prefabricadas de baja tensión *Low voltage busbar trunking systems (busways)*	Todos los de la norma, excepto: - Ensayos CEM (Apdo. 8.2.8) - Resistencia a la propagación de la llama - Características cortafuegos *All the tests of the standard, except:* - *EMC tests (8.2.8)* - *Resistance to flame propagation* - *Fire barrier characteristics*	UNE-EN 60439-2:2001 UNE-EN 60439-2/A1:2006
Conjuntos de aparamenta de baja tensión destinados a estar instalados en lugares accesibles al personal no cualificado durante su utilización. Cuadros de distribución *Low voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use. Distribution boards.*	Todos los de la norma, excepto: - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *EMC tests (8.2.8)*	UNE-EN 60439-3:1994 UNE-EN 60439-3:2010 CORRIGENDUM UNE-EN 60439-3/A1:1997 UNE-EN 60439-3/A2:2002

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de aparamenta de baja tensión destinados a ser utilizados por personas comunes *Low-voltage distribution boards intended to be operated by ordinary persons*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y anexo J) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2. and Annex J)*	UNE-EN 61439-3:2012 IEC 61439-3:2012
Conjuntos de aparamenta de baja tensión: conjuntos para obras (CO). *Low voltage switchgear and controlgear assemblies: assemblies for construction sites (ACS)*	Todos los de la norma, excepto: - Ensayos de choque (Apdo. 8.2.101.3) - Ensayos de verificación de la resistencia a la corrosión en atmósferas fuertemente contaminadas (Apdo. 8.2.102.2.) - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *Shock test (8.2.101.3)* - *Verification of resistance to corrosion in heavily polluted atmosphere (8.2.102.2)* - *EMC tests (8.2.8)*	UNE-EN 60439-4:2005 UNE 201008 IN:2012
Conjuntos de aparamenta de baja tensión destinados a ser instalados al exterior en lugares públicos. Conjuntos de aparamenta para redes de distribución (CRD) *Low voltage switchgear and controlgear assemblies intended to be installed outdoors in public places. Cable distribution cabinets (CDCS) for power distribution networks*	Todos los de la norma, excepto: - Verificación de la resistencia a la corrosión y al envejecimiento (Apdos. 8.2.103.2 y 8.2.103.3) - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *Verification of corrosion and ageing resistance (8.2.103.2 and 8.2.103.3)* - *EMC tests (8.2.8)*	UNE-EN 60439-5:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de aparamenta de baja tensión: conjuntos para obras (CO). *Low voltage switchgear and controlgear assemblies: assemblies for construction sites (ACS)*	Todos los de la norma, excepto: - Ensayo de verificación de la resistencia a la corrosión en atmósferas fuertemente contaminadas (Apdo. 10.2.2.101) - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayo de choque (Apdo. 10.2.6.3) - Ensayos CEM (Apdo. 10.6.2. y anexo J) *All the tests of the standard, except:* - *Verification of resistance to corrosion in heavily polluted atmospheres (10.2.2.101)* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *Shock test (10.2.6.3)* - *EMC tests (10.6.2 and Annex J)*	IEC 61439-4:2012
Conjuntos de aparamenta de baja tensión para redes de distribución pública *Low voltage switchgear and controlgear assemblies for power distribution in networks.*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. - 10.2.4) - Ensayos CEM (Apdo. 10.6.2 y Anexo J) - Verificación de categoría de inflamabilidad - (Apdo. 10.2.3.102) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2 and Annex J)* - *Verification of category of flammability (10.2.3.102)*	IEC 61439-5:2010 UNE-EN 61439-5:2011
Conjuntos de aparamenta de baja tensión: Canalizaciones prefabricadas *Low-voltage switchgear and controlgear assemblies: Busbar trunking systems*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. - 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y anexo J) - Resistencia a la propagación de la llama - (Apdo. 10.101) - Características cortafuegos (Apdo. 10.102) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2 and Annex J)* - *Resistance to flame- propagation (10.101)* - *Fire resistance in building penetrations (10.102)*	IEC 61439-6:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de aparamenta de baja tensión bajo envolvente *Enclosed low-voltage switchgear and controlgear assemblies*	Ensayo en condiciones de arco debidas a un fallo interno *Test under conditions of arcing due to internal fault*	UNE-IEC/TR 61641 IN:2011 IEC/TR3 61641:2008
Fusibles de baja tensión destinados a ser utilizados por personas autorizadas (usos principalmente industriales) *Low-voltage fuses for use by authorized persons (fuses mainly for industrial applications)*	Todos los de las normas para las secciones A, B, C, D y F, excepto para la sección A: - Ensayo de corrosión del Apdo. 8.11.2.3 - Ensayo de resistencia a la formación de caminos conductores del Apdo. 8.2.5 *All the tests of the standards for fuse systems A, B, C, D and F, except for fuse system A:* - *Verification of resistance to rusting (8.11.2.3)* - *Resistance to tracking (8.2.5)*	UNE-EN 60269-1:2008 UNE-EN 60269-1/A1:2010 HD 60269-2:2007 UNE-HD 60269-2:2011 IEC 60269-1:2006 IEC 60269-1/A1:2009 IEC 60269-2:2010
	Todos los de la norma para las Secciones I y III, excepto los ensayos de resistencia a la formación de caminos conductores (Apdo. 8.2.6.), de corrosión (Apdo. 8.11.2.3), para la sección I *All the tests of the standards for the sections I to III, except resistance to tracking (8.2.6) and resistance to rusting (8.11.2.3) for section I*	UNE-EN 60269-2:1996 UNE-EN 60269-2/A1:1999 UNE-EN 60269-2/A2:2002 UNE-EN 60269-2:2005 CORRIGENDUM
Inversores Solares (Monofásicos y Trifásicos) y Sistemas Compensadores de Huecos (FACTS) de potencia asignada máxima de 300 kW *Solar Inverters (single-phase and three-phase) and voltage dips compensation systems (FACTS) of rated power up to 300 kW*	Medida y evaluación de la respuesta de los Sistemas de Conversión Fotovoltaicos (SCFV) ante huecos de tensión, conforme a las condiciones establecidas en el apdo. 5 Anexo III del documento "Procedimientos de Verificación, Validación y Certificación de los requisitos del PO 12.3. sobre la respuesta de las instalaciones eólicas y fotovoltaicas ante huecos de tensión" versión 10 de 26 de enero de 2012 de la Asociación Empresarial Eólica (AEE) *Measurement and assessment of the response of photovoltaic conversion systems (PVCS) in the event of voltage dips, according to conditions of subclause 5 Annex III of document "Procedure for verification, validation and certification of the requirements of the P.O. 12.3 on the response of wind and solar farms in the event of voltage dips" version 10 of 26th January 2012 of the Spanish Wind Energy Association (AEE)*	Procedimiento Interno PE.EE-88-E *Internal procedure* *PE.EE-88-E*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipo electrónico para uso en instalaciones de potencia Electronic equipment for use in power installations	Todos los de la norma, excepto: - Ensayos de estanquidad para EE refrigerado por líquido (Apdo. 9.4.3.3.) - Ensayo de conveniencia del barniz o del recubrimiento (Apdo. 9.4.4.4.) - Ensayo de descarga parcial (Apdo. 9.4.5.3.) - Ensayos CEM (Apdos. 9.4.6.1. y 9.4.6.2.) *All the tests of the standard, except:* - *Seal test for liquid-cooled EE (9.4.3.3)* - *Suitability test of varnish or coating (9.4.4.4)* - *Partial discharge test (9.4.5.3)* - *EMC tests (9.4.6.1 and 9.4.6.2)*	UNE-EN 50178:1998
Equipos generadores en paralelo con redes generales de distribución en baja tensión (requisitos de conexión) *Micro-generators in parallel with public low-voltage distribution networks (requirements for the connection)*	Todos los de las normas para equipos de hasta 300 kVA, excepto: UNE-EN 50438:2008 - Ensayos de compatibilidad electromagnética (Apdo. 5.1) - Ensayo LoM para Austria (última fila de tabla para Austria en Anexo A) *All the tests of the standards, for equipment up to 300 kVA, except:* *UNE-EN 50438:2008* - *EMC tests (5.1)* - *LoM test for Austria (last row in table of annex A for Austria)*	UNE-EN 50438:2008 DIN V VDE V 0126-1-1:2006 DIN V VDE V 0126-1-1/A1:2012 RD 1663/2000, de 29 de septiembre *Spanish regulation RD 1663/2000, of September 29th*
Inversores y dispositivos anti-isla *Inverters and islanding prevention devices*	Ensayo de prevención de funcionamiento en isla *Test of islanding prevention measures*	IEC 62116:2008

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de tratamiento de la información, incluyendo los equipos eléctricos de oficina y equipos conectables a la red de telecomunicación (excluyendo Destructoras personales hogar/oficina de documentos multimedia) *Information technology equipment including office electrical equipment and telecommunications networks equipment*	Seguridad eléctrica *Electrical safety*	UNE-EN 60950-1:2007 UNE-EN 60950-1:2007 CORRIGENDUM UNE-EN 60950-1/A11:2009 UNE-EN 60950-1/A1:2011 UNE-EN 60950-1/A12:2011 Apdos 1.6.2, 1.6.3, 1.7.1, 1.7.2.2, 1.7.2.3, 1.7.2.4, 1.7.2.5, 1.7.3, 1.7.4, 1.7.5, 1.7.6, 1.7.7, 1.7.8, 1.7.9, 1.7.10, 1.7.11, 1.7.12, 1.7.13, 1.7.14, 2.1.1.1, 2.1.1.6, 2.1.1.7, 2.1.2, 2.1.3, 2.3.2, 2.3.3, 2.3.4, 2.6.3.4, 2.6.3.5, 3.1.2, 3.1.3, 3.1.6, 3.1.7, 3.1.8, 3.1.10, 3.2.1, 3.2.2, 3.2.4, 3.2.6, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, 3.4.11, 3.5.1, 3.5.2, 3.5.3, 4.1, 4.2.3, 4.2.4, 4.3.1, 4.3.3, 4.3.4, 4.3.5, 4.3.7, 4.4, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.5.2, 4.6.1, 4.6.2, 4.6.3, 4.6.4, 5.1, 5.2 y 6.2.
Generadores de potencia conectados a redes de BT, sistemas de protección de interfaz e inversores *Power generators connected to low voltage grids, interface protection systems and inverters*	Todos los de la norma salvo ensayos CEM *All the tests of the standard except EMC tests*	CEI 0-21:2012 (Regola técnica di riferimento per la connessione di utenti attivi e posivi ale reti BT delle emprese distributori di energia electtrica)

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 50470-1:2007 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 50470-3:2007 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos o electromecánicos destinados a la medida de energía eléctrica en sistemas de 50Hz y tensión hasta 600V *Electricity metering equipment (a.c.)* *Static or electromechanics meters and intended to the measuring of electrical energy in 50 Hz systems and voltage up to 600 V.*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 62052-11:2004 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos de energía activa (clases 1 y 2) *Electricity metering equipment (a.c.)* *Static meters for active energy (classes 1 and 2)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 62053-21:2003 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a). Contadores estáticos de energía reactiva (clases 2 y 3) *Electricity metering equipment (a.c.)* *Static meters for reactive energy (classes 2 and 3)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 62053-23:2003 Excepto apdo. 5.4

Categoría I (Ensayos "in situ") / *Category I (on-site tests)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de potencia con aislamiento extruido y sus accesorios, de tensión asignada superior a 150 kV (Um = 170 kV) hasta 500 kV (Um = 550 kV) *Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um = 170 kV) up to 500 kV (Um = 550 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayo de tensión continua de la cubierta - exterior (Apdo. 16.2) - Ensayo de tensión en corriente alterna del aislamiento (Apdo. 16.3) *Electrical tests after installation (chap. 16):* - *DC voltage test of the oversheath (16.2)* - *-AC voltage test of the insulation (16.3)*	IEC 62067:2011
Cables de potencia con aislamiento extruido y sus accesorios, de tensión asignada superior a 150 kV (Um = 170 kV) hasta 400 kV (Um = 420 kV) *Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um = 170 kV) up to 400 kV (Um = 420 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayos de comprobación del aislamiento principal: Método 1: Ensayo de tensión soportada a frecuencia industrial. - Ensayo de comprobación de la cubierta - Ensayo de continuidad y resistencia de las pantallas - Ensayo de continuidad y resistencia de los - conductores - Medida de descargas parciales del sistema nuevo de cable *Electrical tests after installation (clause 16):* - *Tests to verify the main insulation: Method 1: Power frequency withstand test.* - *Test to verify the oversheath* - *Continuity and resistance measurement test of screens* - *Continuity and resistance measurement test of conductors* - *Partial discharges measurement on the new cable system*	UNE 211067-1:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de energía con aislamiento extruido y sus accesorios para tensiones asignadas superiores a 36 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV) *Power cables with extruded insulation and their accessories for rated voltages above 36 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV)*	Ensayos eléctricos después de la instalación: Parte 1. - 15.1: ensayo de tensión dc sobre cubierta - 15.2: ensayo de tensión ac sobre el aislamiento. Parte 2. - 8.1 Ensayo eléctrico sobre la "sobrecubierta" (oversheath) 2 Ensayos eléctricos sobre los accesorios - 8.3.1. Ensayo de tensión ac sobre el aislamiento con equipo resonante - 8.4 Ensayo eléctrico después de la instalación, cubierta no metálica - 8.8 Ensayo dc de resistencia del conductor Partes 3 a 11: ensayos realizados por referencia a los de las partes 1 y 2, dentro de los rangos siguientes para los ensayos sobre cubiertas y sobre el aislamiento: - Ensayos sobre cubierta: 25 kV dc - Ensayos sobre aislamiento: 260 kV, 20 Hz a 300 Hz *Electrical tests after installation:* *Part 1.* - *15.1:DC voltage test of the oversheath* - *15.2: AC voltage test of the insulation.* *Part 2.* - *8.1 Electrical test on oversheath* - *8.2 Electrical tests on accessories* - *8.3.1 AC voltage test on the insulation with resonant system* - *8.4 Electrical test after installation, non-metallic sheath* - *8.8 DC conductor resistance test* *Parts 3 to 11: tests performed by reference to those of parts 1 and 2, in the following ranges for the tests of sheaths and of insulation:* - *Tests of sheaths: 25 kV dc* - *Tests of insulation: 260 kV, 20 Hz to 300 Hz*	HD 632 S2:2008

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de energía con aislamiento extruido y sus accesorios para tensiones asignadas superiores a 36 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV) *Power cables with extruded insulation and their accessories for rated voltages above 36 kV (Um=42 kV) up to 150 kV (Um=170 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayo de tensión continua de la cubierta exterior (Apdo. 16.2) - Ensayo de tensión en corriente alterna del aislamiento (Apdo. 16.3) *Electrical tests after installation (chap. 16):* - *DC voltage test of the oversheath (16.2)* - *AC voltage test of the insulation (16.3)*	IEC 60840:2011
Cables de energía con aislamiento extruido y sus accesorios para tensiones asignadas superiores a 36 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV) *Power cables with extruded insulation and their accessories for rated voltages above 36 kV (Um=42 kV) up to 150 kV (Um=170 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayos de comprobación del aislamiento principal. Método 1: Ensayo de tensión soportada a frecuencia industrial. Método 4: Medida de descargas parciales - Ensayo de comprobación de la cubierta - Ensayo de continuidad y resistencia de las pantallas - Ensayo de continuidad y resistencia de los - conductores - Medida de descargas parciales del sistema nuevo de cable *Electrical tests after installation (chap. 16):* - *Tests to verify the main insulation: Method 1: Power frequency withstand test. Method 4: Partial discharges measurement.* - *Test to verify the oversheath* - *Continuity and resistance measurement test of screens* - *Continuity and resistance measurement test of conductors* - *Partial discharges measurement on the new cable system*	UNE 211632-1:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Sistemas de cables eléctricos de alta tensión en corriente alterna *High voltage AC cable systems*	Ensayos previos a la puesta en servicio del sistema nuevo de cable de alta tensión (cap. 4): Sistemas nuevos de cables de tensión asignada superior a 0,6/1 kV e inferior o igual a 87/150 (170 kV) (Apdo. 4.1): - Ensayos de comprobación del aislamiento principal (Apdo. 4.1.1). Método 1: Ensayo de tensión soportada a frecuencia industrial. Método 4: Medida de descargas parciales - Ensayo de comprobación de la cubierta (Apdo. 4.1.2) - Ensayo de continuidad y resistencia de las pantallas (Apdo. 4.1.3) - Ensayo de continuidad y resistencia de los conductores (Apdo. 4.1.4) *Electrical tests after installation of a new high voltage cable system (clause 4): New cable systems of rated voltages above 0.6/1 kV up to 87/150 (170 kV) (4.1):* - *Tests of the insulation (4.1.1). Method 1: Power frequency withstand voltage test. Method 4: Partial discharge measurement* - *Test of the oversheath (4.1.2)* - *Continuity and resistance measurement test of screens (4.1.3)* - *Continuity and resistance measurement test of conductors (4.1.4)*	UNE 211006:2010

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Sistemas de cables eléctricos de alta tensión en corriente alterna *High voltage AC cable systems*	Sistemas nuevos de cables de tensión asignada superior a 87/150 (170 kV) hasta 220/400 (420 kV) (Apdo. 4.2): - Ensayos de comprobación del aislamiento principal (Apdo. 4.2.1): Método 1: Ensayo de tensión soportada a frecuencia industrial. - Ensayo de comprobación de la cubierta (Apdo. 4.2.2) - Ensayo de continuidad y resistencia de las pantallas (Apdo. 4.2.3) - Ensayo de continuidad y resistencia de los conductores (Apdo. 4.2.4) Medida de descargas parciales del sistema nuevo de cable (cap. 5) Ensayo de continuidad y resistencia eléctrica de la pantalla y los conductores de los sistemas nuevos de cable (cap. 6): *New cable systems of rated voltages above 87/150 (170 kV) up to 220/400 (420 kV) (4.2):* *- Tests of the insulation (4.2.1): Method 1: Power frequency withstand voltage test* *- Test of the oversheath (4.2.2)* *- Continuity and resistance measurement test of screens (4.2.3)* *- Continuity and resistance measurement test of conductors (4.2.4).* *Partial discharge measurement of a new cable system (chap. 5)* *Continuity and resistance measurement test of screens and conductors of new cable systems (chap. 6)*	UNE 211006:2010
Líneas eléctricas de alta tensión *High voltage power lines*	Medida de impedancia de línea *Line impedance measurement*	Procedimiento interno PE.EE-90-E *Internal procedure* *PE.EE-90-E*
Equipos y materiales de alta tensión *High voltage equipment and materials*	Ensayos de alta tensión con tensión alterna Límites: - 260 kV, 20 Hz a 300 Hz *High voltage test with alternating voltage* *Limits:* *- 260 kV, 20 Hz to 300 Hz*	UNE-EN 60060-3:2006 UNE-EN 60060-3:2007 CORRIGENDUM IEC 60060-3:2006

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de energía para material rodante en aplicaciones ferroviarias *Power cables of rolling stock for railway applications*	Propiedades dieléctricas: Ensayos de rutina (Apdo. 9.3.3.3) *Dielectric properties: Routine tests (9.3.3.3)*	IEC 60077-1:1999

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Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH
Landsberger Allee 378 A, 12681 Berlin

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-voltage equipment and components
Low-voltage equipment and components
Installation, switching, control and protective equipment
High-voltage, medium-voltage and low-voltage cables and their accessories

The accreditation certificate shall only apply in connection with the notice of accreditation of 2015-11-11 with the accreditation number D-PL-12107-01 and is valid until 2020-11-10. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 42 pages.

Registration number of the certificate: D-PL-12107-01-00

Frankfurt, 2015-11-11

Dipl.-Ing. (FH) Ralf Egner
Head of Division

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

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The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

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Annex to the Accreditation Certificate D-PL-12107-01-00 according to DIN EN ISO/IEC 17025:2005

Period of validity: 2015-11-11 to 2020-11-10 Date of issue: 2015-11-11

Holder of certificate:

IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH
Landsberger Allee 378 A, 12681 Berlin

Tests in the fields:

High-voltage equipment and components
Low-voltage equipment and components
Railway applications
Installation, switching control and protective equipment
High-voltage, medium-voltage and low-voltage cables and their accessories

The testing laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use standards or equivalent testing methods listed here with different issue dates.

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Testing of high-voltage equipment and components as described in the subsequent listed standards			
High-voltage Switchgear, Control gear and Assemblies (general)			
Electrical engineering	IEC 62271-1 (2011-08) Ed. 1.1 EN 62271-1:2008/A1:2011 DIN EN 62271-1 VDE 0671-1/A1): 2012-04	High-voltage switchgear and controlgear – Part 1: Common specifications	

This document is a translation. The definitive version is the original German annex to the accreditation certificate.

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
High-voltage Switchgear and Control gear			
Electrical engineering	IEC 62271-100 (2012-09) Ed. 2.1 STL-Guide EN 62271-100:2009 + A1:2012 DIN EN 62271-100:2013-08 VDE 0671-100	High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit-breakers	
Electrical engineering	IEC 62271-101 (2012-10) Ed. 2.0 STL-Guide EN 62271-101:2013 DIN EN 62271-101:2013-08 VDE 0671-101	High-voltage switchgear and controlgear – Part 101: Synthetic testing	
Electrical engineering	IEC 62271-108 (2005-10) Ed. 1.0 EN 62271-108:2006 DIN EN 62271-108:2006-10 VDE 0671-108	High-voltage switchgear and controlgear – Part 108: High-voltage alternating current disconnecting circuit-breakers for rated voltages of 72,5 kV and above	
Electrical engineering	IEC 62271-109 EN 62271-109:2009 + A1:2013 DIN EN 62271-109:2014-02 VDE 0671-109	High-voltage switchgear and controlgear – Part 109: Alternating-current series capacitor by-pass switches	
Electrical engineering	IEC 62271-110 (2012-09) Ed. 3.0 EN 62271-110:2012 DIN EN 62271-110:2013-08 VDE 0671-110	High-voltage switchgear and controlgear – Part 110: Inductive load switching	
Electrical engineering	IEEE C37.60-2012 IEC 62271-111 (2012-09) Ed. 2.0 VDE 0671-111	Overhead, pad-mounted, dry vault, and submers-ible automatic circuit reclosersand fault interrupters for alternating current systems up to 38 kV.	
Electrical engineering	IEC 62271-205 EN 62271-205:2008 DIN EN 62271-205:2008-12 VDE 0671-205	High-voltage switchgear and controlgear – Part 205: Compact switchgear assemblies for rated voltages above 52 kV.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Load switches			
Electrical engineering	IEC 62271-103 DIN IEC 62271-103 EN 62271-103:2011 DIN EN 62271-103:2012-04 VDE 0671-103 STL-Guide	High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV.	
Electrical engineering	IEC 62271-104 (2015-02) Ed. 2.0 EN 62271-104:2009 DIN EN 62271-104:2010-03 VDE 0671-104	High-voltage switchgear and controlgear – Part 104: Alternating current switches for rated voltages higher than 52 kV.	
Electrical engineering	IEC 62271-105 (2012-09) Ed. 2.0 EN 62271-105:2012 DIN EN 62271-105:2013-08 VDE 0671-105	High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV.	
Electrical engineering	IEC 62271-107 (2012-05) Ed. 2.0 EN 62271-107:2012 DIN EN 62271-107:2013-03 VDE 0671-107	High-voltage switchgear and controlgear – Part 107: Alternating current fused circuit-switchers for rated voltages above 1 kV up to and including 52 kV.	
Current contactors and motor starters			
Electrical engineering	IEC 62271-106 (2014-02) Ed. 1.0 + Corr 1 EN 62271-106:2011 DIN IEC 62271-106:2012-06 VDE 0671-106	High-voltage alternating current contactors and contactor-based motor starters.	
Current disconnectors and earthing switches			
Electrical engineering	IEC 62271-102 (2013-02) Ed. 1.0 + am2 EN 62271-102:2002/A2:2013 DIN EN 62271-102/A2:2013-12 VDE 0671-102/A2	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Fuses			
Electrical engineering	IEC 60282-1 (2014-07) Ed. 7.1 STL-Guide EN 60282-1:2009 + A1:2014 DIN EN 60282-1:2015-05 VDE 0670-4	High-voltage fuses – Part 1: Current-limiting fuses.	
Electrical engineering	IEC 60282-2 (2008-04) Ed. 3.0	High-voltage fuses; – Part 2: Expulsion fuses	
Electrical engineering	IEC 60644 (2009-08) Ed. 2.0 EN 60644:2009 DIN EN 60644:2010-07 VDE 0670-401	Specification for high-voltage fuse-links for motor circuit applications.	
High-voltage switchgear and control gear assemblies			
Electrical engineering	IEC 62271-200 (2011-10) Ed. 2.0 STL- Guide EN 62271-200:2012 DIN EN 62271-200:2012-08 VDE 0671-200	High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.	
Electrical engineering	IEC 62271-201 (2014-03) Ed. 2.0 EN 62271-201:2014 DIN EN 62271-201:2015-03 VDE 0671-201	High-voltage switchgear and controlgear – Part 201: A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.	
Electrical engineering	IEC 62271-203 (2013-07) Ed. 2.0 + Corr. 1 STL-Guide EN 62271-203:2012 DIN EN 62271-203:2012-11 VDE 0671-203	High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV.	
Electrical engineering	IEC 62271-204 (2011-07) Ed. 1.0 STL-Guide EN 62271-204:2011 DIN EN 62271-204:2012-05 VDE 0671-204	High-voltage switchgear and controlgear – Part 204: Rigid gas-insulated transmission lines for rated voltage above 52 kV.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 62271-209 (2007-08) Ed. 1.0 EN 62271-209:2007 DIN EN 62271-209:2008-07 VDE 0671-209	High-voltage switchgear and controlgear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and extruded insulation cables – Fluid-filled and dry-type cable-terminations.	
Electrical engineering	IEC 62271-202 EN 62271-202:2014 + AC:2014 DIN EN 62271-202:2015-02 VDE 0671-202	High-voltage switchgear and controlgear – Part 202: High voltage / low voltage prefabricated substation.	
Electrical engineering	IEC 62271-205 (2008-01) Ed. 1.0 EN 62271-205:2008 DIN EN 62271-205:2008-12 VDE 0671-205	High-voltage switchgear and controlgear – Part 205: Compact switchgear assemblies for rated voltages above 52 kV.	
Electrical engineering	ANSI / IEEE C37.23-2003	IEEE Standard for Metal-Enclosed Bus	
Switch gear for direct current			
Electrical engineering	DIN VDE 0660-112:1987-02 VDE 0660-112	Schaltgeräte; Zusatzbestimmungen für Gleichstrom-Lastschalter, -Trenner und -Lasttrenner über 1200 V bis 3000 V.	
Power transformers, reactors, line traps, tap-changers			
Electrical engineering	IEC 60076-1 (2011-04) Ed. 3.0 EN 60076-1:2011 DIN EN 50076-1:2012-03 VDE 0532-76-1	Power transformers – Part 1: General.	
Electrical engineering	IEC 60076-2 (2011-02) Ed. 3.0 EN 60076-2:2011 DIN EN 60076-2:2012-02 VDE 0532-76-2	Power transformers – Part 2: Temperature rise for liquid-immersed transformers.	
Electrical engineering	IEC 60076-3 (2013-07) Ed. 3.0 EN 60076-3:2013 DIN EN 60076-3:2014-08 VDE 0532-76-3	Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0532-76 -4 DIN EN 60076-4:2003-06 IEC 60076-4 (2002-06) Ed. 1.0	Power transformers – Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors.	
Electrical engineering	IEC 60076-5 (2006-02) Ed. 3.0 STL-Guide EN 60076-5:2006 DIN EN 60076-5:2007-01 VDE 0532-76-5	Power transformers – Part 5: Ability to withstand short circuit.	
Electrical engineering	IEC 60076-6 (2007-12) Ed. 1.0 EN 60076-6:2008 DIN EN 60076-6:2009-02 VDE 0532-76-6	Power transformers – Part 6: Reactors.	
Electrical engineering	IEC 60076-10 (2001-05) Ed. 1.0 IEC 60076-10-1 (2005-10) Ed. 1.0 EN 60076-10:2001 DIN EN 60076-10:2002-04 VDE 0532-76-10	Power transformers – Part 10-1: Determination of sound levels (+ Application guide).	
Electrical engineering	IEC 60076-11 (2004-05) Ed. 1.0 EN 60076-11:2004 DIN EN 60076-11:2005-04 VDE 0532-76-11	Power transformers – Part 11: Dry-type transformers.	
Electrical engineering	IEC 60076-13 EN 60076-13:2006 DIN EN 60076-13:2007-07 VDE 0532-76-13	Power transformers – Part 13: Self-protected liquid-filled transformers.	
Electrical engineering	DIN 57532-21:1982-03 VDE 0532-21	Transformatoren und Drosselspulen; Anlasstransformatoren und Anlassdrosselspulen	
Electrical engineering	VDE 0532 Teil 30 DIN EN 60214:2015-04 IEC 60214-1 (2014-05) Ed. 2.0	Tap-changer	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0851 IEC 60353 (2004-04) Ed. 2.0	Line traps for a.c. power systems.	
Instrument transformers			
Electrical engineering	IEC 61869-1 (2007-10) Ed. 1.0 EN 61869-1:2009 DIN EN 61869-1:2010-04 VDE 0414-9-1	Instrument transformers – Part 1: General requirements.	
Electrical engineering	IEC 61869-2(2012-09) Ed. 1.0 EN 61869-2:2012 DIN EN 61869-2:2013-07 + Ber. VDE 0414-9-2	Instrument transformers – Part 2: Additional requirements for current transformers.	
Electrical engineering	IEC 61869-3 (2011-07) Ed. 1.0 EN 61869-3:2011 DIN EN 61869-3:2012-05 VDE 0414-9-3	Instrument transformers – Part 3: Additional requirements for inductive voltage transformers.	
Electrical engineering	IEC 61869-4 (2013-11) Ed. 1.0 EN 61869-4:2014 DIN EN 61869-4:2015-04 VDE 0414-9-4	Instrument transformers – Part 4: Additional requirements for combined transformers.	
Electrical engineering	VDE 0414-9-5 DIN EN 61869-5:2012-05 IEC 61869-5 (2015-08) Ed. 1.0	Capacitive Voltage Transformers.	
Electrical engineering	VDE 0414-44-8 DIN EN 60044-8:2003-06 IEC 60044-8 (2002-07) Ed.1.0 IEC 61869-8	Instrument transformers – Part 8: Electronic current transformers	
Electrical engineering	IEC 60044-7 (1999-12) Ed. 1.0 EN 60044-7:2000-11 DIN EN 60044-7:2000-11 VDE 0414-44-7 IEC 61869-7	Instrument transformers – Part 7: Electronic voltage transformers.	
Capacitors			
Electrical engineering	DIN VDE 0560-1:1969-12 VDE 0560-1	Bestimmungen für Kondensatoren – Teil 1: Allgemeine Bestimmungen.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60252-1 (2013-08) Ed. 2.1 EN 60252-1:2011 + A1:2013 DIN EN 60252-1:2014-07 VDE 0560-8	AC motor capacitors – Part 1: General - Performance, testing and rating - Safety requirements - Guidance for installation and operation.	
Electrical engineering	IEC 60110-1 (1998-06) Ed. 1.0 EN 60110-1:1998 DIN EN 61110-1:1999-09 VDE 0560-9	Power capacitors for induction heating installations – Part 1: General.	
Electrical engineering	DIN VDE 0560-10:1964-10 VDE 0560-10	Regeln für Kondensatoren – Teil 10: Regeln für Hochfrequenz-Leistungskondensatoren.	
Electrical engineering	DIN VDE 0560-11:1970-05 VDE 0560-11	Regeln für Kondensatoren – Teil 11: Regeln für Kondensatoren ab 600 V zum Glätten pulsierender Gleichspannung.	
Insulators and bushings			
Electrical engineering	DIN VDE 0441-1:1985-07 VDE 0441-1	Prüfung von Kunststoff-Isolatoren für Betriebswechselspannungen über 1 kV; Prüfung von Werkstoffen für Freiluftisolatoren.	
Electrical engineering	IEC 60660 (1999-10) Ed. 2.0 EN 60660:1999 DIN EN 60660:2000-12 VDE 0441-3	Insulators – Tests on indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to but not including 300 kV.	
Electrical engineering	IEC 60383-1 (1993-04) Ed. 4.0 EN 60383-1:1996 DIN EN 60383-1:1997-05 VDE 0446-1	Insulators for overhead lines with a nominal voltage above 1000 V – Part 1: Ceramic or glass insulator units for a.c. systems - Definitions, test methods and acceptance criteria.	
Electrical engineering	IEC 60383-2 (1993-04) Ed. 1.0 EN 60383-2:1995 DIN EN 60383-2:1995-08 VDE 0446-4	Insulators for overhead lines with a nominal voltage above 1000 V – Part 2: Insulator strings and insulator sets for a.c. systems - Definitions, test methods and acceptance criteria.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60168 (2001-04) Ed. 4.2 EN 60168:1994 DIN EN 60168:2001-12 VDE 0674-1	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V.	
Electrical engineering	IEC 62155 (2003-05) Ed. 1.0 EN 62155:2003 DIN EN 62155:2004 VDE 0674-200	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V.	
Electrical engineering	IEC 60137 (2008-07) Ed. 6.0 EN 60137:2008 DIN EN 60137:2009-07 VDE 0674-5	Insulated bushings for alternating voltages above 1000 V.	
Overhead lines			
Electrical engineering	IEC 61284 (1997-09) Ed. 2.0 + Corr. EN 61284:1997 DIN EN 61284:1998-05 VDE 0212-1	Overhead lines – Requirements and tests for fittings.	
Electrical engineering	IEC 61854 (1998-09) Ed. 1.0 EN 61854:1998 DIN EN 61854:1999-08 VDE 0212-2	Overhead lines – Requirements and tests for spacers.	
Electrical engineering	IEC 61897 (1998-09) Ed. 1.0 EN 61897:1998 DIN EN 61897:1999-08 VDE 0212-3	Overhead lines – Requirements and tests for Stockbridge type aeolian vibration dampers.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	DIN VDE 0216:1986-2 VDE 0216	Armaturen für Fahrleitungsanlagen; Statisch-mechanisches Verhalten – Anforderungen, Prüfung.	
HVDC Thyristor valves			
Electrical engineering	IEC 60700-1 (2008-11) Ed. 1.2 EN 60700-1:1998 + A1:2003 + A2:2008 DIN EN 60700-1:2009-07 VDE 0553-1	Thyristor valves for high voltage direct current (HVDC) power transmission – Part 1: Electrical testing.	
Equipment for operating, testing, marking off, live working. Equipment for earthing, short-circuiting.			
Electrical engineering	DIN VDE 0681-1:1986-10 VDE 0681-1	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Allgemeine Festlegungen.	
Electrical engineering	DIN 57681-2:1977-03 DIN VDE 0681-2:1977-03 VDE 0681-2	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Schaltstangen.	
Electrical engineering	DIN 57681-3:1977-03 DIN VDE 0681-3 VDE 0681-3	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Sicherungszangen.	
Electrical engineering	DIN VDE 0681-6:1985-06 VDE 0681-6	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Spannungsprüfer für Oberleitungsanlagen elektrischer Bahnen; 15 kV, 16 2/3 Hz.	
Electrical engineering	DIN VDE 0681-8:2003-10 VDE 0681-8	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Isolierende Schutzplatten.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60832-1 (2010-02) Ed. 1.0 EN 60832-1:2010 + Cor.:2010 DIN EN 60832-1:2010-12 VDE 0682-211	Live working – Insulating sticks and attachable devices – Part 1: Insulating sticks.	
Electrical engineering	IEC 61229 (2002-06) Ed. 1.2 EN 61229:1995/A2:2002 DIN EN 61229/A2:2003-09 VDE 0682-551 /A2	Rigid protective covers for live working on a.c. installations.	
Electrical engineering	IEC 61230 (2008-07) Ed. 2.0 EN 61230:2008 DIN EN 61230:2009-07 VDE 0683-100	Live working – Portable equipment for earthing or earthing and short-circuiting.	
Electrical engineering	IEC 61219 (1993-10) Ed. 1.0 + Cor.200-05 EN 61219:1993 DIN EN 61219:1995-01 VDE 0683-200	Live working – Earthing or earthing and short-circuiting equipment using lances as a short-circuiting device – Lance earthing.	
High-voltage test techniques			
Electrical engineering	IEC 60270 (2000-12) Ed. 3.0 + Cor.1 EN 60270:2001 + Ber. DIN EN 60270:2001-08 + Ber. VDE 0434	High-voltage test techniques – Partial discharge measurements.	
Electrical engineering	IEC 60060-1 (2010-09) Ed. 3.0 STL-Guide HD 558.1 S1 EN 60060-1:2010 DIN EN 60060-1:2011-10 VDE 0432-1	High-voltage test techniques – Part 1: General definitions and test requirements.	
Electrical engineering	IEC 60060-2 (2010-11) Ed. 3.0 EN 60060-2:2011 DIN EN 60060-2:2011-10 VDE 0432-2	High-voltage test techniques – Part 2: Measuring systems.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0432-3 DIN-EN 60060-3:2006-08 IEC 60060-3 (2006-02) Ed. 1.0	High-voltage test techniques – Part 3: Definitions and requirements for on-site testing	
Electrical engineering	IEC 60052 (2002-10) Ed. 3.0 EN 60052:2002 DIN EN 60052:2003-06 VDE 0432-9	Voltage measurement by means of standard air gaps.	
Environmental and protection degree testing			
Electrical engineering	IEC 60068-2-78 (2012-10) Ed. 2.0 EN 60068-2-78:2013 DIN EN 60068-2-78:2014-02 VDE 0468-2-78	Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state.	
Electrical engineering	IEC 60068-3-4 (2001-08) Ed. 1.0	Environmental testing – Part 3-4: Supporting documentation and guidance – Damp heat tests.	
Electrical engineering	IEC 60068-2-30 (2005-08) Ed. 3.0	Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle).	
Electrical engineering	IEC 60068-2-75 (2014-09) Ed. 2.0	Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests.	

