Due to possible developments of standards as well as of materials, the characteristics and dimensions specified in the present catalogue may only be considered binding after confirmation by ABB SACE.

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http://www.abb.com

Emax Low voltage air circuit-breakers

Technical catalogue

Emax

Low voltage air circuit-breakers

1SDC200001D0201

Tmax, Isomax, Emax: Industrial^{IT} enabled!

Industrial^{IT} is the solution developed by ABB for the all-round integration of a company's activities, where each product is seen as part of a complete solution. Products and technologies are grouped into functional categories (Suites), each of which measures, controls, optimizes and supports a specific "block" of activities, and they can ensure coordinated interaction thanks to the platform created by ABB (AIP: Aspect Integrator Platform).

In addition to interactivity between certified products, every certified product also guarantees the ready availability of all the information needed for it to function - technical characteristics, installation instructions, use and maintenance instructions, environmental certificates and declarations, all updated to the latest version … a considerable advantage for the user*.

After **Tmax**, which was the first Industrial^{IT}-certified ABB SACE product, now the whole range of **Tmax** and **Isomax** moulded-case and **Emax** open circuit breakers has obtained certification and is fully entitled to join the Protect^{IT} suite of products. These circuit breakers combine with about 700 products in the ArTu M and ArTu K ranges of distribution boards, thus enabling complete switchboards to be assembled using all Industrial^{IT}-certified components.

Tmax, Isomax and Emax operation can be integrated with the configurable ABB products in a system: this compatibility has always been a fundamental premise of the ABB SACE design process. Mass customization, i.e. the mass production of components customized to meet a given buyer's specific needs is already feasible, as Industrial^{IT} certification demonstrates.

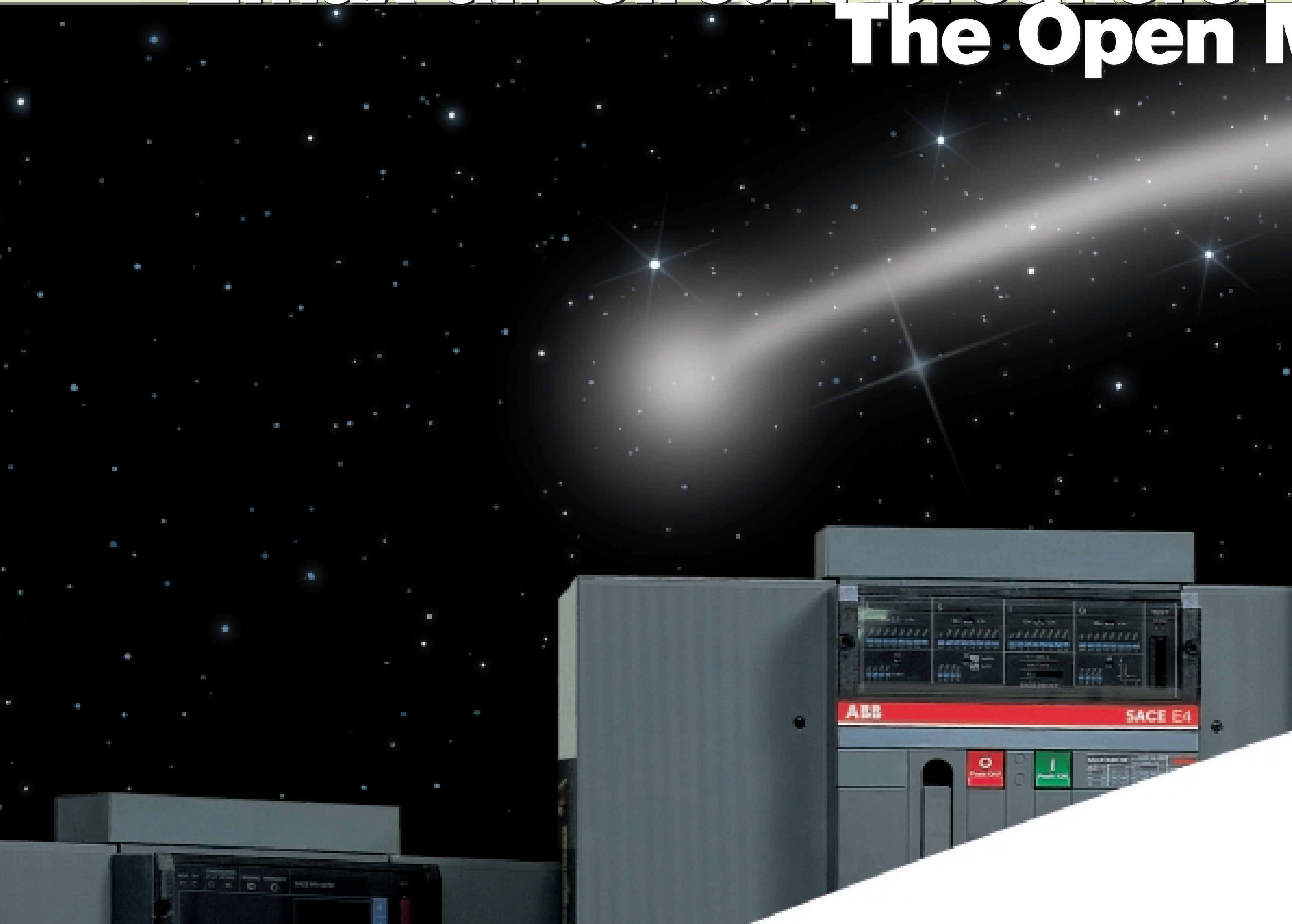
Yet again, ABB SACE is ahead of the field in offering a better and better customer service!

** All product technical data and related documentation can be found in Internet and is accessible to the customer. The standard documentation is in English, but there are local language versions for each country where a given product is marketed.*

For further information, go to the ***Products and services/Industrial*** ^{IT} section on our web site: http://www.abb.com

Summary

Emax air circuit-breakers. The Open M



Emax air circuit-breakers have always been appreciated for their high electrical performances, maximum modularity and standardisation which the all the ranges feature. Their very high safety, quality and rationality features, are the result of absolutely innovative design criteria.

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1SDC200006F0001

Minded.

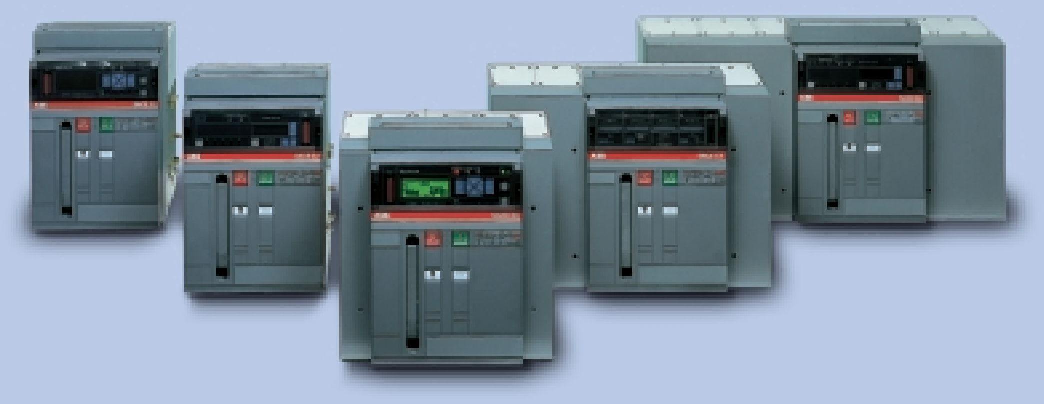
Innovative by tradition.

The Emax low voltage air circuit-breakers, designed and manufactured by ABB SACE, are the absolute top available on the market today for all applications for functional and qualitative excellency. Nothing comes about by chance: the long tradition of quality, reliability, and care that ABB SACE has always put into the design and production of its circuit-breakers are the best guarantee for anyone looking for advanced solutions in absolute peace of mind. Simply pass back over the history of ABB SACE air circuit-breakers to see a long series of success stories - fifty years passed in a constant search for innovative and safe solutions and, above all, always those providing top performances.

INDUSTRIE FORUM DESIGN HANNOVER

Emax air circuit-breakers. Firm ground for y

Modularity and compactness of Emax air circuit-breakers considerably simplify construction of the switchboards. The accessories are always fitted from the front simply and rapidly, without the need for cabling and in complete safety. The simplicity of these operations means that any personalisation required can be carried out directly by the end customer.



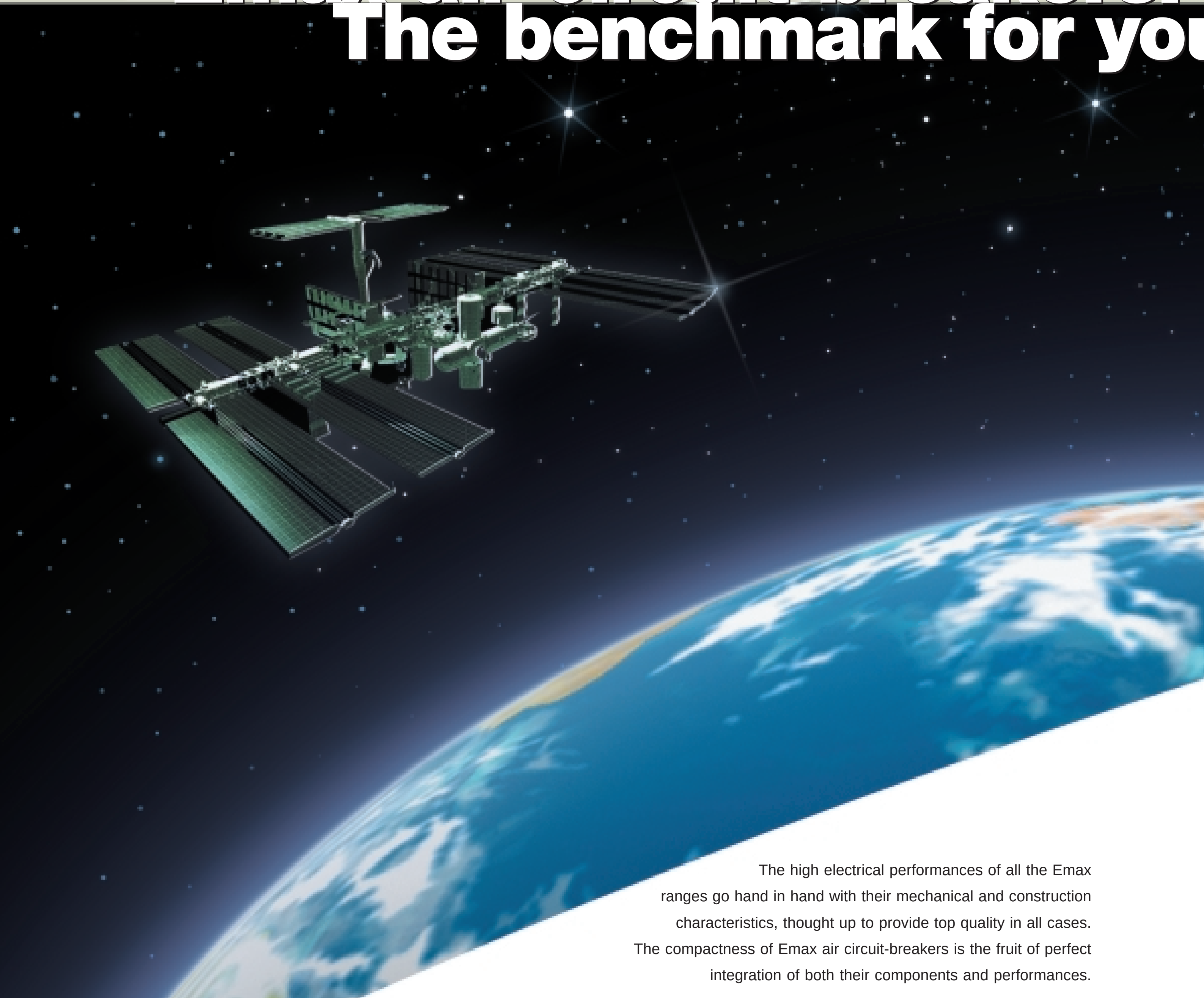
our solutions.

With this choice, there is no choice.

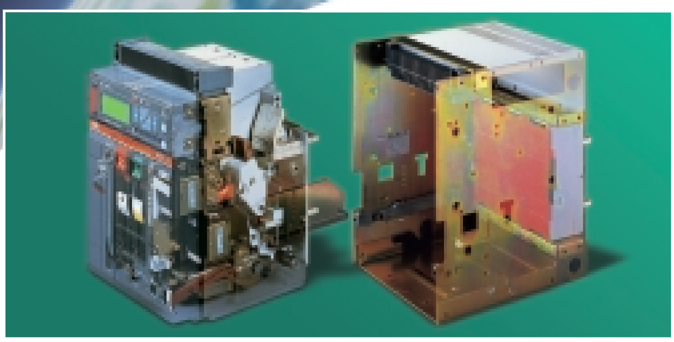
Whatever the application you have in mind, there is certainly just the apparatus you need for your applications in the ranges of Emax air circuit-breakers. The great appreciation shown by the market for this new series of air circuit-breakers has encouraged introduction of new ranges which go to increase the extensive offer available to date.

The very new 1000V AC/DC switch-disconnectors up to 4000A go to extend the circuit-breakers for special applications up to 1000V in alternating current. In order to satisfy more specific and up-to-date needs, ABB SACE proposes two new Full Size circuit-breakers with neutral conductor with full cross-section, specifically for applications in installations with high harmonic content due to advanced electronic devices.

Emax air circuit-breakers.
The benchmark for you



The high electrical performances of all the Emax ranges go hand in hand with their mechanical and construction characteristics, thought up to provide top quality in all cases. The compactness of Emax air circuit-breakers is the fruit of perfect integration of both their components and performances.



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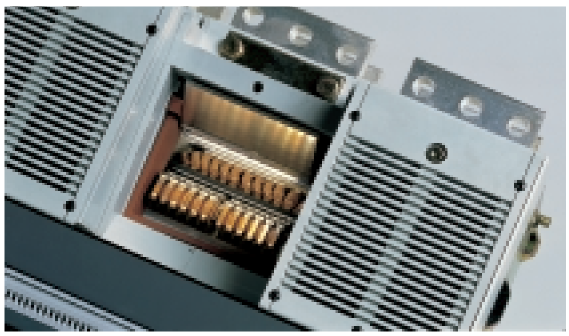

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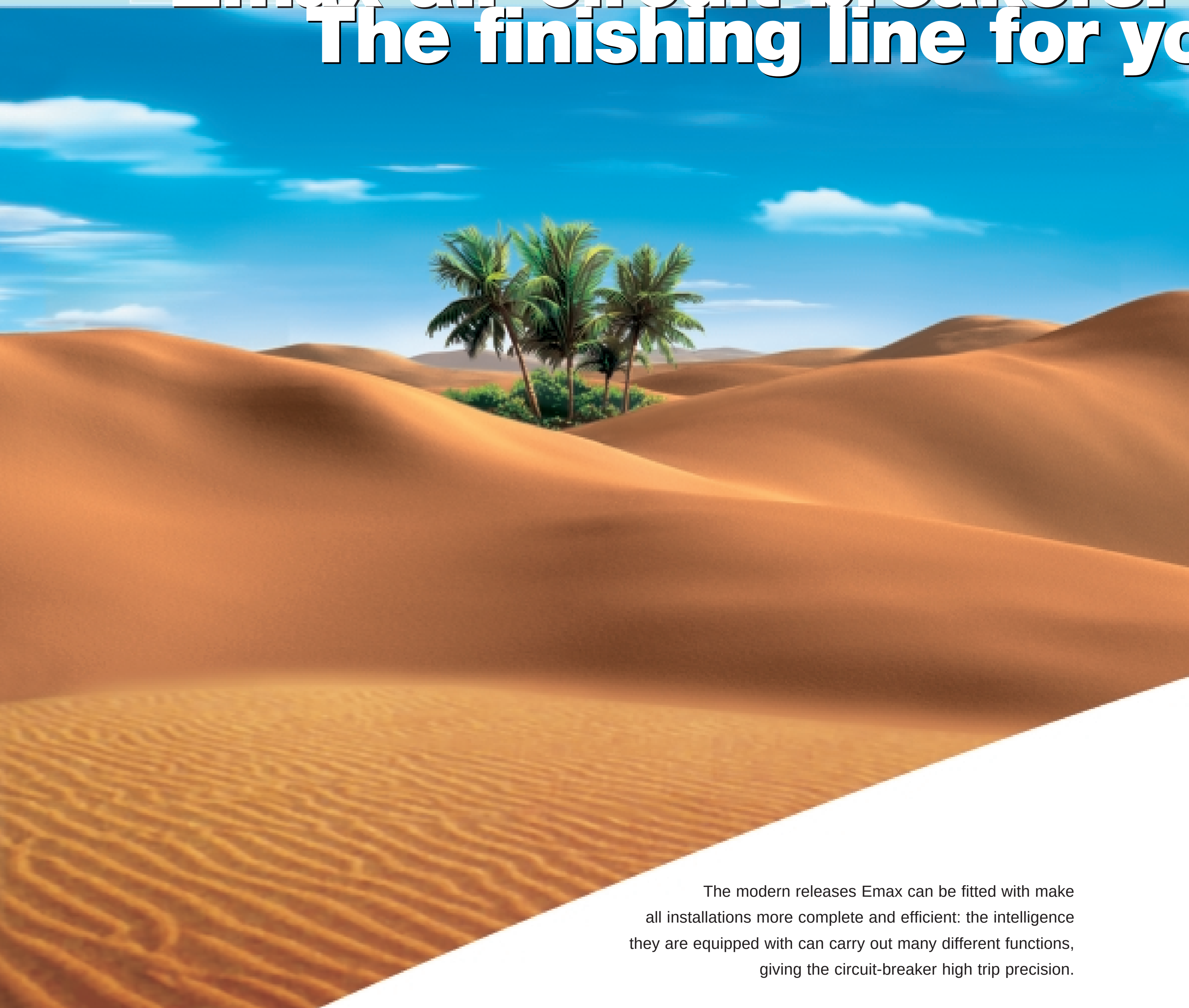
ur solutions.

The strong point - strength.

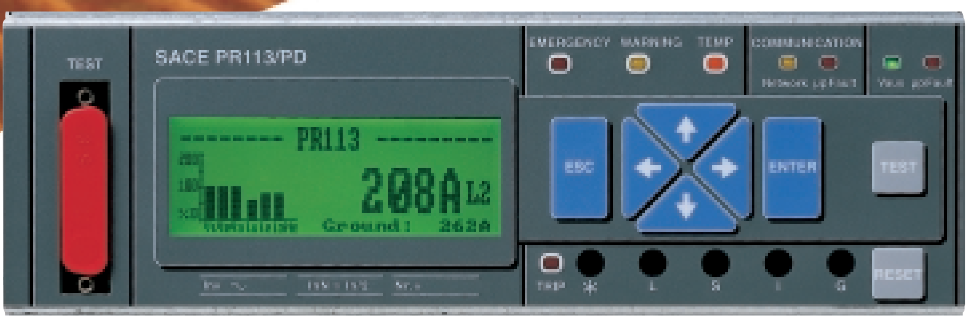
You can tell Emax air circuit-breakers are solid at a glance. Built with an extremely sturdy metal structure, they deal brilliantly with any dynamic or thermal stresses, making each installation reliable and safe. Thanks to the materials used, an Emax air circuit-breaker has a much longer mechanical life compared with the other circuit-breakers in its category, and, during

its very long life span, only requires minimum maintenance. As always, ABB SACE stands out for the quality of its products, for the care and attention it pays to all details - both constructional or technological - to offer the market apparatus which always achieves top performance.

Emax air circuit-breakers. The finishing line for yo



The modern releases Emax can be fitted with make all installations more complete and efficient: the intelligence they are equipped with can carry out many different functions, giving the circuit-breaker high trip precision.



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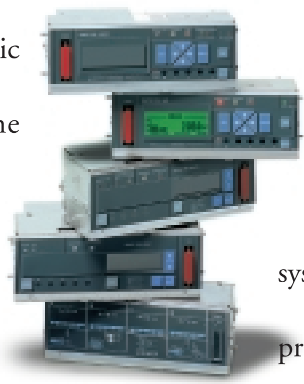
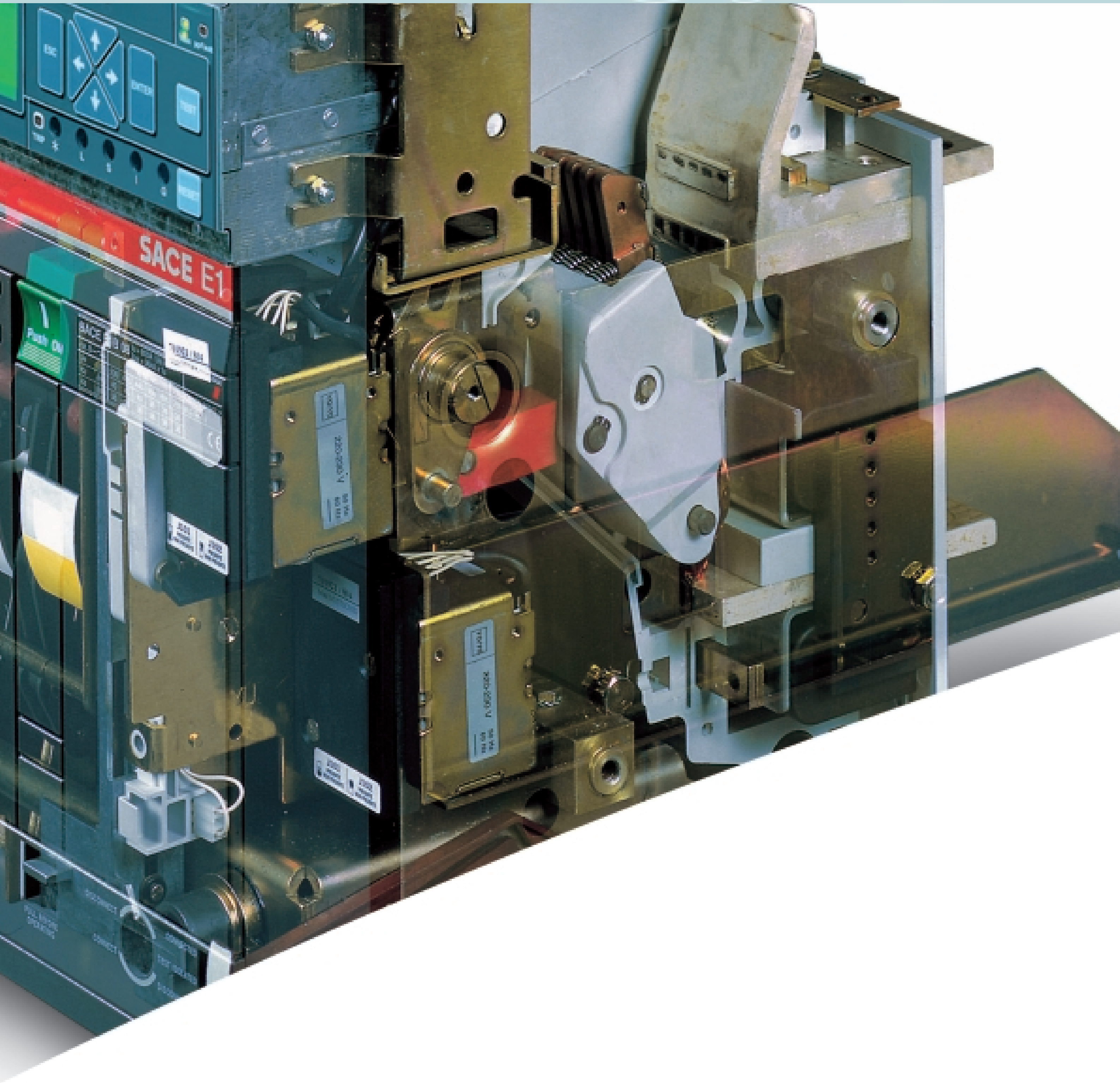
The new intelligence - intelligent.

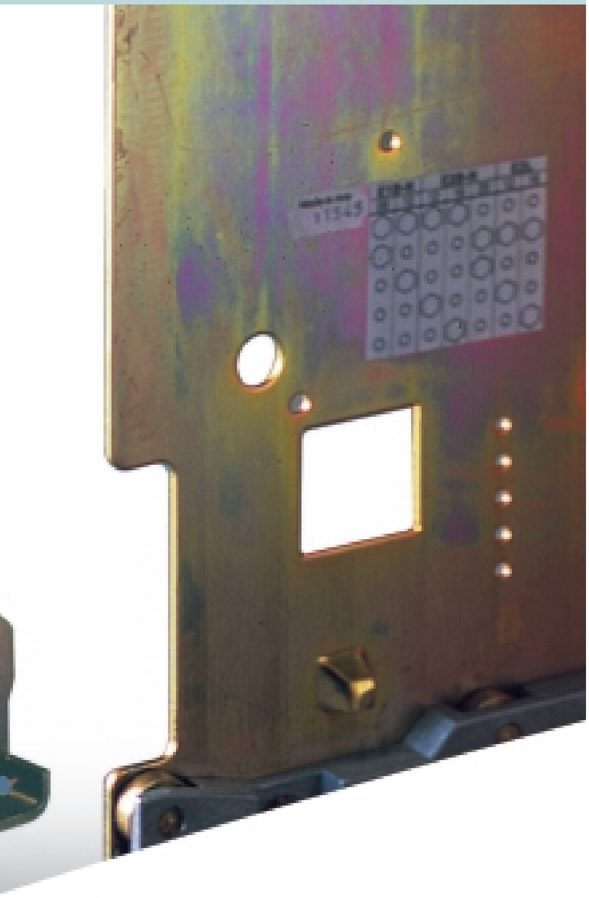
With Emax air circuit-breakers you can always choose the amount of intelligence you need. Like the latest generation PR113 releases, which carry out a complete set of protection, signalling, data storage and control functions. Fitted with a splendid graphic display, these are available both in the protection only and in the protection plus dialogue versions. The PR112 releases have also been improved and new functions have been added, with five languages available to help configure the unit. Moreover, setting protection is carried out using a password.



And there are not only protection functions, but also dialogue functions, meaning that these releases are able to communicate with the most advanced automation and control systems, such as the LON® and Modbus® protocols.

Emax





Main characteristics

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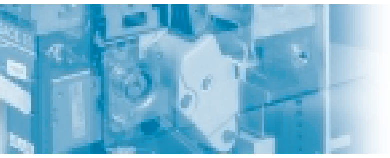
Compliance with Standards



Overview of the SACE Emax family

Fields of application

		E1		E2		
Automatic circuit-breakers		**E1B**	**E1N**	**E2B**	**E2N**	**E2L**
Poles	[No.]	3 - 4			3 - 4	
Neutral capacity of 4p circuit-breakers	[% Iu]	100			100	
Iu (40 °C)	[A]	800-1250	800-1250	1600-2000	1250-1600-2000	1250-1600
Ue	[V~]	690	690	690	690	690
Icu (220...415V)	[kA]	42	50	42	65	130
Ics (220...415V)	[kA]	42	50	42	65	130
Icw (1s)	[kA]	36	50	42	55	10
(3s)	[kA]	36	36	42	42	–

Automatic circuit-breakers with full-size neutral conductor		E1	E2
Poles	[No.]	Standard version	Standard version
Neutral capacity of 4p circuit breakers	[% Iu]		
Iu (40 °C)	[A]		
Ue	[V~]		
Icu (220...415V)	[kA]		
Ics (220...415V)	[kA]		
Icw (1s)	[kA]		
(3s)	[kA]		

Switch-disconnectors		**E1B/MS**	**E1N/MS**	**E2B/MS**	**E2N/MS**
Poles	[No.]	3 - 4	3 - 4	3 - 4	3 - 4
Iu (40 °C)	[A]	800-1250	800-1250	1600-2000	1250-1600-2000
Ue	[V~]	690	690	690	690
Icw (1s)	[kA]	36	50	42	55
(3s)	[kA]	36	36	42	42
Icm (220...440V)	[kA]	75,6	105	88,2	121

Automatic circuit-breakers for applications up to 1000 V AC		**E2B/E**	**E2N/E**
Poles	[No.]	3 - 4	3 - 4
Iu (40 °C)	[A]	1600-2000	1250-1600-2000
Ue	[V~]	1000	1000
Icu (1000V)	[kA]	20	30
Ics (1000V)	[kA]	20	30
Icw (1s)	[kA]	20	30

Switch-disconnectors for applications up to 1000 V AC		**E2B/E MS**	**E2N/E MS**
Poles	[No.]	3 - 4	3 - 4
Iu (40 °C)	[A]	1600-2000	1250-1600-2000
Ue	[V~]	1000	1000
Icw (1s)	[kA]	20	30
Icm (1000V)	[kA]	40	63

Switch-disconnectors for applications up to 1000 V DC		**E1B/E MS**	**E2N/E MS**
Poles	[No.]	3 - 4	3 - 4
Iu (40 °C)	[A]	800-1250	1250-1600-2000
Ue	[V-]	750 (3p)-1000(4p)	750 (3p)-1000(4p)
Icw (1s)	[kA]	20	25
Icm (750V)	[kA]	20	25
(1000V)	[kA]	20	25

Sectionalizing truck		**E1 CS**	**E2 CS**
Iu (40 °C)	[A]	1250	2000

Earthing switch with making capacity		**E1 MTP**	**E2 MTP**
Iu (40 °C)	[A]	1250	2000

Earthing truck		**E1 MT**	**E2 MT**
Iu (40 °C)	[A]	1250	2000

1

E3				E4		E6	
E3N	E3S	E3H	E3L	E4S	E4H	E6H	E6V
3 - 4				3 - 4		3 - 4	
100				50		50	
2500-3200	1250-1600-2000-2500-3200	1250-1600-2000-2500-3200	2000-2500	4000	3200-4000	5000-6300	3200-4000-5000-6300
690	690	690	690	690	690	690	690
65	75	100	130	75	100	100	150
65	75	85	130	75	100	100	125
65	75	75	15	75	100	100	100
65	65	65	–	75	75	85	85

	E4S/f	E6H/f
Standard version	4	4
	100	100
	4000	5000-6300
	690	690
	80	100
	80	100
	80	100
	75	85

E3N/MS	E3S/MS	E4S/MS	E4S/f MS	E4H/MS	E6H/MS	E6H/f MS
3 - 4	3 - 4	3 - 4	4	3 - 4	3 - 4	4
2500-3200	1250-1600-2000-2500-3200	4000	4000	3200-4000	5000-6300	5000-6300
690	690	690	690	690	690	690
65	75	75	80	100	100	100
65	65	75	75	75	85	85
143	165	165	176	220	220	220

E3H/E	E4H/E
3 - 4	3 - 4
1250-1600-2000-2500-3200	3200-4000
1000	1000
50	65
50	65
50	65

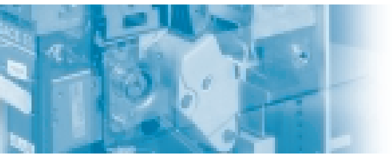
E3H/E MS	E4H/E MS
3 - 4	3 - 4
1250-1600-2000-2500-3200	3200-4000
1000	1000
50	65
105	143

E3H/E MS	E4H/E MS
3 - 4	3
1250-1600-2000-2500-3200	3200-4000
750 (3p)-1000(4p)	750
40	65
40	65
40	–

E3 CS	E4 CS	E6 CS
3200	4000	6300

E3 MTP	E4 MTP	E6 MTP
3200	4000	6300

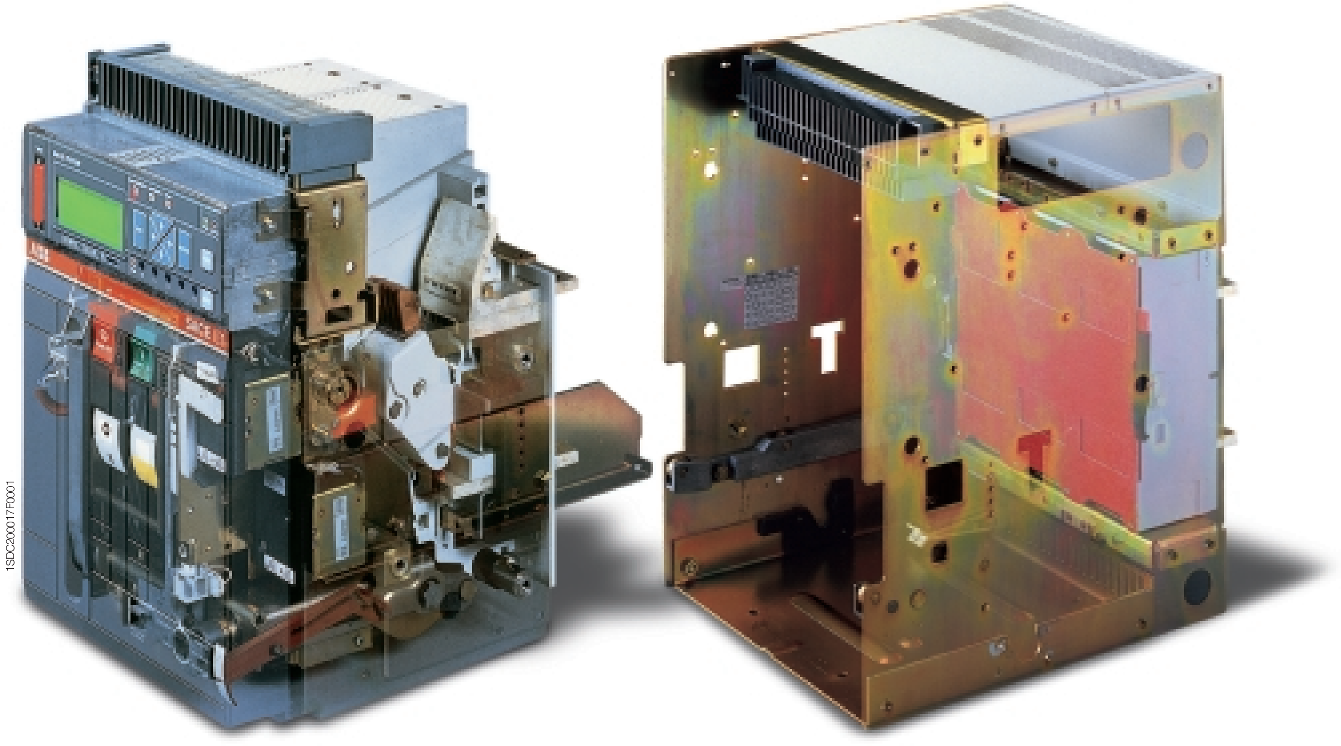
E3 MT	E4 MT	E6 MT
3200	4000	6300



Construction characteristics

Structure of the circuit-breakers

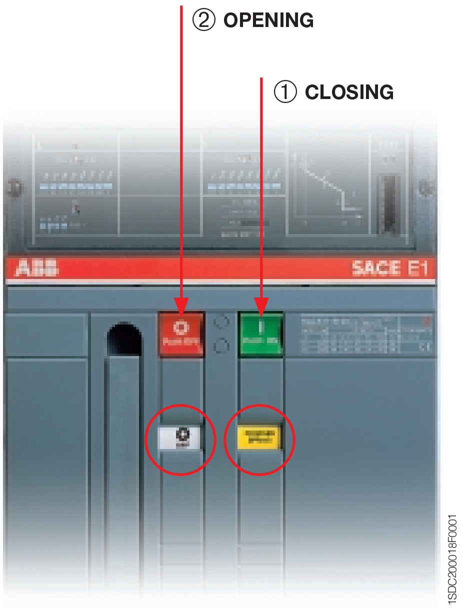
The sheet steel structure of the circuit-breaker is extremely compact, considerably reducing overall dimensions.
Safety is improved by adopting double insulation for the live parts and total segregation between phases.
The sizes have the same height and depth for all of the circuit-breakers in each version.
The depth of the withdrawable version is suitable for installation of switchboards 500 mm deep.
The width of 324 mm (up to 2000 A) in the withdrawable version allows the equipment to be used in switchboard compartments 400 mm wide. The compact dimensions also allow them to replace air circuit breakers of any size from earlier series.

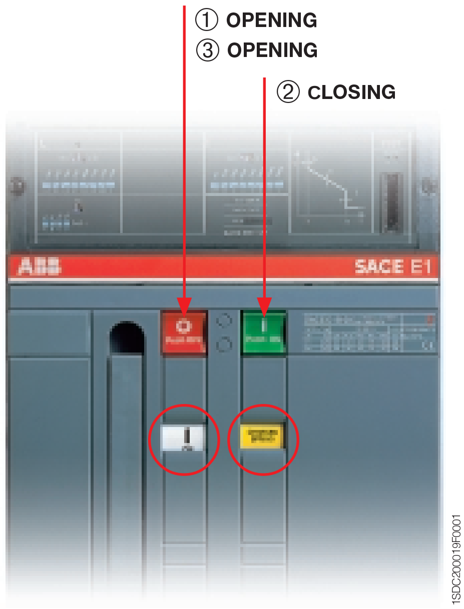


Construction characteristics

Operating mechanism

The operating mechanism is of the stored energy type, operated using pre-charged springs.
The springs are charged manually by operating the front lever or using a gearmotor, supplied on request.
The opening springs are charged automatically during the closing operation.
With the operating mechanism fitted with shunt closing and opening releases and the gearmotor for charging the springs, the circuit-breaker can be operated by remote control and, if required, co-ordinated by a supervision and control system.

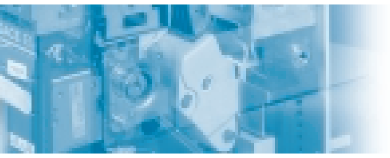




The following operating cycles are possible without recharging the springs:
- starting with the circuit-breaker open (0) and the springs charged ■:
  closing-opening
- starting with the circuit-breaker closed (I) and the springs charged ■:
  opening-closing-opening.

The same operating mechanism is used for the entire series and is fitted with a mechanical and electrical anti-pumping device.

1

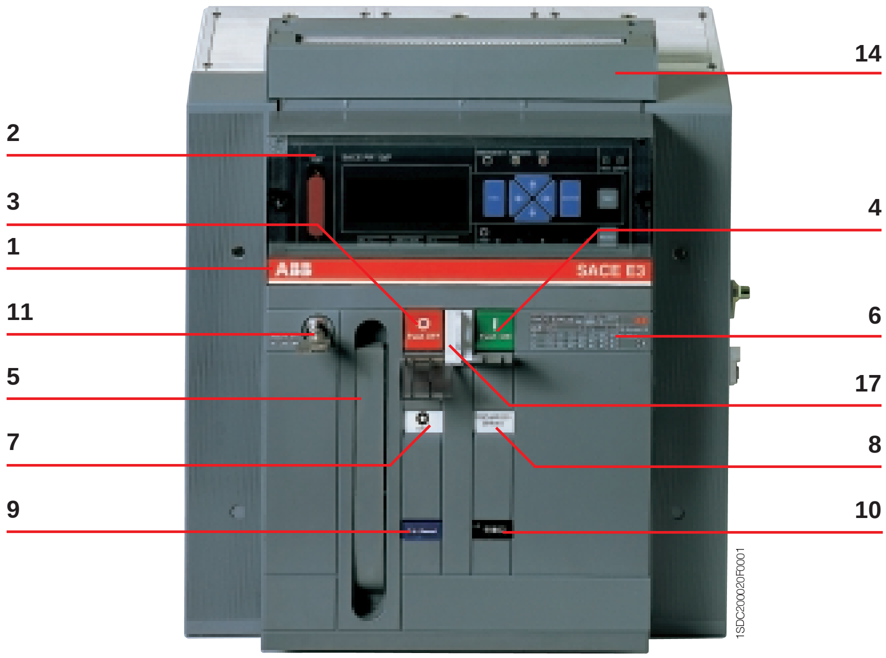


Construction characteristics

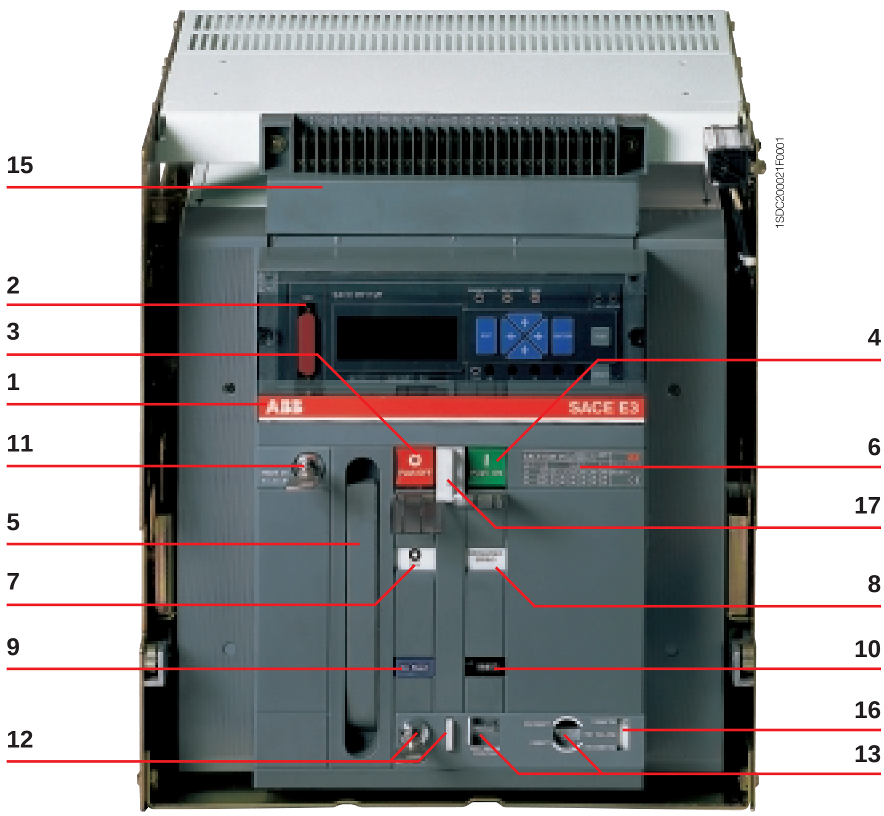
Operating and signalling parts

1

Fixed version



Withdrawable version



Legend

1	Trademark and size of circuit-breaker
2	SACE PR111, PR112 or PR113 Release
3	Pushbutton for manual opening
4	Pushbutton for manual closing
5	Lever to manually charge closing springs
6	Electrical rating plate
7	Mechanical device to signal circuit-breaker open “O” and closed “I”
8	Signal for springs charged or discharged
9	Mechanical signal for protection release tripped
10	Operation counter
11	Key lock in open position
12	Key lock and padlock in racked-in/racked-out position (for withdrawable version only)
13	Racking-in/racking out device (for withdrawable version only)
14	Terminal box (for fixed version only)
15	Sliding contacts (for withdraw-able version only)
16	Circuit breaker position indicator: racked-in/ test isolated /racked-out / connected/test isolated/disconnected (for withdrawable version only)
17	Padlock device in open position

Note:
“Racked-in” refers to the position in which both the power contacts and auxiliary contacts are connected; “racked-out” is the position in which both the power contacts and auxiliary contacts are disconnected; “test isolated” is the position in which the power contacts are disconnected, while the auxiliary contacts are connected.

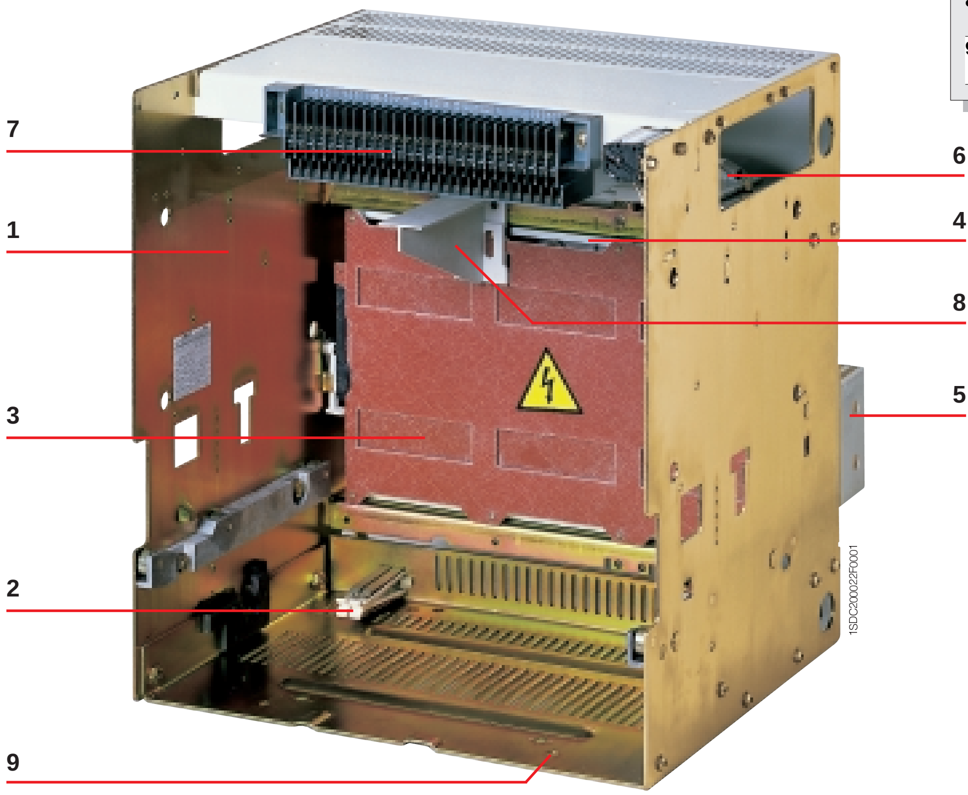
Construction characteristics

Fixed parts of withdrawable circuit-breakers

The fixed parts of withdrawable circuit-breakers have shutters for segregating the fixed contacts when the circuit-breaker is withdrawn from the compartment. These can be locked in their closed position using padlock devices.

Legend

1	Sheet steel supporting structure
2	Single earthing clamp mounted on the left for E1, E2 and E3, double earthing clamps for E4 and E6
3	Safety shutters (protection rating IP20)
4	Terminal support base
5	Terminals (rear, front or flat)
6	Contacts signalling that the circuit-breaker is racked-in, test isolated, racked-out
7	Sliding contacts
8	Padlock device for safety shutters (on request)
9	Fastening points (4 for E1, E2, E3 and 6 for E4, E6)

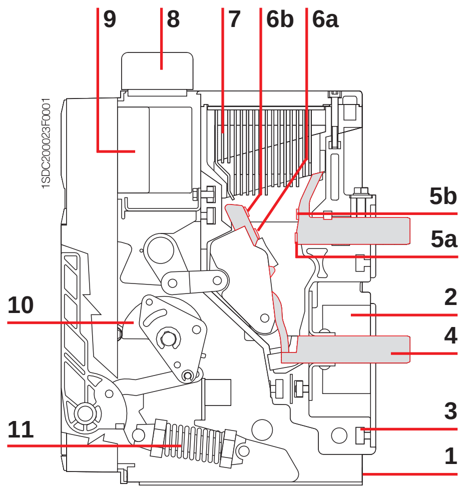


Selective and current-limiting circuit-breakers

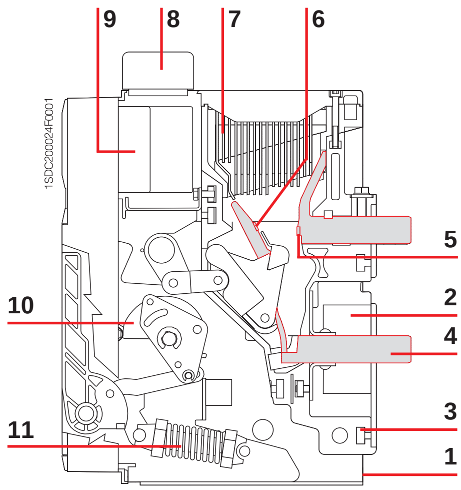
Selective (non current-limiting) **circuit-breakers** are classified in class B (according to IEC 60947-2 Standard). It is important to know their Icw values in relation to any possible delayed operations in the event of short-circuits.

The **current-limiting circuit-breakers** E2L and E3L belong to class A. The short-term current Icw is not very important for these circuit-breakers, and is necessarily low due to the operating principle on which they are based. The fact that they belong to class A does not preclude the possibility of obtaining the necessary selectivity (e.g. current-type or time-type selectivity) within the Icw rated short-time withstand current thresholds.
The special advantages of current-limiting circuit-breakers are also worthy of emphasis. Indeed, they make it possible to:
- significantly reduce the peak current in relation to the prospective value;
- drastically limit specific let-through energy.

The resultant benefits include:
- reduced electrodynamic stresses;
- reduced thermal stresses;
- savings on the sizing of cables and busbars;
- the possibility of coordinating with other circuit-breakers in the series for back-up or discrimination.



Selective circuit-breaker
E1 B-N, E2 B-N, E3 N-S-H, E4 S-H, E6 H-V



Current-limiting circuit-breaker
E2 L, E3 L

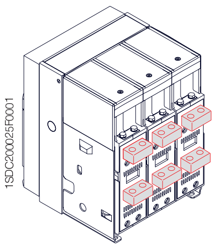
Legend

1	Sheet steel supporting structure
2	Current transformer for protection release
3	Pole group insulating box
4	Horizontal rear terminals
5-5a	Plates for fixed main contacts
5b	Plates for fixed arc-breaking contacts
6-6a	Plates for main moving contacts
6b	Plates for moving arc-breaking contacts
7	Arcing chamber
8	Terminal box for fixed version - Sliding contacts for withdrawable version
9	Protection release
10	Circuit-breaker closing and opening control
11	Closing springs

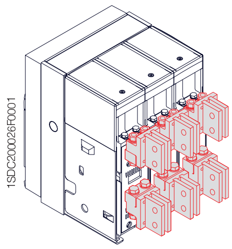
Versions and connections

All circuit-breakers are available in fixed and withdrawable, three-pole or four-pole versions.
Each series of circuit-breakers offers terminals made of silver-plated copper bars in the same sizes, regardless of the rated currents of the circuit-breakers.
The fixed parts for withdrawable circuit-breakers are common to each model, regardless of the rated current and breaking capacity.
A version with gold-plated terminals is available for circuit breakers that must be used in corrosive environments.
The availability of various types of terminals makes it possible to build wall-mounted switchboards, or switchboards to be accessed from behind with rear connections.
For special installation needs, the circuit-breakers may be fitted with various combinations of upper and lower terminals.

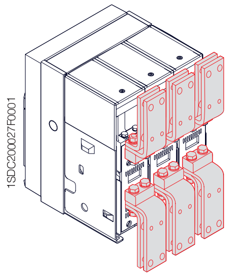
Fixed circuit-breaker



Horizontal rear terminals

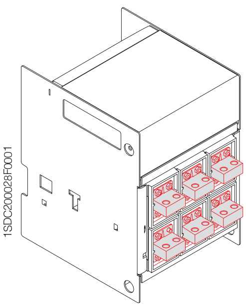


Vertical rear terminals

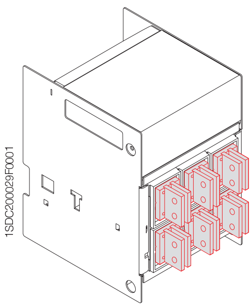


Front terminals

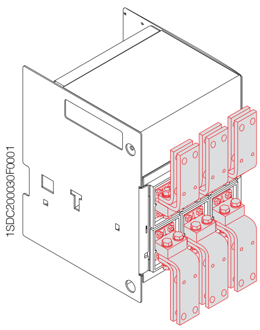
Withdrawable circuit-breaker



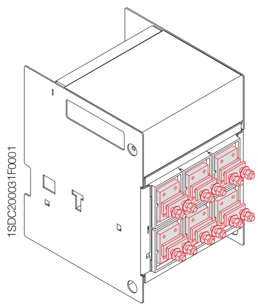
Horizontal rear terminals



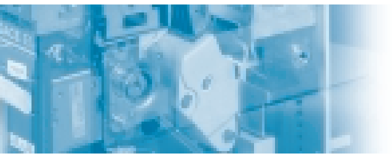
Vertical rear terminals



Front terminals



Flat terminals



Microprocessor-based overcurrent releases

General specifications

The overcurrent protection for AC installations uses three types of microprocessor-based releases in the SACE PR111, PR112 and PR113 series, which can be installed as alternatives to one another on SACE Emax circuit-breakers:

- SACE PR111 with protection functions only
- SACE PR112 with protection, current measurement and dialogue functions
- SACE PR113 with a complete set of functions for protection, measurement, signalling, control and dialogue.

The protection systems can be three-phase or three-phase with neutral depending on the type of circuit-breaker used (three-pole, three-pole with external neutral or four-pole).

The protection system is made up of:

- 3 or 4 current transformers (CT) depending on the number of circuit-breaker poles; the fourth CT may be external
- a protection unit selected from among SACE PR111/P, SACE PR112/P and SACE PR113/P, or a protection and communication unit selected from among SACE PR112/PD with LON® or Modbus® protocol and SACE PR113/PD with Modbus® protocol
- an opening solenoid which acts directly on the circuit-breaker's operating mechanism (supplied with the protection unit).

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Microprocessor-based overcurrent releases

Versions available

General specifications of the microprocessor-based releases include:

- operation without the need for an external power supply
- microprocessor technology (8-bit for SACE PR111 and 16-bit for SACE PR112 and PR113)
- high precision
- sensitivity to the true r.m.s. value of the current
- interchangeability among all types of releases
- setting for neutral normally 50% of setting for phases, with possibility of setting it to 100% (on request only for circuit -breakers E1, E2, E3 standard and E4/f, E6/f full-size versions).

For the release PR113, it is also possible to select neutral protection at 150% and 200% of the rated current of the phases, if compatible with the setting of the current transformers.
The main performance features of the releases are listed in the tables below.

1

SACE PR111

	PR111/P	PR111/P	PR111/P
Protection	L S I G	L S I	L I

SACE PR112

	PR112/P	PR112/P		
Protection	L S I G	L S I		
	PR112/PD Modbus	PR112/PD Modbus	PR112/PD LON	PR112/PD LON
Protection and communication	L S I G	L S I	L S I G	L S I

SACE PR113

	PR113/P
Protection	L S I G D U OT UV OV RV RP M
	PR113/PD Modbus
Protection and communication	L S I G D U OT UV OV RV RP M

Microprocessor-based overcurrent releases

Versions available

Features

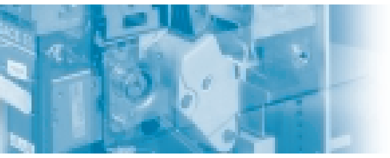
Protection functions	PR111	PR112	PR113
L Inverse long time-delay trip overload protection	■	■	■
Adjustable-slope curve (IEC 60255-3)			■
S Selective short-circuit protection with inverse or definite short time-delay trip	■	■	■
I Instantaneous short-circuit protection with adjustable trip current threshold	■	■	■
G Earth fault protection — residual (internal sensor)	■	■	■
source ground return (external sensor)		■	■
D Directional short-circuit protection with adjustable delay			■
U Protection against phase umbalance			■
OT Protection against overtemperature		■	■
UV OV Undervoltage and overvoltage protection			■
RV Residual voltage protection / neutral displacement protection			■
RP Reverse power protection			■
M Thermal memory for L and S functions		■	■
Measurements			
Currents (phases, neutral, earth fault)		■	■
Voltage (phase-phase, phase-neutral, residual)			■
Power (active, reactive, apparent)			■
Power factor			■
Frequency and peak factor			■
Energy (active, reactive, apparent, counter)			■
Harmonics calculation (displays waveform and module of the harmonics)			■
Maintenance events and data			
Events stored in chronological order		■	■
Counting number of operations and contact wear		■	■
Communication with centralized supervision and control system			
Remote setting of parameters for protection functions, unit configuration and communication		■	■
Transmission of measurements, states and alarms from circuit-breaker to system		■	■
Transmission of maintenance events and data from circuit-breaker to system		■	■
Self-test			
Alarm and tripping for release overtemperature		■	■
Alarm for microprocessor fault		■	■
User interface			
Parameters set using DIP switches	■		
Parameters set using keys and liquid crystal display		■	■
Alarm signals for L, S, I and G functions		■	■
Alarm signalling one of the following protections: undervoltage, overvoltage, residual voltage, reverse power			■
Imbalance phase and overtemperature signal		■	■
Complete management of pre-alarms and alarms for all protection and self-monitoring functions		■	■
Password for use with “READ” or “EDIT” mode		■	■
Load control			
Connection-disconnection of loads in relation to the current flowing through the circuit-breaker		■	■
Zone selectivity			
May be activated for protection functions S or G		■	
May be activated for protection functions S, G or D			■
Number of programmable contacts		1	2
Start-up function S, D, I and G			■

Microprocessor-based overcurrent releases

Setting the current transformers

Rated CT current In [A]

Type of circuit-breaker	Rated current I_u	R250	R400	R800	R1000	R1250	R1600	R2000	R2500	R3200	R4000	R5000	R6300
E1B E1N	800	■	■	■									
	1250	■	■	■	■	■							
E2B	1600	■	■	■	■	■	■						
	2000	■	■	■	■	■	■	■					
E2N	1250	■	■	■	■	■							
	1600	■	■	■	■	■	■						
	2000	■	■	■	■	■	■	■					
E2L	1250	■	■	■	■	■							
	1600	■	■	■	■	■	■						
E3N	2500	■	■	■	■	■	■	■	■				
	3200	■	■	■	■	■	■	■	■	■			
E3S E3H	1250	■	■	■	■	■							
	1600	■	■	■	■	■	■						
	2000	■	■	■	■	■	■	■					
	2500	■	■	■	■	■	■	■	■				
	3200	■	■	■	■	■	■	■	■	■			
E3L	2000	■	■	■	■	■	■	■					
	2500	■	■	■	■	■	■	■	■				
E4S	4000							■		■	■		
E4H	3200							■		■			
	4000							■		■	■		
E4S/f	4000							■		■	■		
E6H	5000									■	■	■	
	6300									■	■	■	■
E6H/f	5000									■	■	■	
	6300									■	■	■	■
E6V	3200									■			
	4000									■	■		
	5000									■	■	■	
	6300									■	■	■	■



Compliance with Standards

Standards, approvals and certifications

SACE Emax circuit-breakers and their accessories meet the international standards IEC 60947, EN 60947 (harmonized in 17 CENELEC countries), CEI EN 60947 and IEC 61000, and comply with EC directive:

– “Low Voltage Directive” (LVD) nr. 73/23 EEC
– “Electromagnetic Compatibility Directive” (EMC) nr. 89/336 EEC.

The main versions of the equipment are approved by the following Shipping Registries:

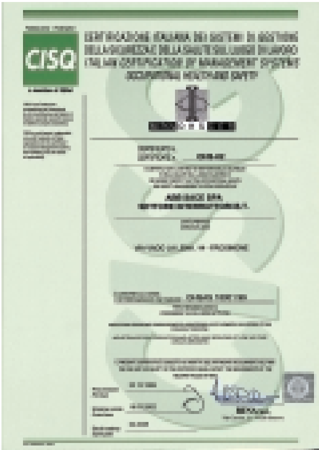
– RINA (Registro Italiano Navale)
– Det Norske Veritas
– Bureau Veritas
– Germanischer Lloyd
– Loyd’s Register of Shipping
– Polskj Reiestr Statkow
– Gost
– ABS (American Bureau of Shipping)
– NK

Note: Contact ABB SACE for a list of approved types of circuit breakers, approved performance data and the corresponding validity

Certification of conformity with the aforementioned product Standards is carried out in compliance with European Standard EN 45011 by the Italian certification body ACAE (Associazione per la Certificazione delle Apparecchiature Elettriche - Association for the Certification of Electrical Equipment), recognized by the European organization LOVAG (Low Voltage Agreement Group).

Compliance with Standards

A design dedicated to Quality and respect for the environment



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Quality has always been the leading commitment of ABB SACE. This commitment involves every function of the company, and has allowed us to achieve prestigious recognition internationally.

The company's Quality System is certified by RINA, one of the most prestigious international certification boards, and complies with ISO 9001 Standards; the ABB SACE test facility is accredited by SINAL; the plants in Frosinone, Patrica, Vittuone and Garbagnate Monastero are also certified in compliance with OHSAS 18001 Standards for workplace health and safety.
ABB SACE, Italy's first industrial company in the electro-mechanical sector to achieve this, has been able to reduce its raw material consumption and machining scrap by 20% thanks to an ecology-centred revision of its manufacturing process. All of the company's Divisions are involved in streamlining raw material and energy consumption, preventing pollution, limiting noise pollution and reducing scrap resulting from manufacturing processes, as well as to carrying out periodic environmental audits of leading suppliers.

ABB SACE is committed to environmental protection, as also evidenced by the Life Cycle Assessments (LCA) of products carried out at the Research Center: thus assessments and improvements of the environmental performance of products throughout their life cycle are included right from the initial engineering stage. The materials, processes and packaging used are chosen with a view to optimizing the actual environmental impact of each product, including its energy efficiency and recyclability.