Technical responsibility for the test reports:

Approval:	Technical verification:
Herr Dipl.-Ing. Ronald Borchert	Herr Dipl.-Ing. Rainer Borchert
Herr Dipl.-Ing. Winfried Moritz	Herr Dipl.-Ing. Ronald Borchert
Herr Dipl.-Wirt.-Ing. Rainer Schiller	Herr Dipl.-Ing. Jens Haring
Herr Dipl.-Ing. Hannes Zinnbauer	Frau Dipl.-Ing. Dagmar Hauschild
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	Herr Dr.-Ing. Frank Wachholz
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	Herr Dipl.-Ing. Sven Georgias
	Herr Dipl.-Ing. Michael Heise
	Herr Dipl.-Ing. Christian Juraschek
	Herr Dipl.-Ing. Markus Göhrs
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	Herr Dipl.-Ing. Matthias Schröder-Heske
	Herr Dipl.-Ing. Christian Kruscha
	Frau Dipl.-Ing. Antje Köhler
	Herr Dipl.-Ing. Stephan Wacker
	Herr Dipl.-Ing. Lars Eberschulz

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Testing of low-voltage equipment and components as well as of installation, switching, control and protective equipment and railway applications as described in the subsequent listed standards.			
Railway applications			
Electrical engineering	VDE 0115 - 300-1 DIN EN 50123-1:2003-12 EN 50123-1:2003 IEC 61992-1 (2014-04) Ed. 2.1	Railway applications – Fixed installations – DC switchgear – Part 1: General.	
Electrical engineering	VDE 0115 - 300-2 DIN EN 50123-2:11-2003 EN 50123-2:2003 IEC 61992-2 (2014-04) Ed. 2.1	Railway applications – Fixed installations – DC switchgear – Part 2: DC circuit-breakers.	
Electrical engineering	VDE 0115 - 300-3 DIN EN 50123-3:10-2003 EN 50123-3:2003 IEC 61992-3 (2006-02) Ed. 2.0	Railway applications – Fixed installations – DC switchgear – Part 3: Indoor d.c. disconnectors, switch-disconnectors and earthing switches.	
Electrical engineering	VDE 0115 - 300-4 DIN EN 50123-4/A1 02-2014 EN 50123-4/A1:2013 IEC 61992-4 (2006-02) Ed 1.0	Railway applications – Fixed installations – DC switchgear – Part 4: Outdoor d.c. disconnectors, switch-disconnectors and earthing switches.	
Electrical engineering	IEC 61992-5 (2006-02) Ed. 1.0 DIN EN 50526-1:2012 VDE 0115-526-1:2012 EN 50526-1:2012	Railway applications – Fixed installations – DC switchgear – Part 5: Surge arresters and low-voltage limiters for specific use in d.c. systems.	
Electrical engineering	DIN EN 50526-2:2014 VDE 0115-526-2:2014 EN 50526-2:2014	Bahnanwendungen – Ortsfeste Anlagen – Überspannungsableiter und Spannungsbegrenzungseinrichtungen für Gleichspannungsnetze – Teil 2: Spannungsbegrenzungseinrichtungen.	
Electrical engineering	VDE 0115 - 300-6 DIN EN 50123-6:09-2003 EN 50123-6:2003 IEC 61992-6 (2014-04) Ed. 1.1	Railway applications – Fixed installations – DC switchgear – Part 6: DC switchgear assemblies.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0115 Teil 420 DIN EN 60310:2005-01 IEC 60310 (2004-02) Ed. 3.0	Railway applications – Traction transformers and inductors on board rolling stock.	
Electrical engineering	IEC 60077-1 (1999-10) Ed. 1.0 DIN EN 60077-1:2003-04 VDE 0115-460-1	Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules.	
Electrical engineering	IEC 60077-2 (1999-03) Ed. 1.0 DIN EN 60077-2:2003-04 VDE 0115-460-2	Railway applications – Electric equipment for rolling stock – Part 2: Electrotechnical components – General rules.	
Electrical engineering	IEC 60077-3 (2001-12) Ed. 1.0 DIN EN 60077-3:2003-04 VDE 0115-460-3	Railway applications – Electric equipment for rolling stock – Part 3: Electrotechnical components – Rules for d.c. circuit-breakers.	
Electrical engineering	IEC 60077-4 (2003-02) Ed. 1.0 DIN EN 60077-4:2004-01 VDE 0115-460-4	Railway applications – Electric equipment for rolling stock – Part 4: Electrotechnical components – Rules for AC circuit-breakers.	
Electrical engineering	IEC 60077-5 (2003-07) Ed. 1.0 DIN EN 60077-5:2004-07 VDE 0115-460-5	Railway applications – Electric equipment for rolling stock – Part 5: Electrotechnical components – Rules for HV fuses.	
Electrical engineering	VDE 0115-327 DIN EN 50327:2006-03 EN 50327:2006-03 IEC 62589 (2010-07) Ed. 1.0	Railway applications – Fixed installations – Harmonisation of the rated values for converter groups and tests on converter groups.	
Electrical engineering	VDE 0115-328 DIN EN 50328:2010-11 EN 50328:2010-11 IEC 62590 (2010-06) Ed. 1.0	Railway applications – Fixed installations – Electronic power converters for substations.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0560-700 DIN EN 61921:2004-02 EN 61921:2003-07 IEC 61921 (2003-04) Ed. 1.0	Power capacitors Low-voltage power factor correction banks.	
Electrical engineering	VDE 0115 - 410 DIN EN 61287-1:2014-12 EN 61278-1:2014-07 IEC 61287-1 (2014-07) Ed. 3.0	Railway applications – Power convertors installed on board rolling stock – Part 1: Characteristics and test methods.	
Low-voltage switchgear and control gear			
Electrical engineering	VDE 0660 - 100 DIN EN 60947-1:2011-10 EN 60947-1:2011 IEC 60947-1 (2014-09) Ed. 5.2	Low-voltage switchgear and control gear – Part 1: General rules.	
Electrical engineering	VDE 0660 - 101 DIN EN 60947-2:2014-01 EN 60947-2:2013 IEC 60947-2 (2013-01) Ed. 4.2	Low-voltage switchgear and control gear – Part 2: Circuit-breakers.	
Electrical engineering	VDE 0660 - 107 DIN EN 60947-3:2015:03 EN 60947-3:2009 IEC 60947-3 (2012-09) Ed. 3.1	Low-voltage switchgear and control gear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units.	
Electrical engineering	VDE 0660 - 102 DIN EN 60947-4-1:2014-02 EN 60947-4-1:2012 IEC 60947-4-1 (2012-07) Ed. 3.1	Low-voltage switchgear and control gear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters.	
Electrical engineering	VDE 0660 - 117 DIN EN 60947-4-2:2013-05 EN 60947-4-2:2012 IEC 60947-4-2 (2012-03) Ed. 3.0	Low-voltage switchgear and control gear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters.	
Electrical engineering	VDE 0660 - 109 DIN EN 60947-4-3:2015-04 EN 60947-4-3:2014 IEC 60947-4-3 (2014-05) Ed. 2.0	Low-voltage switchgear and controlgear – Part 4-3: Contactors and motor-starters – AC semiconductor controllers and contactors for non-motor loads.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0660 - 200 DIN EN 60947-5-1:2010-04 EN 60947-5-1:2009 IEC 60947-5-1 (2009-07) Ed. 3.1	Low-voltage switchgear and control gear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.	
Electrical engineering	VDE 0660 - 208 DIN EN 60947-5-2:2014-01 EN 60947-5-2:2012 IEC 60947-5-2 (2012-09) Ed. 3.1	Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches.	
Electrical engineering	VDE 0660 - 210 DIN EN 60947-5-5:2005-11 EN 60947-5-5:2005 IEC 60947-5-5 (2005-04) Ed. 1.1	Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function.	
Electrical engineering	VDE 0660 - 114 DIN EN 60947-6-1:2014-09 EN 60947-6-1:2014 IEC 60947-6-1 (2013-12) Ed. 2.1	Low-voltage switchgear and controlgear – Part 6-1: Multiple function equipment – Transfer switching equipment.	
Electrical engineering	VDE 0660 - 115 DIN EN 60947-6-2:2007-12 EN 60947-6-2:2007 IEC 60947-6-2 (2007-03) Ed. 2.1	Low-voltage switchgear and controlgear – Part 6-2: Multiple function equipment – Control and protective switching devices (or equipment) (CPS).	
Electrical engineering	VDE 0611 - 1 DIN EN 60947-7-1:2010-03 EN 60947-7-1:2009 IEC 60947-7-1 (2009-04) Ed. 3.0	Niederspannungsschaltgeräte – Teil 7.1: Hilfseinrichtungen: Reihenklemmen für Kupferleiter. Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors.	
Electrical engineering	VDE 0611 - 3 DIN EN 60947-7-2:2010-03 EN 60947-7-2:2009 IEC 60947-7-2 (2009-04) Ed. 3.0	Low-voltage switchgear and controlgear – Part 7-2: Ancillary equipment – Protective conductor terminal blocks for copper conductors.	
Electrical engineering	VDE 0611 - 4 DIN VDE 0611- 4:1991-02	Niederspannungsschaltgeräte; Mehrstöckige Verteiler-Reihenklemmen bis 6 mm²	

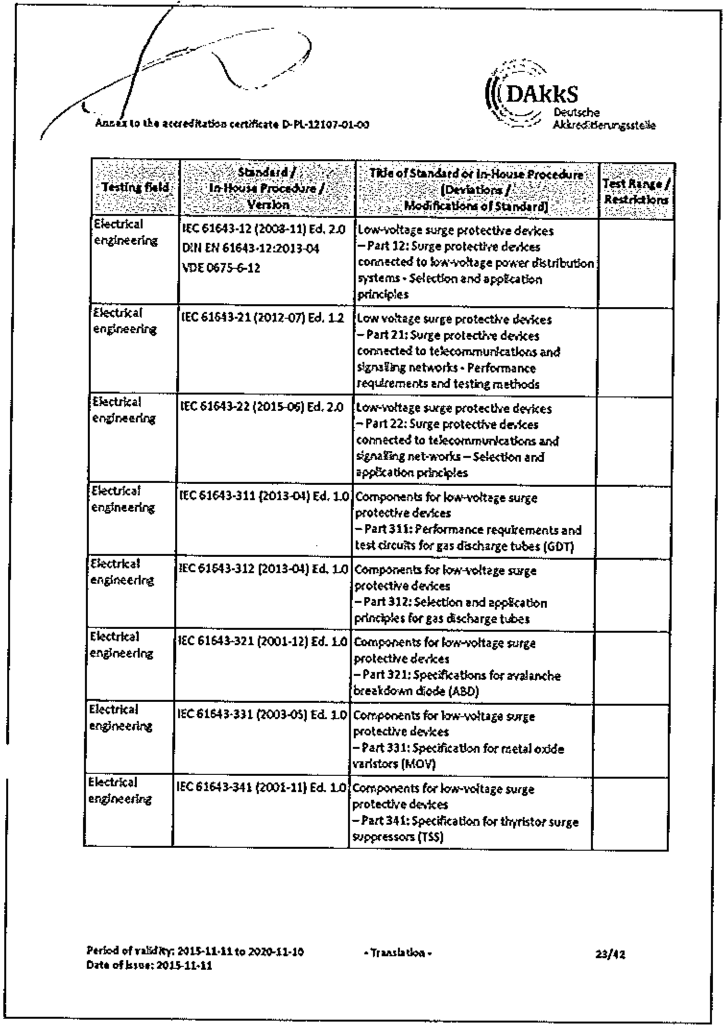
Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0637 - 3 DIN EN 61095:2009-11 EN 61095:2009 IEC 61095 (2009-02) Ed. 2.0	Electromechanical contactors for household and similar purposes.	
Electrical engineering	VDE 0220-100 DIN EN 61238-1:2004-03 IEC 61238-1 (2003-05) Ed. 2.0	Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) – Part 1: Test methods and requirements.	
Fuses			
Electrical engineering	DIN EN 60269-1:2015-05 IEC 60269-1 (2014-06) Ed. 4.2 VDE 0636-1	Low-voltage fuses – Part 1: General requirements	
Electrical engineering	DIN VDE 0636-2:2014-09 IEC 60269-2 (2013-07(Ed. 5.0 HD 60269-2:2013 VDE 0636-2	Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to K	
Electrical engineering	DIN VDE 0636-3:2013-12 IEC 60269-3 (2013-01) Ed. 4.1 HD 60269-2:2013 VDE 0636-3	Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) - Examples of standardized systems of fuses A to F	
Electrical engineering	DIN EN 60269-4:2013-01 EN 60269-4:2012 IEC 60269-4 (2012-05) Ed. 5.1 VDE 0636-4	Low-voltage fuses – Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices	
Electrical engineering	DIN CLC 60269-5 IEC/TR 60269-5 (2014-03) Ed. 2.0 VDE 0636-5	Low-voltage fuses – Part 5: Guidance for the application of low-voltage fuses	
Electrical engineering	DIN EN 60269-6:2012-06 EN 60269-6:2011 IEC 60269-6 (2010-12) Ed. 1.0 + Cor. 1 VDE 0636-6	Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60127-1 (2015-02) Ed. 2.2	Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links.	
Electrical engineering	IEC 60127-2 (2014-09) Ed. 3.0	Miniature fuses – Part 2: Cartridge fuse-links.	
Power Transformers and Reactors			
Electrical engineering	VDE 0532-76-1 DIN EN 60076-1:2012-03 EN 60076-1:2011 IEC 60076-1 (2011-04) Ed. 3.0	Power transformers – Part 1: General.	
Electrical engineering	VDE 0532-76-2 DIN EN 60076-2:2012-02 EN 60076-2:2011 IEC 60076-2 (2011-02) Ed. 3.0	Power transformers – Part 2: Temperature rise for liquid-immersed transformers.	
Electrical engineering	VDE 0532-76-5 DIN EN 60076-5:2007-01 EN 60076-5:2006 IEC 60076-5 (2006-02) Ed. 3.0	Power transformers – Part 5: Ability to withstand short circuit.	
Electrical engineering	VDE 0532-76-6 DIN EN 60076-6:2009-02 EN 60076-6:2008 IEC 60076-6 (2013-09) Ed. 1.0	Power transformers – Part 6: Reactors.	
Electrical engineering	VDE 0532-214-1 DIN EN 60214-1:2015-04 EN 60214-1:2014 IEC 60214-1 (2014-05) Ed. 2.0	Tap-changers – Part 1: Performance requirements and test methods.	
Electrical engineering	IEC 60353 (2002-04) Ed. 2.0	Line traps for a.c. power systems.	
Electrical Installation Material			
Electrical engineering	VDE 0220 -3	Kabelklemmen	
Electrical engineering	VDE 0603-1 DIN VDE 0603-1:1991-01	Installationskleinverteiler und Zählerplätze AC 400 V; Installationskleinverteiler und Zählerplätze.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0603-2 DIN VDE 0603-2:1098-03	Installationskleinverteiler und Zählerplätze AC 400 V; Hauptleitungsabzweigklemmen.	
Electrical engineering	VDE 0609 -1 DIN EN 60999:2000-12 EN 60999:2000 IEC 60999 (1999-11) Ed. 2.0	Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included).	
Electrical engineering	VDE 0623 -1 DIN EN 60309-1:2014-12 EN 60309-1:2005 IEC 60309-1 (2012-06) Ed. 4.2	Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements.	
Electrical engineering	VDE 0604-202 DIN EN 61914:2010-01 IEC 61914 (2009-01) Ed. 1.0	Cable cleats for electrical installations.	
Electrical engineering	VDE 0623 -20 DIN EN 60309-2:2013-01 EN 60309-2:2012 IEC 60309-2 (2012-05) Ed. 4.2	Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories.	
Electrical engineering	VDE 0630 - 1 DIN EN 61058-1:2001-10 EN 61058-1:2008 IEC 61058-1 (2008-04) Ed. 3.2	Switches for appliances – Part 1: General requirements.	
Electrical engineering	VDE 0630 - 2-1 DIN EN 61058-2-1:2001-08 EN 61058-2-1:2011 IEC 61058-2-1 (2010-11) Ed. 2.0	Switches for appliances – Part 2-1: Particular requirements for cord switches.	
Electrical engineering	VDE 0640 DIN EN 62019:2006-01 EN 62019:2005 IEC 62019 (2003-01)	Electrical accessories – Circuit-breakers and similar equipment for household use – Auxiliary contact units.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60898-1 (2015-03) Ed. 2.0 EN 60898-1 DIN EN 60898-1:2013 VDE 0641-1	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation	
Electrical engineering	IEC 60898-2 (2003-07) Ed. 1.1 EN 60898-2: 2007 DIN EN 60898-2:2007 VDE 0641-2	Circuit-breakers for overcurrent protection for household and similar installations – Part 2: Circuit-breakers for a.c. and d.c. operation	
Electrical engineering	IEC 60934 (2013-01) Ed. 3.2 DIN EN 60934:2013-11 VDE 0642	Circuit-breakers for equipment (CBE).	
Electrical engineering	IEC 61008-1 (2013-09) Ed. 3.2 DIN EN 61008-10:2015-11 VDE 0664-10	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules	
Electrical engineering	IEC 61008-2-1 (1990-12) Ed. 1.0 DIN EN 61008-2-11:1999-12 VDE 0664-2-11	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's). – Part 2-1: Applicability of the general rules to RCCB's functionally independent of line voltage	
Electrical engineering	IEC 61008-2-2 (1990-12) Ed. 1.0 DIN EN 61008-2-2 VDE 0664-2-2	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's). – Part 2-2: Applicability of the general rules to RCCB's functionally dependent on line voltage	
Electrical engineering	IEC 61009-1 (2013-09) Ed. 3.2 DIN EN 61009-20:2015-11 VDE 0664-20	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 61009-2-1 (1991-09) Ed. 1.0 DIN EN 61009-21:1999-12 VDE 0664-21	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage	
Electrical engineering	IEC 61009-2-2 (1991-09) Ed. 1.0 DIN EN 61009-2-2 VDE 0664-2-2	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-2: Applicability of the general rules to RCBO's functionally dependent on line voltage	
Electrical engineering	IEC 60099-4 (2014-06) Ed. 3.0 DIN EN 60099-4:2015-07 VDE 0675-4	Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems	
Electrical engineering	IEC 60099-5 (2013-05) Ed. 2.0 DIN EN 60099-5:2014-09 VDE 0675-5	Surge arresters – Part 5: Selection and application recommendations	
Electrical engineering	IEC 60099-6 (2002-08) Ed. 1.0	Surge arresters – Part 6: Surge arresters containing both series and parallel gapped structures - Rated 52 kV and less	
Electrical engineering	IEC 60099-8 (2011-01) Ed. 1.0 DIN EN 60099-8:2011-11 VDE 0675-8	Surge arresters – Part 8: Metal-oxide surge arresters with external series gap (EGLA) for overhead transmission and distribution lines of a.c. systems above 1 kV	
Electrical engineering	IEC 60099-9 (2014-06) Ed. 1.0 DIN EN 60099-9:2015-08 VDE 0675-9	Surge arresters – Part 9: Metal-oxide surge arresters without gaps for HVDC converter stations	
Electrical engineering	IEC 61643-11 (2011-03) Ed. 1.0 DIN EN 61643-11/A1:2015-09 VDE 0675-6-11	Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods	



Annex to the accreditation certificate D-PL-12107-01-00

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Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 61643-12 (2008-11) Ed. 2.0 DIN EN 61643-12:2013-04 VDE 0675-6-12	Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles	
Electrical engineering	IEC 61643-21 (2012-07) Ed. 1.2	Low voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods	
Electrical engineering	IEC 61643-22 (2015-06) Ed. 2.0	Low-voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling net-works – Selection and application principles	
Electrical engineering	IEC 61643-311 (2013-04) Ed. 1.0	Components for low-voltage surge protective devices – Part 311: Performance requirements and test circuits for gas discharge tubes (GDT)	
Electrical engineering	IEC 61643-312 (2013-04) Ed. 1.0	Components for low-voltage surge protective devices – Part 312: Selection and application principles for gas discharge tubes	
Electrical engineering	IEC 61643-321 (2001-12) Ed. 1.0	Components for low-voltage surge protective devices – Part 321: Specifications for avalanche breakdown diode (ABD)	
Electrical engineering	IEC 61643-331 (2003-05) Ed. 1.0	Components for low-voltage surge protective devices – Part 331: Specification for metal oxide varistors (MOV)	
Electrical engineering	IEC 61643-341 (2001-11) Ed. 1.0	Components for low-voltage surge protective devices – Part 341: Specification for thyristor surge suppressors (TSS)	

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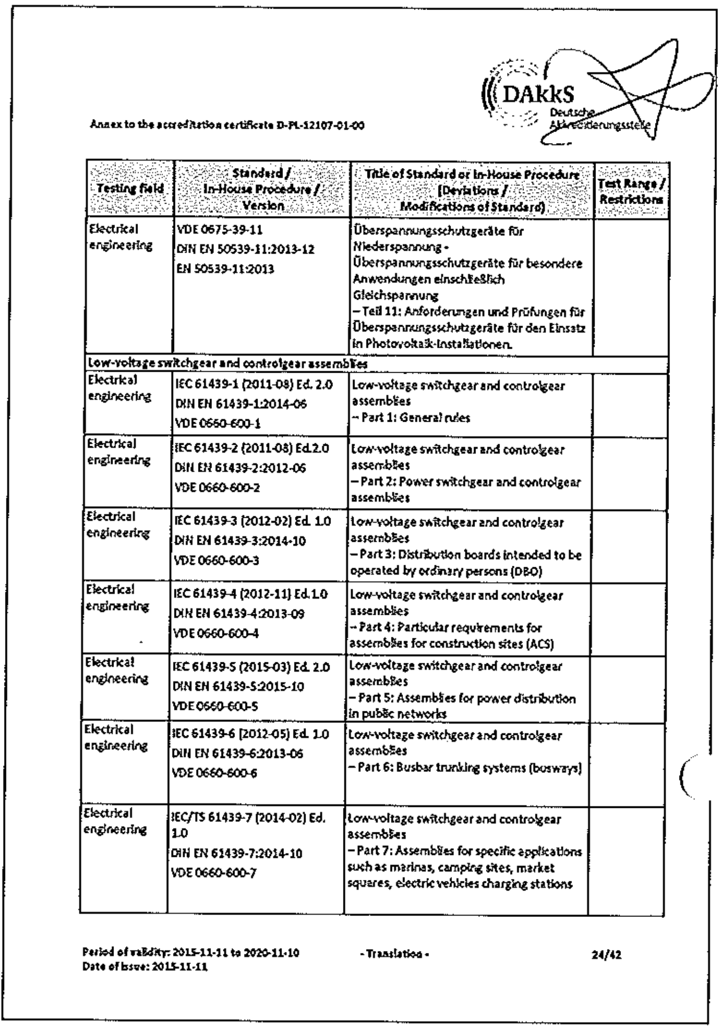

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Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0675-39-11 DIN EN 50539-11:2013-12 EN 50539-11:2013	Überspannungsschutzgeräte für Niederspannung - Überspannungsschutzgeräte für besondere Anwendungen einschließlich Gleichspannung – Teil 11: Anforderungen und Prüfungen für Überspannungsschutzgeräte für den Einsatz in Photovoltaik-Installationen.	
Low-voltage switchgear and controlgear assemblies			
Electrical engineering	IEC 61439-1 (2011-08) Ed. 2.0 DIN EN 61439-1:2014-06 VDE 0660-600-1	Low-voltage switchgear and controlgear assemblies – Part 1: General rules	
Electrical engineering	IEC 61439-2 (2011-08) Ed.2.0 DIN EN 61439-2:2012-06 VDE 0660-600-2	Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies	
Electrical engineering	IEC 61439-3 (2012-02) Ed. 1.0 DIN EN 61439-3:2014-10 VDE 0660-600-3	Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)	
Electrical engineering	IEC 61439-4 (2012-11) Ed.1.0 DIN EN 61439-4:2013-09 VDE 0660-600-4	Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS)	
Electrical engineering	IEC 61439-5 (2015-03) Ed. 2.0 DIN EN 61439-5:2015-10 VDE 0660-600-5	Low-voltage switchgear and controlgear assemblies – Part 5: Assemblies for power distribution in public networks	
Electrical engineering	IEC 61439-6 (2012-05) Ed. 1.0 DIN EN 61439-6:2013-06 VDE 0660-600-6	Low-voltage switchgear and controlgear assemblies – Part 6: Busbar trunking systems (busways)	
Electrical engineering	IEC/TS 61439-7 (2014-02) Ed. 1.0 DIN EN 61439-7:2014-10 VDE 0660-600-7	Low-voltage switchgear and controlgear assemblies – Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations	

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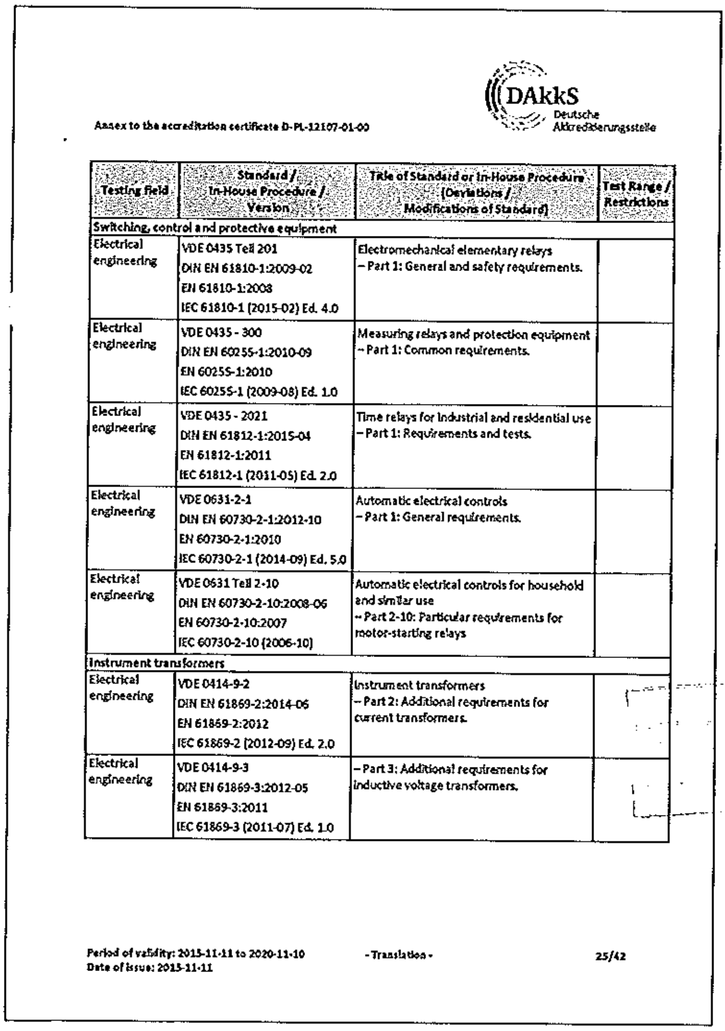
Date of issue: 2015-11-11



Annex to the accreditation certificate D-PL-12107-01-00

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Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Switching, control and protective equipment			
Electrical engineering	VDE 0435 Teil 201 DIN EN 61810-1:2009-02 EN 61810-1:2008 IEC 61810-1 (2015-02) Ed. 4.0	Electromechanical elementary relays – Part 1: General and safety requirements.	
Electrical engineering	VDE 0435 - 300 DIN EN 60255-1:2010-09 EN 60255-1:2010 IEC 60255-1 (2009-08) Ed. 1.0	Measuring relays and protection equipment – Part 1: Common requirements.	
Electrical engineering	VDE 0435 - 2021 DIN EN 61812-1:2015-04 EN 61812-1:2011 IEC 61812-1 (2011-05) Ed. 2.0	Time relays for industrial and residential use – Part 1: Requirements and tests.	
Electrical engineering	VDE 0631-2-1 DIN EN 60730-2-1:2012-10 EN 60730-2-1:2010 IEC 60730-2-1 (2014-09) Ed. 5.0	Automatic electrical controls – Part 1: General requirements.	
Electrical engineering	VDE 0631 Teil 2-10 DIN EN 60730-2-10:2008-06 EN 60730-2-10:2007 IEC 60730-2-10 (2006-10)	Automatic electrical controls for household and similar use – Part 2-10: Particular requirements for motor-starting relays	
Instrument transformers			
Electrical engineering	VDE 0414-9-2 DIN EN 61869-2:2014-06 EN 61869-2:2012 IEC 61869-2 (2012-09) Ed. 2.0	Instrument transformers – Part 2: Additional requirements for current transformers.	
Electrical engineering	VDE 0414-9-3 DIN EN 61869-3:2012-05 EN 61869-3:2011 IEC 61869-3 (2011-07) Ed. 1.0	– Part 3: Additional requirements for inductive voltage transformers.	

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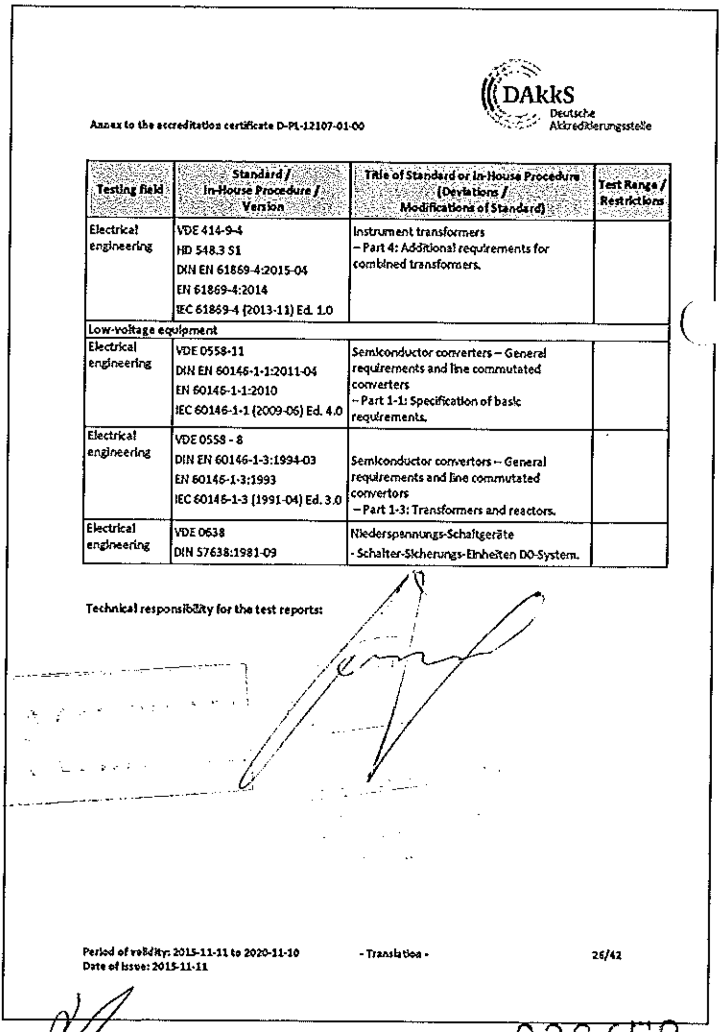

Annex to the accreditation certificate D-PL-12107-01-00

DAkkS Deutsche Akkreditierungsstelle

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 414-9-4 HD 548.3 S1 DIN EN 61869-4:2015-04 EN 61869-4:2014 IEC 61869-4 (2013-11) Ed. 1.0	Instrument transformers – Part 4: Additional requirements for combined transformers.	
Low-voltage equipment			
Electrical engineering	VDE 0558-11 DIN EN 60146-1-1:2011-04 EN 60146-1-1:2010 IEC 60146-1-1 (2009-06) Ed. 4.0	Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements.	
Electrical engineering	VDE 0558 - 8 DIN EN 60146-1-3:1994-03 EN 60146-1-3:1993 IEC 60146-1-3 (1991-04) Ed. 3.0	Semiconductor convertors – General requirements and line commutated convertors – Part 1-3: Transformers and reactors.	
Electrical engineering	VDE 0638 DIN 57638:1981-09	Niederspannungs-Schaltgeräte - Schalter-Sicherungs-Einheiten DO-System.	

Technical responsibility for the test reports:

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Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Testing of high-voltage, medium-voltage and low-voltage cables and their accessories as described in the subsequent listed standards.			
Polyvinyl chloride insulated cables			
Electrical engineering	IEC 60227-1 (2007-10) Ed. 3.0	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 1: General requirements.	
Electrical engineering	IEC 60227-3 (1997-11) Ed. 2.1	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 3: Non-sheathed cables for fixed wiring.	
Electrical engineering	IEC 60227-4 (1997-12) Ed. 2.1	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 4: Sheathed cables for fixed wiring.	
Electrical engineering	IEC 60227-5 (2011-09) Ed. 3.0	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 5: Flexible cables (cords).	
Electrical engineering	IEC 60227-6 (2001-06) Ed. 3.0	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 6: Lift cables and cables for flexible connections.	
Electrical engineering	IEC 60227-7 (2012-01) Ed. 1.2	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 7: Flexible cables screened and unscreened with two or more conductors	
Electrical engineering	VDE 0281 - 8 DIN VDE 0281-8: 2000-09 HD 21.8 S2 + A1:1999	Polyvinylchlorid-isolierte Leitungen mit Nennspannungen bis 450 V / 750 V. Einadrige Leitungen ohne Mantel für Lichterketten.	
Electrical engineering	VDE 0281 - 9 DIN VDE 0281-9:2001-01 HD 21.9 S2 + A1:1999	Polyvinylchlorid-isolierte Leitungen mit Nennspannungen bis 450 V / 750 V. Einadrige Leitungen ohne Mantel zur Verlegung bei tiefen Temperaturen.	
Electrical engineering	VDE 0285-525-1 DIN EN 50525-1:2012-01 EN 50525-1:2011	Starkstromleitungen mit Nennspannungen bis 450 V / 750 V (U_o/U) – Teil 1: Allgemeine Anforderungen.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0285-525-2-11 DIN EN 50525-2-11:2012-01 EN 50525-2-11:2011	– Flexible Leitungen mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-12 DIN EN 50525-2-12:2012-01 EN 50525-2-12:2011	– Wendelleitungen mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-21 DIN EN 50525-2-21:2012-01 EN 50525-2-21:2011	– Flexible Leitungen mit vernetzter Elastomer-Isolierung.	
Electrical engineering	VDE 0285-525-2-31 DIN EN 50525-2-31:2012-01 EN 50525-2-31:2011	– Ader und Verdrahtungsleitung mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-41 DIN EN 50525-2-41:2012-01 EN 50525-2-41:2011	– Einadrige Leitung mit vernetzter Silicon-Isolierung.	
Electrical engineering	VDE 0285-525-2-42 DIN EN 50525-2-42:2012-01 EN 50525-2-42:2011	– Ader- und Verdrahtungsleitungen mit vernetzter EVA-Isolierung.	
Electrical engineering	VDE 0285-525-2-51 DIN EN 50525-2-51:2012-01 EN 50525-2-51:2011	– Ölbeständige Steuerleitung mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-71 DIN EN 50525-2-71:2012-01 EN 50525-2-71:2011	– Lahnlitzen-Leitung mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-72 DIN EN 50525-2-72:2012-01 EN 50525-2-72:2011	– Trennbare Zwillingsleitungen mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-81 DIN EN 50525-2-81:2012-01 EN 50525-2-81:2011	– Lichtbogenschweißleitungen mit vernetzter Elstomer- Hülle.	
Electrical engineering	VDE 0285-525-2-82 DIN EN 50525-2-82:2012-01 EN 50525-2-82:2011	– Leitungen für Lichterketten mit vernetzter Elastomer-Isolierung.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0285-525-2-83 DIN EN 50525-2-83:2012-01 EN 50525-2-83:2011	– Mehradrige Leitungen mit vernetzter Silicon-Isolierung.	
Electrical engineering	VDE 0285-525-3-11 DIN EN 50525-3-11:2012-01 EN 50525-3-11:2011	– Teil 3-11: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Flexible halogenfreie, raucharme Leitungen mit thermoplastischer Isolierung.	
Electrical engineering	VDE 0285-525-3-21 DIN EN 50525-3-21:2012-01 EN 50525-3-21:2011	– Teil 3-21: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Flexible halogenfreie, raucharme Leitungen mit vernetzter Isolierung.	
Electrical engineering	VDE 0285-525-3-31 DIN EN 50525-3-31:2012-01 EN 50525-3-31:2011	– Teil 3-31: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Halogenfreie, raucharme Ader- und Verdraht-ungsleitungen mit thermoplastischer Isolierung.	
Electrical engineering	VDE 0285-525-3-41 DIN EN 50525-3-41:2012-01 EN 50525-3-41:2011	– Teil 4-31: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Halogenfreie, raucharme Ader- und Verdrahtungsleitungen mit vernetzter Isolierung.	
Electrical engineering	VDE 0262 DIN VDE 0262:2004-01	Installationskabel mit Isolierungen aus vernetzten Polyethylen und Mantel aus thermoplastischem PVC mit Nennspannung 0,6 / 1 kV.	
Electrical engineering	DIN VDE 0276-603:2010-03 VDE 0276-603 HD 603:2007	Starkstromkabel – Teil 603: Energiekabel mit Nennspannung 0,6 / 1 kV.	
Electrical engineering	DIN VDE 0276-604:2008-02 VDE 0276-604 HD 604:2005	Starkstromkabel – Teil 603: Energiekabel mit Nennspannung 0,6 / 1 kV mit verbessertem Verhalten im Brandfall für Kraftwerke.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Test methodes			
Electrical engineering	IEC 60332-1-1 (2004-07) Ed. 1.0 IEC 60332-1-2 (2004-07) Ed. 1.0 IEC 60332-1-3 (2004-07) Ed. 1.0 DIN EN 60332 -1-1:2005-06 DIN EN 60332 -1-2:2005-06 DIN EN 60332 -1-3:2005-06 VDE 0482-332 -1-1 VDE 0482-332 -1-2 VDE 0482-332 -1-3	Tests on electric and optical fiber cables under fire conditions – 1-1 Test for vertical flame propagation for a single insulated wire or cable – Apparatus – 1-2 Procedure for 1 kW pre-mixed flame – 1-3 Procedure for determination of flaming droplets/particles. Prüfungen an Kabeln, isolierten Leitungen und Glasfaserkabeln im Brandfall.	
Electrical engineering	VDE 0432 - 1:2011-10	Hochspannungs-Prüftechnik Allgemeine Festlegungen zu Prüfbedingungen.	
Electrical engineering	VDE 0432 - 2:2011-10	Hochspannungs-Prüftechnik Messsysteme.	
Electrical engineering	VDE 0472 - 401 DIN 57472-401:1984-06	Prüfung an Kabel und isolierten Leitungen Außenmaße.	
Electrical engineering	VDE 0472 - 402 DIN 57472-402:1984-06	Prüfung an Kabel und isolierten Leitungen. Wanddicke sowie Dicke von Bewehrungsdrähten und –bändern.	
Electrical engineering	VDE 0472 -1 DIN VDE 0472 -1:1987-06	Prüfung an Kabel und isolierten Leitungen ; Allgemeines.	
Electrical engineering	VDE 0472 – 505:1983-04 DIN 57472-505	Prüfung an Kabel und isolierten Leitungen. Verlustfaktor, dielektrische Verlustzahl und Ableitung.	
Electrical engineering	VDE 0472 - 509 DIN VDE 0472-509:1986-10	Prüfung an Kabel und isolierten Leitungen. Spannungsfestigkeit bei Kabeln und Leitungen, isolierten Schaltdrähten und Schnüren für Fernmeldeanlagen.	
Electrical engineering	VDE 0472 - 512 DIN VDE 0472-512:1985-05	Prüfung an Kabel und isolierten Leitungen. Widerstand zwischen Schutzleiter und Leitschicht.	
Electrical engineering	VDE 0472 – 604:1985-05 DIN VDE 0472-604	Prüfung an Kabel und isolierten Leitungen Dichtheit von Kabelmänteln.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0472 - 605 DIN VDE 0472-605:1985-01	Prüfung an Kabel und isolierten Leitungen Abrieb.	
Electrical engineering	DE 0472 - 613 DIN VDE 0472-613:1986-03	Prüfung an Kabel und isolierten Leitungen Weiterreißwiderstand.	
Electrical engineering	VDE 0472 - 626 DIN 57472-626:1983-01	Prüfung an Kabel und isolierten Leitungen Reißlänge.	
Electrical engineering	DIN EN 50497:2008-11 VDE 0473-497 EN 50497:2007	Empfohlenes Prüfverfahren zur Einschätzung des Risikos von Weichmacher-ausschwitzungen bei PVC-isolierten und –ummantelten Kabeln und Leitungen.	
Electrical engineering	VDE 0473-811-100 DIN EN 60811 – 100:2012-12 EN 60811 – 100:2008 IEC 60811 – 100 (2008-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 100: General.	
Electrical engineering	VDE 0473-811-201 DIN EN 60811 – 201:2012-12 EN 60811 - 201 IEC 60811 – 201 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 201: General tests – Measurement of insulation thickness.	
Electrical engineering	VDE 0473-811-202 DIN EN 60811 – 202:2012-12 EN 60811 - 202 IEC 60811 – 202 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath.	
Electrical engineering	VDE 0473-811-203 DIN EN 60811 – 203:2012-12 EN 60811 - 203 IEC 60811 – 203 (2012-03) Ed. 1.0	Messung der Außenmaße.	
Electrical engineering	VDE 0473-811-301 DIN EN 60811 - 301:2012-12 EN 60811 - 301 IEC 60811 – 301 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 301: Electrical tests – Measurement of the permittivity at 23 °C of filling compounds	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-302 DIN EN 60811 - 302:2012-12 EN 60811 - 302 IEC 60811 – 302 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 302: Electrical tests – Measurement of the d.c. resistivity at 23 °C and 100 °C of filling.	
Electrical engineering	VDE 0473-811-401 DIN EN 60811 - 401:2012-12 EN 60811 - 401 IEC 60811 – 401 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven.	
Electrical engineering	VDE 0473-811-402 DIN EN 60811 - 402:2012-12 EN 60811 - 402 IEC 60811 – 402 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 402: Miscellaneous tests – Water absorption tests.	
Electrical engineering	VDE 0473-811-404 DIN EN 60811 - 404:2012-12 EN 60811 - 404 IEC 60811 – 404 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 404: Miscellaneous tests – Mineral oil immersion tests for sheaths.	
Electrical engineering	VDE 0473-811-405 DIN EN 60811 - 405:2012-12 EN 60811 - 405 IEC 60811 – 405 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 405: Miscellaneous tests – Thermal stability test for PVC insulations and PVC sheaths.	
Electrical engineering	VDE 0473-811-406 DIN EN 60811 - 406:2012-12 EN 60811 - 406 IEC 60811 – 406 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 406: Miscellaneous tests – Resistance to stress cracking of polyethylene and polypropylene compounds.	
Electrical engineering	VDE 0473-811-407 DIN EN 60811 - 407:2012-12 EN 60811 - 407 IEC 60811 – 407 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 407: Miscellaneous tests – Measurement of mass increase of polyethylene and polypropylene compounds.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-408 DIN EN 60811 - 408:2012-12 EN 60811 - 408 IEC 60811 – 408 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 408: Miscellaneous tests – Long-term stability test of polyethylene and polypropylene compounds.	
Electrical engineering	VDE 0473-811-409 DIN EN 60811 - 409:2012-12 EN 60811 - 409 IEC 60811 – 409 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 409: Miscellaneous tests – Loss of mass test for thermoplastic insulations and sheaths.	
Electrical engineering	VDE 0473-811-501 DIN EN 60811 - 501:2012-12 EN 60811 - 501 IEC 60811 – 501 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds.	
Electrical engineering	VDE 0473-811-502 DIN EN 60811 - 502:2012-12 EN 60811 - 502 IEC 60811 – 502 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations.	
Electrical engineering	VDE 0473-811-503 DIN EN 60811 - 503:2012-12 EN 60811 - 503 IEC 60811 – 503 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 503: Mechanical tests – Shrinkage test for sheaths.	
Electrical engineering	VDE 0473-811-504 DIN EN 60811 - 504:2012-12 EN 60811 - 504 IEC 60811 – 504 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 504: Mechanical tests – Bending tests at low temperature for insulation and sheaths.	
Electrical engineering	VDE 0473-811-505 DIN EN 60811 - 505:2012-12 EN 60811 - 505 IEC 60811 – 505 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-506 DIN EN 60811 - 506:2012-12 EN 60811 - 506 IEC 60811 – 506 (2012-03) Ed. 1.0	Schlagprüfung bei niedrigen Temperaturen für Isolierhüllen und Mäntel. Electric and optical fibre cables – Test methods for non-metallic materials – Part 506: Mechanical tests – Impact test at low temperature for insulations and sheaths.	
Electrical engineering	VDE 0473-811-507 DIN EN 60811 - 507:2012-12 EN 60811 - 507 IEC 60811 – 507 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 507: Mechanical tests – Hot set test for cross-linked materials.	
Electrical engineering	VDE 0473-811-508 DIN EN 60811 - 508:2012-12 EN 60811 - 508 IEC 60811 – 508 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulation and sheaths.	
Electrical engineering	VDE 0473-811-509 DIN EN 60811 - 509:2012-12 EN 60811 - 509 IEC 60811 – 509 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 509: Mechanical tests – Test for resistance of insulations and sheaths to cracking (heat shock test).	
Electrical engineering	VDE 0473-811-512 DIN EN 60811 - 512:2012-12 EN 60811 - 512 IEC 60811 – 512 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 512: Mechanical tests – Methods specific to polyethylene and polypropylene compounds – Tensile strength and elongation at break after conditioning at elevated temperature.	
Electrical engineering	VDE 0473-811-513 DIN EN 60811 - 513:2012-12 EN 60811 - 513 IEC 60811 – 513 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 513: Mechanical tests – Methods specific to polyethylene and polypropylene compounds – Wrapping test after conditioning.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-605 DIN EN 60811 - 605:2012-12 EN 60811 - 605 IEC 60811 – 605 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 605: Physical tests – Measurement of carbon black and/or mineral filler in polyethylene compounds.	
Electrical engineering	VDE 0473-811-606 DIN EN 60811 - 606:2012-12 EN 60811 - 606 IEC 60811 – 606 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 606: Physical tests – Methods for determining the density.	
Accessories for power cables with rated voltages up to 30 kV			
Electrical engineering	DIN EN 61442:2006-01 VDE 0278-442 EN 61442:2005 IEC 61442 (2005-03) Ed. 2.0	Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV).	
Electrical engineering	VDE 0278 - 629-1 DIN VDE 0278-629-1:2009-07 HD 629.1:2008	Prüfanforderungen für Kabelgarnituren für extrudierte Kunststoffkabel mit einer Nennspannung von 3,6 / 6 (7,2) kV bis 20,8 / 36 (42) kV, – Teil 1: Kabel mit extrudierter Kunststoffisolierung.	
Electrical engineering	VDE 0278 - 629-2 DIN VDE 0278-629-2:2009-07 HD 629.2:2008	Prüfanforderungen für Kabelgarnituren für extrudierte Kunststoffkabel mit einer Nennspannung von 3,6 / 6 (7,2) kV bis 20,8 / 36 (42) kV, – Teil 2: Kabel mit massegetränkter Papierisolierung.	
Electrical engineering	VDE 0279 DIN 57279:1982-10	Leitungs-Garnituren des Bergbaus unter Tage Muffen (U_0/U) = 0,6 / 1 kV.	
Electrical engineering	DIN EN 61238-1:2004-03 VDE 0220-100 IEC 61238-1 (2003-05) Ed. 2.0	Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) – Part 1: Test methods and requirements.	
Electrical engineering	DIN V 47640	Verbindungsmuffen aus wärmeschrumpfendem Kunststoffschlauch für Kunststoffisolierte Starkstromkabel mit Nennspannung 0,6 / 1 (1,2) kV.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Power cables and Accessories for power cables with rated voltages up to 400 kV (Um ≤ 420 kV)			
Electrical engineering	DIN VDE 0276–632:1999-05 HD 632 S1:1996	Kabel mit Isolierung aus vernetztem Polyethylen und ihre Garnituren für Nennspannung von 30 bis 150 kV.	
Electrical engineering	DIN VDE 0276–633:1999-05 HD 633 S1:1997	Niederdruck Ölkabel und ihre Garnituren für Nennspannungen bis 220 kV.	
Electrical engineering	DIN VDE 0276 – 634:1999-05 HD 634 S1:1997	Gasinnendruckkabel und ihre Garnituren für Nennspannungen bis 220 kV.	
Electrical engineering	DIN VDE 0276 – 635:1999-05 HD 635 S1:1997	Gasaußendruckkabel und ihre Garnituren für Nennspannungen bis 220 kV.	
Electrical engineering	VDE 0265 DIN VDE 0265:1995-12	Kabel mit Kunststoffisolierung und Bleimantel für Starkstromanlagen.	
Electrical engineering	VDE 0266 DIN VDE 0266:2006-03	Starkstromkabel mit verbessertem Verhalten im Brandfall.	
Electrical engineering	VDE 0271 DIN VDE 0271:2008-02	Kabel; Starkstromkabel mit Isolierung und Mantel aus thermoplastischem PVC und Nennspannungen bis Uo/U (Um): 3,6 / 6 (7,2) kV.	
Electrical engineering	VDE 0276 - 605 DIN VDE 0276-605:2008-02	Starkstromkabel Ergänzende Prüfverfahren.	
Electrical engineering	VDE 0276 - 620 DIN VDE 0276-620:2010-11	Energieverteilungskabel mit extrudierter Isolierung für Nennspannungen Uo/U: 3,6 / 6 kV bis 20,8 / 36 kV.	
Electrical engineering	VDE 0276 - 621 DIN VDE 0276-621:1997-05	Energieverteilungskabel mit getränkter Papierisolierung für Mittelspannung.	
Electrical engineering	VDE 0276 - 622 DIN VDE 0276-622:2006-05	Starkstromkabel mit Nennspannungen von3,6 / 6 (7,2) kV bis 20,8 / 36 (42) kV mit verbessertem Verhalten im Brandfall für Kraftwerke.	
Electrical engineering	VDE 0276 - 626 DIN VDE 0276-626:1997-01	Isolierte Freileitungsseile für oberirdische Verteilungsnetze mit Nennspannung Uo/U (Um): 0,6 / 1 (1,2) kV.	
Electrical engineering	VDE 0276 - 627 DIN VDE 0276-627:2006-09	Vieladrige und vielpaarige Kabel für die Verlegung in Luft und in Erde.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0279 DIN 50279:1982-10	Leitungsgarnituren des Bergbaus unter Tage, Muffen 1 kV.	
Electrical engineering	VDE 0278-393 DIN EN 50393:2006-11 EN 50393:2006	Prüfverfahren und Prüfanforderungen für die Garnituren von Verteilerkabeln mit Nennspannung von 0,6 / 1,0 (1,2) kV.	
Electrical engineering	IEC 60141-1 (1998-08) Ed. 3.0	Tests on oil-filled and gas-pressure cables and their accessories – Part 1: Oil-filled, paper-insulated, metal-sheathed cables and accessories for alternating voltages up to and including 400 kV.	
Electrical engineering	IEC 60141-2 (1967-01) Ed. 1.0	Tests on oil-filled and gas-pressure cables and their accessories. – Part 2: Internal gas-pressure cables and accessories for alternating voltages up to 275 kV.	
Electrical engineering	IEC 60141-3 (1967-01) Ed. 1.0	Tests on oil-filled and gas-pressure cables and their accessories. – Part 3: External gas-pressure (gas compression) cables and accessories for alternating voltages up to 275 kV.	
Electrical engineering	IEC 60141-4 (1990-10) Ed. 1.0	Tests on oil-filled and gas-pressure cables and their accessories. – Part 4: Oil-impregnated paper-insulated high pressure oil-filled pipe-type cables and accessories for alternating voltages up to and including 400 kV.	
Electrical engineering	IEC 60840 (2011-11) Ed. 4.0	Tests for power cables with extruded insulation for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV).	
Electrical engineering	IEC 60055-1 (2005-05) Ed. 5.1	Paper-insulated metal-sheathed cables for rated voltages up to 18 / 30 kV (with copper or aluminum conductors and excluding gas-pressure and oil-filled cables) – Part 1: Tests on cables and their accessories.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60055-2 (2005-02) Ed. 1.0	Paper-insulated metal-sheathed cables for rated voltages up to 18 / 30 kV (with copper or aluminium conductors and excluding gaspressure and oil-filled cables). – Part 2: General and construction requirements.	
Electrical engineering	EC 60502-1 (2009-09) Ed. 2.0	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV).	
Electrical engineering	IEC 60502-2 (2014-02) Ed. 2.0	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 2: Cables for rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV.	
Electrical engineering	IEC 60502-4 (2010-12) Ed. 3.0	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 4: Test requirements on accessories for cables with rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV).	
Electrical engineering	VDE 0276-2067 DIN IEC 62067:2013-08 IEC 62067 (2011-11) Ed. 2.0	Starkstromkabel mit extrudierter Isolierung und ihre Garnituren für Nennspannungen über 150 kV (Um = 170 kV) bis einschließlich 500 kV (Um = 550 kV) – Prüfverfahren und Anforderungen. Power cables with extruded insulation and their accessories for rated voltage above 150 kV (Um = 170 kV) up to 500 kV (Um = 550 kV) – Test methods and requirements.	
Electrical engineering	IEC 60227-2 (2003-04) Ed. 2.1	Electrical test methods for electric cables. – Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450 V / 750 V.	
Electrical engineering	VDE 0481 - 885-2 DIN EN 60885-2 IEC 60885-2 (1987-03) Ed. 1.0	Prüfung an Kabeln und isolierten Leitungen; Teilentladung. Electrical test methods for electric cables. – Part 2: Partial discharge tests.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0481 - 885-3 DIN EN 60885-3 IEC 60885-3 (2015-04) Ed. 2.0	Prüfung an Kabeln und isolierten Leitungen; Teilentladung an extrudierten Kabellängen. Electrical test methods for electric cables. – Part 3: Test methods for partial discharge measurements on lengths of extruded power cables.	
Electrical engineering	VDE 0473-229 DIN EN 60229:2009-04 EN 60229:2008 IEC 60229 (2007-10) Ed. 3.0	Tests on cable oversheaths which have a special protective function and are applied by extrusion.	
Electrical engineering	VDE 0481-395 DIN EN 50395:2006-07 EN 50395:2005	Elektrische Prüfung für Niederspannungskabel und -leitungen.	
Electrical engineering	VDE 0473-396 DIN EN 50396:2006-07 EN 50396:2005	Nicht-elektrische Prüfverfahren für Niederspannungskabel und -leitungen.	
Electrical engineering	VDE 0481 - 230 DIN EN 60230:2003-03 EN 60230:2002 IEC 60230 (1966-01) Ed. 1.0	Impulse tests on cables and their accessories.	
Electrical engineering	IEEE 48:2009	IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.	
Electrical engineering	IEEE 404:2012	IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500.000 V.	
Electrical engineering	IEEE 386:2006	IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEEE 592:2007	IEEE Standard for Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Connectors.	

Technical responsibility for the test reports:

Approval:

Herr Dipl.-Wirt.-Ing. Rainer Schiller
Herr Dipl.-Ing. Hannes Zinnbauer
Herr Dipl.-Ing. Detlef Jegust

Technical verification:

Herr Dipl.-Ing. Winfried Moritz
Herr Dipl.-Ing. Klaus Vaterrodt
Herr Dipl.-Ing. Jürgen Wittwer
Herr Dipl.-Ing. Detlef Jegust
Herr Dipl.-Ing. Uwe Fischer
Herr Dipl.-Ing. Michael Schelde
Herr Dipl.-Ing. Matthias Schröder-Heske
Herr Dipl.-Ing. Carlos Pereira
Herr Dipl.-Ing. Martin Brüggemann
Herr Ronny Baumgart

Acreditación

ENAC
Entidad Nacional de Acreditación

Otorga la presente / Grants this

ACREDITACIÓN
3/LE130(*)

a la entidad técnica / to the technical entity

LABORATORIO CENTRAL OFICIAL DE ELECTROTECNIA (LCOE)

Según criterios recogidos en la Norma UNE-EN ISO/IEC 17025, para la realización de ENSAYOS en el SECTOR INDUSTRIAL definidos en el ANEXO TÉCNICO adjunto.

According to the criteria in UNE-EN ISO/IEC 17025 for the performance of Test in the Industrial Sector as defined in the attached Technical Annex.

Fecha de entrada en vigor / Coming into effect: 21/12/1988

D. José Manuel Prieto Barrio
Presidente

La acreditación mantiene su vigencia hasta notificación en contra. Este documento no tiene validez sin su correspondiente anexo técnico, cuyo número coincide con el de la acreditación. La presente acreditación y su anexo técnico están sujetos a modificaciones, suspensiones temporales y retirada. Su vigencia puede confirmarse en www.enac.es.

The accreditation maintains its validity unless otherwise stated. The present accreditation is not valid without its corresponding technical annex, which number coincides with the accreditation. This accreditation and its technical annex could be reduced, temporarily suspended and withdrawn. The state of validity of it can be confirmed at www.enac.es.

ENAC es firmante del Acuerdo Europeo de Reconocimiento Mutuo firmado entre Organismos Nacionales de Acreditación (www.european-accreditation.org).
ENAC is signatory of the European Recognition Agreement signed among National Accreditation Bodies (www.european-accreditation.org)

(*) Incluye las acreditaciones nº 3/LE190, 3/LE192, 3/LE261

000483

Ref.: CLE/6463 Fecha de emisión 03/03/2014
El presente documento anula y sustituye a los de ref. CLE/1788, CLE/1710, CLE/1711, CLE/1712

Código Validación Electrónica: f285T67862y56Ufc6j

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

Siemens Aktiengesellschaft
Wittelsbacher Platz 2, 80333 München

Standort:
Siemens Aktiengesellschaft
PSW (Prüffeld der Schaltwerke)
EM HP BSS LAB
Nonnendammallee 104, 13629 Berlin

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Hochspannungsschaltgeräte und -anlagen sowie
Geräte der elektrischen Energietechnik

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 26.02.2016 mit der Akkreditierungsnummer D-PL-11055-10 und ist gültig bis 25.02.2021. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 12 Seiten.

Registrierungsnummer der Urkunde: **D-PL-11055-10-00**

Frankfurt, 26.02.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Deutsche Akkreditierungsstelle GmbH

Standort Berlin	Standort Frankfurt am Main	Standort Braunschweig
Spittelmarkt 10	Europa-Allee 52	Bundesallee 100
10117 Berlin	60327 Frankfurt am Main	38116 Braunschweig

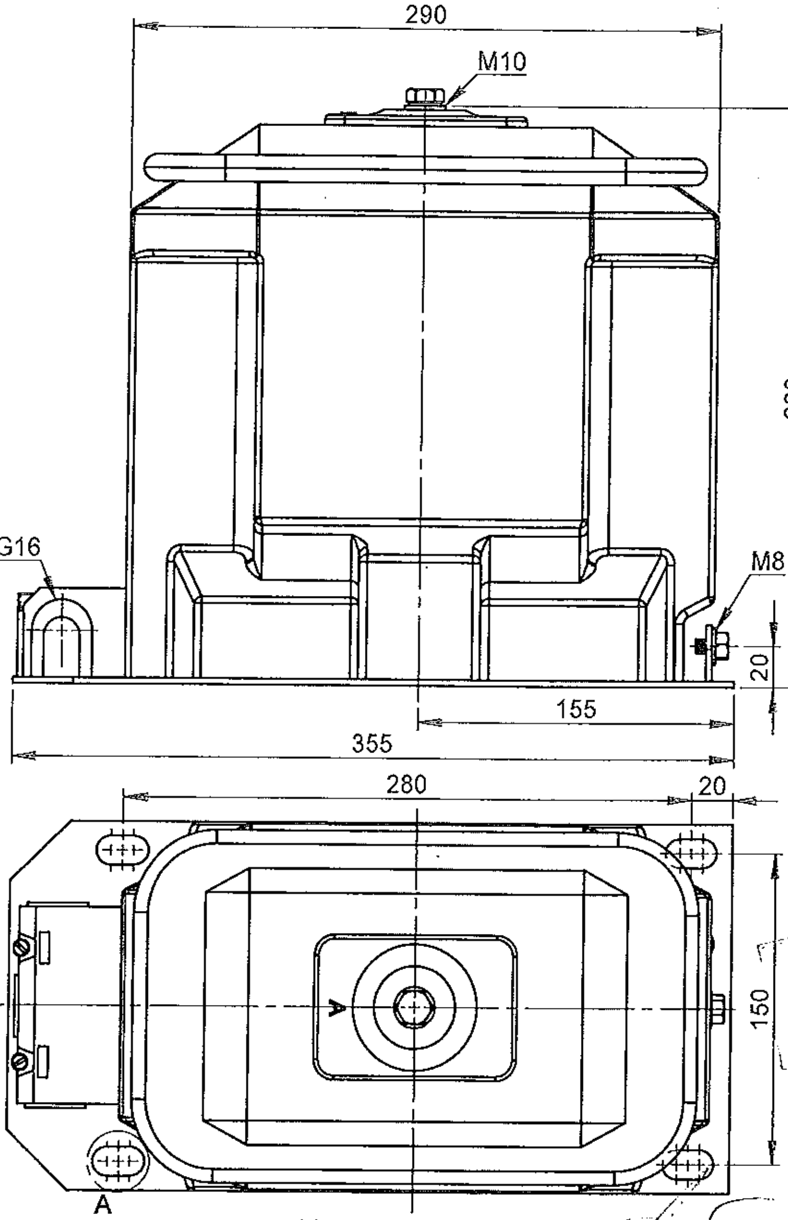
Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

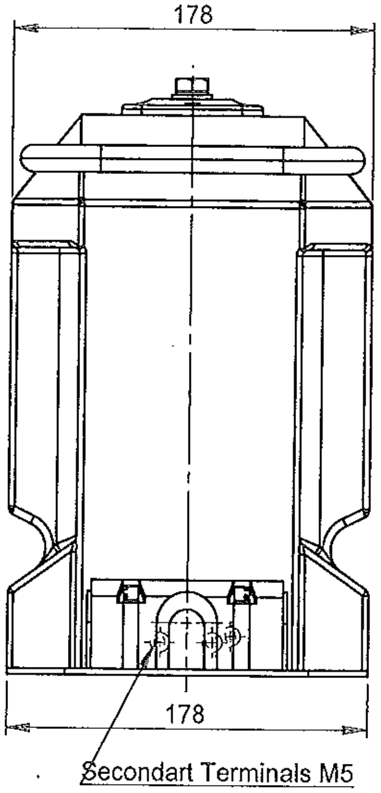
Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

~~REV 1~~	The drawing has been revised.	20/06/2011
REV 2		
REV 3		





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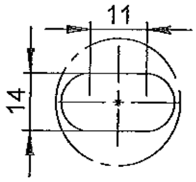
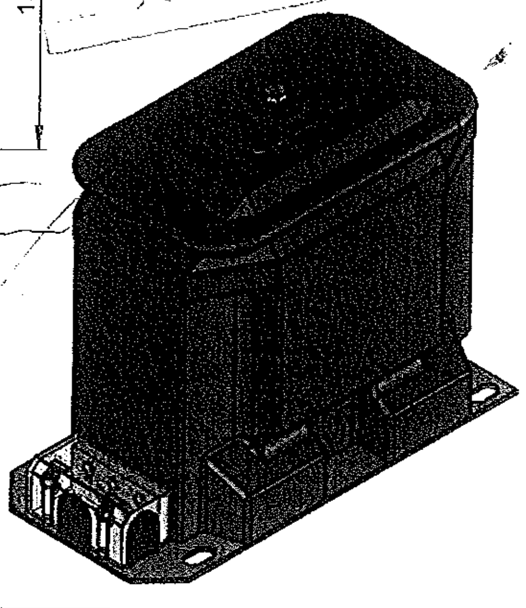


A-DETAIL
SCALE 3:1



TIGHTENING TORQUE (Nm)	Min.	Max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M10 (Primary Terminal)	30	40

Note: All dimensions are in mm.
Small deviations in dimensions and construction possible.

						CAST RESIN
UNIT	PARTNAME	ITEM	MTRL.DIMEN.	MTRL.COD.	DRAWING NO.	MTRL.TYPE

		DATE	NAME	SIGNATURE
REV.	DRW.BY	20/06/2011	M.AKSU	
TOLERANCE DIN 7168-g	CONTROL	20/06/2011	T.DEMİRCAN	
	PREPARED BY		CHECK BY	
SCALE --------	VTB 20-K VOLTAGE TRANSFORMER			

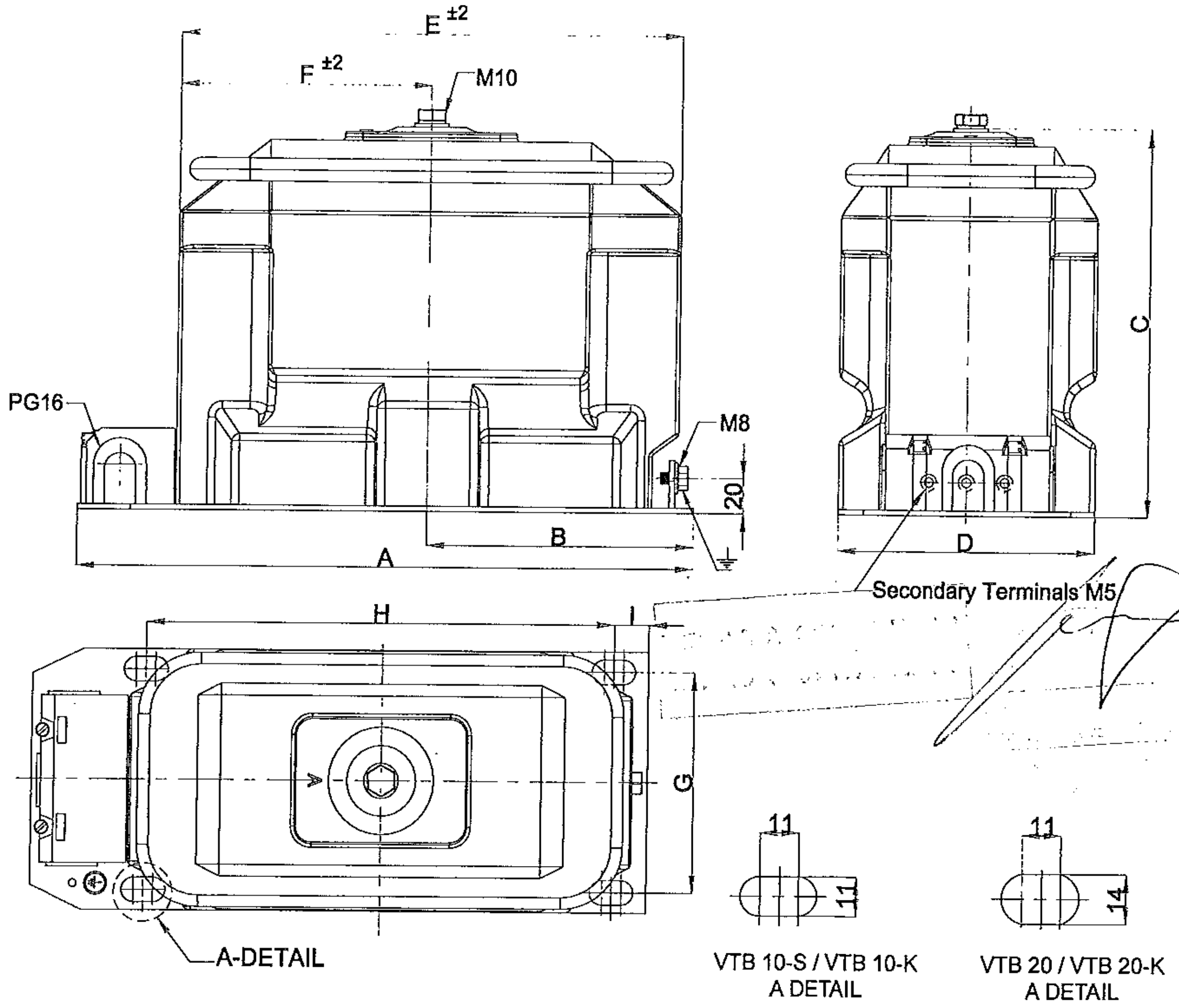
ESİTAŞ
Instrument Transformers

RAW.MTRL.CODE	ALT SAC 3934
SEMI FINISHED MTRL.	C0C466
	5382-00

E-135

INDOOR SINGLE PHASE SUPPORT TYPE CAST RESIN INSULATED VOLTAGE TRANSFORMERS TECHNICAL DRAWING

(Um=3,6kV............24kV BLOCK TYPES)



TYPES	A	B	C	D	E	F	G	H	I
VTB 10-S	355	155	220	148	290	145	125	270	20
VTB 10-K	355	155	220	148	290	145	125	270	20
VTB 20	355	155	280	178	290	145	150	280	20
VTB 20-K	355	155	280	178	290	145	150	280	20

TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M10 (Primary Terminal)	30	40

- All dimensions are in mm.
- Tolerances are according to DIN 7168-g when not specified.
- Esitas reserves the right to change the specifications and the dimensions of the goods. Please ask for updated information.
- Customer designed products are also available.