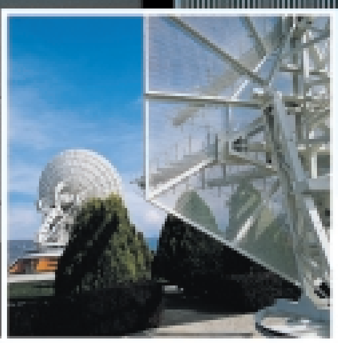
ENVIRONMENTAL MANAGEMENT
SYSTEM CERTIFIED
RINA
EMS CER
ISO 14001

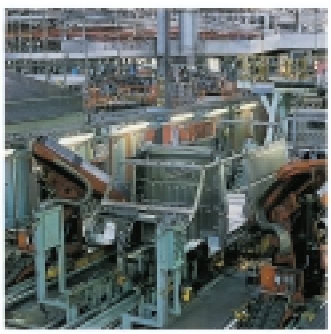
1SDC200051F0001

1

Emax


SACE PR112/P
WARNING EMERGENCY
TEST
ESC
SACE E2
Push OFF
Push ON
OFF
DISCHARGED SPRING
SACE PR113/PD
EMERGENCY WARNING TEMP COMMUNICATION
PR113
208A L2
ESC
ENTER
ABB
Push OFF



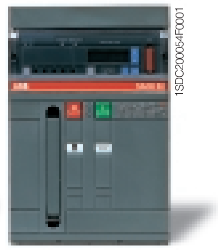


The Ranges

Contents

SACE Emax automatic circuit-breakers

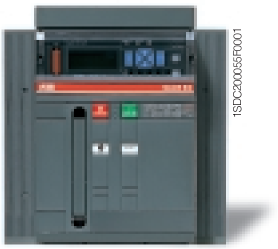
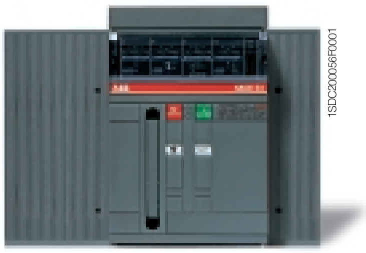
Shared specifications		
Voltages		
Rated service voltage **Ue**	[V]	690 ~
Rated insulation voltage **Ui**	[V]	1000
Rated impulse withstand voltage **Uimp**	[kV]	12
Test voltage at industrial frequency for 1 minute	[V]	3500 ~
Service temperature	[°C]	-25....+70
Storage temperature	[°C]	-40....+70
Frequency f	[Hz]	50 - 60
Number of poles		3 - 4
Versions		Fixed - Withdrawable



			E1		E2		
Performance levels			B	N	B	N	L
Currents							
Rated uninterrupted current (at 40 °C) Iu		[A]	**800**	**800**	**1600**	**1250**	**1250**
		[A]	**1250**	**1250**	**2000**	**1600**	**1600**
		[A]				**2000**	
		[A]					
		[A]					
Capacity of neutral pole on four-pole circuit-breakers		[%Iu]	100	100	100	100	100
Rated ultimate short-circuit breaking capacity **Icu**							
220/230/380/400/415 V ~		[kA]	42	50	42	65	130
440 V ~		[kA]	42	50	42	65	110
500/660/690 V ~		[kA]	36	36	42	55	85
Rated service short-circuit breaking capacity **Ics**							
220/230/380/400/415 V ~		[kA]	42	50	42	65	130
440 V ~		[kA]	42	50	42	65	110
500/660/690 V ~		[kA]	36	36	42	55	65
Rated short-time withstand current Icw	(1s)	[kA]	36	50	42	55	10
	(3s)		36	36	42	42	–
Rated short-circuit making capacity (peak value) **Icm**							
220/230/380/400/415 V ~		[kA]	88,2	105	88,2	143	286
440 V ~		[kA]	88,2	105	88,2	143	242
500/660/690 V ~		[kA]	75,6	75,6	88,2	121	187
Utilisation category (in accordance with IEC 60947-2)			B	B	B	B	A
Isolation behavior (in accordance with IEC 60947-2)			■	■	■	■	■
Overcurrent protection							
Microprocessor-based releases for AC applications			■	■	■	■	■
Operating times							
Closing time (max)		[ms]	80	80	80	80	80
Break time for I<Icw (max) (1)		[ms]	70	70	70	70	70
Break time for I>Icw (max)		[ms]	30	30	30	30	12
Overall dimensions							
Fixed: H = 418 mm - D = 302 mm L (3/4 poles)		[mm]	296/386		296/386		
Withdrawable: H = 461 mm - D = 396.5 mm L (3/4 poles)		[mm]	324/414		324/414		
Weights (circuit-breaker complete with releases and CT, not including accessories)							
Fixed 3/4 poles		[kg]	45/54	45/54	50/61	50/61	52/63
Withdrawable 3/4 poles (including fixed part)		[kg]	70/82	70/82	78/93	78/93	80/95

(1) Without intentional delays (2) Performance at 600 V is 100 kA (3) Performance at 500 V is 100 kA

		E1 B-N		E2 B-N			E2 L	
Rated uninterrupted current (a 40 °C) **Iu**	[A]	800	1250	1250	1600	2000	1250	1600
Mechanical life with regular routine maintenance	[No. operations x 1000]	25	25	25	25	25	20	20
Frequency	[Operations per hour]	60	60	60	60	60	60	60
Electrical life	(440 V ~) [No. operations x 1000]	10	10	15	12	10	4	3
	(690 V ~) [No. operations x 1000]	10	8	15	10	8	3	2
Frequency	[Operations per hour]	30	30	30	30	30	20	20


E3				E4		E6	
N	S	H	L	S	H	H	V
2500	**1250**	**1250**	**2000**	**4000**	**3200**	**5000**	**3200**
3200	**1600**	**1600**	**2500**		**4000**	**6300**	**4000**
	2000	**2000**					**5000**
	2500	**2500**					**6300**
	3200	**3200**					
100	100	100	100	50	50	50	50
65	75	100	130	75	100	100	150
65	75	100	110	75	100	100	150
65	75	85 [2]	85	75	85 [2][3]	100	100
65	75	85	130	75	100	100	125
65	75	85	110	75	100	100	125
65	75	85	65	75	85 [3]	100	100
65	75	75	15	75	100	100	100
65	65	65	–	75	75	85	85
143	165	220	286	165	220	220	330
143	165	220	242	165	220	220	330
143	165	187	187	165	187	220	220
B	B	B	A	B	B	B	B
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
80	80	80	80	80	80	80	80
70	70	70	70	70	70	70	70
30	30	30	12	30	30	30	30
404/530				566/656		782/908	
432/558				594/684		810/936	
66/80	66/80	66/80	72/83	97/117	97/117	140/160	140/160
104/125	104/125	104/125	110/127	147/165	147/165	210/240	210/240

E3 N-S-H					E3 L		E4 S-H		E6 H-V			
1250	1600	2000	2500	3200	2000	2500	3200	4000	3200	4000	5000	6300
20	20	20	20	20	15	15	15	15	12	12	12	12
60	60	60	60	60	60	60	60	60	60	60	60	60
12	10	9	8	6	2	1,8	7	5	5	4	3	2
12	10	9	7	5	1,5	1,3	7	4	5	4	2	1,5
20	20	20	20	20	20	20	10	10	10	10	10	10

Automatic circuit-breakers with full-size neutral conductor

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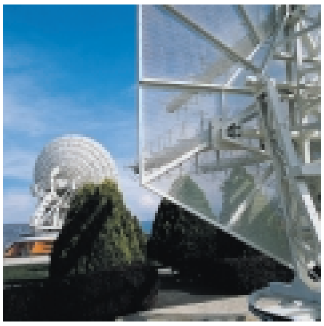

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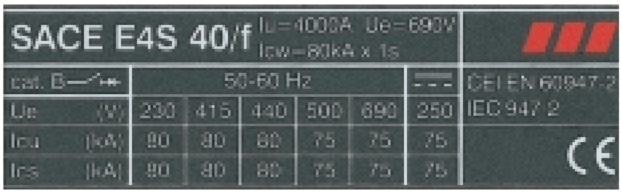
The Emax range of automatic circuit-breakers with full-size neutral conductor is used in special applications where the presence of triple-N harmonics on individual phases may lead to a very high current on the neutral conductor.
Typical applications include installations with loads having high harmonics distortion (computers and electronic devices in general), lighting systems with a large number of fluorescent lamps, systems with inverters and rectifiers, UPS, systems for adjusting the speed of electric motors.
This range includes standard circuit-breakers with full-size neutral conductor in sizes E1, E2, E3. Models E4 and E6 are available in the "Full size" version up to rated currents of 6300A.
Models E4/f and E6/f are available in fixed and withdrawable four-pole versions. These models may be fitted with all accessories available for the Emax range; the exception, on the E6/f model, are the mechanical interlocks made using flexible wires and 15 external auxiliary contacts, which are therefore incompatible.
All the models may be fitted with all available versions of electronic protection relays, in the standard version.



1SDC200059F0001

			E4S/f	E6H/f
Rated uninterrupted current (at 40 °C) Iu		[A]	**4000**	**5000**
		[A]		**6300**
Number of poles			4	4
Rated service voltage **Ue**		[V ~]	690	690
Rated ultimate short-circuit breaking capacity **Icu**				
	220/230/380/400/415 V ~	[kA]	80	100
	440 V ~	[kA]	80	100
	500/660/690 V ~	[kA]	75	100
Rated service short-circuit breaking capacity **Ics**				
	220/230/380/400/415 V ~	[kA]	80	100
	440 V ~	[kA]	80	100
	500/660/690 V ~	[kA]	75	100
Rated short-time withstand current **Icw**				
	(1s)	[kA]	80	100
	(3s)	[kA]	75	85
Rated short-circuit making capacity (peak value) **Icm**		[kA]	176	220
Application category (in accordance with IEC 60947-2)			B	B
Isolation behavior (in accordance with IEC 60947-2)			■	■
Overall dimensions				
	Fixed: H = 418 mm - D = 302 mm L	[mm]	746	1034
	Withdrawable: H = 461 - D = 396.5 mm L	[mm]	774	1062
Weights (circuit-breaker complete with releases and CT, not including accessories)				
	Fixed	[kg]	120	165
	Withdrawable (including fixed part)	[kg]	170	250

Switch-disconnectors

1SDC200060F0001

The switch-disconnectors are derived from the corresponding automatic circuit-breakers, of which they maintain the overall dimensions and the possibility of mounting accessories.
This version differs from the automatic circuit-breakers only in the absence of overcurrent releases.
The circuit-breaker is available in both fixed and withdrawable versions, three-pole and four-pole. The switch-disconnectors, identified by the label "/MS", may be used according to the category of use AC-23A (switching motor loads or other highly inductive loads) in accordance with the standard IEC 60947-3. The electrical specifications of the switch-disconnectors are listed in the table below.

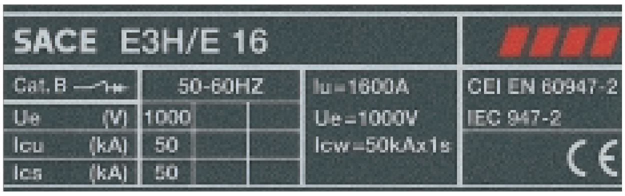
2

			E1B/MS	E1N/MS	E2B/MS	E2N/MS	E3N/MS	E3S/MS	E4S/MS	E4S/fMS	E4H/MS	E6H/MS	E6H/f MS
Rated uninterrupted current (a 40 °C) Iu		[A]	**800**	**800**	**1600**	**1250**	**2500**	**1250**	**4000**	**4000**	**3200**	**5000**	**5000**
		[A]	**1250**	**1250**	**2000**	**1600**	**3200**	**1600**			**4000**	**6300**	**6300**
		[A]				**2000**		**2000**					
		[A]						**2500**					
		[A]						**3200**					
Rated service voltage **Ue**		[V ~]	690	690	690	690	690	690	690	690	690	690	690
		[V –]	250	250	250	250	250	250	250	250	250	250	250
Rated insulation voltage **Ui**		[V ~]	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Rated impulse withstand voltage **Uimp**		[kV]	12	12	12	12	12	12	12	12	12	12	12
Rated short-time withstand current **Icw**	(1s)	[kA]	36	50	42	55	65	75	75	80	100	100	100
	(3s)	[kA]	36	36	42	42	65	65	75	75	75	85	85
Rated short-circuit making capacity (peak value) **Icm**													
220/230/380/400/415/440 V ~		[kA]	75,6	105	88,2	121	143	165	165	176	220	220	220
500/660/690 V ~		[kA]	75,6	75,6	88,2	121	143	165	165	165	187	220	220

Automatic circuit-breakers for applications up to 1000V AC

1SDC200061F0001

SACE Emax circuit-breakers may be supplied in a special version for rated service voltages up to 1000 V in AC.
Circuit-breakers in this version are identified by the label of the standard range (rated service voltage up to 690 V AC) plus "/E", and are derived from the corresponding standard SACE Emax circuit-breakers. They offer the same versions and accessories as the latter. The SACE Emax range of circuit-breakers for applications up to 1000V in AC may be either fixed and withdrawable, in both three-pole and four-pole versions. SACE Emax/E circuit-breakers are especially suitable for installation in mines, oil and chemical plants, and for traction.
The table below shows the electrical specifications of the range.



1SDC200062F0001

		E2B/E		E2N/E			E3H/E					E4H/E	
Rated uninterrupted current (at 40 °C) Iu	[A]	**1600**	**2000**	**1250**	**1600**	**2000**	**1250**	**1600**	**2000**	**2500**	**3200**	**3200**	**4000**
Rated service voltage **Ue**	[V~]	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Rated ultimate short-circuit breaking capacity **Icu**	[kA]	20	20	30	30	30	50	50	50	50	50	65	65
Rated service short-circuit breaking capacity **Ics**	[kA]	20	20	30	30	30	50	50	50	50	50	65	65
Rated short-time withstand current **Icw** (1s)	[kA]	20	20	30	30	30	50	50	50	50	50	65	65

Switch-disconnectors for applications up to 1000V AC

1SDC200061F0001

The switch-disconnectors complete the range of equipment for applications at 1000V in alternating current (AC). These circuit-breakers meet international IEC standard 60947-3.
Circuit-breakers in this version are identified by the label of the standard range, where the rated service voltage is up to 690 V AC, plus “/E”, thus becoming SACE Emax/E MS. They are derived from the corresponding standard SACE Emax switch-disconnectors.
They are available in three-pole and four-pole, both in the fixed and withdrawable versions in the same sizes, accessory options and installations as the corresponding standard circuit-breakers. All accessories available for the SACE Emax range may be used. Standard fixed parts may also be used for circuit-breakers in the withdrawable version.

2

		E2B/E MS	E2N/E MS	E3H/E MS	E4H/E MS
Rated uninterrupted current (at 40 °C) Iu	[A]	**1600**	**1250**	**1250**	**3200**
	[A]	**2000**	**1600**	**1600**	**4000**
	[A]		**2000**	**2000**	
	[A]			**2500**	
	[A]			**3200**	
Number of poles		3/4	3/4	3/4	3/4
Rated AC service voltage **Ue**	[V]	1000	1000	1000	1000
Rated AC insulation voltage **Ui**	[V]	1000	1000	1000	1000
Rated impulse withstand voltage **Uimp**	[kV]	12	12	12	12
Rated short-time withstand current **Icw** (1s)	[kA]	20	30	50	65
Rated making capacity **Icm** 1000 VAC (peak value)	[kA]	40	63	105	143

Switch-disconnectors for applications up to 1000V DC

1SDC200061F0001

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ABB SACE has developed the SACE Emax/E MS range of switch-disconnectors for applications in direct current up to 1000V in compliance with international standard IEC60947-3. These non-automatic circuit-breakers are especially suitable for use as busbar links or main isolators in direct current systems, such as for applications involving electric traction.
The range covers all installation needs up to 1000V DC / 3200A or up to 750V DC/ 4000A.
They are available in fixed and withdrawable versions, three-pole and four-pole.
By connecting three breaking poles in series, it is possible to achieve a rated insulation voltage of 750V DC, while with four poles in series the limit rises to 1000V DC.
The switch-disconnectors of the SACE Emax/E MS range maintain the overall dimensions and fastening points of the standard range circuit-breakers. They may be fitted with the various terminal kits and all accessories common to the SACE Emax range. They may obviously not be associated with the electronic releases, CT and with the current detection and protection accessories for AC applications.
The withdrawable circuit-breakers should be used together with the special version fixed parts for applications at 750/1000V DC.

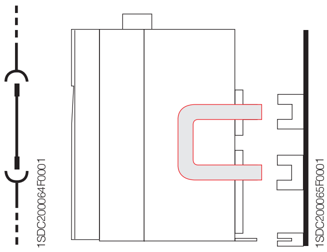
			E1B/E MS		E2N/E MS		E3H/E MS		E4H/E MS
Rated uninterrupted current (at 40 °C) Iu		[A]	**800**		**1250**		**1250**		**3200**
		[A]	**1250**		**1600**		**1600**		**4000**
		[A]			**2000**		**2000**		
		[A]					**2500**		
		[A]					**3200**		
Number of poles			3	4	3	4	3	4	3
Rated AC service voltage **Ue**		[V]	750	1000	750	1000	750	1000	750
Rated AC insulation voltage **Ui**		[V]	1000	1000	1000	1000	1000	1000	1000
Rated impulse withstand voltage **Uimp**		[kV]	12	12	12	12	12	12	12
Rated short-time withstand current **Icw** (1s)		[kA]	20	20	25	25	40	40	65
Rated making capacity **Icm**	750 V DC	[kA]	20	20	25	25	40	40	65
	1000 V DC		–	20	–	25	–	40	–

Sectionalizing truck

Sectionalizing truck - CS

This version is derived from the corresponding withdrawable circuit-breaker, replacing all of the circuit breaking parts and operating mechanism with simple connections between the upper and lower contacts.

It is used as a no load isolator where required by the system.



Earthing switch with making capacity

Earthing switch with making capacity - MTP

This version is based on the mobile part of the corresponding withdrawable circuit-breaker (without overcurrent releases) and the top or bottom isolating contacts, which are replaced with connections that short circuit the phases to earth through the circuit-breaker. The earthing switch is available with top or bottom isolating contacts.

The earthing circuit is dimensioned for a short-time current equal to 60% of the maximum Icw of the circuit-breaker from which it is derived (IEC 60439-1).

The earthing switch is inserted in the fixed part of a withdrawable circuit-breaker to earth the top or bottom terminals before carrying out inspection or maintenance operations on the external circuit in safety conditions. It should be used in cases where the installations to be earthed may produce residual or recovery voltages.

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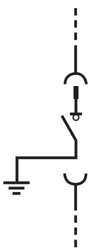

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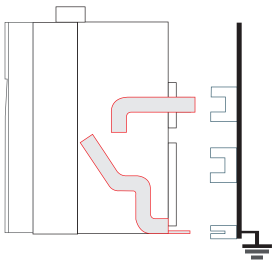

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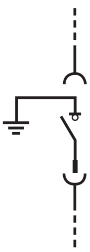

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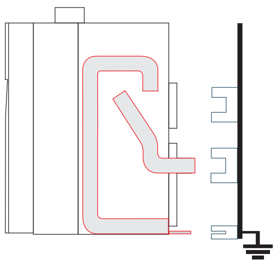

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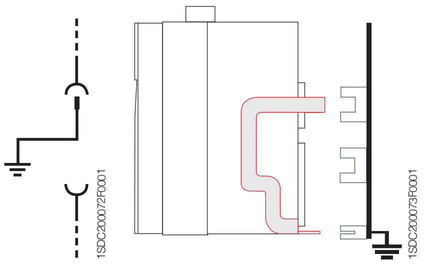
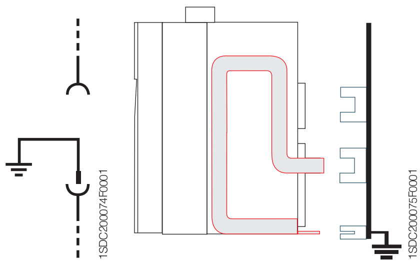
Earthing truck

Other versions

Earthing truck- MT

This version is similar to the sectionalizing truck, but with the bottom or top isolating contacts replaced by short-circuited, earthed connections. The earthing truck is available with bottom or top isolating contacts, suitable for the fixed part of the size.
The earthing circuit is dimensioned for a short-time current equal to 60% of the maximum Icw of the circuit-breaker from which it is derived (IEC 60439-1).
The truck is temporarily racked into the fixed part of a withdrawable circuit-breaker to earth the top or bottom terminals before carrying out maintenance operations on the external circuit when no residual voltages are expected.





Other versions

Upon request, SACE Emax circuit breakers may be built in special versions designed for particularly aggressive environments (SO2 / H2S) and for seismic installations.

Emax

Installations

Contents

Installation in switchboards

Modular design

The circuit-breakers in the SACE Emax series have been built to modular design criteria for easier installation and integration in Low Voltage electrical switchboards, giving them the same depth and height for every model while simultaneously achieving a significant reduction in their overall installation dimensions.
The front shield of the circuit-breaker is also identical for the entire series. This simplifies the construction of the switchboard doors since only one type of drilling is required and makes the front of the switchboard the same for all sizes.
SACE Emax circuit-breakers are suitable for Power Center switchboards and make it easy to comply with the segregation requirements of the IEC 60439-1 standards.

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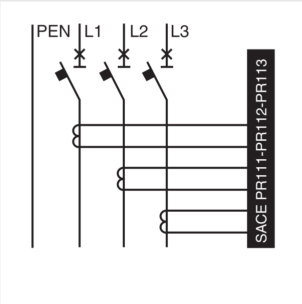
Installation in switchboards

Choosing the type of circuit breaker

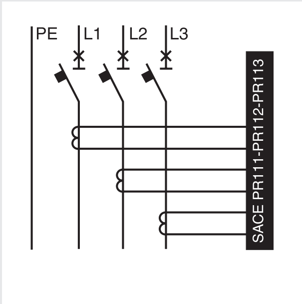
Number of poles

The choice of the number of poles for circuit-breakers that simultaneously provide switching, protection and isolation functions in three-phase installations depends on the type of electrical system (TT, TN-S, TN-C, IT) and the type of user or, more generally, whether it features a distributed or non-distributed neutral.

Three-pole circuit breakers

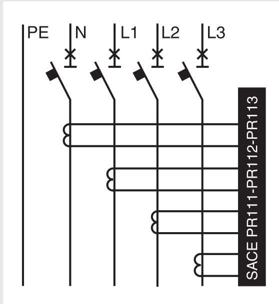


For TN-C systems (the neutral cannot be interrupted because it also acts as the protection conductor).



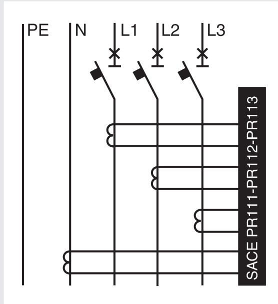
For users that do not use the neutral (e.g.: asynchronous motors) and, for systems with non-distributed neutral in general.

Four-pole circuit breakers



In all other instances, with exceptions for the IT system (see CEI Standards 64-8/ 473.3.2.2).

Three-pole circuit breakers with external neutral



Current transformers can be installed on the external neutral of five-wire systems (TN-S) with 3-pole circuit-breakers.

Fixed or withdrawable version

The fixed version of the circuit-breaker is more compact in size than the withdrawable version. It is recommended for installations that can tolerate service interruptions in the event of faults or routine maintenance.

The withdrawable version of the circuit-breaker is recommended for:

– applications that can only tolerate brief interruptions due to faults or routine maintenance:

– dual lines, one of which is a standby for the other, with a single circuit-breaker for each pair.

1SDC200083F0001

1SDC200084F0001

Installation in switchboards

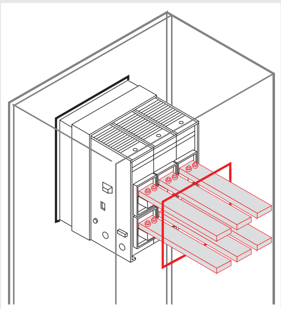
Choosing the type of circuit breaker

Connecting the main circuit-breaker circuits

When designing switchboards, one must always bear in mind the problem of making the most rational connections between the circuit-breaker and main busbar system and the busbars to the users. The SACE Emax series offers switchboard analysts a range of options to satisfy different circuit-breaker connection requirements.

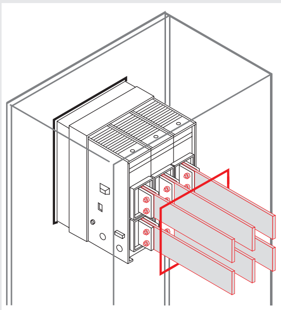
The figures alongside here show a number of indications for terminal selection.

Horizontal rear terminals



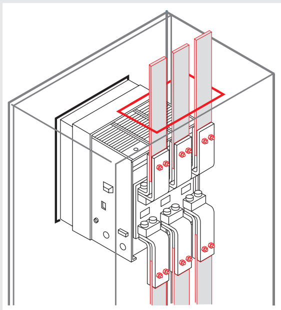
For switchboards with access from the rear

Vertical rear terminals



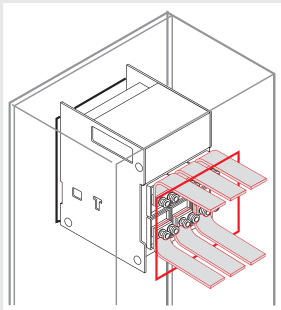
For switchboards with access from the rear

Front terminals



For wall-mounted switchboards, with access from the front only

Flat rear terminals



(withdrawable version only) For switchboards with access from the rear

Protection degrees

A number of solutions have been adopted on SACE Emax circuit-breakers to achieve IP22 protection degree for fixed or withdrawable circuit-breakers, not including their terminals, and IP30 for their front parts using a flange. Automatic shutters have been designed for the fixed parts of withdrawable circuit-breakers which can be locked using padlock devices to allow maintenance of the load side or power-supply side of the fixed part.

A transparent protective cover is also available upon request, to completely segregate the front of the circuit breaker with a protection degree of IP54. The front panel and protection release, as well as their indicators, still remain completely visible.

IP22 Fixed or withdrawable circuit-breaker, not including terminals.

IP30 Front parts of circuit-breakers (using flange).

IP54 Fixed or withdrawable circuit-breaker, fitted with transparent protective cover to be fastened to the front of the switchboard (on request).

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Power losses

The IEC 439-1 and CEI EN 60439-1 standards prescribe calculations for determining the heat dissipation of ANS (non-standard) switchboards which require the engineer to consider the following:

– the overall dimensions
– the rated current of the busbars and connections and their power loss values
– the power loss of the switchgear fitted in the switchboard.

For the latter, the following table provides information on the circuit-breakers. Where other equipment is concerned, please consult the catalogues of the relative manufacturers.

Power loss

Circuit breaker	Iu [A]	Fixed 3/4 Poles [W]	Withdrawable 3/4 Poles [W]
E1 B-N	800	65	95
	1250	150	230
E2 B-N	1250	70	130
	1600	115	215
	2000	180	330
E2 L	1250	105	165
	1600	170	265
E3 N-S-H	1250	60	90
	1600	85	150
	2000	130	225
	2500	205	350
	3200	330	570
E3 L	2000	215	330
	2500	335	515
E4 S-H	3200	235	425
	4000	360	660
E6 H-V	3200	170	290
	4000	265	445
	5000	415	700
	6300	650	1100

Note
The table values refer to balanced loads, a current flow of Iu, and automatic circuit-breakers.

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Note
The same standards prescribe type tests for AS switchboards (standard factory-manufactured switchgear), including those for maximum temperature rise.

3

Installation in switchboards

Current carrying capacity in switchboards

The following table lists examples of the continuous current carrying capacity for circuit breakers installed in a switchboard with the dimensions indicated below.
These values refer to withdrawable switchgear installed in non-segregated switchboards with a protection rating of up to IP31, and the following dimensions:
2300x800x900 (HxLxD) for E1 - E2 - E3;
2300x1400x1500 (HxLxD) for E4 - E6.
The values refer to a maximum temperature at the terminals of 120°C.
For withdrawable circuit-breakers with a rated current of 6300A, the use of vertical rear terminals is recommended.

Note:
The tables should be used solely as a general guideline for selecting products. Due to the extensive variety of switchboard formats and conditions that may affect the behavior of the equipment switchboard, solutions must always be tested in the actual installation.

		Vertical terminals				Horizontal and front terminals			
Type	Iu [A]	Continuous capacity [A]			Busbars section [mm^2]	Continuous capacity [A]			Busbars section [mm^2]
		35°C	**45°C**	**55°C**		**35°C**	**45°C**	**55°C**	
E1B/N 08	800	800	800	800	1x(60x10)	800	800	800	1x(60x10)
E1B/N 12	1250	1250	1250	1250	1x(80x10)	1250	1250	1200	2x(60x8)
E2N 12	1250	1250	1250	1250	1x(60x10)	1250	1250	1250	1x(60x10)
E2B/N 16	1600	1600	1600	1600	2x(60x10)	1600	1600	1530	2x(60x10)
E2B/N 20	2000	2000	2000	1800	3x(60x10)	2000	2000	1750	3x(60x10)
E2L 12	1250	1250	1250	1250	1x(60x10)	1250	1250	1250	1x(60x10)
E2L 16	1600	1600	1600	1500	2x(60x10)	1600	1490	1400	2x(60x10)
E3S/H 12	1250	1250	1250	1250	1x(60x10)	1250	1250	1250	1x(60x10)
E3S/H 16	1600	1600	1600	1600	1x(100x10)	1600	1600	1600	1x(100x10)
E3S/H 20	2000	2000	2000	2000	2x(100x10)	2000	2000	2000	2x(100x10)
E3N/S/H 25	2500	2500	2500	2500	2x(100x10)	2500	2490	2410	2x(100x10)
E3N/S/H 32	3200	3200	3100	2800	3x(100x10)	3000	2880	2650	3x(100x10)
E3L 20	2000	2000	2000	2000	2x(100x10)	2000	2000	1970	2x(100x10)
E3L 25	2500	2500	2390	2250	2x(100x10)	2375	2270	2100	2x(100x10)
E4H 32	3200	3200	3200	3200	3x(100x10)	3200	3200	3020	3x(100x10)
E4S/H 40	4000	4000	3980	3500	4x(100x10)	3600	3510	3150	6x(60x10)
E6V 32	3200	3200	3200	3200	3x(100x10)	3200	3200	3200	3x(100x10)
E6V 40	4000	4000	4000	4000	4x(100x10)	4000	4000	4000	4x(100x10)
E6H/V 50	5000	5000	4850	4600	6x(100x10)	4850	4510	4250	6x(100x10)
E6H/V 63	6300	6000	5700	5250	7x(100x10)	-	-	-	-

Changing the rated uninterrupted current in relation to temperature

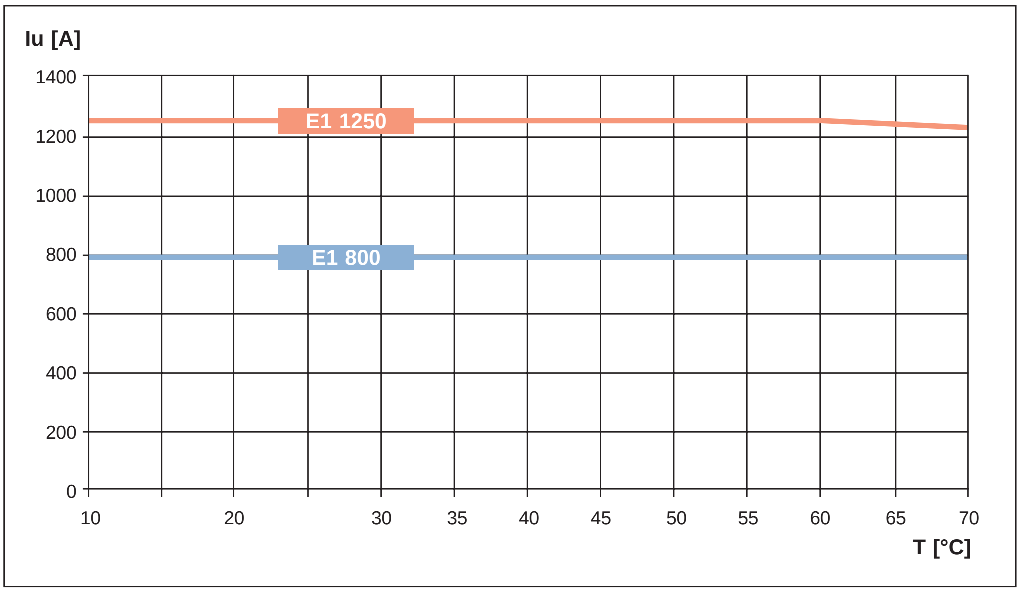
Temperature derating

The circuit-breakers may operate at higher temperatures than their reference temperature (40 °C) in certain installation conditions. In these cases the current-carrying capacity of the switchgear should be reduced.
The SACE Emax series of air circuit-breakers uses microprocessor-based electronic releases that offer the benefit of great operating stability when subjected to temperature changes.
The tables below show the current-carrying capacities of the circuit breakers (as absolute values and percentage values) in relation to their rated values at T = 40 °C.

3

SACE Emax E1

Temperature	E1 800		E1 1250	
[°C]	%	[A]	%	[A]
10	100	800	100	1250
20	100	800	100	1250
30	100	800	100	1250
40	100	800	100	1250
45	100	800	100	1250
50	100	800	100	1250
55	100	800	100	1250
60	100	800	100	1250
65	100	800	99	1240
70	100	800	98	1230

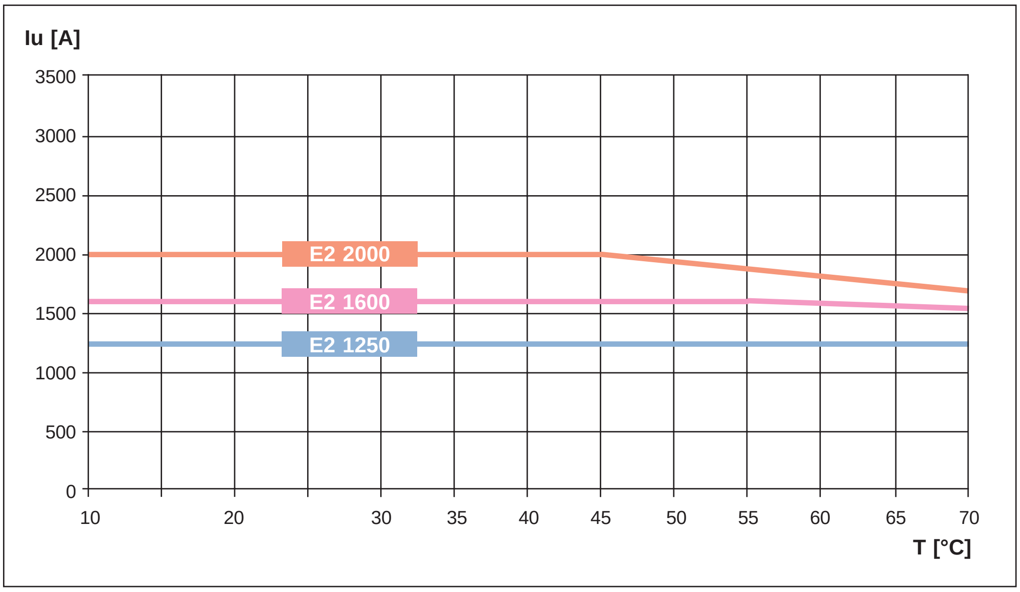


Changing the rated uninterrupted current in relation to temperature

Temperature derating

SACE Emax E2

Temperature	E2 1250		E2 1600		E2 2000	
[°C]	%	[A]	%	[A]	%	[A]
10	100	1250	100	1600	100	2000
20	100	1250	100	1600	100	2000
30	100	1250	100	1600	100	2000
40	100	1250	100	1600	100	2000
45	100	1250	100	1600	100	2000
50	100	1250	100	1600	97	1945
55	100	1250	100	1600	94	1885
60	100	1250	98	1570	91	1825
65	100	1250	96	1538	88	1765
70	100	1250	94	1510	85	1705



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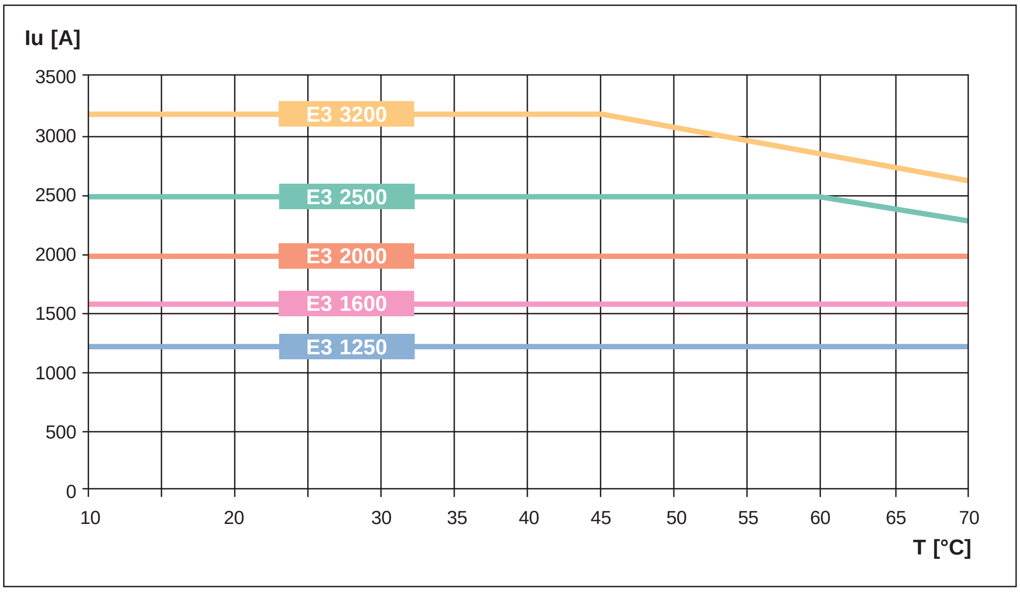
SACE Emax E3

Temperature	E3 1250		E3 1600		E3 2000		E3 2500		E3 3200	
[C°]	%	[A]	%	[A]	%	[A]	%	[A]	%	[A]
10	100	1250	100	1600	100	2000	100	2500	100	3200
20	100	1250	100	1600	100	2000	100	2500	100	3200
30	100	1250	100	1600	100	2000	100	2500	100	3200
40	100	1250	100	1600	100	2000	100	2500	100	3200
45	100	1250	100	1600	100	2000	100	2500	100	3200
50	100	1250	100	1600	100	2000	100	2500	97	3090
55	100	1250	100	1600	100	2000	100	2500	93	2975
60	100	1250	100	1600	100	2000	100	2500	89	2860
65	100	1250	100	1600	100	2000	97	2425	86	2745
70	100	1250	100	1600	100	2000	94	2350	82	2630

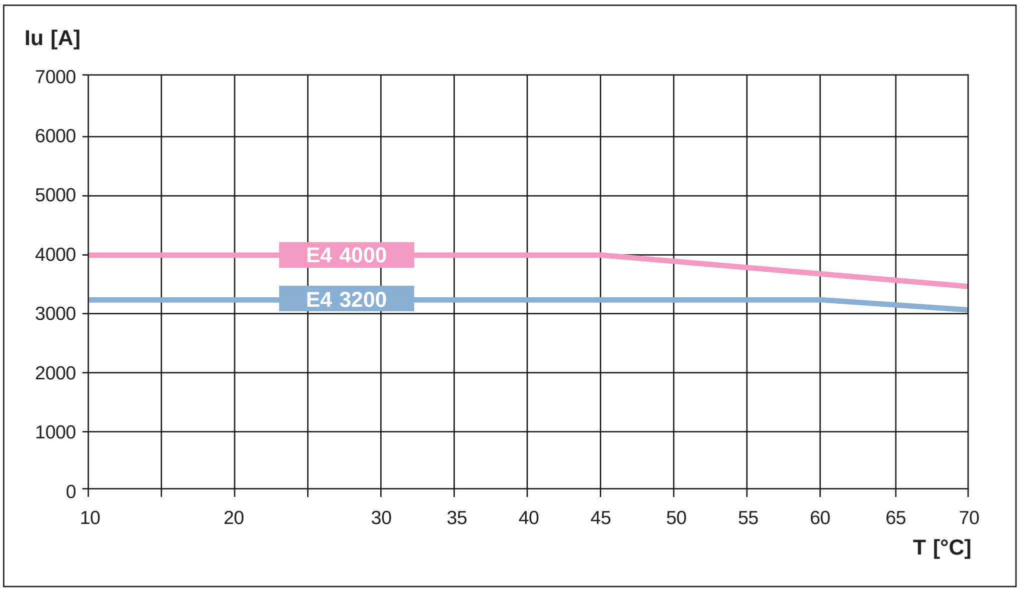


Changing the rated uninterrupted current in relation to temperature

Temperature derating

SACE Emax E4

Temperature	E4 3200		E4 4000	
[°C]	%	[A]	%	[A]
10	100	3200	100	4000
20	100	3200	100	4000
30	100	3200	100	4000
40	100	3200	100	4000
45	100	3200	100	4000
50	100	3200	98	3900
55	100	3200	95	3790
60	100	3200	92	3680
65	98	3120	89	3570
70	95	3040	87	3460



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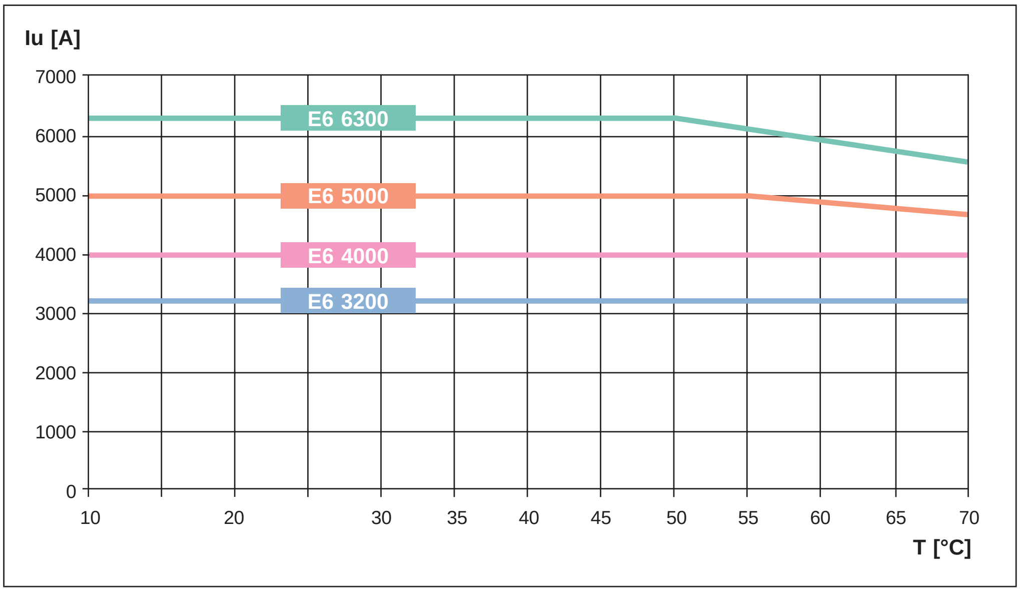
SACE Emax E6

Temperature [°C]	E6 3200 %	E6 3200 [A]	E6 4000 %	E6 4000 [A]	E6 5000 %	E6 5000 [A]	E6 6300 %	E6 6300 [A]
10	100	3200	100	4000	100	5000	100	6300
20	100	3200	100	4000	100	5000	100	6300
30	100	3200	100	4000	100	5000	100	6300
40	100	3200	100	4000	100	5000	100	6300
45	100	3200	100	4000	100	5000	100	6300
50	100	3200	100	4000	100	5000	100	6300
55	100	3200	100	4000	100	5000	98	6190
60	100	3200	100	4000	98	4910	96	6070
65	100	3200	100	4000	96	4815	94	5850
70	100	3200	100	4000	94	4720	92	5600



Derating in altitude

SACE Emax air circuit-breakers do not undergo any changes in their rated performance up to an altitude of 2000 meters.
As the altitude increases the atmospheric properties alter in terms of composition, dielectric capacity, cooling power and pressure.
The performance of the circuit-breakers therefore undergoes derating which can be measured through the variation in significant parameters such as the maximum rated voltage of operation and the rated uninterrupted current.
The table below shows the aforementioned values in relation to altitude.

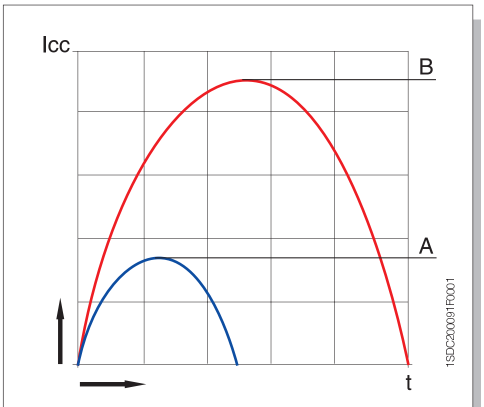
Altitude	**H**	[m]	<2000	3000	4000	5000
Rated service voltage	**Ue**	[V]	690	600	500	440
Rated current	**In**	[A]	In	0,98xIn	0,93xIn	0,90xIn

Current-limiting and specific let-through energy curves for circuit-breakers E2L and E3L

The current-limiting capacity of an automatic current-limiting circuit-breaker indicates its ability to let through or determine a current lower than the prospective fault current in short-circuit conditions. This characteristic is represented by two different curves which indicate the following, respectively:

- the value of the specific energy "I^2t" (in A^2s) let through by the circuit-breaker in relation to the uninterrupted symmetrical short-circuit current.
- the peak value (in kA) of the limited current in relation to the uninterrupted symmetrical short-circuit current.

The graph shown here schematically indicates the pattern of uninterrupted current, with its established peak (curve B), and the pattern of limited current with a lower peak value (curve A).
Comparing the areas beneath the two curves shows how the specific let-through energy is reduced as a result of the limiting effects of the circuit breaker.

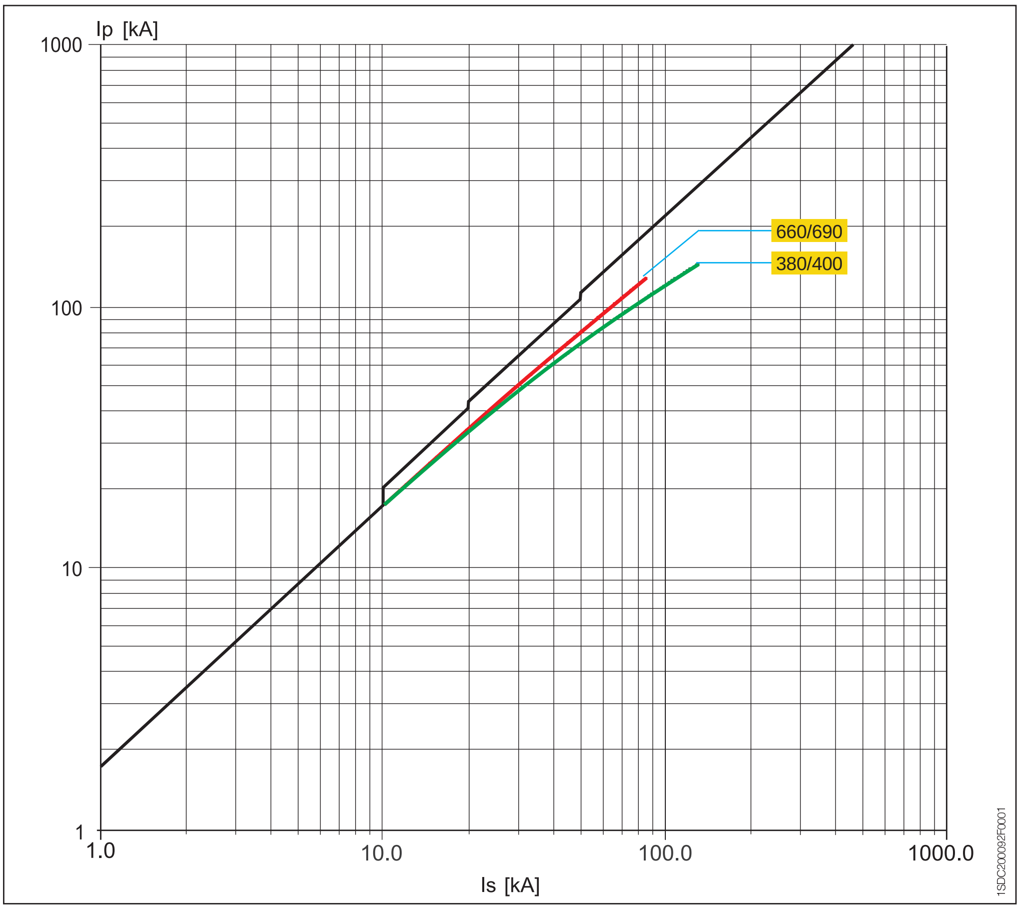


A peak limited Icc
B prospective Icc (peak value)

Current-limiting and specific let-through energy curves for circuit-breakers E2L and E3L

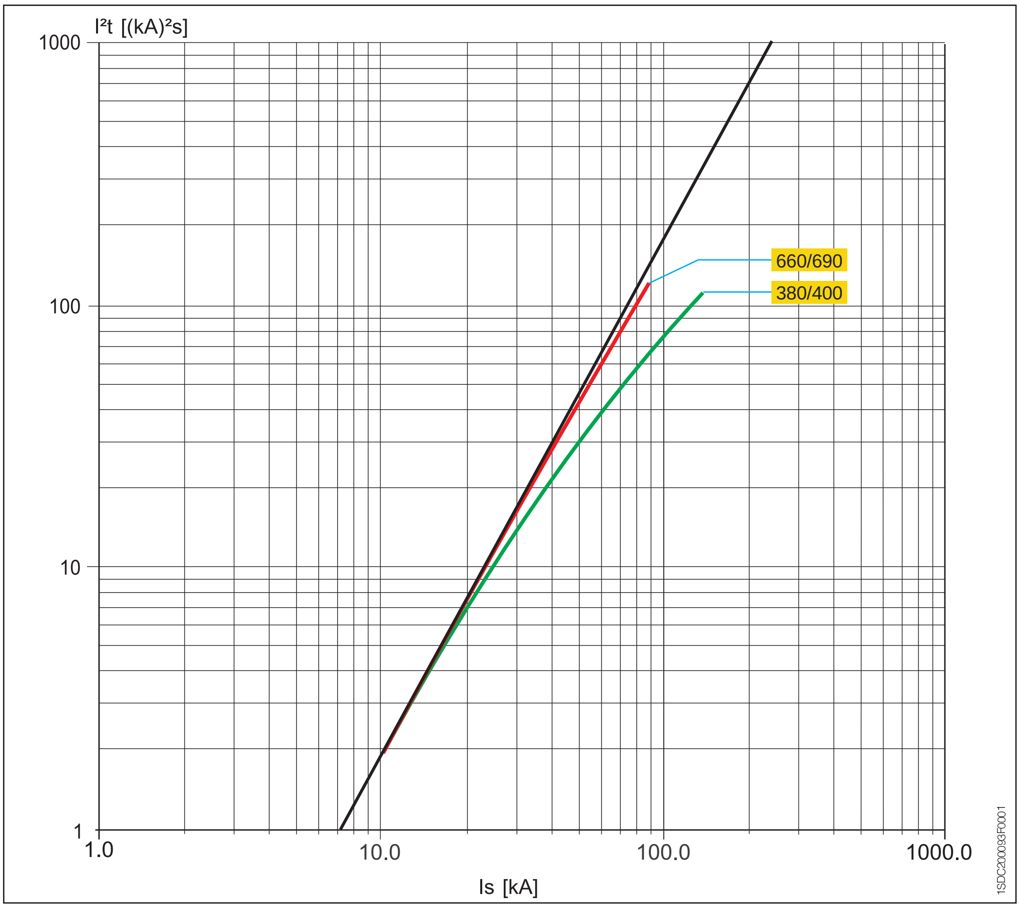
E2L

Current-limiting curves



E2L

Specific let-through energy curves



Is prospective symmetrical short-circuit current

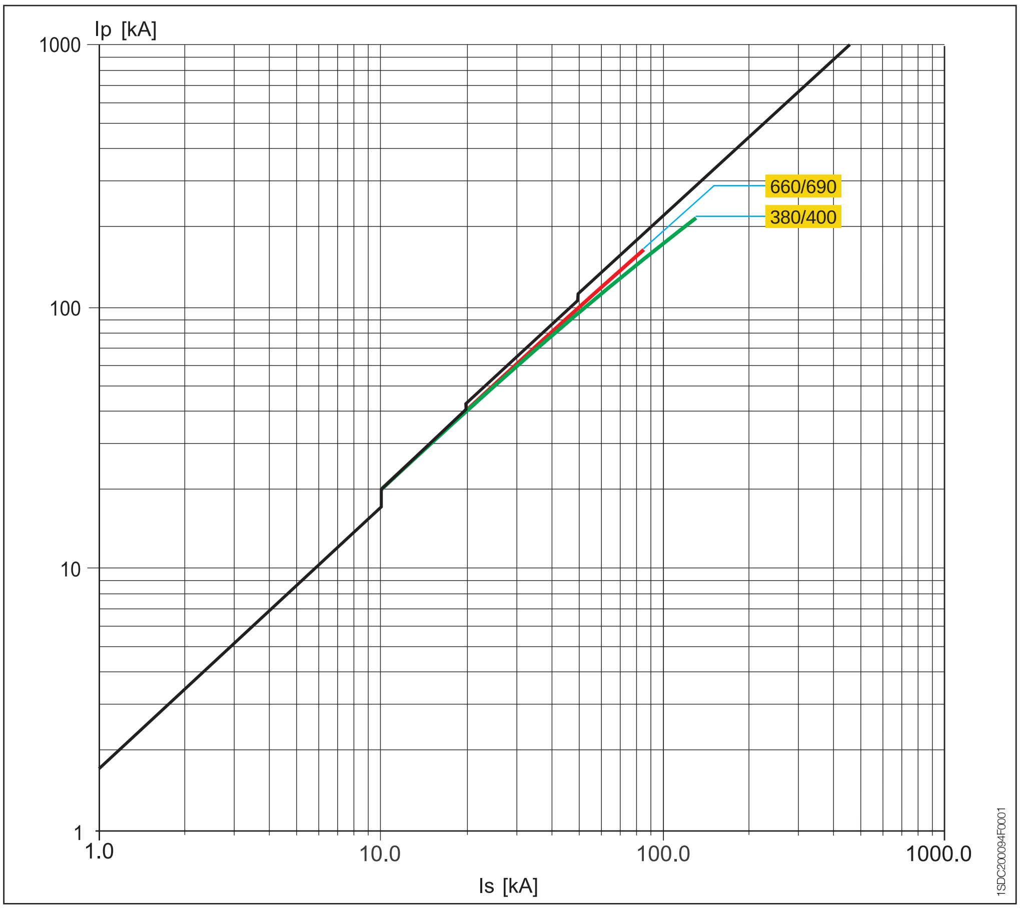
Ip peak current

I²t specific let-through energy at the voltages indicated

3

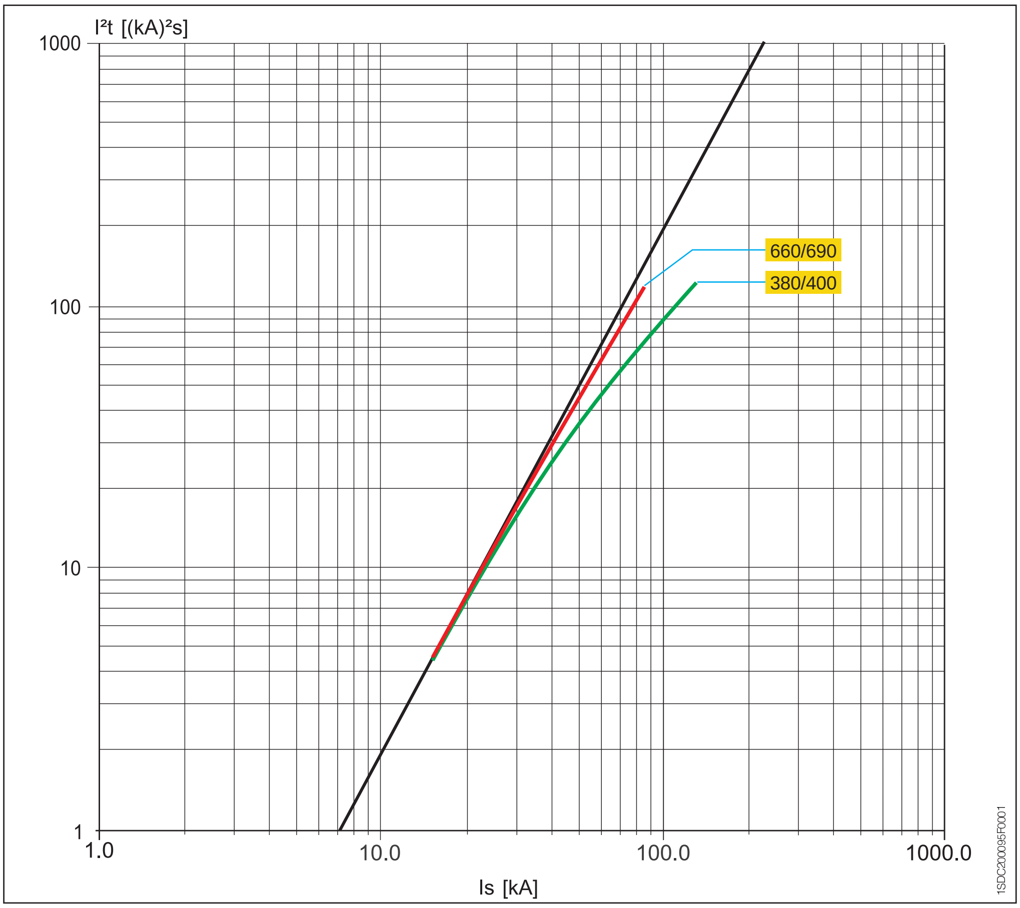
E3L

Current-limiting curves



E3L

Specific let-through energy curves



Is prospective symmetrical short-circuit current

Ip peak current

I²t specific let-through energy at the voltages indicated

3

Emax


SACE PR113/PD
TEST
PR113
208A L2
Ground: 262A
ESC
TRIP
SACE PR112/PD
COMMUNICATION
NETWORK
WARNING
EMERGENCY
RESET
Vaux

Overcurrent releases and related accessories

Contents

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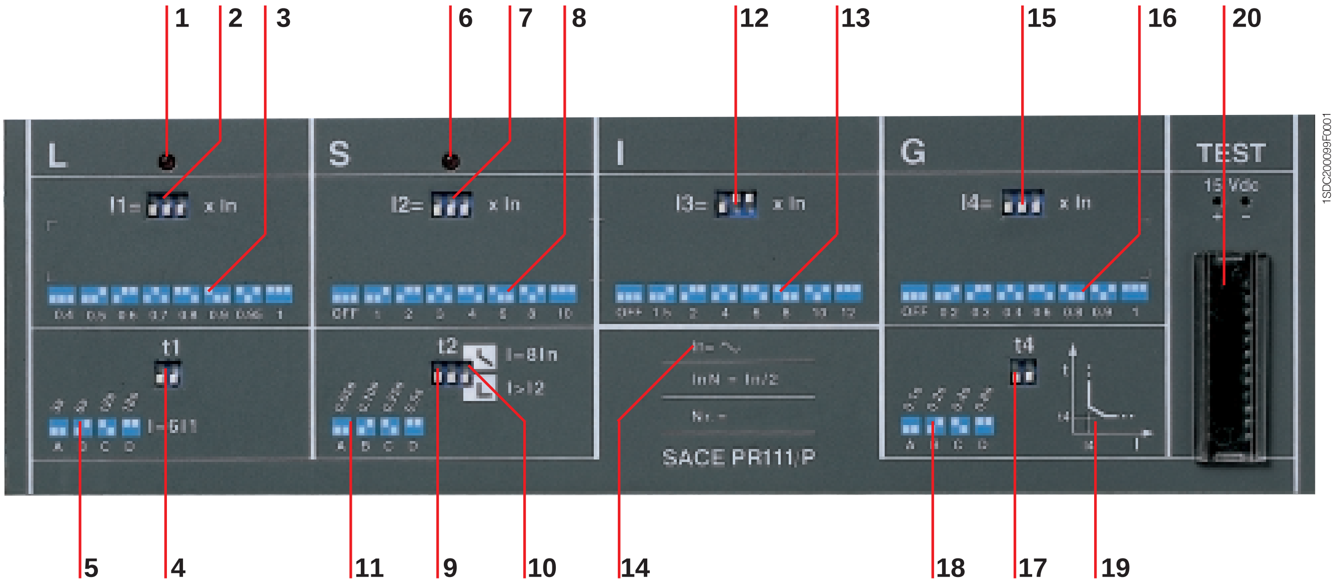
Microprocessor-based protection releases and trip curves

PR111/P

Characteristics

This is the basic release for the Emax series. The complete range of protection functions and the variety of thresholds and trip times offered make it suitable for protecting any type of alternating current installation. The release does not have any additional functions over and above its protection functions, except a few signals.



Legend

1 Alarm indicator LED for protection function L

2 DIP switches for setting current threshold I1

3 Indication of the DIP switch positions for the various values of current thresholds I1

4 DIP switches for setting trip time t1 (type of curve)

5 Indication of the DIP switch positions for the various time settings

6 Alarm indicator LED for protection function S

7 DIP switches for setting current threshold I2

8 Indication of the DIP switch positions for the various current threshold values I2

9 DIP switches for setting trip time t2 (type of curve)

10 Dip switches for setting inverse time or definite time characteristic

11 Indication of DIP switch positions for the various time settings

12 DIP switches for setting current threshold I3

13 Indication of the DIP switch positions for the various current threshold values I3

14 Rating plate showing the rated current of the neutral CT and the release serial number

15 DIP switches for setting current threshold I4

16 Indication of the DIP switch positions for the various current threshold values I4

17 DIP switches for setting trip time t4 (type of curve)

18 Indication of DIP switch positions for the various time settings

19 Symbol diagram showing operation of function G

20 Connection module with external units for testing the release and socket for connection to the trip test (SACE TT1 unit and SACE PR010/T unit)

Operation and protection functions

Power supply

The unit requires no external power supply. It is self-powered by means of the current transformers installed on the circuit-breaker. For it to operate, it is sufficient for at least one phase to be loaded at 18% of the rated current of the current transformers (In).

Protection functions

The PR111 release offers the following protection functions:

- overload (L)
- selective short-circuit (S)
- instantaneous short-circuit (I)
- earth fault G).

Overload (L)

The inverse long time-delay trip overload protection L is type $I^2t=k$; eight current thresholds and 4 curves are available, labeled A, B, C, D. Each curve is identified by the trip time in relation to the current I = 6 x I1 (I1=set threshold).

Selective short-circuit (S)

The selective short-circuit protection S can be set with two different types of curves with a trip time that is independent of the current (t=k) or with a constant specific let-through energy (t = k/I²).

Seven current thresholds and 4 curves are available, labeled A, B, C, D. Each curve is identified as follows:

– for curves (t = k) by the trip time for I > I2

– for curves t = k/I² by the trip time for I = 8xIn (In=rated current of the current transformer).

The function can be excluded by setting the DIP switches to the combination labeled "OFF".

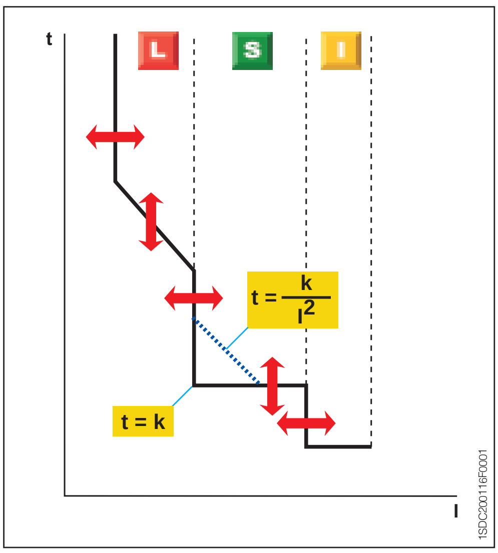
Adjustable instantaneous short-circuit (I)

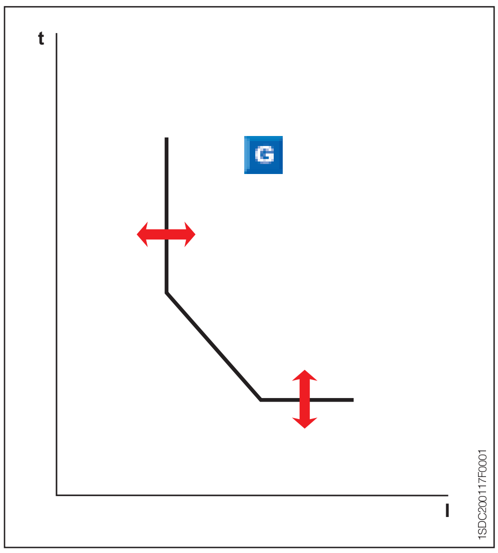
The protection I offers 7 trip thresholds and may be excluded (dip switches in "OFF" position).

Earth fault (G)

The inverse short time-delay trip earth fault protection G (which can be excluded) offers 7 current thresholds and 4 curves labeled A, B, C, D. Each curve is identified by the time t4 in relation to current I4 as shown in the diagram on the front of the release.

Note: the function G is repressed for fault current values I > 4xIn (In=rated current of the CT).





Microprocessor-based protection releases and trip curves

PR111/P

User interface

The user communicates with the release in the trip parameter preparation stage by means of the dip switches.
Two LEDs are also available for alarm signalling (timing start) for the L and S functions respectively.

Setting the neutral

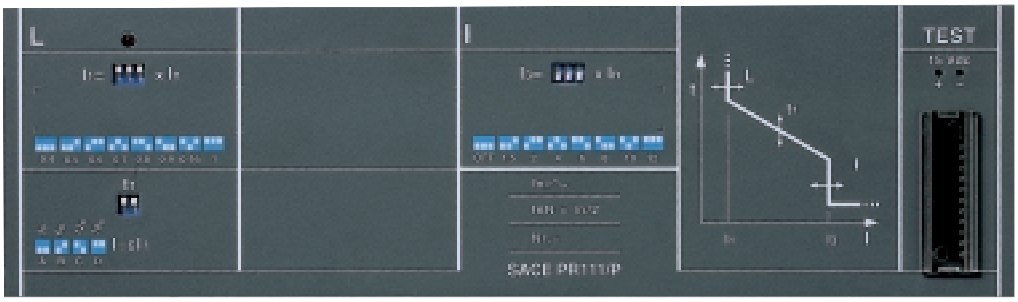
Protection of the neutral is available at 50% in the standard version or at 100% (version which can be supplied on request for E1-E2-E3-E4/f and E6/f), of the phase currents.

Test Function

The Test function is carried out by means of the pocket-sized SACE TT1 Trip Test unit, fitted with a two-pole polarized connector housed on the bottom of the box, which allows the device to be connected to the test input sockets on the front of PR111/P releases.
A complete test of the PR111/P microprocessor-based electronic release can be carried out using the special SACE PR010/T apparatus by applying it to the TEST connector.
All the release functions can be checked by means of this unit.