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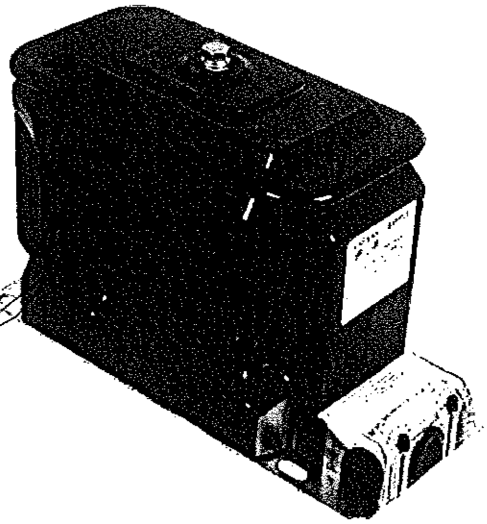
VOLTAGE TRANSFORMERS

INDOOR SINGLE PHASE SUPPORT TYPE CAST RESIN INSULATED VOLTAGE TRANSFORMERS
(Um=3,6kV............24kV BLOCK TYPES)

Types: VTB 10-S
VTB 10-K
VTB 20
VTB 20-K

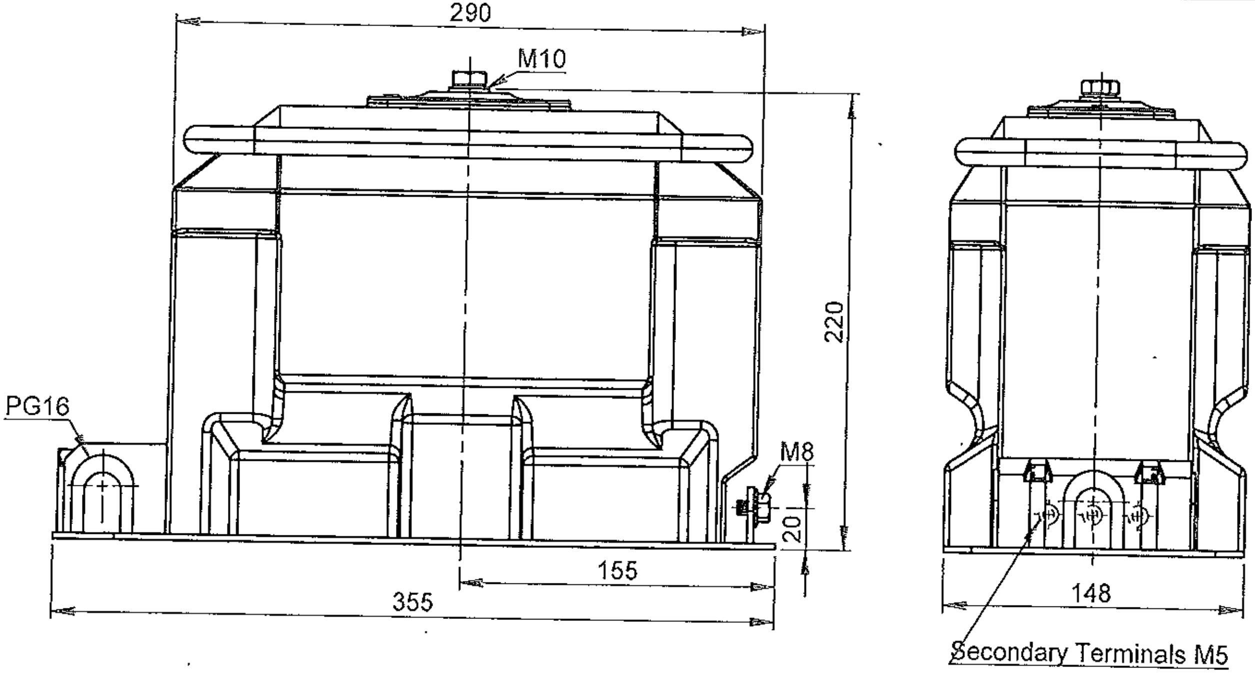


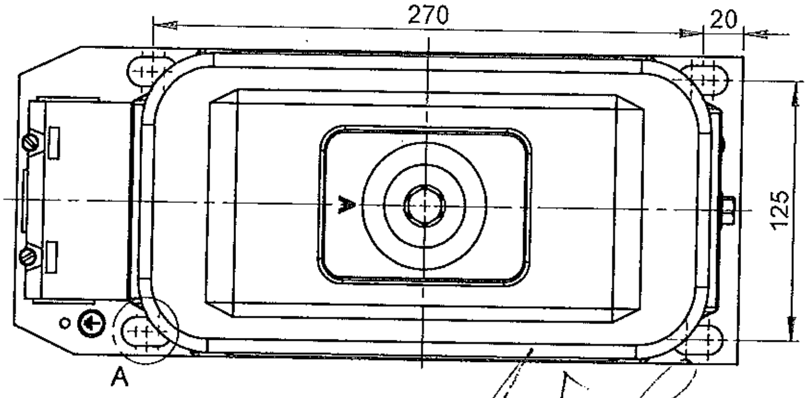
Technical Data

TYPES	VTB 10-S	VTB 10-K	VTB 20	VTB 20-K
Operating voltage: Um (kV)	3,6 7,2 12		17,5	24
Rated power-frequency withstand voltage (1 minute) (kV)	10 20 28		38	50
Rated impulse test voltage (1.2/50 µs) full wave (kV)	40 60 75		95	125
Rated frequency (Hz)	50-60			
Rated primary voltage (max.) (kV)	12/√3		24/√3	
Secondary voltage (V)	100/√3 110/√3 120/√3		100/3 110/3 120/3	
Rated burden (max.) in class 0.2 (VA)	30		50	
Rated burden (max.) in class 0.5 (VA)	100		120	
Rated burden (max.) in class 1 (VA)	200		250	
Rated burden for protection purpose in class 3P (VA)	100			
Rated voltage factor (30 sec. or 8h) (Un)	1,9			
Insulation class	E			
Ambient temperature (°C)	-25 ...... +40*			
Altitude (m)	1000			
Standard	According to the customer requirements			
Weight (approx.) (kg)	27		40	

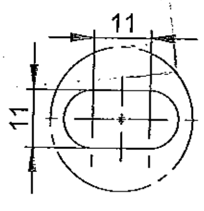
* It can be produced according to customer's specified ambient temperature. Please contact with ESITAS for feasibility.

REV 1	The drawing has been revised.	20/06/2011
REV 2		
REV 3		

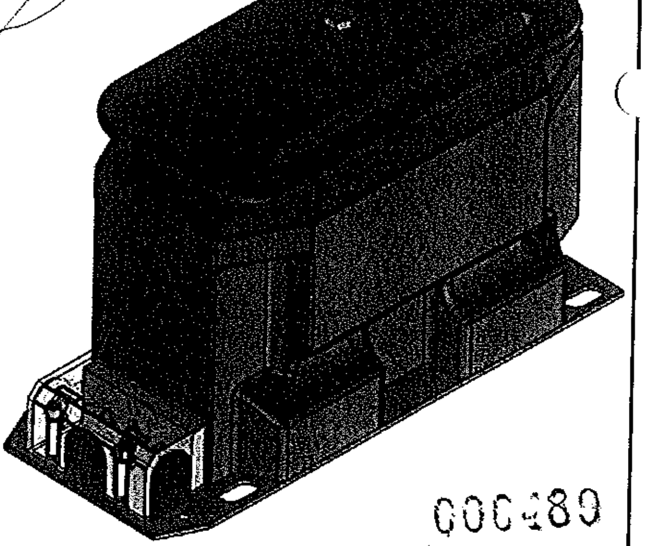




INFORMATION



A-DETAIL
SCALE 3:1



TIGHTENING TORQUE (Nm)	Min.	Max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M10 (Primary Terminal)	30	40

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Note: All dimensions are in mm.
Small deviations in dimensions and construction possible.

						CAST RESIN
UNIT	PARTNAME	ITEM	MTRL.DIMEN.	MTRL.COD.	DRAWING NO.	MTRL.TYPE

		DATE	NAME	SIGNATURE	
REV.	DRW.BY	20/06/2011	M.AKSU		ESİTAŞ Instrument Transformers
TOLERANCE DIN 7168-g	CONTROL	20/06/2011	T.DEMİRCAN		
	PREPARED BY		CHECK BY		RAW.MTRL.CODE: ALT SAC 3933
SCALE --------	VTB 10-K VOLTAGE TRANSFORMER				SEMI FINISHED MTRL.
					5381-00

E-135

ESİTAŞ
Elektrik Sanayi ve Ticaret A.Ş.

HİLAL MAH.PAŞAKÖY CAD.NO:31
SANCAKTEPE / İSTANBUL
34791 İSTANBUL / TÜRKİYE
Tel: +90 216 304 32 70 Pbx
Faks: +90 216 304 32 82
E-mail:info@esitas.com
Sultanbeyli V.D. 380 034 3395

ИНСТРУКЦИЯ ЗА ТРАНСПОРТ,СЪХРАНЕНИЕ,МОНТАЖ И ЕКСПЛОАТАЦИЯ НА НАПРЕЖЕНОВИ ТРАНСФОРМАТОРИ ЗА ЗАКРИТ МОНТАЖ

Съхранение:

- Тип за закрит монтаж, трябва да се съхранява в затворени помещения;
- Съхранявайте при температурни нива, отбелязани на етикета на дървената опаковка.

Транспорт:

- Транспортна опаковка съгласно международните стандарти и практики;
- За последващ транспорт не изваждайте от оригиналната опаковка или обезопасете внимателно;
- Следвайте инструкциите за товарене върху етикетите на дървените каси.

Товарене:

- Тежки обекти- използвайте транспалетни колички или мотокар за товарене;
- Не поставяйте върху по-крехки обекти;
- Не поставяйте повече от два сандъка един върху друг;
- Следвайте инструкциите за товарене върху етикетите на дървените каси

Инсталиране:

- Следвайте инструкциите на Esitas, доставени с Вашия трансформатор;
- Инсталацията трябва да се извърши само от обучен персонал;
- Винаги заземявайте стоманената основна плоча;
- Винаги заземявайте края на вторичните клеми;
- Никога не свързвайте вторичните намотки на късо.

Поддръжка:

- Животът на продукта се удължава, ако се използва при нормални условия на системата без проблеми;
- Почиствайте всяка година, ако съществува натрупване на прах върху изолираните части на трансформатора. (Не забравяйте да изключите захранването преди почистване).

БЪЛГАРСКИ ИНСТИТУТ ПО МЕТРОЛОГИЯ

Главна дирекция МЕРКИ И ИЗМЕРВАТЕЛНИ УРЕДИ

София 1040, бул. "Г. М. Димитров" № 52Б
АУ-ОТСИ № 32
05.06.13 г.

ДО
"Контрагент 35" ЕООД,
6000 – гр. Стара Загора,
ул. „Индустриална", ПК 177

<u>ОТНОСНО:</u> Одобряване на тип VTB 10/20/30 на напреженови измервателни трансформатори, *(по Заявление, вх. № АУ-ОТСИ-32/30.04.2013 г.)*

УВАЖАЕМИ ГОСПОДА,

Уведомяваме Ви, че в регистъра на одобрените за използване типове средства за измерване под ***№ 5008*** са вписани ***напреженови измервателни трансформатори тип VTB 10/20/30,*** с метрологични характеристики съгласно Удостоверение № 13.06.5008.

Фирма – производител: ESITAS Elektrik Sanayi ve Ticaret A.S., Турция

Срокът на валидност на одобряване на типа е: ***03.06.2023 г.***

Измервателните трансформатори, подлежат на задължителна първоначална проверка.

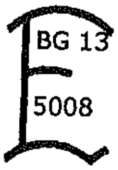
Производителят/вносителят на средството за измерване от одобрен тип се задължава да постави знак за одобрен тип в съответствие с чл. 35 от Закона за измерванията (ДВ, бр. 46 от 2002 г.).

С уважение:
СТЕФКА ХРИСТОВА
/Гл. директор/

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология
REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ
Measuring Instrument Type-approval Certificate

№ 13.06.5008

Издадено на производител: *Issued to manufacturer:*	ESITAS Elektrik Sanayl ve Ticaret A.S., Турция
На основание на: *In Accordance with:*	чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)
Относно: *In Respect of:*	напреженови измервателни трансформатори тип VTB 10/20/30
Знак за одобрен тип: *Type Approval Mark:*	
Технически и метрологични характеристики: *Technical and metrological characteristics:*	приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване
Срок на валидност: *Valid until:*	03.06.2023 г.
Вписва се в регистъра на одобрените за използване типове средства за измерване под №: *Reference №:*	5008
Дата на издаване на удостоверението за одобрен тип: *Date:*	03.06.2013 г.

И.Д. ПРЕДСЕДАТЕЛ:
Димка Иванова

страница 1 от 2

000492

Приложение към удостоверение за одобрен тип № 13.06.5008

Издадено на производител: ESITAS Elektrik Sanayi ve Ticaret A.S., Турция

Относно: напреженови измервателни трансформатори тип VTB 10/20/30

1. Описание на типа:

Напреженовите измервателни трансформатори тип VTB 10/20/30 са предназначени за измерване и релейна защита в уредби за средно напрежение. Максималното работно напрежение е от 3,6 kV до 36 kV.

Напреженовите трансформатори тип VTB 10/20/30 са еднополюсни - свързване фаза-земя и са залети с епоксидна смола. Конструкцията представлява магнитопровод с висока магнитна проницаемост и малки магнитни загуби, първична и вторични намотки. Магнитопроводът и намотките са залети с епоксидна смола с много високо качество, която гарантира необходимата диелектрична якост и механична здравина. Към залятото със смола тяло е закрепена стоманена монтажна плоча и отделна изолирана клемна кутия, в която са изведени вторичните вериги.

Вторичните клеми са обозначени със стандартни маркировки на изводите.

2. Технически и метрологични характеристики:

Тип на трансформатора	**VTB 10/20/30**
Ниво на изолация, kV	3,6/10/40; 7,2/20/60; 12/28/75; 17,5/38/95; 24/50/125; 36/70/170
Номинално вторично напрежение, V	100/√3; 110/√3; 120/√3 и 100/3
Номинална честота, Hz	50 - 60
Клас на точност - намотки за измерване - намотки за защита	0,2; 0,5; 1 3P и 6P
Коефициент на напрежение	1,9
Мощност на вторичните намотки, VA	25 - 250

3. Типово означение: тип **VTB 10/20/30**

4. Описание на местата, предназначени за поставяне на знаци от метрологичен контрол:

- Знакът за одобрен тип се нанася до табелката с технически данни.
- Знакът за първоначална проверка (марка за залепване) се поставя до знака за одобрен тип.

БЪЛГАРСКИ ИНСТИТУТ ПО МЕТРОЛОГИЯ

Главна дирекция МЕРКИ И ИЗМЕРВАТЕЛНИ УРЕДИ

ДО
„КОНТРАГЕНТ 35" ЕООД
6000 ГР. СТАРА ЗАГОРА
УЛ. „ИНДУСТРИАЛНА" П.К. № 177
ТЕЛ.: 042/600 032, ФАКС: 042/600 129

АУ-000029 / 16903
07. 07. 2015 г.

Относно: Издаване на допълнение № 15.07.5008.2 към удостоверение за одобрен тип № 13.06.5008 на напреженови измервателни трансформатори тип VTB 10/20/30.
(по Заявление, вх. № АУ-000029-16903/26.06.2015 г.)

УВАЖАЕМИ ГОСПОДА,

Уведомяваме Ви, че е издадено допълнение **№ 15.07.5008.2** към удостоверение № 13.06.5008 за одобрен и вписан под **№ 5008** в регистъра на одобрените за използване типове средства за измерване **– напреженов измервателен трансформатор тип VTB 10/20/30** с метрологични характеристики съгласно горепосоченото допълнение.

- Фирма–производител: ESITAŞ Elektrik Sanayi ve Ticaret A.Ş., Турция
  Hilal Mahallesi Paşaköy Caddesi No: 31 Sancaktepe
  İSTANBUL / TÜRKİYE;
- Срокът на валидност на одобряване на типа е: **03.06.2023 г.**

Измервателните трансформатори подлежат на задължителна първоначална проверка.

Производителят/вносителят на средството за измерване от одобрен тип се задължава да постави знак за одобрен тип в съответствие с чл. 35 от Закона за измерванията (ДВ, бр. 46 от 2002 г.).

С УВАЖЕНИЕ,
ВАЛЕНТИН СТАРЕВ
Главен директор на ГД МИУ

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

ДОПЪЛНЕНИЕ № 15.07.5008.2

КЪМ УДОСТОВЕРЕНИЕ
ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ № 13.06.5008

Measuring Instrument Type-approval Certificate-Revision 1

Издадено на производител:
Issued to manufacturer:
ESITAŞ Elektrik Sanayi ve Ticaret A.Ş., Турция
Hilal Mahallesi Paşaköy Caddesi No:31 Sancaktepe
İSTANBUL / TÜRKİYE

На основание на:
In Accordance with:
чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)

Относно:
In Respect of:
напреженов измервателен трансформатор
тип VTB 10/20/30

Технически и метрологични характеристики:
Technical and metrological characteristics:
приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване

Срок на валидност:
Valid until:
03.06.2023 г.

Средството за измерване е вписано в регистъра на одобрените за използване типове средства за измерване под №:
Reference №:
5008

Дата на издаване на допълнението към удостоверението за одобрен тип:
Date:
06.07.2015 г.

ПРЕДСЕДАТЕЛ:
доц. д-р Димитър Станков

Приложение към Допълнение № 15.07.5008.2 към удостоверение № 13.06.5008

Издадено на производител: ESITAŞ Elektrik Sanayl ve Ticaret A.Ş, Турция
Hilal Mahallesi Paşaköy Caddesi No: 31 Sancaktepe
İSTANBUL / TÜRKİYE

Относно: напреженов измервателен трансформатор тип VTB 10/20/30

Описание на допълнението към удостоверение за одобрен тип № 13.06.5008

- В т. 2. **Технически и метрологични характеристики:**
Мощност на вторичните намотки, VA „5-250" да се промени на: „от 5 до 250";

- Към т.3. **Типово означение да се допълни:**
„XX" към към типовото означение VTB 10/20/30: VTV 10-XX/20-XX/30-XX, където:

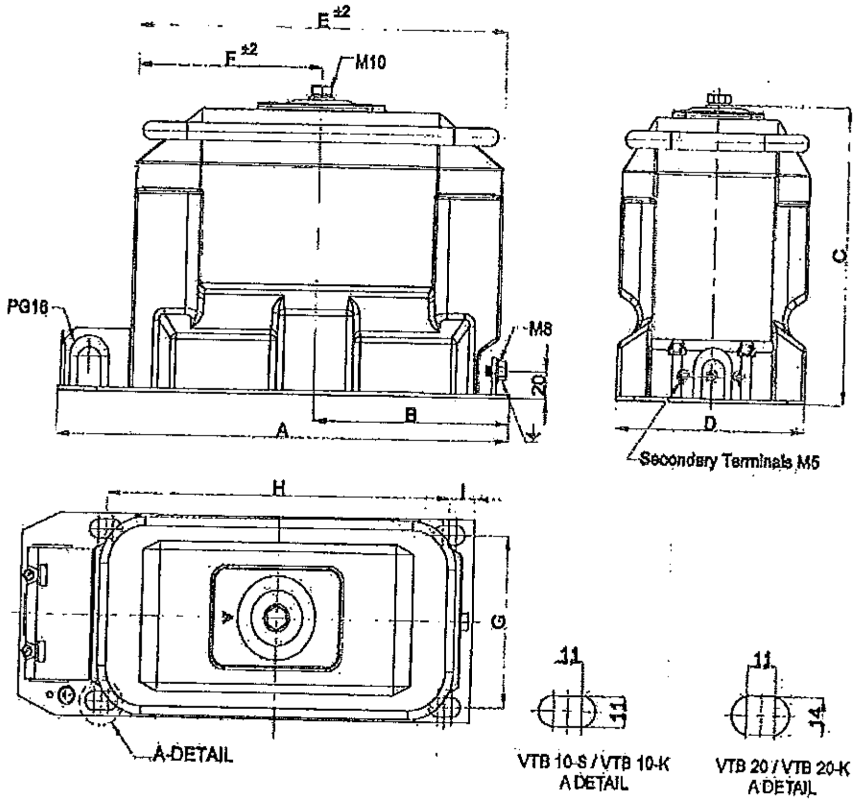
XX е цифрово-буквена комбинация, състояща се от една цифра и/или буква или от две цифри и/или букви,обозначаваща следното значение:

S - размер на корпус VTB 10-S (Чертеж № 1)
K - размер на корпус VTB 10-K (Чертеж № 1)
- размер на корпус VTB 20-K (Чертеж № 1)
- размер на корпус VTB 30-K (Чертеж № 2)

без букви и цифри – размер на корпус VTB 20 (Чертеж № 1)
– размер на корпус VTB 30 (Чертеж № 3)

ЧЕРТЕЖ № 1

НАПРЕЖЕНОВ ТРАНСФОРМАТОР ЕДНОФАЗЕН, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=3,6kV....24kV BLOCK TYPES)



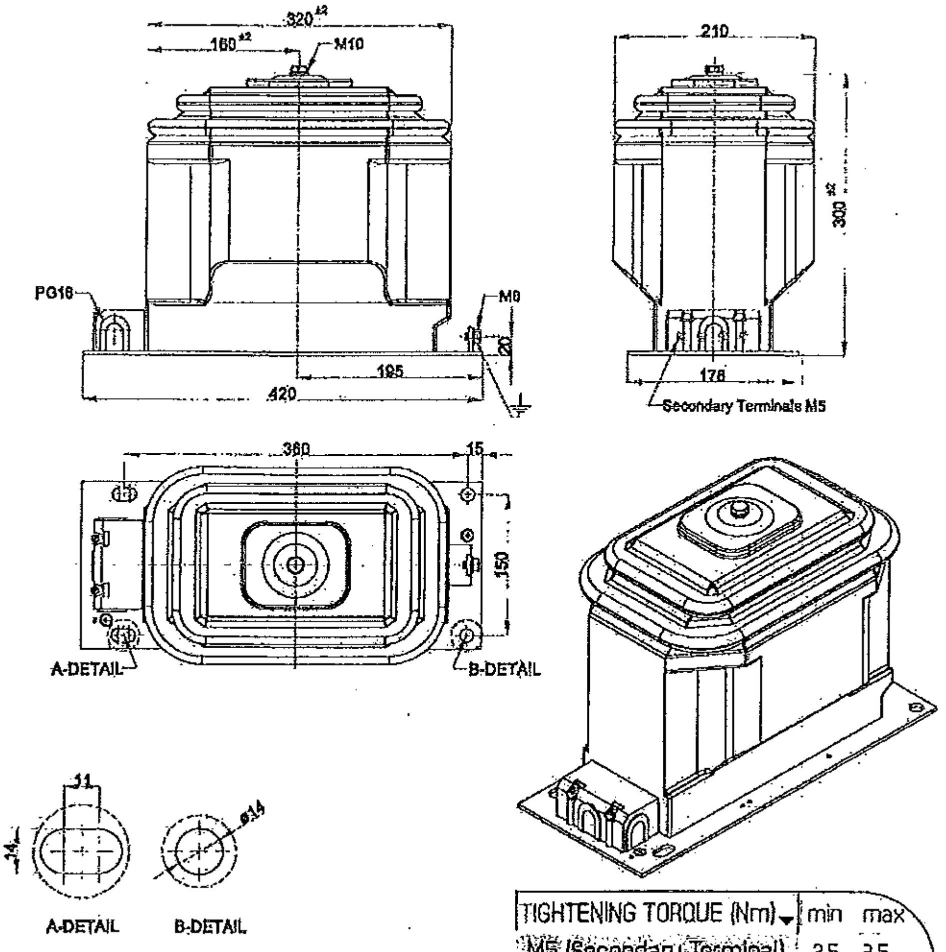
TYPES	A	B	C	D	E	F	G	H	I
VTB 10-S	355	155	220	148	290	145	125	270	20
VTB 10-K	355	155	220	148	290	145	125	270	20
VTB 20	355	155	280	178	290	145	150	280	20
VTB 20-K	355	155	280	178	290	145	150	280	20

TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M10 (Primary Terminal)	30	40

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

ЧЕРТЕЖ № 2

НАПРЕЖЕНОВ ТРАНСФОРМАТОР ТИП VTB 30-K, ЕДНОФАЗЕН, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=36kV Block types)



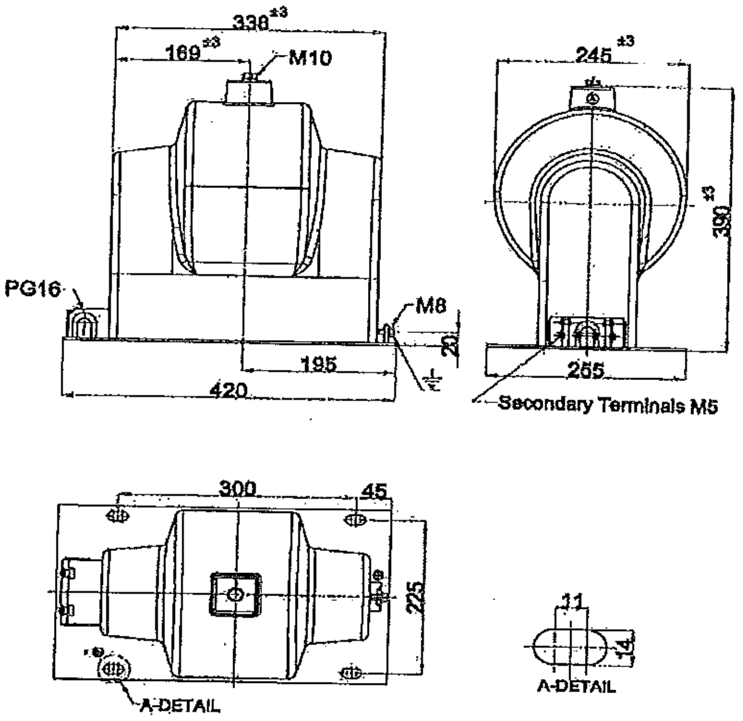
TIGHTENING TORQUE (Nm)	min	max
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M10 (Primary Terminal)	30	40

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

ЧЕРТЕЖ № 3

НАПРЕЖЕНОВ ТРАНСФОРМАТОР ЕДНОФАЗЕН ТИП VTB 30, ОПОРЕН ТИП, С ИЗОЛАЦИЯ ОТ ЛЯТА СМОЛА, ЗА ЗАКРИТ МОНТАЖ (Um=24k & 36kV Large Types)

VTB 30



TIGHTENING TORQUE (Nm)	min.	max.
M5 (Secondary Terminal)	2.5	3.5
M8 (Ground Terminal)	15	20
M10 (Primary Terminal)	30	40

Всички размери са в милиметри. Допустимите отклонения са съгласно DIN 7168-g.

Este documento es una versión bilingüe español-inglés, realizada por TECNALIA, del anexo técnico original emitido en español (Rev. 22, 24/04/2015) de la acreditación 4/LE148.
This document is an English-Spanish version, prepared by TECNALIA, of the original technical annex issued in Spanish (Rev. 22, 2015/04/24) of the accreditation 4/LE148.

ANEXO TÉCNICO
TECHNICAL ANNEX

ACREDITACIÓN Nº 4/LE148
ACCREDITATION No. 4/LE 148

Entidad / *Organization*: FUNDACIÓN TECNALIA RESEARCH & INNOVATION

Sede / *Address* Derio: Parque Científico y Tecnológico de Bizkaia, C/ Geldo, Edificio 700;
48160 Derio (Vizcaya)
Sede / *Address* Zamudio: Parque Científico y Tecnológico de Bizkaia, Laida Bidea, Edificio 413;
48170 Zamudio (Vizcaya)

Norma de referencia / *Standard Reference*: UNE-EN ISO/IEC 17025: 2005 (CGA-ENAC-LEC)

Ensayos en las siguientes áreas / *Tests in the following areas:*

Sede / *Address* Derio

Ensayos ambientales / *Environmental testing*

Categoría 0 (Ensayos en el laboratorio permanente) / *Category 0 (Tests in the permanent laboratory)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Ensayos ambientales en equipos eléctricos y electrónicos / *Environmental testing in electric and electronic equipment*		
Equipos y componentes eléctrico-electrónicos / *Electrical and electronic equipment and components*	Frío: Ensayos Ab, Ad y Ae. Temperatura mínima: -40°C Volumen máximo del espécimen: 0,6 m^3 *Cold: Tests Ab, Ad and Ae* *Minimum temperature: -40°C* *Maximum volume of the specimen:0.6 m3*	UNE-EN 60068-2-1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Calor seco: Ensayos Bb, Bd y Be. Temperatura máxima: 85°C Volumen máximo del espécimen: 0,6 m^3 *Dry heat: Tests Bb, Bd and Be* *Maximum temperature: 85ºC* *Maximum volume of the specimen:0.6 m^3*	UNE-EN 60068-2-2:2008
	Ensayo cíclico de calor húmedo (ciclos de 12+12 h). Ensayo Db. Volumen máximo del espécimen: 0,6 m^3 *Damp heat, cyclic (12 h + 12 h cycle). Test Db* *Maximum volume of the specimen:0.6 m^3*	UNE-EN 60068-2-30:2006
	Calor húmedo, ensayo continuo. Ensayo Cab Volumen máximo del espécimen: 0,2 m^3 *Damp heat, steady state: Test Cab* *Maximum volume of the specimen:0.2 m^3*	UNE-EN 60068-2-78:2013
	Variación de temperatura, Ensayo Na. Rango de temperaturas: -40°C a 85°C Volumen máximo del espécimen: 0,2 m^3 *Change of temperature Test Na* *Temperature range: -40°C a 85°C* *Maximum volume of the specimen: 0.2 m^3*	UNE-EN 60068-2-14:2011
	Vibración sinusoidal. Ensayo Fc. Dimensiones del espécimen inferiores a: 0,6x0,6x0,3 m. Peso inferior a 25 kg Aceleraciones hasta 30 g Frecuencias de 1 a 2000 Hz *Vibration (sinusoidal): Test Fc* *Dimensions of the specimen less than 0.6x0.6x0.3 m* *Weight less than 25 kg* *Accelerations up to 30 g* *Frequencies from 1 to 2000 Hz*	UNE-EN 60068-2-6:2008
	Choques. Ensayo Ea Dimensiones del espécimen inferiores a: 0,6x0,6x0,3 m. Peso inferior a 25 kg *Shock: Test Ea* *Dimensions of the specimen less tan 0.6x0.6x0.3 m* *Weight less than 25 kg*	UNE-EN 60068-2-27:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Vibración aleatoria de banda ancha. Ensayo Fh Dimensiones del espécimen inferiores a: 0,6x0,6x0,3 m. Peso inferior a 25 kg Aceleraciones RMS hasta 10 m/s^2 Frecuencias de 1 a 2000 Hz *Vibration, broadband random. Test Fh* *Dimensions of the specimen less than 0.6x0.6x0.3 m* *Weight less than 25 kg* *RMS accelerations up to 10 m/s^2* *Frequencies from 1 to 2000 Hz*	UNE-EN 60068-2-64:2009 ETSI EN 300 019-2-2:2013, random vibration
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 50470-1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 50470-3:2007
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos o electromecánicos destinados a la medida de energía eléctrica en sistemas de 50Hz y tensión hasta 600V *Electricity metering equipment (a.c.)* *Static or electromechanics meters and intended to the measuring of electrical energy in 50 Hz systems and voltage up to 600 V.*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 62052-11:2004

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos de energía activa (clases 1 y 2) *Electricity metering equipment (a.c.) Static meters for active energy (classes 1 and 2)*	Ensayos climáticos - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing:* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 62053-21:2003
Equipos de medida de la energía eléctrica (c.a). Contadores estáticos de energía reactiva (clases 2 y 3) *Electricity metering equipment (a.c.) Static meters for reactive energy (classes 2 and 3)*	Ensayos climáticos: - Humedad relativa - Ensayo de calor seco - Ensayo de frío - Ensayo cíclico de calor húmedo - Ensayo de vibración sinusoidal - Ensayo de choque Excepto el ensayo de protección contra radiación solar (6.3.5) *Climatic testing: .* - *Relative humidity* - *Dry heat test* - *Cold test* - *Damp heat cyclic test* - *Sinusoidal vibration test* - *Impact test* *Except the test of protection against solar radiation (6.3.5)*	UNE-EN 62053-23:2003

Ensayos de compatibilidad electromagnética (EMC) y evaluación de la exposición humana a campos electromagnéticos / *Electromagnetic Compatibility*

Categoría 0 (Ensayos en el laboratorio permanente) / *Category 0 (Tests in the permanent laboratory)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos industriales, científicos y médicos (ICM) *Industrial, scientific and medical equipment (ISM)*	Emisión: Medida de las perturbaciones radioeléctricas *Equipos del grupo 1* *Rango de frecuencias hasta 1 GHz* *Emission:* *Measurements of the radioelectric disturbances* *Group 1 equipment* *Frequency range up to 1 GHz*	UNE-EN 55011:2011 UNE-EN 55011/A1:2011
Electrodomésticos, herramientas eléctricas y aparatos análogos *Household appliances, electric tools and similar apparatus*	Emisión: Medida de las perturbaciones radioeléctricas Rango de frecuencias hasta 1GHz *Emission:* *Measurements of the radioelectric disturbances* *Frequency range up to 1 GHz*	UNE-EN 55014-1:2008 UNE-EN 55014-1/A1:2009 UNE-EN 55014-1/A2:2012 UNE-EN 55014-1:ERRATUM:2009
Equipos de la tecnología de la información *Information technology equipment*	Emisión: Medida de las perturbaciones radioeléctricas *Rango de frecuencias hasta 1GHz* *Emission:* *Measurements of the radioelectric disturbances* *Frequency range up to 1 GHz*	UNE-EN 55022: 2011 UNE-EN 55022:AC:2012
Equipos eléctricos y electrónicos con corriente de entrada ≤ 16 A por fase *Electric and electronic products with current input ≤ 16 A per phase*	Emisión: Medida de armónicos de corriente *Emission:* *Measurements of voltage fluctuations and flicker*	UNE-EN 61000-3-2: 2006 UNE-EN 61000-3-2/A1: 2010 UNE-EN 61000-3-2/A2: 2010
Equipos eléctricos y electrónicos con corriente de entrada ≤ 16 A por fase *Electric and electronic products with current input ≤ 16 A per phase*	Emisión: Medida de flicker y fluctuaciones de tensión *Emission:* *Measurements of voltage fluctuations and flicker*	UNE-EN 61000-3-3: 2013

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos eléctricos y electrónicos de entorno residencial, comercial e industria ligera	Emisión: Medida de las perturbaciones radioeléctricas	UNE-EN 61000-6-3:2007 UNE-EN 61000-6-3/A1 : 2012
Equipos eléctricos y electrónicos de entorno industrial *Residential, commercial and light industry environments electric and electronic products*	Emisión: Medida de las perturbaciones radioeléctricas *Emission:* *Measurements of the radioelectric disturbances*	UNE-EN 61000-6-4:2007 UNE-EN 61000-6-4/A1 : 2011 UNE-EN 61000-6-4:ERRATUM:2008
Equipos eléctricos y electrónicos *Industrial environments electric and electronic products*	Inmunidad a descargas electrostáticas *Immunity to electrostatic discharges*	UNE-EN 61000-4-2:2010
	Inmunidad a campos electromagnéticos radiados *Frecuencias entre 80 MHz y 3 GHz* *Intensidad de campo hasta 10 V/m* *Immunity to radiated electromagnetic fields* *Frequencies between 80 MHz and 3 GHz* *Field intensity up to 10 V/m*	UNE-EN 61000-4-3:2007 UNE-EN 61000-4-3/A1:2008 UNE-EN 61000-4-3/A2:2011
	Inmunidad a ráfagas de transitorios rápidos *Immunity to electrical fast transients*	UNE-EN 61000-4-4:2013
	Inmunidad a ondas de choque (surges) *Immunity to surge*	UNE-EN 61000-4-5:2007 UNE-EN 61000-4-5:CORR:2010
	Inmunidad a las perturbaciones conducidas inducidas por los campos de radiofrecuencia *Immunity to conducted disturbances induced by radiofrequency fields*	UNE-EN 61000-4-6:2009
	Inmunidad a campos magnéticos amortiguados *Volumen efectivo 0,6 m x 0,6 m x 0,5 m* *Immunity to damped magnetic fields* *Effective volume: 0.6 m x 0.6 m x 0.5 m*	UNE-EN 61000-4-10:1996 UNE-EN 61000-4-10/A1:2001

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Inmunidad a campos magnéticos de frecuencia industrial *Volumen efectivo 0,6 m x 0,6 m x 0,5 m* *Immunity to power frequency magnetic fields* *Effective volume: 0,6 m x 0,6 m x 0,5 m*	UNE-EN 61000-4-8:2011
	Inmunidad a huecos de tensión, interrupciones breves y variaciones de tensión DC *Immunity to DC voltage dips, short interruptions and voltage variations*	UNE-EN 61000-4-29:2002
	Inmunidad a ondas oscilatorias amortiguadas *Frecuencias de 100 kHz y 1 MHz* *Immunity to damped oscillatory waves* *Frequencies of 100 kHz and 1 MHz*	UNE-EN 61000-4-18:2008 UNE-EN 61000-4-18/A1:2011
	Inmunidad a huecos de tensión, interrupciones breves y variaciones de tensión *Immunity to voltage dips, short interruptions and voltage variations*	UNE-EN 61000-4-11:2005
Dispositivos eléctricos y electrónicos para formar esquemas para la protección destinados a funcionar en sistemas eléctricos *Electrical and electronic devices manufactured for configuring schemes for the protection destined to operate in electrical systems*	Medidas de resistencia de aislamiento, rigidez dieléctrica e impulso de tensión *Measurements of insulation resistance, dielectric test and voltage impulse test*	IEC 60255-5:2000 IEC 60255-27:2013 Apto. 10.6.4.2; 10.6.4.3 y 10.6.4.4
Equipos eléctricos y electrónicos de entorno residencial, comercial e industria ligera *Residential, commercial and light industry environments electric and electronic products*	Inmunidad a las perturbaciones electromagnéticas *Immunity to electromagnetic disturbances*	UNE-EN 61000-6-1:2007
Equipos eléctricos y electrónicos de entorno industrial *Industrial environments electric and electronic products*	Inmunidad a las perturbaciones electromagnéticas *Immunity to electromagnetic disturbances*	UNE-EN 61000-6-2:2006 UNE-EN 61000-6-2:ERRATUM:2009

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz*	Requisitos generales, bandas de frecuencia y perturbaciones electromagnéticas *General requirements, frequency bands and electromagnetic disturbances*	UNE-EN 50065-1:2012 Capítulo 6 Tensión de salida del transmisor
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz destinados para uso en entornos residenciales, comerciales y de industria ligera *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz and intended to residential, commercial and light industry*	Requisitos de inmunidad *Immunity requisites*	UNE-EN 50065-2-1:2004 UNE-EN 50065-2-1:2004+A1:2006
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz destinados para uso en entornos industriales *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz destined to industry*	Requisitos de inmunidad *Immunity requisites*	UNE-EN 50065-2-2:2004 UNE-EN 50065-2-2:2004+A1:2006 UNE-EN 50065-2-2:2004/A1:2006/CORR A1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz destinados para uso por los suministradores y distribuidores de electricidad *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz and intended for use by electricity suppliers and distributors*	Requisitos de inmunidad *Immunity requisites*	UNE-EN 50065-2-3:2004 UNE-EN 50065-2-3:2004/A1:2006
Transmisión de señales por la red eléctrica de baja tensión en la banda de frecuencias de 3 kHz a 148,5 kHz *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz*	Medidas de impedancia *Immunity requisites*	UNE-EN 50065-7:2002
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 50470-1:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
	Ensayos de inmunidad a: - Huecos e interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas Inmunidad Campo Magnético continuo y externo *Immunity test:* - *Dips and Interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave* *Constant and external Magnetic-Field Immunity*	
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 50470-3:2007
	Ensayos de inmunidad a: - Huecos e interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas Inmunidad Campo Magnético continuo y externo *Immunity test:* - *Dips and Interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave* *Constant and external Magnetic-Field Immunity*	

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos o electromecánicos destinados a la medida de energía eléctrica en sistemas de 50Hz y tensión hasta 600V *Electricity metering equipment (a.c.) Static or electromechanics meters and intended to the measuring of electrical energy in 50 Hz systems and voltage up to 600 V.*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 62052-11:2004
	Ensayos de inmunidad a: - Huecos e interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas *Immunity test:* - *Dips and Interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave*	
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos de energía activa (clases 1 y 2) *Electricity metering equipment (a.c.) Static meters for active energy (classes 1 and 2)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission* Ensayos de inmunidad a: - Huecos e interrupciones - Descargas Electrostáticas - Inmunidad Radiada - Transitorios rápidos - Inmunidad Conducida - Surge - Ondas oscilatorias amortiguadas *Immunity test:* - *Dips and Interruptions* - *Electrostatic Discharge* - *Radiated Immunity* - *Fast transient* - *Conducted Immunity* - *Surge* - *Damped Oscillatory Wave*	UNE-EN 62053-21:2003

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a). Contadores estáticos de energía reactiva (clases 2 y 3) *Electricity metering equipment (a.c.) Static meters for reactive energy (classes 2 and 3)*	Emisión: Emisión radiada Emisión conducida *Emission:* *Radiated emission* *Conducted emission*	UNE-EN 62053-23:2003

Sede / *Address* Zamudio

Equipos de generación, transporte, distribución y uso de la energía eléctrica, en media y alta tensión /
Equipment for Generation, Transmission, Distribution and use of Electric Power, high and medium voltage

Categoría 0 (Ensayos en el laboratorio permanente) / *Category 0 (Tests in the permanent laboratory)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transformadores de distribución y transformadores de media potencia *Distribution transformers and medium power transformers*	Ensayos tipo, ensayos individuales y ensayos especiales, excepto: - Medida de las características de transmisión de tensiones - Medida de gases disueltos - Medida del calentamiento del punto caliente - Verificación del recubrimiento externo Límites: - Dieléctricos: hasta 145 kV de tensión más elevada para el material - Determinación del nivel de ruido: método de presión acústica *Type tests, routine tests and special tests, except:* *- Determination of transient voltage transfer characteristics* *- Measurement of dissolved gases* *- Winding hot-spot temperature-rise measurements* *- Check of external coating* *Limits:* *- Dielectric tests: up to 145 kV higher voltage for the material* *- Determination of sound levels: sound pressure method*	UNE-EN 60076-1:1998 UNE-EN 60076-1/A1:2001 UNE-EN 60076-1/A12:2002 IEC 60076-1:2011 UNE-EN 60076-2:1998 UNE-EN 60076-2:2006 ERRATUM IEC 60076-2 :2011 UNE-EN 60076-3: 2002 UNE-EN 60076-3: 2006 ERRATUM IEC 60076-3:2000 IEC 60076-3:2000 CORRIGENDUM 1 UNE-EN 60076-5:2008 IEC 60076-5:2006 UNE-EN 60076-10:2002 IEC 60076-10:2001 UNE-EN 60076-16:2012 IEC 60076-16:2011
Transformadores de distribución sumergidos en aceite, de 25 kVA a 2500 kVA *Oil-immersed distribution transformers, from 25 up to 2500 kVA*	Todos los de la norma excepto: - Ensayo de fatiga de las cubas de llenado integral - Características de la pintura *All the tests of the standard, except:* *- Endurance test on corrugated tanks of completely oil filled and hermetically sealed distribution transformers* *- Tests of painting characteristics*	UNE 21428-1 :2011 UNE 21428-1-1 :2011 UNE 21428-1-2 :2011 UNE-EN 50464-1:2010 UNE-EN 50464-2-1 :2010 UNE-EN 50464-2-2 :2010 UNE-EN 50464-2-3 :2010 UNE-EN 50464-3:2010
Transformadores de potencia tipo seco *Dry-type power transformers*	Todos los de la norma sobre transformadores de distribución y transformadores de media potencia, excepto: - Ensayos de choque térmico, ambientales y de fuego *All the tests of the standard on distribution and medium power transformers, except:* *- Thermal shock, fire behaviour and environmental tests*	UNE-EN 60076-11:2005 IEC 60076-11:2004 UNE 21538-1: 2007 UNE-EN 50541-1:2012 UNE-EN 60076-16:2012 IEC 60076-16:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transformadores autoprotegidos sumergidos en líquido *Self-protected liquid-filled transformers*	- Todos los de la norma realizados por referencia a la serie de normas 60076 - Ensayo de descargas parciales (cap. 12) *- All the tests of the standard performed by reference to 60076 series* *- Partial discharges test (chap. 12)*	UNE-EN 60076-13:2008 IEC 60076-13:2006
Transformadores de medida y protección *Instrument transformers*	Todos los de la norma Límites: - Precisión: hasta 5 kA hasta 10 kV; 40 kV desde 10 VA - Dieléctricos: hasta Um ≤ 145 kV *All the tests of the standard* *Limits:* *- Accuracy: up to 5 kA* *up to 10 kV; 40 kV* *from 10 VA* *- Dielectric tests: up to Um ≤ 145 kV*	UNE-EN 60044-1:2000 UNE-EN 60044-1/A1:2001 UNE-EN 60044-1/A2:2004 UNE-EN 60044-2:1999 UNE-EN 60044-2/A1:2001 UNE-EN 60044-2/A2:2004 UNE-EN 60044-3:2004 IEC 60044-3:2002
Transformadores de tensión electrónicos Electronic voltage transformers	Ensayos de tipo: - Dieléctricos: hasta Um ≤ 145 kV - Ensayo de impulso tipo rayo - Ensayo bajo lluvia para tipo exterior - Ensayo de resistencia a la tensión de impulso para componentes de baja tensión - Precisión: hasta 10 kV; 40 kV; 50 Hz desde 10 VA Ensayos individuales y ensayos especiales *Type tests:* *- Dielectric tests: up to Um ≤ 145 kV* *- Lightning impulse test* *- Wet test for outdoor type* *- Impulse voltage withstand test for low-voltage components.* *- Accuracy: up to 10 kV, 40 kV, 50 Hz from 10 VA* *Routine tests and special tests*	UNE-EN 60044-7: 2001 IEC 60044-7:1999

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Transformadores de medida y protección *Instrument transformers*	Todos los de la norma para transformadores de tensión, transformadores de intensidad para medida y transformadores de intensidad para protección de clase P, excepto: - Ensayo de estanquidad de la envolvente en sistemas de gas, a temperatura ambiente (Apdos. 7.2.8 y 7.3.7) y a alta y baja temperatura (Apdo. 7.4.7) - Ensayo de presión sobre la envolvente (Apdos. 7.2.9 y 7.3.8) - Ensayo de impulsos cortados múltiples (Apdo. 7.4.2) - Ensayos mecánicos (Apdo. 7.4.5) - Ensayo de defecto por arco interno (Apdo. 7.4.6) - Ensayo de punto de rocío del gas (Apdo. 7.4.8) - Ensayo de corrosión (Apdo. 7.4.9) - Ensayo de riesgo de incendio (Apdo. 7.4.10) Límites: - Ensayos dieléctricos: hasta: Um ≤ 145 kV - Transformadores de tensión: Precisión: Potencia de precisión rango II. Tensiones primarias asignadas hasta 40 kV *All the tests of the standard for voltage transformers, measuring current transformers and class P current transformers for protection, except:* *- Enclosure tightness test in gas systems, at ambient temperature (7.2.8 and 7.3.7) and at low and high temperatures (7.4.7)* *- Pressure test for the enclosure (7.2.9 and 7.3.8)* *- Multiple chopped impulse test (7.4.2)* *- Mechanical tests (7.4.5)* *- Internal arc fault test (7.4.6)* *- Gas dew point test (7.4.8)* *- Corrosion test (7.4.9)* *- Fire hazard test (7.4.10)* *Limits:* *- Dielectric tests: up to Um ≤ 145 kV* *- Voltage transformers:* *Accuracy: burden range II. Rated primary voltages up to 40 kV*	UNE-EN 61869-1:2010 UNE EN 61869-1:2011 ERRATUM IEC 61869-1:2007 IEC 61869-2:2012 UNE-EN 61869-3:2012 IEC 61869-3:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aisladores pasantes (pasatapas) *Insulated bushings*	Todos los de la norma, excepto: - Ensayo de presión interna - Ensayo de estanquidad en pasatapas con gas o sumergidos en gas Límites: Um ≤ 145 kV *All the tests of the standard, except:* *- Internal pressure test* *- Tightness test on gas-filled and gas-insulated bushings* *Limits: Um ≤ 145 kV*	UNE-EN 50180:1997 UNE-EN 50180:1999 CORRIGENDUM UNE-EN 50180:2011 UNE-EN 50181:1997 UNE-EN 50181:2011 UNE EN 60137:2011 IEC 60137:2008
Aisladores de apoyo de interior de materia orgánica para instalaciones de tensión nominal superiores a 1 kV e inferiores a 300 kV *Indoor post insulators of organic material for systems with nominal voltages greater than 1kV and below 300 kV*	Todos los de la norma Límites: Um ≤ 145 kV *All the tests of the standard* *Limits: Um ≤ 145 kV*	UNE-EN 60660:2001 IEC 60660:1999
Centros de transformación prefabricados *High voltage/low voltage prefabricated substations*	Todos los de la norma, excepto: Apdo 6.9. Ensayos CEM Límites: Arco interno: 1000 V *All the tests of the standard,* *except:* *- EMC tests (6.9)* *Limits:* *Arcing due to an internal fault: 1000V*	UNE-EN 62271-202:2007 IEC 62271-202:2006

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos compactos de aparamenta para centros de transformación (CEADS) *Compact equipment assemblies for distribution substations (CEADS)*	Todos los de la norma, excepto: - Ensayos CEM (apdo. 6.9) - Ensayos de robustez mecánica de cubas herméticas de llenado integral (incluidos en el apdo. 6.201) - Ensayo de estanquidad de la unidad funcional de alta tensión (apdo. 7.4) Límites: Arco interno: 1000 V *All the tests of the standard, except:* *- EMC tests (6.9)* *- Mechanical strength tests of hermetically sealed tanks (included in 6.201)* *- Tightness tests of high voltage functional unit (7.4)* *Limits:* *Arcing due to an internal fault: 1000V*	UNE-EN 50532:2011
Materiales aislantes *Insulating materials*	Rigidez dieléctrica, ensayos a frecuencias industriales, tensión continua e impulsos 1,2/50 sobre materiales en placas y planchas y tubos rígidos Límites: Tensión alterna < 200 kV Tensión continua - 70 kV, sólo polaridad negativa Impulsos hasta 500 kV *Electric strength, tests at power frequencies, direct voltage and 1,2/50 µs impulse tests on boards and sheets materials, and rigid tubes* *Limits:* *Power frequency voltage < 200 kV* *Direct voltage -70 kV, only negative polarity* *Impulses up to 500 kV*	UNE-EN 60243-1:1999 UNE-EN 60243-2:2001 UNE-EN 60243-3:2002 IEC 60243-1:1998 IEC 60243-2:2001 IEC 60243-3:2001

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Materiales aislantes sólidos plásticos *Electrical insulating plastic materials*	Ensayo del hilo incandescente *Glow wire test*	UNE-EN 60695-2-10:2002 UNE-EN 60695-2-11:2001 UNE-EN 60695-2-12:2001 UNE-EN 60695-2-12 :2011 UNE-EN 60695-2-13:2002 UNE-EN 60695-2-13 :2011 IEC 60695-2-10:2000 IEC 60695-2-11:2000 IEC60695-2-11:2001 CORRIGENDUM 1 IEC 60695-2-12:2010 IEC 60695-2-13:2010 IEC 60695-2-13:2012 CORRIGENDUM 1
Alfombras de material aislante para trabajos eléctricos *Electrical insulating matting for live working*	Todos los ensayos de la norma, excepto - Ensayos mecánicos (apdos. 5.5, 5.9 y - 5.10) - Ensayo de envejecimiento (Aptdo. 5.7) - Ensayo de llama (apdo. 5.8.1) - Resistencia al ácido (apdo. 5.9) - Resistencia al aceite (apdo. 5.10) *All the tests of the standard, except:* *- Mechanical tests (5.5, 5.9 y 5.10)* *- Aging test (5.7)* *- Flame retardance test (5.8.1)* *- Acid resistance (5.9)* *- Oil resistance (5.10)*	UNE-EN 61111 :2010 IEC 61111:2009
Mantas eléctricas aislantes *Electrical insulating matting for live working*	- Inspección visual y mediciones (apdo. 5.2) - Marcado (apdo. 5.3) - Embalaje e instrucciones de uso (apdo. 5.4) - Ensayos dieléctricos (apdo 5.6) - Ensayo de plegado a baja temperatura (apdo. - 5.8.2) - Categoría A. Resistencia al ácido. Parte eléctrica (apdo. 6.2) - Categoría C: Ensayo de doblado a temperaturas - extremadamente bajas (apdo. 6.6) *- Visual inspection and measurements (5.2)* *- Marking (5.3)* *- Packaging and instructions for use (5.4)* *- Dielectric tests (5.6)* *- Low temperature folding test (5.8.2)* *- Category A: Acid resistance. Electrical part (6.2)* *- Category C: Extremely low temperature folding test (6.6)*	UNE-EN 61112:2010 IEC 61112:2009

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Envolventes de materiales eléctricos *Enclosures for electric material*	Clasificación de los grados de protección proporcionados por las envolventes, códigos IP e IK (excepto IK01) *Degrees of protection provided by enclosures. Code IP and IK (except IK01)*	UNE 20324:1993 UNE 20324/1M:2000 UNE 20324:2004 ERRATUM IEC 60529:1989 IEC 60529/A1:1999 UNE-EN 50102:1996 UNE-EN 50102:2002 CORRIGENDUM UNE-EN 50102/A1:1999 UNE-EN 50102/A1:2002 CORRIGENDUM IEC 62262:2002
Envolventes destinadas a los conjuntos de aparamenta de baja tensión *Empty enclosures for low-voltage switchgear and controlgear assemblies*	Ensayos para las envolventes vacías, todos los de la norma excepto: - Ensayo de resistencia a la radiación ultravioleta (UV) *Tests for empty enclosures, all the tests of the standard except:* *- Resistance to ultra-violet(UV) radiation*	UNE-EN 62208: 2004 UNE-EN 62208:2012 IEC 62208:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aparamenta de alta tension *High-voltage switchgear and controlgear*	Ensayos de tipo: Todos los de la norma excepto: - Ensayos CEM sobre circuitos auxiliares y de mando (Apdos. 6.9.1.2 , 6.9.2 y 6.9.3) - Aparamenta en gas: estanquidad (Apdo. - 6.8) - Ensayos sísmicos sobre circuitos auxiliares - (Apdo. 6.10.5.6) - Ensayo de rayos X para botellas de vacío - (Apdo. 6.11) - Aparamenta de Um > 245 kV: impulso tipo maniobra - - Aparamenta exterior: contaminación - artificial Límites: Ensayos dieléctricos: Frecuencia industrial hasta 550 kV Impulso tipo rayo hasta 750 kV Tensión de perturbaciones radioeléctricas hasta 300 kV Ensayos individuales: Todos los de la norma excepto estanquidad de aparamenta en gas (Apdo. 7.4) *Type tests:* *All the tests of the standard, except:* *- EMC tests on auxiliary and control circuits (6.9.1.2, 6.9.2 and 6.9.3)* *- Gas insulated switchgear and controlgear: tightness test (6.8)* *- Seismic tests on auxiliary circuits (6.10.5.6)* *- X-radiation test procedure for vacuum interrupters (6.11)* *- Switchgear and controlgear of Um>245 kV: switching impulse voltage test* *- Outdoor switchgear and controlgear: Artificial pollution test* *Limits:* *Dielectric tests:* *Power frequency up to 550 kV* *Lightning impulse up to 750 kV* *Radio interference voltage up to 300 kV* *Routine tests:* *All the tests of the standard, except tightness test in gas insulated switchgear and controlgear (7.4)*	UNE-EN 62271-1:2009 UNE-EN 62271-1/A1:2011 IEC 62271-1:2007 IEC 62271-1/A1:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aparamenta bajo envolvente metálica para corriente alterna de tensiones asignadas superiores a 1 kV e inferiores o iguales a 52 kV *AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*	Ensayos de tipo: Todos los de la norma, excepto: - Ensayos CEM (Apdo. 6.9.) - Aparamenta en gas: estanquidad (Apdo. 6.8) - Ensayos sísmicos sobre circuitos auxiliares (Apdo. 6.10.5.6) - Ensayo de rayos X para botellas de vacío (Apdo. 6.11) - Aparamenta exterior: contaminación artificial sobre aisladores (Apdo. 6.2.8) Límites: - Ensayos de establecimiento y corte: 200 MVA, 36 kV - Arco interno: 1000 V Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests (6.9)* *- Gas insulated switchgear and controlgear: tightness test (6.8)* *- Seismic tests on auxiliary circuits (6.10.5.6)* *- X-radiation test procedure for vacuum interrupters (6.11)* *- Outdoor switchgear and controlgear: artificial pollution test on insulators (6.2.8)* *Limits:* *- Making and breaking tests: 200 MVA, 36 kV* *- Arcing due to an internal fault: 1000V* *Routine tests:* *All the tests of the standard, except tightness test on gas insulated switchgear and controlgear*	UNE-EN 62271-200:2012 (Vcorr:2013) UNE-EN 62271-200:2005 IEC 62271-200: 2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Aparamenta bajo envolvente aislante para corriente alterna de tensiones asignadas superiores a 1 kV e inferiores o iguales a 52kV *AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*	Ensayos de tipo: Todos los de la norma excepto - Ensayos CEM (Apdo.6.9.) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares Límites: Ensayos de establecimiento y corte: 200 MVA, 36 kV Arco interno: 1000 V Ensayos individuales: Todos los de la norma excepto estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests (6.9)* *- Gas insulated switchgear and controlgear: tightness test* *- Seismic tests on auxiliary circuits* *Limits:* *- Making and breaking tests: 200 MVA, 36 kV* *- Arcing due to an internal fault: 1000V* *Routine tests:* *All the tests of the standard, except tightness test on gas insulated switchgear and controlgear*	UNE-EN 62271-201:2007 IEC 62271-201:2006
Aparamenta de interior bajo envolvente de tensiones asignadas superiores a 1 kV e inferiores o iguales a 52 kV para ser utilizada en condiciones climáticas severas *Indoor enclosed switchgear and controlgear for rated voltages above 1 kV up to and including 52 kV to be used in severe climatic conditions*	Todos los de la norma *All the tests of the standard*	IEC/TS 62271-304:2008 IEC/TS 62271-304:2010 CORRIGENDUM 1
Aparamenta bajo envolvente metálica aislada en SF6 hasta 36 Kv *SF6 insulated metal-enclosed switchgear and controlgear up to 36 kV*	Ensayo de inmersión *Immersion test*	Procedimiento interno PE.EE-27-E Apdo. E.1. *Internal procedure PE.EE-27-E Section E.1.*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Seccionadores y seccionadores de puesta a tierra de corriente alterna para alta tensión *High-voltage alternating current disconnectors and earthing switches*	Ensayos de tipo: Todos los de la norma excepto - Ensayos CEM sobre circuitos auxiliares y de mando (Apdos. 6.9.1.2, 6.9.2 y 6.9.3) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares - Aparamenta de Um > 245 kV: impulso tipo maniobra - Aparamenta exterior: contaminación artificial operación bajo condiciones severas de hielo Límites: - Ensayos dieléctricos: - Frecuencia industrial hasta 550 kV - Impulso tipo rayo hasta 750 kV - Tensión de perturbaciones radioeléctricas - hasta 300 kV - Ensayos de conexión: 200 MVA, 36 kV Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* *- EMC tests on auxiliary and control circuits (6.9.1.2, 6.9.2 and 6.9.3)* *- Gas insulated switchgear and controlgear: tightness test* *- Seismic tests on auxiliary circuits* *- Switchgear and controlgear of Um > 245 kV: Switching impulse voltage test* *- Outdoor switchgear and controlgear: Artificial pollution test and operation under severe ice conditions* *Limits:* *Dielectric tests:* *- Power frequency up to 550 kV* *- Lightning impulse up to 750 kV* *- Radio interference voltage up to 300 kV* *- Making tests: 200 MVA, 35 kV* *Routine tests:* *All the tests of the standard, except:* *- Gas insulated switchgear and controlgear: tightness test*	UNE-EN 62271-102:2005 UNE-EN 62271-102:2011 ERRATUM UNE-EN 62271-102/A1:2012 IEC 62271-102:2001 IEC 62271-102:2002 CORRIGENDUM 1 IEC 62271-102:2003 CORRIGENDUM 2 IEC 62271-102:2005 CORRIGENDUM 3 IEC 62271-102/A1:2011 IEC 62271-102/A1:2012 CORRIGENDUM 1 IEC 62271-102/A2:2013

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Interruptores automáticos de corriente alterna para alta tensión *High-voltage alternating-current circuit-breakers*	Ensayos de tipo: Todos los de la norma, excepto: - Ensayos CEM sobre circuitos auxiliares y de mando - (Apdos. 6.9.1.2, 6.9.2 y 6.9.3) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares - Ensayos de corte - Aparamenta de Um > 245 kV: impulso tipo maniobra - Aparamenta exterior: contaminación artificial y operación bajo condiciones severas de hielo Límites: - Ensayos dieléctricos: - Frecuencia industrial hasta 550 kV - Impulso tipo rayo hasta 750 kV - Tensión de perturbaciones radioeléctricas hasta 300 kV - Ensayos de conexión: 200 MVA, 36 kV Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* - *EMC tests on auxiliary and control circuits (6.9.1.2, 6.9.2 and 6.9.3)* - *Gas insulated switchgear and controlgear: Tightness test* - *Seismic tests on auxiliary circuits* - *Breaking tests* - *Switchgear and controlgear of Um > 245 kV: Switching impulse voltage test* - *Outdoor switchgear and controlgear: Artificial pollution test and operation under severe ice conditions* *Limits:* *Dielectric tests:* - *Power frequency up to 550 kV* - *Lightning impulse up to 750 kV* - *Radio interference voltage up to 300 kV* - *Making tests: 200 MVA, 35 kV* *Routine tests:* *All the tests of the standard, except:* - *Gas insulated switchgear and controlgear: tightness test*	UNE-EN 62271-100:2011 IEC 62271-100:2008 IEC 62271-100/A1:2012 IEC 62271-100/A1:2012 CORRIGENDUM 1

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Interruptores de alta tensión para tensiones asignadas superiores a 1 kV e inferiores a 52 kV *High voltage switches for rated voltages above 1 kV and less than 52 kV*	Ensayos de tipo: Todos los de la norma, excepto: - Ensayos CEM (Apdo. 6.9) - Aparamenta en gas: estanquidad - Ensayos sísmicos sobre circuitos auxiliares - Aparamenta exterior: contaminación - artificial y operación bajo condiciones severas de hielo Límites: - Ensayos de establecimiento y corte: 200 - MVA, 35 kV Ensayos individuales: Todos los de la norma, excepto: - Estanquidad de aparamenta en gas *Type tests:* *All the tests of the standard, except:* - *EMC tests (6.9)* - *Gas insulated switchgear and controlgear: Tightness test* - *Seismic tests on auxiliary circuits* - *Outdoor switchgear and controlgear: Artificial pollution test and operation under severe ice conditions.* *Limits:* *Making and breaking tests: 200 MVA, 35 kV* *Routine tests:* *All the tests of the standard, except:* - *Gas insulated switchgear and controlgear: Tightness test*	UNE-EN 60265-1:1999 UNE-EN 60265-1:2005 CORRIGENDUM UNE-EN 62271-103:2012 IEC 62271-103:2011

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos y materiales de alta tensión *High voltage equipment and materials*	Ensayos de alta tensión: Ensayos en seco y bajo lluvia Ensayos con tensión alterna Ensayos con tensión continua Ensayos con impulsos tipo rayo Límites: - Tensión alterna hasta 550 kV - Tensión continua hasta 100 Kv - Impulsos tipo rayo hasta 750 kV *High voltage tests:* *Dry and Wet tests* *Tests with Alternating Voltage* *Tests with Direct Voltage* *Lightning impulse voltage tests* *Limits:* - *Alternating voltage up to 550 kV* - *Direct voltage up to 100 kV* - *Lightning impulse voltage up to 750 kV*	UNE 21308-1:1994 UNE-EN 60060-1:2012 IEC 60060-1:2010
	Medida de las descargas parciales Límite : Tensión de ensayo ≤ 550 kV *Partial discharges measurement* *Limit: Test voltage ≤ 550 kV*	UNE-EN 60270:2002 IEC 60270:2000 IEC 60270:2001 CORRIGENDUM 1
Pértigas aislantes de maniobra para alta tensión *Insulating poles (insulating sticks) for electrical purposes on high-voltage installations*	Ensayos eléctricos: corriente de fugas (Apdo. 8.2.2) Ensayos mecánicos: ensayo de flexión (Adpo. 8.4.1) *Dielectric tests: leakage current (8.2.2)* *Mechanical tests : bending test (8.4.1)*	UNE 204003:2003 UNE 204003:2004 ERRATUM
Detectores de tipo capacitivo para utilización con tensiones superiores a 1 kV en corriente alterna *Capacitive type detectors to be used for voltages exceeding 1 kV a.c.*	Ensayos funcionales (apdo. 6.2) Ensayos dieléctricos (apdo. 6.3) Ensayos mecánicos (apdo. 6.4) Ensayos específicos (cap. 7) Límites: Vdc ≤ 100 kV Vac ≤ 550 kV *Function tests (6.2)* *Dielectric tests (6.3)* *Mechanical tests (6.4)* *Specific tests (7)* *Limits:* *Vdc ≤ 100 kV* *Vac ≤ 550 kV*	UNE-EN 61243-1:2006 UNE-EN 61243-1/A1:2011 IEC 61243-1:2003 IEC 61243-1:2005 CORRIGENDUM 1 IEC 61243-1/A1:2009

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Detectores de tensión tipo bipolar para baja tensión *Two-pole low-voltage type voltage detectors*	Ensayos para requisitos funcionales (apdo. 5.3), excepto: Dependencia de la frecuencia (apdo 5.3.5) Dependencia del rizado para detectores de tensión con CC (apdo. 5.3.6) Ensayos de requisitos eléctricos (apdo. 5.4), excepto: Protección contra sobretensiones transitorias (apdo. 5.4.5.1) Ensayos de requisitos mecánicos (apdo. 5.5), excepto: Ensayo de vibraciones (apdo. 5.5.4) Resistencia al calor (apdo. 5.5.9) Buena adherencia del aislamiento de la parte aislada del electrodo de contacto (apdo. 5.5.10.3) Ensayos del cable (apdo. 5.5.11) Marcas (apdo. 5.6) Mal uso de la tensión CA/CC (apdo. 5.8.1) *Tests for general requirements (5.3), except:* *Frequency dependency (5.3.5)* *Ripple dependency for d.c. voltage detector (5.3.6)* *Tests for electrical requirements (5.4), except:* *Protection against transient overvoltages (5.4.5.1)* *Tests for mechanical requirements (5.5), except:* *Vibration resistance (5.5.4)* *Heat resistance (5.5.9)* *Close adhesion of insulation of the insulated part of the contact electrode (5.5.10.3)* *Lead tests (5.5.11)* *Marking (5.6)* *AC/DC voltage misuse (5.8.1)*	UNE-EN 61243-3:2011 IEC 61243-3:2009
Aparamenta de baja tensión *Low voltage switchgear and controlgear*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 8.4) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (8.4)*	UNE-EN 60947-1 :2008 UNE-EN 60947-1/A1:2011 IEC 60947-1:2007 IEC 60947-1/A1:2010

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Interruptores automáticos de baja tensión *Low voltage circuit-breakers*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos del anexo B - Anexo J: CEM *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *Tests of annex B* - *Annex J: EMC*	UNE-EN 60947-2:2007 UNE-EN 60947-2/A1:2011 IEC 60947-2:2006 IEC 60947-2/A1:2009 IEC 60947-2/A2:2013
Interruptores, seccionadores, interruptores-seccionadores y combinados fusibles de baja tensión *Low voltage switches, disconnectors, switch-disconnectors and fuse-combination units*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 8.4) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (8.4)*	UNE-EN 60947-3:2000 UNE-EN 60947-3/A1:2002 UNE-EN 60947-3/A2:2006 UNE-EN 60947-3:2009 UNE-EN 60947-3:2010 ERRATUM IEC 60947-3:2008 IEC 60947-3/A1:2012 IEC 60947-3/Corr1:2012
Contactores y arrancadores electromecánicos de baja tensión *Low voltage electromechanical contactors and motor starters*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 9.4) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (9.4)*	UNE-EN 60947-4-1:2002 UNE-EN 60947-4-1:2002 ERRATUM UNE-EN 60947-4-1/A1:2003 UNE-EN 60947-4-1/A2:2006 IEC 60947-4-1:2009 IEC 61947-4-1/A1:2012
Controladores y arrancadores semiconductores de motores de corriente alterna de baja tensión *Low voltage contactors and motor starters – AC semiconductor motor controllers and starters*	Todos los de la norma, excepto: - Inflamabilidad: ensayos de ignición al hilo caliente y de ignición al arco (Apdo. - 8.2.1.1.2) - Ensayos CEM (Apdo. 9.3.5) *All the tests of the standard, except:* - *Flammability: hot wire ignition and arc ignition tests (8.2.1.1.2)* - *EMC tests (9.3.5)*	UNE-EN 60947-4-2:2002 UNE-EN 60947-4-2:2008 ERRATUM UNE-EN 60947-4-2/A1:2003 UNE-EN 60947-4-2/A2:2007 IEC 60947-4-2:2011 IEC 60947-4-2/CORR1:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de serie y conjuntos derivados de serie de aparamenta de baja tensión *Low voltage switchgear and controlgear assemblies. Type-tested and partially type-tested assemblies*	Todos los de la norma, excepto: - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *EMC tests (8.2.8)*	UNE-EN 60439-1:2001 UNE-EN 60439-1/A1:2005
Conjuntos de aparamenta de baja tensión *Low voltage switchgear and controlgear assemblies*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y anexo J) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2 and annex J)*	IEC 61439-1:2011 UNE-EN 61439-1:2011 UNE-EN 61439-1:2012 IEC/TR 61439-0:2010
Conjuntos de aparamenta de potencia de baja tensión *Low voltage power switchgear and controlgear assemblies*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y Anexo J) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (Apdo. 10.6.2. y anexo J)*	IEC 61439-2:2011 UNE-EN 61439-2:2011 UNE-EN 61439-2:2012
Canalizaciones prefabricadas de baja tensión *Low voltage busbar trunking systems (busways)*	Todos los de la norma, excepto: - Ensayos CEM (Apdo. 8.2.8) - Resistencia a la propagación de la llama - Características cortafuegos *All the tests of the standard, except:* - *EMC tests (8.2.8)* - *Resistance to flame propagation* - *Fire barrier characteristics*	UNE-EN 60439-2:2001 UNE-EN 60439-2/A1:2006
Conjuntos de aparamenta de baja tensión destinados a estar instalados en lugares accesibles al personal no cualificado durante su utilización. Cuadros de distribución *Low voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use. Distribution boards.*	Todos los de la norma, excepto: - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *EMC tests (8.2.8)*	UNE-EN 60439-3:1994 UNE-EN 60439-3:2010 CORRIGENDUM UNE-EN 60439-3/A1:1997 UNE-EN 60439-3/A2:2002