Versions available

The following versions are available:



1SDC200097F0001

PR111/P LI

1SDC200098F0001

PR111/P LSI

1SDC200099F0001

PR111/P LSIG

Protection functions and setting values - PR111

Function		Trip threshold	Trip time	Can be excluded	Relation t=f(I)
L	Overload protection	**I1**= 0,4 - 0.5 - 0.6 - 0.7 - 0.8 - 0.9 - 0.95 - 1 x In	With current I= 6 x I1 t1 = 3 s (curve A), 6 s (curve B), 12 s (curve C), 18 s (curve D)	–	$t=k/I^2$
	Tolerance (1)	Release between 1.1 and 1.2 x I1	± 10% Ig ≤ 3 x In ± 20% Ig > 3 x In		
S	Selective short-circuit protection	**I2**= 1 - 2 - 3 - 4 - 6 - 8 - 10 x In	With current I= 8 x In t2 = 0.05 s (curve A), 0.10 s (curve B) 0.25 s (curve C), 0.5 s (curve D)	■	$t=k/I^2$
	Tolerance (1)	± 10 %	± 20%		
		I2= 1 - 2 - 3 - 4 - 6 - 8 - 10 x In	With current I>I2 t2 = 0.05 s (curve A), 0.10 s (curve B) 0.25 s (curve C), 0.5 s (curve D)	■	t=k
	Tolerance (1)	± 10 %	The better of the two figures: ± 20% o ± 50 ms		
I	Instantaneous short-circuit protection	**I3**= 1,5 - 2 - 4 - 6 - 8 - 10 - 12 x In	Instantaneous	■	t=k
	Tolerance (1)	± 20 %	≤ 35 ms Ig ≤ 3 x In ≤ 30 ms Ig > 3 x In		
G	Earth fault protection	**I4**= 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 0.9 - 1 x In	With current I = 4 x I4 t4 = 0.1 s (curve A), 0.2 s (curve B) 0.4 s (curve C), 0.8 s (curve D)	■	$t=k/I^2$
	Tolerance (1)	± 10 %	± 20%		

(1) These tolerances hold in the following conditions:
- self-powered relay at full power (without start-up)
- two- or three-phase power supply

The following tolerance values apply in all cases not covered by the above:

	Trip threshold	Trip time
L	Release between 1.1 and 1.25 x I1	± 20%
S	± 10%	± 20%
I	± 20%	≤ 60ms
G	± 15%	± 20%

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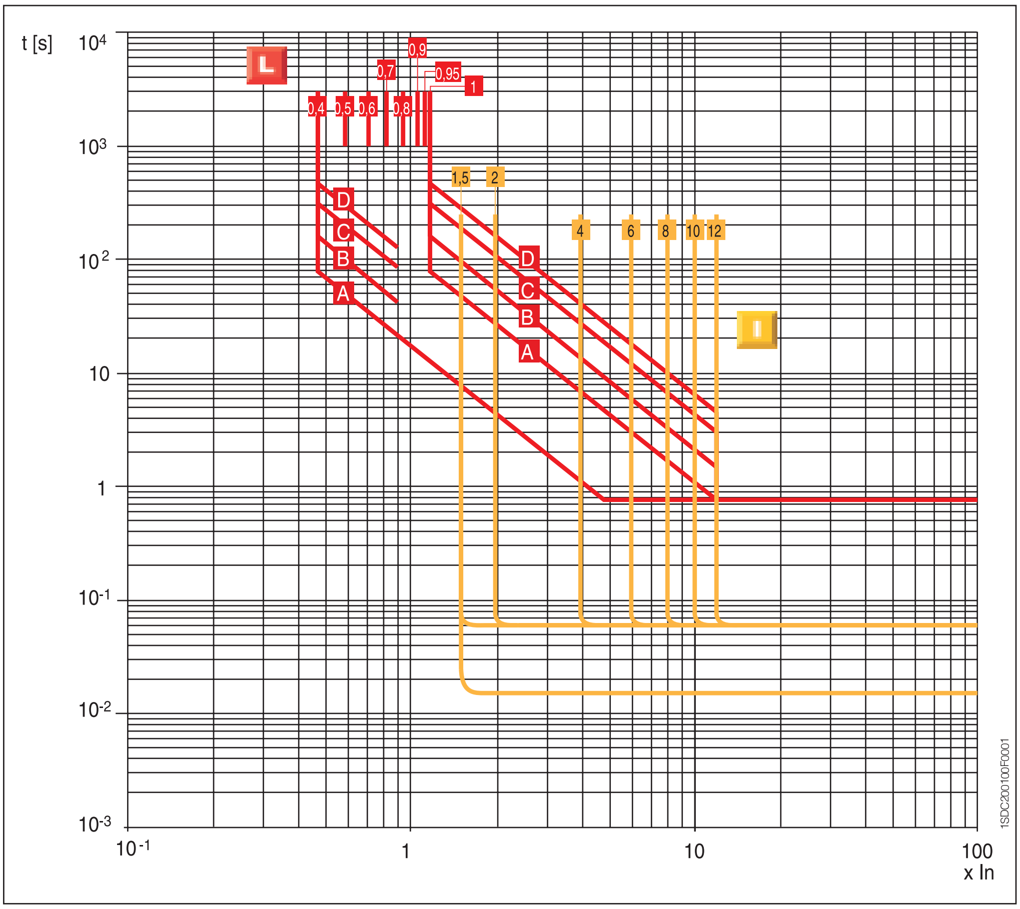
Microprocessor-based protection releases and trip curves

PR111/P

Functions L-I



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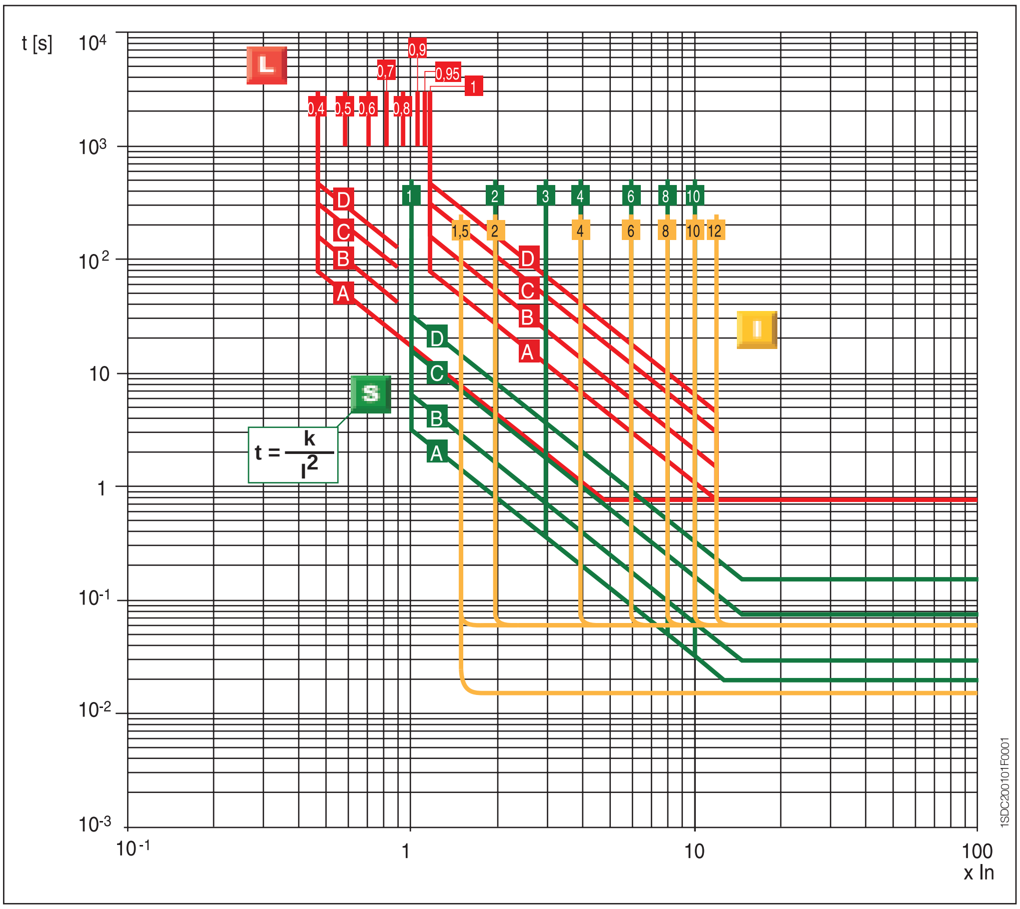
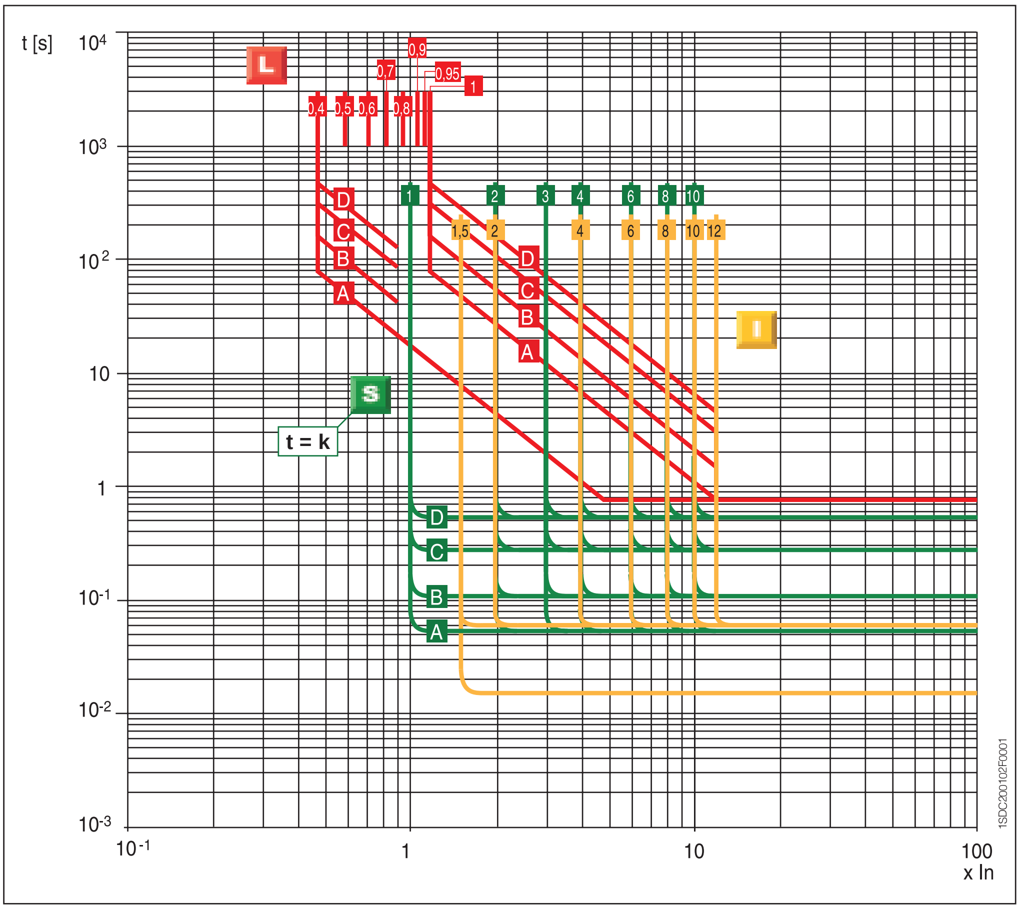
Functions L-S-I

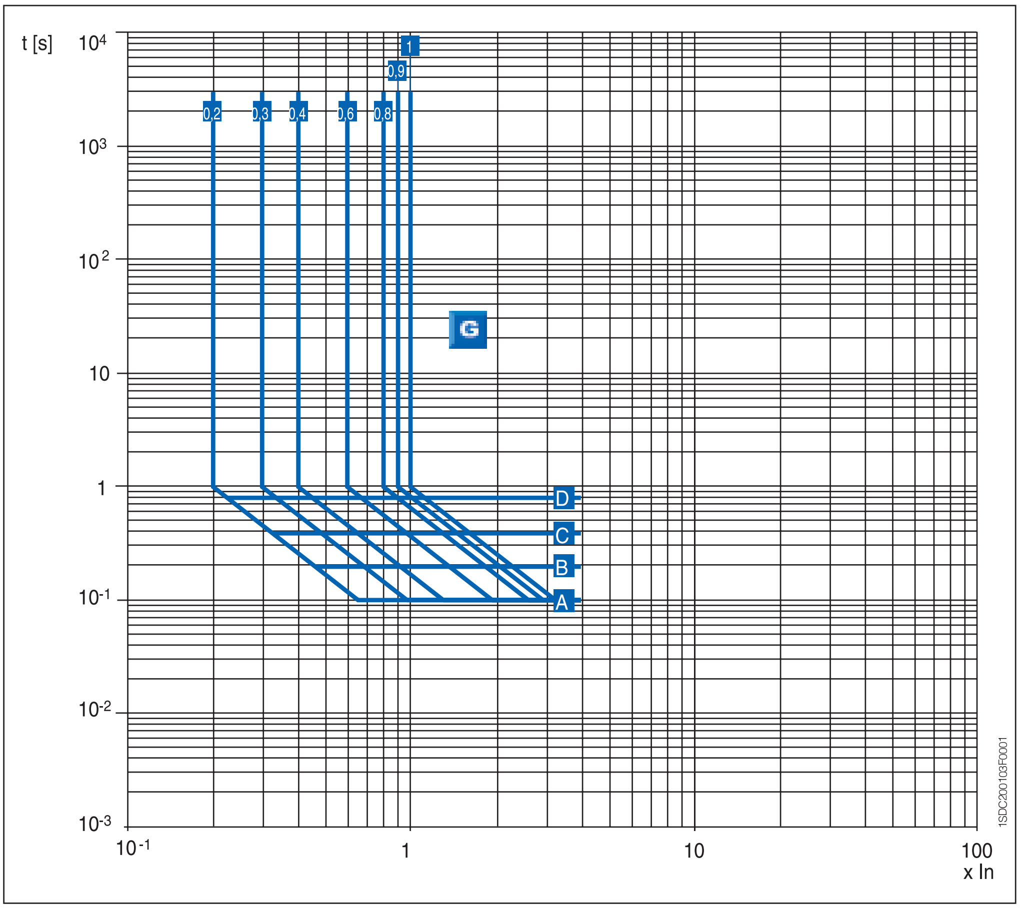


Tolerances on thresholds and trip times .... page 4/5

Functions L-S-I



Functions G



Tolerances on thresholds and trip times .... page 4/5

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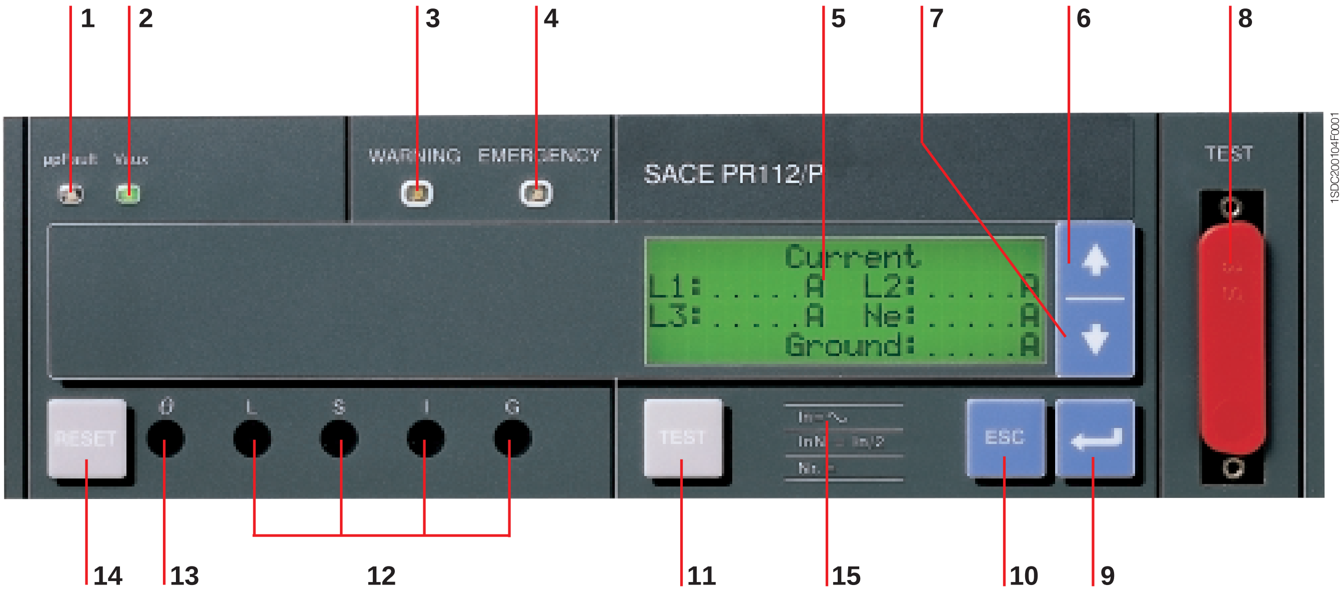
Characteristics

The SACE PR112 release is a sophisticated protection system using microprocessor technology. It comprises the PR112/P protection unit and, on request, the PR112/PD protection and dialogue unit. In this case both versions are available: the PR112/PD LON for the LON® communication protocol, and PR112/PD Modbus for the Modbus® protocol.
The wide range of settings makes this protection unit ideal for general use in any type of installation.
Consulting information and programming is extremely easy using a keyboard and alphanumeric liquid crystal display.
An ammeter function and many additional functions are provided over and above the protection functions. These additional functions can be further increased with the addition of the dialogue and signalling unit.



Legend

- **1** Microprocessor fault indicator LED
- **2** Auxiliary power supply indicator LED
- **3** Pre-alarm indicator LED
- **4** Alarm indicator LED
- **5** Backlit alphanumeric display
- **6** Cursor UP button
- **7** Cursor DOWN button
- **8** TEST connector to link to SACE PR010/T and SACE PR120/B external accessory units
- **9** ENTER button to confirm data or change pages
- **10** Button to exit submenus or cancel operations (ESC)
- **11** TEST button
- **12** Magnetic devices to signal protection functions L, S, I, G tripped
- **13** Magnetic device to signal excessive release case temperature rise
- **14** Key for resetting the magnetic signalling devices and protection device tripped signalling contact (RESET)
- **15** Rating plate indicating the rated current of the CTs and neutral plus the release serial number

Operation, protection functions and self-test

Power supply

The PR112 release does not normally require any external power supplies, being self-powered from the current transformers (CT): to activate the protection and ammeter functions, it is sufficient for at least one phase to have a current load equivalent to 35% of the rated current of the CTs (20% in cases where two phases are powered, 15% for three phases). In order for the display to come on, at least one phase must have a current load equivalent to 50% of the rated current of the CTs, 30% if two phases are powered and 20% for three phases.

The unit ensures fully self-powered operation; when an auxiliary power supply is present, it is also possible to use the unit with the circuit-breaker open or closed.

It is also possible to use an auxiliary power supply provided by the PR120/B portable battery unit (always supplied) which allows the protection functions to be set when the release is not self-powered.

A wide range of setting options is available for the thresholds and trip times of all the functions.

Functions S and G can operate with a time delay that is independent of the current (t = k) or with an inverse time delay (constant specific let-through energy: $I^2t = k$), as required.

Protection against earth faults can also be obtained by connecting the PR112 release to an external toroid located on the conductor that connects the transformer star center to earth (homopolar toroid).

All the thresholds and trip curve delays of the protection functions are stored in special memories which retain the information even if no power is supplied.

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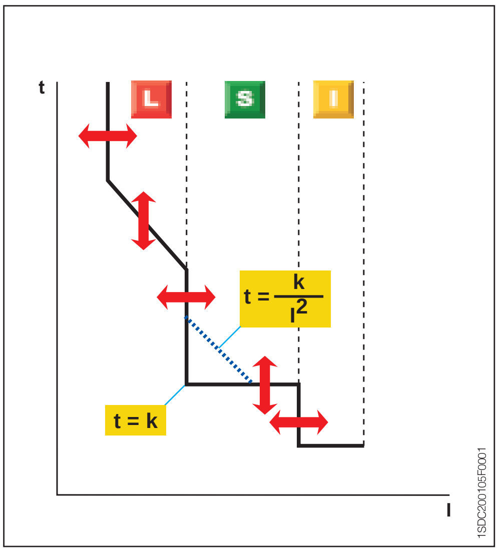
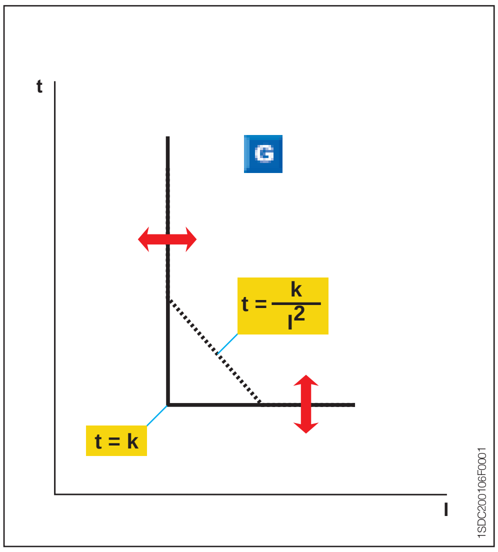
	PR112/P	PR112/PD
Auxiliary power supply (galvanically insulated)	24 V DC ± 20%	24 V DC ± 20%
Maximum ripple	5%	5%
Inrush current @ 24V	~3 A for 30 ms	~5 A for 30 ms
Starting current @ 24V	~1.0 A for 150 ms	~1.0 A for 150 ms
Rated current @ 24V	~125 mA	~250 mA
Rated power @ 24V	~3 W	~6 W





Microprocessor-based protection releases and trip curves

PR112/P

Protection functions

The PR112 release offers the following protection functions:
- overload (L)
- selective short-circuit (S)
- instantaneous short-circuit (I)
- earth fault (G) (Residual or Source ground return: the latter via a toroid installed on the earth connection of the main power supply)
- self-protection against overtemperature (OT)
- thermal memory for L and S functions
- zone selectivity for functions S or G

Setting the neutral

The neutral protection is 50% of the value set for phase protection in the standard version. The neutral protection may be set to 100% for E1, E2, E3, E4/f, E6/f.

Protection against overtemperature

The range of SACE PR112 releases allows the presence of abnormal temperatures, which could cause temporary or continuous malfunctions of the microprocessor, to be signalled to the user. The user has the following signals or commands available:
- lighting up of the “Warning” LED when the temperature is higher than 70 °C (temperature at which the microprocessor is still able to operate correctly)
- lighting up of the “Emergency” LED when the temperature is higher than 85 °C (temperature above which the microprocessor can no longer guarantee correct operation) and, when decided during the unit configuration stage, simultaneous opening of the circuit-breaker with change-over of the corresponding magnetic signal.

Zone selectivity for S or G

The zone selectivity function S or G may be activated or deactivated using the keyboard. Protection is provided by connecting together all of the zone selectivity outputs of the releases belonging to the same zone, and bringing this signal to the zone selectivity input of the release just upstream.

Phase umbalance U

Function U against phase umbalance simply emits a warning signal if an umbalance is detected between two or more phases. This function may be disabled.

Microprocessor self-diagnosis

The PR112 range of releases contains an electronic circuit which checks operation of the microprocessor of the protection unit in real time (an additional electronic circuit is provided for the PR112/PD unit for checking the microprocessor of the dialogue unit).
In case of a temporary or continuous malfunction, the following two signals are activated:
- lighting up of the LED “µP Fault” (if the 112/PD unit is present, the LED “µP Communication Fault” also lights)
- when there is auxiliary power supply, closure of the “µP Fault” contact.

Test Functions

Once enabled from the “control” menu, the “TEST” pushbutton on the front of the release allows correct operation of the chain consisting of the microprocessor, opening solenoid and circuit-breaker to be checked.
The control menu also includes the option of testing correct operation of the display, indicator LEDs, magnetic signals and electrical contacts supplied in all versions of the PR112 release.
By means of the front multi-pin connector it is possible to apply a SACE PR010/T Test unit, which allows the functions of the PR111, PR112 and PR113 ranges of releases to be tested and checked.

User interface

The human-machine interface (HMI) of the device is made up of an alphanumeric display, LEDs, pushbuttons and magnetic flags to signal the release trip causes.
A password system has been installed in this new version to manage “Read” or “Edit” modes.
The protection parameters (curves and trip thresholds) may be set directly via the device’s HMI.
The parameters may be changed only when the release is operating in “Edit” mode, but the information available and the parameter settings may be checked at any time in “Read” mode.
The language may be selected from among five available options: Italian, English, German, French and Spanish.

Indicator LEDs

LEDs on the front panel of the release are used to indicate pre-alarms (“WARNING”) and alarms (“ALARM”). A message on the display always explicitly indicates the type of event concerned.
Events indicated by the “WARNING” LED:
– umbalance between phases;
– pre-alarm for overload (L1>90%);
– first temperature threshold exceeded (70 °C);
– contact wear beyond 80%.
Events indicated by the “EMERGENCY” LED:
– overload (may begin from 1.05xI1<I<1.3xI1 in accordance with the standard IEC 60947-2);
– timing of function L;
– timing of function S;
– timing of function G;
– second temperature threshold exceeded (85 °C);
– contact wear 100%.

Other LEDs indicate, respectively:
– “µP Fault”: indicates that the protection unit microprocessor has a temporary (briefly lit) or permanent (steadily lit) fault
– “Vaux”: indicates there is an auxiliary power supply

Electrical signalling contacts PR112

Three clean contacts provided on all versions of the PR112 release enable electrical signalling of the following :
– contact K51/p1, which may be set to any of the following based on user preference: timing for protections L, S, G; protections L, S, I, G, OT tripped and other events;
– contact K51/Y01, for when any of the protections L, S, I, G is tripped;
– contact K51/µP, for microprocessor with temporary or permanent fault.

Note:
The overload and microcontroller fault alarm contacts are available with an external auxiliary power supply.

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Microprocessor-based protection releases and trip curves

PR112/P

Resetting trip signals

The "RESET" pushbutton allows local resetting of the protection trip signals (relay tripped contact and magnetic flags).
In the case of remote control, the resetting signal for the protection trip signals can be transmitted by means of a dialogue unit (PR112/PD version) only for relay trip caused by excessive temperature and by overload (L). Trip signals for the other functions (S, I and G) may only be reset locally. When the signal is not reset, the dialogue unit is prevented from actuating the circuit-breaker closing command.

Load control

The load control function takes place in combination with the PR020/K accessory unit. The function is active only when auxiliary power supply is present.
Alternatively, using two separate curves (with lower threshold currents and trip times than those available for selection with protection L), the load-control function implements the following logics:
– disconnection of two separate loads,
– connection and disconnection of a load.
These functions make it possible to engage/disengage individual downstream loads before the overload protection L is tripped, thereby tripping the upstream circuit-breaker.

Measuring function

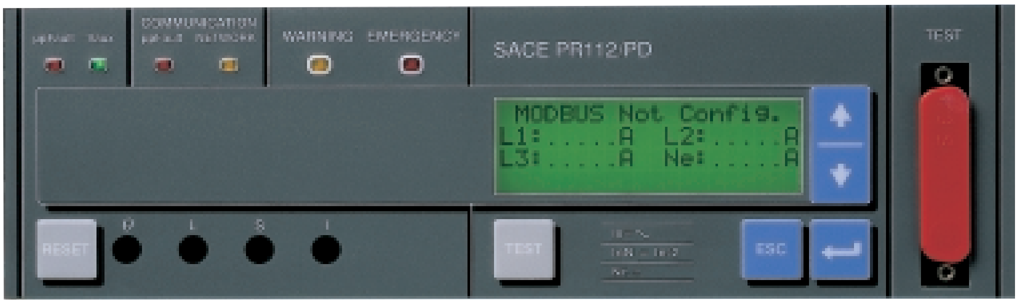
The current measuring function (ammeter) is present on all versions of the SACE PR112 unit.
The display shows the currents of the three phases, neutral and earth fault.
The latter current value takes on two different meanings depending on whether the external toroidal transformer for the "Source Ground Return" function or the internal transformer (residual type) is connected.
The ammeter can operate either with self-supply or with auxiliary power supply voltage.
Accuracy of the ammeter measurement chain (current transformer plus ammeter) is no more than 5% in the current interval 30% - 120% of In.

Versions available

The following versions are available:

PR112/P LSI

PR112/P LSIG



PR112/PD LSI

PR112/PD LSIG

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Protection functions and setting values - PR112

	Function	Trip threshold	Threshold steps	Trip Time	Time Step	Can be excluded	Relation t=f(I)	Thermal memory	Zone selectivity
L	Overload protection	I1= 0,4….1 x In	0,01 x In	t1= 3 s....144 s	3 s (1)	–	t=k/I²	■	–
	Tolerance (3)	Release between 1,1 and 1,2 x I1		± 10% Ig ≤ 4 x In ± 20% Ig > 4 x In					
S	Selective short-circuit protection	I2= 0,6….10 x In	0,1 x In	t2= 0,05 s….0,75 s (2)	0,01s	■	t=k	–	■
	Tolerance (3)	± 7% Ig ≤ 4 x In ± 10% Ig > 4 x In		The better of the two figures: ± 10% or ± 50 ms Ig ≤ 4 x In ± 15% or 50 ms Ig > 4 x In					
		I2= 0,6….10 x In	0,1 x In	t2= 0,05 s….0,75 s	0,01s	■	t=k/I²	■	–
	Tolerance (3)	± 7% Ig ≤ 4 x In ± 10% Ig > 4 x In		± 15% Ig ≤ 4 x In ± 20% Ig > 4 x In					
I	Instantaneous short-circuit protection	I3= 1,5….15 x In	0,1 x In	Instantaneous	–	■	t=k	–	–
	Tolerance (3)	± 10% Ig ≤ 4 x In ± 15% Ig > 4 x In		≤ 25 ms					
G	Earth fault protection	I4= 0,2….1 x In	0,02 x In	t4= 0,1 s…..1s	0,05 s	■	t=k	–	■
	Tolerance (3)	± 10%		The better of the two figures: ± 10% or ± 50 ms Ig ≤ 4 x In					
		I4= 0,2….1 x In	0,02 x In	t4= 0,1 s…..1s	0,05 s	■	t=k/I²	–	–
	Tolerance (3)	± 10%		± 20%					
OT	Protection against overtemperature	may not be set	–	Instantaneous	–	–	temp=k	–	–

(1) The minimum trip value is 750 ms, regardless of the type of curve set (self-protection)
(2) In addition, if the fixed time trip curve is selected (t=k), it will also be possible to set the trip time t2=minimum time
(3) These tolerances hold in the following conditions:
- self-powered relay at full power and/or auxiliary power supply (without start-up)
- two- or three-phase power supply

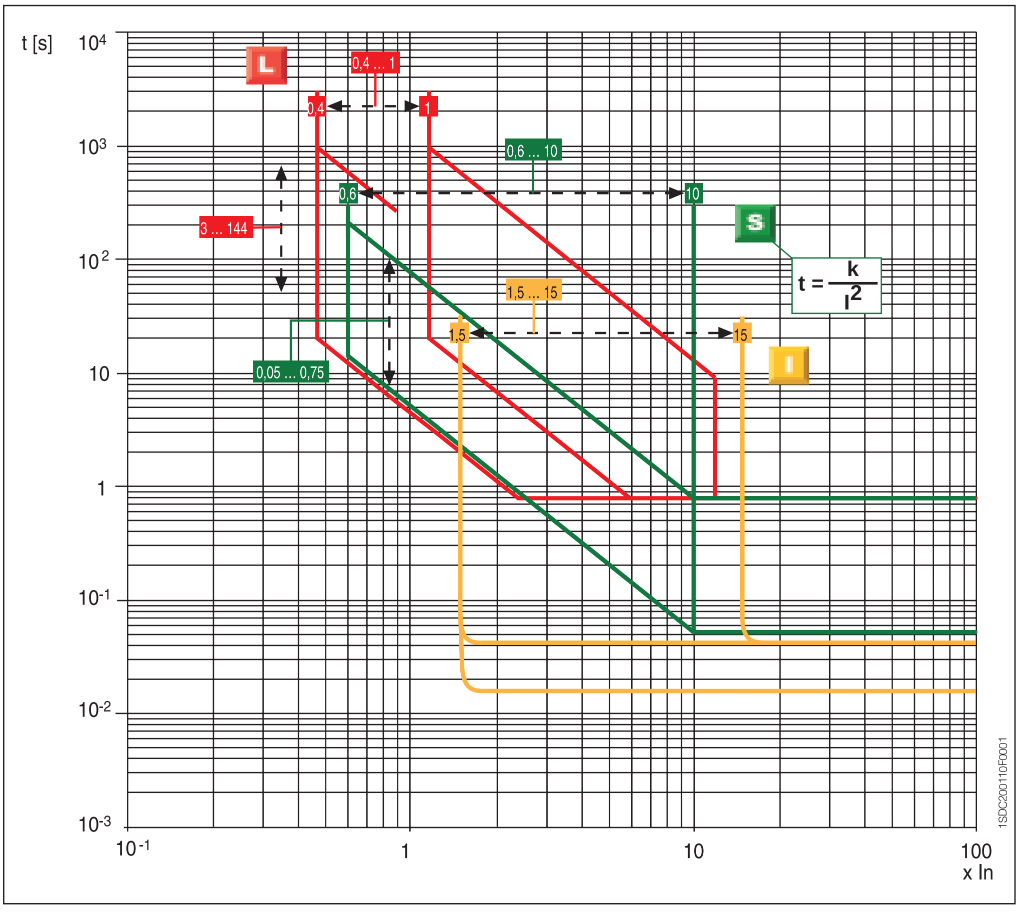
The following tolerance values apply in all cases not covered by the above:

	Trip threshold	Trip time
L	Release between 1.1 and 1.25 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 15%	± 20%

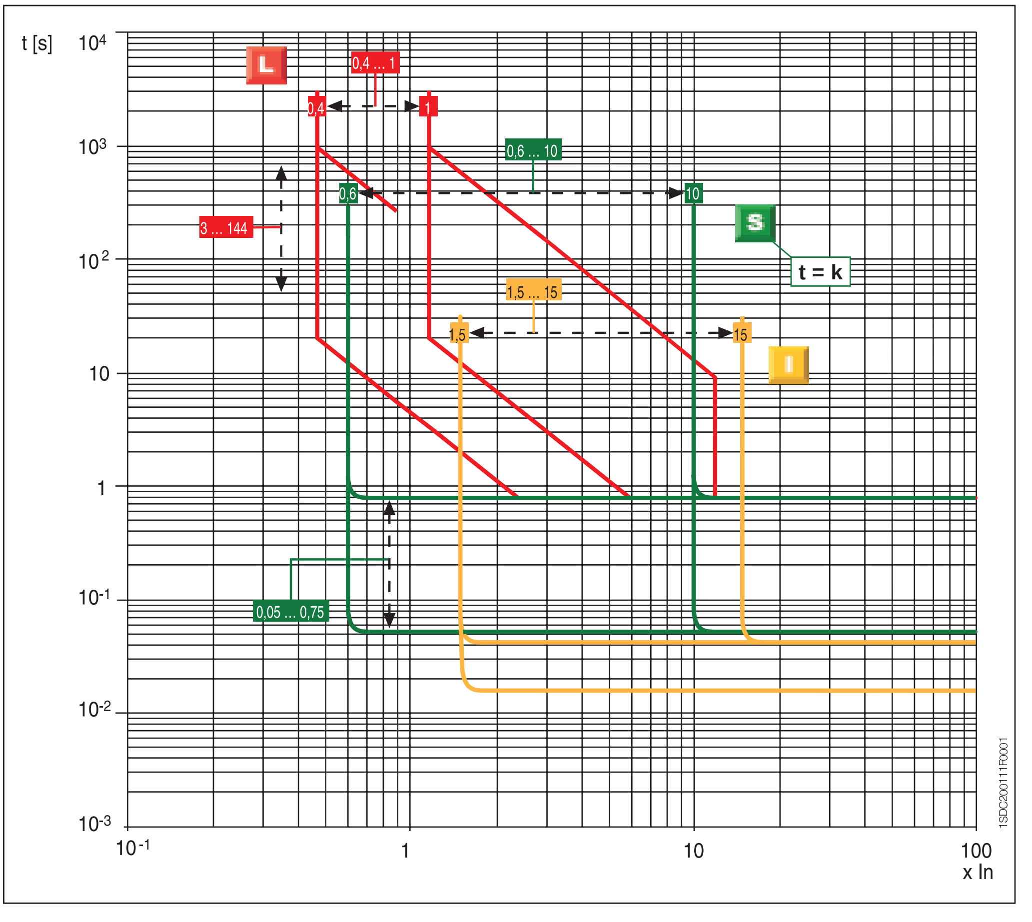
Microprocessor-based protection releases and trip curves

PR112/P

Functions L-S-I

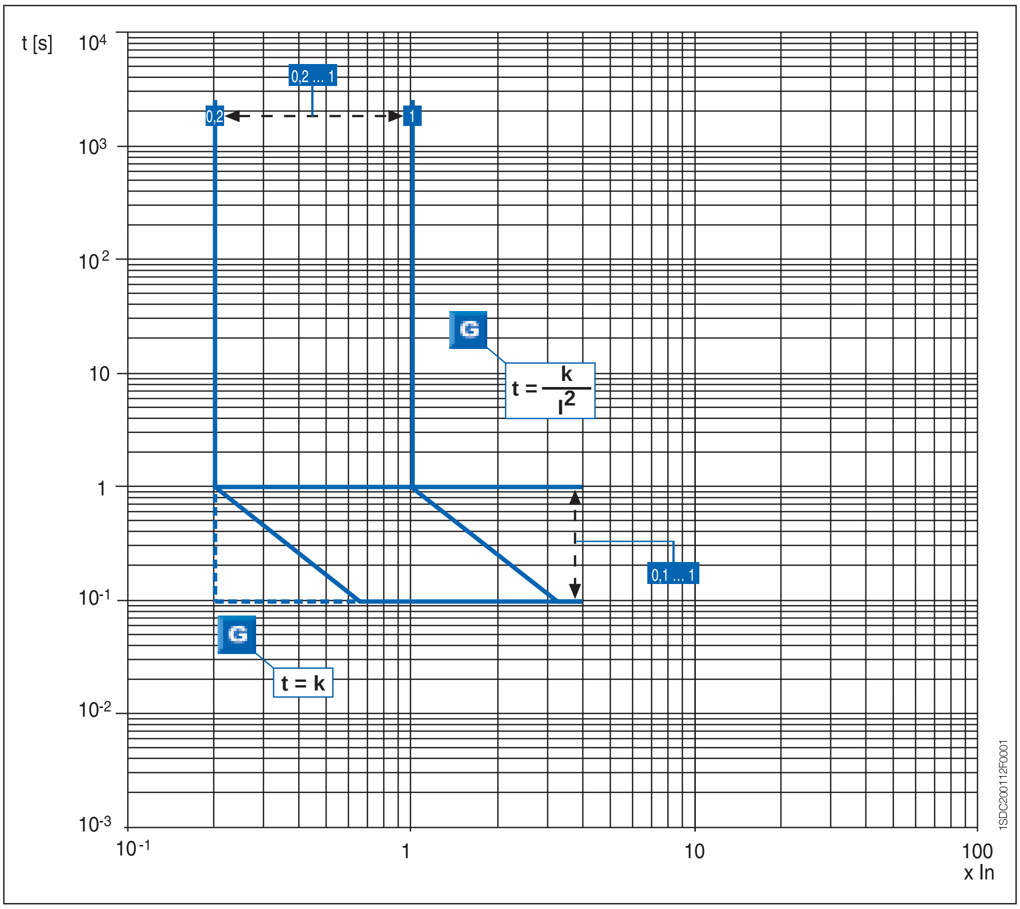


Functions L-S-I



Tolerances on thresholds and trip times .... page 4/13

Function G



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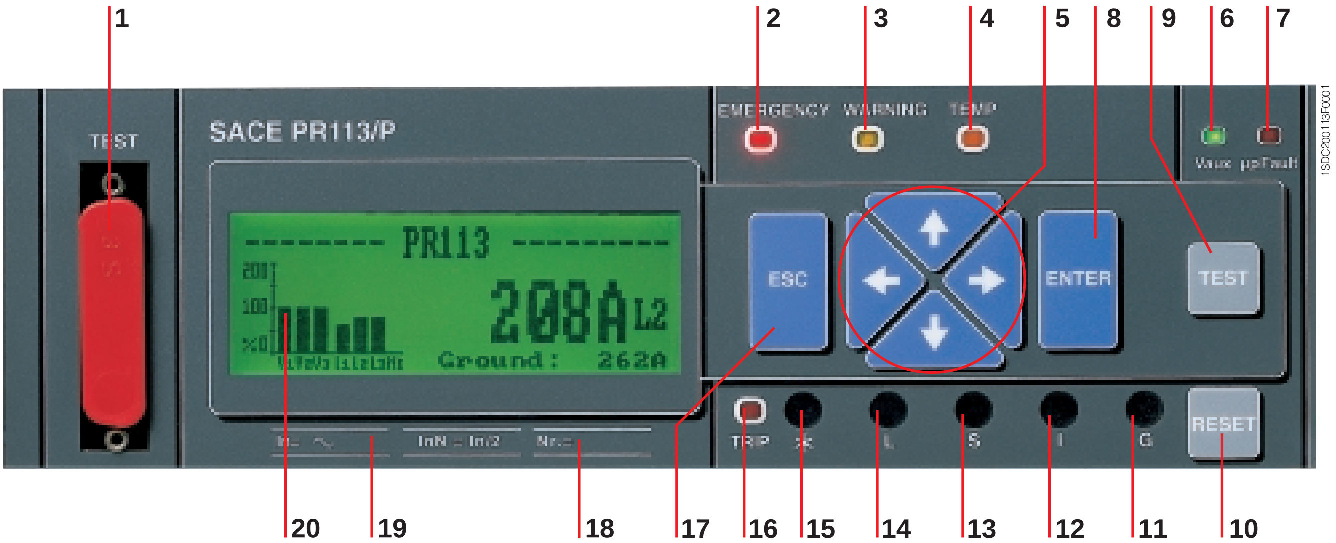
Tolerances on thresholds and trip times .... page 4/13

Microprocessor-based protection releases and trip curves

PR113/P

Characteristics

The PR113 protection release completes the range of available releases for the Emax family of circuit-breakers. It is available in versions PR113/P, for the protection unit, and PR113/PD, fitted with a dialogue unit.
It is a high-performance and extraordinarily versatile release that can offer a complete set of functions for protection, measurement, self-monitoring, signalling, data storage and control of the circuit-breaker.
The front interface of the unit is extremely simple thanks to the aid of the graphical liquid crystal display (LCD), which shows diagrams, bar graphs, measurements and sine curves for the various electrical values.
The PR113 release also offers other functions in addition to standard protections, such as protection against under- and overvoltage, residual voltage protection, phase umbalance protection and protection from directional short-circuit (i.e., those used for ring distribution networks).



Legend

1 TEST connector to apply SACE PR120/B or SACE PR010/T accessories
2 Alarm indicator LED
3 Pre-alarm indicator LED
4 Overtemperature alarm indicator LED
5 Buttons to move the cursor and set parameters: UP, DOWN, LEFT, RIGHT
6 Auxiliary power supply indicator LED
7 Microprocessor fault indicator LED
8 ENTER button to enter or confirm data
9 Test button (TEST) and setting values
10 Pushbutton to reset magnetic and electrical alarm signals (RESET), end the self-Test or return to the currents page from the Trip page
11 Magnetic signal indicating earth fault protection "G" tripped
12 Magnetic signal indicating instantaneous short-circuit protection "I" tripped.
13 Magnetic signal indicating protection functions "S" or "D" tripped
14 Magnetic signal indicating overload protection "L" tripped
15 Magnetic signal indicating that one of the following protections is tripped: undervoltage, overvoltage, residual voltage, reverse power, phase umbalance, overtemperature
16 "TRIP" indicator LED
17 Button to exit submenus or cancel operations (ESC)
18 Serial number of the unit
19 Rating plate indicating the rated current of the CTs and neutral
20 Backlit graphics display

Operation, protection functions and self-test

Power supply

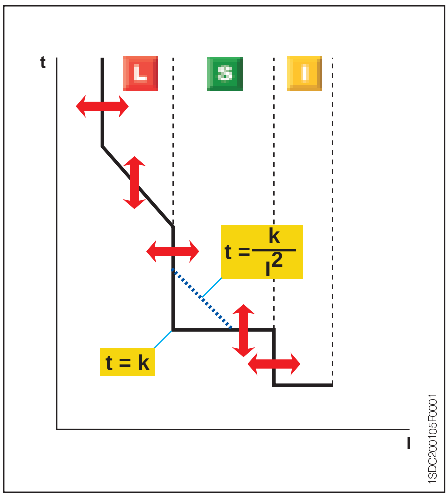
The PR113 release does not require auxiliary power supply for its protection functions: it draws the energy it needs for operation from the current transformers (CT) installed on the circuit-breaker. Indeed, for the protections to operate, it is sufficient for at least one phase to be powered at 35% of the rated current of the CTs (20% of the current if two phases are powered, and 15% for three phases). Instead, in order for the display to come on, at least one phase must have a current load equivalent to 50% of the rated current of the CTs (30% if two phases are powered and 20% for three phases).

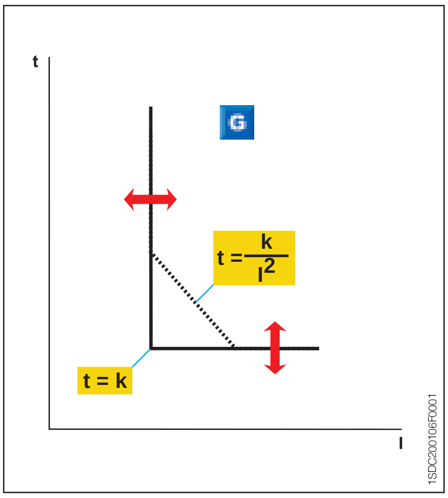
Complete operation of the protection unit may be guaranteed by providing an auxiliary power supply capable of monitoring the functions and protections, including: zone selectivity, load control, measuring and calculating harmonics, energy and maintenance.

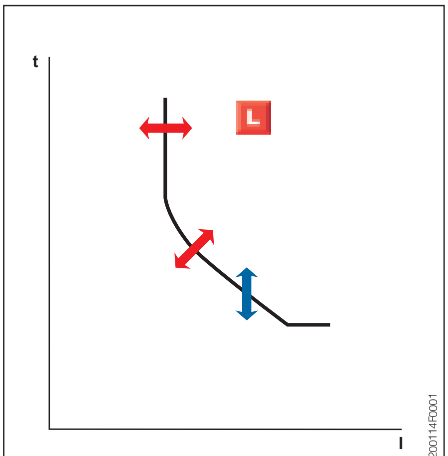
Auxiliary power is available through the SACE PR120/B accessory, always supplied, which makes it possible to read data and program the releases in the event of:
- circuit-breaker not powered
- circuit-breaker unavailable for power
- withdrawable circuit-breaker in racked-out position.

The earth fault protection may also be obtained by connecting the PR113 release to an external toroid located on the conductor that connects the transformer star center to earth (homopolar toroid).
All the thresholds and trip curve delays of the protection functions are stored in special memories which retain the information even if no power is supplied.

	PR113/P	PR113/PD
Auxiliary power supply (galvanically insulated)	24 V DC ± 20%	24 V DC ± 20%
Maximum ripple	5%	5%
Inrush current @ 24V	~3 A for 30 ms	~5 A for 30 ms
Starting current @ 24V	~1.0 A for 150 ms	~1.0 A for 150 ms
Rated current @ 24V	~200 mA	~310 mA
Rated power @ 24V	~5 W	~8 W







In accordance with IEC 60255-3

Microprocessor-based protection releases and trip curves

PR113/P

Protection functions

The PR113 release offers the following protection functions:
– overload (L),
– selective short-circuit (S),
– instantaneous short-circuit (I),
– earth fault with adjustable delay (G),
– directional short-circuit with adjustable delay (D)(1),
– phase umbalance (U),
– protection against overtemperature (OT),
– load control (K),
– undervoltage (UV)(1),
– overvoltage (OV)(1),
– residual voltage (RV)(1),
– reverse power (RP)(1)

Note (1): For these protections it is necessary to use a set of three external voltage transformers.

Shielded Voltage Transformers			
Rated Primary Voltage ANSI/IEC	(Un)	[V]	[100, 115, 120, 190, 208, 220, 230, 240, 277, 347, 380, 400, 415, 440, 480, 500, 550, 600, 660, 690, 910, 950, 1000] / √3
Rated Secondary Voltage (recommended)	(Us)	[V]	100/√3
Precision class			0,5
Primary winding resistance		[Ohm]	> 600
Load resistance		[kOhm]	≥ 10
Overload			20% permanent
Insulation		[kV]	4 between IN and OUT 4 between shield and IN (the shield must be earthed) 4 between shield and OUT (the shield must be earthed)
Frequency		[Hz]	$45 \leq f \leq 66$

Note: sample choice of the voltage transformer.

For maximum measuring performance in installations with rated phase-phase voltage 690V AC it is necessary to use a voltage transformer with
Un = 690/√3
Class = 0,5

Notes:

The directional short-circuit protection can be disabled for an adjustable set time (t = k), and may either be self-powered or use the auxiliary power supply.
Directional protection is not available on the 250A and 400A CTs.

Overload protection L

With the PR113 unit, the overload protection L includes the option to adjust the slope of the protection curve. This adjustment allows perfect coordination with fuses or with medium-voltage protection systems.

Directional short-circuit protection with adjustable delay D

The protection works in a similar way to the fixed-time protection “S”, with the added ability to recognize the direction of the phases current during the fault period.
The current direction makes it possible to determine whether the fault is upstream or downstream of the circuit-breaker; particularly in ring distribution systems, this makes it possible to identify and disconnect the distribution segment where the fault has occurred, while keeping the rest of the installation running. If multiple PR112 or PR113 releases are used, this protection may be associated with zone selectivity.

Phase umbalance protection U

Protection function U, against phase umbalance, is used in those situations requiring especially accurate control over missing and/or umbalanced phase currents. This function can be excluded.

Load control function K

There are two separate curves with threshold currents and trip times lower than those available for selection with the protection L, which may be used for the two applications:
– disconnection of two separate loads;
– connection and disconnection of a load.
These functions make it possible to engage/disengage individual loads before the overload protection L is tripped and definitively opens the circuit-breaker.
The load control may be activated directly through the programmable contacts, or using the load control and signalling device PR020/K.

Voltage protections UV, OV, RV

The PR113 unit offers three types of voltage protection, which may be excluded:
– undervoltage (UV),
– overvoltage (OV),
– residual voltage (RV).
The residual voltage protection RV identifies interruptions of the neutral (or of the earthing conductor in systems with earthed neutral) and faults that shift the star center in systems with insulated neutral (e.g., large earth faults). The star center shift is calculated as a vector sum of the phase voltages.
With the circuit-breaker closed, these protections also operate when the release is self-powered. With the circuit-breaker open they operate only when the auxiliary power supply is present: in this case the release will indicate the “ALARM” status.

Microprocessor-based protection releases and trip curves

PR113/P

Reverse power protection RP

Reverse power protection is especially suited for protecting large machines such as engines and generators. The PR113 unit can analyze the direction of the active power and open the circuit-breaker if the direction is opposite to normal operation. The reverse power threshold and the trip time are adjustable.

Setting the neutral

The neutral protection is normally set to a current value equivalent to 50% of the phase setting. In installations where very high harmonics occur, the resulting current at the neutral may be higher than that of the phases.
This protection may be set for the following values on the PR113 release:
I1N = 50% - 100% - 150% - 200% x I1
The table below lists the neutral settings for the various possible combinations between type of circuit-breaker and the setting of threshold I1.

Adjustable neutral protection settings

	Threshold I1 settings (overload protection)		
Circuit-breaker size	0,4 ≤ I1 ≤ 0,5	0,5 < I1 ≤ 0,66	0,66 < I1 ≤ 1 (*)
E1B	50-100-150-200%	50-100-150%	50-100%
E1N	50-100-150-200%	50-100-150%	50-100%
E2B	50-100-150-200%	50-100-150%	50-100%
E2N	50-100-150-200%	50-100-150%	50-100%
E2L	50-100-150-200%	50-100-150%	50-100%
E3N	50-100-150-200%	50-100-150%	50-100%
E3S	50-100-150-200%	50-100-150%	50-100%
E3H	50-100-150-200%	50-100-150%	50-100%
E3L	50-100-150-200%	50-100-150%	50-100%
E4S	50-100%	50%	50%
E4H	50-100%	50%	50%
E4S/f	50-100-150-200%	50-100-150%	50-100%
E6H	50-100%	50%	50%
E6V	50-100%	50%	50%
E6H/f	50-100-150-200%	50-100-150%	50-100%

(*) The setting I1=1 indicates the maximum overload protection setting. The actual maximum allowable setting must take into account any derating based on temperature, the terminals used and the altitude (see chapter “Installations”)

Start-up function

The start-up function allows the protections S, D, I and G to operate with higher trip thresholds during the start-up phase. This avoids untimely tripping caused by the high inrush currents of certain loads (motors, transformers, lamps).
The start-up phase lasts from 100 ms to 1.5 s, in steps of 0.05 s. It is automatically recognized by the PR113 release as follows:
– when the circuit-breaker closes with self-powered release;
– when the peak value of the maximum current exceeds 0.1 x In; a new start-up becomes possible after the current has fallen below the threshold of 0.1 x In, if the release is powered by an external source.

Zone selectivity function

The zone selectivity function permits the fault area to be insulated by very rapidly segregating the system only at the level closest to the fault, while leaving the rest of the installation running.
This is done by connecting the releases: the release nearest the fault is instantly tripped, sending a block signal to the other releases affected by the same fault
The zone selectivity function may be enabled if the fixed-time curve has been selected and the auxiliary power supply is present.
Zone selectivity may be applied with protections S and G or, alternatively, with protection D.

Contact programming functions

The PR113 release is equipped with two relays, with contacts known as K51/p1 and K51/p2 (the latter is not available on PR113/PD).
They may signal a variety of situations selected by the user, including: protection timing, alarms, cause of opening, temperature thresholds exceeded, zone selectivity, load control, disconnected opening solenoid or CT, harmonic distortion, etc.

Measuring functions

The PR113 release provides a complete set of measurements:
- Currents: three phases (L1, L2, L3), neutral (Ne), earth fault
- Voltage: phase-phase, phase-neutral, residual voltage(1)
- Power: active, reactive, apparent(1)
- Power factor(1)
- Frequency and peak factor
- Energy: active, reactive, apparent, counter(1)
- Harmonics calculation: up to the twentieth harmonic (waveform and module of the harmonics displayed); up to the nineteenth for frequency f=60Hz
- Maintenance: number of operations, percentage of contact wear, opening data storage.

The PR113 unit is able to provide the pattern of measurements for some values over an adjustable period of time P, such as: mean active power, maximum active power, maximum current, maximum voltage and minimum voltage. The last 24 periods P (adjustable from 5 to 120 min.) are stored in non-volatile memory and displayed in a bar graph.

Note (1): These measurements require voltage transformers

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Microprocessor-based protection releases and trip curves

PR113/P

Signalling functions

The PR113 unit provides optic signals (via indicator LEDs, magnetic flags and display messages) and electrical signals.

Optic signals on the front of the release:

- Vaux LED (green): indicates there is an auxiliary power supply
- µP Fault LED (red): indicates a temporary or permanent fault in the microprocessor
- Temp LED (orange): the signals is flashing for internal relay temperatures <-20°C or >+70°C, steadily lit for temperatures <-25°C or >+85°C
- Trip LED (red): with auxiliary voltage only, this lights after the circuit-breaker opens due to tripped protections
- Warning LED (yellow): is a generic pre-alarm signal following the occurrence of any of the conditions listed below:
  - one or more phases with current values in the range of $0.9 \times I1 < I < 1.05 \times I1$ (IEC)
  - two or three phases with umbalance greater than the programmed level for the protection U (phase umbalance), with protection trip disabled
  - distorted waveform with form factor >2.1 (harmonic distortion)
  - contact wear beyond 80%.
  - frequency out of range
  - Warning Threshold exceeded (current pre-alarm threshold settable via the configuration menu)
  - circuit-breaker status error
- Emergency LED (red): it's a generic alarm signal when one of the conditions listed below occurs:
  - one or more phases overloaded with current values $I > 1.3 \times I1$
  - timing in progress for protection functions: S, I, G, D, UV, OV, RV, RP
  - timing in the event of a phase umbalance greater than the value set, with protection trip set to on
  - contact wear at 100%
  - CTs disconnected
  - opening solenoid disconnected
- Yellow magnetic flag ⋆ indicates one of the following protections is tripped: undervoltage (UV), overvoltage (OV), residual voltage (RV), reverse power (RP), phase umbalance (U), overtemperature (OT). The release display indicates which protection has been tripped
- Yellow magnetic flag L: indicates protection L tripped
- Yellow magnetic flag S: signals protection S or D tripped
- Yellow magnetic flag I: instantaneous short-circuit protection I is tripped
- Yellow magnetic flag G: earth fault protection G is tripped.

The **electrical signals** refer instead to the contacts:

- K51/p1 and K51/p2, which may be set by the user (with auxiliary power supply only)
- K51/YO1, which signals that one of the following protections is tripped: L, S, D, I, G, U, OT, UV, OV, RV, RP
- K51/µP, to signal temporary or permanent fault of the microprocessor.

In addition to the optic and electrical signals, the PR113 release display also shows messages about incorrect configurations, general alarms, tripped protection functions, load control (with the aid of SACE PR020/K) and password management.