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de aparamenta de baja tensión destinados a ser utilizados por personas comunes *Low-voltage distribution boards intended to be operated by ordinary persons*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y anexo J) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2. and Annex J)*	UNE-EN 61439-3:2012 IEC 61439-3:2012
Conjuntos de aparamenta de baja tensión: conjuntos para obras (CO). *Low voltage switchgear and controlgear assemblies: assemblies for construction sites (ACS)*	Todos los de la norma, excepto: - Ensayos de choque (Apdo. 8.2.101.3) - Ensayos de verificación de la resistencia a la corrosión en atmósferas fuertemente contaminadas (Apdo. 8.2.102.2.) - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *Shock test (8.2.101.3)* - *Verification of resistance to corrosion in heavily polluted atmosphere (8.2.102.2)* - *EMC tests (8.2.8)*	UNE-EN 60439-4:2005 UNE 201008 IN:2012
Conjuntos de aparamenta de baja tensión destinados a ser instalados al exterior en lugares públicos. Conjuntos de aparamenta para redes de distribución (CRD) *Low voltage switchgear and controlgear assemblies intended to be installed outdoors in public places. Cable distribution cabinets (CDCS) for power distribution networks*	Todos los de la norma, excepto: - Verificación de la resistencia a la corrosión y al envejecimiento (Apdos. 8.2.103.2 y 8.2.103.3) - Ensayos CEM (Apdo. 8.2.8) *All the tests of the standard, except:* - *Verification of corrosion and ageing resistance (8.2.103.2 and 8.2.103.3)* - *EMC tests (8.2.8)*	UNE-EN 60439-5:2007

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de aparamenta de baja tensión: conjuntos para obras (CO). *Low voltage switchgear and controlgear assemblies: assemblies for construction sites (ACS)*	Todos los de la norma, excepto: - Ensayo de verificación de la resistencia a la corrosión en atmósferas fuertemente contaminadas (Apdo. 10.2.2.101) - Ensayo de radiación ultravioleta (Apdo. 10.2.4) - Ensayo de choque (Apdo. 10.2.6.3) - Ensayos CEM (Apdo. 10.6.2. y anexo J) *All the tests of the standard, except:* - *Verification of resistance to corrosion in heavily polluted atmospheres (10.2.2.101)* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *Shock test (10.2.6.3)* - *EMC tests (10.6.2 and Annex J)*	IEC 61439-4:2012
Conjuntos de aparamenta de baja tensión para redes de distribución pública *Low voltage switchgear and controlgear assemblies for power distribution in networks*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. - 10.2.4) - Ensayos CEM (Apdo. 10.6.2 y Anexo J) - Verificación de categoría de inflamabilidad - (Apdo. 10.2.3.102) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2 and Annex J)* - *Verification of category of flammability (10.2.3.102)*	IEC 61439-5:2010 UNE-EN 61439-5:2011
Conjuntos de aparamenta de baja tensión: Canalizaciones prefabricadas *Low-voltage switchgear and controlgear assemblies: Busbar trunking systems*	Todos los de la norma, excepto: - Ensayo de radiación ultravioleta (Apdo. - 10.2.4) - Ensayos CEM (Apdo. 10.6.2. y anexo J) - Resistencia a la propagación de la llama - (Apdo. 10.101) - Características cortafuegos (Apdo. 10.102) *All the tests of the standard, except:* - *Resistance to ultra-violet (UV) radiation (10.2.4)* - *EMC tests (10.6.2 and Annex J)* - *Resistance to flame- propagation (10.101)* - *Fire resistance in building penetrations (10.102)*	IEC 61439-6:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Conjuntos de aparamenta de baja tensión bajo envolvente *Enclosed low-voltage switchgear and controlgear assemblies*	Ensayo en condiciones de arco debidas a un fallo interno *Test under conditions of arcing due to internal fault*	UNE-IEC/TR 61641 IN:2011 IEC/TR3 61641:2008
Fusibles de baja tensión destinados a ser utilizados por personas autorizadas (usos principalmente industriales) *Low-voltage fuses for use by authorized persons (fuses mainly for industrial applications)*	Todos los de las normas para las secciones A, B, C, D y F, excepto para la sección A: - Ensayo de corrosión del Apdo. 8.11.2.3 - Ensayo de resistencia a la formación de caminos conductores del Apdo. 8.2.5 *All the tests of the standards for fuse systems A, B, C, D and F, except for fuse system A:* - *Verification of resistance to rusting (8.11.2.3)* - *Resistance to tracking (8.2.5)*	UNE-EN 60269-1:2008 UNE-EN 60269-1/A1:2010 HD 60269-2:2007 UNE-HD 60269-2:2011 IEC 60269-1:2006 IEC 60269-1/A1:2009 IEC 60269-2:2010
	Todos los de la norma para las Secciones I y III, excepto los ensayos de resistencia a la formación de caminos conductores (Apdo. 8.2.6), de corrosión (Apdo. 8.11.2.3), para la sección I *All the tests of the standards for the sections I to III, except resistance to tracking (8.2.6) and resistance to rusting (8.11.2.3) for section I*	UNE-EN 60269-2:1996 UNE-EN 60269-2/A1:1999 UNE-EN 60269-2/A2:2002 UNE-EN 60269-2:2005 CORRIGENDUM
Inversores Solares (Monofásicos y Trifásicos) y Sistemas Compensadores de Huecos (FACTS) de potencia asignada máxima de 300 kW *Solar inverters (single-phase and three-phase) and voltage dips compensation systems (FACTS) of rated power up to 300 kW*	Medida y evaluación de la respuesta de los Sistemas de Conversión Fotovoltaicos (SCFV) ante huecos de tensión, conforme a las condiciones establecidas en el apdo. 5 Anexo III del documento "Procedimientos de Verificación, Validación y Certificación de los requisitos del PO 12.3. sobre la respuesta de las instalaciones eólicas y fotovoltaicas ante huecos de tensión" versión 10 de 26 de enero de 2012 de la Asociación Empresarial Eólica (AEE) *Measurement and assessment of the response of photovoltaic conversion systems (PVCS) in the event of voltage dips, according to conditions of subclause 5 Annex III of document "Procedure for verification, validation and certification of the requirements of the P.O. 12.3 on the response of wind and solar farms in the event of voltage dips" version 10 of 26th January 2012 of the Spanish Wind Energy Association (AEE)*	Procedimiento Interno PE.EE-88-E *Internal procedure* *PE.EE-88-E*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipo electrónico para uso en instalaciones de potencia Electronic equipment for use in power installations	Todos los de la norma, excepto: - Ensayos de estanquidad para EE refrigerado por líquido (Apdo. 9.4.3.3.) - Ensayo de conveniencia del barniz o del recubrimiento (Apdo. 9.4.4.4.) - Ensayo de descarga parcial (Apdo. 9.4.5.3.) - Ensayos CEM (Apdos. 9.4.6.1. y 9.4.6.2.) *All the tests of the standard, except:* - *Seal test for liquid-cooled EE (9.4.3.3)* - *Suitability test of varnish or coating (9.4.4.4)* - *Partial discharge test (9.4.5.3)* - *EMC tests (9.4.6.1 and 9.4.6.2)*	UNE-EN 50178:1998
Equipos generadores en paralelo con redes generales de distribución en baja tensión (requisitos de conexión) *Micro-generators in parallel with public low-voltage distribution networks (requirements for the connection)*	Todos los de las normas para equipos de hasta 300 kVA, excepto: UNE-EN 50438:2008 - Ensayos de compatibilidad electromagnética - (Apdo. 5.1) - Ensayo LoM para Austria (última fila de tabla para Austria en Anexo A) *All the tests of the standards, for equipment up to 300 kVA, except:* *UNE-EN 50438:2008* - *EMC tests (5.1)* - *LoM test for Austria (last row in table of annex A for Austria)*	UNE-EN 50438:2008 DIN V VDE V 0126 -1-1:2006 DIN V VDE V 0126 -1-1/A1:2012 RD 1663/2000, de 29 de septiembre *Spanish regulation RD 1663/2000, of September 29th*
Inversores y dispositivos anti-isla *Inverters and islanding prevention devices*	Ensayo de prevención de funcionamiento en isla *Test of islanding prevention measures*	IEC 62116:2008

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de tratamiento de la información, incluyendo los equipos eléctricos de oficina y equipos conectables a la red de telecomunicación (excluyendo Destructoras personales hogar/oficina de documentos multimedia) *Information technology equipment including office electrical equipment and telecommunications networks equipment*	Seguridad eléctrica *Electrical safety*	UNE-EN 60950-1:2007 UNE-EN 60950-1:2007 CORRIGENDUM UNE-EN 60950-1/A11:2009 UNE-EN 60950-1/A1:2011 UNE-EN 60950-1/A12:2011 Apdos 1.6.2, 1.6.3, 1.7.1, 1.7.2.2, 1.7.2.3, 1.7.2.4, 1.7.2.5, 1.7.3, 1.7.4, 1.7.5, 1.7.6, 1.7.7, 1.7.8, 1.7.9, 1.7.10, 1.7.11, 1.7.12, 1.7.13, 1.7.14, 2.1.1.1, 2.1.1.6, 2.1.1.7, 2.1.2, 2.1.3, 2.3.2, 2.3.3, 2.3.4, 2.6.3.4, 2.6.3.5, 3.1.2, 3.1.3, 3.1.6, 3.1.7, 3.1.8, 3.1.10, 3.2.1, 3.2.2, 3.2.4, 3.2.6, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, 3.4.11, 3.5.1, 3.5.2, 3.5.3, 4.1, 4.2.3, 4.2.4, 4.3.1, 4.3.3, 4.3.4, 4.3.5, 4.3.7, 4.4, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.5.2, 4.6.1, 4.6.2, 4.6.3, 4.6.4, 5.1, 5.2 y 6.2.
Generadores de potencia conectados a redes de BT, sistemas de protección de interfaz e inversores *Power generators connected to low voltage grids, interface protection systems and inverters*	Todos los de la norma salvo ensayos CEM *All the tests of the standard except EMC tests*	CEI 0-21:2012 (Regola técnica di riferimento per la connessione di utenti attivi e posivi ale reti BT delle emprese distributtici di energía electtrica)

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Seguridad eléctrica, mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precisión *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 50470-1:2007 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores de energía activa, destinados a uso residencial, comercial y de Industria ligera, para uso en redes eléctricas de 50 Hz (índices de clase A, B y C) *Electricity metering equipment (a.c.) Metering equipment of active energy intended to residential, commercial and light industry for use in 50 Hz electrical networks (class indexes A, B and C)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 50470-3:2007 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos o electromecánicos destinados a la medida de energía eléctrica en sistemas de 50Hz y tensión hasta 600V *Electricity metering equipment (a.c.)* *Static or electromechanics meters and intended to the measuring of electrical energy in 50 Hz systems and voltage up to 600 V.*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 62052-11:2004 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a.). Contadores estáticos de energía activa (clases 1 y 2) *Electricity metering equipment (a.c.)* *Static meters for active energy (classes 1 and 2)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 62053-21:2003 Excepto apdo. 5.4

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Equipos de medida de la energía eléctrica (c.a). Contadores estáticos de energía reactiva (clases 2 y 3) *Electricity metering equipment (a.c.)* *Static meters for reactive energy (classes 2 and 3)*	Seguridad eléctrica , mecánicos y funcionales - Ensayo de tensión de impulso - Ensayos con tensión alterna - Potencia absorbida - Ensayo de calentamiento - Ventana - Tapa de bornes - Distancias en el aire y líneas de fuga - Contador con envolvente. Aislante clase II - Ensayo de martillo de resorte (Eh) - Protección contra penetración de polvo y agua - Resistencia al calor y al fuego Ensayos de precision *Electrical, mechanical and functional safety* - *Impulse voltage test* - *AC voltage test* - *Absorbed power* - *Heating* - *Window* - *Terminal cover* - *Clearance and creepage distances* - *Insulating encased meter of protective class II* - *Hammer tests (Eh)* - *Resistance to heat and fire* - *Protection against penetration of dust and water* *Precision tests*	UNE-EN 62053-23:2003 Excepto apdo. 5.4

Categoría I (Ensayos "in situ") / *Category I (on-site tests)*

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de potencia con aislamiento extruido y sus accesorios, de tensión asignada superior a 150 kV (Um = 170 kV) hasta 500 kV (Um = 550 kV) *Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um = 170 kV) up to 500 kV (Um = 550 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayo de tensión continua de la cubierta - exterior (Apdo. 16.2) - Ensayo de tensión en corriente alterna del aislamiento (Apdo. 16.3) *Electrical tests after installation (chap. 16):* - *DC voltage test of the oversheath (16.2)* - *-AC voltage test of the insulation (16.3)*	IEC 62067:2011
Cables de potencia con aislamiento extruido y sus accesorios, de tensión asignada superior a 150 kV (Um = 170 kV) hasta 400 kV (Um = 420 kV) *Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um = 170 kV) up to 400 kV (Um = 420 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayos de comprobación del aislamiento principal: Método 1: Ensayo de tensión soportada a frecuencia industrial. - Ensayo de comprobación de la cubierta - Ensayo de continuidad y resistencia de las pantallas - Ensayo de continuidad y resistencia de los - conductores - Medida de descargas parciales del sistema nuevo de cable *Electrical tests after installation (clause 16):* - *Tests to verify the main insulation: Method 1: Power frequency withstand test.* - *Test to verify the oversheath* - *Continuity and resistance measurement test of screens* - *Continuity and resistance measurement test of conductors* - *Partial discharges measurement on the new cable system*	UNE 211067-1:2012

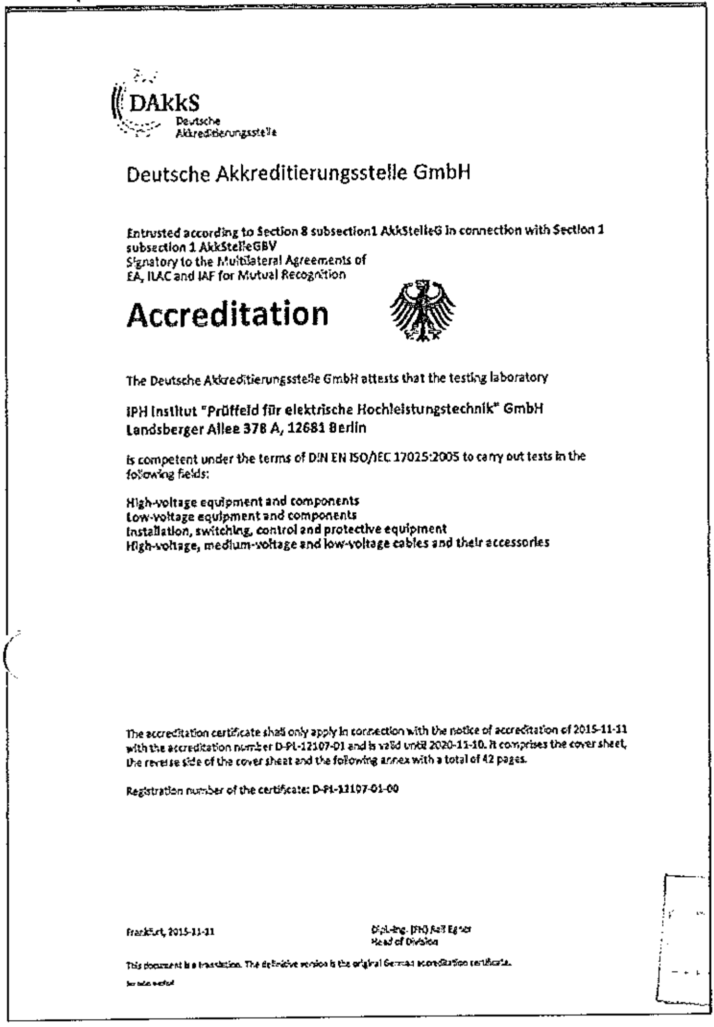
PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de energía con aislamiento extruido y sus accesorios para tensiones asignadas superiores a 35 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV) *Power cables with extruded insulation and their accessories for rated voltages above 35 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV)*	Ensayos eléctricos después de la instalación: Parte 1. - 15.1: ensayo de tensión dc sobre cubierta - 15.2: ensayo de tensión ac sobre el aislamiento. Parte 2. - 8.1 Ensayo eléctrico sobre la "sobrecubierta" (oversheath) 2 Ensayos eléctricos sobre los accesorios - 8.3.1 Ensayo de tensión ac sobre el aislamiento con equipo resonante - 8.4 Ensayo eléctrico después de la instalación, cubierta no metálica - 8.8 Ensayo dc de resistencia del conductor Partes 3 a 11: ensayos realizados por referencia a los de las partes 1 y 2, dentro de los rangos siguientes para los ensayos sobre cubiertas y sobre el aislamiento: - Ensayos sobre cubierta: 25 kV dc - Ensayos sobre aislamiento: 260 kV, 20 Hz a 300 Hz *Electrical tests after installation:* *Part 1.* - *15.1:DC voltage test of the oversheath* - *15.2: AC voltage test of the insulation.* *Part 2.* - *8.1 Electrical test on oversheath* - *8.2 Electrical tests on accessories* - *8.3.1 AC voltage test on the insulation with resonant system* - *8.4 Electrical test after installation, non-metallic sheath* - *8.8 DC conductor resistance test* *Parts 3 to 11: tests performed by reference to those of parts 1 and 2, in the following ranges for the tests of sheaths and of insulation:* - *Tests of sheaths: 25 kV dc* - *Tests of insulation: 260 kV, 20 Hz to 300 Hz*	HD 632 S2:2008

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de energía con aislamiento extruido y sus accesorios para tensiones asignadas superiores a 35 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV) *Power cables with extruded insulation and their accessories for rated voltages above 36 kV (Um=42 kV) up to 150 kV (Um=170 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayo de tensión continua de la cubierta exterior (Apdo. 16.2) - Ensayo de tensión en corriente alterna del aislamiento (Apdo. 16.3) *Electrical tests after installation (chap. 16):* - *DC voltage test of the oversheath (16.2)* - *AC voltage test of the insulation (16.3)*	IEC 60840:2011
Cables de energía con aislamiento extruido y sus accesorios para tensiones asignadas superiores a 35 kV (Um = 42 kV) hasta 150 kV (Um = 170 kV) *Power cables with extruded insulation and their accessories for rated voltages above 35 kV (Um=42 kV) up to 150 kV (Um=170 kV)*	Ensayos eléctricos después de la instalación (cap. 16): - Ensayos de comprobación del aislamiento principal. Método 1: Ensayo de tensión soportada a frecuencia industrial. Método 4: Medida de descargas parciales - Ensayo de comprobación de la cubierta - Ensayo de continuidad y resistencia de las pantallas - Ensayo de continuidad y resistencia de los - conductores - Medida de descargas parciales del sistema nuevo de cable *Electrical tests after installation (chap. 16):* - *Tests to verify the main insulation: Method 1: Power frequency withstand test. Method 4: Partial discharges measurement.* - *Test to verify the oversheath* - *Continuity and resistance measurement test of screens* - *Continuity and resistance measurement test of conductors* - *Partial discharges measurement on the new cable system*	UNE 211632-1:2012

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Sistemas de cables eléctricos de alta tensión en corriente alterna *High voltage AC cable systems*	Ensayos previos a la puesta en servicio del sistema nuevo de cable de alta tensión (cap. 4): Sistemas nuevos de cables de tensión asignada superior a 0,6/1 kV e inferior o igual a 87/150 (170 kV) (Apdo. 4.1): - Ensayos de comprobación del aislamiento principal (Apdo. 4.1.1). Método 1: Ensayo de tensión soportada a frecuencia industrial. Método 4: Medida de descargas parciales - Ensayo de comprobación de la cubierta (Apdo. 4.1.2) - Ensayo de continuidad y resistencia de las pantallas (Apdo. 4.1.3) - Ensayo de continuidad y resistencia de los conductores (Apdo. 4.1.4) *Electrical tests after installation of a new high voltage cable system (clause 4): New cable systems of rated voltages above 0.6/1 kV up to 87/150 (170 kV) (4.1):* - *Tests of the insulation (4.1.1). Method 1: Power frequency withstand voltage test. Method 4: Partial discharge measurement* - *Test of the oversheath (4.1.2)* - *Continuity and resistance measurement test of screens (4.1.3)* - *Continuity and resistance measurement test of conductors (4.1.4)*	UNE 211006:2010

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Sistemas de cables eléctricos de alta tensión en corriente alterna *High voltage AC cable systems*	Sistemas nuevos de cables de tensión asignada superior a 87/150 (170 kV) hasta 220/400 (420 kV) (Apdo. 4.2): - Ensayos de comprobación del aislamiento principal (Apdo. 4.2.1): Método 1: Ensayo de tensión soportada a frecuencia industrial. - Ensayo de comprobación de la cubierta (Apdo. 4.2.2) - Ensayo de continuidad y resistencia de las pantallas (Apdo. 4.2.3) - Ensayo de continuidad y resistencia de los conductores (Apdo. 4.2.4) Medida de descargas parciales del sistema nuevo de cable (cap. 5) Ensayo de continuidad y resistencia eléctrica de la pantalla y los conductores de los sistemas nuevos de cable (cap. 6): *New cable systems of rated voltages above 87/150 (170 kV) up to 220/400 (420 kV) (4.2):* - *Tests of the Insulation (4.2.1): Method 1: Power frequency withstand voltage test* - *Test of the oversheath (4.2.2)* - *Continuity and resistance measurement test of screens (4.2.3)* - *Continuity and resistance measurement test of conductors (4.2.4).* *Partial discharge measurement of a new cable system (chap. 5)* *Continuity and resistance measurement test of screens and conductors of new cable systems (chap. 6)*	UNE 211006:2010
Líneas eléctricas de alta tensión *High voltage power lines*	Medida de impedancia de línea *Line impedance measurement*	Procedimiento interno PE-EE-90-E *Internal procedure PE-EE-90-E*
Equipos y materiales de alta tensión *High voltage equipment and materials*	Ensayos de alta tensión con tensión alterna Límites: - 260 kV, 20 Hz a 300 Hz *High voltage test with alternating voltage* *Limits:* - *260 kV, 20 Hz to 300 Hz*	UNE-EN 60060-3:2006 UNE-EN 60060-3:2007 CORRIGENDUM IEC 60060-3:2006

PRODUCTO/MATERIAL A ENSAYAR / *PRODUCT/MATERIAL TO TEST*	ENSAYO *TEST*	NORMA/PROCEDIMIENTO DE ENSAYO *STANDARD/TEST PROCEDURE*
Cables de energía para material rodante en aplicaciones ferroviarias *Power cables of rolling stock for railway applications*	Propiedades dieléctricas: Ensayos de rutina (Apdo. 9.3.3.3) *Dielectric properties: Routine tests (9.3.3.3)*	IEC 60077-1:1999



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Deutsche
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Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH
Landsberger Allee 378 A, 12681 Berlin

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-voltage equipment and components
Low-voltage equipment and components
Installation, switching, control and protective equipment
High-voltage, medium-voltage and low-voltage cables and their accessories

The accreditation certificate shall only apply in connection with the notice of accreditation of 2015-11-11 with the accreditation number D-PL-12107-01 and is valid until 2020-11-10. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 42 pages.

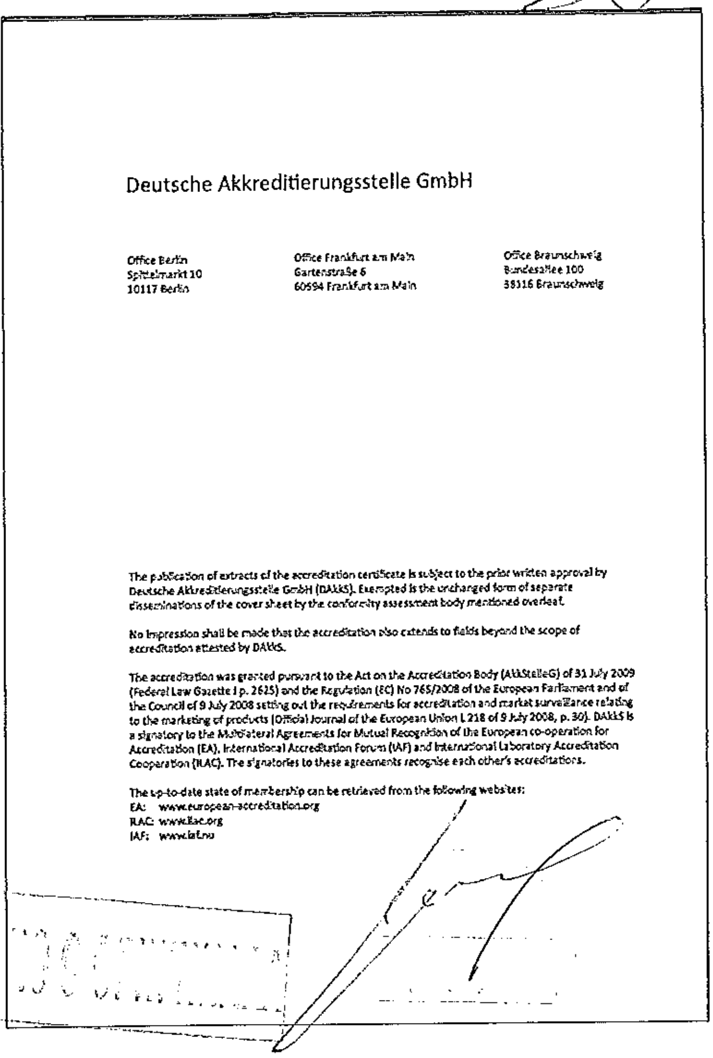
Registration number of the certificate: D-PL-12107-01-00

Frankfurt, 2015-11-11

Dipl.-Ing. (FH) Ralf Egner
Head of Division

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf



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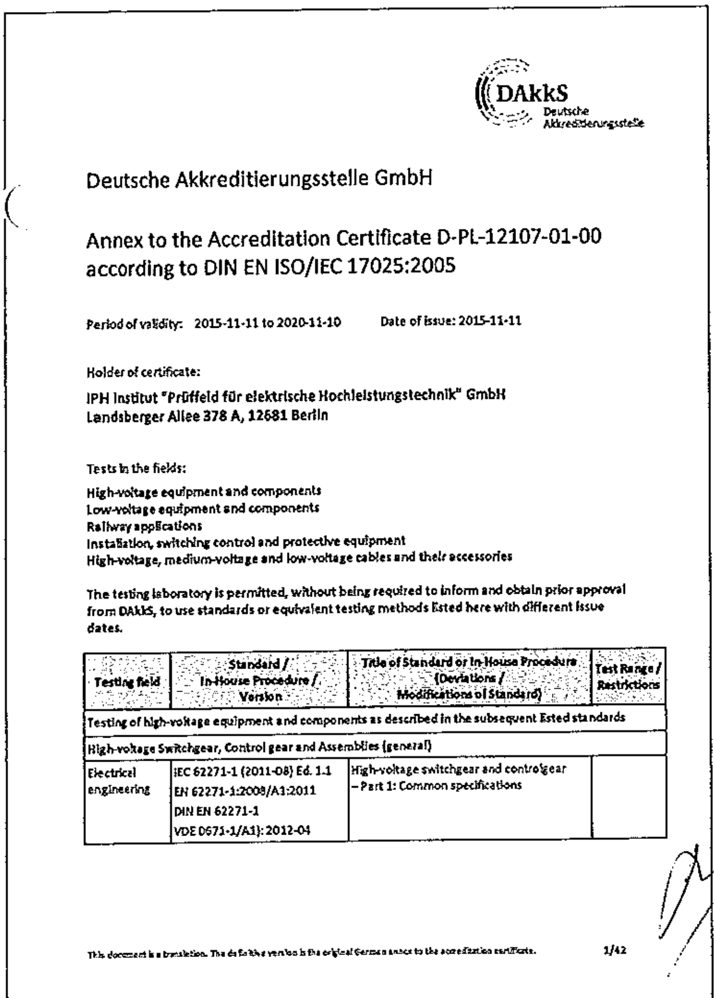

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Annex to the Accreditation Certificate D-PL-12107-01-00 according to DIN EN ISO/IEC 17025:2005

Period of validity: 2015-11-11 to 2020-11-10 **Date of issue:** 2015-11-11

Holder of certificate:

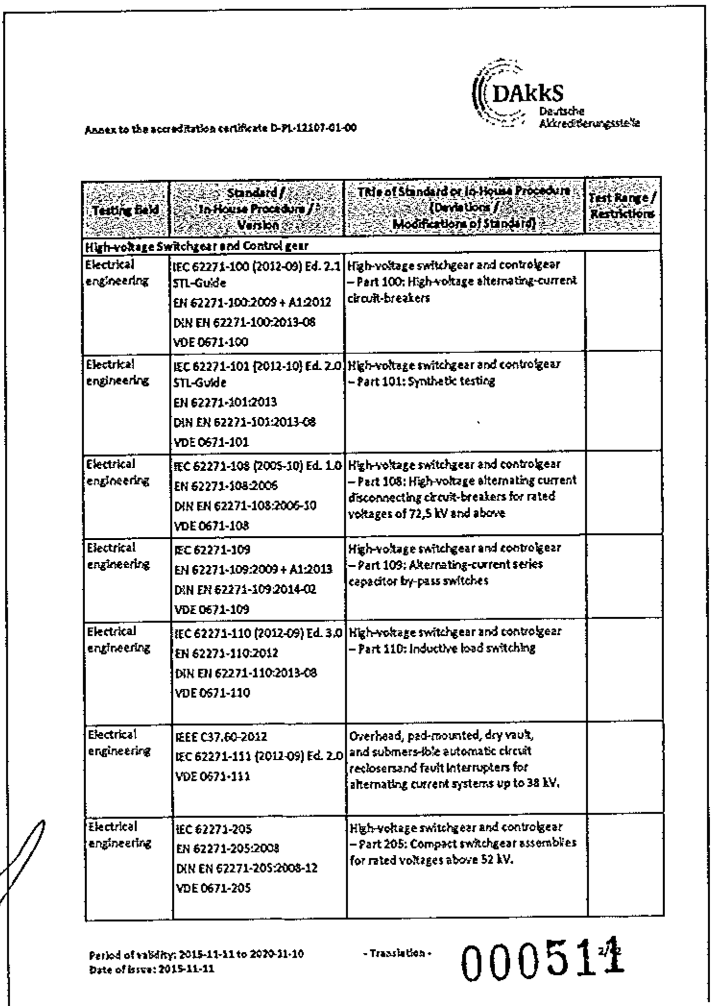
IPH Institut "Prüffeld für elektrische Hochleistungstechnik" GmbH
Landsberger Allee 378 A, 12681 Berlin

Tests in the fields:

High-voltage equipment and components
Low-voltage equipment and components
Railway applications
Installation, switching control and protective equipment
High-voltage, medium-voltage and low-voltage cables and their accessories

The testing laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use standards or equivalent testing methods listed here with different issue dates.

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Testing of high-voltage equipment and components as described in the subsequent listed standards			
High-voltage Switchgear, Control gear and Assemblies (general)			
Electrical engineering	IEC 62271-1 (2011-08) Ed. 1.1 EN 62271-1:2008/A1:2011 DIN EN 62271-1 VDE 0671-1/A1): 2012-04	High-voltage switchgear and controlgear – Part 1: Common specifications	



DAkkS
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Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
High-voltage Switchgear and Control gear			
Electrical engineering	IEC 62271-100 (2012-09) Ed. 2.1 STL-Guide EN 62271-100:2009 + A1:2012 DIN EN 62271-100:2013-08 VDE 0671-100	High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit-breakers	
Electrical engineering	IEC 62271-101 (2012-10) Ed. 2.0 STL-Guide EN 62271-101:2013 DIN EN 62271-101:2013-08 VDE 0671-101	High-voltage switchgear and controlgear – Part 101: Synthetic testing	
Electrical engineering	IEC 62271-108 (2005-10) Ed. 1.0 EN 62271-108:2006 DIN EN 62271-108:2006-10 VDE 0671-108	High-voltage switchgear and controlgear – Part 108: High-voltage alternating current disconnecting circuit-breakers for rated voltages of 72,5 kV and above	
Electrical engineering	IEC 62271-109 EN 62271-109:2009 + A1:2013 DIN EN 62271-109:2014-02 VDE 0671-109	High-voltage switchgear and controlgear – Part 109: Alternating-current series capacitor by-pass switches	
Electrical engineering	IEC 62271-110 (2012-09) Ed. 3.0 EN 62271-110:2012 DIN EN 62271-110:2013-08 VDE 0671-110	High-voltage switchgear and controlgear – Part 110: Inductive load switching	
Electrical engineering	IEEE C37.60-2012 IEC 62271-111 (2012-09) Ed. 2.0 VDE 0671-111	Overhead, pad-mounted, dry vault, and submersible automatic circuit reclosersand fault interrupters for alternating current systems up to 38 kV.	
Electrical engineering	IEC 62271-205 EN 62271-205:2008 DIN EN 62271-205:2008-12 VDE 0671-205	High-voltage switchgear and controlgear – Part 205: Compact switchgear assemblies for rated voltages above 52 kV.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Load switches			
Electrical engineering	IEC 62271-103 DIN IEC 62271-103 EN 62271-103:2011 DIN EN 62271-103:2012-04 VDE 0671-103 STL-Guide	High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV.	
Electrical engineering	IEC 62271-104 (2015-02) Ed. 2.0 EN 62271-104:2009 DIN EN 62271-104:2010-03 VDE 0671-104	High-voltage switchgear and controlgear – Part 104: Alternating current switches for rated voltages higher than 52 kV.	
Electrical engineering	IEC 62271-105 (2012-09) Ed. 2.0 EN 62271-105:2012 DIN EN 62271-105:2013-08 VDE 0671-105	High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV.	
Electrical engineering	IEC 62271-107 (2012-05) Ed. 2.0 EN 62271-107:2012 DIN EN 62271-107:2013-03 VDE 0671-107	High-voltage switchgear and controlgear – Part 107: Alternating current fused circuit-switchers for rated voltages above 1 kV up to and including 52 kV.	
Current contactors and motor starters			
Electrical engineering	IEC 62271-106 (2014-02) Ed. 1.0 + Corr 1 EN 62271-106:2011 DIN IEC 62271-106:2012-06 VDE 0671-106	High-voltage alternating current contactors and contactor-based motor starters.	
Current disconnectors and earthing switches			
Electrical engineering	IEC 62271-102 (2013-02) Ed. 1.0 + am2 EN 62271-102:2002/A2:2013 DIN EN 62271-102/A2:2013-12 VDE 0671-102/A2	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Fuses			
Electrical engineering	IEC 60282-1 (2014-07) Ed. 7.1 STL-Guide EN 60282-1:2009 + A1:2014 DIN EN 60282-1:2015-05 VDE 0670-4	High-voltage fuses – Part 1: Current-limiting fuses.	
Electrical engineering	IEC 60282-2 (2008-04) Ed. 3.0	High-voltage fuses; – Part 2: Expulsion fuses	
Electrical engineering	IEC 60644 (2009-08) Ed. 2.0 EN 60644:2009 DIN EN 60644:2010-07 VDE 0670-401	Specification for high-voltage fuse-links for motor circuit applications.	
High-voltage switchgear and control gear assemblies			
Electrical engineering	IEC 62271-200 (2011-10) Ed. 2.0 STL-Guide EN 62271-200:2012 DIN EN 62271-200:2012-08 VDE 0671-200	High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.	
Electrical engineering	IEC 62271-201 (2014-03) Ed. 2.0 EN 62271-201:2014 DIN EN 62271-201:2015-03 VDE 0671-201	High-voltage switchgear and controlgear – Part 201: A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.	
Electrical engineering	IEC 62271-203 (2013-07) Ed. 2.0 + Corr. 1 STL-Guide EN 62271-203:2012 DIN EN 62271-203:2012-11 VDE 0671-203	High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV.	
Electrical engineering	IEC 62271-204 (2011-07) Ed. 1.0 STL-Guide EN 62271-204:2011 DIN EN 62271-204:2012-05 VDE 0671-204	High-voltage switchgear and controlgear – Part 204: Rigid gas-insulated transmission lines for rated voltage above 52 kV.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 62271-209 (2007-08) Ed. 1.0 EN 62271-209:2007 DIN EN 62271-209:2008-07 VDE 0671-209	High-voltage switchgear and controlgear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and extruded insulation cables – Fluid-filled and dry-type cable-terminations.	
Electrical engineering	IEC 62271-202 EN 62271-202:2014 + AC:2014 DIN EN 62271-202:2015-02 VDE 0671-202	High-voltage switchgear and controlgear – Part 202: High voltage / low voltage prefabricated substation.	
Electrical engineering	IEC 62271-205 (2008-01) Ed. 1.0 EN 62271-205:2008 DIN EN 62271-205:2008-12 VDE 0671-205	High-voltage switchgear and controlgear – Part 205: Compact switchgear assemblies for rated voltages above 52 kV.	
Electrical engineering	ANSI / IEEE C37.23-2003	IEEE Standard for Metal-Enclosed Bus	
Switch gear for direct current			
Electrical engineering	DIN VDE 0660-112:1987-02 VDE 0660-112	Schaltgeräte; Zusatzbestimmungen für Gleichstrom-Lastschalter, -Trenner und -Lasttrenner über 1200 V bis 3000 V.	
Power transformers, reactors, line traps, tap-changers			
Electrical engineering	IEC 60076-1 (2011-04) Ed. 3.0 EN 60076-1:2011 DIN EN 50076-1:2012-03 VDE 0532-76-1	Power transformers – Part 1: General.	
Electrical engineering	IEC 60076-2 (2011-02) Ed. 3.0 EN 60076-2:2011 DIN EN 60076-2:2012-02 VDE 0532-76-2	Power transformers – Part 2: Temperature rise for liquid-immersed transformers.	
Electrical engineering	IEC 60076-3 (2013-07) Ed. 3.0 EN 60076-3:2013 DIN EN 60076-3:2014-03 VDE 0532-76-3	Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0532-76-4 DIN EN 60076-4:2003-06 IEC 60076-4 (2002-06) Ed. 1.0	Power transformers – Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors.	
Electrical engineering	IEC 60076-5 (2006-02) Ed. 3.0 STL-Guide EN 60076-5:2006 DIN EN 60076-5:2007-01 VDE 0532-76-5	Power transformers – Part 5: Ability to withstand short circuit.	
Electrical engineering	IEC 60076-6 (2007-12) Ed. 1.0 EN 60076-6:2008 DIN EN 60076-6:2009-02 VDE 0532-76-6	Power transformers – Part 6: Reactors.	
Electrical engineering	IEC 60076-10 (2001-05) Ed. 1.0 IEC 60076-10-1 (2005-10) Ed. 1.0 EN 60076-10:2001 DIN EN 60076-10:2002-04 VDE 0532-76-10	Power transformers – Part 10-1: Determination of sound levels (+ Application guide).	
Electrical engineering	IEC 60076-11 (2004-05) Ed. 1.0 EN 60076-11:2004 DIN EN 60076-11:2005-04 VDE 0532-76-11	Power transformers – Part 11: Dry-type transformers.	
Electrical engineering	IEC 60076-13 EN 60076-13:2006 DIN EN 60076-13:2007-07 VDE 0532-76-13	Power transformers – Part 13: Self-protected liquid-filled transformers.	
Electrical engineering	DIN 57532-21:1982-03 VDE 0532-21	Transformatoren und Drosselspulen; Anlasstransformatoren und Anlassdrosselspulen	
Electrical engineering	VDE 0532 Teil 30 DIN EN 60214:2015-04 IEC 60214-1 (2014-05) Ed. 2.0	Tap-changer	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0351 IEC 60353 (2004-04) Ed. 2.0	Line traps for a.c. power systems.	
Instrument transformers			
Electrical engineering	IEC 61869-1 (2007-10) Ed. 1.0 EN 61869-1:2009 DIN EN 61869-1:2010-04 VDE 0414-9-1	Instrument transformers – Part 1: General requirements.	
Electrical engineering	IEC 61869-2(2012-09) Ed. 1.0 EN 61869-2:2012 DIN EN 61869-2:2013-07 + Ber. VDE 0414-9-2	Instrument transformers – Part 2: Additional requirements for current transformers.	
Electrical engineering	IEC 61869-3 (2011-07) Ed. 1.0 EN 61869-3:2011 DIN EN 61869-3:2012-05 VDE 0414-9-3	Instrument transformers – Part 3: Additional requirements for inductive voltage transformers.	
Electrical engineering	IEC 61869-4 (2013-11) Ed. 1.0 EN 61869-4:2014 DIN EN 61869-4:2015-04 VDE 0414-9-4	Instrument transformers – Part 4: Additional requirements for combined transformers.	
Electrical engineering	VDE 0414-9-5 DIN EN 61869-5:2012-05 IEC 61869-5 (2015-08) Ed. 1.0	Capacitive Voltage Transformers.	
Electrical engineering	VDE 0414-44-8 DIN EN 60044-8:2003-06 IEC 60044-8 (2002-07) Ed.1.0 IEC 61869-8	Instrument transformers – Part 8: Electronic current transformers	
Electrical engineering	IEC 60044-7 (1999-12) Ed. 1.0 EN 60044-7:2000-11 DIN EN 60044-7:2000-11 VDE 0414-44-7 IEC 61869-7	Instrument transformers – Part 7: Electronic voltage transformers.	
Capacitors			
Electrical engineering	DIN VDE 0560-1:1969-12 VDE 0560-1	Bestimmungen für Kondensatoren – Teil 1: Allgemeine Bestimmungen.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60252-1 (2013-08) Ed. 2.1 EN 60252-1:2011 + A1:2013 DIN EN 60252-1:2014-07 VDE 0560-8	AC motor capacitors – Part 1: General - Performance, testing and rating - Safety requirements - Guidance for installation and operation.	
Electrical engineering	IEC 60110-1 (1998-06) Ed. 1.0 EN 60110-1:1998 DIN EN 61110-1:1999-09 VDE 0560-9	Power capacitors for induction heating installations – Part 1: General.	
Electrical engineering	DIN VDE 0560-10:1964-10 VDE 0560-10	Regeln für Kondensatoren – Teil 10: Regeln für Hochfrequenz-Leistungskondensatoren.	
Electrical engineering	DIN VDE 0560-11:1970-05 VDE 0560-11	Regeln für Kondensatoren – Teil 11: Regeln für Kondensatoren ab 600 V zum Glätten pulsierender Gleichspannung.	
Insulators and bushings			
Electrical engineering	DIN VDE 0441-1:1985-07 VDE 0441-1	Prüfung von Kunststoff-Isolatoren für Betriebswechselspannungen über 1 kV; Prüfung von Werkstoffen für Freiluftisolatoren.	
Electrical engineering	IEC 60660 (1999-10) Ed. 2.0 EN 60660:1999 DIN EN 60660:2000-12 VDE 0441-3	Insulators – Tests on indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to but not including 300 kV.	
Electrical engineering	IEC 60383-1 (1993-04) Ed. 4.0 EN 60383-1:1996 DIN EN 60383-1:1997-05 VDE 0446-1	Insulators for overhead lines with a nominal voltage above 1000 V – Part 1: Ceramic or glass insulator units for a.c. systems - Definitions, test methods and acceptance criteria.	
Electrical engineering	IEC 60383-2 (1993-04) Ed. 1.0 EN 60383-2:1995 DIN EN 60383-2:1995-08 VDE 0446-4	Insulators for overhead lines with a nominal voltage above 1000 V – Part 2: Insulator strings and insulator sets for a.c. systems - Definitions, test methods and acceptance criteria.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60168 (2001-04) Ed. 4.2 EN 60168:1994 DIN EN 60168:2001-12 VDE 0674-1	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V.	
Electrical engineering	IEC 62155 (2003-05) Ed. 1.0 EN 62155:2003 DIN EN 62155:2004 VDE 0674-200	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V.	
Electrical engineering	IEC 60137 (2008-07) Ed. 6.0 EN 60137:2008 DIN EN 60137:2009-07 VDE 0674-5	Insulated bushings for alternating voltages above 1000 V.	
Overhead lines			
Electrical engineering	IEC 61284 (1997-09) Ed. 2.0 + Corr. EN 61284:1997 DIN EN 61284:1998-05 VDE 0212-1	Overhead lines – Requirements and tests for fittings.	
Electrical engineering	IEC 61854 (1998-09) Ed. 1.0 EN 61854:1998 DIN EN 61854:1999-08 VDE 0212-2	Overhead lines – Requirements and tests for spacers.	
Electrical engineering	IEC 61897 (1998-09) Ed. 1.0 EN 61897:1998 DIN EN 61897:1999-08 VDE 0212-3	Overhead lines – Requirements and tests for Stockbridge type aeolian vibration dampers.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	DIN VDE 0216:1986-2 VDE 0216	Armaturen für Fahrleitungsanlagen; Statisch-mechanisches Verhalten – Anforderungen, Prüfung.	
HVDC Thyristor valves			
Electrical engineering	IEC 60700-1 (2008-11) Ed. 1.2 EN 60700-1:1998 + A1:2003 + A2:2008 DIN EN 60700-1:2009-07 VDE 0553-1	Thyristor valves for high voltage direct current (HVDC) power transmission – Part 1: Electrical testing.	
Equipment for operating, testing, marking off, live working. Equipment for earthing, short-circuiting.			
Electrical engineering	DIN VDE 0681-1:1986-10 VDE 0681-1	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Allgemeine Festlegungen.	
Electrical engineering	DIN 57681-2:1977-03 DIN VDE 0681-2:1977-03 VDE 0681-2	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Schaltstangen.	
Electrical engineering	DIN 57681-3:1977-03 DIN VDE 0681-3 VDE 0681-3	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Sicherungszangen.	
Electrical engineering	DIN VDE 0681-6:1985-06 VDE 0681-6	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Spannungsprüfer für Oberleitungsanlagen elektrischer Bahnen; 15 kV, 16 2/3 Hz.	
Electrical engineering	DIN VDE 0681-8:2003-10 VDE 0681-8	Geräte zum Betätigen, Prüfen und Abschranken unter Spannung stehender Teile mit Nennspannungen über 1 kV; Isolierende Schutzplatten.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60832-1 (2010-02) Ed. 1.0 EN 60832-1:2010 + Cor.:2010 DIN EN 60832-1:2010-12 VDE 0682-211	Live working – Insulating sticks and attachable devices – Part 1: Insulating sticks.	
Electrical engineering	IEC 61229 (2002-06) Ed. 1.2 EN 61229:1995/A2:2002 DIN EN 61229/A2:2003-09 VDE 0682-551 /A2	Rigid protective covers for live working on a.c. installations.	
Electrical engineering	IEC 61230 (2008-07) Ed. 2.0 EN 61230:2008 DIN EN 61230:2009-07 VDE 0683-100	Live working – Portable equipment for earthing or earthing and short-circuiting.	
Electrical engineering	IEC 61219 (1993-10) Ed. 1.0 + Cor.200-05 EN 61219:1993 DIN EN 61219:1995-01 VDE 0683-200	Live working – Earthing or earthing and short-circuiting equipment using lances as a short-circuiting device – Lance earthing.	
High-voltage test techniques			
Electrical engineering	IEC 60270 (2000-12) Ed. 3.0 + Cor.1 EN 60270:2001 + Ber. DIN EN 60270:2001-08 + Ber. VDE 0434	High-voltage test techniques – Partial discharge measurements.	
Electrical engineering	IEC 60060-1 (2010-09) Ed. 3.0 STL-Guide HD 558.1 S1 EN 60060-1:2010 DIN EN 60060-1:2011-10 VDE 0432-1	High-voltage test techniques – Part 1: General definitions and test requirements.	
Electrical engineering	IEC 60060-2 (2010-11) Ed. 3.0 EN 60060-2:2011 DIN EN 60060-2:2011-10 VDE 0432-2	High-voltage test techniques – Part 2: Measuring systems.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0432-3 DIN-EN 60060-3:2006-08 IEC 60060-3 (2006-02) Ed. 1.0	High-voltage test techniques – Part 3: Definitions and requirements for on-site testing	
Electrical engineering	IEC 60052 (2002-10) Ed. 3.0 EN 60052:2002 DIN EN 60052:2003-06 VDE 0432-9	Voltage measurement by means of standard air gaps.	
Environmental and protection degree testing			
Electrical engineering	IEC 60068-2-78 (2012-10) Ed. 2.0 EN 60068-2-78:2013 DIN EN 60068-2-78:2014-02 VDE 0468-2-78	Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state.	
Electrical engineering	IEC 60068-3-4 (2001-08) Ed. 1.0	Environmental testing – Part 3-4: Supporting documentation and guidance – Damp heat tests.	
Electrical engineering	IEC 60068-2-30 (2005-08) Ed. 3.0	Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle).	
Electrical engineering	IEC 60068-2-75 (2014-09) Ed. 2.0	Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests.	

Technical responsibility for the test reports:

Approval:

Herr Dipl.-Ing. Ronald Borchert
Herr Dipl.-Ing. Winfried Moritz
Herr Dipl.-Wirt.-Ing. Rainer Schiller
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Herr Dipl.-Ing. Rainer Borchert
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Frau Dipl.-Ing. Dagmar Hauschild
Herr Dipl.-Ing. Winfried Moritz
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Herr Dipl.-Ing. Christian Juraschek
Herr Dipl.-Ing. Markus Gührs
Herr Dipl.-Ing. Klaus Vaterrodt
Herr Dipl.-Ing. Matthias Schröder-Heske
Herr Dipl.-Ing. Christian Kruscha
Frau Dipl.-Ing. Antje Köhler
Herr Dipl.-Ing. Stephan Wacker
Herr Dipl.-Ing. Lars Eberschulz

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Testing of low-voltage equipment and components as well as of installation, switching, control and protective equipment and railway applications as described in the subsequent listed standards.			
Railway applications			
Electrical engineering	VDE 0115 - 300-1 DIN EN 50123-1:2003-12 EN 50123-1:2003 IEC 61992-1 (2014-04) Ed. 2.1	Railway applications – Fixed installations – DC switchgear – Part 1: General.	
Electrical engineering	VDE 0115 - 300-2 DIN EN 50123-2:11-2003 EN 50123-2:2003 IEC 61992-2 (2014-04) Ed. 2.1	Railway applications – Fixed installations – DC switchgear – Part 2: DC circuit-breakers.	
Electrical engineering	VDE 0115 - 300-3 DIN EN 50123-3:10-2003 EN 50123-3:2003 IEC 61992-3 (2006-02) Ed. 2.0	Railway applications – Fixed installations – DC switchgear – Part 3: Indoor d.c. disconnectors, switch-disconnectors and earthing switches.	
Electrical engineering	VDE 0115 - 300-4 DIN EN 50123-4/A1 02-2014 EN 50123-4/A1:2013 IEC 61992-4 (2006-02) Ed 1.0	Railway applications – Fixed installations – DC switchgear – Part 4: Outdoor d.c. disconnectors, switch-disconnectors and earthing switches.	
Electrical engineering	IEC 61992-5 (2006-02) Ed. 1.0 DIN EN 50526-1:2012 VDE 0115-526-1:2012 EN 50526-1:2012	Railway applications – Fixed installations – DC switchgear – Part 5: Surge arresters and low-voltage limiters for specific use in d.c. systems.	
Electrical engineering	DIN EN 50526-2:2014 VDE 0115-526-2:2014 EN 50526-2:2014	Bahnanwendungen – Ortsfeste Anlagen – Überspannungsableiter und Spannungsbegrenzungseinrichtungen für Gleichspannungsnetze – Teil 2: Spannungsbegrenzungseinrichtungen.	
Electrical engineering	VDE 0115 - 300-6 DIN EN 50123-6:09-2003 EN 50123-6:2003 IEC 61992-6 (2014-04) Ed. 1.1	Railway applications – Fixed installations – DC switchgear – Part 6: DC switchgear assemblies.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0115 Teil 420 DIN EN 60310:2005-01 IEC 60310 (2004-02) Ed. 3.0	Railway applications – Traction transformers and inductors on board rolling stock.	
Electrical engineering	IEC 60077-1 (1999-10) Ed. 1.0 DIN EN 60077-1:2003-04 VDE 0115-460-1	Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules.	
Electrical engineering	IEC 60077-2 (1999-03) Ed. 1.0 DIN EN 60077-2:2003-04 VDE 0115-460-2	Railway applications – Electric equipment for rolling stock – Part 2: Electrotechnical components – General rules.	
Electrical engineering	IEC 60077-3 (2001-12) Ed. 1.0 DIN EN 60077-3:2003-04 VDE 0115-460-3	Railway applications – Electric equipment for rolling stock – Part 3: Electrotechnical components – Rules for d.c. circuit-breakers.	
Electrical engineering	IEC 60077-4 (2003-02) Ed. 1.0 DIN EN 60077-4:2004-01 VDE 0115-460-4	Railway applications – Electric equipment for rolling stock – Part 4: Electrotechnical components – Rules for AC circuit-breakers.	
Electrical engineering	IEC 60077-5 (2003-07) Ed. 1.0 DIN EN 60077-5:2004-07 VDE 0115-460-5	Railway applications – Electric equipment for rolling stock – Part 5: Electrotechnical components – Rules for HV fuses.	
Electrical engineering	VDE 0115-327 DIN EN 50327:2006-03 EN 50327:2006-03 IEC 62589 (2010-07) Ed. 1.0	Railway applications – Fixed installations – Harmonisation of the rated values for converter groups and tests on converter groups.	
Electrical engineering	VDE 0115-328 DIN EN 50328:2010-11 EN 50328:2010-11 IEC 62590 (2010-06) Ed. 1.0	Railway applications – Fixed installations – Electronic power converters for substations.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0560-700 DIN EN 61921:2004-02 EN 61921:2003-07 IEC 61921 (2003-04) Ed. 1.0	Power capacitors Low-voltage power factor correction banks.	
Electrical engineering	VDE 0115 - 410 DIN EN 61287-1:2014-12 EN 61278-1:2014-07 IEC 61287-1 (2014-07) Ed. 3.0	Railway applications – Power convertors installed on board rolling stock – Part 1: Characteristics and test methods.	
Low-voltage switchgear and control gear			
Electrical engineering	VDE 0660 - 100 DIN EN 60947-1:2011-10 EN 60947-1:2011 IEC 60947-1 (2014-09) Ed. 5.2	Low-voltage switchgear and control gear – Part 1: General rules.	
Electrical engineering	VDE 0660 - 101 DIN EN 60947-2:2014-01 EN 60947-2:2013 IEC 60947-2 (2013-01) Ed. 4.2	Low-voltage switchgear and control gear – Part 2: Circuit-breakers.	
Electrical engineering	VDE 0660 - 107 DIN EN 60947-3:2015:03 EN 60947-3:2009 IEC 60947-3 (2012-09) Ed. 3.1	Low-voltage switchgear and control gear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units.	
Electrical engineering	VDE 0660 - 102 DIN EN 60947-4-1:2014-02 EN 60947-4-1:2012 IEC 60947-4-1 (2012-07) Ed. 3.1	Low-voltage switchgear and control gear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters.	
Electrical engineering	VDE 0660 - 117 DIN EN 60947-4-2:2013-05 EN 60947-4-2:2012 IEC 60947-4-2 (2012-03) Ed. 3.0	Low-voltage switchgear and control gear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters.	
Electrical engineering	VDE 0660 - 109 DIN EN 60947-4-3:2015-04 EN 60947-4-3:2014 IEC 60947-4-3 (2014-05) Ed. 2.0	Low-voltage switchgear and controlgear – Part 4-3: Contactors and motor-starters – AC semiconductor controllers and contactors for non-motor loads.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0660 - 200 DIN EN 60947-5-1:2010-04 EN 60947-5-1:2009 IEC 60947-5-1 (2009-07) Ed. 3.1	Low-voltage switchgear and control gear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.	
Electrical engineering	VDE 0660 - 208 DIN EN 60947-5-2:2014-01 EN 60947-5-2:2012 IEC 60947-5-2 (2012-09) Ed. 3.1	Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches.	
Electrical engineering	VDE 0660 - 210 DIN EN 60947-5-5:2005-11 EN 60947-5-5:2005 IEC 60947-5-5 (2005-04) Ed. 1.1	Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function.	
Electrical engineering	VDE 0660 - 114 DIN EN 60947-6-1:2014-09 EN 60947-6-1:2014 IEC 60947-6-1 (2013-12) Ed. 2.1	Low-voltage switchgear and controlgear – Part 6-1: Multiple function equipment – Transfer switching equipment.	
Electrical engineering	VDE 0660 - 115 DIN EN 60947-6-2:2007-12 EN 60947-6-2:2007 IEC 60947-6-2 (2007-03) Ed. 2.1	Low-voltage switchgear and controlgear – Part 6-2: Multiple function equipment – Control and protective switching devices (or equipment) (CPS).	
Electrical engineering	VDE 0611 - 1 DIN EN 60947-7-1:2010-03 EN 60947-7-1:2009 IEC 60947-7-1 (2009-04) Ed. 3.0	Niederspannungsschaltgeräte – Teil 7.1: Hilfseinrichtungen: Reihenklemmen für Kupferleiter. Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors.	
Electrical engineering	VDE 0611 - 3 DIN EN 60947-7-2:2010-03 EN 60947-7-2:2009 IEC 60947-7-2 (2009-04) Ed. 3.0	Low-voltage switchgear and controlgear – Part 7-2: Ancillary equipment – Protective conductor terminal blocks for copper conductors.	
Electrical engineering	VDE 0611 - 4 DIN VDE 0611- 4:1991-02	Niederspannungsschaltgeräte; Mehrstöckige Verteiler-Reihenklemmen bis 6 mm^2	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0637 - 3 DIN EN 61095:2009-11 EN 61095:2009 IEC 61095 (2009-02) Ed. 2.0	Electromechanical contactors for household and similar purposes.	
Electrical engineering	VDE 0220-100 DIN EN 61238-1:2004-03 IEC 61238-1 (2003-05) Ed. 2.0	Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) – Part 1: Test methods and requirements.	
Fuses			
Electrical engineering	DIN EN 60269-1:2015-05 IEC 60269-1 (2014-06) Ed. 4.2 VDE 0636-1	Low-voltage fuses – Part 1: General requirements	
Electrical engineering	DIN VDE 0636-2:2014-09 IEC 60269-2 (2013-07{ Ed. 5.0 HD 60269-2:2013 VDE 0636-2	Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to K	
Electrical engineering	DIN VDE 0636-3:2013-12 IEC 60269-3 (2013-01) Ed. 4.1 HD 60269-2:2013 VDE 0636-3	Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) - Examples of standardized systems of fuses A to F	
Electrical engineering	DIN EN 60269-4:2013-01 EN 60269-4:2012 IEC 60269-4 (2012-05) Ed. 5.1 VDE 0636-4	Low-voltage fuses – Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices	
Electrical engineering	DIN CLC 60269-5 IEC/TR 60269-5 (2014-03) Ed. 2.0 VDE 0636-5	Low-voltage fuses – Part 5: Guidance for the application of low-voltage fuses	
Electrical engineering	DIN EN 60269-6:2012-06 EN 60269-6:2011 IEC 60269-6 (2010-12) Ed. 1.0 + Cor. 1 VDE 0636-6	Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60127-1 (2015-02) Ed. 2.2	Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links.	
Electrical engineering	IEC 60127-2 (2014-09) Ed. 3.0	Miniature fuses – Part 2: Cartridge fuse-links.	
Power Transformers and Reactors			
Electrical engineering	VDE 0532-76-1 DIN EN 60076-1:2012-03 EN 60076-1:2011 IEC 60076-1 (2011-04) Ed. 3.0	Power transformers – Part 1: General.	
Electrical engineering	VDE 0532-76-2 DIN EN 60076-2:2012-02 EN 60076-2:2011 IEC 60076-2 (2011-02) Ed. 3.0	Power transformers – Part 2: Temperature rise for liquid-immersed transformers.	
Electrical engineering	VDE 0532-76-5 DIN EN 60076-5:2007-01 EN 60076-5:2006 IEC 60076-5 (2006-02) Ed. 3.0	Power transformers – Part 5: Ability to withstand short circuit.	
Electrical engineering	VDE 0532-76-6 DIN EN 60076-6:2009-02 EN 60076-6:2008 IEC 60076-6 (2013-09) Ed. 1.0	Power transformers – Part 6: Reactors.	
Electrical engineering	VDE 0532-214-1 DIN EN 60214-1:2015-04 EN 60214-1:2014 IEC 60214-1 (2014-05) Ed. 2.0	Tap-changers – Part 1: Performance requirements and test methods.	
Electrical engineering	IEC 60353 (2002-04) Ed. 2.0	Line traps for a.c. power systems.	
Electrical Installation Material			
Electrical engineering	VDE 0220-3	Kabelklemmen	
Electrical engineering	VDE 0603-1 DIN VDE 0603-1:1991-01	Installationskleinverteiler und Zählerplätze AC 400 V; Installationskleinverteiler und Zählerplätze.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0603-2 DIN VDE 0603-2:1093-03	Installationskleinverteiler und Zählerplätze AC 400 V; Hauptleitungsabzweigklemmen.	
Electrical engineering	VDE 0609 -1 DIN EN 60999:2000-12 EN 60999:2000 IEC 60999 (1999-11) Ed. 2.0	Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included).	
Electrical engineering	VDE 0623 -1 DIN EN 60309-1:2014-12 EN 60309-1:2005 IEC 60309-1 (2012-05) Ed. 4.2	Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements.	
Electrical engineering	VDE 0604-202 DIN EN 61914:2010-01 IEC 61914 (2009-01) Ed. 1.0	Cable cleats for electrical installations.	
Electrical engineering	VDE 0623 -20 DIN EN 60309-2:2013-01 EN 60309-2:2012 IEC 60309-2 (2012-05) Ed. 4.2	Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories.	
Electrical engineering	VDE 0630 - 1 DIN EN 61058-1:2001-10 EN 61058-1:2008 IEC 61058-1 (2008-04) Ed. 3.2	Switches for appliances – Part 1: General requirements.	
Electrical engineering	VDE 0630 - 2-1 DIN EN 61058-2-1:2001-08 EN 61058-2-1:2011 IEC 61058-2-1 (2010-11) Ed. 2.0	Switches for appliances – Part 2-1: Particular requirements for cord switches.	
Electrical engineering	VDE 0640 DIN EN 62019:2006-01 EN 62019:2005 IEC 62019 (2003-01)	Electrical accessories – Circuit-breakers and similar equipment for household use – Auxiliary contact units.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60898-1 (2015-03) Ed. 2.0 EN 60898-1 DIN EN 60898-1:2013 VDE 0641-1	Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation	
Electrical engineering	IEC 60898-2 (2003-07) Ed. 1.1 EN 60898-2: 2007 DIN EN 60898-2:2007 VDE 0641-2	Circuit-breakers for overcurrent protection for household and similar installations – Part 2: Circuit-breakers for a.c. and d.c. operation	
Electrical engineering	IEC 60934 (2013-01) Ed. 3.2 DIN EN 60934:2013-11 VDE 0642	Circuit-breakers for equipment (CBE).	
Electrical engineering	IEC 61008-1 (2013-09) Ed. 3.2 DIN EN 61008-10:2015-11 VDE 0664-10	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules	
Electrical engineering	IEC 61008-2-1 (1990-12) Ed. 1.0 DIN EN 61008-2-11:1999-12 VDE 0664-2-11	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's). – Part 2-1: Applicability of the general rules to RCCB's functionally independent of line voltage	
Electrical engineering	IEC 61008-2-2 (1990-12) Ed. 1.0 DIN EN 61008-2-2 VDE 0664-2-2	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's). – Part 2-2: Applicability of the general rules to RCCB's functionally dependent on line voltage	
Electrical engineering	IEC 61009-1 (2013-09) Ed. 3.2 DIN EN 61009-20:2015-11 VDE 0664-20	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 61009-2-1 (1991-09) Ed. 1.0 DIN EN 61009-21:1999-12 VDE 0664-21	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage	
Electrical engineering	IEC 61009-2-2 (1991-09) Ed. 1.0 DIN EN 61009-2-2 VDE 0664-2-2	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-2: Applicability of the general rules to RCBO's functionally dependent on line voltage	
Electrical engineering	IEC 60099-4 (2014-06) Ed. 3.0 DIN EN 60099-4:2015-07 VDE 0675-4	Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems	
Electrical engineering	IEC 60099-5 (2013-05) Ed. 2.0 DIN EN 60099-5:2014-09 VDE 0675-5	Surge arresters – Part 5: Selection and application recommendations	
Electrical engineering	IEC 60099-6 (2002-08) Ed. 1.0	Surge arresters – Part 6: Surge arresters containing both series and parallel gapped structures - Rated 52 kV and less	
Electrical engineering	IEC 60099-8 (2011-01) Ed. 1.0 DIN EN 60099-8:2011-11 VDE 0675-8	Surge arresters – Part 8: Metal-oxide surge arresters with external series gap (EGLA) for overhead transmission and distribution lines of a.c. systems above 1 kV	
Electrical engineering	IEC 60099-9 (2014-06) Ed. 1.0 DIN EN 60099-9:2015-08 VDE 0675-9	Surge arresters – Part 9: Metal-oxide surge arresters without gaps for HVDC converter stations	
Electrical engineering	IEC 61643-11 (2011-03) Ed. 1.0 DIN EN 61643-11/A1:2015-09 VDE 0675-6-11	Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 61643-12 (2008-11) Ed. 2.0 DIN EN 61643-12:2013-04 VDE 0675-6-12	Low-voltage surge protective devices – Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles	
Electrical engineering	IEC 61643-21 (2012-07) Ed. 1.2	Low voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods	
Electrical engineering	IEC 61643-22 (2015-06) Ed. 2.0	Low-voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling net-works – Selection and application principles	
Electrical engineering	IEC 61643-311 (2013-04) Ed. 1.0	Components for low-voltage surge protective devices – Part 311: Performance requirements and test circuits for gas discharge tubes (GDT)	
Electrical engineering	IEC 61643-312 (2013-04) Ed. 1.0	Components for low-voltage surge protective devices – Part 312: Selection and application principles for gas discharge tubes	
Electrical engineering	IEC 61643-321 (2001-12) Ed. 1.0	Components for low-voltage surge protective devices – Part 321: Specifications for avalanche breakdown diode (ABD)	
Electrical engineering	IEC 61643-331 (2003-05) Ed. 1.0	Components for low-voltage surge protective devices – Part 331: Specification for metal oxide varistors (MOV)	
Electrical engineering	IEC 61643-341 (2001-11) Ed. 1.0	Components for low-voltage surge protective devices – Part 341: Specification for thyristor surge suppressors (TSS)	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0675-39-11 DIN EN 50539-11:2013-12 EN 50539-11:2013	Überspannungsschutzgeräte für Niederspannung - Überspannungsschutzgeräte für besondere Anwendungen einschließlich Gleichspannung – Teil 11: Anforderungen und Prüfungen für Überspannungsschutzgeräte für den Einsatz in Photovoltaik-Installationen.	
Low-voltage switchgear and controlgear assemblies			
Electrical engineering	IEC 61439-1 (2011-08) Ed. 2.0 DIN EN 61439-1:2014-06 VDE 0660-600-1	Low-voltage switchgear and controlgear assemblies – Part 1: General rules	
Electrical engineering	IEC 61439-2 (2011-08) Ed.2.0 DIN EN 61439-2:2012-06 VDE 0660-600-2	Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies	
Electrical engineering	IEC 61439-3 (2012-02) Ed. 1.0 DIN EN 61439-3:2014-10 VDE 0660-600-3	Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)	
Electrical engineering	IEC 61439-4 (2012-11) Ed 1.0 DIN EN 61439-4:2013-09 VDE 0660-600-4	Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS)	
Electrical engineering	IEC 61439-5 (2015-03) Ed. 2.0 DIN EN 61439-5:2015-10 VDE 0660-600-5	Low-voltage switchgear and controlgear assemblies – Part 5: Assemblies for power distribution in public networks	
Electrical engineering	IEC 61439-6 (2012-05) Ed. 1.0 DIN EN 61439-6:2013-06 VDE 0660-600-6	Low-voltage switchgear and controlgear assemblies – Part 6: Busbar trunking systems (busways)	
Electrical engineering	IEC/TS 61439-7 (2014-02) Ed. 1.0 DIN EN 61439-7:2014-10 VDE 0660-600-7	Low-voltage switchgear and controlgear assemblies – Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Switching, control and protective equipment			
Electrical engineering	VDE 0435 Teil 201 DIN EN 61810-1:2009-02 EN 61810-1:2008 IEC 61810-1 (2015-02) Ed. 4.0	Electromechanical elementary relays – Part 1: General and safety requirements.	
Electrical engineering	VDE 0435 - 300 DIN EN 60255-1:2010-09 EN 60255-1:2010 IEC 60255-1 (2009-08) Ed. 1.0	Measuring relays and protection equipment – Part 1: Common requirements.	
Electrical engineering	VDE 0435 - 2021 DIN EN 61812-1:2015-04 EN 61812-1:2011 IEC 61812-1 (2011-05) Ed. 2.0	Time relays for industrial and residential use – Part 1: Requirements and tests.	
Electrical engineering	VDE 0631-2-1 DIN EN 60730-2-1:2012-10 EN 60730-2-1:2010 IEC 60730-2-1 (2014-09) Ed. 5.0	Automatic electrical controls – Part 1: General requirements.	
Electrical engineering	VDE 0631 Teil 2-10 DIN EN 60730-2-10:2008-06 EN 60730-2-10:2007 IEC 60730-2-10 (2006-10)	Automatic electrical controls for household and similar use – Part 2-10: Particular requirements for motor-starting relays	
Instrument transformers			
Electrical engineering	VDE 0414-9-2 DIN EN 61869-2:2014-06 EN 61869-2:2012 IEC 61869-2 (2012-09) Ed. 2.0	Instrument transformers – Part 2: Additional requirements for current transformers.	
Electrical engineering	VDE 0414-9-3 DIN EN 61869-3:2012-05 EN 61869-3:2011 IEC 61869-3 (2011-07) Ed. 1.0	– Part 3: Additional requirements for inductive voltage transformers.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 414-9-4 HD 548.3 S1 DIN EN 61869-4:2015-04 EN 61869-4:2014 IEC 61869-4 (2013-11) Ed. 1.0	Instrument transformers – Part 4: Additional requirements for combined transformers.	
Low-voltage equipment			
Electrical engineering	VDE 0558-11 DIN EN 60146-1-1:2011-04 EN 60146-1-1:2010 IEC 60146-1-1 (2009-06) Ed. 4.0	Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements.	
Electrical engineering	VDE 0558 - 8 DIN EN 60146-1-3:1994-03 EN 60146-1-3:1993 IEC 60146-1-3 (1991-04) Ed. 3.0	Semiconductor convertors – General requirements and line commutated convertors – Part 1-3: Transformers and reactors.	
Electrical engineering	VDE 0638 DIN 57638:1981-09	Niederspannungs-Schaltgeräte - Schalter-Sicherungs-Einheiten D0-System.	