Versions available

The following versions are available:

1SDC200113F0001

PR113/P LSIG

1SDC200115F0001

PR113/PD LSIG

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Microprocessor-based protection releases and trip curves

PR113/P

Protection functions and setting values - PR113

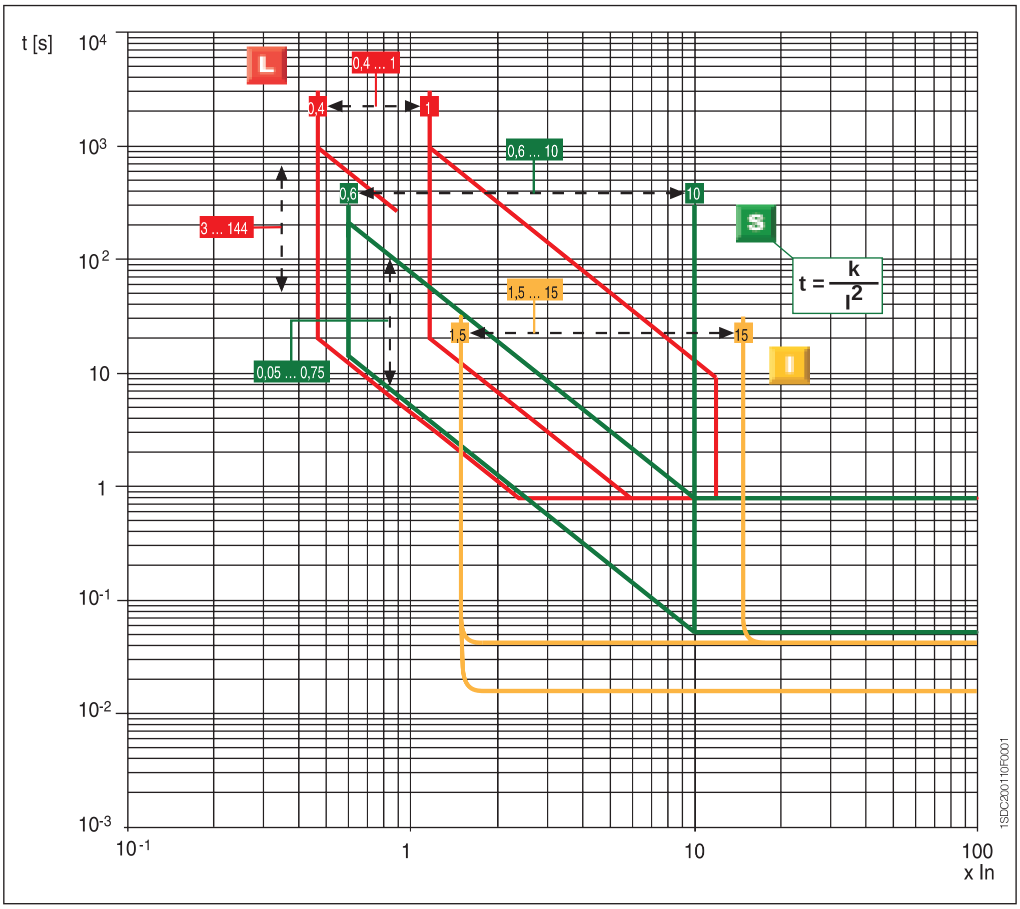
	Function	Trip threshold	Threshold steps	Trip Time	Time Step	Can be excluded	Relation t=f(I)	Thermal memory	Zone selectivity
L	Overload protection	I1= 0.4….1 x In	0.01 x In	t1= 3 s....144 s	3 s (1)	–	$t=k/I^2$	■	–
	Tolerance (3)	Release between 1.1 e 1.2 x I1		± 10% Ig ≤ 4 x In ± 20% Ig > 4 x In					
		I1= 0.4….1 x In	0.01 x In	b= 0.2....10	0,1s	–			
	Tolerance	1.1 ... 1.25 x I1 (in accordance with IEC 60255-3)		± 20% Ig > 5 x I1 ± 30% 2xI1< Ig < 5 x I1 In					
S	Selective short-circuit protection	I2= 0.6….10 x In	0.1 x In	t2= 0.05 s….0.75 s (2)	0.01s	■	t=k	–	■
	Tolerance (3)	± 7% Ig ≤ 4 x In ± 10% Ig > 4 x In		The better of the two figures: ± 10% o ± 50 ms Ig ≤ 4 x In ± 15% o ± 50 ms Ig > 4 x In					
		I2= 0.6….10 x In	0.1 x In	t2= 0.05 s….0.75 s	0.01s	■	$t=k/I^2$	■	–
	Tolerance (3)	± 7% Ig ≤ 4 x In ± 10% Ig > 4 x In		± 15% Ig ≤ 4 x In ± 20% Ig > 4 x In					
I	Instantaneous short-circuit protection	I3= 1,5….15 x In	0,1 x In	Instantaneous	–	■	t=k	–	–
	Tolerance (3)	± 10% Ig ≤ 4 x In ± 15% Ig > 4 x In		≤ 25 ms					
G	Earth fault protection	I4= 0.2….1 x In	0.02 x In	t4= 0.1 s…..1 s	0.05 s	■	t=k	–	■
	Tolerance (3)	± 7% Ig ≤ 4 x In		The better of the two figures: ± 10% o ≤ 50 ms Ig ≤ 4 x In					
		I4= 0.2….1 x In	0.02 x In	t4= 0.1 s…..1 s	0.05 s	■	$t=k/I^2$	–	–
	Tolerance (3)	± 7% Ig ≤ 4 x In		± 15%					
D	Directional short-circuit protection	I7= 0.6….10 x In	0.1 x In	t7= 0.20 s…..0.75 s	0.01 s	■	t=k	–	■
	Tolerance	± 10%		± 20%					
U	Phase umbalance protection	I6= 10%….90%	10%	t6= 0.5 s…..60 s	0.5 s	■	t=k	–	–
	Tolerance	± 10%		± 20%					
OT	Protection against overtemperature	may not be set	–	Instantaneous	–	–	temp=k	–	–
UV	Undervoltage protection	I8= 0.6….0.95 x Un	0.01 x In	t8= 0.1 s…..5 s	0.1 s	■	t=k	–	–
	Tolerance	± 5%		± 20%					
OV	Overvoltage protection	I9= 1.05….1.2 x Un	0.01 x In	t9= 0.1 s…..5 s	0.1 s	■	t=k	–	–
	Tolerance	± 5%		± 20%					
RV	Residual voltage protection	I10= 0.1….0.4 x Un	0.05 Un	t10= 0.5 s…..30 s	0.5 s	■	t=k	–	–
	Tolerance	± 5%		± 20%					
RP	Reverse power protection	P11= -0.3….-0.1 x Pn	0.02 Pn	t11= 0.5 s…..25 s	0.1 s	■	t=k	–	–
	Tolerance	± 10%		± 20%					

(1) The minimum trip value is 750 ms, regardless of the type of curve set (self-protection)
(2) In addition, if the fixed time trip curve is selected (t=k), it will also be possible to set the trip time t2=minimum time
(3) These tolerances hold in the following conditions:
- self-powered relay at full power and/or auxiliary power supply (without start-up)
- two- or three-phase power supply

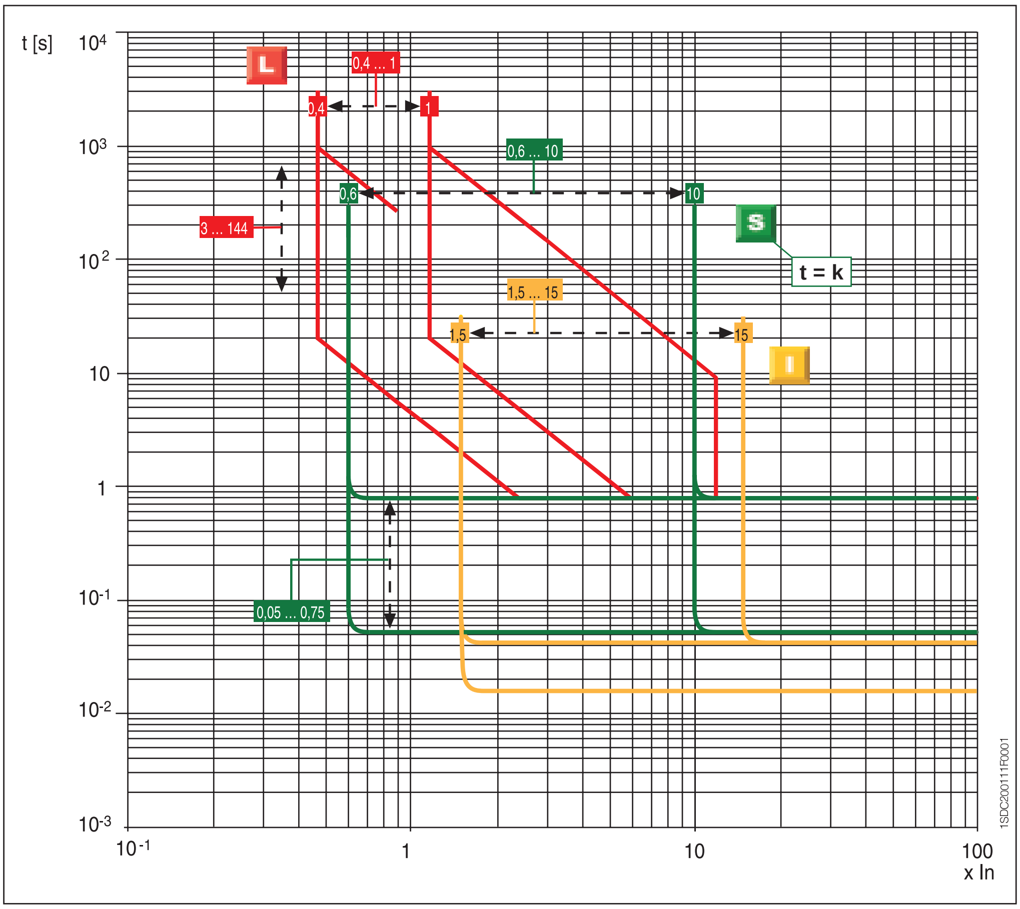
The following tolerance values apply in all cases not covered by the above:

	Trip threshold	Trip time
L	Release between 1.1 and 1.25 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 10%	± 20%

Functions L-S-I



Functions L-S-I



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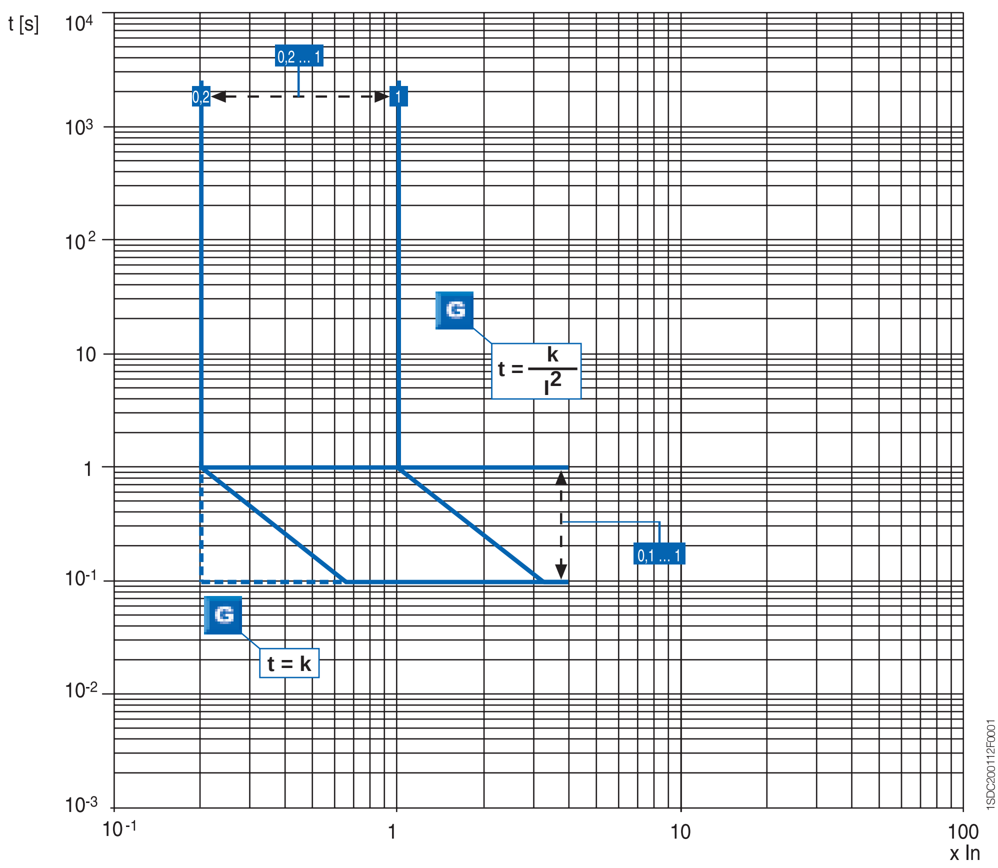
Tolerances on thresholds and trip times .... page 4/24

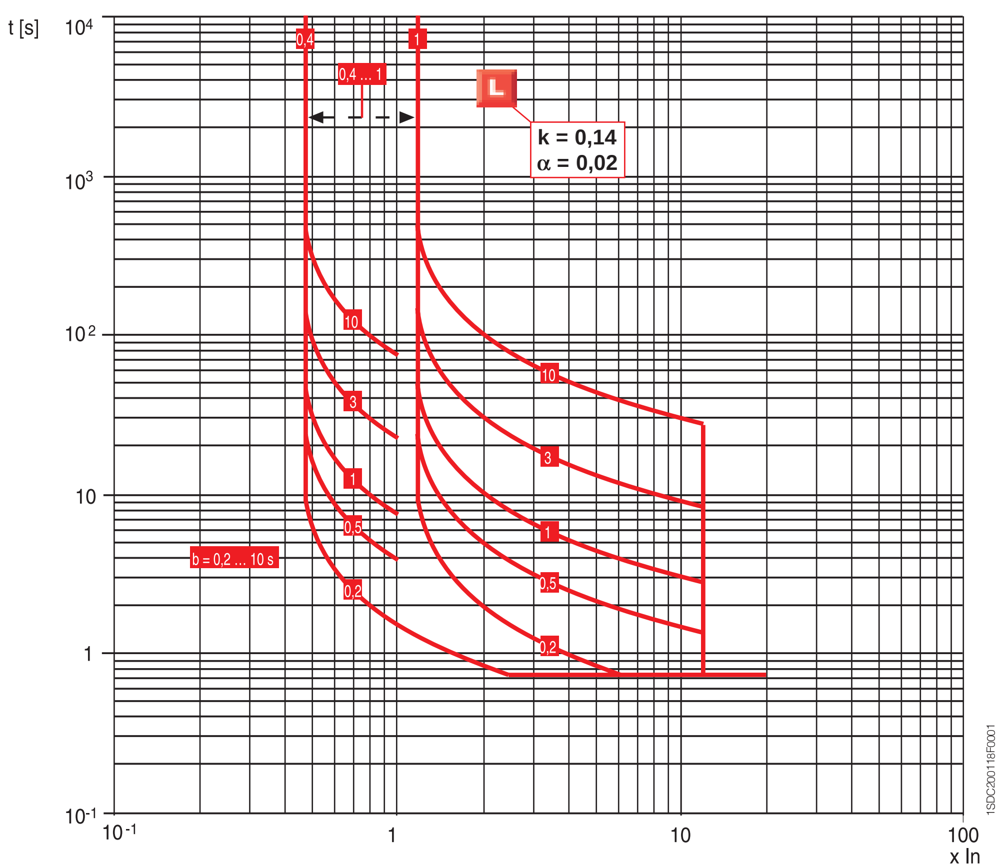
Microprocessor-based protection releases and trip curves

PR113/P

Function G

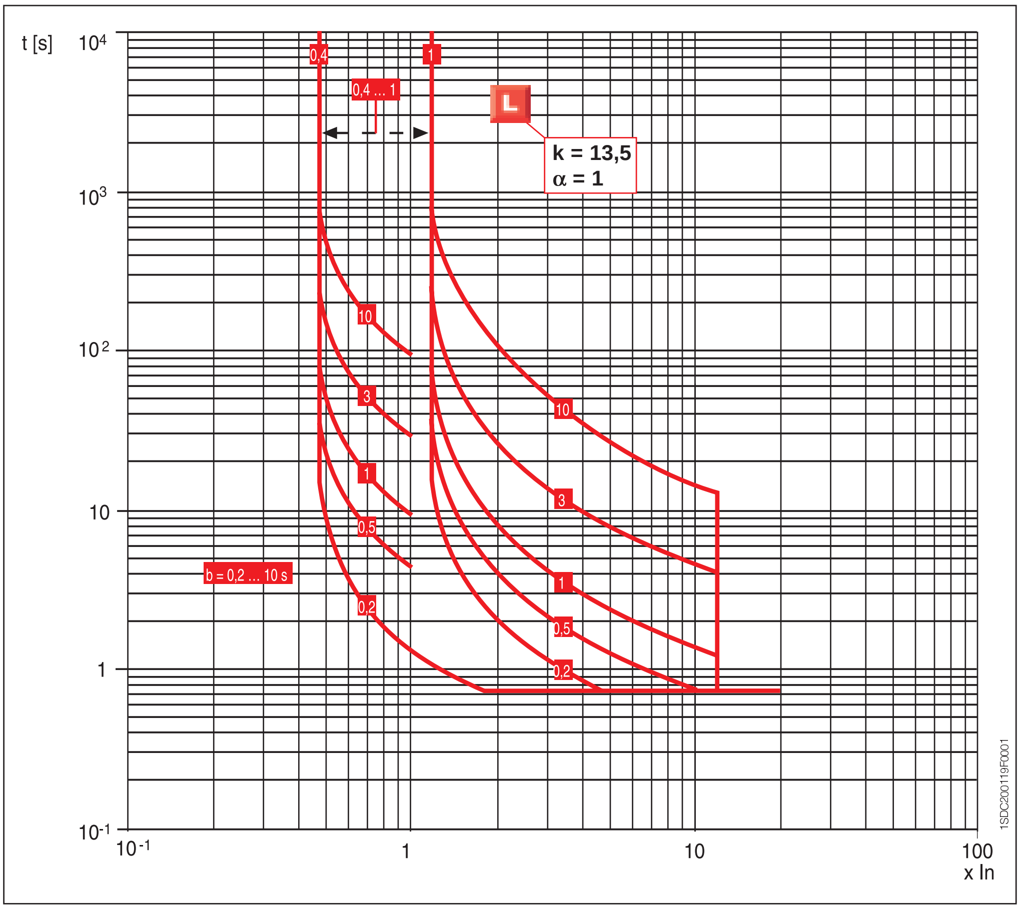


Function L

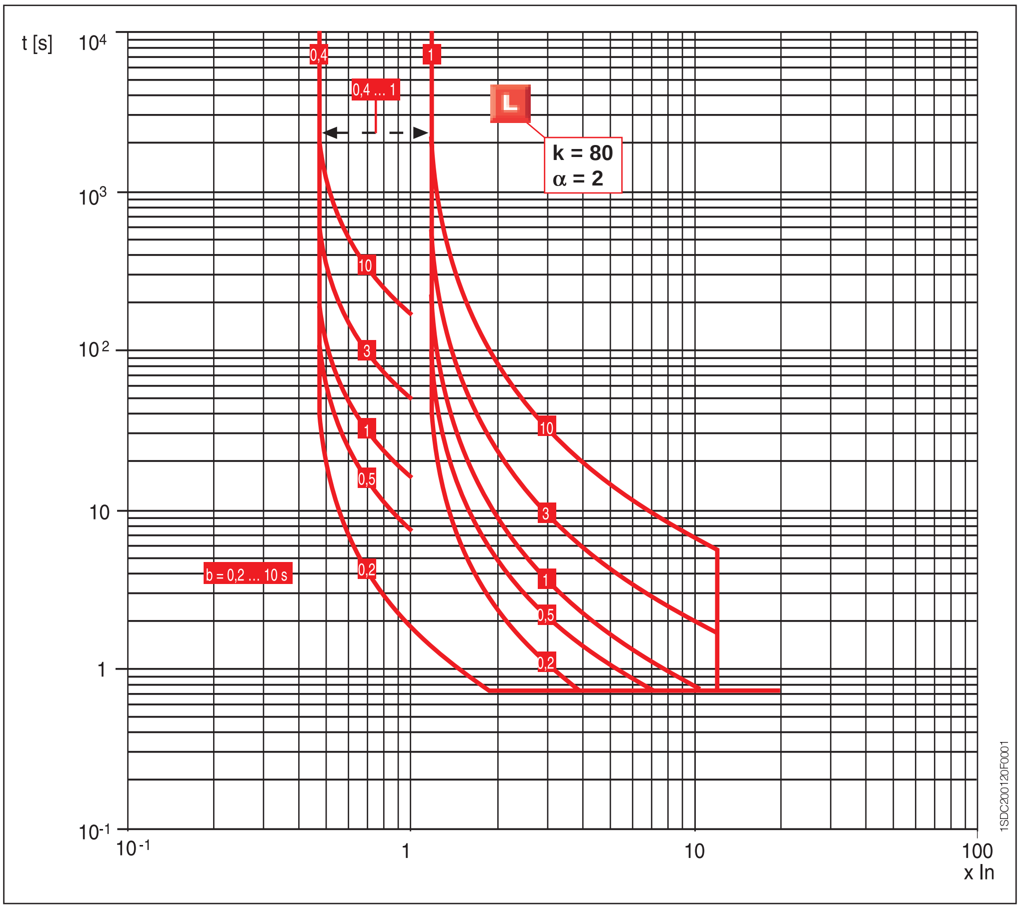


Tolerances on thresholds and trip times .... page 4/24

Function L



Function L



Tolerances on thresholds and trip times .... page 4/24

Microprocessor-based protection releases and trip curves

PR113/P

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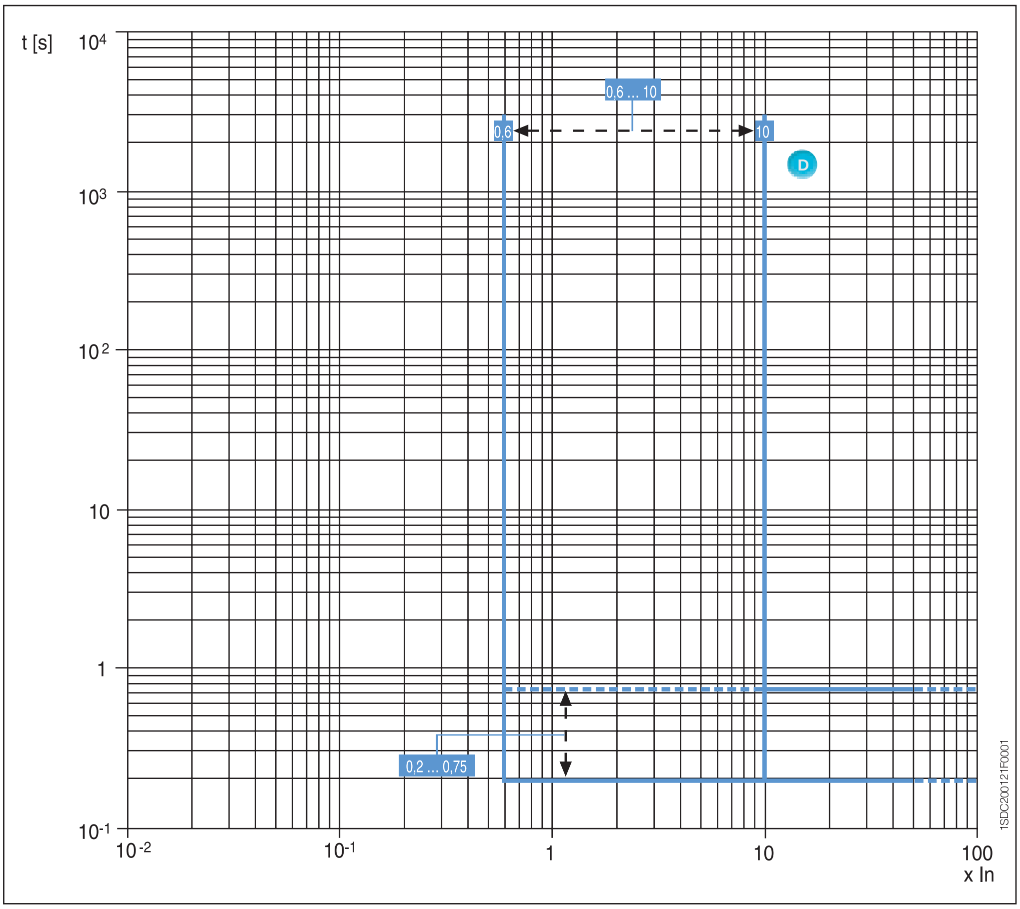
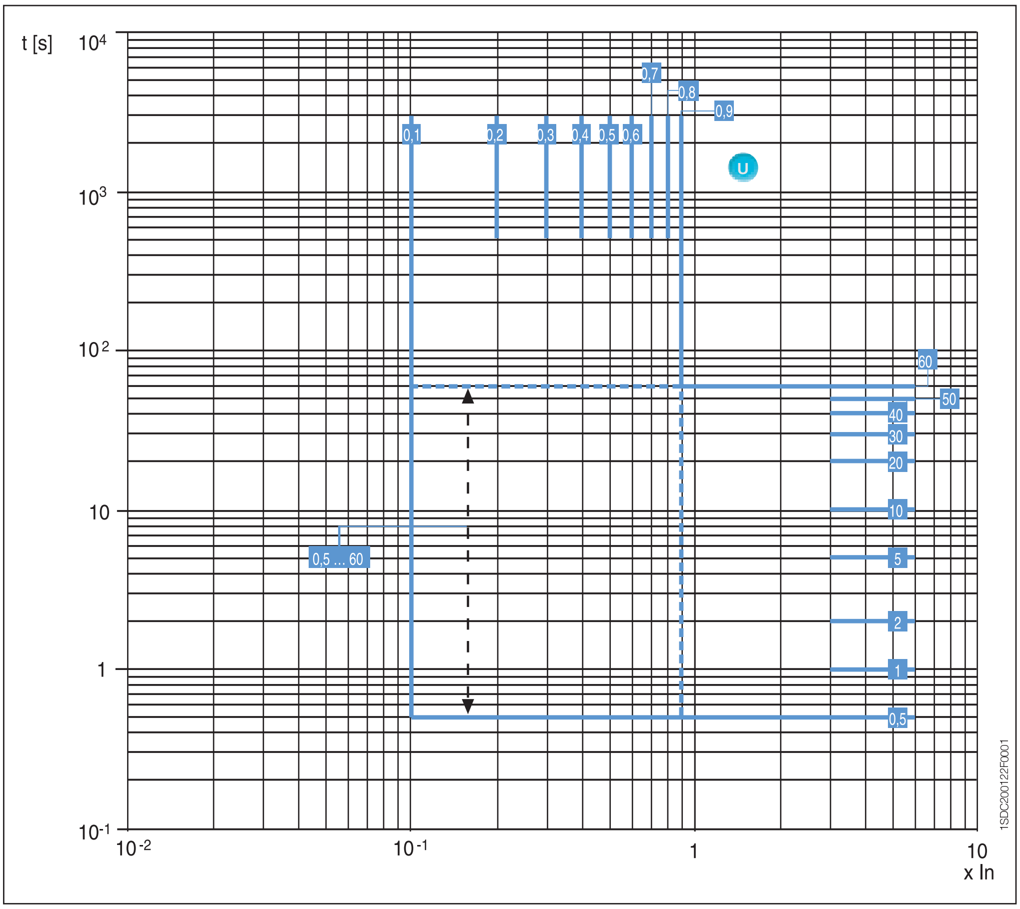
Function D

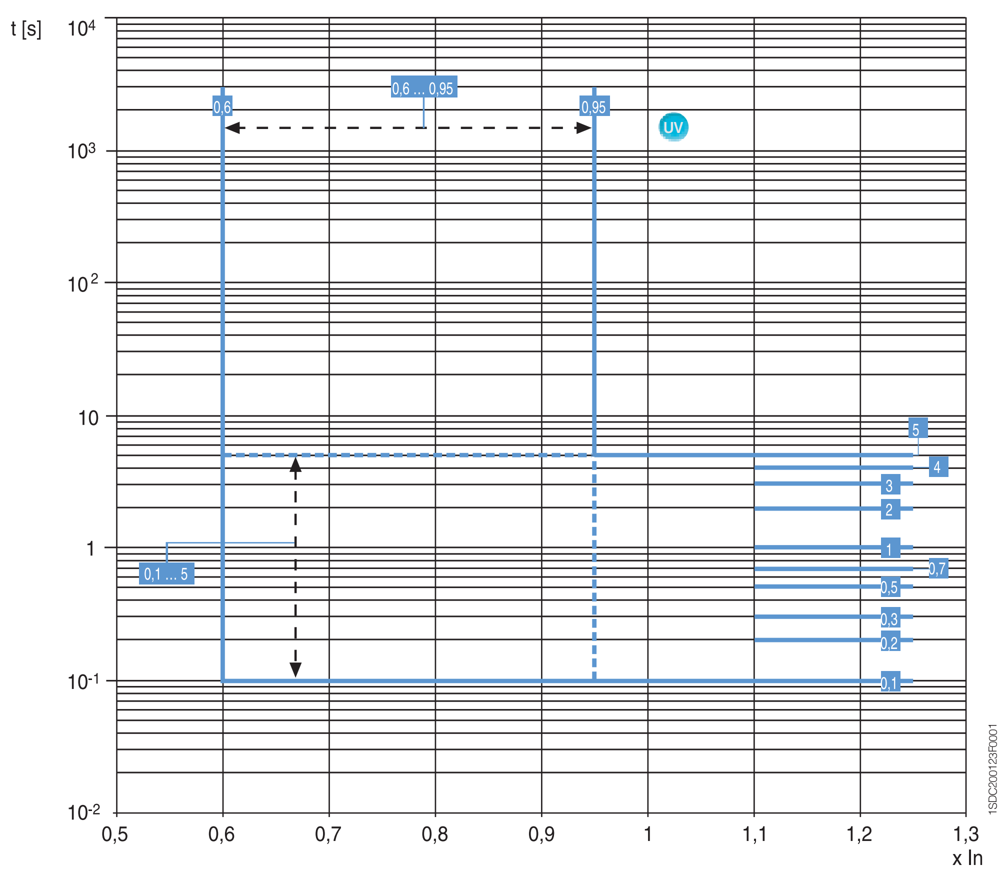


Function U

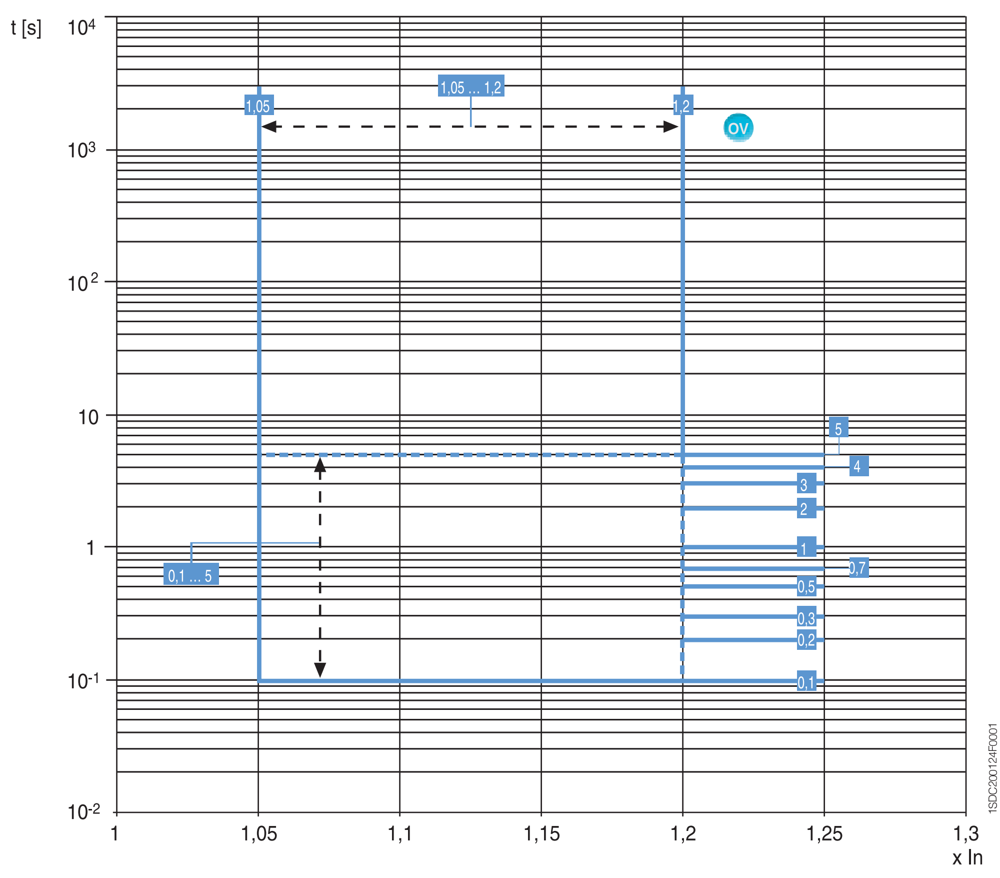


Tolerances on thresholds and trip times .... page 4/24

Function UV



Functions OV

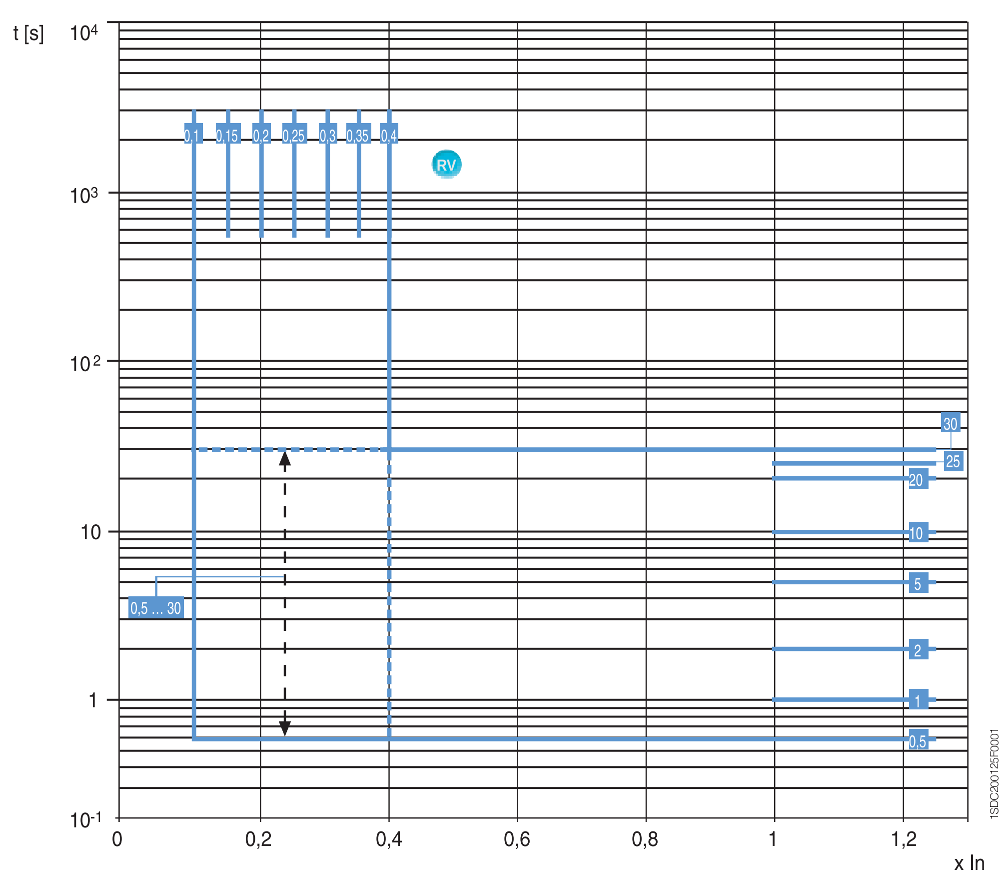


Tolerances on thresholds and trip times .... page 4/24

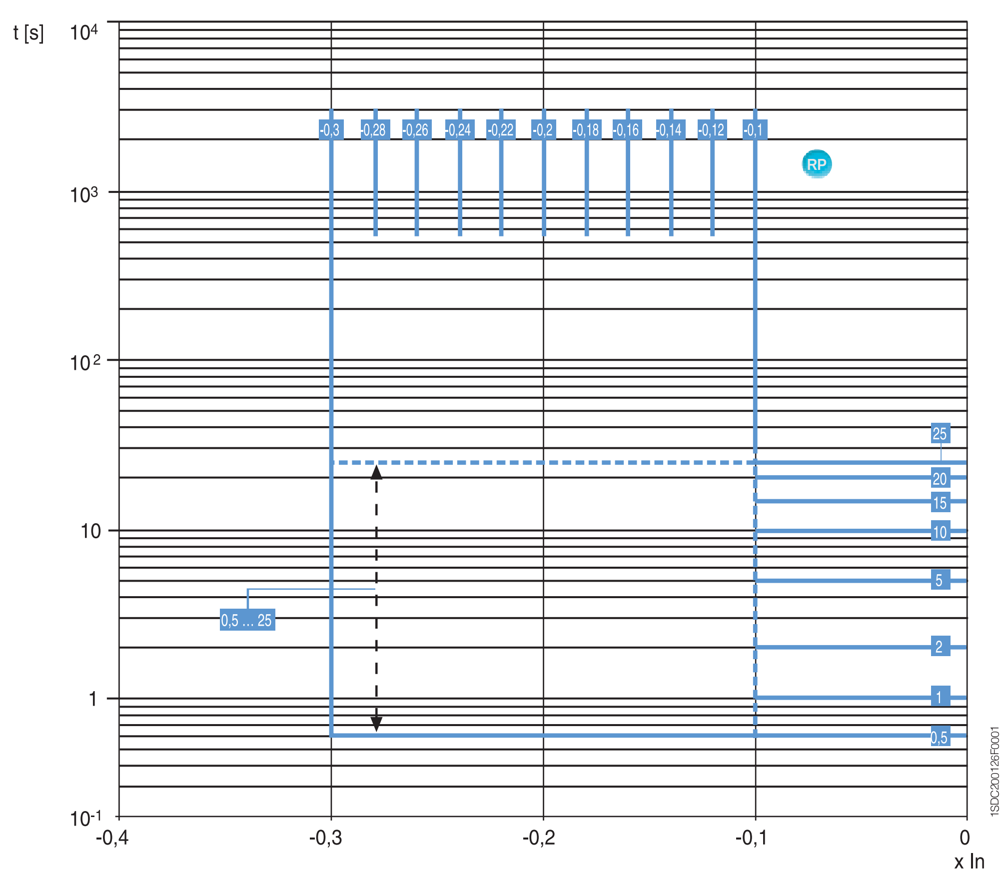
Microprocessor-based protection releases and trip curves

PR113/P

Function RV



Functions RP



Tolerances on thresholds and trip times .... page 4/24

Protection and dialogue releases for LonWorks® and Modbus® networks

PR112/PD and PR113/PD

Functional integration among various kinds of technological installations in industry and services is gradually increasing the need for communication, control and automation in low-voltage electrical installations. Modern microprocessor-based systems that operate using a logic of distributed intelligence (through components able to process data, exchange information, signals and commands) offer the most effective and flexible solution and cover a variety of different applications and specific needs. For a prompt and effective response to the demand for interconnection, intelligence, function, flexibility, interoperability and ease of installation, ABB SACE has developed new communication and control devices for low-voltage circuit-breakers based on the LonTalk® and Modbus® RTU protocols.

The new devices developed for the Emax range of air circuit-breakers, in particular, include:
– PR112/PD LON® releases, based on LonWorks® technology with LonTalk® protocol;
– PR112/PD Modbus® releases, based on the Modbus® RTU protocol;
– PR113/PD Modbus® releases, based on the Modbus® RTU protocol.

LonWorks®

LON® (Local Operate Network) is a data transmission technology with applications in a variety of settings, from the service industry to process control. The PR112/PD LON releases (available in LSI and LSIG versions) and the device PR212/D-L (the latter available on the Isomax range of moulded-case circuit-breakers), make it possible to integrate ABB SACE Emax air circuit-breakers and SACE Isomax S moulded-case circuit-breakers in a communication network based on LonWorks® technology, according to the LonTalk® protocol (Ansi/EIA 709.1-A-199). The devices are developed in accordance with LonMark® directives to ensure HW and SW development in line with the interoperability standard defined by the LonMark® Association. These devices also make it possible to integrate the circuit-breakers with ABB INSUM, the integrated supervision and measurement control system instrument gauge for motor control centers (MCC). LonWorks® technology allows high performance while ensuring event-driven peer-to-peer communication. The devices use the TP/XF 78 transceiver (physical data transmission means: braided pair; transmission rate: 78000 bit/sec).

Modbus® RTU

The Modbus® RTU protocol has been well known and used worldwide for several years. It is essentially the market standard thanks to its ease of installation, configuration and integration into different supervision, control and automation systems, in addition to good performance. PR112/PD Modbus (available in LSI and LSIG versions) and PR112/PD Modbus releases and the PR212/D-M device (the latter available on the Isomax range of moulded-case circuit-breakers), allow ABB SACE Emax air circuit-breakers and Isomax S moulded-case circuit-breakers to be integrated into a communication network based on the Modbus®RTU protocol. Modbus®RTU provides a Master-Slave system architecture in which a Master (PLC, PC, etc.) cyclically queries multiple Slaves (field devices). The devices use the standard EIA RS485 as the physical data transmission means, and a maximum transmission rate of 19200 bit/sec.

Note:
LonWorks®, LonMark®, LonTalk®, LON® are registered trademarks of Echelon® Corporation.
Modbus® and Modbus® RTU are registered trademarks of Modicon, Inc.

Protection and dialogue releases for LONWORKS® and Modbus® networks

PR112/PD and PR113/PD

PR112/PD and PR113/PD dialogue units

The human-machine interface (HMI) of the PR112/PD LON, PR112/PD Modbus and PR112/PD Modbus devices is made up of a graphic display (LCD), LEDs, magnetic flags and touchpad pushbuttons.
The user may choose from among five available languages: Italian, English, German, French and Spanish. The HMI is active when the auxiliary power supply is used, if the PR120/B battery unit is connected, or, finally, if the single-phase current is more than 35% of the rated current of the current transformers.
PR112/PD LON, PR112/PD Modbus and PR112/PD Modbus releases are always supplied with the PR120/B battery unit. This accessory is connected to the front connector of the release, and allows the protection parameters to be set regardless of the circuit-breaker status.
The dialogue functions and parameter settings are available only when the auxiliary power supply is present.

Sending and receiving data

Releases with built-in dialogue and control functions—PR112/PD LON, PR112/PD Modbus and PR113/PD Modbus—allow the remote acquisition and transmission of a wide range of information; opening and closing, thanks to opening and closing releases installed on the circuit-breaker; storing configuration and programming parameters for the unit; the current thresholds of the protection functions ad protection curves.
All information may be consulted either locally, directly on the front of the circuit-breaker, or remotely via supervision and control systems.

Protection functions

All releases with dialogue functions perform the same protection functions as the corresponding protection releases. See the corresponding sections for the protection releases.

Measuring, signalling, available data functions

The table below provides details of the functions available on each of the releases PR112/PD LON, PR112/PD Modbus and PR113/PD Modbus.

	PR112/PD LON	PR112/PD Modbus	PR113/PD Modbus
Communication functions			
Protocol	LonTalk	Modbus RTU standard	Modbus RTU standard
Physical means	Twisted pair	EIA RS485	EIA RS485
Speed (maximum)	78000bps	19200bps	19200bps
Measuring functions			
Phase currents	■	■	■
Neutral	■	■	■
Earth	■	■	■
Voltage (phase-phase, phase-neutral, residual)			■
Power (active, reactive, apparent)			■
Power factor			■
Frequency and peak factor			■
Energy (active, reactive, apparent)			■
Harmonics calculation up to the 20th harmonic			■
Signalling functions			
LED: auxiliary power supply, microprocessor fault, warning, emergency	■	■	■
Temperature			■
Magnetic flags: indicate trip for L, S, I, G and T	■	■	
Magnetic flags: indicate trip for L, S, I, G and other protection			■
Output contacts: microprocessor fault, trip and one available for configuration	■	■	
Output contacts: microprocessor fault, trip and two available for configuration			■
Data available			
Circuit-breaker status (open, closed)	■	■	■
Circuit-breaker position (racked-in, racked-out)	■	■	■
Mode (local, remote)	■	■	■
Protection parameters set	■	■	■
Load control parameters	■	■	■
Alarms			
Protection L	■	■	■
Protection S	■	■	■
Protection I	■	■	■
Protection G	■	■	■
Protection T	■	■	■
Fault release mechanism failure	■	■	■
Undervoltage, overvoltage and residual voltage (timing and trip) protection			■
Reverse power protection (timing and trip)			■
Directional protection (timing and trip)			■
Maintenance			
Total number of operations	■	■	■
Total number of trips	■	■	■
Number of trip tests	■	■	■
Number of manual operations	■	■	■
Number of separate trips for each protection function	■	■	■
Contact wear (%)	■	■	■
Record data of last trip	■	■	■
Operating mechanisms			
Circuit-breaker opening/closing	■	■	■
Reset alarms	■	■	■
Setting of curves and protection thresholds	■	■	■
Synchronize system time	■		
Safety function			
Automatic opening in case of failure to release for fault (through opening coil)	■	■	■
Events			
Status changes in circuit-breaker, protections and all alarms	■		

4

Event time-stamping and saving function (only with LON® protocol)

The PR112/PD LON release keeps its base synchronized with the absolute system time. The availability of absolute time makes it possible to time-stamp the events that occur in the circuit-breaker and in the PR112 release itself.
By gathering these events from the various devices installed, the supervision and control system can compile a list of significant events for managing and analyzing the installation. Such an analysis may be especially useful, for example, in tracing the causes that led to a fault.
Detected and time-stamped events:
– all protection events,
– all “Warning” and “Emergency” signals,
– all “Read/Edit” change-overs
– all opening and closing operations.

The above information is stored locally and made available to the supervision and control system.

Accessories for protection releases

1SDC200127F0001

SACE PR120/B power supply unit

This accessory, always supplied with the PR112 and PR113 range of releases, makes it possible to read and configure the parameters of the unit whatever the status of the circuit-breaker (open-closed, in test isolated or racked-in position, with/without auxiliary power supply).
An internal electronic circuit powers the unit for approximately 3 consecutive hours for the sole purpose of reading and configuring data.
In relation to the amount of use, battery life decreases if the SACE PR120/B accessory is also used to perform the “COMMAND” menu functions (Trip test, Auto test).

1SDC200128F0001

SACE TT1 test unit

The SACE TT1 unit checks the tripping of the PR111/P releases and tests the tripping of the opening solenoid.
The device is powered by a 12V replaceable battery.

1SDC200129F0001

SACE PR010/T configuration test unit

The SACE PR010/T unit is an instrument capable of performing the functions of testing, programming and reading parameters for the protection units equipping SACE Emax low-voltage air circuit-breakers.
The test function in particular involves the units:
- PR111 (all versions)
- PR112 (all versions)
- PR113 (all versions)

while the parameter programming and reading functions concern the range of PR112 and PR113 releases.
All of the functions mentioned may be carried out “on board” by connecting the SACE PR010/T unit to the front multi-pin connector on the various protection units. Special interface cables supplied with the unit should be used for this connection.
The human-machine interface takes the form of a touchpad and multi-line alphanumeric display.
The unit also has two LEDs to indicate, respectively:
- POWER-ON and STAND BY
- battery charge status.

Accessories for protection releases

The unit also has two LEDs to indicate, respectively:
– POWER-ON and STAND BY
– battery charge status.
Two different types of test are available: automatic (for PR111, PR112 and PR113) and manual. By connecting to a PC (using the disc supplied by ABB SACE) it is also possible to upgrade the software of the SACE PR010/T unit and thus adapt the test unit to the development of new products.
It is also possible to store the most interesting test results in the unit itself, and send a report to the personal computer with the following information:
– type of protection tested
– threshold selected
– curve selected
– phase tested
– test current
– estimated trip time
– measured trip time
– test results.
At least 5 complete tests may be stored in memory. The report downloaded onto PC allow the creation of an archive of tests carried out on the installation.
In automatic mode, the SACE PR010/T unit is capable of testing the following with the PR112 range:
– protection functions L, S, I,
– G protection function with internal transformer,
– G protection function with toroid on the transformer star center,
– monitoring of smooth microprocessor operation.

The PR113 release also tests:
– overvoltage protection function OV,
– undervoltage protection function UV,
– residual voltage protection function RV,
– phase umbalance protection function U.

The same tests may be repeated manually for PR111 and PR112.
The SACE PR010/T unit is portable and runs on rechargeable batteries and/or with an external power supply (always supplied) with a rated voltage of 100-240V AC/12V DC.

The standard version of the SACE PR010/T unit includes:
– SACE PR010/T test unit complete with rechargeable batteries
– SACE TT1 test unit
– 100 - 240V AC/12V DC external power supply with cord
– cables to connect the unit and the connector
– cable to connect the unit and the computer (RS232 serial)
– user manual and disc containing application software
– plastic suitcase.

SACE PR020/K signalling unit

The SACE PR020/K signalling unit can convert the digital signals supplied by the PR112 and PR113 protection unit (in version P or PD) into electrical signals, via normally open electrical contacts.
The unit is connected to the protection release by means of a dedicated serial line through which flows all of the information about the activation status of the protection functions. The corresponding power contacts are closed based on this information.
The following signals/contacts are available for the PR112 release:

- overload pre-alarm L
- timing and tripping of the protections L, S and G
- protection I tripped
- timing and exceeded overtemperature threshold (T>85 °C)
- two load control contacts (connection and disconnection of a load, or disconnection of two loads)
- release tripped
- dialogue fault on a serial line (connecting the protection and signalling units).

With the release PR113 in standard configuration, tripping of the phase umbalance protection is also indicated in addition to the signals listed above.
Setting a dip-switch allows up to seven signal contacts to be freely configured, including: directional protection D tripped, under- and overvoltage UV and OV tripped, reverse power RP tripped, and others.
Two contacts available on the SACE PR020/K unit (load control) can pilot a circuit-breaker opening or closing release. These contacts allow various applications, including load control, alarms, signals, electrical locks.

The alarm signal remains active throughout the overload, until the release is tripped.
The trip signals of the protections remain active during the timing phase, and even after the release is tripped.
Pressing the Reset pushbutton resets the status of all signals.

The unit also contains ten LEDs to visually signal the following information:

- "Power ON": auxiliary power supply present
- "TX (Int Bus)": flashing synchronized with dialogue with the Internal Bus
- eight LEDs associated with the internal contacts

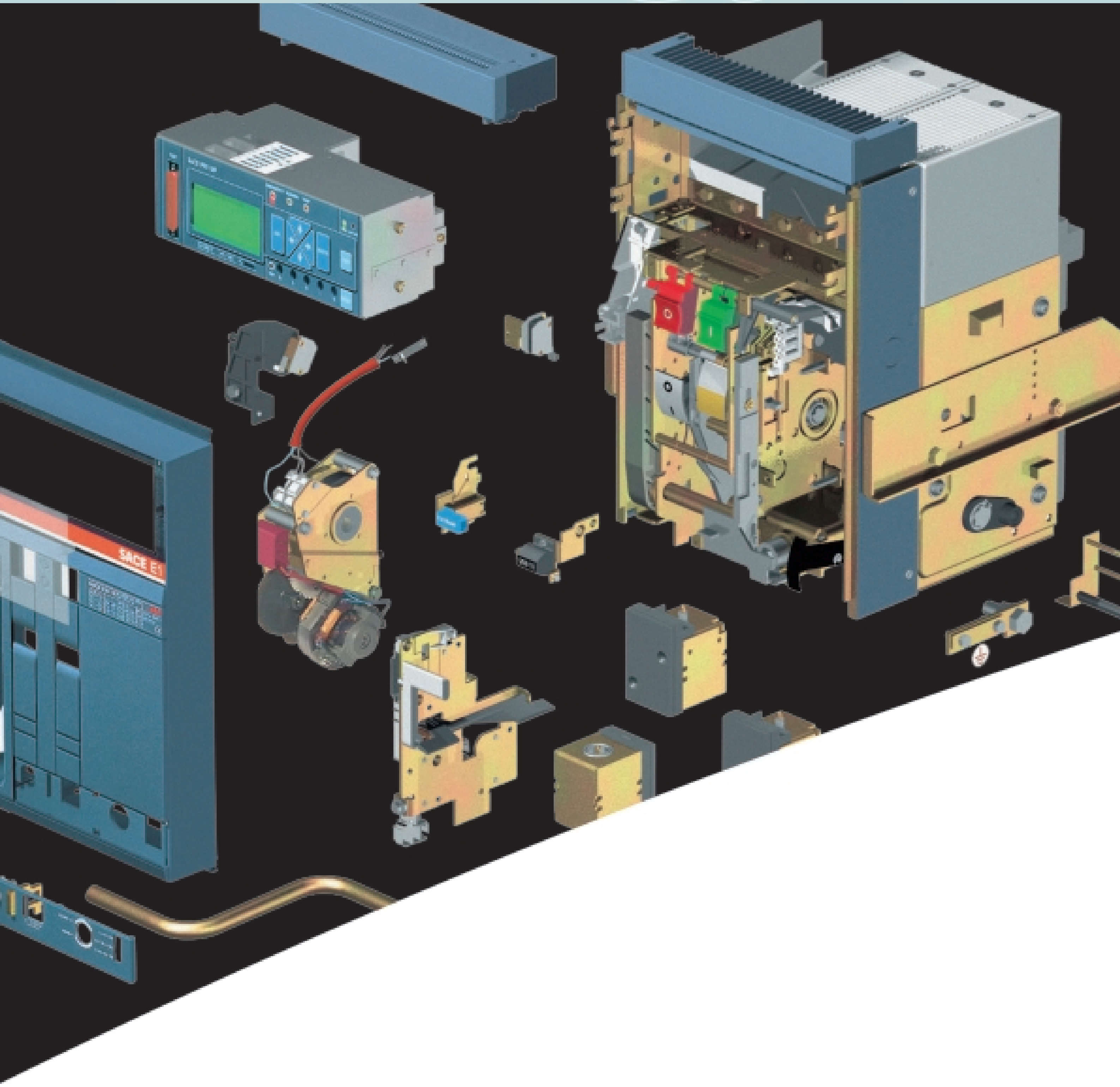
the table below lists the characteristics of the signalling relays available in the SACE PR020/K unit.

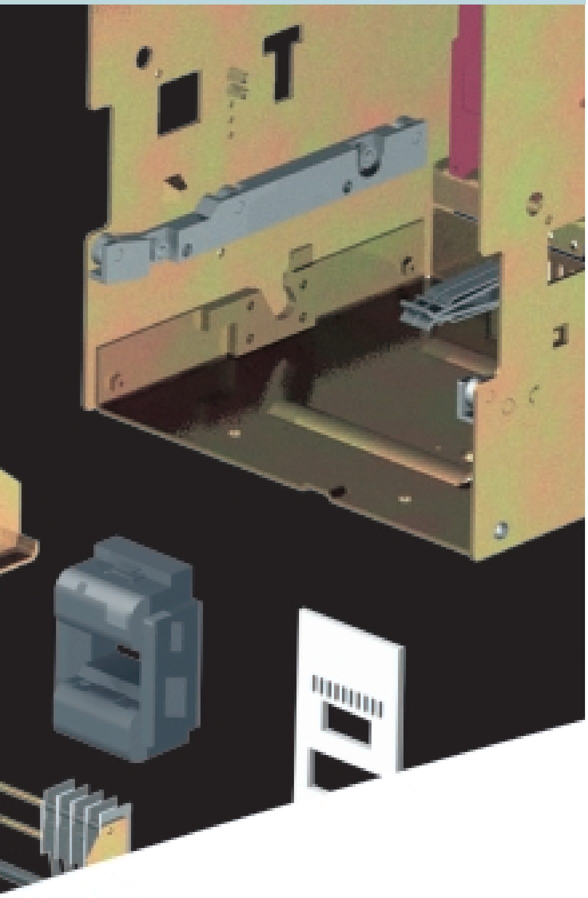
Auxiliary power supply	24 V DC ± 20%
Maximum ripple	5%
Rated power @ 24 V	4.4 W

Specifications of the signalling relays	
Type	Monostable STDP
Maximum switching power (resistive load)	100 W/1250 VA
Maximum switching voltage	130 V DC/250 V AC
Maximum switching current	5 A
Breaking capacity (resistive load)	
@ 30V DC	3.3 A
@ 250V AC	5 A
Contact/coil insulation	2000 V eff (1 min@ 50 Hz)

4

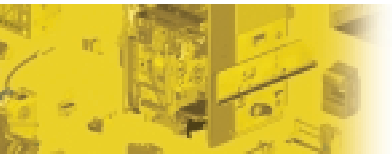
Emax





Accessories

Contents



Functions of the accessories

The table that follows lists a few functions that may be obtained by selecting the appropriate accessories from among those provided. Several of the functions listed may be needed at the same time depending on how the circuit-breaker is used. See the related section for a detailed description of the individual accessories.

Function	Components
Remote control	• Opening release • Closing release • Gearmotor for the automatic charging of the closing springs
Remote signalling or actuation of automatic functions depending on the state (open-closed) or position (racked-in, test isolated, racked-out) of the circuit-breaker.	• Auxiliary contacts of open-closed circuit-breaker • Auxiliary contacts of circuit-breaker racked-in, test isolated, racked-out (withdrawable c.-breaker only) • Contact for electrical signalling of overcurrent releases tripped • Contact for signalling undervoltage release de-energized • Contact for signalling springs charged
Remote opening for various needs, including: – manual emergency control – opening dependent on the tripping of other protective breaking devices or system automation needs. Examples: – circuit-breakers on L.V. side of parallel transformers that must open automatically when the M.V. side device opens. – automatic opening for control by external relay (undervoltage, residual current, etc.)	• Opening or undervoltage release
Automatic opening of the circuit-breaker for undervoltage (for example, when operating asynchronous motors)	• Instantaneous or time delay undervoltage release NOTE The time-delay device is recommended when unwarranted operation due to temporary voltage drops, is to be avoided (for functional or safety reasons) • Contact for signalling undervoltage release energized
Increased protection rating	• IP54 door protection
Mechanical safety locks for maintenance or functional requirements for interlocking two or more circuit-breakers	• Key lock in open position • Padlock device in open position • Key lock and padlocks in racked-in, test isolated, racked-out position
Automatic switching of power supplies	• Mechanical interlock between two or three circuit-breakers • Automatic transfer switch - ATS010

Accessories supplied as standard

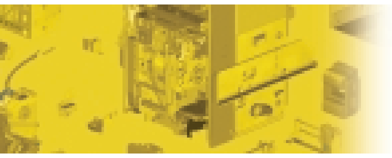
The following standard accessories are supplied depending on the circuit-breaker version:

Fixed circuit-breaker:

- flange for switchboard compartment door (IP30)
- support for service releases
- four auxiliary contacts for electrical signalling of circuit-breaker open/closed (for automatic circuit-breakers only)
- terminal box for connecting outgoing auxiliaries
- horizontal rear terminals
- lifting plate

Withdrawable circuit-breaker:

- flange for switchboard compartment door
- support for service releases
- four auxiliary contacts for electrical signalling of circuit-breaker open/closed (for automatic circuit-breakers only)
- sliding contacts for connecting outgoing auxiliaries
- horizontal rear terminals
- anti-insertion lock for circuit-breakers with different rated currents
- racking-out crank handle
- lifting plate



Accessories supplied on request

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The ranges	Automatic circuit-breakers Circuit-breakers with full-size neutral Circuit-breakers for applications up to 1000V AC	
Circuit-breaker version	**Fixed**	**Withdrawable**
1a) Shunt opening/closing release (YO/YC) and second opening release (YO2)	■	■
1b) SOR test unit	■	■
2a) Undervoltage release (YU)	■	■
2b) Time-delay device for undervoltage release (D)	■	■
3) Gearmotor for the automatic charging of the closing springs (M)	■	■
4a) Mechanical signalling of overcurrent releases tripped	■	■
4b) Electrical and mechanical signalling of overcurrent releases tripped	■	■
5a) Electrical signalling of circuit-breaker open/closed (1) (2)	■	■
5b) Electrical signalling of circuit-breaker racked-in/test isolated/racked-out		■
5c) Contact signalling closing springs charged	■	■
5d) Contact signalling undervoltage release de-energized (C. Aux YU)	■	■
6a) Current transformer for neutral conductor outside circuit-breaker	■	■
6b) Homopolar toroid for the main power supply earthing conductor (star center of the transformer)	■	■
7) Mechanical operation counter	■	■
8a) Lock in open position	■	■
8b) Circuit-breaker lock in racked-in/racked-out/test isolated position		■
8c) Accessories for lock in racked-out/test isolated		■
8d) Accessory for shutter padlock device		■
8e) Mechanical lock for compartment door	■	■
9a) Protection for opening and closing pushbuttons	■	■
9b) IP54 door protection	■	■
10) Interlock between circuit-breakers (3)	■	■
11) Automatic transfer switch - ATS010 (4)	■	■

LEGEND

■ Accessory on request on fixed circuit-breaker or moving part

■ Accessory on request on fixed part

■ Accessory on request on moving part

	Switch-disconnectors Switch-disconnectors for applications up to 1000V AC Switch-disconnectors for applications up to 1000V DC		Isolating truck (CS)	Earthing switch with making capacity (MPT)	Earthing truck (MT)
	Fixed	Withdrawable	Withdrawable	Withdrawable	Withdrawable
	■	■		■ (YC)	
	■	■			
	■	■			
	■	■			
	■	■		■	
	■	■		■	
		■	■	■	■
	■	■		■	
	■	■			
	■	■		■	
	■	■		■	
		■	■	■	■
		■	■	■	■
		■	■	■	■
	■	■		■	
	■	■		■	
	■	■	■	■	■
	■	■			
	■	■			

(1) For automatic circuit-breakers, four auxiliary contacts to electrically signal circuit-breaker open/closed are included in the supply as standard.
(2) The version with 15 auxiliary contacts is incompatible with E4/f and E6/f versions with full-size neutral
(3) Incompatible with the E4/f and E6/f versions with full-size neutral
(4) Incompatible with the range of circuit-breakers for applications up to 1000V AC

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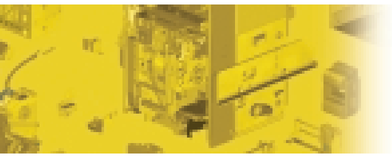


Shunt opening and closing releases

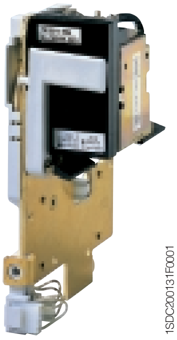
1a) Shunt opening/closing release (YO/YC) and second opening release (YO2)

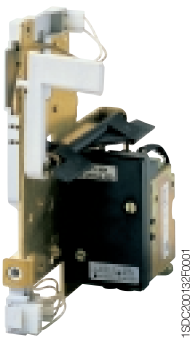
(1) The minimum impulse current duration time in instantaneous service must be 100 ms

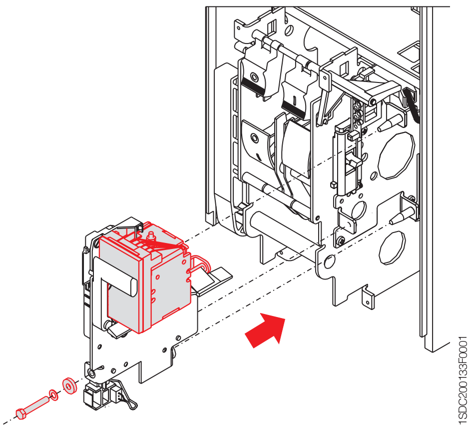
(2) If the opening release is permanently connected to the power supply, wait at least 30 ms before sending the command to the closing release.

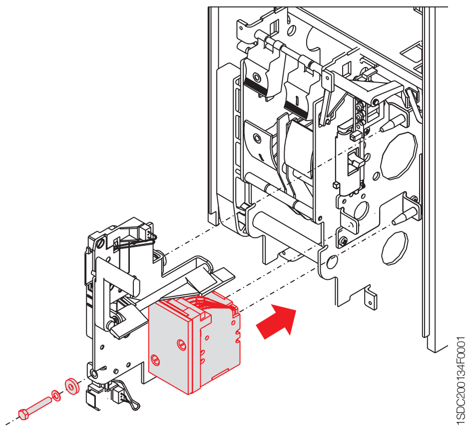
Allows remote control opening or closing of the switchgear depending on the installation position and connection of the releases in the support. The release can be used for either of these applications. Given the characteristics of the circuit-breaker operating mechanism, opening (with the circuit-breaker closed) is always possible, while closing is only possible when the closing springs are charged. The release can operate with direct current or alternating current. This release provides instantaneous operation (1), but may be powered permanently (2).
Some installations require very high safety in controlling remote circuit-breaker opening. The control and opening release circuits in particular must be duplicated. To meet these needs, SACE Emax circuit-breakers may be equipped with a second opening release, fitted with a special support to hold it, that can house the standard shunt closing and opening releases.
The housing of the second opening release is that of the undervoltage release, which is therefore incompatible with this type of installation. The special support, including the second opening release, is installed in place of the standard support.
The technical specifications of the second opening release remain identical to those of the standard opening release.
When used as a permanently powered closing release, it is necessary to momentarily de-energize the closing release in order to close the circuit-breaker again after opening (the circuit-breaker operating mechanism has an anti-pumping device).

Reference figure in circuit diagrams: YO (4-5) - YC (2-3) - YO2 (8)









Characteristics		
Power supply (Un):	24 V DC	120-127 V AC/DC
	30 V AC/DC	220-240 V AC/DC
	48 V AC/DC	240-250 V AC/DC
	60 V AC/DC	380-400 V AC
	110-120 V AC/DC	440 AC
Operating limits:	(YO-YO2): 70% ... 110% Un	
(IEC Standards EN 60947-2)	(YC): 85% ... 110% Un	
Inrush power (Ps):	DC = 200 W	
Inrush time ~100 ms	AC = 200 VA	
Continuous power (Pc):	DC = 5 W	
	AC = 5 VA	
Opening time (YO- YO2):	(max) 60 ms	
Closing time (YC):	(max) 80 ms	
Insulation voltage:	2500 V 50 Hz (per 1 min)	

1b) SOR Test Unit

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The SOR control and monitoring Test Unit helps ensure that the various versions of SACE Emax opening releases are running smoothly, for high reliability in controlling circuit-breaker opening.

Under particularly severe operating conditions or simply for remote control of the circuit-breaker, the opening release is widely used as an accessory for the SACE Emax series of air circuit-breakers.

Maintenance of all functions of this accessory is a necessary condition to guarantee a high level of safety in the installation: this brings about the need to have a device available which cyclically checks correct operation of the release, signalling any malfunctions.

The SOR control and monitoring Test Unit ensures the continuity of opening releases with a rated operating voltage between 24 V and 250 V (AC and DC), as well as the functions of the opening coil electronic circuit.

Continuity is checked cyclically with an interval of 20s between tests.

The unit has optic signals via a LED on the front, which provide the following information:

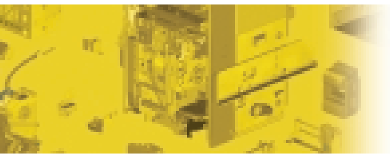
– POWER ON: power supply present
– YO TESTING: test in progress
– TEST FAILED: signal following a failed test or lack of auxiliary power supply
– ALARM: signal following three failed tests.

Two relays with one change-over are also available on board the unit, which allow remote signalling of the following two events:

– failure of a test - resetting takes place automatically when the alarm stops)
– failure of three tests - resetting occurs only by pressing the manual RESET on the front of the unit)

There is also a manual RESET button on the front of the unit.

Characteristics	
Auxiliary power supply	24 V ... 250 V AC/DC
Maximum interrupted current	6 A
Maximum interrupted voltage	250V AC



Undervoltage release

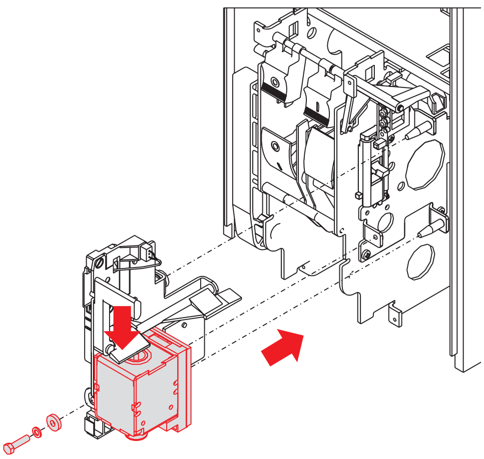
1SDC200136F0001

2a) Undervoltage release (YU)

The undervoltage release opens the circuit-breaker when there is a significant voltage drop or power failure. It may be used for remote release (using normally-closed pushbuttons), for a lock on closing or for monitoring the voltage in the primary and secondary circuits. The power supply for the release is therefore obtained upstream of the circuit-breaker or from an independent source. The circuit-breaker may be closed only when the release is powered (closing is mechanically locked). The release can operate with direct current or alternating current.
The circuit-breaker is opened with release power supply voltages of 35-70% Un.
The circuit-breaker can be closed with a release power supply voltage of 85-110% Un.
It may be fitted with a contact to signal when the undervoltage release is energized (C. aux YU) (see accessory 5d).

Reference figure in circuit diagrams: YU (6)

Characteristics		
Power supply (Un):	24 V DC	120-127 V AC/DC
	30 V AC/DC	220-240 V AC/DC
	48 V AC/DC	240-250 V AC
	60 V AC/DC	380-400 V AC
	110-120 V AC/DC	440 V AC
Operating limits:	CEI Standards EN 60947-2	
Inrush power (Ps):	DC = 200 W	
	AC = 200 VA	
Continuous power (Pc):	DC = 5 W	
	AC = 5 VA	
Opening time (YU):	30 ms	
Insulation voltage:	2500 V 50 Hz (for 1 min)	



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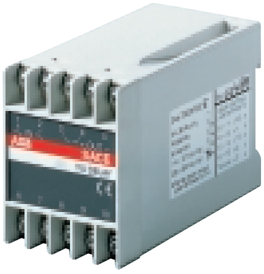
2b) Time-delay device for undervoltage release (D)



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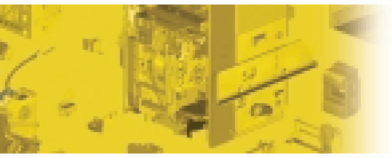
The undervoltage release may be combined with an electronic time-delay device for installation outside the circuit-breaker, allowing delayed release tripping with adjustable preset times. Use of the delayed undervoltage release is recommended to prevent tripping when the power supply network for the release may be subject to brief voltage drops or power supply failures. Closing of the circuit-breaker is inhibited when it is not powered. The time-delay device must be used with an undervoltage release with the same voltage.

Reference figure in circuit diagrams: YU +D (7)

Characteristics	
Power supply (D):	24-30 V DC
	48 V AC/DC
	60 V AC/DC
	110-127 V AC/DC
	220-250 V AC/DC
Adjustable opening time (YU+D):	0.5-1-1.5-2-3 s



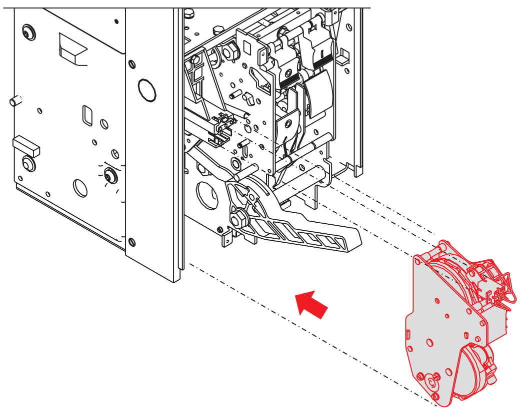
Gearmotor for the automatic charging of the closing springs

3) Gearmotor for the automatic charging of the closing springs (M)

Automatically charges the closing springs of the circuit-breaker operating mechanism. The gearmotor immediately recharges the closing springs after closing the circuit-breaker.
The closing springs can, however, be charged manually (using the relative operating mechanism lever) in the event of a power supply failure or during maintenance work.
It is always supplied with a limit contact and microswitch for signalling that the closing springs are charged (see accessory 5d).

Reference figure in circuit diagrams: M (1)

Characteristics	
Power supply	24-30 V AC/DC
	48-60 V AC/DC
	100-130 V AC/DC
	220-250 V AC/DC
Operating limits:	85%...110% Un (CEI Standards EN 60947-2)
Inrush power (Ps):	DC = 500 W
	AC = 500 VA
Rated power (Pn):	DC = 200 W
	AC = 200 VA
Inrush time	0,2 s
Charging time:	4-5 s
Insulation voltage:	2500 V 50 Hz (for 1 min)



Signal for overcurrent releases tripped

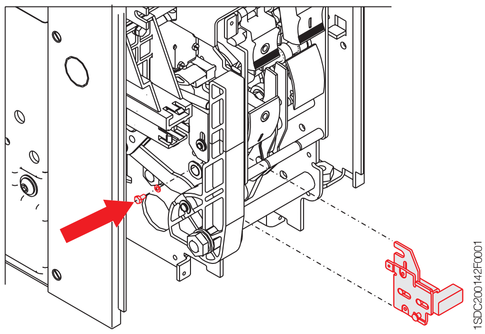
4) Mechanical and electrical signalling of undervoltage releases tripped

The following signals are available after the overcurrent release has tripped:

4a) Mechanical signalling of overcurrent releases tripped

Where the circuit-breaker is open following operation of the overcurrent releases, this can be signalled visually on the operating mechanism, moving the release tripped pushbutton out. The circuit-breaker can only be closed again by resetting the pushbutton to its normal position.

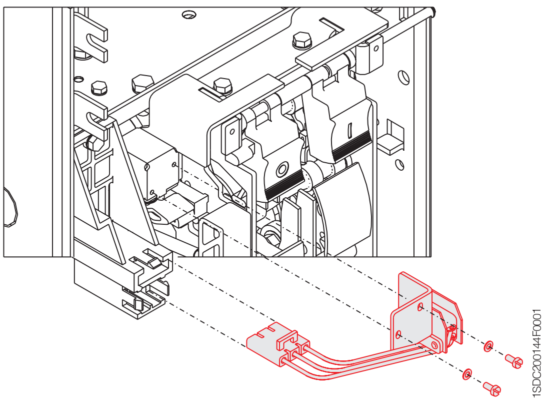
Reference figure in circuit diagrams: S51 (12)



4b) Electrical and mechanical signalling of overcurrent releases tripped

Allows visual signalling on the operating mechanism (mechanical) and remote signalling (electrical using switch) that the circuit-breaker is open following operation of the overcurrent releases. The mechanical signalling pushbutton must be rearmed to reset the circuit-breaker.
SACE PR112 and PR113 releases are already equipped with built-in overcurrent signalling contact.

Reference figure in circuit diagrams: S51 (12)



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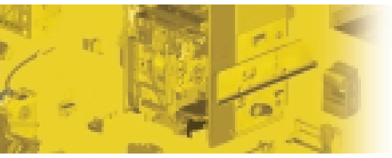
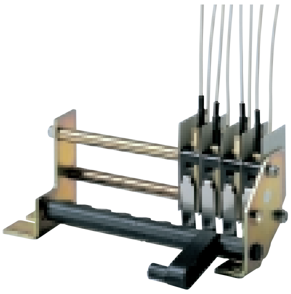


5) Auxiliary contacts

Auxiliary contacts are available installed on the circuit-breaker, which enable signalling of the circuit-breaker status.
The auxiliary contacts are also available in a special version for application with rated voltages Un < 24 V (digital signals).

Characteristics		
Un	**In max**	**T**
125 V DC	0.3 A	10 ms
250 V DC	0.15 A	
Un	**In max**	**cosφ**
250 V AC	5 A	0,3

The versions available are as follows:

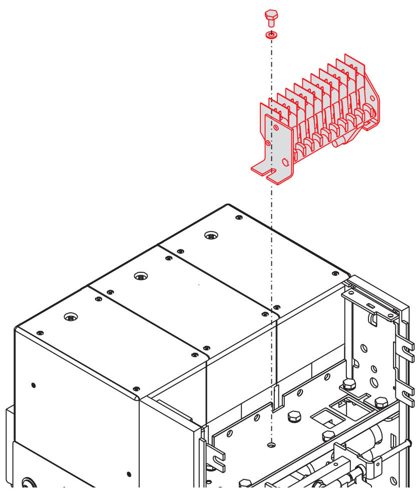

1SDC200145F0001

5a) Electrical signalling of circuit-breaker open/closed

It is possible to have electrical signalling of the status (open/closed) of the circuit-breaker using 4, 10 or 15 auxiliary contacts.
The auxiliary contacts have the following configurations:
- 4 open/closed contacts (2 normally open + 2 normally closed)
- 10 open/closed contacts (5 normally open + 5 normally closed); not available when the SACE PR112 or PR113 overcurrent release is required
- 15 supplementary open/closed contacts for installation outside the circuit-breaker.

The basic configuration described above may be modified by the user for normally open or normally closed indication by re-positioning the faston connector on the microswitch.

Reference figures in circuit diagrams: Q/1÷10 (21-22)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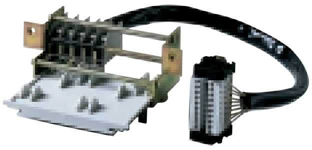
5b) Electrical signalling of circuit-breaker racked-in/test isolated/racked out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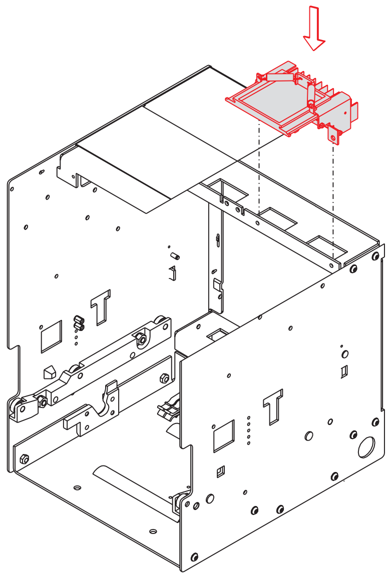
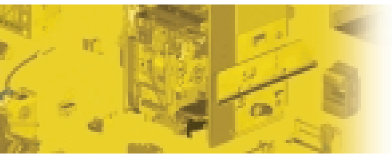
In addition to mechanical signalling of the circuit-breaker position, it is also possible to obtain electrical signalling using 5 or 10 auxiliary contacts which are installed on the fixed part.
It is available only for withdrawable circuit-breakers, for installation on the fixed part.
The auxiliary contacts take on the following configurations:
- 5 contacts; set comprising 2 contacts for racked-in signal, 2 contacts for racked-out signal, and 1 contact to signal the test isolated position (main clamps isolated, but sliding contacts inserted).
- 10 contacts; set comprising 4 contacts for racked-in signal, 4 contacts for racked-out signal, and 2 contacts to signal the test isolated position (main clamps isolated, but sliding contacts inserted).

Reference figures in circuit diagrams:
S75I (31-32)
S75T (31-32)
S75E (31-32)


1SDC200148F0001



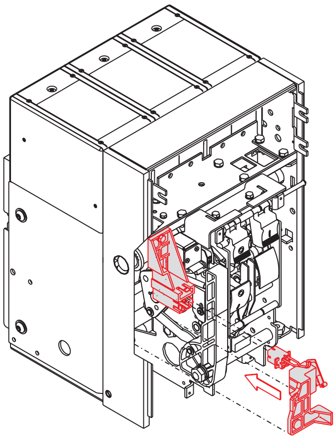
Auxiliary Contacts

1SDC200149F0001

5c) Contact for signalling closing springs charged

It is made up of a microswitch that allows remote signalling of the status of the circuit-breaker operating mechanism closing springs (always supplied with the spring charging gearmotor).

Reference figure in circuit diagrams: S33 M/2 (11)



1SDC200150F0001

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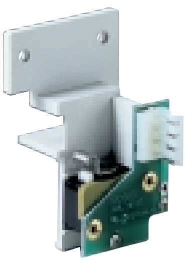
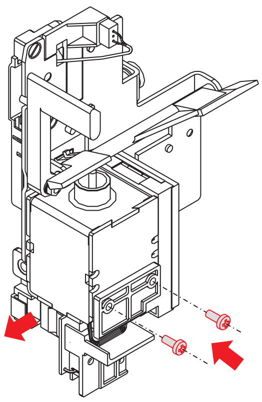


1SDC200151F0001

5d) Contact signalling undervoltage release de-energized (C.aux YU)

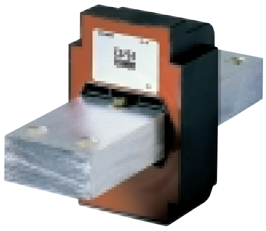
The undervoltage releases may be fitted with a contact (normally closed or open as preferred) for signalling undervoltage release energized, to remotely signal the status of the undervoltage release.

Reference figure in circuit diagrams: (12)



1SDC200152F0001

Transformers and operation counters



1SDC200153F0001

6a) Current transformer for neutral conductor outside circuit-breaker

For three-pole circuit-breakers only, allows protection of the neutral by connecting to the overcurrent release. Supplied on request.

Reference figure in circuit diagrams: TI/N-UI/N (51-52)

1SDC200154F0001

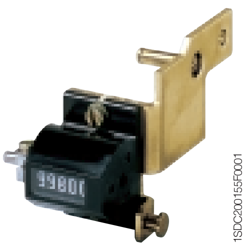
6b) Homopolar toroid for the main power supply earthing conductor (star center of the transformer)

SACE PR112 and PR113 microprocessor-based electronic releases may be used in combination with an external toroid located on the conductor, which connects the star center of the MV/LV transformer (homopolar transformer) to earth. In this case, the earth protection is defined as Source Ground Return.
The homopolar transformer is available in four different versions in terms of rated current (but keeping the same overall dimensions in any case).

Figura di riferimento negli schemi elettrici: TI/O (51-52)

Characteristics				
Rated current	100 A	250 A	400 A	800 A

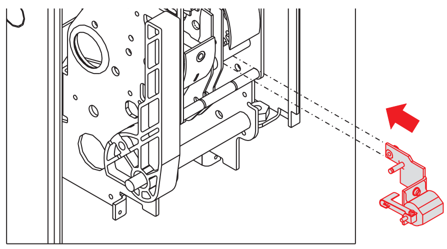
5



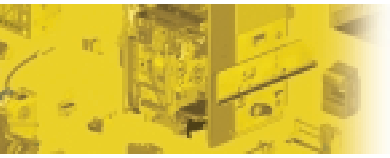
1SDC200155F0001

7) Mechanical operation counter

This is connected to the operating mechanism by means of a simple lever mechanism, and indicates the number of mechanical operations carried out by the circuit-breaker.
The count is shown on the front of the circuit-breaker.



1SDC200156F0001

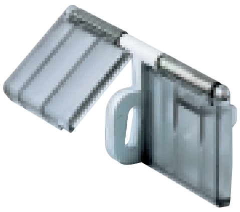


Mechanical safety locks

8) Mechanical safety locks

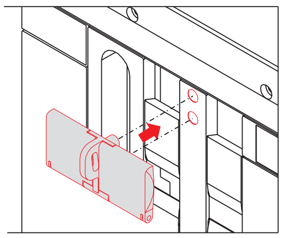
8a) Lock in open position

1SDC200157F0001



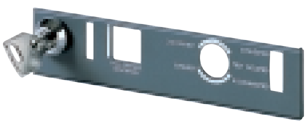
1SDC200158F0001

Several different mechanisms are available which allow the circuit-breaker to be locked in the open position.
These devices can be controlled by:
- Key: a special circular lock with different keys (for a single circuit-breaker) or the same keys (for several circuit-breakers). In the latter case, up to four different key numbers are available.
- Padlocks: up to 3 padlocks (not supplied): ø 4 mm.



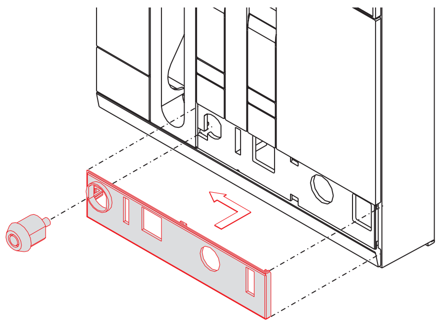
1SDC200159F0001

8b) Circuit-breaker lock in racked-in/test isolated/racked-out position



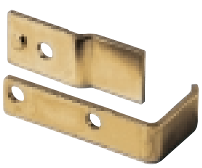
1SDC200160F0001

This device may be controlled by a special circular key lock with different keys (for a single circuit-breaker) or the same keys (for several circuit-breakers - up to four different key numbers available) and padlocks (up to 3 padlocks, not supplied - Ø 4 mm).
It is available only for withdrawable circuit-breakers, to be installed on the moving part.



1SDC200161F0001

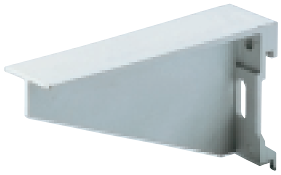
8c) Accessories for lock in test isolated/racked-out position



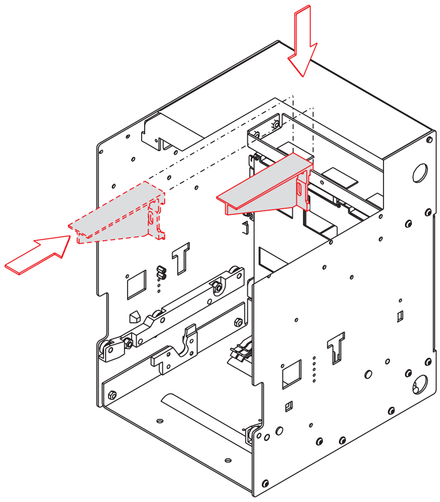
1SDC200162F0001

In addition to the circuit-breaker lock in racked-in/test isolated/racked-out position, allows the circuit-breaker to be locked only in the racked-out or test isolated positions.
It is available only for withdrawable circuit-breakers, to be installed on the moving part.

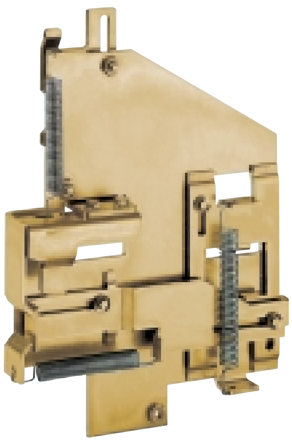
8d) Accessory for shutter padlock device



Allows the shutters (installed on the fixed part) to be padlocked in their closed position.
It is available only for withdrawable circuit-breakers, to be installed on the fixed part.

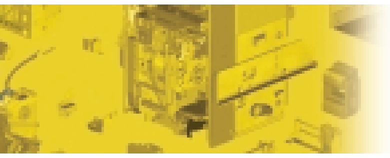


8e) Mechanical lock for compartment door

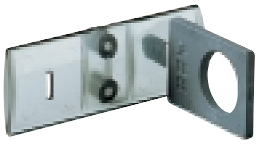


Stops the compartment door from being opened when the circuit-breaker is closed (and circuit-breaker racked in for withdrawable circuit-breakers) and prevents the circuit-breaker from closing when the compartment door is open.

5



Transparent protective covers

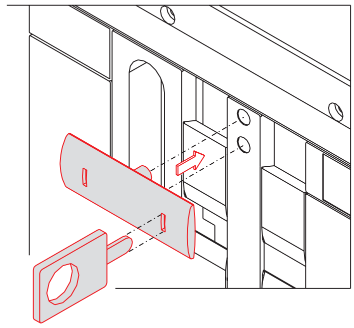


1SDC200166F0001

9) Transparent protective covers

9a) Protective cover for opening and closing pushbuttons

These protections are fitted over the opening and closing pushbuttons, preventing the relative circuit-breaker operations unless a special tool is used.

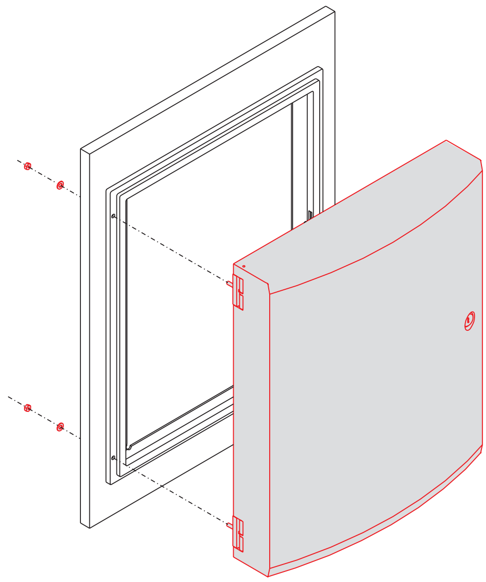


1SDC200167F0001

1SDC200168F0001

9b) IP54 door protection

This is a transparent plastic protective cover which completely protects the front panel of the circuit-breaker, with a protection rating of IP54. Mounted on hinges, it is fitted with a key lock.



1SDC200169F0001

5

Interlock between circuit-breakers

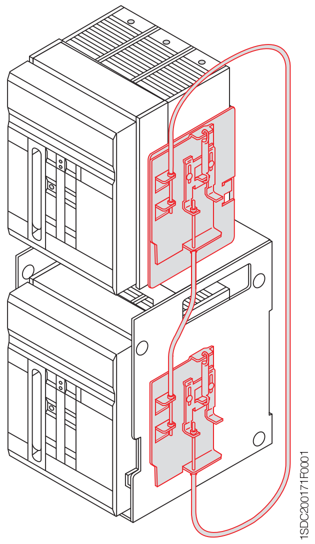
10) Mechanical interlock

This mechanism creates a mechanical interlock between two or three circuit-breakers (even different models and different versions, fixed/withdrawable) using a flexible cable. The circuit diagram for electrical switching using a relay (for installation by the customer) is supplied with the mechanical interlock. The circuit-breakers can be installed vertically or horizontally.

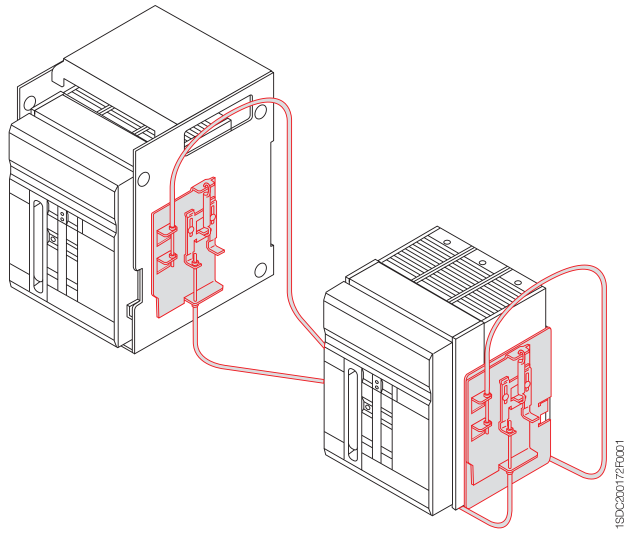
Four types of mechanical interlocks are available:

Type A:	between 2 circuit-breakers (power supply + emergency power supply)
Type B:	between 3 circuit-breakers (2 power supplies + emergency power supply)
Type C:	between 3 circuit-breakers (2 power supplies + bus-tie)
Type D:	between 3 circuit-breakers (3 power supplies / one single closed c.-breaker)

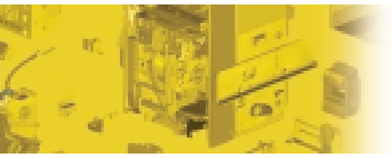
Note:
See the chapters “Overall dimensions” and “Circuit diagrams” for information about dimensions (fixed and withdrawable versions) and settings.



Vertical interlock

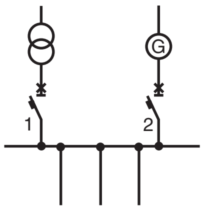
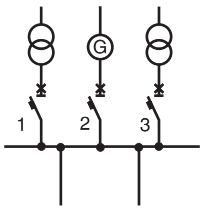
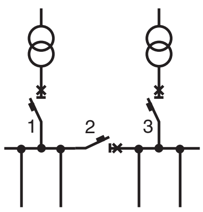
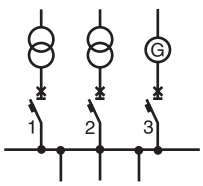


Horizontal interlock



Interlock between circuit-breakers

The possible mechanical interlocks are shown below, depending on whether 2 or 3 circuit-breakers (any model in any version) are used in the switching system.

Type of interlock	Typical circuit	Possible interlocks
Type A **Between two circuit-breakers** One normal power supply and one emergency power supply	 O = Circuit-breaker open I = Circuit-breaker closed	Circuit-breaker 1 can only be closed if 2 is open, and vice-versa. 1 2 O O I O O I
Type B **Between three circuit-breakers** Two normal power supplies and one emergency power supply.	 O = Circuit-breaker open I = Circuit-breaker closed	Circuit-breakers 1 and 3 can only be closed if 2 is open. Circuit-breaker 2 can only be closed if 1 and 3 are open. 1 2 3 O O O I O O O O I I O I O I O
Type C **Between three circuit-breakers** The two half-busbars can be powered by a single transformer (bus-tie closed) or by both at the same time (bus-tie open)	 O = Circuit-breaker open I = Circuit-breaker closed	One or two circuit-breakers out of three can be closed at the same time. 1 2 3 O O O I O O O I O O O I O I I I I O I O I
Type D **Between three circuit-breakers** Three power supplies (generators or transformers) on the same busbar, so parallel operation is not allowed	 O = Circuit-breaker open I = Circuit-breaker closed	Only one of three circuit-breakers can be closed. 1 2 3 O O O I O O O I O O O I

5

The emergency power supply is usually installed to take over from the normal power supply in two instances:

- to power health and safety services (e.g., hospital installations);
- to power parts of installations which are essential for requirements other than safety (e.g., continuous-cycle industrial plants).

The range of accessories for SACE Emax circuit-breakers includes solutions for a wide variety of different plant engineering requirements.

See the specific regulations regarding protections against overcurrents, direct and indirect contacts, and provisions to improve the reiliability and safety of emergency circuits.

Switching from the normal to the emergency power supply may be carried out manually (locally or by remote control) or automatically.

To this end, the circuit-breakers used for switching must be fitted with the accessories required to allow electric remote control and provide the electrical and mechanical interlocks required by the switching logic.

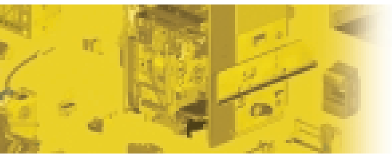
These include:

- the opening release
- the closing release
- the motor control
- the auxiliary contacts.

Switching may be automated by means of a special electronically-controlled relay circuit, installed by the customer (diagrams provided by ABB SACE).

Mechanical interlocks between two or three circuit-breakers are achieved using cables that may be applied to horizontally or vertically installed circuit.

5



Automatic transfer switch - ATS010

1SDC200177F0001

11) Automatic transfer switch - ATS010

The switching unit ATS010 (Automatic Transfer Switch) is the new network-group switching device offered by ABB SACE. It is based on microprocessor technology in compliance with the leading electromagnetic compatibility and environmental standards (EN 50178, EN 50081-2, EN 50082-2, IEC 68-2-1, IEC 68-2-2, IEC 68-2-3).
The device is able to manage the entire switching procedure between the normal line and emergency line circuit-breakers automatically, allowing great flexibility of settings.
In case of an error in the normal line voltage, in accordance with the delays set, the normal line circuit-breaker is opened, the generator started and the emergency line circuit-breaker closed. Similarly, when the normal line returns to range, the reverse switching procedure is automatically controlled.
It is especially suited for use in all emergency power supply systems requiring a solution that is ready to install, easy to use and reliable.
Some of the main applications include: power supply for UPS (Uninterrupted Power Supply) units, operating rooms and primary hospital services, emergency power supply for civilian buildings, airports, hotels, data banks and telecommunications systems, power supply of industrial lines for continuous processes.
The switching system consists of the ATS010 unit connected to two motor-driven and mechanically interlocked circuit-breakers. Any of the circuit-breakers in the SACE Emax series may be used.
The built-in mains sensor of the SACE ATS010 device makes it possible to detect errors in the mains voltage. The three inputs may be directly connected to the three phases of the normal power supply line for networks with rated voltage up to 500V AC. Networks with a higher voltage require the insertion of voltage transformers (TV), setting a rated voltage for the device that matches their secondary voltage (typically 100V).
Two change-over contacts for each circuit-breaker connect directly to the shunt opening and closing releases. The circuit-breaker connection is completed by wiring the status contacts: Open/Closed, Relay tripped, Racked-in (for withdrawable/plug-in circuit-breakers).
That is why on every circuit-breaker connected to the ATS010 unit, the following are included in addition to the mechanical interlock accessories:
– spring charging motor,
– opening and closing coil,
– open/closed contact,
– racked-in contact (for withdrawable versions),
– signal and mechanical lock for protection relay tripped.

The ATS010 device is designed to ensure extremely high reliability for the system it controls. It contains various safety systems intrinsically related to software and hardware operation.
For software safety, a special logic prevents unwarranted operations, while a constantly operative watchdog system points out any microprocessor malfunctions via a LED on the front of the device.
Hardware safety allows integration of an electrical interlock via power relay, so that there is no need to use an external electrical interlock system. The manual selector on the front of the device can also control the entire switching procedure, even in the event of a microprocessor fault, by working electromechanically on the control relays.

5

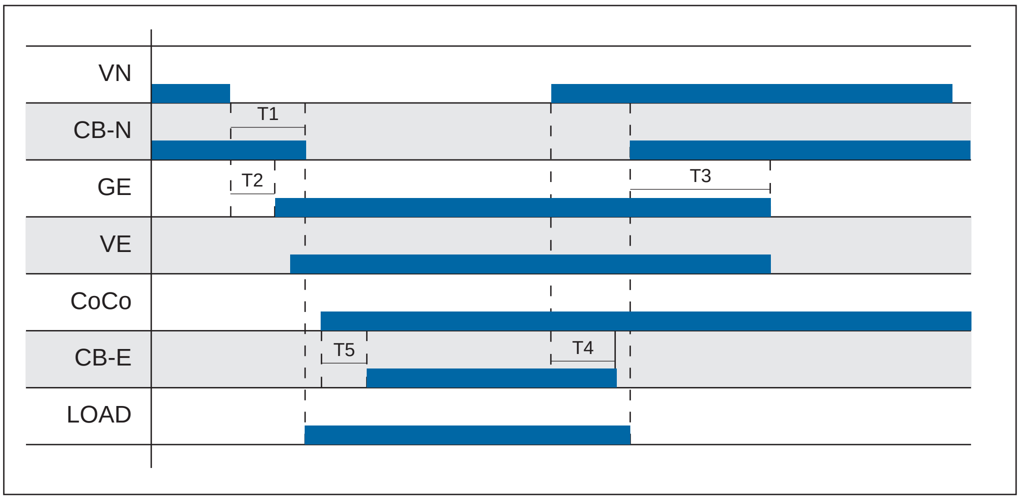
General specifications	
Rated supply voltage (galvanically insulated from earth)	24V DC ± 20% 48V DC ± 10% (maximum ripple ± 5%)
Maximum absorbed power	5W at 24V DC 10W at 48V DC
Rated power (mains present and circuit-breakers not controlled)	1.8W a 24V DC 4.5W at 48V DC
Operating temperature	-25 °C…+70 °C
Maximum humidity	90% without condensation
Storage temperature	-25 °C…+80 °C
Protection rating	IP54 (front panel)
Dimensions [mm]	144 x 144 x 85
Weight [kg]	0.8

Setting range for thresholds and times		
Minimum voltage	Un Min	-5%…-30% Un
Maximum voltage	Un Max	+5%…+30% Un
Fixed frequency thresholds		10%…+10% fn
T1: opening delay of the normal line circuit-breaker due to network error (CB-N)		0…32s
T2: generator start-up delay due to network error		0…32s
T3: stopping delay of the generator		0…254s
T4: switching delay due to network stop		0…254s
T5: closing delay of the emergency line circuit-breaker after detecting the generator voltage (CB-E)		0…32s

Rated voltages settings available	100, 115, 120, 208, 220, 230, 240, 277, 347, 380, 400, 415, 440, 480, 500 V

5

Operating sequence

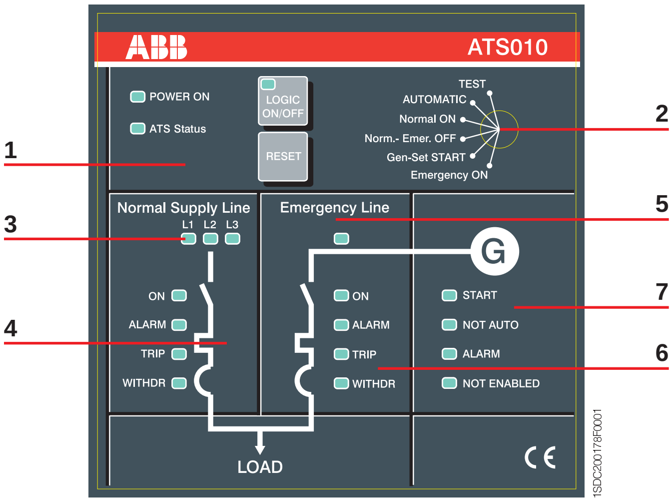


Caption

VN Mains voltage
CB-N Normal line circuit-breaker closed
GE Generator
VE Emergency line voltage
CoCo Enable switching to emergency line
CB-E Emergency line circuit-breaker closed
LOAD Disconnection of lower priority connected loads

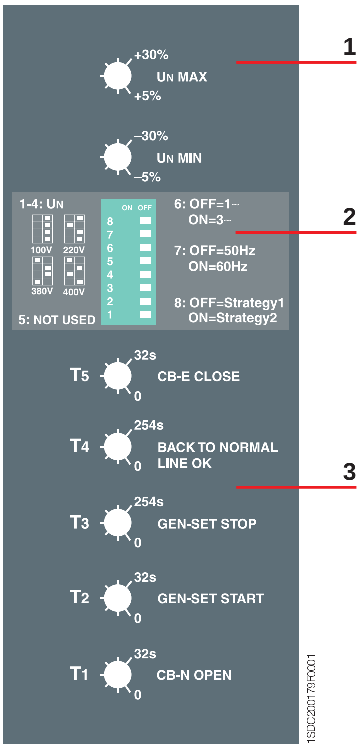
Automatic transfer switch - ATS010

Front panel



Caption
1 Status of the ATS010 unit and logic
2 Operating mode selector
3 Normal line check
4 Normal line circuit-breaker status
5 Voltage on the emergency line
6 Emergency line circuit-breaker status
7 Generator status

Side panel settings



Caption
1 Selectors to set the under- and overvoltage thresholds
2 Dip-switches to set:
– rated voltage
– normal single-phase or three-phase line
– mains frequency
– switching strategy
3 Switching delay time settings for T1... T5

5

Spare parts and retrofitting

Spare parts

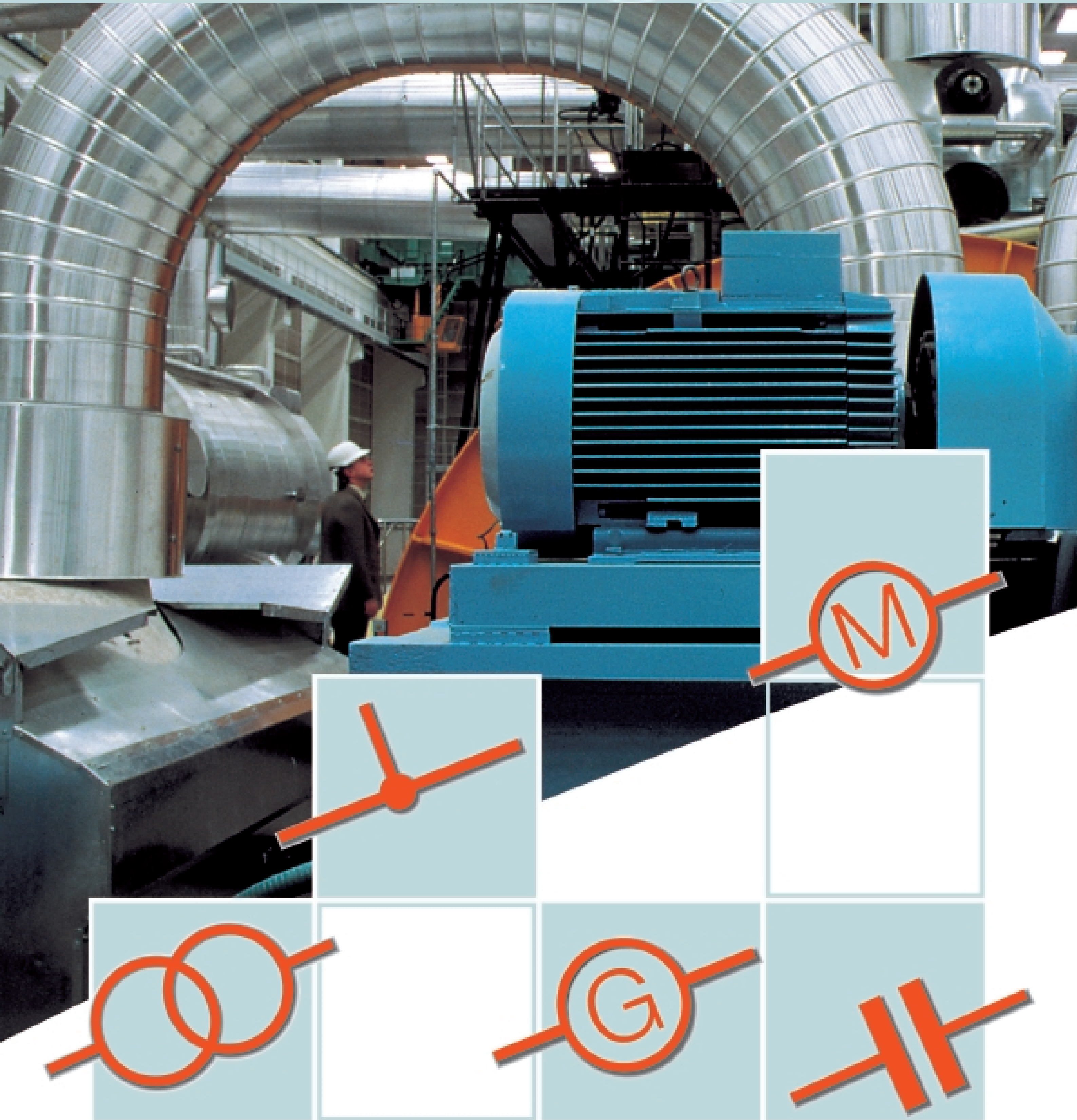
The following spare parts are available:
- front metal shields and escutcheon plate
- opening solenoid for PR111, PR112 and PR113 overcurrent release
- arcing chamber
- closing springs
- clamp isolation contact for the fixed part of the withdrawable circuit-breaker
- earthing sliding contact (for withdrawable version)
- shutters for fixed part
- complete pole
- operating mechanism
- connection cables for releases and current transformers
- transparent protective cover for releases
- SACE PR120/B power supply unit
- toolbox
- battery for SACE PR120/B power supply unit
- front escutcheon plate for Ronis key lock

For more details, request a copy of the ABB SACE spare parts catalogue.

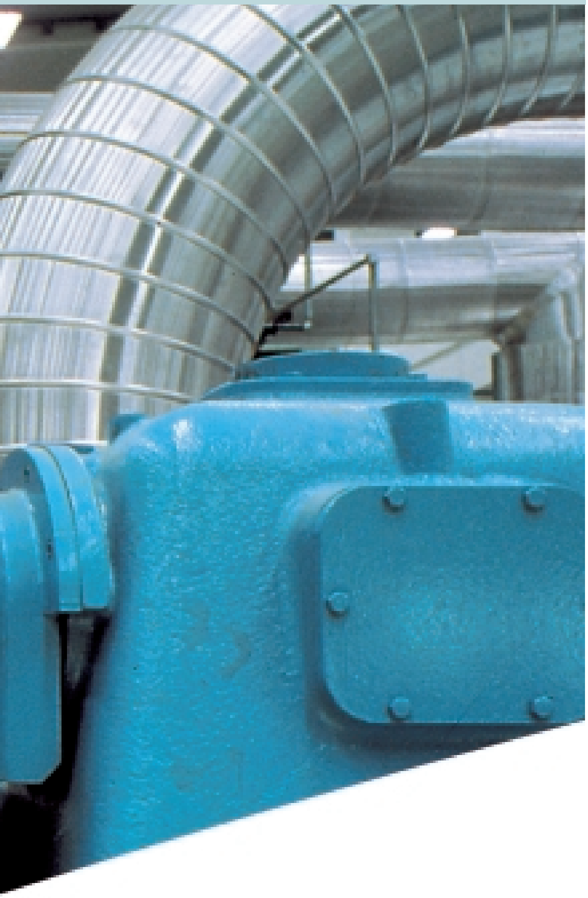
Retrofitting Kits

Special kits have been prepared to replace old SACE Otomax and SACE Novomax G30 circuit-breakers. The kits include SACE Emax circuit-breakers that take advantage of all components of the existing switchboard. Installing a new circuit-breaker in the old switchboard, offers uncontested technical and economic benefits, and is extremely rapid as there is no need to redo the main switchboard connections.

Emax



Applications of the circuit-breaker



Contents

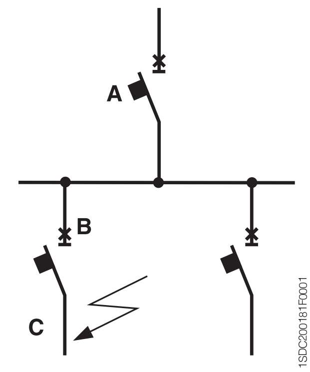
6

Primary and secondary distribution

Selective protection

Discrimination is normally used for tripping overcurrent protection devices in civil and industrial installations to isolate the part affected by a fault from the system, causing only the circuit-breaker immediately on the supply side of the fault to trip. The example in the figure below highlights the need to coordinate tripping between the two circuit-breakers A and B so that only circuit-breaker B is tripped in the event of a fault in C, ensuring continuity of service for the rest of the system powered by circuit-breaker A.
Whereas natural discrimination within the overload current range is normally found due to the difference between the rated currents of the user protection circuit-breaker and the main circuit-breaker on the supply side, discrimination can be obtained in the short-circuit current range by differentiating the current values and, if necessary, the trip times.

Circuit diagram with selective coordination of protections



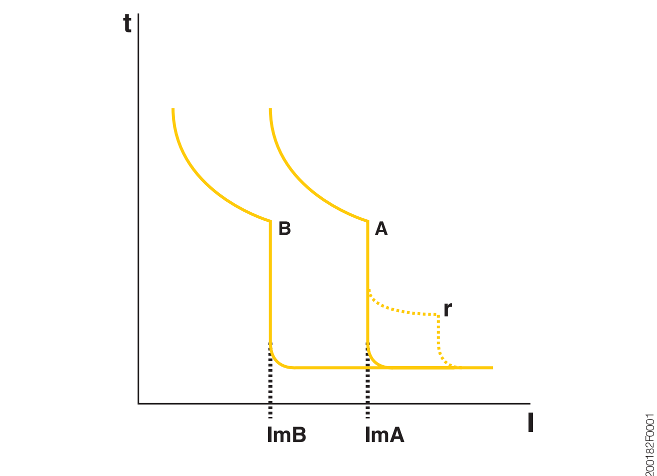
Discrimination may be total or partial:

- total discrimination: only circuit-breaker B opens for all current values lesser than or equal to the maximum short-circuit current in C;
- partial discrimination: only circuit-breaker B opens for fault currents below a certain value; A and B are both tripped for greater or equal values.

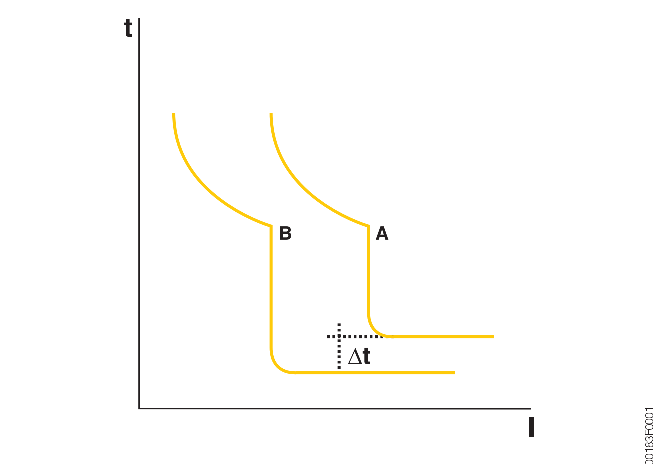
In principle, the following types of discrimination are possible:

Current discrimination, obtained by setting the instantaneous trip currents of the circuit-breaker chain to different values (higher settings for the circuit-breakers on the supply side). This often results in partial discrimination.

Time-current discrimination, obtained by intentionally incorporating increasing time-delays in the trip times of the circuit-breakers furthest on the supply side in the chain. The ratio between the trip thresholds on the supply side and load side must be greater than 1.5, as for current discrimination.



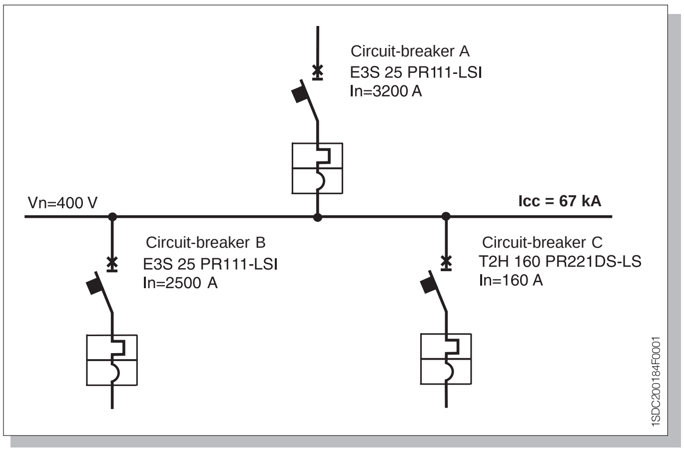
Example of current discrimination



Example of time-current discrimination

In this case it is necessary to make sure that the circuit-breakers with delayed trip have an Icw current value that is suitable for the most severe situation that can be envisaged in the point of installation (maximum prospective current - time-delay set).
Time-current discrimination requires a delay to be set to at least 100 ms in relation to the trip time of the circuit-breaker on the load side.
All versions of the microprocessor-based releases PR111, PR112 and PR113 are fitted with the S protection function, and are therefore suitable for time-current discrimination (see chap. on overcurrent releases).
In the following example, circuit-breakers A, B and C have the following characteristics:

		Icu [kA] (≤400V)	Icw [kA]
A	E3S 32	75	75
B	E3S 25	75	75
C	T2H 160	70	–



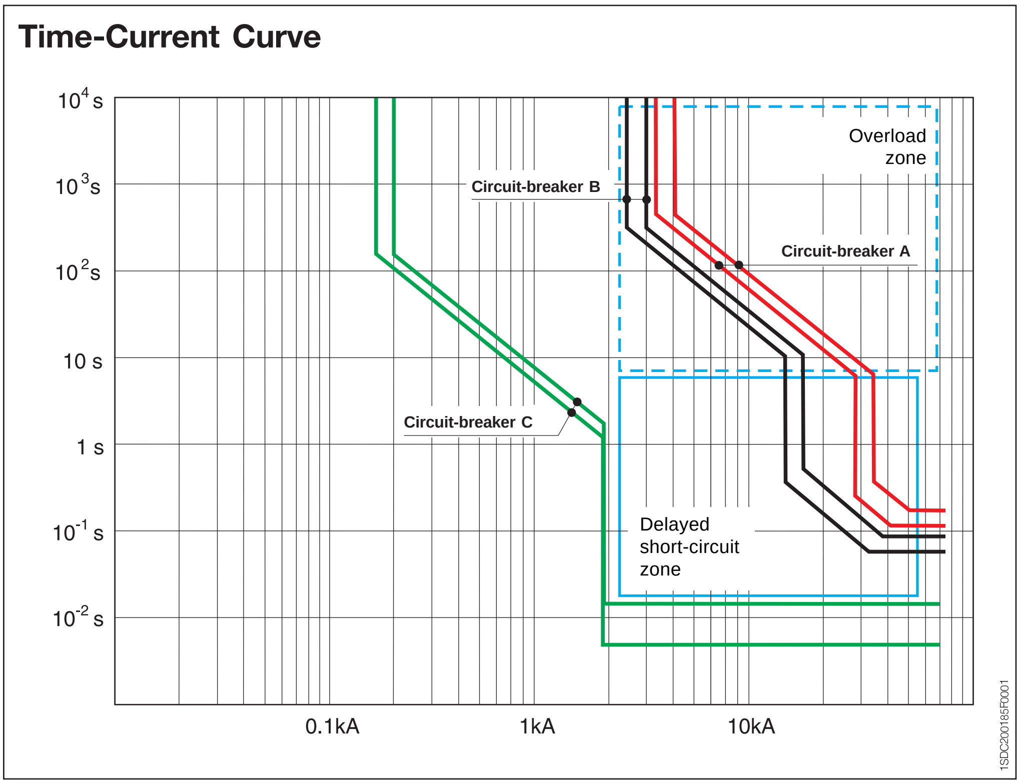
Primary and secondary distribution

Selective protection

The table below shows the discrimination values (in kA) for the circuit-breakers in the example:

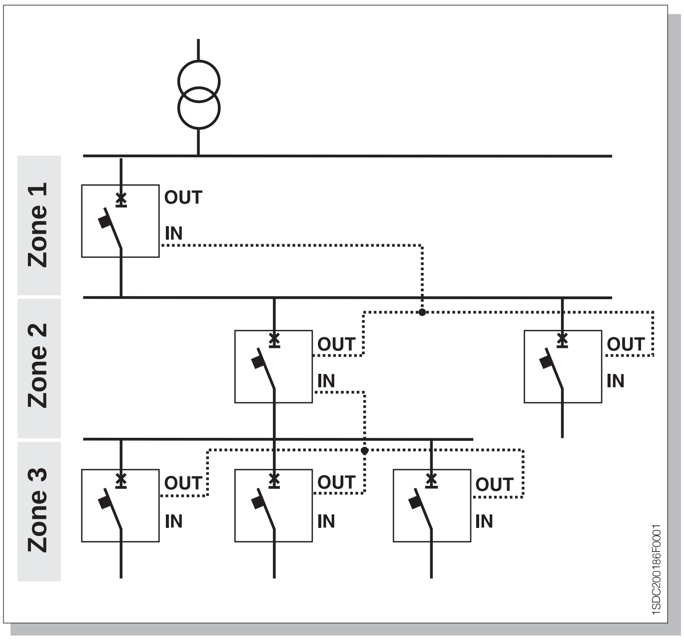
Load-side circuit-breaker	Supply-side circuit-breaker
	A - E3S 32
B - E3S 25	75
C - T2H 160	70

As can be seen in the following figure, there are no intersections in the overload and delayed short-circuit zone of the protection release trip curves.



Zone discrimination, applicable to protection functions S, G and D. This type of discrimination allows shorter trip times for the circuit-breaker closest to the fault than in the case of time discrimination.
The word zone is used to refer to the part of an installation between two circuit-breakers in series. Each circuit-breaker that detects a fault communicates this to the circuit-breaker on the supply side using a simple connection wire. The fault zone is the zone immediately on the load side of the circuit-breaker that detects the fault, but does not receive any communication from those on the load side. This circuit-breaker opens without waiting for the set time-delay.
All Emax circuit-breakers in versions B-N-S-H-V fitted with PR112 and PR113 release allow zone discrimination.
ABB SACE provides important calculation tools to facilitate the work of designers in coordinating protection devices, including the Slide rule kits, DOCWin and CAT software packages and updated coordination charts.

Note
For discrimination in the event of earth faults with circuit-breakers in series, see page **6**/14.



Discrimination tables

Emax air circuit-breakers with Isomax moulded-case circuit-breakers

			Supply-side circuit-breaker	E1		E2			E3				E4		E6	
			Version	B	N	B	N	L	N	S	H	L	S	H	H	V
			Relay	EL		EL			EL				EL		EL	
Load-side circuit-breaker	Version	Relay	Iu [A]	800 1250	800 1250	1600 2000	1250 1600 2000	1250 1600	2500 3200	1250 1600 2000 2500 3200	1250 1600 2000 2500 3200	2000 2500	4000	3200 4000	5000 6300	3200 4000 5000 6300
S3	N	TM	160 250	T	T	T	T	T	T	T	T	T	T	T	T	T
	H			36	T	T	55	T	T	T	T	T	T	T	T	T
	L			36	T	T	55	T	T	T	75	T	T	T	T	T
S4	N	EL	160 250	T	T	T	T	T	T	T	T	T	T	T	T	T
	H			36	T	T	55	T	T	T	T	T	T	T	T	T
	L			36	T	T	55	T	T	T	75	T	T	T	T	T
S5	N	EL	400 630	T	T	T	T	T	T	T	T	T	T	T	T	T
	H			36	T	T	55	T	T	T	T	T	T	T	T	T
	L			36	T	T	55	T	T	T	75	T	T	T	T	T
S6	N	EL	630 800	T	T	T	T	T	T	T	T	T	T	T	T	T
	S			36	T	T	T	T	T	T	T	T	T	T	T	T
	H			36	T	T	55	T	T	T	T	T	T	T	T	
	L			36	T	T	55	T	T	T	75	T	T	T	T	T
S7	S	EL	1250 1600			T	T		T	T	T	42	T	T	T	T
	H					T	55		T	T	T	42	T	T	T	T
	L					T	55		T	T	75	42	T	T	T	T
S8	H	EL							T	T	75		T	T	T	T
	V								T	T	75		T	T	T	100
S3	X	TM	125/200	36	T	T	55	100	T	T	75	100	T	T	T	100
S4	X	EL	250	36	T	T	55	100	T	T	75	100	T	T	T	100
S6	X	EL	400/630	36	T	T	55	100	T	T	75	100	T	T	T	100

Emax air circuit-breakers with Tmax moulded-case circuit-breakers

			Supply-side circuit-breaker	E1		E2			E3				E4		E6	
			Version	B	N	B	N	L	N	S	H	L	S	H	H	V
			Relay	EL		EL			EL				EL		EL	
Load-side circuit-breaker	Version	Relay	Iu [A]	800 1250	800 1250	1600 2000	1250 1600 2000	1250 1600	2500 3200	1250 1600 2000 2500 3200	1250 1600 2000 2500 3200	2000 2500	4000	3200 4000	5000 6300	3200 4000 5000 6300
T1	B	TM	160	T	T	T	T	T	T	T	T	T	T	T	T	T
	C			T	T	T	T	T	T	T	T	T	T	T	T	T
	N			T	T	T	T	T	T	T	T	T	T	T	T	T
T2	N	TM, EL	160	T	T	T	T	T	T	T	T	T	T	T	T	T
	S			36	T	T	T	T	T	T	T	T	T	T	T	T
	H			36	T	T	55	T	T	T	T	T	T	T	T	T
	L			36	T	T	55	T	T	T	75	T	T	T	T	T
T3	N	TM	250	T	T	T	T	T	T	T	T	T	T	T	T	T
	S			36	T	T	T	T	T	T	T	T	T	T	T	T

The table below takes the following settings into consideration:

Releases				
TM	I1 = 1 x Ith		I3 = 10 x In	
PR211	I1 = 1 x Ith		I3 = 12 x In	
PR212	I1 = 1 x Ith	I2 = OFF	I3 = 12 x In	t1 = curva D
PR221 DS	I1 = 1 x Ith	I2 = 10 x In	I3 = 10 x In	t1 = curva B
PR112	I1 = 1 x Ith	I2 = 10 x In	I3 = 12 x In	t1 = 72 s
PR113	I1 = 1 x Ith	I2 = 10 x In	I3 = 12 x In	t1 = 72 s

Notes:

- T = total discrimination.
- Discrimination is expressed in kA at the supply voltage of 380-415 V AC in accordance with the CEI Standards EN 60947-2.
- The values shown in the table refer to either the maximum short-circuit current for which discrimination is ensured, or the maximum breaking capacity of the circuit-breaker on the load side.
- Releases PR112-PR113 for Emax circuit-breakers, PR211-PR21a2 for Isomax and PR221/DS for Tmax allow numerous possible time-current settings of the functions L, S and I.

Primary and secondary distribution

Back-up protection

Back-up protection is required by CEI Standards 64-8, IEC standard 60364-4-43 and annex A of the standard IEC 60947-2, which permit the use of a protective device with breaking capacity below the prospective short-circuit current in the points where it is installed, on condition that there is another protective device on the supply side with the necessary breaking capacity. In this case the characteristics of the two devices must be coordinated in such a way that the specific energy let through by the combination is not higher than that which can be withstood without damage by the device on the load side, and by the protected conductors.

In the diagram in the figure, circuit-breaker B, located on the load side of circuit-breaker A, can have a lower breaking capacity than the prospective short-circuit current in the event of a fault in “C”, if circuit-breaker A is able to satisfy both of the following conditions:

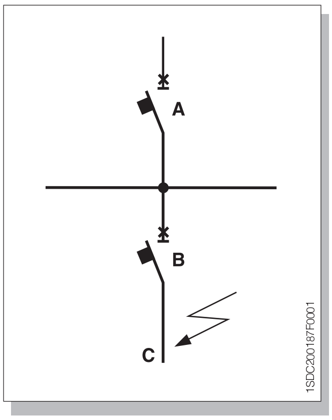
– it has a suitable breaking capacity (greater than or equal to the prospective short-circuit current in its point of installation and obviously greater than the short-circuit current in “C”)

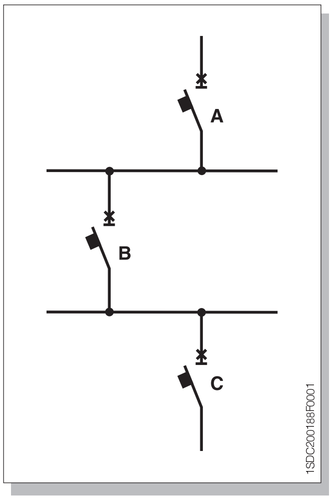
– in the event of a fault in “C” with short-circuit values higher than the breaking capacity of circuit-breaker B, circuit-breaker A must provide a specific let-through energy limiting function, limiting it to a value that can be withstood by circuit-breaker B and the protected conductors.

A fault in “C” can therefore cause a double interruption, however the back-up protection must ensure that B always trips within the limits of its breaking capacity.

It is necessary to choose switchgear combinations that have been verified in laboratory tests for this type of protection. The combinations possible are specified in ABB SACE documents (Slide rule kits, DOCWin) and shown here for SACE Emax circuit-breakers.

Back-up protection is used in electrical installations in which there is no essential need for continuous operation: when the supply-side circuit-breaker opens, it also excludes users that are not affected by the fault. However, the adoption of this type of coordination limits the size of the installation and therefore reduces costs.





Note

Back-up protection may also be implemented on more than two levels: the figure above shows an example of coordination on three levels. In this case the choices are correct if at least one of the two situations below occurs:

– the circuit-breaker furthest on the supply side A is coordinated with both circuit-breakers B and C (coordination between circuit-breakers B and C is not necessary);

– each circuit-breaker is coordinated with the circuit-breaker immediately on the load side of it, which is to say the circuit-breaker furthest on the supply side A is coordinated with the next one B, which is in turn coordinated with circuit-breaker C.

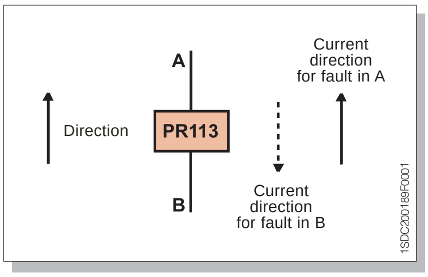
Table showing coordination for back-up protection

Supply-side circuit-breaker	Breaking capacity
E2L - E3L	130 [kA] (at 380/415 V)

Load-side circuit-breaker	Breaking capacity on the outgoing lines with back-up
S5N	65 [kA
S5H - S6N - E1B - E2B	85 [kA]
S6S - S6H - S7S - S7H - E1N - E2N	100 [kA]

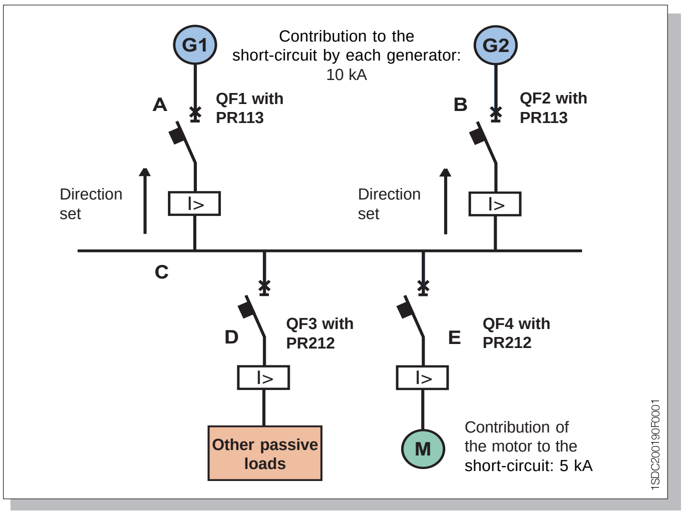
Directional protection

Directional protection is based on the ability to correlate the circuit-breaker's behavior with the direction of the fault current.
Two different trip times may be set on the relay PR113 depending on the current direction:
– a direction time in agreement (Fw) with the reference direction set;
– a direction time discordant (Bw) to the reference direction set.



With reference to the figure below, for the circuit breaker QF1 if a fault occurs at point B the current will flow in direction A-B, discordant to the reference direction: the trip time will be Bw. Similarly, for a fault in A, the current direction will be B-A in agreement with the reference direction: the trip time will be Fw.

In the following example, the combinations shown in the table occur:



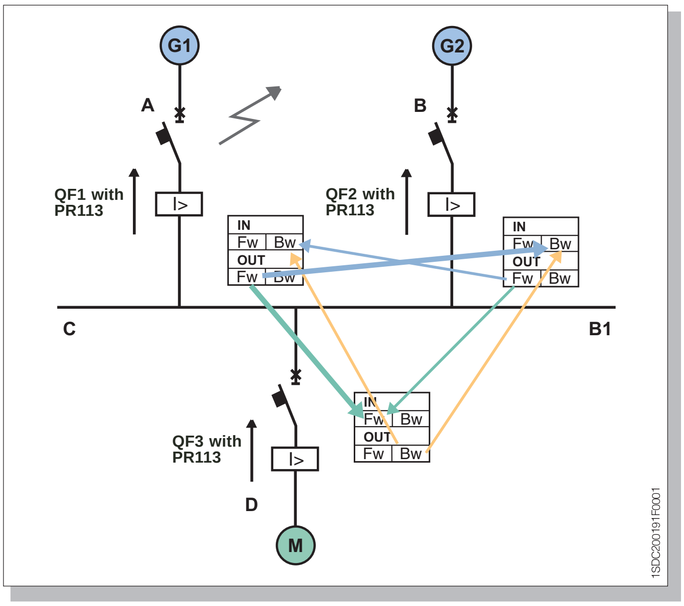
Circuit-breaker	Fault in	Current measured [kA]	Direction	Trip time
QF1	A	15	Agreement	Fw
	B, C, D, E	10	Discordant	Bw
QF2	B	15	Agreement	Fw
	A, C, D, E	10	Discordant	Bw

This installation aims for discrimination between QF1, QF2, QF3 and QF4.
Upon examining the table we see that the only instance in which the fault current direction is in agreement with that set for the circuit-breaker QF1 is for a fault in point A. The circuit-breaker QF1 must trip more quickly than the other circuit-breakers, since it is the one nearest the fault. To achieve this, the trip time Fw must be set to a value below that of circuit-breakers QF2 and QF4.
For the other possible faults, the circuit-breaker QF1 will have to be the slowest. Since the fault current always flows in a direction discordant to the setting, the trip time Bw must be set to a value greater than that of circuit-breakers QF2 and QF4.
Similarly to the process described for the circuit-breaker QF1, the QF2 circuit-breaker must trip first in the case of a fault in B, and delay tripping in the case of faults elsewhere in the installation to ensure discrimination.

Directional zone discrimination

Adopting zone discrimination with the function D allows the behavior of the various releases PR113 to be coordinated, if the relay buses are appropriately wired. Each relay has 4 signals available, two input signals (one in the same direction and one discordant), through which the relay receives the block signal from other relays, and two output signals (one in the same direction and one discordant), through which the relay sends the block signal to other relays. Thanks to these connections, the tripped-circuit breaker will be always the one nearest the fault, thereby ensuring maximum discrimination of the installation.
For example, the diagram below shows the connections that must be made to enable the transmission of the interlock signals between the various relays. Note in particular that:

1) for a fault in A, the circuit-breaker QF1 is traversed by current from the busbar B1. This current flows in the same direction as the setting. The OUT bus Fw of QF1 locks the IN Bus Bw of the circuit-breaker QF2, and the IN Bus Fw of the circuit-breaker QF3. QF2 is traversed by an uninterrupted current discordant to the setting, while QF3 is traversed by a current in the same direction as the setting.
   The figure below shows all of the connections between the relays; the thicker arrows indicate the active lock signal in addition to the connection.

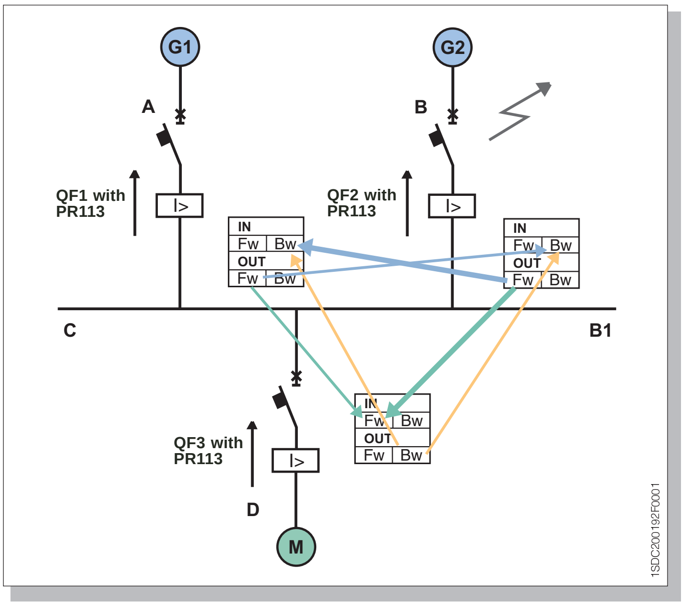


Direction (OUT-IN)	Direction
Fw → Fw	
Fw → Bw	
Bw → Fw	
Bw → Bw	

Direction set →

Directional protection

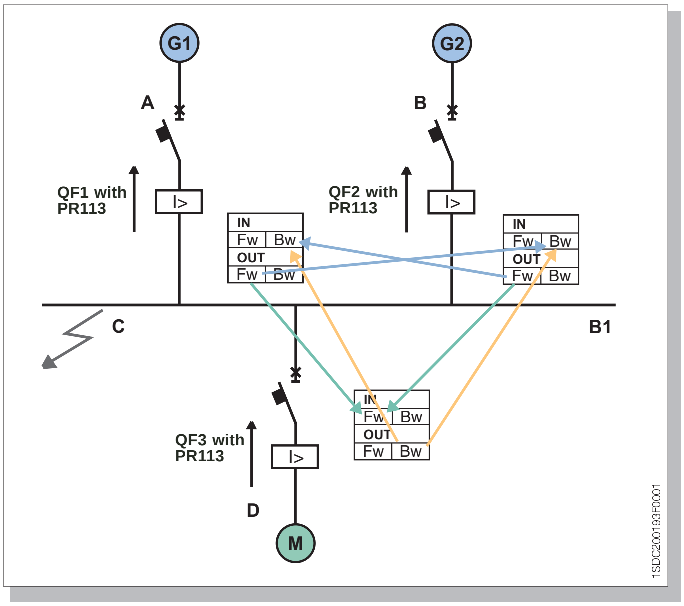
2) for a fault in B, the circuit-breaker QF2 is traversed by a current from the busbar B1. This current flows in the same direction as the setting. The OUT bus Fw of QF2 locks the IN Bus Bw of the circuit-breaker QF1, and the IN Bus Fw of the circuit-breaker QF3. QF1 is traversed by an uninterrupted current discordant to the setting, while QF3 is traversed by a current in the same direction as the setting.
The figure below shows all connections between the relays, the thicker arrows indicate the active lock signal in addition to the connection.