Technical responsibility for the test reports:

Approval:	**Technical verification:**
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Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Testing of high-voltage, medium-voltage and low-voltage cables and their accessories as described in the subsequent listed standards.			
Polyvinyl chloride insulated cables			
Electrical engineering	IEC 60227-1 (2007-10) Ed. 3.0	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 1: General requirements.	
Electrical engineering	IEC 60227-3 (1997-11) Ed. 2.1	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 3: Non-sheathed cables for fixed wiring.	
Electrical engineering	IEC 60227-4 (1997-12) Ed. 2.1	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 4: Sheathed cables for fixed wiring.	
Electrical engineering	IEC 60227-5 (2011-09) Ed. 3.0	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 5: Flexible cables (cords).	
Electrical engineering	IEC 60227-6 (2001-06) Ed. 3.0	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 6: Lift cables and cables for flexible connections.	
Electrical engineering	IEC 60227-7 (2012-01) Ed. 1.2	Polyvinyl chloride insulated cables of rated voltages up to and including 450 V / 750 V – Part 7: Flexible cables screened and unscreened with two or more conductors	
Electrical engineering	VDE 0281 - 8 DIN VDE 0281-8: 2000-09 HD 21.8 S2 + A1:1999	Polyvinylchlorid-isolierte Leitungen mit Nennspannungen bis 450 V / 750 V. Einadrige Leitungen ohne Mantel für Lichterketten.	
Electrical engineering	VDE 0281 - 9 DIN VDE 0281-9:2001-01 HD 21.9 S2 + A1:1999	Polyvinylchlorid-isolierte Leitungen mit Nennspannungen bis 450 V / 750 V. Einadrige Leitungen ohne Mantel zur Verlegung bei tiefen Temperaturen.	
Electrical engineering	VDE 0285-525-1 DIN EN 50525-1:2012-01 EN 50525-1:2011	Starkstromleitungen mit Nennspannungen bis 450 V / 750 V (U_o/U) – Teil 1: Allgemeine Anforderungen.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0285-525-2-11 DIN EN 50525-2-11:2012-01 EN 50525-2-11:2011	– Flexible Leitungen mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-12 DIN EN 50525-2-12:2012-01 EN 50525-2-12:2011	– Wendelleitungen mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-21 DIN EN 50525-2-21:2012-01 EN 50525-2-21:2011	– Flexible Leitungen mit vernetzter Elastomer-Isolierung.	
Electrical engineering	VDE 0285-525-2-31 DIN EN 50525-2-31:2012-01 EN 50525-2-31:2011	– Ader und Verdrahtungsleitung mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-41 DIN EN 50525-2-41:2012-01 EN 50525-2-41:2011	– Einadrige Leitung mit vernetzter Silicon-Isolierung.	
Electrical engineering	VDE 0285-525-2-42 DIN EN 50525-2-42:2012-01 EN 50525-2-42:2011	– Ader- und Verdrahtungsleitungen mit vernetzter EVA-Isolierung.	
Electrical engineering	VDE 0285-525-2-51 DIN EN 50525-2-51:2012-01 EN 50525-2-51:2011	– Ölbeständige Steuerleitung mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-71 DIN EN 50525-2-71:2012-01 EN 50525-2-71:2011	– Lahnlitzen-Leitung mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-72 DIN EN 50525-2-72:2012-01 EN 50525-2-72:2011	– Trennbare Zwillingsleitungen mit thermoplastischer PVC-Isolierung.	
Electrical engineering	VDE 0285-525-2-81 DIN EN 50525-2-81:2012-01 EN 50525-2-81:2011	– Lichtbogenschweißleitungen mit vernetzter Elstomer- Hülle.	
Electrical engineering	VDE 0285-525-2-82 DIN EN 50525-2-82:2012-01 EN 50525-2-82:2011	– Leitungen für Lichterketten mit vernetzter Elastomer-Isolierung.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0285-525-2-83 DIN EN 50525-2-83:2012-01 EN 50525-2-83:2011	– Mehradrige Leitungen mit vernetzter Silicon-Isolierung.	
Electrical engineering	VDE 0285-525-3-11 DIN EN 50525-3-11:2012-01 EN 50525-3-11:2011	– Teil 3-11: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Flexible halogenfreie, raucharme Leitungen mit thermoplastischer Isolierung.	
Electrical engineering	VDE 0285-525-3-21 DIN EN 50525-3-21:2012-01 EN 50525-3-21:2011	– Teil 3-21: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Flexible halogenfreie, raucharme Leitungen mit vernetzter Isolierung.	
Electrical engineering	VDE 0285-525-3-31 DIN EN 50525-3-31:2012-01 EN 50525-3-31:2011	– Teil 3-31: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Halogenfreie, raucharme Ader- und Verdraht-ungsleitungen mit thermoplastischer Isolierung.	
Electrical engineering	VDE 0285-525-3-41 DIN EN 50525-3-41:2012-01 EN 50525-3-41:2011	– Teil 4-31: Starkstromleitungen mit verbessertem Verhalten im Brandfall – Halogenfreie, raucharme Ader- und Verdrahtungsleitungen mit vernetzter Isolierung.	
Electrical engineering	VDE 0262 DIN VDE 0262:2004-01	Installationskabel mit Isolierungen aus vernetzten Polyethylen und Mantel aus thermoplastischem PVC mit Nennspannung 0,6 / 1 kV.	
Electrical engineering	DIN VDE 0276-603:2010-03 VDE 0276-603 HD 603:2007	Starkstromkabel – Teil 603: Energiekabel mit Nennspannung 0,6 / 1 kV.	
Electrical engineering	DIN VDE 0276-604:2008-02 VDE 0276-604 HD 604:2005	Starkstromkabel – Teil 603: Energiekabel mit Nennspannung 0,6 / 1 kV mit verbessertem Verhalten im Brandfall für Kraftwerke.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Test methodes			
Electrical engineering	IEC 60332-1-1 (2004-07) Ed. 1.0 IEC 60332-1-2 (2004-07) Ed. 1.0 IEC 60332-1-3 (2004-07) Ed. 1.0 DIN EN 60332 -1-1:2005-06 DIN EN 60332 -1-2:2005-06 DIN EN 60332 -1-3:2005-06 VDE 0482-332 -1-1 VDE 0482-332 -1-2 VDE 0482-332 -1-3	Tests on electric and optical fiber cables under fire conditions – 1-1 Test for vertical flame propagation for a single insulated wire or cable – Apparatus – 1-2 Procedure for 1 kW pre-mixed flame – 1-3 Procedure for determination of flaming droplets/particles. Prüfungen an Kabeln, isolierten Leitungen und Glasfaserkabeln im Brandfall.	
Electrical engineering	VDE 0432 - 1:2011-10	Hochspannungs-Prüftechnik Allgemeine Festlegungen zu Prüfbedingungen.	
Electrical engineering	VDE 0432 - 2:2011-10	Hochspannungs-Prüftechnik Messsysteme.	
Electrical engineering	VDE 0472 - 401 DIN 57472-401:1984-06	Prüfung an Kabel und isolierten Leitungen Außenmaße.	
Electrical engineering	VDE 0472 - 402 DIN 57472-402:1984-06	Prüfung an Kabel und isolierten Leitungen. Wanddicke sowie Dicke von Bewehrungsdrähten und –bändern.	
Electrical engineering	VDE 0472 -1 DIN VDE 0472 -1:1987-06	Prüfung an Kabel und isolierten Leitungen ; Allgemeines.	
Electrical engineering	VDE 0472 – 505:1983-04 DIN 57472-505	Prüfung an Kabel und isolierten Leitungen. Verlustfaktor, dielektrische Verlustzahl und Ableitung.	
Electrical engineering	VDE 0472 - 509 DIN VDE 0472-509:1986-10	Prüfung an Kabel und isolierten Leitungen. Spannungsfestigkeit bei Kabeln und Leitungen, isolierten Schaltdrähten und Schnüren für Fernmeldeanlagen.	
Electrical engineering	VDE 0472 - 512 DIN VDE 0472-512:1985-05	Prüfung an Kabel und isolierten Leitungen. Widerstand zwischen Schutzleiter und Leitschicht.	
Electrical engineering	VDE 0472 – 604:1985-05 DIN VDE 0472-604	Prüfung an Kabel und isolierten Leitungen Dichtheit von Kabelmänteln.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0472 - 605 DIN VDE 0472-605:1985-01	Prüfung an Kabel und isolierten Leitungen Abrieb.	
Electrical engineering	DE 0472 - 613 DIN VDE 0472-613:1986-03	Prüfung an Kabel und isolierten Leitungen Weiterreißwiderstand.	
Electrical engineering	VDE 0472 - 626 DIN 57472-626:1983-01	Prüfung an Kabel und isolierten Leitungen Reißlänge.	
Electrical engineering	DIN EN 50497:2008-11 VDE 0473-497 EN 50497:2007	Empfohlenes Prüfverfahren zur Einschätzung des Risikos von Weichmacher-ausschwitzungen bei PVC-isolierten und –ummantelten Kabeln und Leitungen.	
Electrical engineering	VDE 0473-811-100 DIN EN 60811 – 100:2012-12 EN 60811 – 100:2008 IEC 60811 – 100 (2008-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 100: General.	
Electrical engineering	VDE 0473-811-201 DIN EN 60811 – 201:2012-12 EN 60811 - 201 IEC 60811 – 201 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 201: General tests – Measurement of insulation thickness.	
Electrical engineering	VDE 0473-811-202 DIN EN 60811 – 202:2012-12 EN 60811 - 202 IEC 60811 – 202 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath.	
Electrical engineering	VDE 0473-811-203 DIN EN 60811 – 203:2012-12 EN 60811 - 203 IEC 60811 – 203 (2012-03) Ed. 1.0	Messung der Außenmaße.	
Electrical engineering	VDE 0473-811-301 DIN EN 60811 - 301:2012-12 EN 60811 - 301 IEC 60811 – 301 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 301: Electrical tests – Measurement of the permittivity at 23 °C of filling compounds	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-302 DIN EN 60811 - 302:2012-12 EN 60811 - 302 IEC 60811 – 302 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 302: Electrical tests – Measurement of the d.c. resistivity at 23 °C and 100 °C of filling.	
Electrical engineering	VDE 0473-811-401 DIN EN 60811 - 401:2012-12 EN 60811 - 401 IEC 60811 – 401 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven.	
Electrical engineering	VDE 0473-811-402 DIN EN 60811 - 402:2012-12 EN 60811 - 402 IEC 60811 – 402 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 402: Miscellaneous tests – Water absorption tests.	
Electrical engineering	VDE 0473-811-404 DIN EN 60811 - 404:2012-12 EN 60811 - 404 IEC 60811 – 404 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 404: Miscellaneous tests – Mineral oil immersion tests for sheaths.	
Electrical engineering	VDE 0473-811-405 DIN EN 60811 - 405:2012-12 EN 60811 - 405 IEC 60811 – 405 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 405: Miscellaneous tests – Thermal stability test for PVC insulations and PVC sheaths.	
Electrical engineering	VDE 0473-811-406 DIN EN 60811 - 406:2012-12 EN 60811 - 406 IEC 60811 – 406 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 406: Miscellaneous tests – Resistance to stress cracking of polyethylene and polypropylene compounds.	
Electrical engineering	VDE 0473-811-407 DIN EN 60811 - 407:2012-12 EN 60811 - 407 IEC 60811 – 407 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 407: Miscellaneous tests – Measurement of mass increase of polyethylene and polypropylene compounds.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-408 DIN EN 60811 - 408:2012-12 EN 60811 - 408 IEC 60811 – 408 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 408: Miscellaneous tests – Long-term stability test of polyethylene and polypropylene compounds.	
Electrical engineering	VDE 0473-811-409 DIN EN 60811 - 409:2012-12 EN 60811 - 409 IEC 60811 – 409 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 409: Miscellaneous tests – Loss of mass test for thermoplastic insulations and sheaths.	
Electrical engineering	VDE 0473-811-501 DIN EN 60811 - 501:2012-12 EN 60811 - 501 IEC 60811 – 501 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds.	
Electrical engineering	VDE 0473-811-502 DIN EN 60811 - 502:2012-12 EN 60811 - 502 IEC 60811 – 502 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations.	
Electrical engineering	VDE 0473-811-503 DIN EN 60811 - 503:2012-12 EN 60811 - 503 IEC 60811 – 503 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 503: Mechanical tests – Shrinkage test for sheaths.	
Electrical engineering	VDE 0473-811-504 DIN EN 60811 - 504:2012-12 EN 60811 - 504 IEC 60811 – 504 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 504: Mechanical tests – Bending tests at low temperature for insulation and sheaths.	
Electrical engineering	VDE 0473-811-505 DIN EN 60811 - 505:2012-12 EN 60811 - 505 IEC 60811 – 505 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-506 DIN EN 60811 - 506:2012-12 EN 60811 - 506 IEC 60811 – 506 (2012-03) Ed. 1.0	Schlagprüfung bei niedrigen Temperaturen für Isolierhüllen und Mäntel. Electric and optical fibre cables – Test methods for non-metallic materials – Part 506: Mechanical tests – Impact test at low temperature for insulations and sheaths.	
Electrical engineering	VDE 0473-811-507 DIN EN 60811 - 507:2012-12 EN 60811 - 507 IEC 60811 – 507 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 507: Mechanical tests – Hot set test for cross-linked materials.	
Electrical engineering	VDE 0473-811-508 DIN EN 60811 - 508:2012-12 EN 60811 - 508 IEC 60811 – 508 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulation and sheaths.	
Electrical engineering	VDE 0473-811-509 DIN EN 60811 - 509:2012-12 EN 60811 - 509 IEC 60811 – 509 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 509: Mechanical tests – Test for resistance of insulations and sheaths to cracking (heat shock test).	
Electrical engineering	VDE 0473-811-512 DIN EN 60811 - 512:2012-12 EN 60811 - 512 IEC 60811 – 512 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 512: Mechanical tests – Methods specific to polyethylene and polypropylene compounds – Tensile strength and elongation at break after conditioning at elevated temperature.	
Electrical engineering	VDE 0473-811-513 DIN EN 60811 - 513:2012-12 EN 60811 - 513 IEC 60811 – 513 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 513: Mechanical tests – Methods specific to polyethylene and polypropylene compounds – Wrapping test after conditioning.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0473-811-605 DIN EN 60811 - 605:2012-12 EN 60811 - 605 IEC 60811 – 605 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 605: Physical tests – Measurement of carbon black and/or mineral filler in polyethylene compounds.	
Electrical engineering	VDE 0473-811-606 DIN EN 60811 - 606:2012-12 EN 60811 - 606 IEC 60811 – 606 (2012-03) Ed. 1.0	Electric and optical fibre cables – Test methods for non-metallic materials – Part 606: Physical tests – Methods for determining the density.	
Accessories for power cables with rated voltages up to 30 kV			
Electrical engineering	DIN EN 61442:2006-01 VDE 0278-442 EN 61442:2005 IEC 61442 (2005-03) Ed. 2.0	Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV).	
Electrical engineering	VDE 0278 - 629-1 DIN VDE 0278-629-1:2009-07 HD 629.1:2008	Prüfanforderungen für Kabelgarnituren für extrudierte Kunststoffkabel mit einer Nennspannung von 3,6 / 6 (7,2) kV bis 20,8 / 36 (42) kV, – Teil 1: Kabel mit extrudierter Kunststoffisolierung.	
Electrical engineering	VDE 0278 - 629-2 DIN VDE 0278-629-2:2009-07 HD 629.2:2008	Prüfanforderungen für Kabelgarnituren für extrudierte Kunststoffkabel mit einer Nennspannung von 3,6 / 6 (7,2) kV bis 20,8 / 36 (42) kV, – Teil 2: Kabel mit massegetränkter Papierisolierung.	
Electrical engineering	VDE 0279 DIN 57279:1982-10	Leitungs-Garnituren des Bergbaus unter Tage Muffen (U_o/U) = 0,6 / 1 kV.	-
Electrical engineering	DIN EN 61238-1:2004-03 VDE 0220-100 IEC 61238-1 (2003-05) Ed. 2.0	Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) – Part 1: Test methods and requirements.	
Electrical engineering	DIN V 47640	Verbindungsmuffen aus wärmeschrumpfendem Kunststoffschlauch für Kunststoffisolierte Starkstromkabel mit Nennspannung 0,6 / 1 (1,2) kV.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Power cables and Accessories for power cables with rated voltages up to 400 kV (Um ≤ 420 kV)			
Electrical engineering	DIN VDE 0276–632:1999-05 HD 632 S1:1996	Kabel mit Isolierung aus vernetztem Polyethylen und ihre Garnituren für Nennspannung von 30 bis 150 kV.	
Electrical engineering	DIN VDE 0276–633:1999-05 HD 633 S1:1997	Niederdruck Ölkabel und ihre Garnituren für Nennspannungen bis 220 kV.	
Electrical engineering	DIN VDE 0276 – 634:1999-05 HD 634 S1:1997	Gasinnendruckkabel und ihre Garnituren für Nennspannungen bis 220 kV.	
Electrical engineering	DIN VDE 0276 – 635:1999-05 HD 635 S1:1997	Gasaußendruckkabel und ihre Garnituren für Nennspannungen bis 220 kV.	
Electrical engineering	VDE 0265 DIN VDE 0265:1995-12	Kabel mit Kunststoffisolierung und Bleimantel für Starkstromanlagen.	
Electrical engineering	VDE 0266 DIN VDE 0266:2006-03	Starkstromkabel mit verbessertem Verhalten im Brandfall.	
Electrical engineering	VDE 0271 DIN VDE 0271:2008-02	Kabel; Starkstromkabel mit Isolierung und Mantel aus thermoplastischem PVC und Nennspannungen bis Uo/U (Um): 3,6 / 6 (7,2) kV.	
Electrical engineering	VDE 0276 - 605 DIN VDE 0276-605:2008-02	Starkstromkabel Ergänzende Prüfverfahren.	
Electrical engineering	VDE 0276 - 620 DIN VDE 0276-620:2010-11	Energieverteilungskabel mit extrudierter Isolierung für Nennspannungen Uo/U: 3,6 / 6 kV bis 20,8 / 36 kV.	
Electrical engineering	VDE 0276 - 621 DIN VDE 0276-621:1997-05	Energieverteilungskabel mit getränkter Papierisolierung für Mittelspannung.	
Electrical engineering	VDE 0276 - 622 DIN VDE 0276-622:2006-05	Starkstromkabel mit Nennspannungen von3,6 / 6 (7,2) kV bis 20,8 / 36 (42) kV mit verbessertem Verhalten im Brandfall für Kraftwerke.	
Electrical engineering	VDE 0276 - 626 DIN VDE 0276-626:1997-01	Isolierte Freileitungsseile für oberirdische Verteilungsnetze mit Nennspannung Uo/U (Um): 0,6 / 1 (1,2) kV.	
Electrical engineering	VDE 0276 - 627 DIN VDE 0276-627:2006-09	Vieladrige und vielpaarige Kabel für die Verlegung in Luft und in Erde.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0279 DIN 50279:1982-10	Leitungsgarnituren des Bergbaus unter Tage, Muffen 1 kV.	
Electrical engineering	VDE 0278-393 DIN EN 50393:2006-11 EN 50393:2006	Prüfverfahren und Prüfanforderungen für die Garnituren von Verteilerkabeln mit Nennspannung von 0,6 / 1,0 (1,2) kV.	
Electrical engineering	IEC 60141-1 (1998-08) Ed. 3.0	Tests on oil-filled and gas-pressure cables and their accessories – Part 1: Oil-filled, paper-insulated, metal-sheathed cables and accessories for alternating voltages up to and including 400 kV.	
Electrical engineering	IEC 60141-2 (1967-01) Ed. 1.0	Tests on oil-filled and gas-pressure cables and their accessories. – Part 2: Internal gas-pressure cables and accessories for alternating voltages up to 275 kV.	
Electrical engineering	IEC 60141-3 (1967-01) Ed. 1.0	Tests on oil-filled and gas-pressure cables and their accessories. – Part 3: External gas-pressure (gas compression) cables and accessories for alternating voltages up to 275 kV.	
Electrical engineering	IEC 60141-4 (1990-10) Ed. 1.0	Tests on oil-filled and gas-pressure cables and their accessories. – Part 4: Oil-impregnated paper-insulated high pressure oil-filled pipe-type cables and accessories for alternating voltages up to and including 400 kV.	
Electrical engineering	IEC 60840 (2011-11) Ed. 4.0	Tests for power cables with extruded insulation for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV).	
Electrical engineering	IEC 60055-1 (2005-05) Ed. 5.1	Paper-insulated metal-sheathed cables for rated voltages up to 18 / 30 kV (with copper or aluminum conductors and excluding gas-pressure and oil-filled cables) – Part 1: Tests on cables and their accessories.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEC 60055-2 (2005-02) Ed. 1.0	Paper-insulated metal-sheathed cables for rated voltages up to 18 / 30 kV (with copper or aluminium conductors and excluding gaspressure and oil-filled cables). – Part 2: General and construction requirements.	
Electrical engineering	EC 60502-1 (2009-09) Ed. 2.0	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV).	
Electrical engineering	IEC 60502-2 (2014-02) Ed. 2.0	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 2: Cables for rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV.	
Electrical engineering	IEC 60502-4 (2010-12) Ed. 3.0	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 4: Test requirements on accessories for cables with rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV).	
Electrical engineering	VDE 0276-2067 DIN IEC 62067:2013-08 IEC 62067 (2011-11) Ed. 2.0	Starkstromkabel mit extrudierter Isolierung und ihre Garnituren für Nennspannungen über 150 kV (Um = 170 kV) bis einschließlich 500 kV (Um = 550 kV) – Prüfverfahren und Anforderungen. Power cables with extruded insulation and their accessories for rated voltage above 150 kV (Um = 170 kV) up to 500 kV (Um = 550 kV) – Test methods and requirements.	
Electrical engineering	IEC 60227-2 (2003-04) Ed. 2.1	Electrical test methods for electric cables. – Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450 V / 750 V.	
Electrical engineering	VDE 0481 - 885-2 DIN EN 60885-2 IEC 60885-2 (1987-03) Ed. 1.0	Prüfung an Kabeln und isolierten Leitungen; Teilentladung. Electrical test methods for electric cables. – Part 2: Partial discharge tests.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	VDE 0481 - 885-3 DIN EN 60885-3 IEC 60885-3 (2015-04) Ed. 2.0	Prüfung an Kabeln und isolierten Leitungen; Teilentladung an extrudierten Kabellängen. Electrical test methods for electric cables. – Part 3: Test methods for partial discharge measurements on lengths of extruded power cables.	
Electrical engineering	VDE 0473-229 DIN EN 60229:2009-04 EN 60229:2008 IEC 60229 (2007-10) Ed. 3.0	Tests on cable oversheaths which have a special protective function and are applied by extrusion.	
Electrical engineering	VDE 0481-395 DIN EN 50395:2006-07 EN 50395:2005	Elektrische Prüfung für Niederspannungskabel und -leitungen.	
Electrical engineering	VDE 0473-396 DIN EN 50396:2006-07 EN 50396:2005	Nicht-elektrische Prüfverfahren für Niederspannungskabel und -leitungen.	
Electrical engineering	VDE 0481 - 230 DIN EN 60230:2003-03 EN 60230:2002 IEC 60230 (1966-01) Ed. 1.0	Impulse tests on cables and their accessories.	
Electrical engineering	IEEE 48:2009	IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.	
Electrical engineering	IEEE 404:2012	IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500.000 V.	
Electrical engineering	IEEE 386:2006	IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.	

Testing field	Standard / In-House Procedure / Version	Title of Standard or In-House Procedure (Deviations / Modifications of Standard)	Test Range / Restrictions
Electrical engineering	IEEE 592:2007	IEEE Standard for Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Connectors.	

Technical responsibility for the test reports:

Approval:	Technical verification:
Herr Dipl.-Wirt.-Ing. Rainer Schiller	Herr Dipl.-Ing. Winfried Moritz
Herr Dipl.-Ing. Hannes Zinnbauer	Herr Dipl.-Ing. Klaus Vaterrodt
Herr Dipl.-Ing. Detlef Jegust	Herr Dipl.-Ing. Jürgen Wittwer
	Herr Dipl.-Ing. Detlef Jegust
	Herr Dipl.-Ing. Uwe Fischer
	Herr Dipl.-Ing. Michael Scheide
	Herr Dipl.-Ing. Matthias Schröder-Heske
	Herr Dipl.-Ing. Carlos Pereira
	Herr Dipl.-Ing. Martin Brüggemann
	Herr Ronny Baumgart

ENAC

Entidad Nacional de Acreditación

Otorga la presente / Grants this

ACREDITACIÓN
3/LE130(*)

a la entidad técnica / to the technical entity

LABORATORIO CENTRAL OFICIAL DE ELECTROTECNIA (LCOE)

Según criterios recogidos en la Norma UNE-EN ISO/IEC 17025, para la realización de ENSAYOS en el SECTOR INDUSTRIAL definidos en el ANEXO TÉCNICO adjunto.
According to the criteria in UNE-EN ISO/IEC 17025 for the performance of Test in the Industrial Sector as defined in the attached Technical Annex.

Fecha de entrada en vigor / Coming into effect: 21/12/1988

D. José Manuel Prieto Barrio
Presidente

La acreditación mantiene su vigencia hasta notificación en contra. Este documento no tiene validez sin su correspondiente anexo técnico, cuyo número coincide con el de la acreditación.
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(*) Incluye las acreditaciones nº 3/LE190, 3/LE192, 3/LE261

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El presente documento anula y sustituye a los de ref. CLE/1788, CLE/1710, CLE/1711, CLE/1712

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Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

Siemens Aktiengesellschaft
Wittelsbacher Platz 2, 80333 München

Standort:
Siemens Aktiengesellschaft
PSW (Prüffeld der Schaltwerke)
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die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Hochspannungsschaltgeräte und -anlagen sowie
Geräte der elektrischen Energietechnik

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 26.02.2016 mit der Akkreditierungsnummer D-PL-11055-10 und ist gültig bis 25.02.2021. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 12 Seiten.

Registrierungsnummer der Urkunde: **D-PL-11055-10-00**

000523

Frankfurt, 26.02.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
Spittelmarkt 10
10117 Berlin

Standort Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

ПРИЛОЖЕНИЕ № 3

ТАБЛИЦА 9 КЪМ ОБОСОБЕНА ПОЗИЦИЯ № 2
КОМУНИКАЦИЯ НА ЦИФРОВИ УСТРОЙСТВА С RTU

Предложеното оборудване отговаря на посочените по-долу минималните технически изисквания на Възложителя:

№	Параметър/характеристика	Минимални технически изисквания
1.	Всяка защита и контролер да притежава стандартен интерфейс за комуникация по Ethernet, RS-485 или оптичен интерфейс, стандартен интерфейс за комуникация с персонален компютър и съответно програмно осигуряване.	Да
2. -	Комуникацията между RTU и ЦЗ, чрез оптичен интерфейс се осъществява с HFBR-4516Z connector .	Да
3. -	Комуникацията между RTU и ЦЗ, чрез четирипроводна или двупроводна мрежа RS-485 се осъществява с RJ-45.	Да
4. -	Комуникацията между ЦЗ и персонален компютър се осъществява с USB порт.	Да
5. -	Комуникационния интерфейс за връзка с RTU да се счита като неразделна част от ЦЗ. Комуникационния интерфейс да има светодиодна индикация за режима на работа.	Да
6.	ЦЗ трябва да включва система за самоконтрол и самодиагностика, на комуникациите с вътрешни и външни потребители.	Да
7.	Наличие на сменяема парола за достъп до данните за настройките на комуникационните функции.	Да
8.	Наличие на стандартен интерфейс и протокол съгласно MODBUS TCP/IP и IEC 61850 по жична връзка с локална мрежа за предаване на информацията .	Да
9.	Потребителска настройка на комуникацията по комуникационен протокол:	-
10. -	При осъществяване на комуникацията по комуникационен протокол съгласно БДС EN 61850-5	Потребителска настройка на IP адрес на ЦУ (ЦЗ и контролер)
11. -	При осъществяване на комуникацията по комуникационен протокол съгласно MODBUS TCP/IP	Потребителска настройка на MODBUS server адрес на ЦУ (ЦЗ и контролер)
12.	Предаване на данни :	Адресите на всички цифрови входове, цифрови изходи, аналогови входове и изчислени аналогови величини по съответният комуникационен протокол

Дата 21.07.2017 г.

ПОДПИС и ПЕЧАТ:
Петър Терев
(име и фамилия)
Управител
(длъжност на представителя на участника)

ДЕКЛАРАЦИЯ

за конфиденциалност и извършен оглед на обект по предмета на поръчката

Долуподписаният/-ната/ Петър Атанасов Терев
в качеството ми на представляващ „НЕОПЕТ“ ООД участник в процедура за възлагане на обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика“,

ДЕКЛАРИРАМ, ЧЕ:

1/ Представител на участника, когото представлявам е извършил оглед на енергийния обект от обхвата на обособена позиция № 2, а именно: п/ст „Долна Митрополия“ и съм запознат със съществуващото положение в обекта.

2/ Няма да разпространявам поверителна информация, във връзка с извършения оглед на обекта на Възложителя, като ми е известно, че за поверителна се счита всяка информация, относно пропускателен режим в обекта, организацията на работната сила и работния процес, наличното оборудване и техническите схеми на функционирането му, системите за защита и сигурност в обекта и всичко, което е свързано с наличното оборудване, съоръжения и тяхното функциониране в съответния обект.

3/ Прилагам документ за извършен оглед, съставен на място в подстанцията.

Приложение: съгласно текста

Дата 21.07.2017 г.

Декларатор: ____________
Петър Терев
/име, подпис и печат/

Забележка:

Когато участник подава оферта за повече от една обособена позиция, настоящата декларация се представя в комплекта документи на техническо предложение за съответната обособена позиция, за която участва. Т.е., декларацията се попълва и подписва в толкова екземпляра, за колкото обособени позиции участва съответния участник, като този брой следва да е съответен на броя предложения за изпълнение на поръчката, които участникът представя в офертата си. На съответното място в декларацията задължително се посочва обособената позиция, за която се отнася декларацията

ДЕКЛАРАЦИЯ

за конфиденциалност във връзка с посещение на обект

Долуподписаният Петър Атанасов Терев
(собствено, бащино и фамилно име)

ЕГН 8012047586, притежаващ лична карта № 645578900, издадена на 03.12.2014г.

от МВР Стара Загора с постоянен адрес: гр. Стара Загора, ул. "Старозагорско въстание" 24, вх. А, ет. 5, ап. 30

Представител на "НЕОПЕТ ООД"
(наименование на юридическото лице/физическото лице и вид на търговеца)

Със седалище и адрес на управление:

гр. Стара Загора, ул. "12^ти Пехотен полк" № 1,

заинтересовано лице по смисъла на §2, т.14 от Допълнителните разпоредби на Закона за обществените поръчки за открита процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика ", реф. № PPD 17 - 052, във връзка с посещението на обекта, предмет на обществената поръчка, с цел запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС "ПС "Долно Митрополие" 110/20kV

ДЕКЛАРИРАМ:

1. Няма да разгласявам по никакъв начин информацията станала ми известна при запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС "Долно Митрополие" 110/20kV.
2. Наясно съм, че разгласяване на информация по смисъла на настоящата декларация представлява всякакъв вид устно или писмено изявление, предаване наинформация на хартиен, електронен или друг носител, включително по поща, факс или електронна поща, както и всякакъв друг начин на разгласяване наинформация, в това число чрез средствата за масово осведомяване, печатните издания или интернет.

Известна ми е отговорността по чл.313 от Наказателния кодекс.

Дата 30.06.2017г.

Декларатор:
подпис

Петър Атанасов Терев
трите имена

Документът е съставен на място в ПС „Д. Митрополие"
Лице на Възложител: Красимир Димитров

ДЕКЛАРАЦИЯ

за приемане на условията в проекта на договор

Долуподписаният/-ната/ Петър Атанасов Терев в качеството ми на представляващ „НЕОПЕТ“ ООД (името на участника) участник в обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика“, обособена позиция № 2 – Модернизация (ретрофит) на подстанция „Долна Митрополия” 110/20 kV (*посочва се № и наименование на обособената позиция*)

ДЕКЛАРИРАМ, ЧЕ:

Приемам условията в проекта на договор, приложен в документацията за участие.

Дата 24.07.2017 г.

Декларатор: ______________

Петър Терев

/име, подпис и печат/

Забележка:

Когато участник подава оферта за повече от една обособена позиция, настоящата декларация се представя в комплекта документи на техническо предложение за съответната обособена позиция, за която участва. Т.е., декларацията се попълва и подписва в толкова екземпляра, за колкото обособени позиции участва съответния участник, като този брой следва да е съответен на броя предложения за изпълнение на поръчката, които участникът представя в офертата си. На съответното място в декларацията задължително се посочва обособената позиция, за която се отнася декларацията.

ДЕКЛАРАЦИЯ
за срока на валидност на офертата

Долуподписаният/ -ата Петър Атанасов Терев ,

(собствено, бащино, фамилно име)

притежаващ/а лична карта № 645578900, издадена на 03.12.2014 г. от МВР– гр. Стара Загора,

адрес: гр. Стара Загора, ул. „Старозагорско въстание“ 24, вх. А. ет. 5, ап. 30

(постоянен адрес)

в качеството ми на управител

(посочва се длъжността)

На „НЕОПЕТ“ ООД

(посочете наименованието на участника)

участник в процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика", реф. № PPD 17-052,

(наименование на поръчката)

Обособена позиция № 2 Модернизация (ретрофит) на подстанция „Долна Митрополия" 110/20 kV
(*посочва се № и наименование на обособената позиция*)

ДЕКЛАРИРАМ, ЧЕ:

С подаване на офертата за участие в обществената поръчка, направените от нас предложения и поети ангажименти са валидни за срока, посочен в обявлението, считано от крайния срок за подаване на офертите.

Дата 24.07.2017 г.

Декларатор: ____________________
Петър Терев
/име, подпис и печат/

Забележки:

1/ Декларацията се подписва от законния представител на участника или от надлежно упълномощено лице, което подава офертата.

2/ Когато участник подава оферта за повече от една обособена позиция, настоящата декларация се представя в комплекта документи на техническо предложение за съответната обособена позиция, за която участва. Т.е., декларацията се попълва и подписва в толкова екземпляра, за колкото обособени позиции участва съответния участник, като този брой следва да е съответен на броя предложения за изпълнение на поръчката, които участникът представя в офертата си. На съответното място в декларацията задължително се посочва обособената позиция, за която се отнася декларацията.

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