Direction (OUT-IN)	Arrow
Fw → Fw	
Fw → Bw	
Bw → Fw	
Bw → Bw	

Direction set

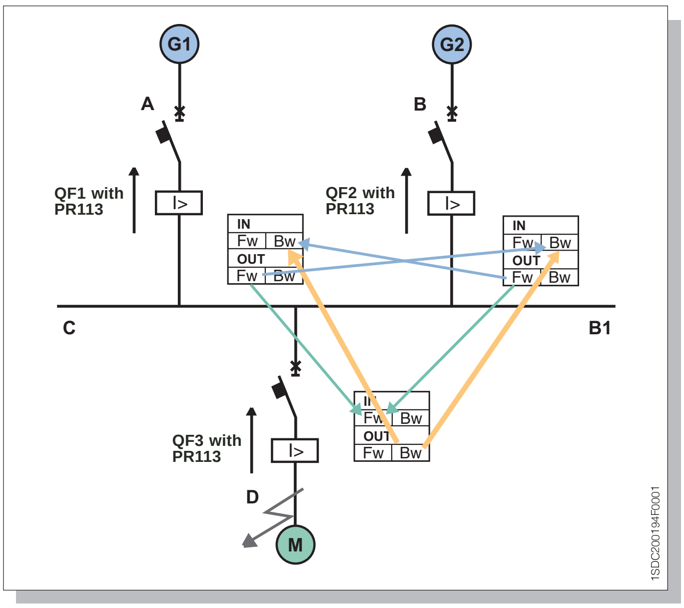
3) for a fault in C, the circuit-breakers QF1 and QF2 are traversed by a current with direction discordant to the setting, while QF3 is traversed by a current in the same direction as the setting. No circuit-breaker, however, is locked and thus all will trip according to the selected times.
The figure below shows only the connections, as no lock signal is active.



Direction (OUT-IN)	Arrow
Fw → Fw	
Fw → Bw	
Bw → Fw	
Bw → Bw	

Direction set

4) for a fault in D, the circuit-breaker QF3 is traversed by a current from the busbar B1; this current flows in a direction discordant to the setting. The OUT bus Bw of QF3 locks the IN Bus Bw of the circuit-breakers QF1 and QF2: both are traversed by fault currents discordant to the direction set. The figure below shows the connections between the relays, and the thicker arrows indicate the active lock signals in addition to the connections.



Direction (OUT-IN)	Arrow
Fw → Fw	
Fw → Bw	
Bw → Fw	
Bw → Bw	

Direction set

6

Earth fault protection

Circuit-breakers with protection G

Circuit-breakers fitted with releases offering earth fault protection function G are usually used in MV/LV distribution substations to protect both the transformers and distribution lines.

The protection function G detects the residual current of the sum of the currents detected by the current transformers on the phases and neutral. It is effectively used in TT, IT, and TN-S electrical installations and, limited to the section of the installation with a neutral conductor (N) branched and separated from the conductor PE, also in TN-CS systems (for the TN-S area only).

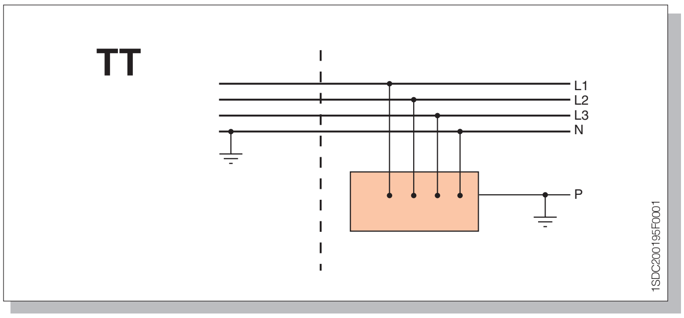
Protection function G is not used in TN-C systems, since they provide the neutral and protection functions using a single conductor.

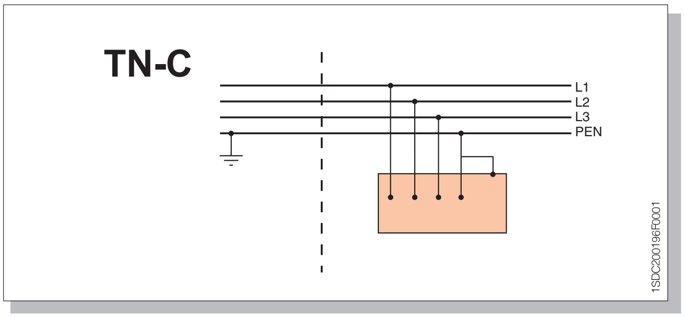
The protection device thresholds and trip times can be selected from a wide range, also making it easy to achieve discrimination for this type of fault with regard to the protection devices installed on the load side. Discrimination is therefore ensured regarding the residual-current releases located on the load side.

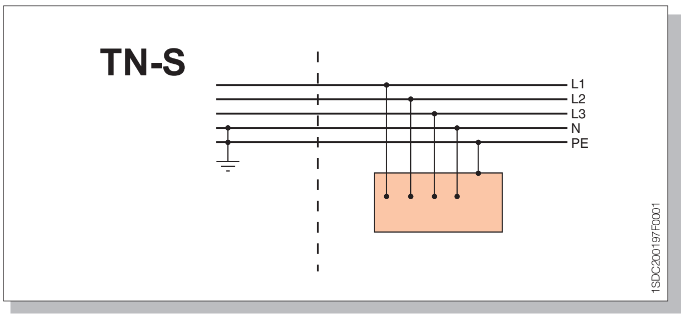
Function G of the PR111 release has constant specific let-through energy curves ($I^2t = k$); In the PR112 and PR 113 releases, curves with trip times independent of the current ($t = k$) can also be selected.

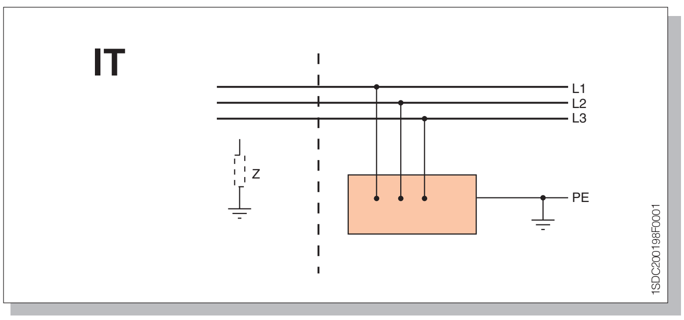
The figure below shows an example of one possible choice of earth fault protection devices and their possible settings.

The protection functions G of the circuit-breakers on the main switchboard A has the task of guaranteeing discrimination, with respect to each other and the residual-current protection devices located on the users of the distribution switchboards B.

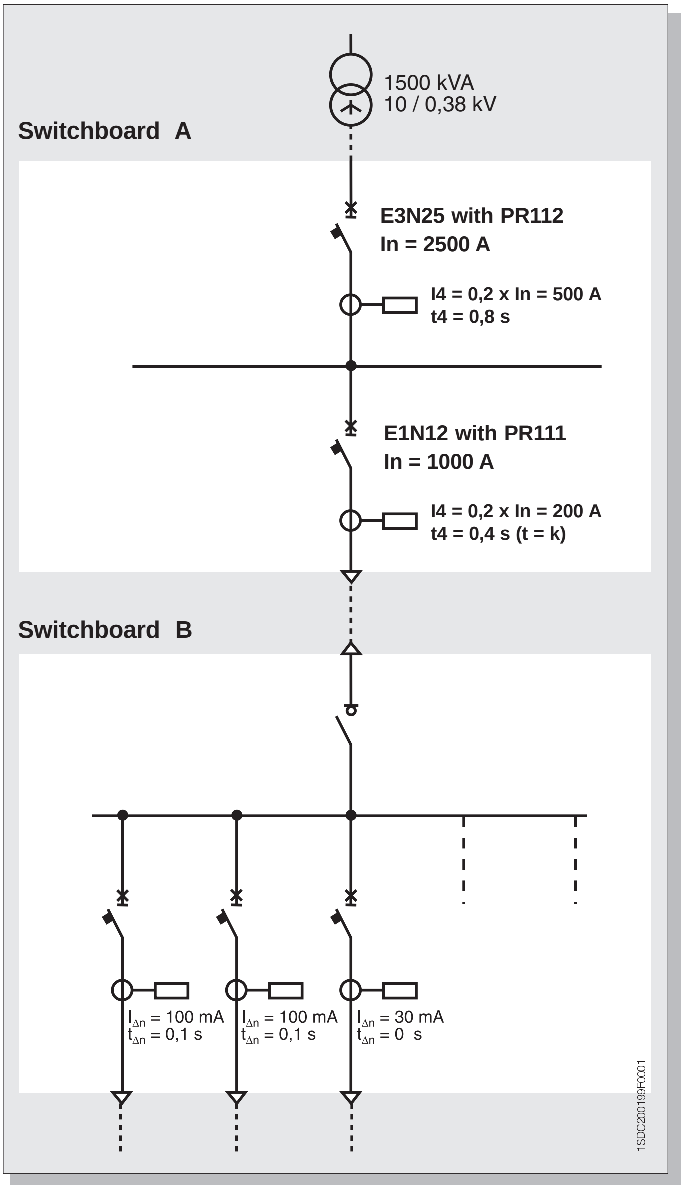








Example of choice of earth fault protection devices and their corresponding settings.

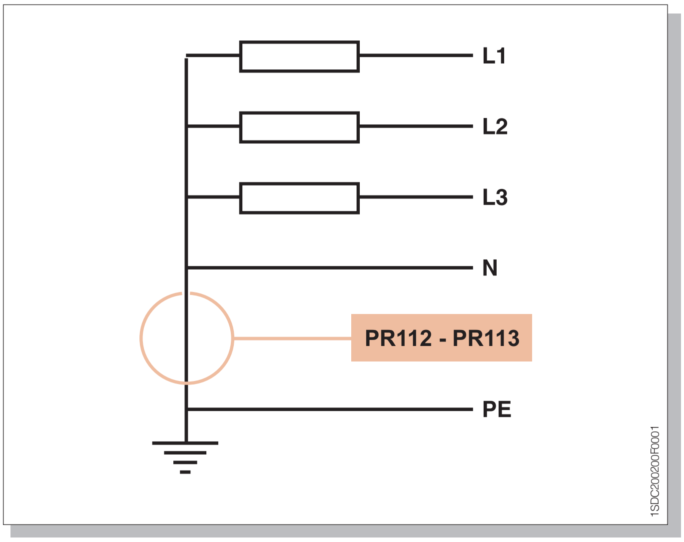


6

Earth fault protection

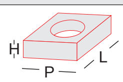
Use of the toroid on the star center of the transformer

In the case of circuit-breakers to protect MV/LV transformers, it is possible to install a toroid on the conductor connecting the star center of the transformer to earth (application allowed with the SACE Emax series fitted with the PR112 and PR113 range of electronic releases). This determines the earth fault current.
The figure below shows the operating principle of the toroid installed on the star center of the transformer.
The use of this accessory allows the protection threshold against earth fault (function G) to be independent of the size of the primary current transformers installed on the circuit-breaker phases.



The table shows the main characteristics of the range of toroids (available only in the closed version).

Characteristics of toroid ranges

Rated current	**100 A, 250 A, 400 A, 800 A**
Outer dimensions of the toroid	
	L = 165 mm
	P = 160 mm
	H = 35 mm
Internal diameter of the toroid	Ø = 112 mm

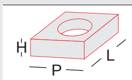
Using the SACE RCQ switchboard electronic residual current relays

The family of SACE Emax circuit-breakers with a rated current up to 2000A can be combined, if fitted with a shunt opening release, to the residual current relay for SACE RCQ switchboards with a separate toroid transformer (for outside installation on the line conductors) thus enabling earth leakage currents to be determined for values between 0.03 and 30A.
Thanks to the wide range of settings, the SACE RCQ switchboard relay is suitable for applications where a residual current protection system coordinated with the various distribution levels is to be constructed from the main switchboard to the final user. It is particularly suitable where low-sensitivity residual current protection is required, for example in both partial (current-type) or total (time-current) discrimination chains, and for high-sensitivity applications to protect people against direct contact.
When the auxiliary power supply voltage drops, the opening command intervenes after a minimum time of 100ms and after the time set above 100ms.
The SACE RCQ relay is suitable for use in the presence of alternating only earth current (Type AC), for alternating and/or pulsating current with continuous components (Type A), and is suitable for achieving residual current discrimination.
The SACE RCQ relay is indirectly acting, and works on the release mechanism of the circuit-breaker by means of the circuit-breaker shunt opening release (to be ordered by the customer) to be housed in the circuit-breaker itself.
The table below shows the main characteristics of the SACE RCQ relay.

SACE RCQ residual current switchboard relay

Power supply voltage	AC	[V]	80 ... 500
	DC	[V]	48 ... 125
Tripping threshold setting	IΔn		
- 1a setting range		[A]	0,03 - 0,05 - 0,1 - 0,3 - 0,5
- 2a setting range		[A]	1 - 3 - 5 - 10 - 30
Trip time settings 1a range		[s]	0 - 0,05 - 0,1 - 0,25
Trip time settings 2a range		[s]	0,5 - 1 - 2,5 - 5
Range of use of closed transformers			
- Toroidal transformer ∅ 60mm		[A]	0,03 ... 30
- Toroidal transformer ∅ 110mm		[A]	0,03 ... 30
Range of use of transformers that may be opened			
- Toroidal transformer ∅ 110mm		[A]	0,3 ... 30
- Toroidal transformer ∅180mm		[A]	0,1 ... 30
- Toroidal transformer ∅ 230mm		[A]	0,1 ... 30
Dimensions L x H x P		[mm]	96 x 96 x 131,5
Drilling for assembly on door		[mm]	92 x 92

Dimensions of the external toroid for SACE RCQ

Outer dimensions of the toroid			Closed		Openable		
	L	[mm]	94	165	166	241	297
	P	[mm]	118	160	200	236	292
	H	[mm]	81	40	81	81	81
Internal diameter	Ø	[mm]	60	110	110	180	230

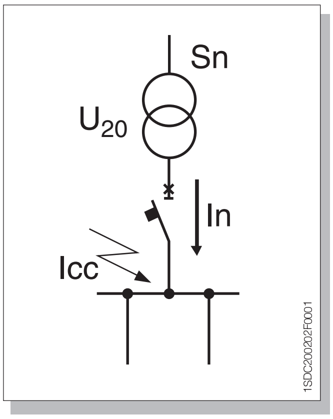
General information

When choosing circuit-breakers to protect the LV side of MV/LV transformers, one basically needs to take the following into account:

- the rated current of the protected transformer on the LV side, on which the circuit-breaker capacity and protection settings both depend;
- the maximum short-circuit current at the point of installation, which determines the minimum breaking capacity that must be offered by the protection device.

MV-LV substation with a single transformer

The rated current of the transformer, LV side, is determined by the following equation



$$In = \frac{Sn \times 10^3}{\sqrt{3} \times U_{20}}$$

where

Sn = rated power of the transformer, in kVA

U_{20} = rated secondary voltage (no load) of the transformer, in V

In = rated current of the transformer, LV side, in A (rms value)

The three-phase short-circuit current at full voltage, right at the LV terminals of the transformer, may be expressed by the following equation (assuming infinite short-circuit power at the primary):

$$Icc = \frac{In \times 100}{Ucc\%}$$

where:

Ucc % = short-circuit voltage of the transformer, in %

In = rated current, LV side, in A (rms value)

Icc = rated three-phase short-circuit current, LV side, in A (rms value)

The short-circuit current is lower than the values obtained using the equation above if the circuit-breaker is installed some distance away from the transformer using a cable or busbar connection, determined by the impedance of the connection.

In practice, contrary to the above, the short-circuit value provided by the transformer is also affected by the short-circuit power of the Pcc network to which the transformer is connected.

6

Choosing the circuit-breaker

The table below shows a number of possible choices of SACE Emax circuit-breakers in relation to the characteristics of the transformers to be protected.

Warning

The information provided is valid for the conditions indicated in the table. The calculations will need to be adjusted for different conditions, and choices altered as needed.

Note: infinite short-circuit power of the supply side network

		E1B 800	E1B 1250	E1B 1250	E2B 1600	E2B 2000	E3N 2500	E3N 3200	E4S 4000	E6H 5000
Sn	[kVA]	500	630	800	1000	1250	1600	2000	2500	3150
Ucc	[%]	4	4	5	5	5	6,25	6,25	6,25	6,25
U_{20}	[V]	400	400	400	400	400	400	400	400	400
In (1)	[A]	722	909	1155	1443	1804	2309	2887	3608	4547
Icc (1)	[kA]	18,1	22,7	23,1	28,9	36,1	36,9	46,2	57,7	72,7

(1) For voltages U'_{20} other than 400V, multiply In and Icc for the following factors K:

U'_{20}	[V]	220	380	400	415	440	480	500	660	690
K		1.82	1.05	1	0.96	0.91	0.83	0.8	0.606	0.580

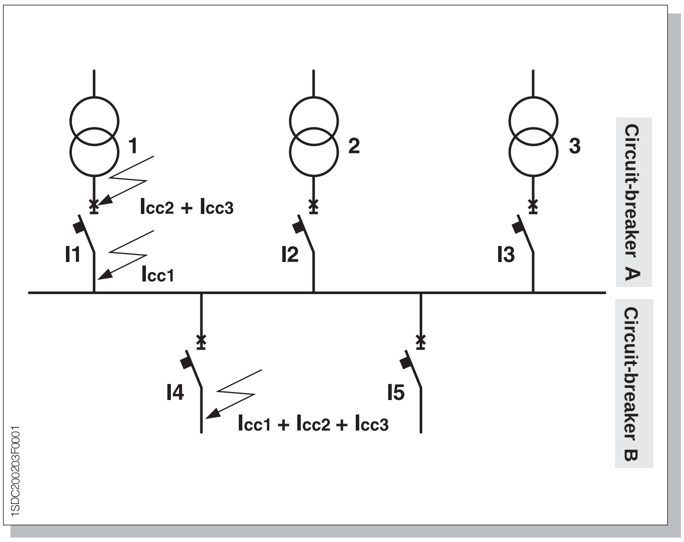
6

MV-LV substation with multiple transformers in parallel

The rated current of the transformer is calculated following the same procedure outlined in the previous section.
The minimum breaking capacity of each protection circuit-breaker on the LV side must be higher than whichever of the following values is greatest (the example is for machine 1 in the figure and applies to three machines in parallel):

- Icc1 (short-circuit current of transformer 1) in the event of a fault immediately on the load side of circuit-breaker I1;
- Icc2 + Icc3 (Icc2 and Icc3 = short-circuit currents of transformers 2 and 3) in the event of a short-circuit on the supply side of circuit-breaker I1.

Circuit-breakers I4 and I5 on the outgoing lines must have a breaking capacity greater than Icc1 + Icc2 + Icc3; the contribution to the short-circuit current by each transformer obviously depends on the short-circuit power of the network to which it is connected (the table below assumes Pcc=750 MVA), and on the line connecting the transformer and circuit-breaker (to be determined in each instance).



Switching and protection of Pcc transformers 750MVA Vn= 400V

Transformer power		Circuit-breaker A (secondary circuit of the transformer)			Circuit-breaker B (outgoing user line)									
P	Ib	Icc	Type	Relay PR111-112-113	Ib total	Icc	Rated current and model of circuit-breaker (relay PR111-PR112-PR113)							
[kVA]	[A]	[kA]		TA [A]	[A]	[kA]	800 A	1000 A	1250 A	1600 A	2000 A	2500 A	3200 A	4000 A
1 x 500	722	17,7	E1B 800	In=800	722	17,7	E1B 800*	-	-	-	-	-	-	-
2 x 500	722	17,5	E1B 800	In=800	1444	34,9	E1B 800*	E1B 1250*	E1B 1250*	-	-	-	-	-
1 x 630	909	22,3	E1B 1250	In=1000	909	22,3	E1B 800*	-	-	-	-	-	-	-
2 x 630	909	21,8	E1B 1250	In=1000	1818	43,6	E1N 800*	E1N 1250*	E1N 1250*	E2N 1600*	-	-	-	-
3 x 630	909	42,8	E1N 1250	In=1000	2727	64,2	E2N 1250*	E2N 1250*	E3S 1250*	E2N 1600*	E2N 2000*	E3N 2500*	-	-
1 x 800	1155	22,6	E1B 1250	In=1250	1155	22,6	E1B 800*	-	-	-	-	-	-	-
2 x 800	1155	22,1	E1B 1250	In=1250	2310	44,3	E1N 800*	E1N 1250*	E1N 1250*	E2N 1600*	E2N 2000*	-	-	-
3 x 800	1155	43,4	E1N 1250	In=1250	3465	65,0	E2N 1250*	E2N 1250*	E3S 1250*	E2N 1600*	E2N 2000*	E3N 2500*	E3N 3200*	-
1 x 1000	1443	28,1	E2B 1600	In=1600	1443	28,1	E1B 800*	E1B 1250*	E1B 1250*	-	-	-	-	-
2 x 1000	1443	27,4	E2B 1600	In=1600	2886	54,8	E2N 1250*	E2N 1250*	E2N 1250*	E2N 1600*	E2N 2000*	E3N 2500*	-	-
3 x 1000	1443	53,5	E2N 1600	In=1600	4329	80,2	E3H 1250*	E3H 1250*	E3H 1250*	E3H 1600*	E3H 2000*	E3H 2500*	E3H 3200*	E4H 4000
1 x 1250	1804	34,9	E2B 2000	In=2000	1804	34,9	E1B 800*	E1B 1250*	E1B 1250*	E2B 1600*	-	-	-	-
2 x 1250	1804	33,8	E2B 2000	In=2000	3608	67,7	E3S 1250*	E3S 1250*	E3S 1250*	E3S 1600*	E3S 2000*	E3S 2500*	E3S 3200*	-
3 x 1250	1804	65,6	E3S 2000	In=2000	5412	98,4	E3H 1250*	E3H 1250*	E3H 1250*	E3H 1600*	E3H 2000*	E3H 2500*	E3H 3200*	E4H 4000
1 x 1600	2309	35,7	E3N 2500	In=2500	2309	35,7	E1B 800*	E1B 1250*	E1B 1250*	E2B 1600*	E2B 2000*	-	-	-
2 x 1600	2309	34,6	E3N 2500	In=2500	4618	69,2	E3S 1250*	E3S 1250*	E3S 1250*	E3S 1600*	E3S 2000*	E3S 2500*	E3S 3200*	E4S 4000
3 x 1600	2309	67,0	E3S 2500	In=2500	6927	100,6	E2L 1250*	E2L 1250*	E2L 1250*	E2L 1600*	E3L 2000*	E3L 2500*	E6V 3200*	E6V 4000
1 x 2000	2887	44,3	E3N 3200	In=3200	2887	44,3	E1N 800*	E1N 1250*	E1N 1250*	E2N 1600*	E2N 2000*	E3N 2500*	-	-
2 x 2000	2887	42,6	E3N 3200	In=3200	5774	85,1	E3H 1250*	E3H 1250*	E3H 1250*	E3H 1600*	E3H 2000*	E3H 2500*	E3H 3200*	E4H 4000
1 x 2500	3608	54,8	E4S 4000	In=4000	3608	54,8	E2N 1250*	E2N 1250*	E2N 1250*	E2N 1600*	E2N 2000*	E3N 2500*	E3N 3200*	-
1 x 3125	4547	68,2	E6H 5000	In=5000	4547	68,2	E3S 1250*	E3S 1250*	E3S 1250*	E3S 1600*	E3S 2000*	E3S 2500*	E3S 3200*	E4S 4000

WARNING!

The table refers to the conditions specified on the previous page. The information for choosing the circuit-breakers is provided only in relation to the operating current and prospective short-circuit current. To make the correct choice other factors such as discrimination, back-up protection, the decision to use current-limiting circuit-breakers, etc, must be considered. It is therefore essential for designers to carry out precise verification.
The types of circuit-breakers proposed are all from the SACE Emax series. Positions marked by an asterisk (*) are suitable for other possible choices from the SACE Isomax series of moulded-case circuit-breakers. It is also needed to bear in mind that the short-circuit currents shown in the table have been calculated on the assumption of 750MVA power on the supply side of the transformers, and without taking the impedances of the busbars and connections to the circuit-breakers into account.

Line protection

The following main parameters must be known in order to make the correct choice of circuit-breakers for line operation and protection:
- operating current of the line IB
- permanent current carrying capacity of the conductor IZ
- section S and cable insulation material, with relative constant K
- short-circuit current Icc in the point of installation of the circuit-breaker.

The protective device chosen must offer a breaking capacity (Icu or Ics at the system voltage) greater than or equal to the short-circuit value at the application point. The operating characteristics of the chosen device must also meet the following conditions:

Overload protection

$$I_B \le I_N \le I_Z$$

$$I_f \le 1{,}45\ I_Z$$

where
I_B is the operating current of the circuit;
I_Z is the permanent current carrying capacity of the conductor;
I_n is the permanent current carrying capacity of the conductor;
I_f is the current that ensures operation of the protective device.

Note
Concerning the verification required by the CEI 64-8 Standards, which stipulate that the overload protection must have a trip current If that ensures operation for a value less than 1.45 Iz (If < 1.45 Iz), this condition is always satisfied since SACE Emax circuit-breakers conform to CEI EN 60947-2 Standards and this value is 1.3 In.

The above inequalities are easily achieved thanks to the broad setting ranges offered by the PR111-PR112-PR113 releases.

Short-circuit protection

Assuming that conductor overheats adiabatically during the passage of the short-circuit current, the following formula must be observed:

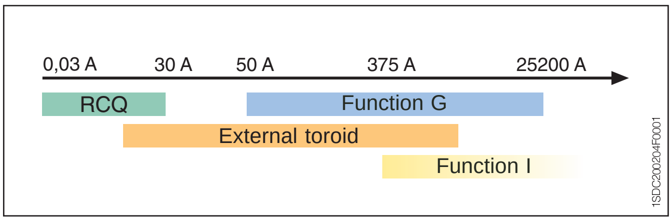
$$(I^2t)_{circuit\text{-}breaker} \le (K^2S^2)_{cable}$$

thus the specific let-through energy (I^2t) of the circuit-breaker must be lesser than or equal to the specific let-through energy (K^2S^2) withstood by the cable.

Also make sure that the circuit-breaker trips within the limits prescribed by international standards for the minimum value of the baseline short-circuit current.
The minimum short-circuit current is the current corresponding to a short-circuit produced between phase and neutral (or between phase and phase if the neutral conductor is not distributed) at the farthest point of the conductor.

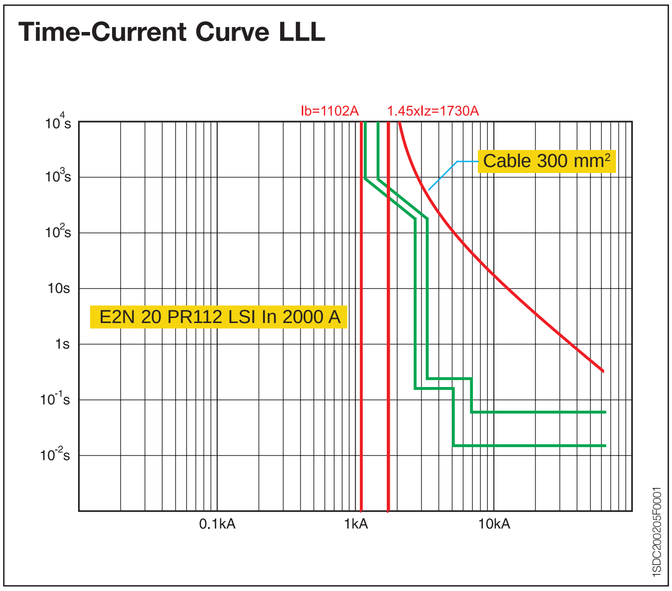
Protection against indirect contacts

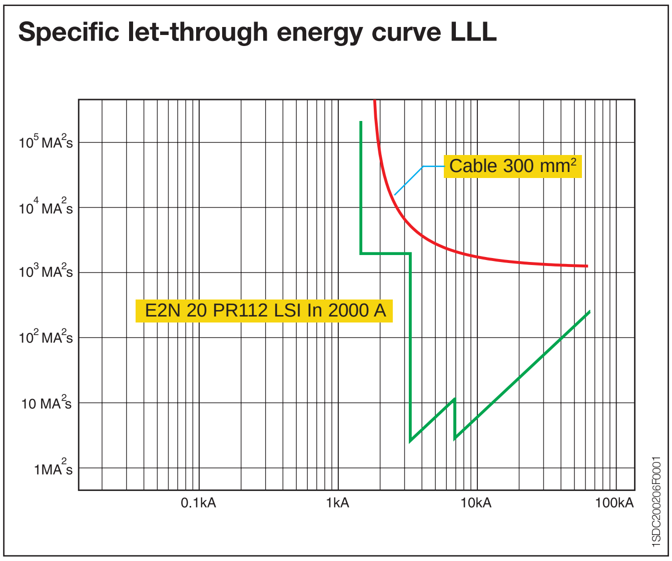
In the event of a fault involving a phase and a part of the installation that is not normally live, it is best to make sure that the circuit-breaker trip within the times prescribed by international standards for current values lesser than or equal to the fault current.
Based on the value of this current, it may be possible to intervene using the function I of the relay, function G or, for extremely low values, the RCQ device.



The figure shows which function of the electronic release or device to use based on the fault current.

Example:
In an installation with Vn=400V and Icc=45kA, a load with Ib=1102A is powered with 4 cables in parallel, insulated in EPR by 300mm2 and Iz=1193A
With appropriate settings, the E2N2000 In=2000A circuit-breaker equipped with the electronic protection relay PR112, protects the cable in accordance with the above conditions, as illustrated in the following graphs.





Note
For protection against indirect contacts, it may be necessary to link the setting of the short-circuit protection to the length of the line protected. See the Slide rule kit and DOCWin software package for the calculation procedures required.
Special attention must be devoted to the selective coordination of circuit-breakers in series, to limit disservice in the event of faults.

Switching and protection of generators

Emax circuit-breakers are suitable for use with low-voltage generators employed in the following applications:

A - back-up generators for essential users

B - generators in insulated operation

C - generators for small power stations connected in parallel with other generators and, possibly, with the power supply network.

In cases A and B, the generator does not operate in parallel with the power supply network: the short-circuit current therefore depends on the generator itself and, possibly, the users connected.

In case C, the breaking capacity must be determined by assessing the short-circuit current imposed by the network at the point of circuit-breaker installation.

The main points to check for generator protection are:

– the short-circuit current delivered by the generator; this may be assessed only if one is familiar with the machine's typical reactance and time constants. Here one can simply note that low short-circuit protection device settings are normally required (2-4 times In);
– the thermal overload limit of the machine. According to the standard IEC 60034-1, this value is set at 1.5xIn for a period of 30 seconds.

For a detailed assessment, see the DOCWin software or specialized books on the topic.

The wide range of settings offered by microprocessor-based releases:

PR111	Threshold I (1.5 to 12) x In	Threshold S (1 to 10) x In
PR112	Threshold I (1.5 to 15) x In	Threshold S (0.6 to 10) x In
PR113	Threshold I (1.5 to 15) x In	Threshold S (0.6 to 10) x In

makes SACE Emax circuit-breakers perfectly suitable for protecting large generators for the short-circuit current and for the thermal overload limit.

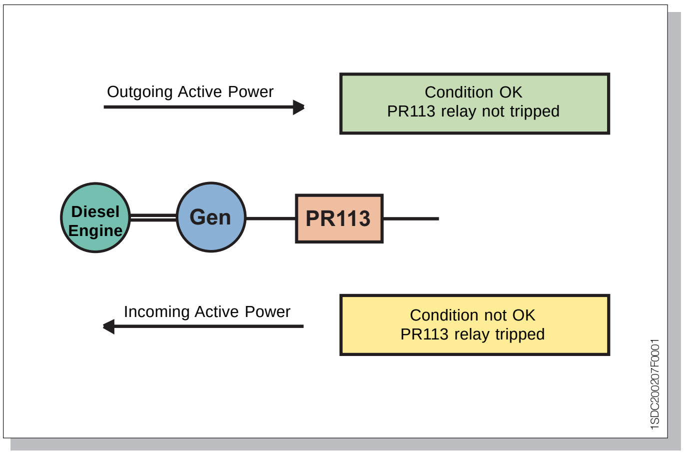
Choiche of the circuit-breakers to protect generators

The table shows the rated currents of the circuit-breakers, based on the electrical specifications of the generators. The breaking capacity required by the application must be defined in order to choose the appropriate circuit-breaker.
The microprocessor-based protection releases available are suitable for every need.

Frequency 50 Hz - Voltage 400 V			Frequency 60 Hz - Voltage 450 V		
Rated power of the alternator [kVA]	Rated power of the alternator [A]	Rated current of the circuit-breaker [A]	Rated power of the alternator [kVA]	Rated power of the alternator [A]	Rated current of the circuit-breaker [A]
630	909	**1000**	760	975	**1000**
710	1025	**1250**	850	1091	**1250**
800	1155	**1250**	960	1232	**1250**
900	1299	**1600**	1080	1386	**1600**
1000	1443	**1600**	1200	1540	**1600**
1120	1617	**2000**	1344 - 1350	1724 - 1732	**2000**
1250	1804	**2000**	1500	1925	**2000**
1400	2021	**2500**	1650 - 1680 - 1700	2117 - 2155 - 2181	**2500**
1600	2309	**2500**	1920 - 1900	2463 - 2438	**2500**
1800	2598	**3200**	2160 - 2150	2771 - 2758	**3200**
2000	2887	**3200**	2400	3079	**3200**
2250	3248	**4000**	2700	3464	**4000**
2500	3608	**4000**	3000	3849	**4000**
2800	4041	**5000**	3360	4311	**5000**
3150	4547	**5000**	3780	4850	**5000**
3500	5052	**6300**	4200	5389	**6300**

Reverse power protection RP

The reverse power protection gets tripped when active power is incoming to the generator rather than outgoing as in normal conditions. Power reversal takes place if the mechanical power supplied by the prime mover driving the generator drops sharply. In this condition the generator acts as a motor, and may cause serious damage to the prime movers such as overheating for steam turbines, cavitation for hydraulic turbines, or explosions of uncombusted diesel fuel in diesel engines.

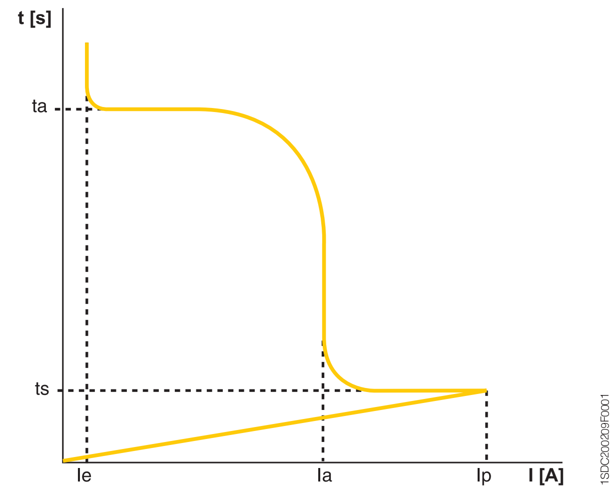


When the power measured by the relay falls below zero, the PR113 release trips, opening the circuit-breaker and thus preventing damage.

6

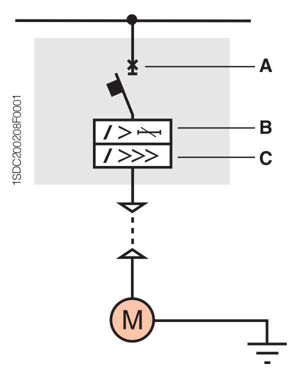
Switching and protection of asynchronous motors

The low-voltage automatic circuit-breaker alone can guarantee the following functions in circuits for powering three-phase asynchronous motors:
– switching
– overload protection
– short-circuit protection.



Ie = Rated current of the motor
Ia = Initial value of the transient starting current
Ip = Maximum instantaneous value of the subtransient starting current
ta = Starting time
ts = Duration of transient phase

Pattern of peak current values in the starting phase of a three-phase asynchronous motor.



A = Circuit-breaker
B = Overload protection (inverse long time-delay trip)
C = Short-circuit protection (instantaneous)
M = Asynchronous motor

Diagram showing direct starting of asynchronous motor using only the circuit-breaker fitted with a microprocessor-based overcurrent release.

This solution is particularly suitable if the switching frequency is not high, as is normally the case for large motors. In this case, using only the circuit-breaker for the switching and protection of the motor represents a highly advantageous solution due to its competitive cost-efficiency, reliability, ease of installation and maintenance and compact dimensions.
The automatic circuit-breakers in the SACE Emax selective (not current-limiting) series are able to provide the motor switching and protection function by virtue of their high breaking capacities and the wide range of possible settings offered by the microprocessor-based releases.
SACE Emax circuit-breakers are suitable for use with motors with rated powers within the range 355 kW to 630 kW. For power ratings up to 355 kW the insulated moulded-case circuit-breakers in the SACE Isomax range are also available. Medium voltage power supplies are normally used for powers above 630 kW.

6

Switching and protection of asynchronous motors

The switching of three-phase asynchronous motors demands considerable attention to the starting operation, since the current during this phase follows the typical behaviour shown in the figure, which must be taken into account when choosing the protection devices.
It is essential to calculate the typical values of the times and currents indicated in the figure in order to choose the correct switching and protection devices for the motor. These data are normally provided by the motor manufacturer.

The following ratios generally apply:
– Ia = 6-10 Ie (Ia and Ie: rms values)
– Ip = 8-15 Ia (Ip and Ia: rms values).

Note
The current Ip is commonly calculated from its peak value (Ip = 1.4 - 2.5 Ia): the corresponding rms value is obtained by dividing the result by 1.41.

The rated current of the circuit-breaker must be at least 20% higher than that of the motor.
The protection releases must be adjusted so as to:
– prevent slow operation in the motor starting phase
– ensure the installation is protected against the overcurrents which might occur at any point on the load side of the circuit-breaker (including internal motor faults).
The inverse long time-delay trip protection and instantaneous short-circuit protection must be set as close as possible to the motor starting curve without, however, interfering with it.

Note
The IEC 947-4-1 standard covers motor starters. The following classes are considered for overload protection:

Operating class	Trip time t (s) for I = 7,2 x I1 (I1 = release setting current)
10A	2 < t ≤ 10
10	4 < t ≤ 10
20	6 < t ≤ 20
30	9 < t ≤ 30

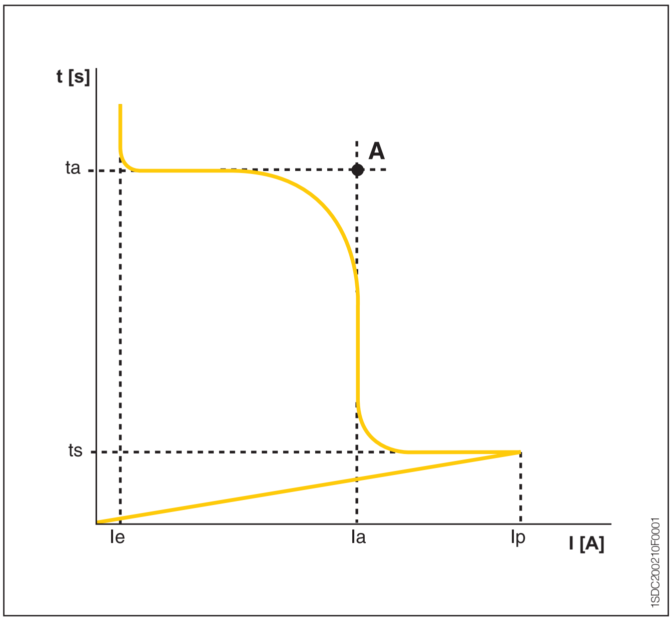
The table specifies that the protection device must trip in a time t within the limits for the class when the current flowing through the device to be protected is 7.2 times the release setting current (assumed to be equal to the rated current of the motor).
The overload devices are divided into classes in a manner closely linked to the motor starting time: for example, a motor with a starting time of 5 seconds requires a protection device in class 20.
The same standards provide specific prescriptions for the protection device in cases of three-phase operation or with the loss of a phase.

Warning

The curves of the motor and releases are not directly comparable, in that they both express time-current links, but have conceptually different meanings:

– the motor starting curve represents the values assumed by the starting current moment by moment;
– the release curve represents the currents and corresponding trip times for the protection device.

The overload trip curve is set correctly when it is immediately above point A (figure alongside), which identifies the top of the rectangle with sides formed by the starting time "ta" and the current "Ia," respectively, thermally equivalent to the variable starting current.



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Three-phase operation

The overload protection device must ensure tripping in more than two hours with currents equal to 1.05 times the rated current of the motor and in less than two hours with currents equal to 1.2 times the same rated current, as indicated in the table which follows (page **6**/29).

Switching and protection of asynchronous motors

Operation with the loss of a phase

Tripping must occur in less than two hours at 20°C in the event of the loss of a phase when the current in the energized poles reaches 1.2 times the rated current. It is possible to trip the circuit-breaker using the PR113 release.

Choosing the circuit-breakers to be used for motor protection

The table below shows the starting characteristics for large motors, from 355 to 630 kW, with circuit-breakers in the SACE Emax series for switching and protecting motors in category AC-3 - 440 V - 50 Hz.
The table shows the choice of current transformers able to ensure a sufficiently high value for the instantaneous trip threshold setting (I): in the absence of experimental data it is advisable to verify that the ratio between the threshold of protection device I (I3) and the threshold of protection device L (I1) is:

$I3/I1 = 12 \dots 15$.

The PR112 and PR113 microprocessor-based releases are in compliance with international standard IEC 947-4-1. In particular the devices ensure the protection of class 10A, 10, 20 and 30 motors setting the function L trip time at I=7.2 I1 between 0.52s and 25s, where I1 is the L threshold setting current. PR112 and PR113 protection releases are compensated in temperature, and their operation is not negatively affected by the loss of a phase.

Benefits of earth fault protection G

The earth fault protection (G) is advisable in order to:
– improve safety against fire hazards
– improve protection of the motor and personnel in the event of machine faults.

Benefits of thermal memory

The suitability of enabling the thermal memory (option offered by PR112 and PR113 releases) must be evaluated in relation to the type of user. Enabling the thermal memory (which makes the microprocessor-based protection similar to that provided by a thermomagnetic device) increases the protection level of the motor when restarting after tripping due to an overload.

Undervoltage protection

The undervoltage protection device in control systems for asynchronous motors demands particular attention, performing, amongst other things, two important functions:
– it prevents simultaneous restarting of all the motors upon return of the power supply, with the risk of causing the entire installation to go out of service by tripping the main circuit-breaker overcurrent protection devices
– it prevents the motor from restarting without a control signal, which could cause a hazard for maintenance personnel or damage the processing cycle.

This protection is available by means of:
– undervoltage release,
– protection function UV (undervoltage) on the PR113 release.

I/In	1.05	1.2	1.5	7.2	Operating class
Tp	> 2h	< 2h	< 120 s	2 < t ≤ 10s	10A
			< 240 s	4 < t ≤ 10s	10
			< 480 s	6 < t ≤ 20s	20
			< 720 s	9 < t ≤ 30s	30

Motor		SACE Emax circuit-breaker			Microprocessor-based release		
Pe [kW]	Ie [A]	Operations (AC-3) [No.]	**Type**	Icu [kA]	In [A]	**Type**	TA [A]
220	408	10000	**E1B**	42	800	**PR112/PR113**	800
250	418	10000	**E1B**	42	800	**PR112/PR113**	800
315	580	10000	**E1B**	42	1250	**PR112/PR113**	1250
355	636	10000	**E1B**	42	1250	**PR112/PR113**	1250
400	710	10000	**E1B**	42	1250	**PR112/PR113**	1250
450	800	10000	**E1B**	42	1250	**PR112/PR113**	1250
220	408	10000	**E1N**	50	800	**PR112/PR113**	800
250	418	10000	**E1N**	50	800	**PR112/PR113**	800
315	580	10000	**E1N**	50	1250	**PR112/PR113**	1250
355	636	10000	**E1N**	50	1250	**PR112/PR113**	1250
400	710	10000	**E1N**	50	1250	**PR112/PR113**	1250
450	800	10000	**E1N**	50	1250	**PR112/PR113**	1250
500	910	12000	**E2B**	42	1600	**PR112/PR113**	1600
560	1020	12000	**E2B**	42	1600	**PR112/PR113**	1600
630	1140	12000	**E2B**	42	1600	**PR112/PR113**	1600
220	408	15000	**E2N**	65	1250	**PR112/PR113**	800
250	418	15000	**E2N**	65	1250	**PR112/PR113**	800
315	580	15000	**E2N**	65	1250	**PR112/PR113**	1250
355	636	15000	**E2N**	65	1250	**PR112/PR113**	1250
400	710	15000	**E2N**	65	1250	**PR112/PR113**	1250
450	800	15000	**E2N**	65	1250	**PR112/PR113**	1250
500	910	12000	**E2N**	65	1600	**PR112/PR113**	1600
560	1020	12000	**E2N**	65	1600	**PR112/PR113**	1600
630	1140	12000	**E2N**	65	1600	**PR112/PR113**	1600
220	408	12000	**E3S**	75	1250	**PR112/PR113**	800
250	418	12000	**E3S**	75	1250	**PR112/PR113**	800
315	580	12000	**E3S**	75	1250	**PR112/PR113**	1250
355	636	12000	**E3S**	75	1250	**PR112/PR113**	1250
400	710	12000	**E3S**	75	1250	**PR112/PR113**	1250
450	800	12000	**E3S**	75	1250	**PR112/PR113**	1250
500	910	10000	**E3S**	75	1600	**PR112/PR113**	1600
560	1020	10000	**E3S**	75	1600	**PR112/PR113**	1600
630	1140	10000	**E3S**	75	1600	**PR112/PR113**	1600
220	408	12000	**E3H**	100	1250	**PR112/PR113**	800
250	418	12000	**E3H**	100	1250	**PR112/PR113**	800
315	580	12000	**E3H**	100	1250	**PR112/PR113**	1250
355	636	12000	**E3H**	100	1250	**PR112/PR113**	1250
400	710	12000	**E3H**	100	1250	**PR112/PR113**	1250
450	800	12000	**E3H**	100	1250	**PR112/PR113**	1250
500	910	10000	**E3H**	100	1600	**PR112/PR113**	1600
560	1020	10000	**E3H**	100	1600	**PR112/PR113**	1600
630	1140	10000	**E3H**	100	1600	**PR112/PR113**	1600

Switching and protection of capacitors

Operating conditions of circuit-breakers during continuous service for capacitor banks

According to IEC Standards 60831-1 and 60931-1, capacitors must be able to operate in service conditions with a rated rms current of up to 1.3 times the rated current Icn of the capacitor. This prescription is due to the possible presence of harmonics in the power supply voltage.
It should also be kept in mind that a tolerance of +15% is admissible for the capacitance value corresponding to its rated power, so that the circuit-breakers for switching capacitor banks must be chosen to permanently carry a maximum current equal to:
In = 1.3 x 1.15 x Inc = 1.5 x Inc.

Current for connecting capacitor banks

Connection of a capacitor bank can be compared to closing in short-circuit conditions, where the transient making capacity Ip has high peak values, above all when capacitor banks are connected in parallel with others that are already powered. The value of Ip needs to be calculated for each individual situation because it depends on the individual circuit conditions and may in certain cases even have a peak value equal to 100-200 x Icn for a duration of 1 - 2 ms.
This fact must be taken into consideration when choosing the circuit-breaker, which must have a suitable making capacity, and when setting the overcurrent release, which must not cause unwarranted trips when the bank is connected.

Choosing the circuit-breaker

Using the information on the rating plate of the three-phase capacitor bank
Qn = rated power in kVar
Un = rated voltage in V
the rated current of the capacitor bank is determined as follows:

$$Inc = \frac{Qn \times 10^{3}}{\sqrt{3} \times Un}\text{, in A.}$$

The following conditions must be verified for the circuit-breaker:
Rated current Iu > 1.5 Inc
Overload protection setting I1 = 1.5 x Inc
Short-circuit protection setting I3 = OFF
Breaking capacity Icu > = Icc, at the point of installation.

Choosing the protection and switching circuit-breakers for capacitors

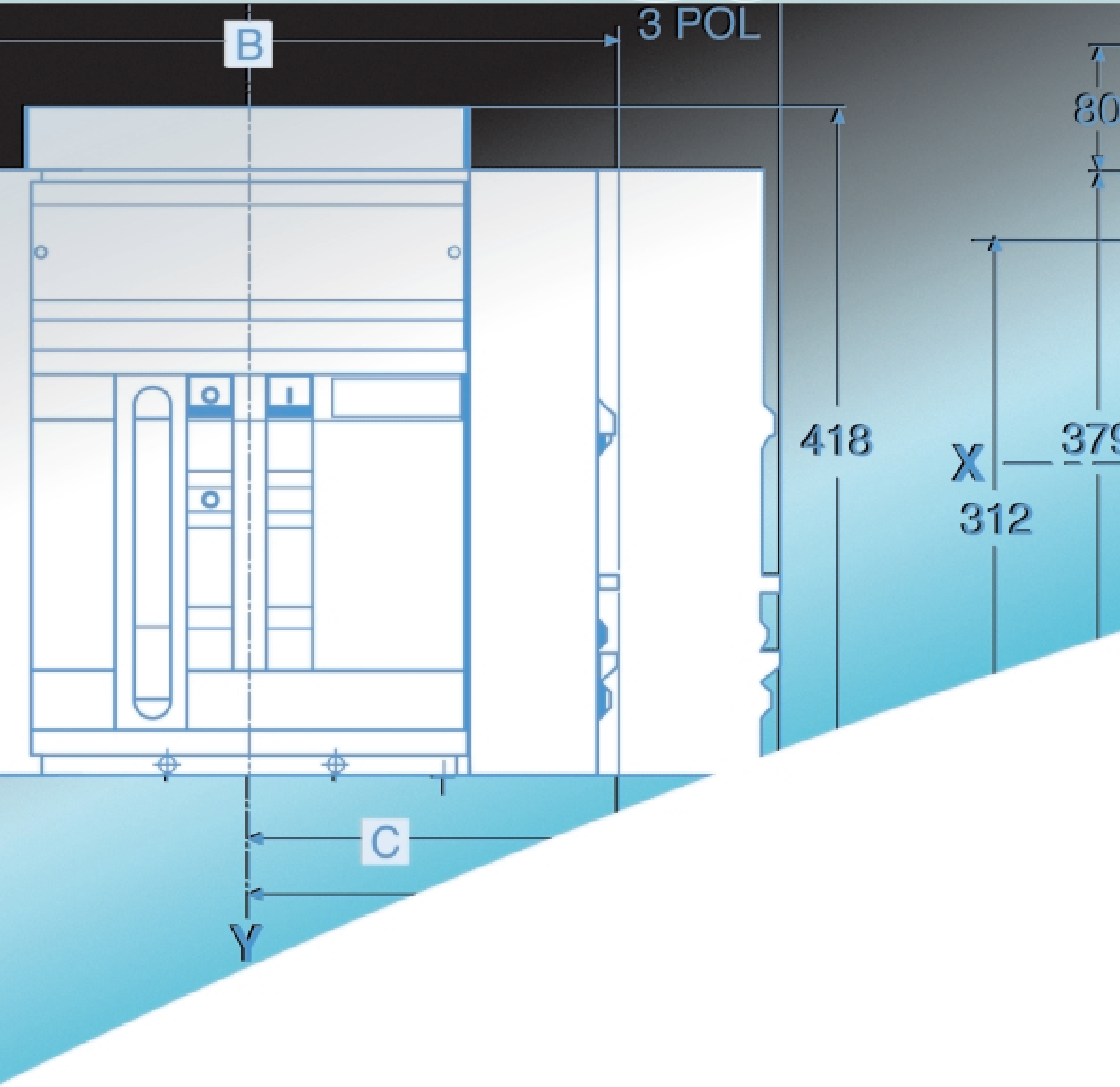
The breaking capacity of the circuit-breaker must take the prospective short-circuit current in the point of installation into account. The possible models are shown in the table.

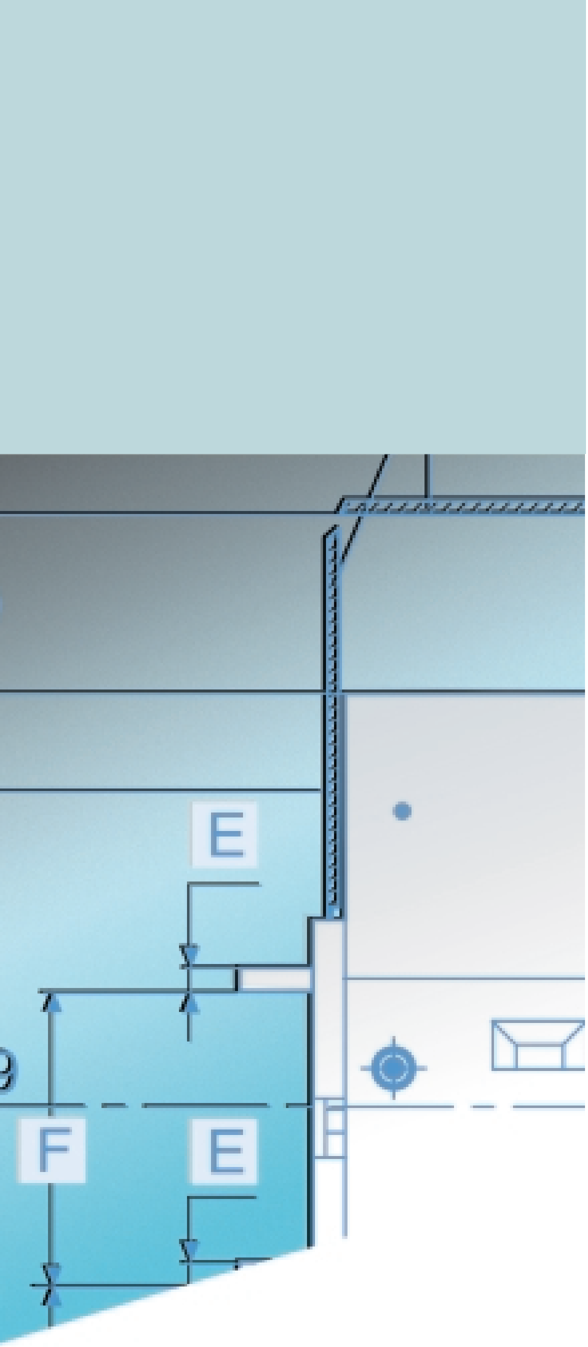
Maximum power of the capacitor bank at 50Hz [kvar]				Circuit-breaker	Rated current of the current transformer	Rated current of the capacitor bank	Overload protection setting	Short-circuit protection setting
400V	440V	500V	690V	Type	In [A]	Inc [A]	I1 [A]	I3 [A]
578	636	722	997	E1 - E2 - E3	1250	834	1 x In	OFF
739	813	924	1275	E2 - E3	1600	1067	1 x In	OFF
924	1017	1155	1594	E2 - E3	2000	1334	1 x In	OFF
1155	1270	1444	1992	E3	2500	1667	1 x In	OFF
1478	1626	1848	2550	E3 - E4 - E6	3200	2134	1 x In	OFF

Note

The circuit-breakers E2L and E2L are not suitable for switching capacitor banks.

Emax

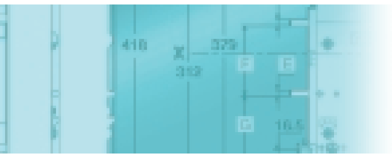




Overall dimensions

Contents

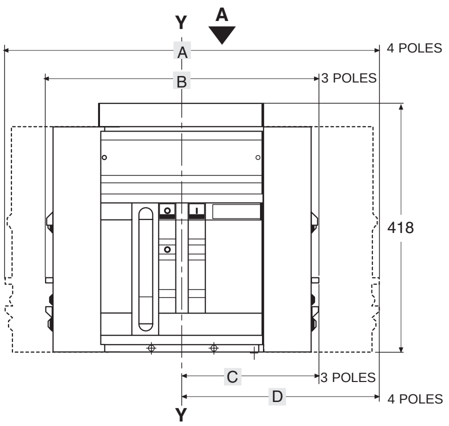
7

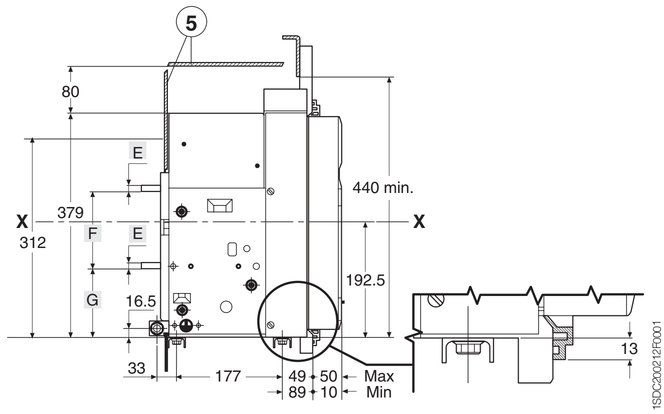


Overall dimensions

Fixed circuit-breaker

Basic version with horizontal rear terminals



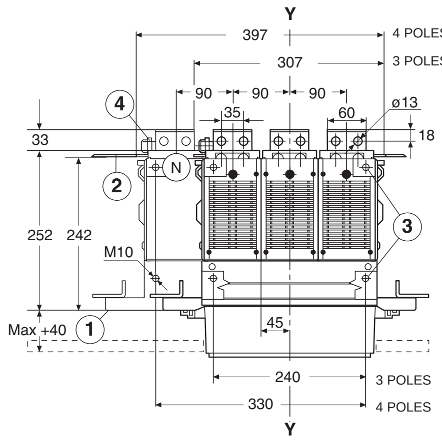


Caption

1. Inside edge of compartment door
2. Segregation (when provided)
3. M10 mounting holes for circuit-breaker (use M10 screws)
4. 1xM12 screw (E1, E2, E3) or 2 x M12 screws (E4, E6) for earthing (included in the supply)
5. Insulating wall or insulated metal wall

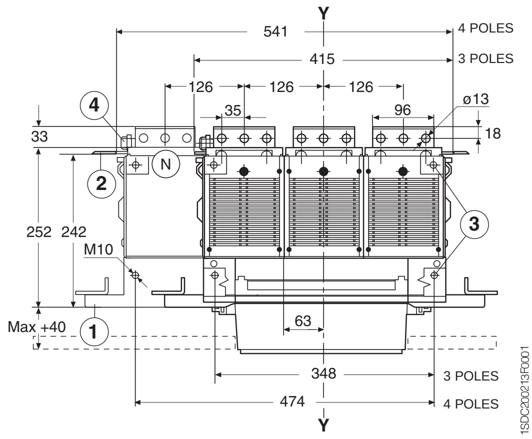
E1/E2

View A



E3

View A



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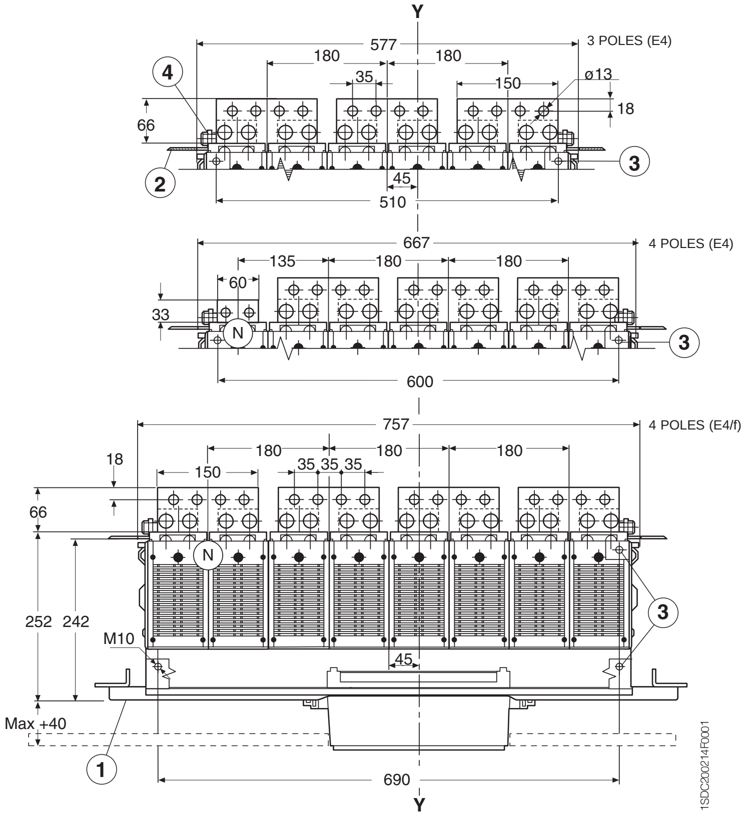
	A	B	C	D	E	F	G
E1	386	296	148	148	10	130	117.5
E2	386	296	148	148	26	114	117.5
E3	530	404	202	202	26	114	117.5
E4	656	566	238	328	26	166	91.5
E4/f	746	-	-	328	26	166	91.5
E6	908	782	328	454	26	166	91.5
E6/f	1034	-	-	454	26	166	91.5

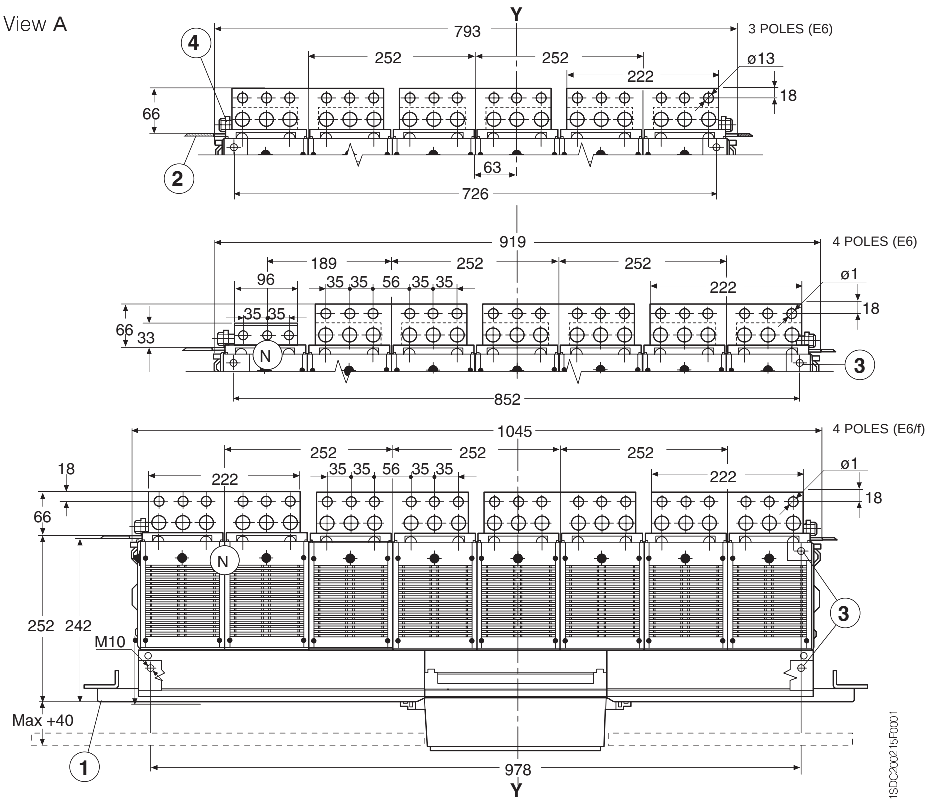
E4

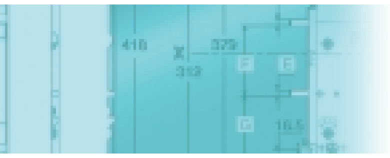
View A



E6

View A



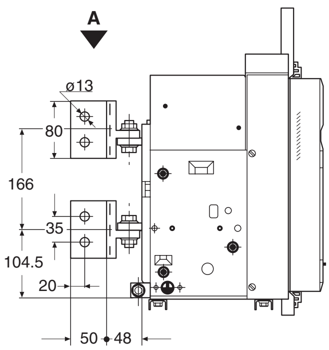


Overall dimensions

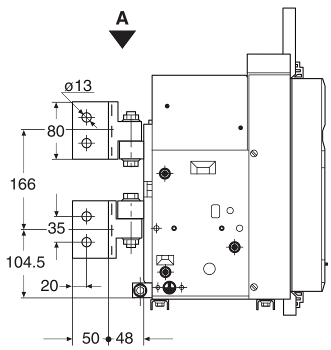
Fixed circuit-breaker

Basic version with vertical rear terminals

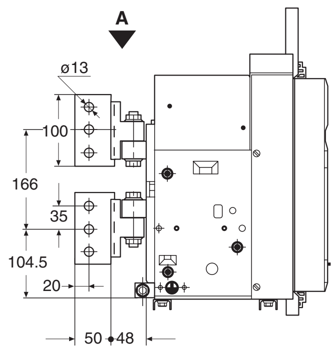
E1



E2/E4

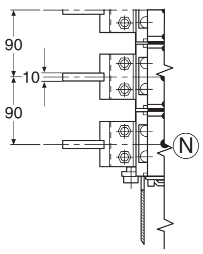


E3/E6



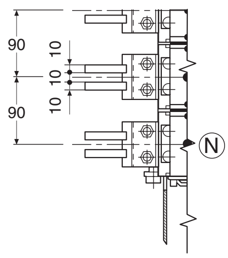
E1

View A



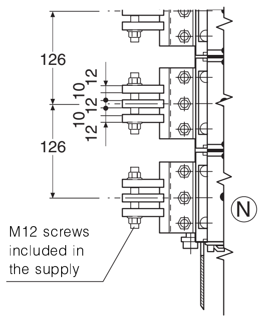
E2

View A



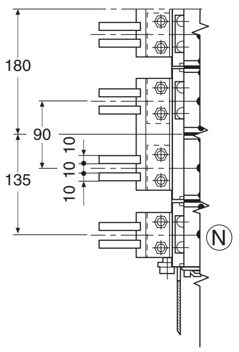
E3

View A



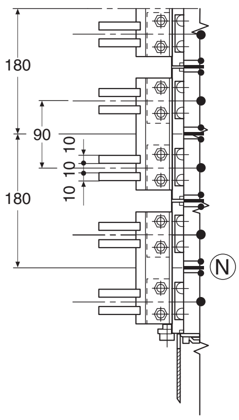
E4

View A



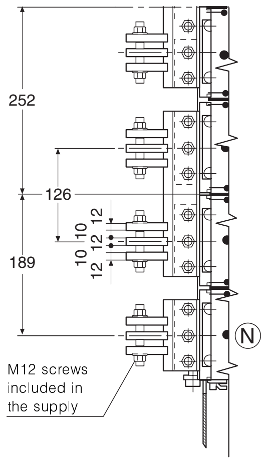
E4/f

View A



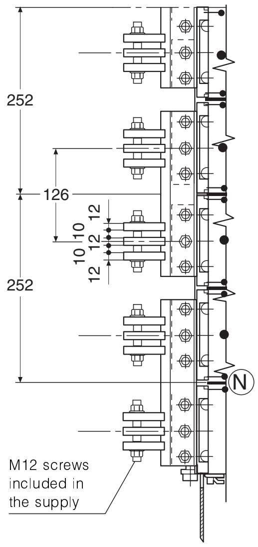
E6

View A



E6/f

View A



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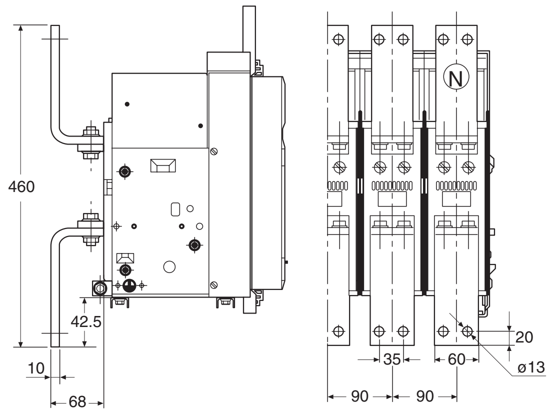
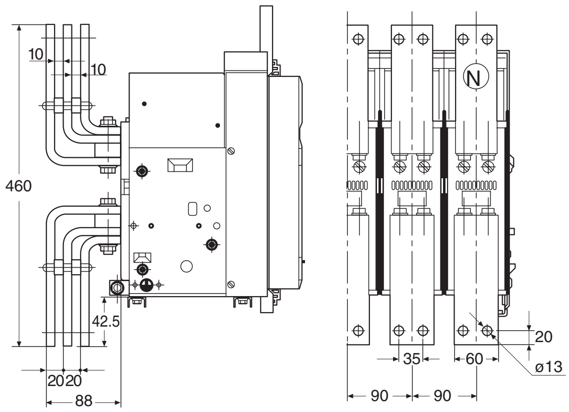
Version with front terminals

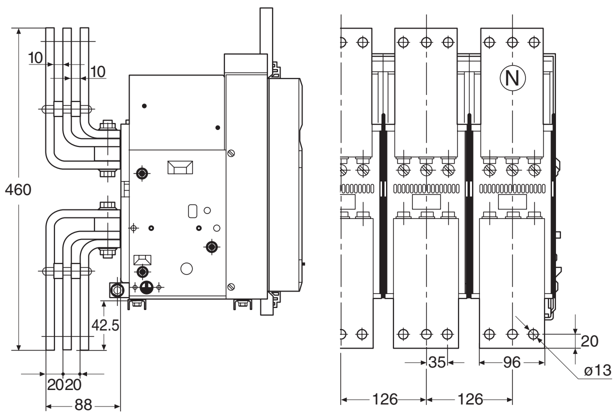
E1



E2



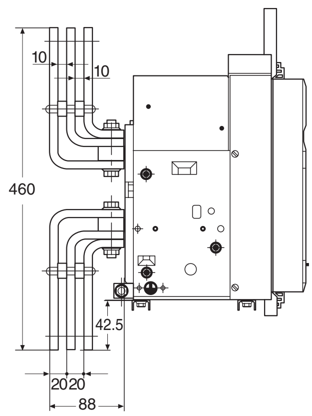
E3



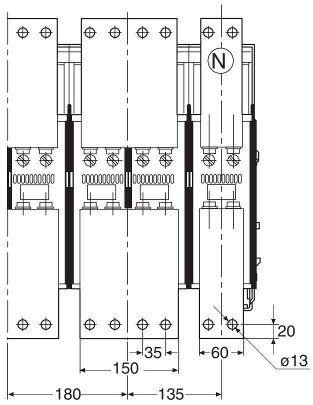
7

Version with front terminals

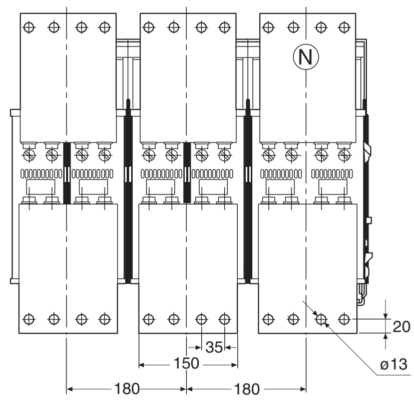
E4



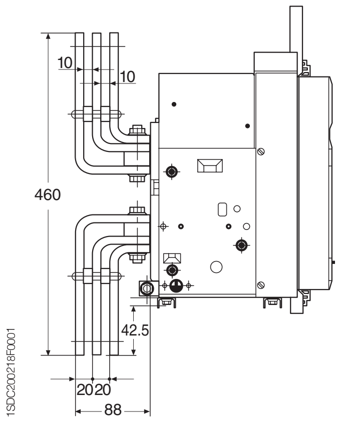
E4



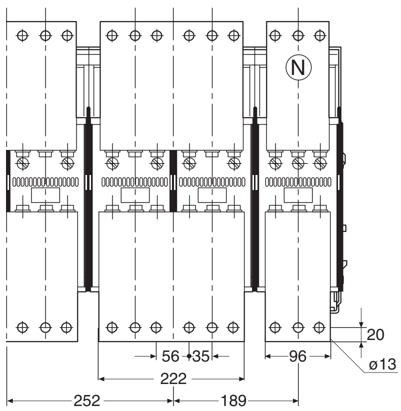
E4/f



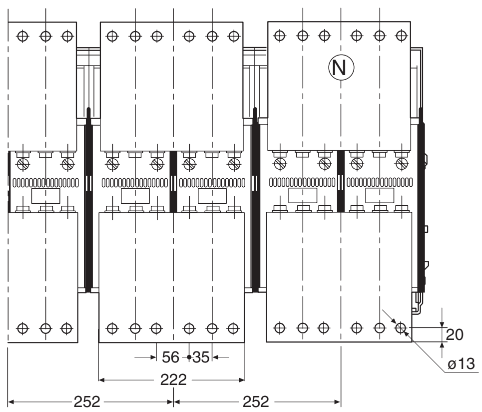
E6



E6



E6/f



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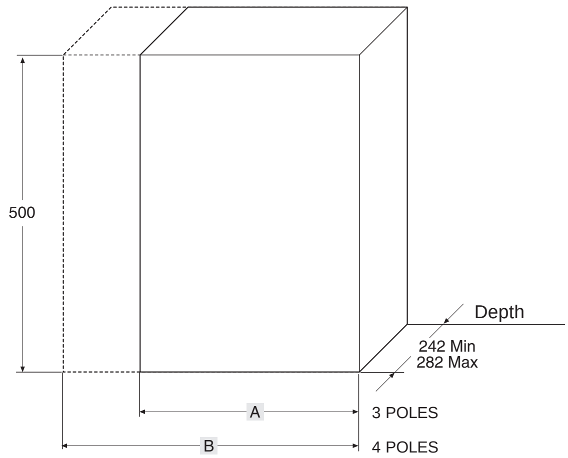
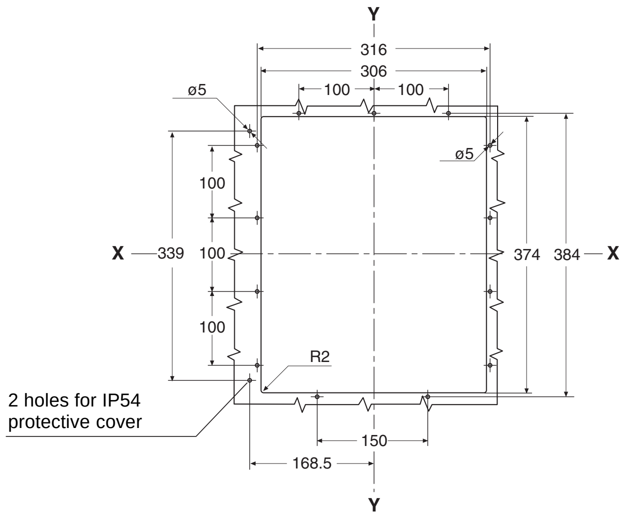
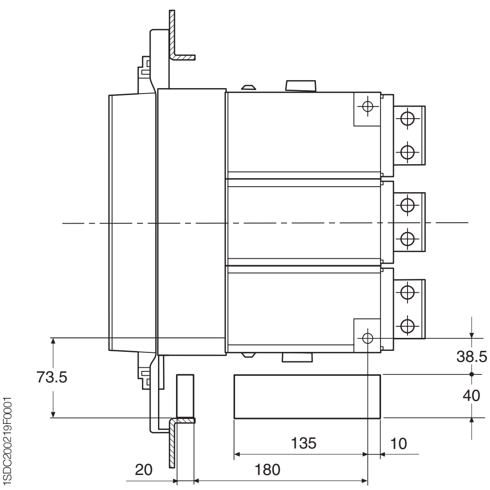
Compartment dimensions



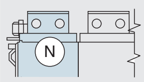
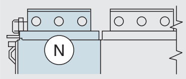
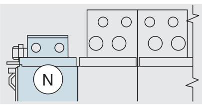
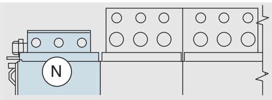
Drilling of compartment door



Through-holes for flexible cables for mechanical interlocks



Tightening torque for main terminals Nm 70
Tightening torque for earthing screw Nm 70

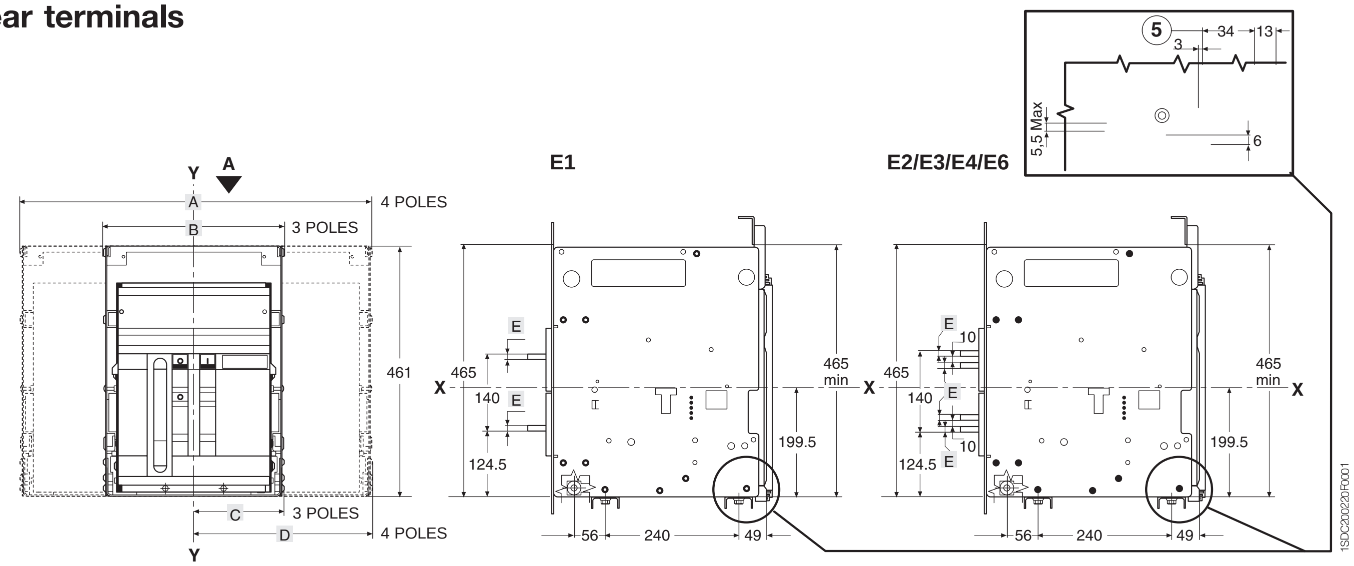
		High strength M12 screw Number per terminal	
		PHASE	NEUTRAL
	E1-E2	2	2
	E3	3	3
	E4-E4/f	4	2
	E6-E6/f	6	3

	A	B
E1	400	490
E2	400	490
E3	500	630
E4	700	790
E4/f	-	880
E6	1000	1130
E6/f	-	1260

Overall dimensions

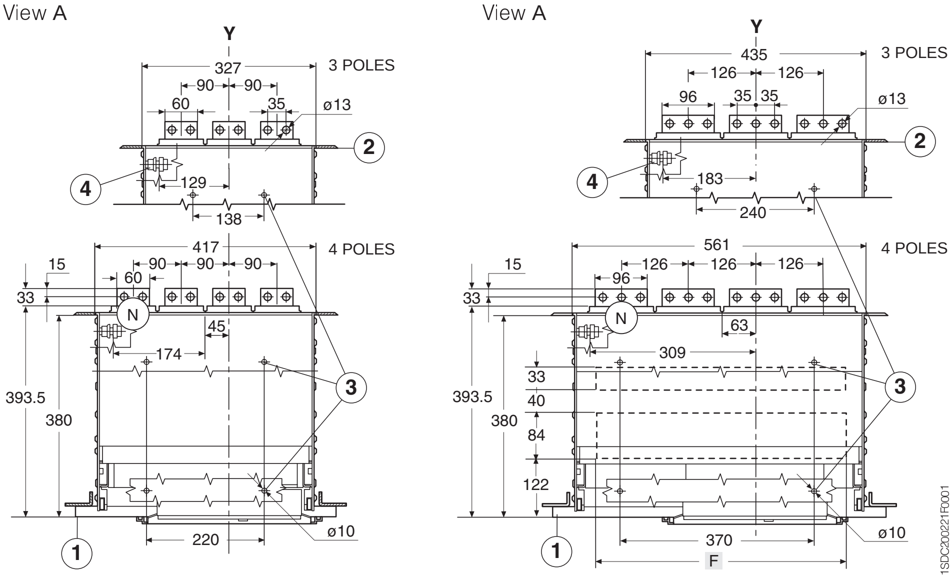
Withdrawable circuit-breaker

Basic version with horizontal rear terminals



Caption

1. Inside edge of compartment door
2. Segregation (when provided)
3. Ø10 mounting holes for fixed part (use M8 screws)
4. 1x M12 screw (E1, E2, E3) or 2xM12 screws (E4, E6) for earthing (included in the supply)
5. Travel from connected for testing to isolated

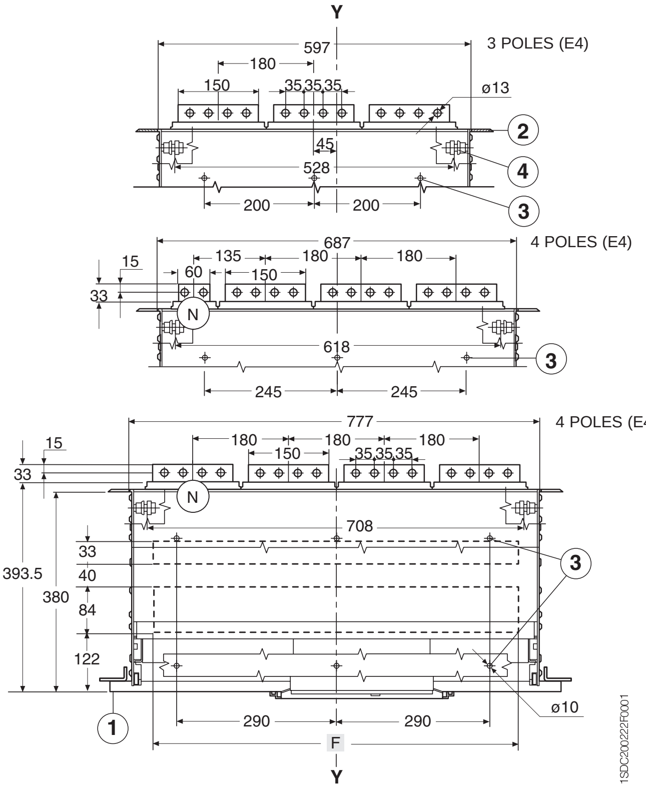


	A	B	C	D	E	F	
						3 poles	4 poles
E1	414	324	162	162	10	–	–
E2	414	324	162	162	8	–	–
E3	558	432	216	216	8	370	490
E4	684	594	252	342	8	530	610
E4/f	774	-	-	432	8	–	700
E6	936	810	342	468	8	750	870
E6/f	1062	-	-	594	8	-	1000

7

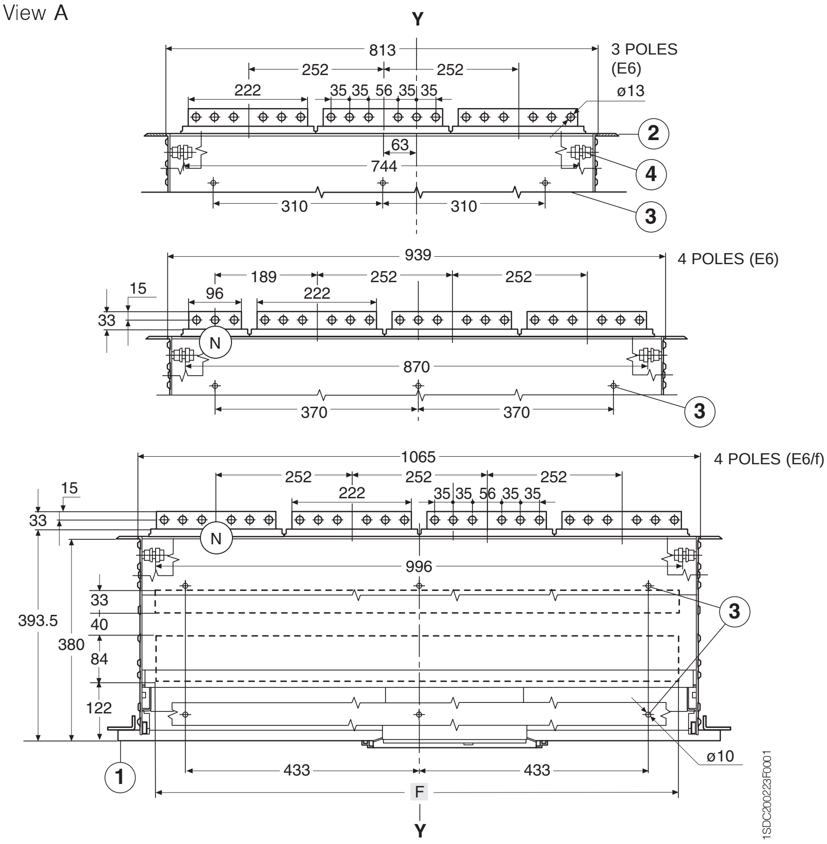
E4

View A



E6

View A



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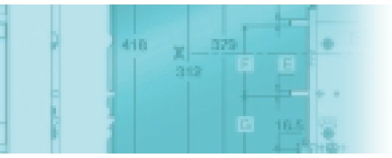
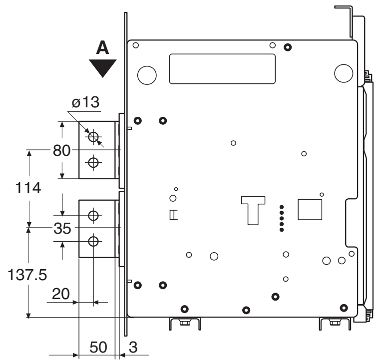


Overall dimensions

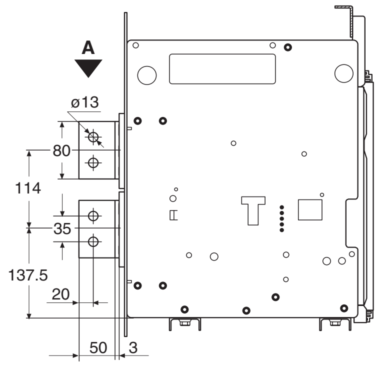
Withdrawable circuit-breaker

Basic version with vertical rear terminals

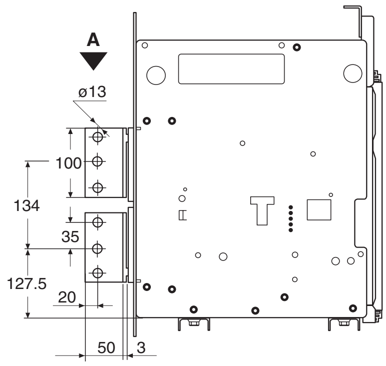
E1



E2/E4

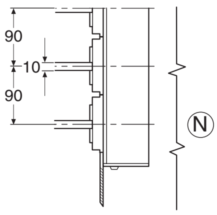


E3/E6



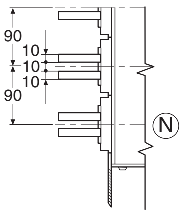
E1

View A



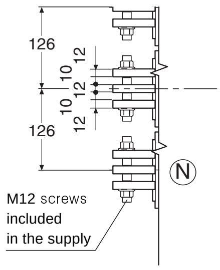
E2

View A



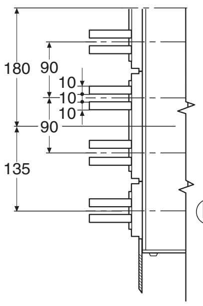
E3

View A



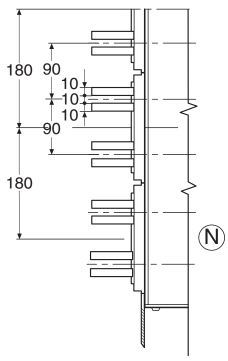
E4

View A



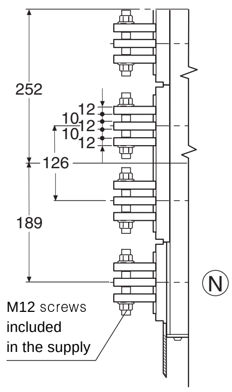
E4/f

View A



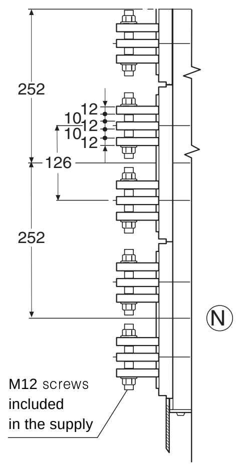
E6

View A



E6/f

View A



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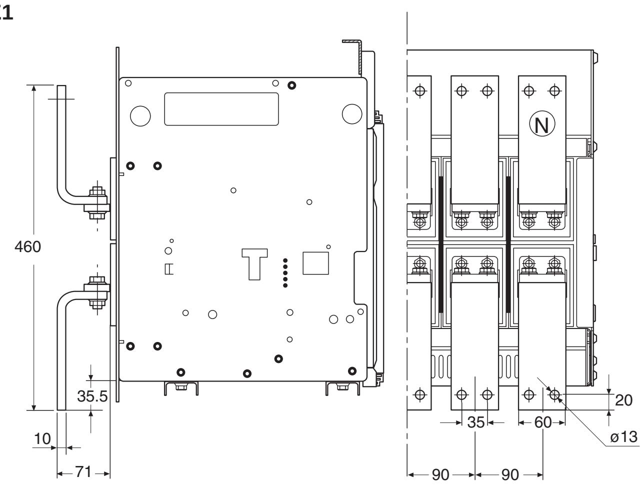
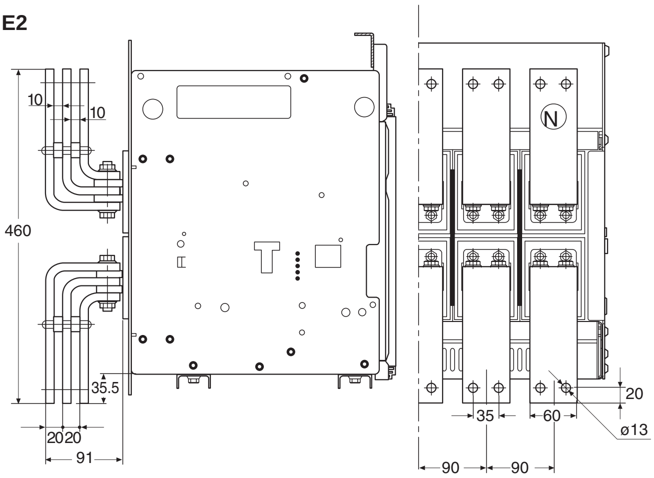
Version with front terminals

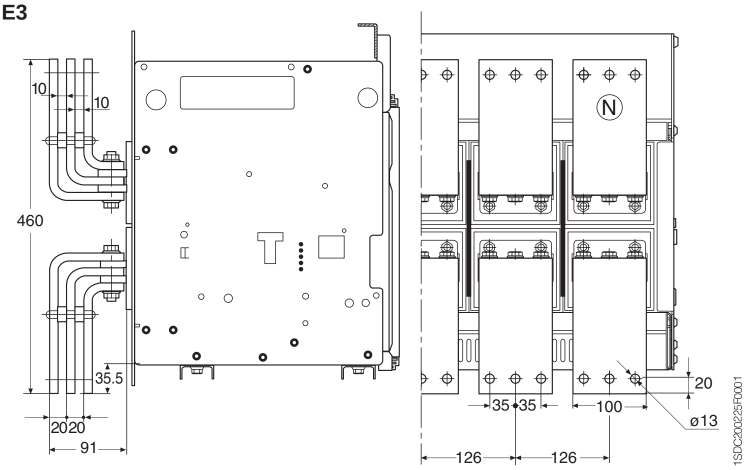
E1

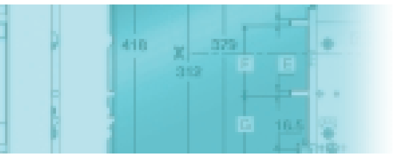


E2



E3



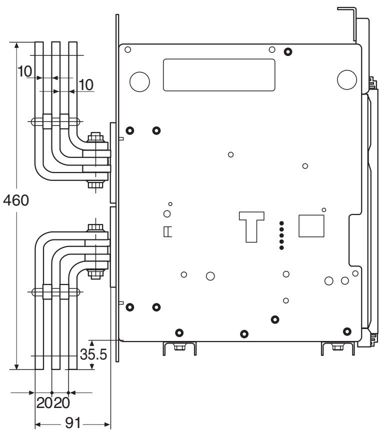


Overall dimensions

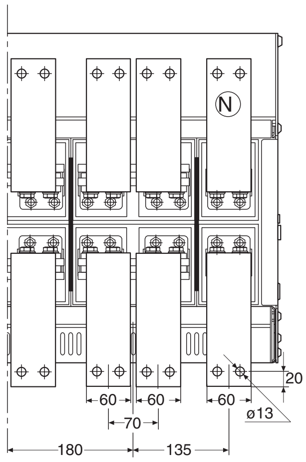
Withdrawable circuit-breaker

Version with front terminals

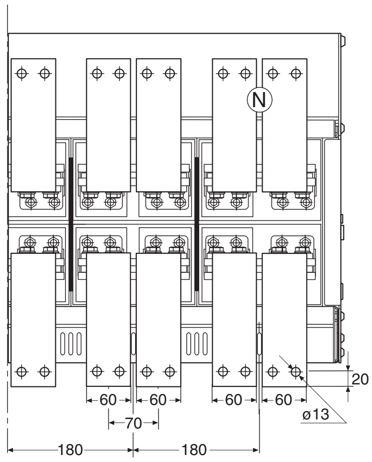
E4



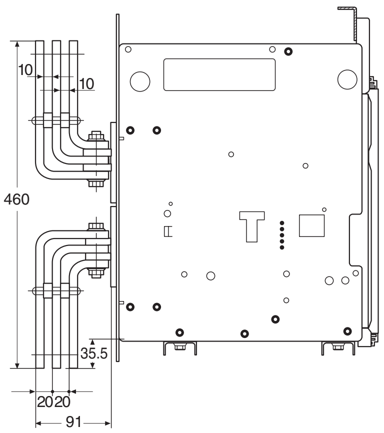
E4



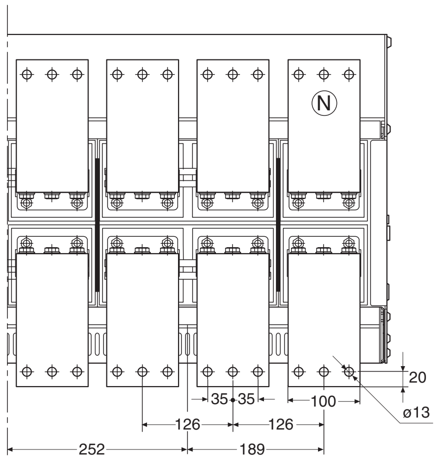
E4/f



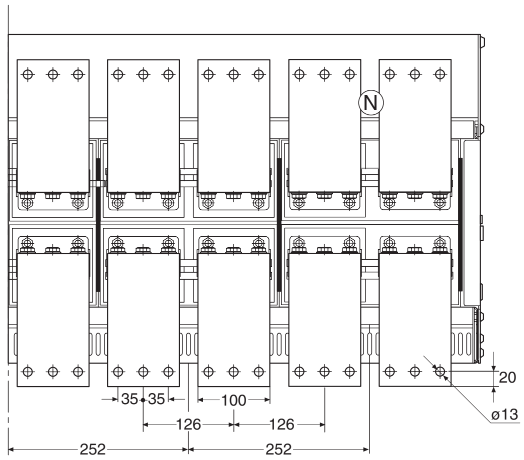
E6



E6



E6/f

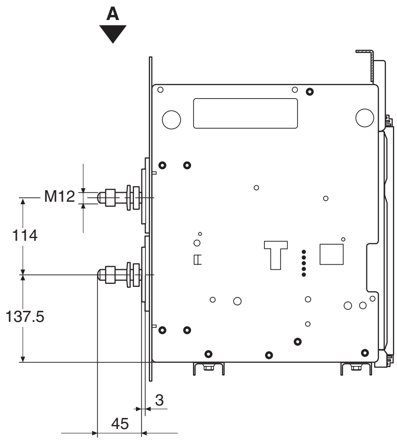


1SDC200226F0001

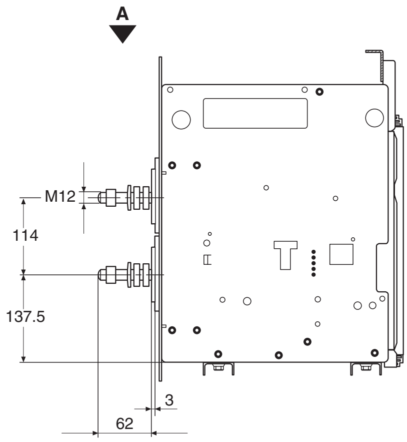
7

Version with front terminals

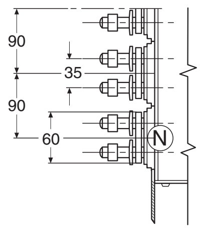
E1



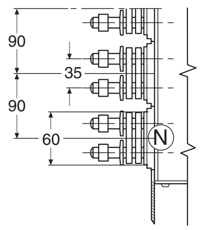
E2



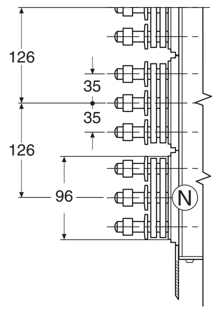
E1
View A



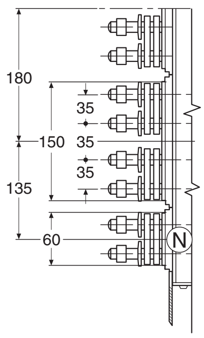
E2
View A



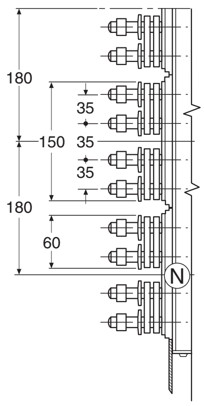
E3
View A



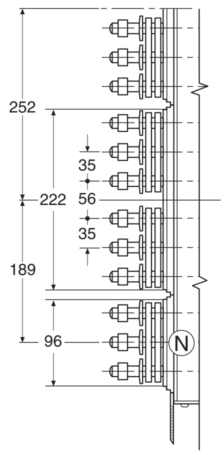
E4
View A



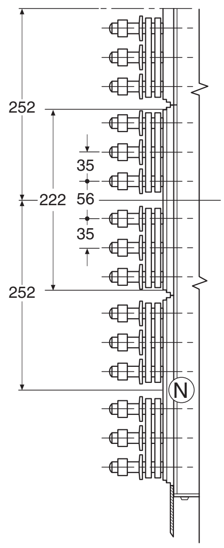
E4/f
View A



E6
View A



E6/f
View A



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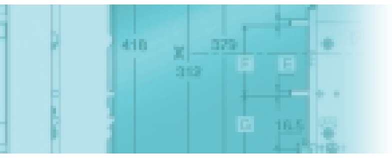
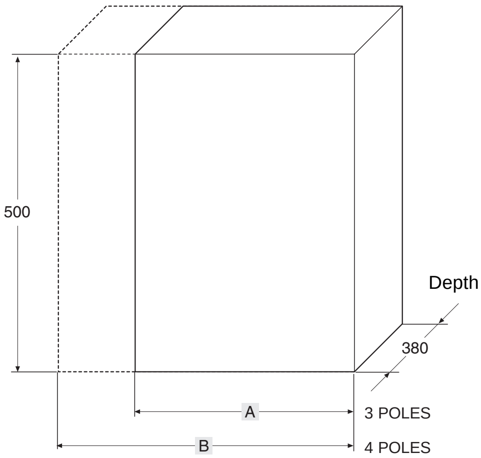


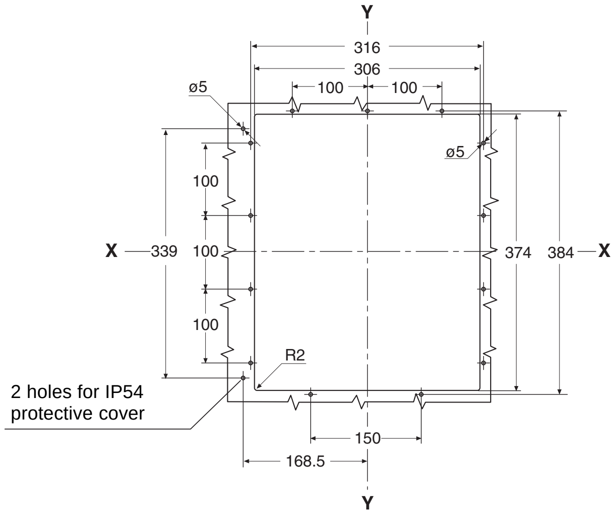
Overall dimensions

Withdrawable circuit-breaker

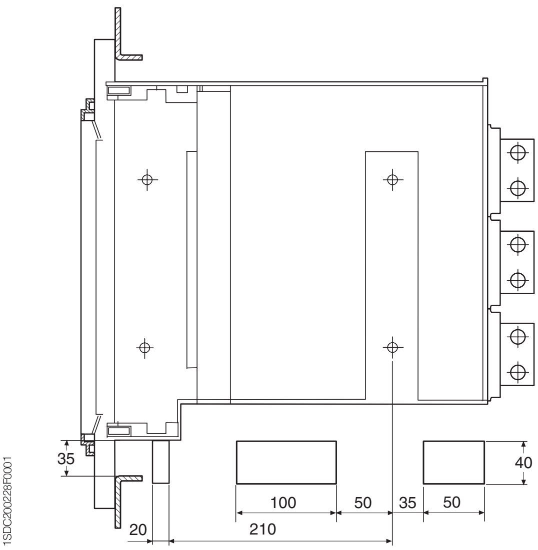
Compartment dimensions



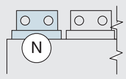
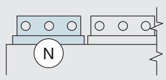
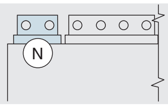
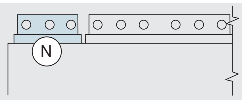
Drilling of compartment door



Through-holes for flexible cables for mechanical interlocks



Tightening torque for fastening screws Nm 20
Tightening torque for main terminals Nm 70
Tightening torque for earthing screw Nm 70

		High strength M12 screw Number per terminal	
		PHASE	NEUTRAL
	E1-E2	2	2
	E3	3	3
	E4-E4/f	4	2-4
	E6-E6/f	6	3-6

	A	B
E1	400	490
E2	400	490
E3	500	630
E4	700	790
E4/f	-	880
E6	1000	1130
E6/f	-	1260

Overall dimensions

Mechanical interlock

Interlock assembly

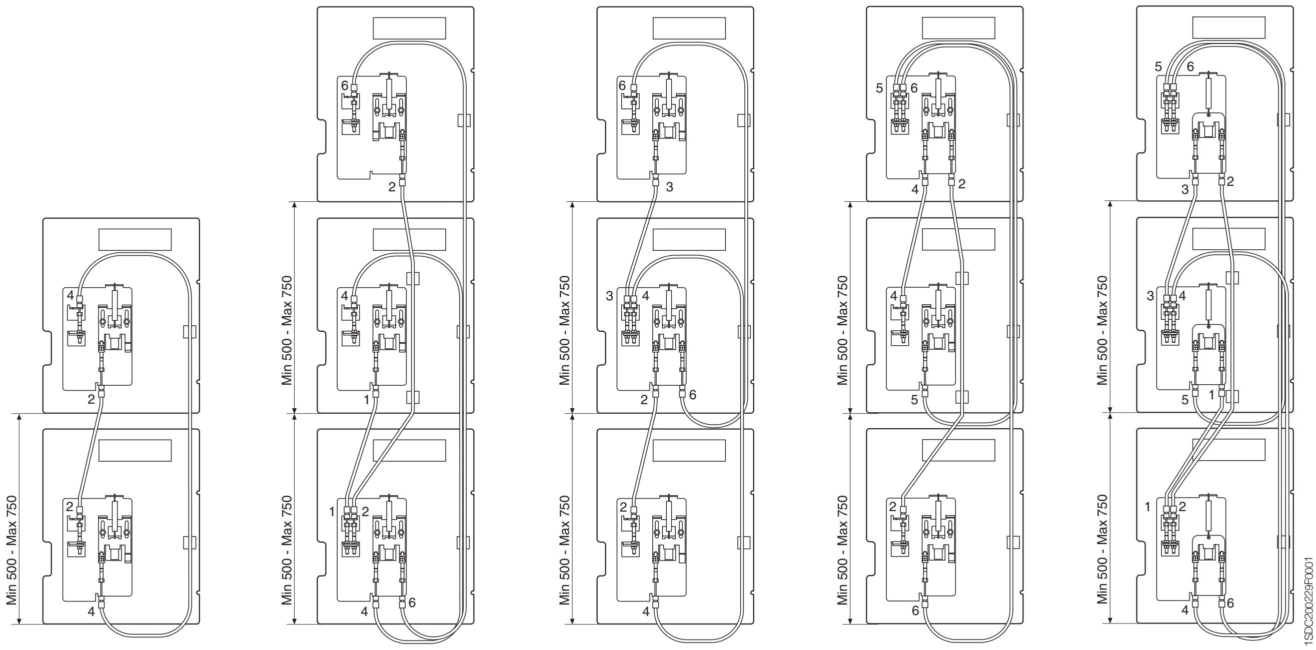
Type A
Horizontal
Vertical

Type B
(emergency interlock below)
Horizontal Vertical

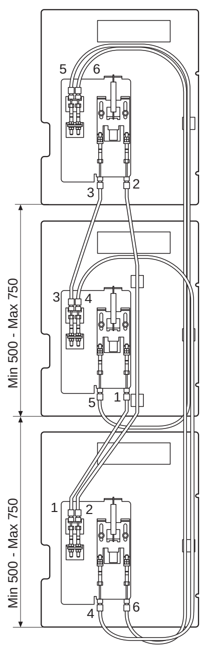
Type B
(emergency interlock in the middle)
Horizontal Vertical

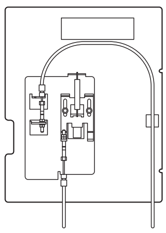
Type B
(emergency interlock above)
Horizontal Vertical

Type C
Horizontal Vertical

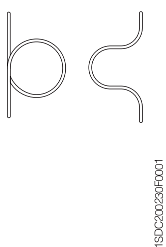


Type D
Horizontal Vertical





Horizontal interlocks
Maximum distance between two interlocks 1200 mm from one interlock to the other. The cables pass under the fixed parts, following the same connection layout shown for vertical circuit-breakers.



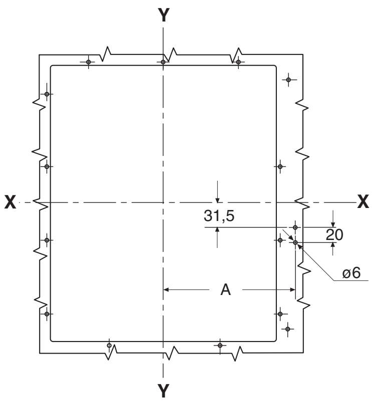
Take up the excess cable by making it go through one complete turn only or an omega as shown in the figure.

Notes
When fitting interlocks between two circuit-breakers, it is necessary to make suitable holes (through the switchboard) in the mounting surface for fixed circuit-breakers or for the fixed part of withdrawable circuit-breakers in order to pass through the flexible cables, observing the measurements shown in the figures on pages 7/7 and 7/14.
For vertical interlocks, align the right-hand sides vertically and reduce the bends in the flexible cables to a minimum (radius R. 70 mm). All the angle values of the bends which the cable passes through added together must not exceed 720°.

7

Mechanical compartment door lock

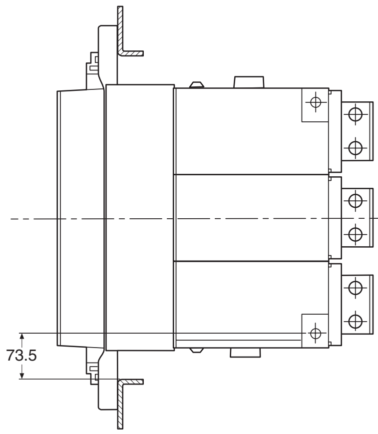
Holes in compartment door



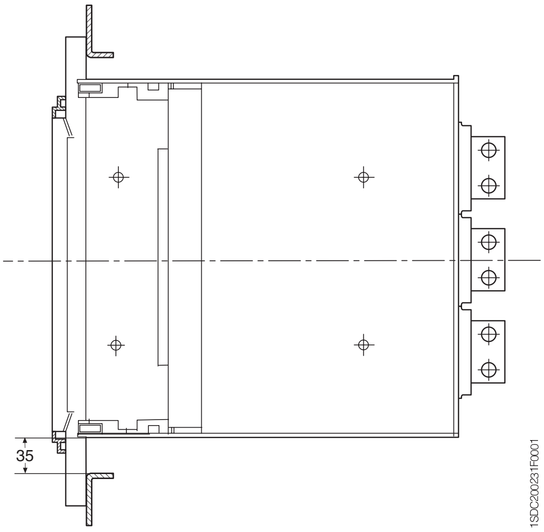
	A 3 POLES	A 4 POLES
E1	180	180
E2	180	180
E3	234	234
E4	270	360
E4/f	-	360
E6	360	486
E6/f	-	486

Minimum distance between circuit-breaker and switchboard wall

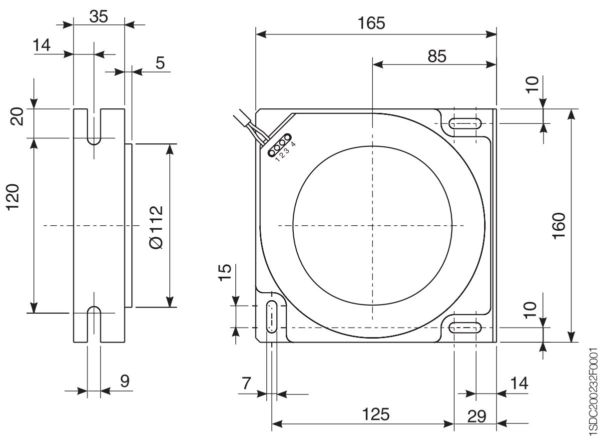
Fixed version



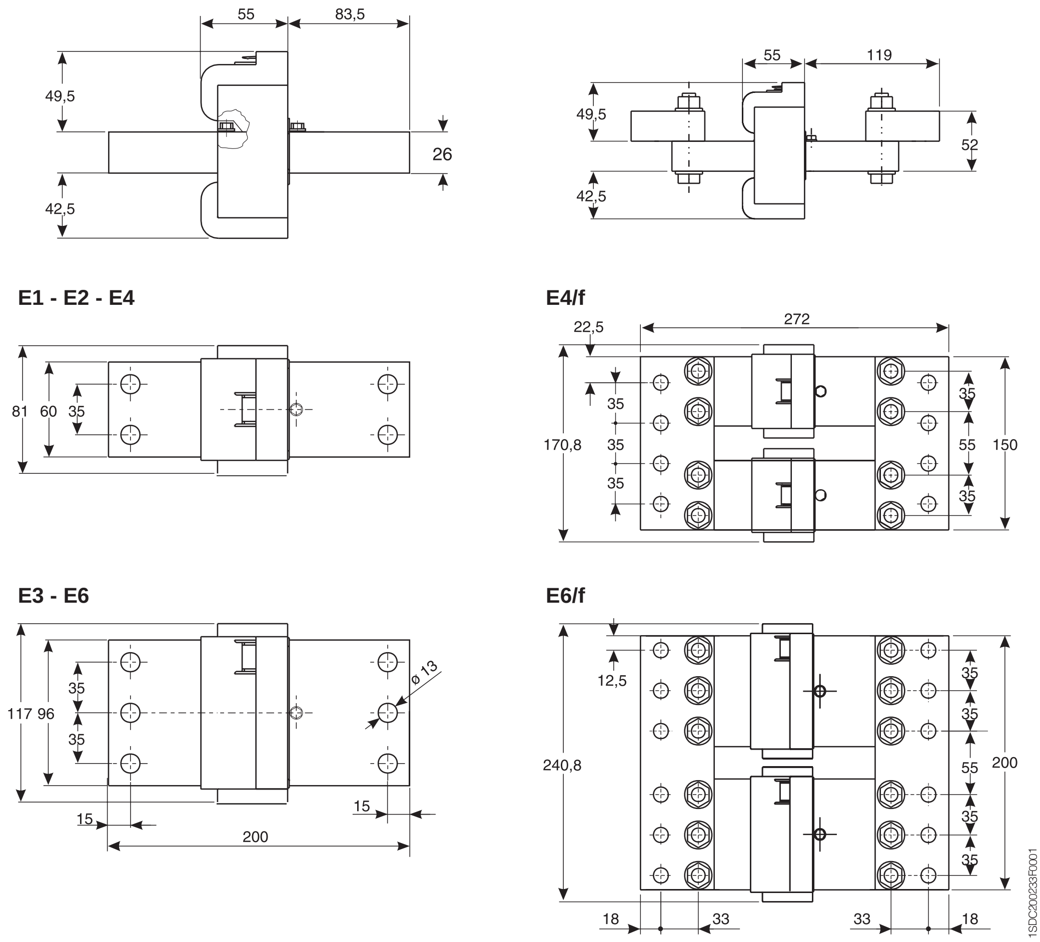
Withdrawable version

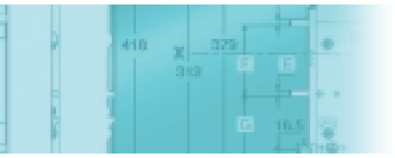


Homopolar toroid



Current transformer for the external neutral



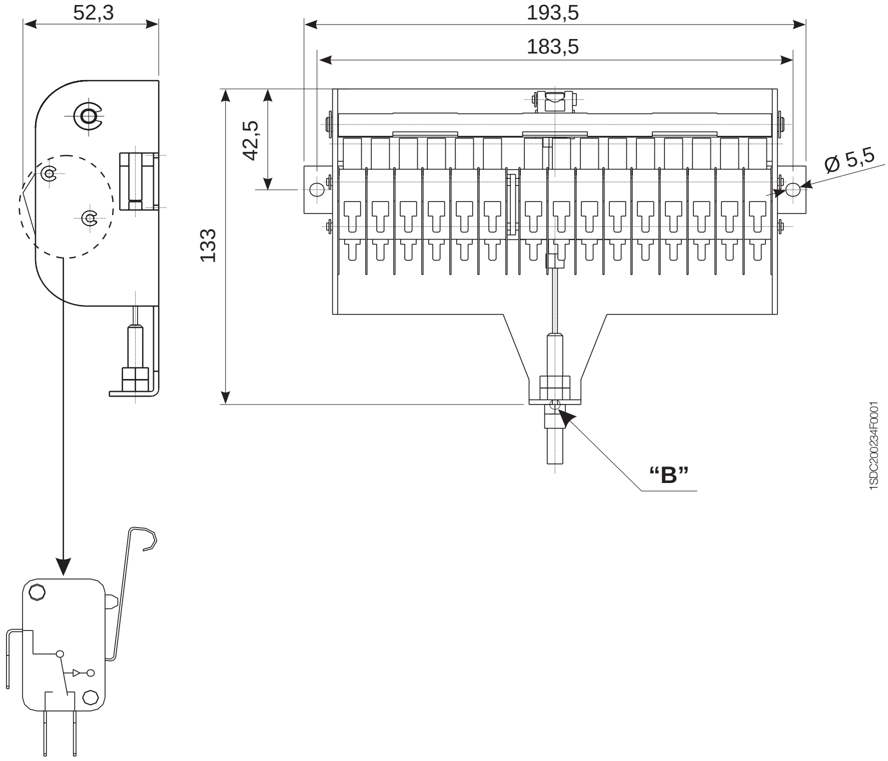


Overall dimensions

Circuit-breaker accessories

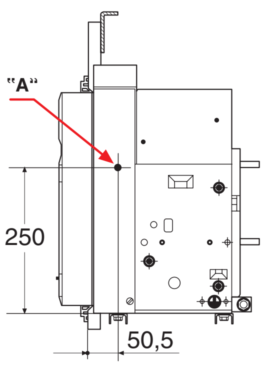
Electrical signalling of circuit-breaker open/closed

15 supplementary auxiliary contacts

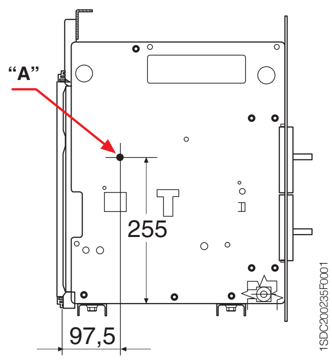


A flexible cable 650 mm long is available from point "A" to point "B".

Fixed version

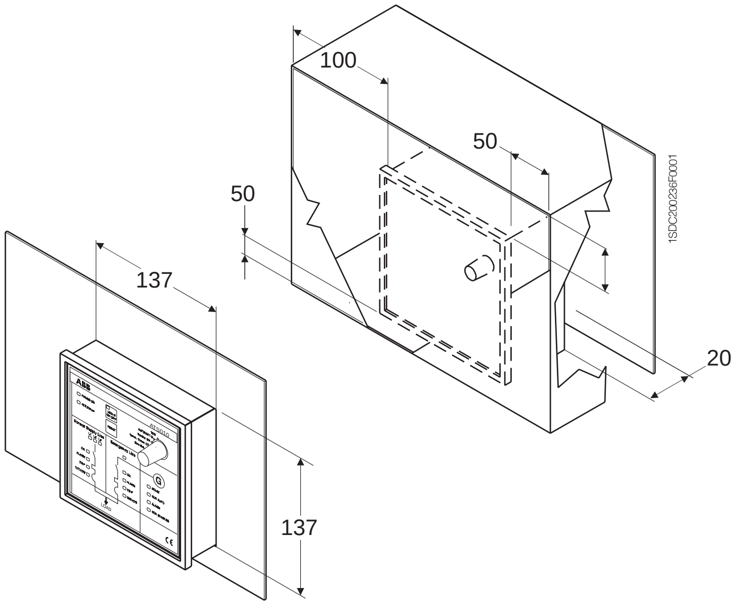


Withdrawable version

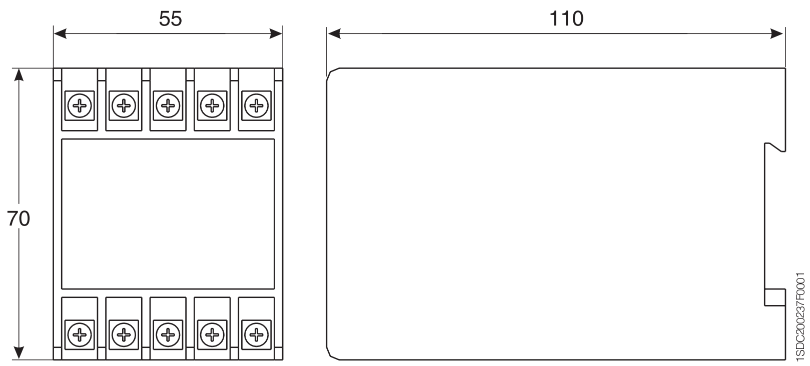


7

ATS010

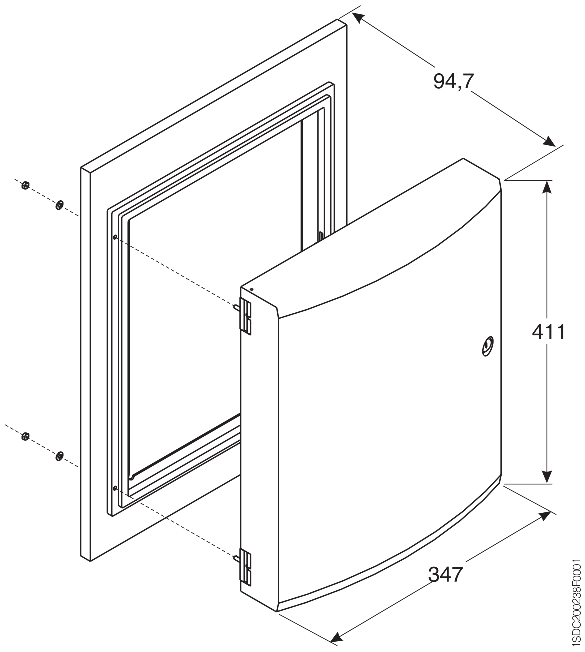


Electronic time-delay device

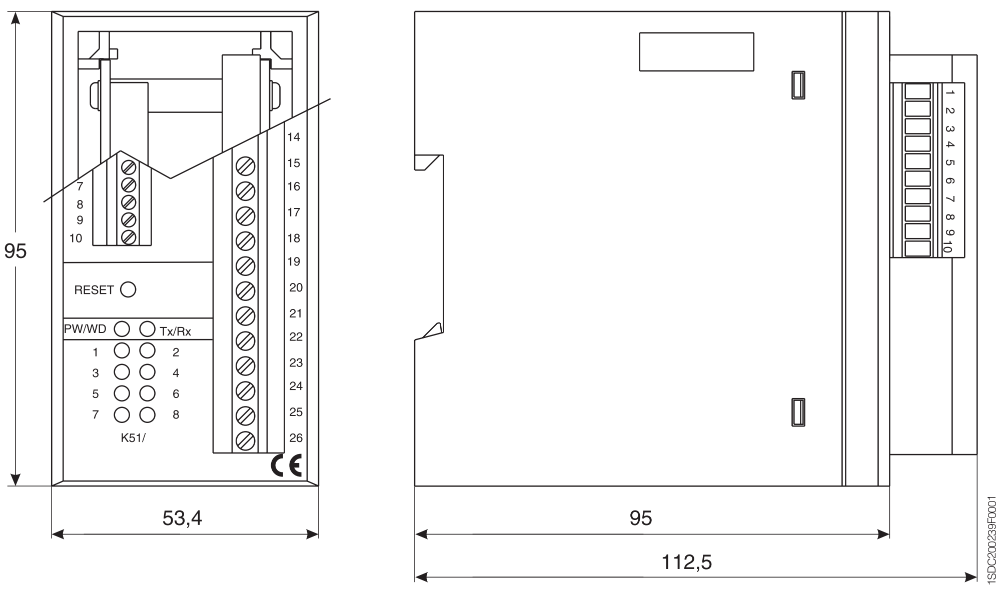


7

IP54 Protective cover

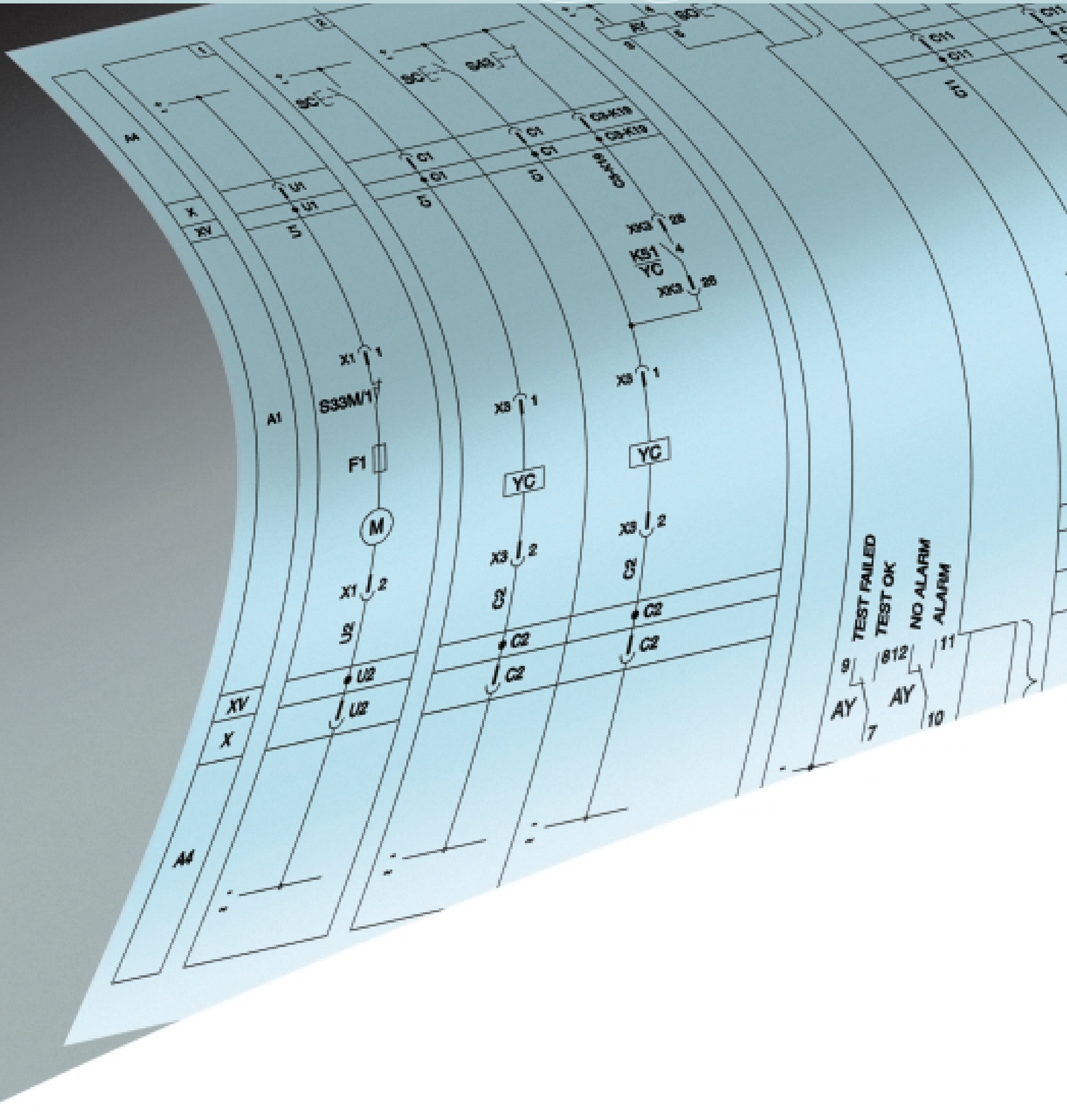


PR020/K Unit



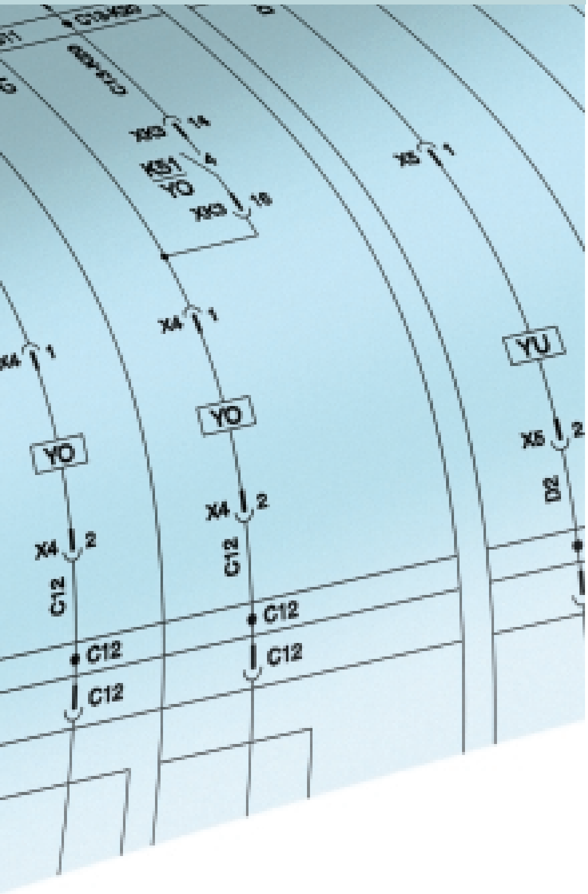
7

Emax



A4
X
XV
A1
S33M/1
F1
M
YC
K51
YC
XV
X
A4
TEST FAILED
TEST OK
NO ALARM
ALARM
AY
AY

Circuit diagrams



Contents

Circuit diagrams

Reading information - circuit-breakers

Operating status shown of the circuit-breakers

The circuit diagram is for the following conditions:
– withdrawable circuit-breaker, open and racked-in
– circuits de-energised
– releases not tripped
– motor operating mechanism with springs discharged.

Versions

The diagram shows a withdrawable circuit-breaker, but is also valid for fixed circuit-breakers.

Fixed version
The control circuits are between terminals XV (connector X is not supplied).
With this version, the applications indicated in figures 31, 32, and 51 cannot be provided.

Withdrawable version
The control circuits are between the poles of connector X (terminal box XV is not supplied).
With this version, the application shown in figure 52 cannot be supplied.

Version without overcurrent release
With this version, the applications shown in figures 3, 5, 13, 41, 42, 43, 44, 51, 52, 53, 62 cannot be supplied.

Version with PR111 microprocessor-based release
The PR111 overcurrent release is fitted with the protection unit only.
With this version, the applications shown in figures 3, 5, 41, 42, 43, 44, 53, 62 cannot be supplied.

Version with PR112/P microprocessor-based release
The PR112/P overcurrent release is fitted with the protection unit only.
With this version, the applications shown in figures 3, 5, 22, 42, 43, 44, 53 cannot be supplied.

Version with PR112/PD microprocessor-based release
The PR112/PD overcurrent release is fitted with the protection and dialogue unit.
With this version, the applications shown in figures 22, 41, 43, 44, 53 cannot be supplied.

Version with PR113/P microprocessor-based release
The PR113/P overcurrent release is fitted with the protection unit only.
With this version, the applications shown in figures 3, 5, 22, 41, 42, 44 cannot be supplied.

Version with PR113/PD microprocessor-based release
The PR113/PD overcurrent release is fitted with the protection and dialogue unit.
With this version, the applications shown in figures 22, 41, 42, 43 cannot be supplied.

Caption

□	=	Figure number of diagram
*	=	See the note indicated by the letter
A1	=	Circuit-breaker applications
A13	=	PR020/K Signalling unit (available only with release PR112/P, PR112/PD, PR113/P or PR113/PD)
A3	=	Applications located on the fixed part of the circuit-breaker (available only with withdrawable circuit-breakers)
A4	=	Examples of switchgear and connections for control and signalling, outside the circuit-breaker
AY	=	SACE SOR TEST UNIT Test/monitoring Unit (see note R)
D	=	Electronic time-delay device of the undervoltage release, outside the circuit-breaker
F1	=	Delayed-trip fuse
K51	=	PR111, PR112/P, PR112/PD, PR113/P or PR113/PD microprocessor-based overcurrent release with the following protection functions (see note G): - L overload protection with inverse long time-delay trip - setting I1 - S short-circuit protection with inverse or definite short time-delay trip - setting I2 - I short-circuit protection with instantaneous trip - setting I3 - G earth fault protection with inverse short time-delay trip - setting I4
K51/µP	=	Electrical signalling of alarm due to microprocessor operating faults (only with Uaux. and PR112/P, PR112/PD, PR113/P or PR113/PD release)
K51/1...8	=	Contacts of the PR020/K signalling unit
K51/GZin (DBin)	=	Zone selectivity: input for protection G or “reverse” direction input for protection D (only with Uaux. and PR113/P or PR113/PD release)
K51/GZout (DBout)	=	Zone selectivity: output for protection G or “reverse” direction output for protection D (only with Uaux. and PR113/P or PR113/PD release)
K51/P1	=	Programmable electrical signalling (only with Uaux. and PR112/P, PR112/PD, PR113/P or PR113/PD release)
K51/P2	=	Programmable electrical signalling (only with Uaux. and PR113/P release)
K51/SZin (DFin)	=	Zone selectivity: input for protection S or “direct” input for protection D (only with Uaux. and PR113/P or PR113/PD release)

K51/SZout (DFout)	=	Zone selectivity: output for protection S or “direct” output for protection D (only with Uaux. and PR113/P or PR113/PD release)
K51/YC	=	Closing control from PR112/PD or PR113/PD microprocessor-based release
K51/Y0	=	Opening control from PR112/PD or PR113/PD microprocessor-based release
K51/Y01	=	Electrical alarm signal for release Y01 TRIPPED (only with release PR112/P, PR112/PD, PR113/P or PR113/PD)
K51/Zin	=	Zone selectivity: input (only with Uaux. and PR112/P or PR112/PD release)
K51/Zout	=	Zone selectivity: output (only with Uaux. and PR112/P or PR112/PD release)
M	=	Motor for charging the closing springs
Q	=	Circuit-breaker
Q/1...25	=	Auxiliary contacts of the circuit-breaker
S33M/1	=	Limit contact of the spring charging motor
S33M/2	=	Contact for the electrical signal of springs charged
S43	=	Switch for setting remote/local control
S51	=	Contact for the electrical signal of circuit-breaker open due to overcurrent release tripped. The circuit-breaker can only be closed after the reset pushbutton has been pressed.
S75E/14	=	Contacts for the electrical signal of circuit-breaker in racked-out position (only with withdrawable circuit-breakers)
S75I/14	=	Contacts for the electrical signal of circuit-breaker in racked-in position (only with withdrawable circuit-breakers)
S75T/14	=	Contacts for the electrical signal of circuit-breaker in test isolated position (only with withdrawable circuit-breakers)
SC	=	Pushbutton or contact for closing the circuit-breaker
SO	=	Pushbutton or contact for opening the circuit-breaker
SO1	=	Pushbutton or contact for opening the circuit-breaker with delayed trip
SO2	=	Pushbutton or contact for opening the circuit-breaker with instantaneous trip
TI/L1	=	Current transformer located on phase L1
TI/L2	=	Current transformer located on phase L2
TI/L3	=	Current transformer located on phase L3
TI/N	=	Current transformer located on neutral
TI/O	=	Homopolar current transformer located on the conductor that links the transformer star center MV/LV to earth (see note G)
TU	=	Insulating transformer
Uaux.	=	Auxiliary power supply voltage (see note F)
UI/L1	=	Current sensor (Rogowski coil) located on phase L1
UI/L2	=	Current sensor (Rogowski coil) located on phase L2
UI/L3	=	Current sensor (Rogowski coil) located on phase L3
UI/N	=	Current sensor (Rogowski coil) located on neutral
W1	=	Serial interface with the control system (external bus): EIA RS485 interface (see note E)
W2	=	Serial interface with the accessories of PR112/P, PR112/PD, PR113/P and PR113/PD releases (internal bus)
X	=	Delivery connector for auxiliary circuits of the withdrawable circuit-breaker
X1...X7	=	Connectors for circuit-breaker applications
XF	=	Delivery terminal box for the position contacts of the withdrawable circuit-breaker (located on the fixed part of the circuit-breaker)
XK1	=	Connector for the power circuits of the PR111, PR112/P, PR112/PD, PR113/P and PR113/PD releases
XK2 - XK3	=	Connectors for the auxiliary circuits of the PR112/P, PR112/PD, PR113/P and PR113/PD releases
XO	=	Connector for the release YO1
XV	=	Delivery terminal box for the auxiliary circuits of the fixed circuit-breaker
YC	=	Closing release
YO	=	Opening release
YO1	=	Overcurrent shunt opening release
YO2	=	Second shunt opening release (see note Q)
YU	=	Undervoltage release (see notes B and Q)

Circuit diagrams

Reading information - circuit-breakers

Description of figures

Fig. 1 = Motor circuit to charge the closing springs
Fig. 2 = Closing release circuit
Fig. 3 = Closing release circuit controlled by the dialogue unit of the PR112/PD or PR113/PD release
Fig. 4 = Opening release
Fig. 5 = Opening release circuit controlled by the dialogue unit of the PR112/PD or PR113/PD release
Fig. 6 = Instantaneous undervoltage release (see notes B and Q)
Fig. 7 = Undervoltage release with electronic time-delay device, outside the circuit-breaker (see notes B and Q)
Fig. 8 = Second shunt opening release (see note Q)
Fig. 11 = Contact for the electrical signal of springs charged.
Fig. 12 = Contact for the electrical signal of undervoltage release energized (see notes B, L and S)
Fig. 13 = Contact for the electrical signal of circuit-breaker open due to overcurrent release tripped. The circuit-breaker can only be closed after the reset pushbutton has been pressed.
Fig. 21 = First set of circuit-breaker auxiliary contacts
Fig. 22 = Second set of circuit-breaker auxiliary contacts (not available with PR112/P, PR112/PD, PR113/P and PR113/PD releases).
Fig. 23 = Third set of supplementary auxiliary contacts outside the circuit-breaker
Fig. 31 = First set of contacts for the electrical signal of circuit-breaker in racked-in, test isolated, racked-out position
Fig. 32 = Second set of contacts for the electrical signal of circuit-breaker in racked-in, test isolated, racked-out position
Fig. 41 = Auxiliary circuits of the PR112/P release (see note F)
Fig. 42 = Auxiliary circuits of the PR112/PD release (see notes D, F and M)
Fig. 43 = Auxiliary circuits of the PR113/P release (see note F)
Fig. 44 = Auxiliary circuits of the PR113/PD release (see notes F and M)
Fig. 51 = Circuit of current transformer on neutral conductor outside circuit-breaker, for withdrawable circuit-breaker
Fig. 52 = Circuit of current transformer on neutral conductor outside circuit-breaker, for fixed circuit-breaker (see note C)
Fig. 53 = Circuit valid for three-pole circuit-breaker with PR113/P or PR113/PD release without current transformer on neutral conductor outside circuit-breaker (see note H)
Fig. 61 = SACE SOR TEST UNIT test/monitoring unit (see note R)
Fig. 62 = PR020/K Signalling unit (only with PR112/P, PR112/PD, PR113/P or PR113/PD release)

Incompatibility

The circuits indicated in the following figures cannot be supplied simultaneously on the same circuit-breaker:
2 - 3
4 - 5
6 - 7 - 8
22 - 41 - 42 - 43 - 44
31 - 51
51 - 52 - 53

Notes

A) The circuit-breaker is only fitted with the applications specified in the ABB SACE order acknowledgement. Consult this catalogue for information on how to make out an order.

B) The undervoltage release is supplied for operation using a power supply branched on the supply side of the circuit-breaker or from an independent source. The circuit-breaker can only close when the release is energized (there is a mechanical lock on closing).
If the same power supply is used for the closing and undervoltage releases and the circuit-breaker is required to close automatically when the auxiliary power supply comes back on, a 30 ms delay must be introduced between the undervoltage release accept signal and the energizing of the closing release. This can be done by means of a circuit outside the circuit-breaker comprising a permanent make contact, the contact illustrated in figure 12 and a time-delay relay.

C) For fixed circuit-breakers with current transformers on the neutral conductors outside the circuit-breakers, the terminals of transformer TI/N must be short-circuited to remove the circuit-breaker.

D) Connect the contact S33M/2 shown in fig. 11, one of the make contacts and one of the break contacts of the circuit-breaker shown in fig. 21 as illustrated in fig. 42.

E) See the following documentation on how to connect the EIA RS485 serial line:
- RH0180 for LON communication
- RH0199 for MODBUS communication

F) The auxiliary voltage Uaux. allows actuation of all operations of the PR112/P, PR112/PD, PR113/P and PR113/PD releases. In this regard, refer to the corresponding user manuals.

G) Earth fault protection is available with the PR112/P, PR112/PD, PR113/P and PR113/PD releases by means of a current transformer located on the conductor connecting the star center of the MV/LV transformer to earth.
The connection between terminals 1 and 2 of the TI/O current transformer and poles T5 and T6 of connector X (or XV) must be made with a two-pole shielded and stranded cable (see user manual) no more than 15 m long. The shield must be earthed on the circuit-breaker side and current transformer side.

H) In the case of PR113/P or PR113/PD releases mounted on a three-pole circuit-breaker without connection to the external neutral, poles T3 and T4 of connector X (or XV) should be short-circuited by the customer.

I) The contact may not be used if the PR112/PD or PR113/PD unit is present.

L) The contact may not be used if the PR113/P or PR113/PD unit is present.

M) Connect one of the S75I contacts shown in fig. 31 or 51 as illustrated in fig. 42-44.
On fixed circuit-breakers, connect terminal XV-K14 directly to terminal XV-K16 (contact S75I does not exist).

N) Connections to the zone selectivity inputs and outputs on PR112/P, 112/PD, PR113/P e PR113/PD releases must be made using a two-pole shielded and stranded cable (see user manual) no more than 300m long. The shield must be earthed on the selectivity input side.

O) The connection between the voltage sensors (TV) and circuit-breaker on PR113/P and PR113/PD releases must be made using a two-pole shielded and stranded cable (see user manual) no more than 15m long.
The shield must be earthed on both sides (sensor and circuit-breaker).

P) The power supply of coils YO and YC must not be derived from the main power supply on PR112/PD and PR113/PD releases.
The coils may be controlled directly by contacts K51/YO and K51/YC with maximum voltages of 60VDC and 240-250VAC for PR112/PD, 240-250VDC and 240-250VAC for PR113/PD.

Q) The second opening release may be installed as an alternative to the undervoltage release.

R) The SACE SOR TEST UNIT + opening release (YO) is guaranteed to operate starting at 75% of the Uaux of the opening release itself.
While the YO power supply contact is closing (short-circuit on terminals 4 and 5), the SACE SOR TEST UNIT is unable to detect the opening coil status.
Thus:
- For continuously powered opening coil, the TEST FAILED and ALARM signals will be activated
- If the coil opening command is of the pulsing type, the TEST FAILED signal may appear at the same time. In this case, the TEST FAILED signal is actually an alarm signal only if it remains lit for more than 20s.

S) Also available in version with normally-closed contact.

T) Configuration valid for four-pole or three-pole circuit-breaker with external neutral. See the manual for additional installation configurations.

Rules to observe when replacing PR111/P, PR112/P, PR112/PD, PR113/P or PR113/PD releases:
– Pay careful attention to the notes provided on the circuit diagrams supplied
– The contact to electrically signal the undervoltage release energized (Fig. 12 of the enclosed diagrams) must be removed from the terminal box.

Circuit diagrams

Reading information - Automatic transfer-switch ATS010

Operating status shown of the Automatic transfer-switch ATS010

The circuit diagram is for the following conditions:
– circuit-breakers open and racked-in #
– generator not in alarm
– closing springs discharged
– overcurrent relays not tripped ⋆
– ATS010 not powered
– generator in automatic mode and not started
– generator switching enabled
– circuits de-energised
– logic enabled via input provided (terminal 47).

The present diagram shows withdrawable circuit-breakers, but is also valid for fixed circuit-breakers: the auxiliary circuits of the circuit-breakers do not connect to connector X but to terminal box XV; also connect terminal 17 to 20 and terminal 35 to 38 on the ATS010 device.

⋆ The present diagram shows circuit-breakers with overcurrent relays, but is also valid for circuit-breakers without overcurrent relays: connect terminal 18 to 20 and terminal 35 to 37 of the ATS010 device.

@The present diagram shows four-pole circuit-breakers but is also valid for two-pole circuit-breakers: use only terminals 26 and 24 (phase and neutral) for the voltage connection of the normal power supply to the ATS010 device; also use the Q61/2 two-pole rather than four-pole auxiliary protection circuit-breaker.

Caption

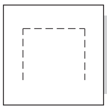
A1	=	Circuit-breaker applications
A	=	ATS010 device for automatic switching of two circuit-breakers
F1	=	Delayed-trip fuse
K1	=	Auxiliary contact for emergency power supply voltage present
K2	=	Auxiliary contact for normal supply voltage present
K51/Q1	=	Overcurrent relay of the emergency power supply line *
K51/Q2	=	Overcurrent relay of the normal power supply line *
M	=	Motor for charging the closing springs
Q/1	=	Auxiliary contact of the circuit-breaker
Q1	=	Emergency power supply line circuit-breaker
Q =		Normal power supply line circuit-breaker
Q61/1-2	=	Thermomagnetic circuit-breakers to isolate and protect the auxiliary circuits @
S11...S16	=	Signal contacts for the inputs of the ATS010 device
S33M/1	=	Limit contact of the closing springs
S51	=	Contact for the electrical signal of circuit-breaker open due to overcurrent relay tripped *
S75I/1	=	Contact for the electrical signal of withdrawable circuit-breaker racked-in #
TI/ ...	=	Current transformers for the overcurrent relay power supply
X	=	Connector for the auxiliary circuits of the withdrawable circuit-breaker
XF	=	Delivery terminal box for the position contacts of the withdrawable circuit-breaker
XV	=	Delivery terminal box for the auxiliary circuits of the fixed circuit-breaker
YC	=	Closing release
YO	=	Opening release

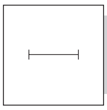
Note

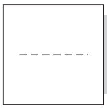
A) For the auxiliary circuits of the circuit-breakers, see the circuit diagram of the circuit-breaker/accessory. The applications shown in the following figures are required: 1 - 2 - 4 - 13 (only if the overcurrent relay is supplied) - 21 - 31 (only for withdrawable circuit-breakers).

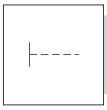
Circuit diagrams

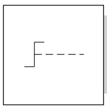
Circuit diagram symbols (IEC 60617 and CEI 3-14 ... 3-26 Standards

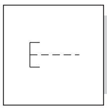

Shield
(may be drawn
in any shape)

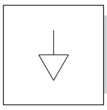

Timing

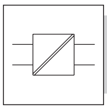

Mechanical connection

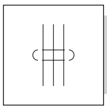

Manual mechanical
control (general)

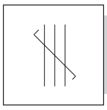

Rotary operating
mechanism

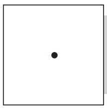

Pushbutton control

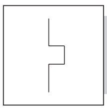

Equipotential

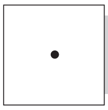

Galvanically
separated converter

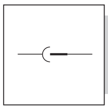

Shielded cable conductors
(i.e., 3 conductors)

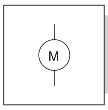

Stranded conductors or
cables (i.e., 3 conductors)


Connection of conductors

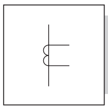

Thermal effect

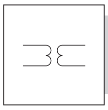

Terminal

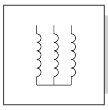

Socket and plug
(female and male)

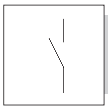


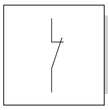
Motor
(general symbol)

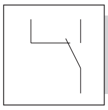

Current transformer

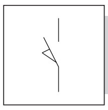

Voltage transformer

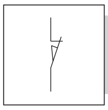

Winding of three-phase
transformer, star connection

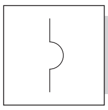

Make contact

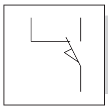

Break contact with
automatic circuit
breaking

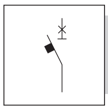

Change-over contact

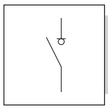

Make position contact
(limit contact)

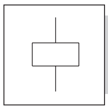

Break position contact
(limit contact)

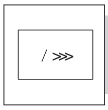

Electromagnetic effect

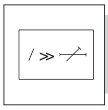

Change-over position
contact with momentary
circuit breaking (limit
contact)

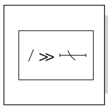

Power circuit-breaker-
isolator with automatic
opening

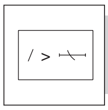

Switch-disconnector

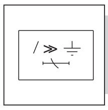

Control coil
(general symbol)

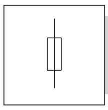

Instantaneous
overcurrent relay

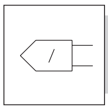

Overcurrent relay with
adjustable short time-delay
trip

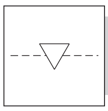

Overcurrent relay with
inverse short time-delay
trip


Overcurrent relay
with inverse long time-
delay trip


Overcurrent relay
for earth fault with inverse
short time-delay trip


Fuse
(general symbol)


Current sensor

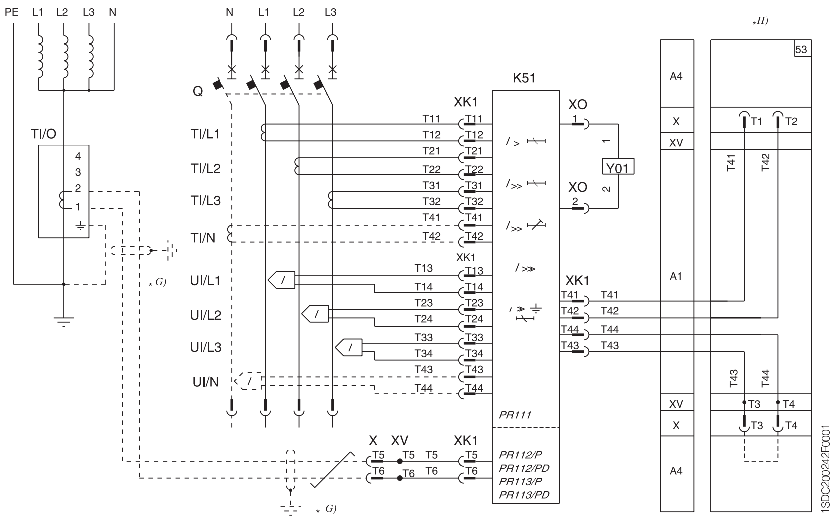

Mechanical interlock
between two circuit-
breakers

8

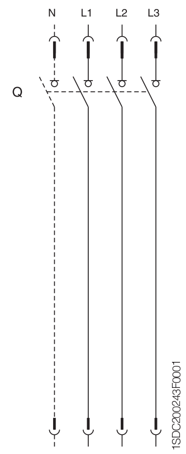
Circuit diagrams

Circuit-breakers

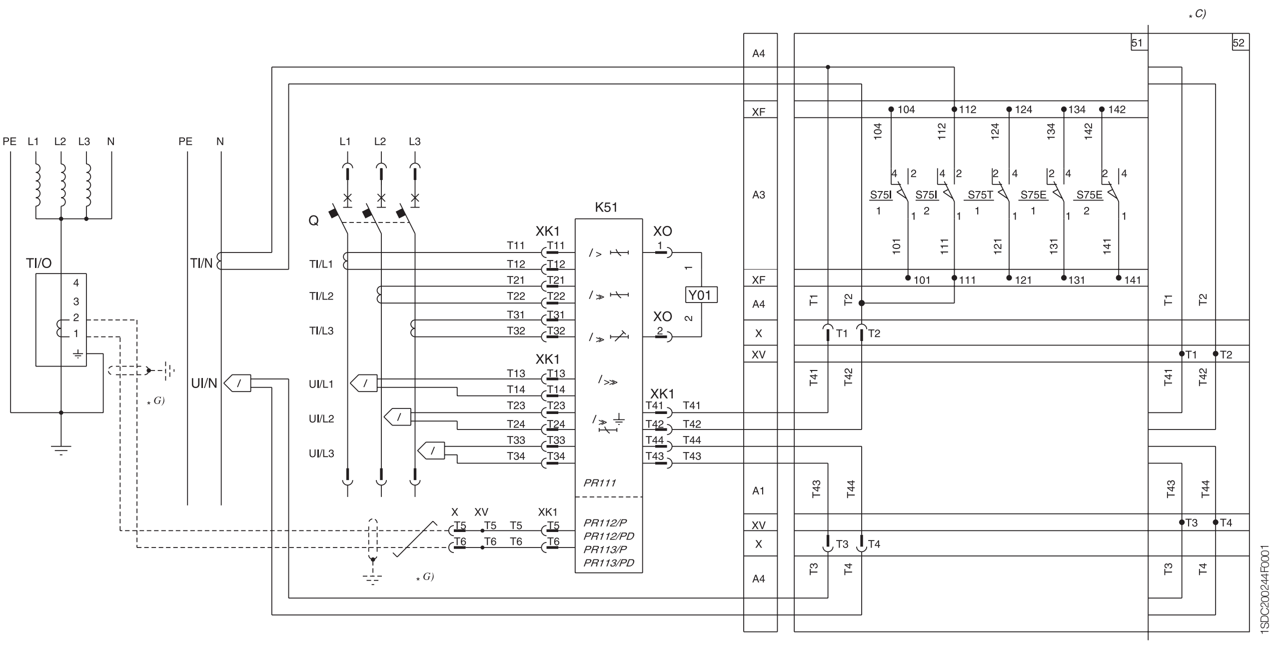
Operating status



Three- or four-pole circuit-breaker with microprocessor-based PR111, PR112/P, PR112/PD, PR113P, PR113/PD release



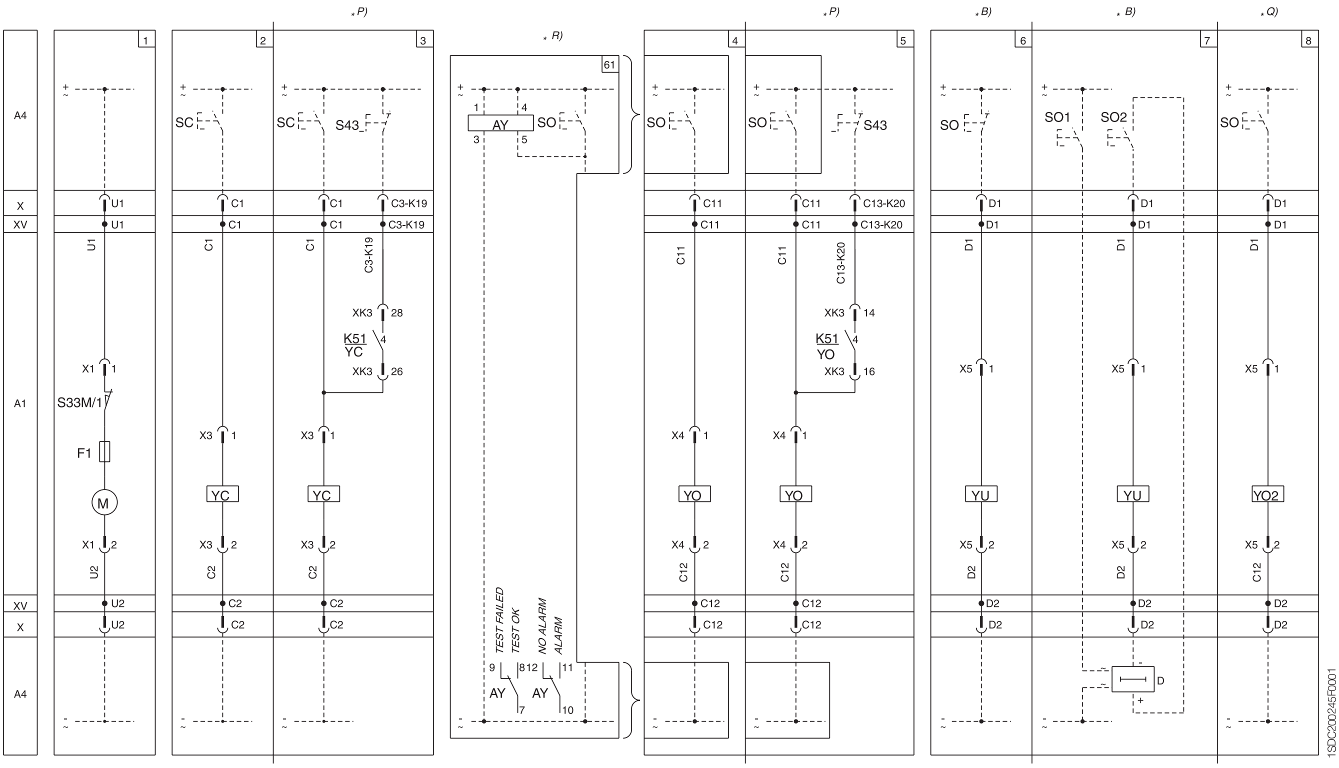
Three- or four-pole switch-disconnector



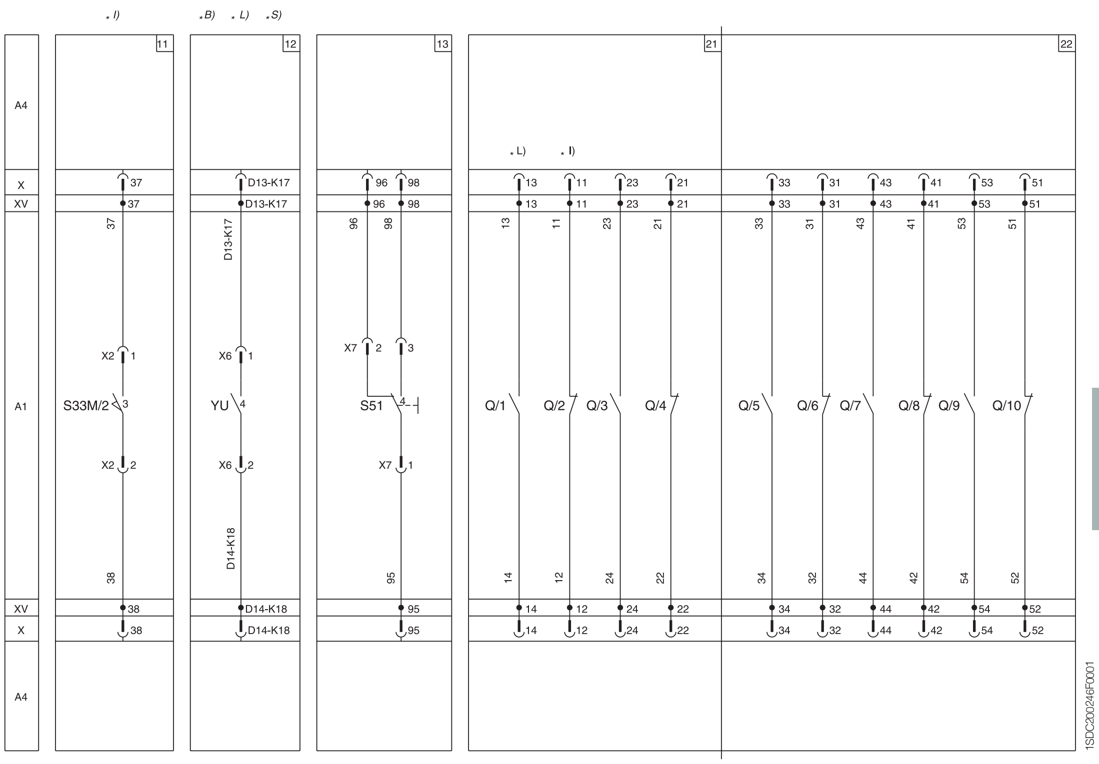
Three-pole circuit-breaker with PR111, PR112/P, PR112/PD, PR113P, PR113/PD microprocessor-based release and current transformer on neutral conductor outside circuit-breaker

8

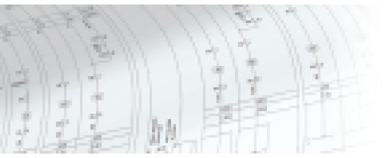
Motor operating mechanism, opening, closing and undervoltage releases



Signalling contacts

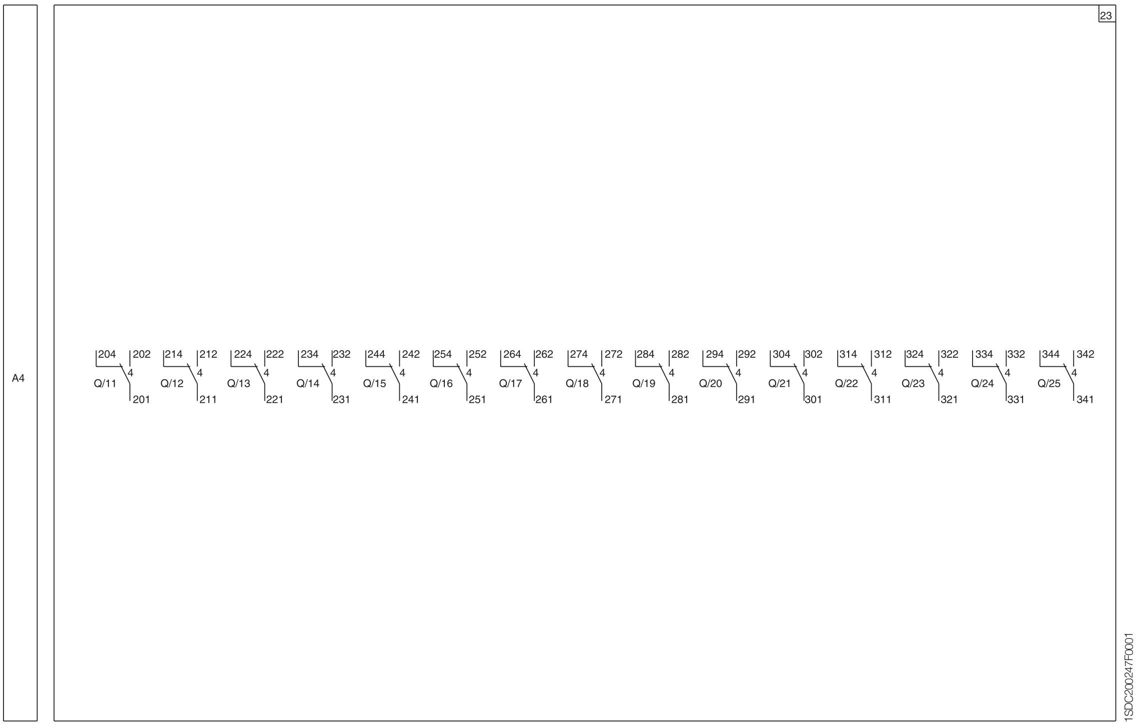


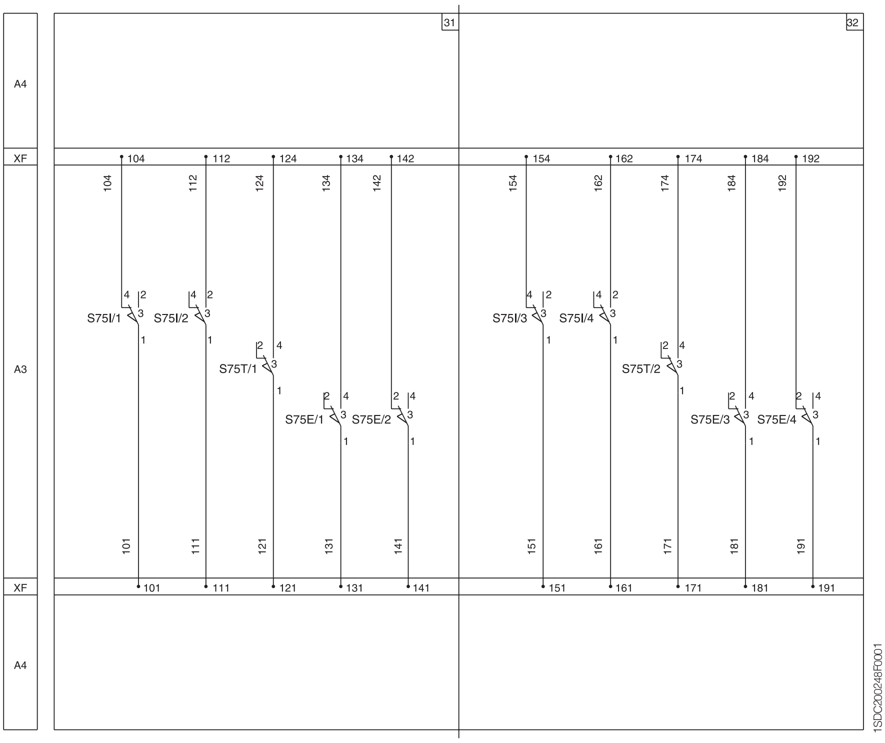
8



Circuit diagrams
Electrical accessories

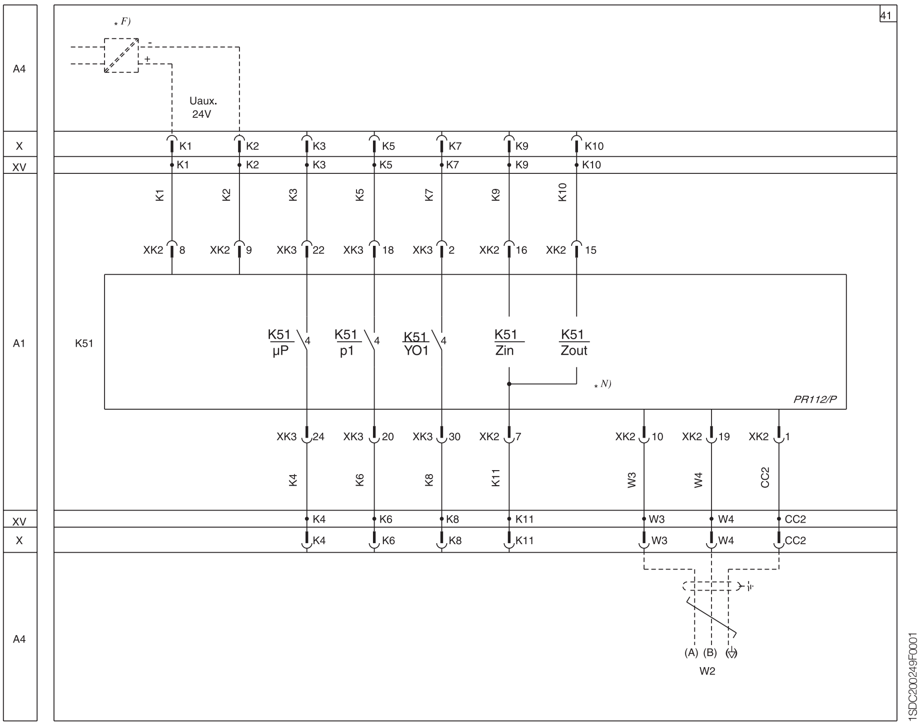
Signalling contacts



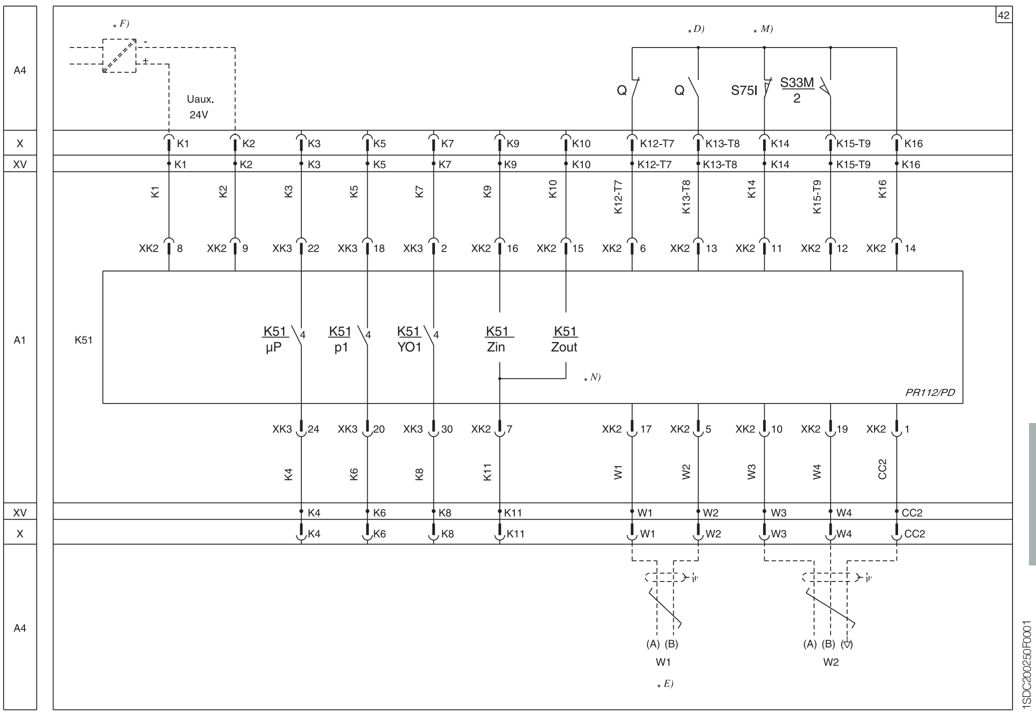


8

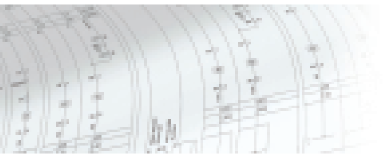
Auxiliary circuits of the PR112/P release



Auxiliary circuits of the PR112/PD release



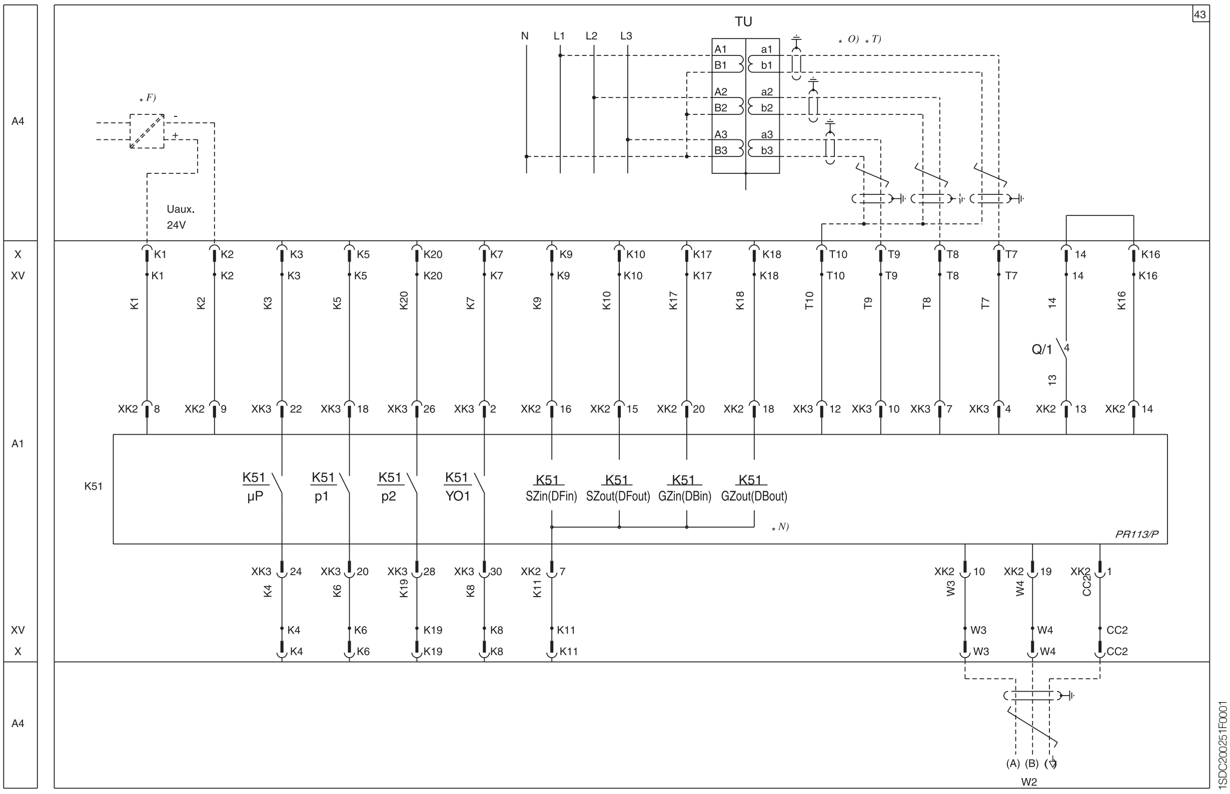
8



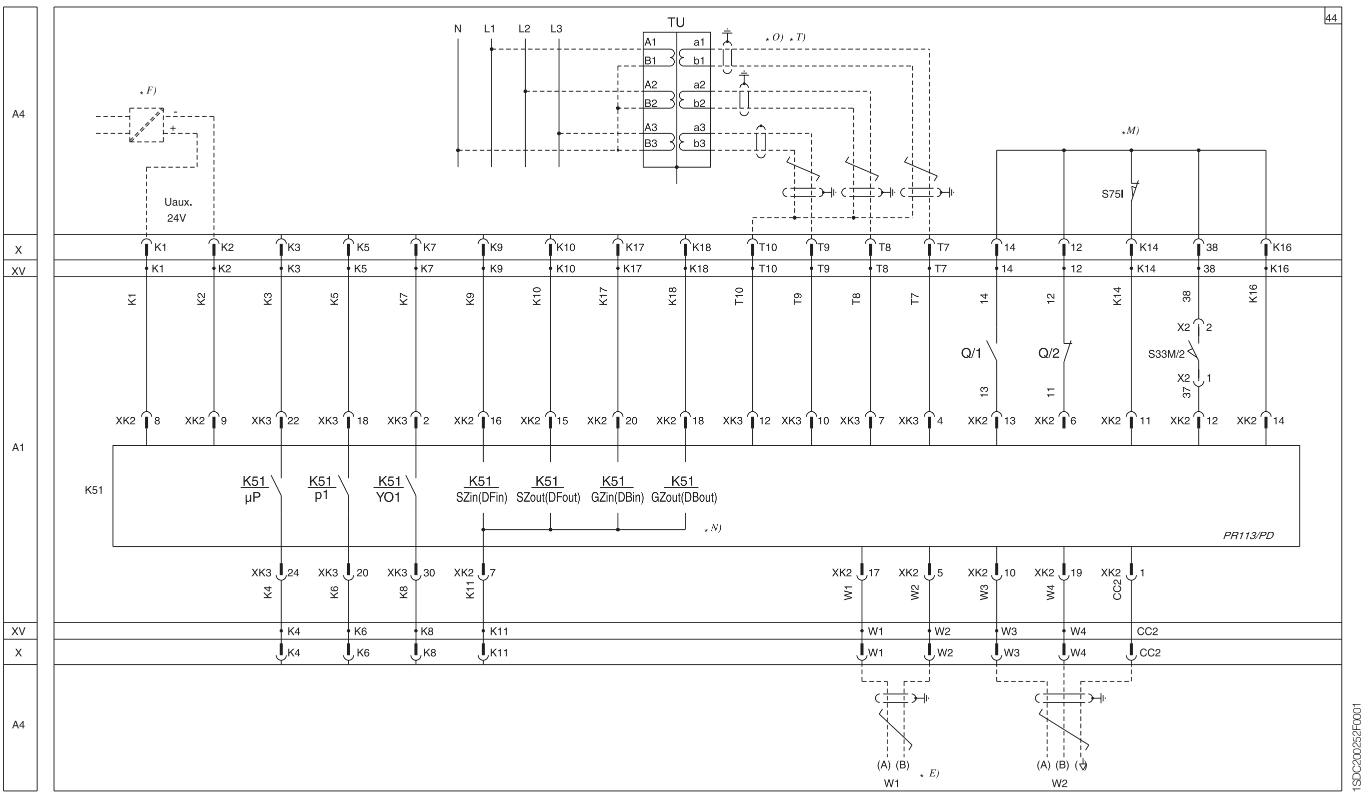
Circuit diagrams

Electrical accessories

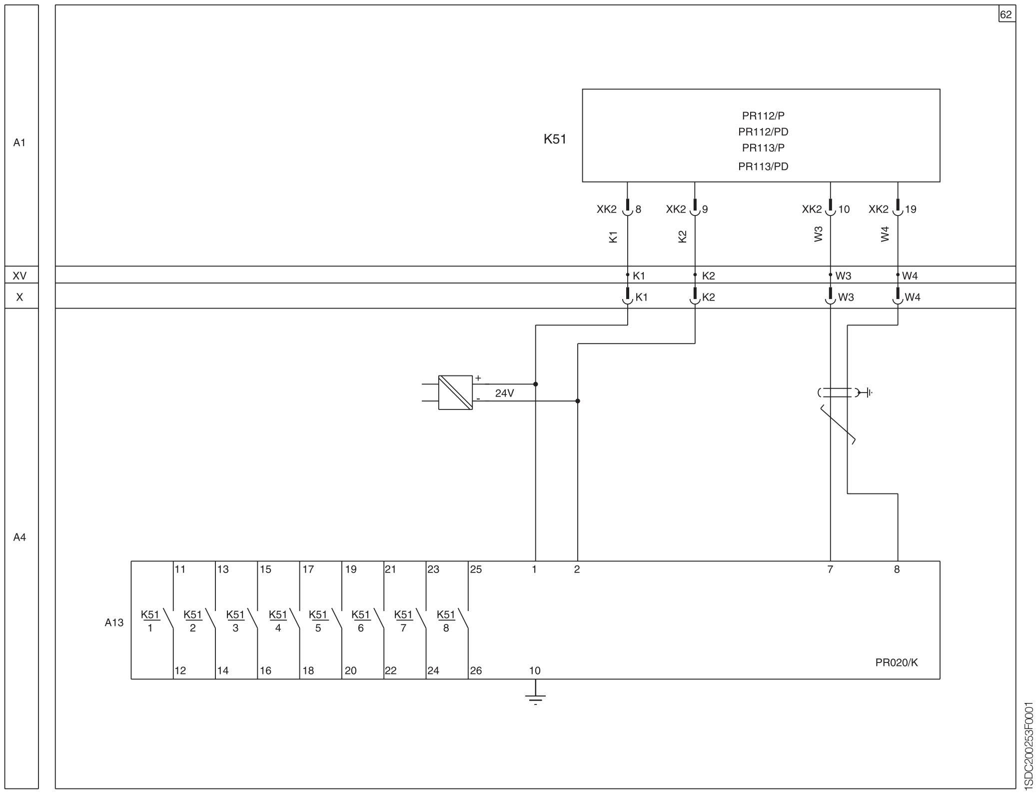
Auxiliary circuits of the PR113/P release

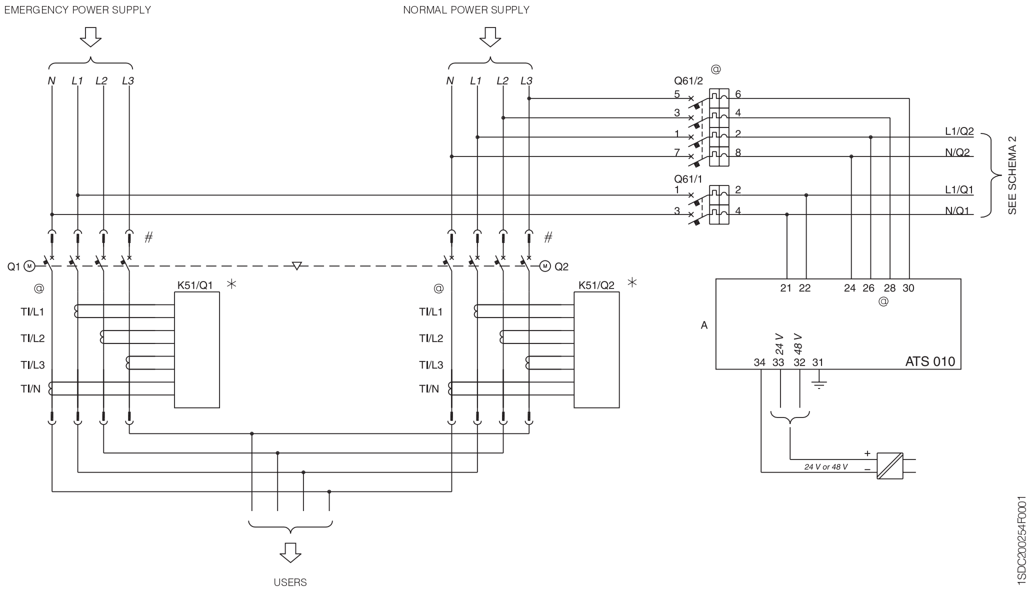


Auxiliary circuits of the PR113/PD release

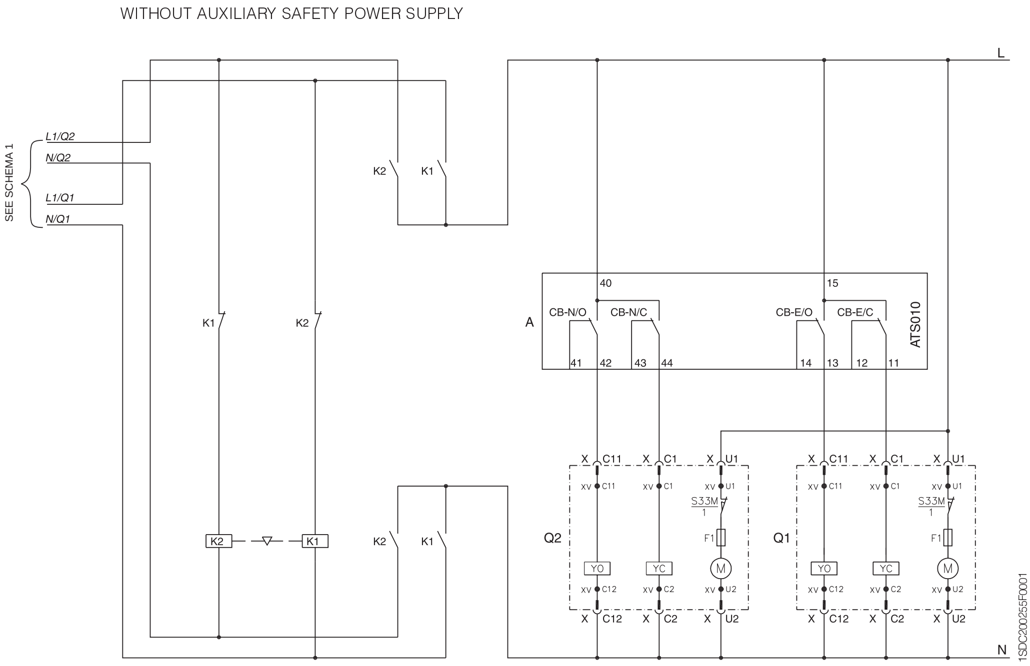


PR020/K Signalling unit



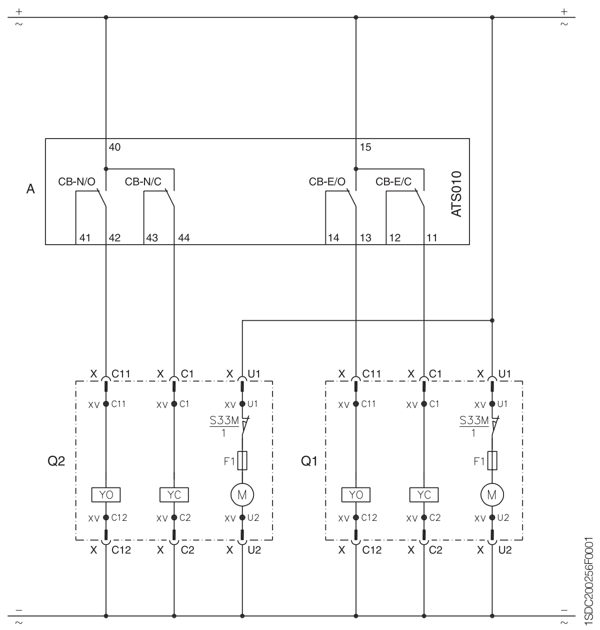


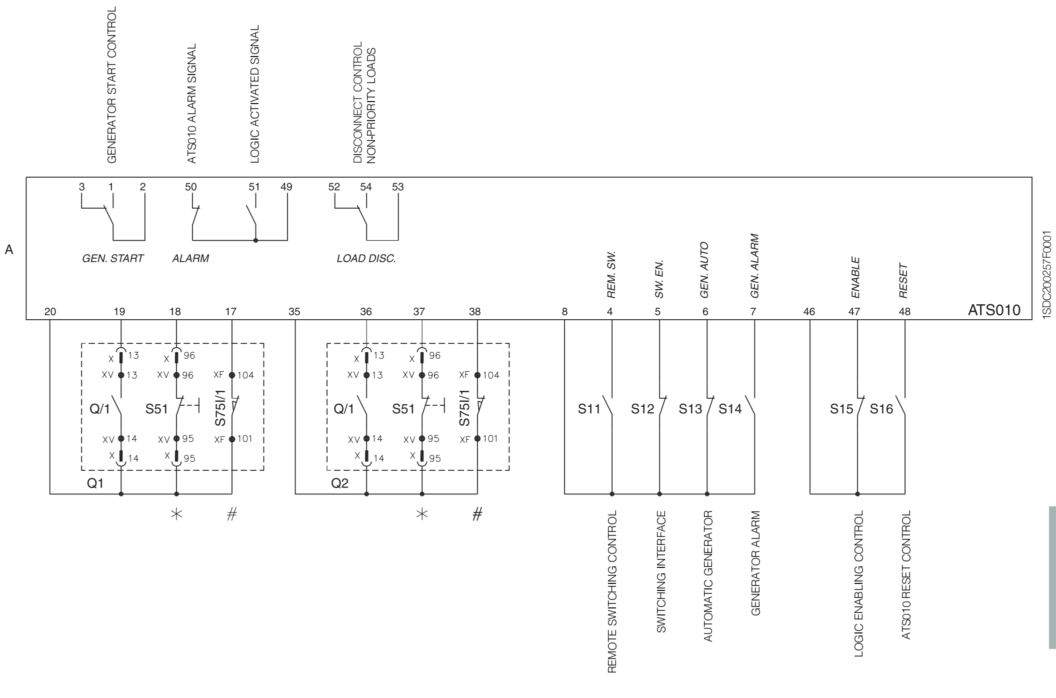
EMERGENCY POWER SUPPLY
NORMAL POWER SUPPLY
N L1 L2 L3
N L1 L2 L3
Q61/2
Q61/1
L1/Q2
N/Q2
L1/Q1
N/Q1
SEE SCHEMA 2
Q1
Q2
K51/Q1
K51/Q2
TI/L1
TI/L2
TI/L3
TI/N
A
ATS 010
21 22
24 26 28 30
34 33 32 31
24 V
48 V
24 V or 48 V
USERS
1SDC200254F0001



WITHOUT AUXILIARY SAFETY POWER SUPPLY
L
N
SEE SCHEMA 1
L1/Q2
N/Q2
L1/Q1
N/Q1
K2
K1
A
ATS010
CB-N/O
CB-N/C
CB-E/O
CB-E/C
40
15
41 42 43 44
14 13 12 11
Q2
Q1
C11
C1
U1
C12
C2
U2
S33M
F1
YO
YC
M
1SDC200255F0001

WITH AUXILIARY SAFETY POWER SUPPLY





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Emax

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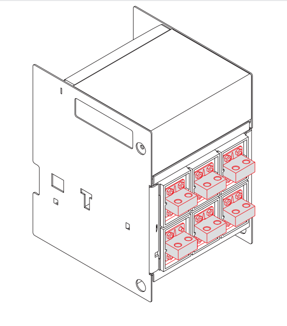
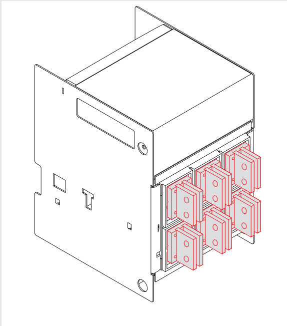
General information

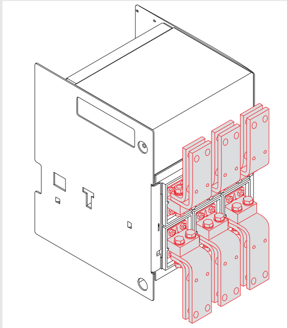
Abbreviations used in switchgear descriptions



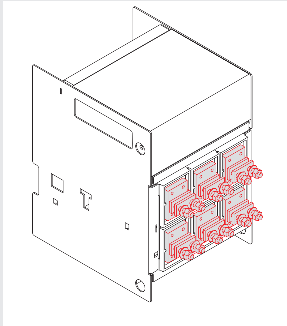
HR = Horizontal rear terminals



VR = Vertical rear terminals



F = Front terminals



FL = Flat terminals

F Fixed
W Withdrawable
MP Moving part for withdrawable circuit-breakers
FP Fixed part for withdrawable circuit-breakers

PR111/P Microprocessor-based electronic release (LI, LSI, LSIG functions)
PR112/P Microprocessor-based electronic release (LSI, LSIG functions)
PR113/P Microprocessor-based electronic release (LSIG and other functions)
PR112/PD LON® Microprocessor-based electronic release with dialogue and communication protocol options LON® Talk (LSI, LSIG functions)
PR112/PD Modbus® Microprocessor-based electronic release with dialogue and communication protocol options Modbus® (LSI, LSIG functions)
PR113/PD Modbus® Microprocessor-based electronic release with dialogue and communication protocol options Modbus® (LSIG and other functions)

Iu Rated uninterrupted current of the circuit-breaker
In Rated current of the electronic release current transformers
Icu Rated ultimate short-circuit breaking capacity
Icw Rated short-time withstand current
AC AC applications
DC DC applications

/MS Switch-disconnector
/E Automatic circuit-breaker for applications up to 1000V
/E MS Switch-disconnector for applications up to 1000V
CS Sectionalizing truck
MTP Earthing switch
MT Earthing truck

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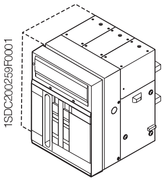
Ordering codes

SACE Emax automatic circuit-breakers





	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E1B 08
Fixed (F)

Iu (40 °C) = **800 A** Icu (415 V) = **42 kA** Icw (1 s) = **36 kA**

HR = Horizontal rear terminals						
LI	37527	39000				
LSI	37861	39003	38195	39009		
LSIG	38192	39006	38198	39012	52672	52736

E1N 08
Fixed (F)

Iu (40 °C) = **800 A** Icu (415 V) = **50 kA** Icw (1 s) = **50 kA**

HR = Horizontal rear terminals						
LI	53753	53760				
LSI	53754	53761	53757	53763		
LSIG	53755	53762	53758	53764	53759	53765

E1B 12
Fixed (F)

Iu (40 °C) = **1250 A** Icu (415 V) = **42 kA** Icw (1 s) = **36 kA**

HR = Horizontal rear terminals						
LI	39092	39205				
LSI	39093	39208	39101	39217		
LSIG	39097	39213	39105	39221	52673	52737

E1N 12
Fixed (F)

Iu (40 °C) = **1250 A** Icu (415 V) = **50 kA** Icw (1 s) = **50 kA**

HR = Horizontal rear terminals						
LI	53766	53772				
LSI	53767	53773	53769	53775		
LSIG	53768	53774	53770	53776	53771	53777

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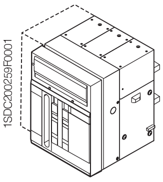
SACE Emax automatic circuit-breakers



	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E1B 08

Withdrawable (W) - MP

Iu (40 °C) = **800 A** Icu (415 V) = **42 kA** Icw (1 s) = **36 kA**

MP = Moving part						
LI	38978	39066				
LSI	38981	39069	38987	39075		
LSIG	38984	39072	38990	39078	52704	52772

E1N 08

Withdrawable (W) - MP

Iu (40 °C) = **800 A** Icu (415 V) = **50 kA** Icw (1 s) = **50 kA**

MP = Moving part						
LI	53778	53785				
LSI	53780	53786	53782	53788		
LSIG	53781	53787	53783	53789	53784	53790

E1B 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icu (415 V) = **42 kA** Icw (1 s) = **36 kA**

MP = Moving part						
LI	39176	39292				
LSI	39180	39296	39188	39304		
LSIG	39184	39300	39192	39308	52705	52773

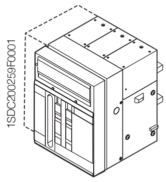
E1N 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icu (415 V) = **50 kA** Icw (1 s) = **50 kA**

MP = Moving part						
LI	53791	53797				
LSI	53792	53798	53794	53800		
LSIG	53793	53799	53795	53801	53796	53802

Fixed parts .... page 9/40 Terminals .... page 9/41 Dialogue unit .... page 9/42 Current transformers .... page 9/43



	PR111/P 1SDA0.....R1 3 Poles	4 Poles	PR112/P 1SDA0.....R1 3 Poles	4 Poles	PR113/P 1SDA0.....R1 3 Poles	4 Poles

E2N 12
Fixed (F)

Iu (40 °C) = **1250 A** Icu (415 V) = **65 kA** Icw (1 s) = **55 kA**

HR = Horizontal rear terminals						
LI	39673	39788				
LSI	39677	39792	39685	39800		
LSIG	39681	39796	39689	39803	52676	52740

E2L 12
Fixed (F)

Iu (40 °C) = **1250 A** Icu (415 V) = **130 kA** Icw (1 s) = **10 kA**

HR = Horizontal rear terminals						
LI	43390	40337				
LSI	43394	40341	43402	40349		
LSIG	43398	40345	43406	40353	52679	52743

E2B 16
Fixed (F)

Iu (40 °C) = **1600 A** Icu (415 V) = **42 kA** Icw (1 s) = **42 kA**

HR = Horizontal rear terminals						
LI	39320	39408				
LSI	39323	39411	39329	39417		
LSIG	39326	39414	39332	39420	52674	52738

E2N 16
Fixed (F)

Iu (40 °C) = **1600 A** Icu (415 V) = **65 kA** Icw (1 s) = **55 kA**

HR = Horizontal rear terminals						
LI	39903	39991				
LSI	39906	39994	39912	40000		
LSIG	39909	39997	39915	40003	52677	52741

E2L 16
Fisso (F)

Iu (40 °C) = **1600 A** Icu (415 V) = **130 kA** Icw (1 s) = **10 kA**

HR = Horizontal rear terminals						
LI	40452	40540				
LSI	40455	40543	40461	40549		
LSIG	40458	40546	40464	40552	52680	52744

E2B 20
Fixed (F)

Iu (40 °C) = **2000 A** Icu (415 V) = **42 kA** Icw (1 s) = **42 kA**

HR = Horizontal rear terminals						
LI	39496	39584				
LSI	39499	39587	39505	39593		
LSIG	39502	39590	39508	39596	52675	52739

E2N 20
Fixed (F)

Iu (40 °C) = **2000 A** Icu (415 V) = **65 kA** Icw (1 s) = **55 kA**

HR = Horizontal rear terminals						
LI	40079	40167				
LSI	40082	40170	40088	40176		
LSIG	40085	40173	40091	40179	52678	52742

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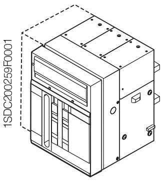


	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E2N 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icu (415 V) = **65 kA** Icw (1 s) = **55 kA**

MP = Moving part						
LI	39759	39875				
LSI	39763	39879	39771	39887		
LSIG	39767	39883	39775	39891	52708	52776

E2L 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icu (415 V) = **130 kA** Icw (1 s) = **10 kA**

MP = Moving part						
LI	40292	40424				
LSI	40296	40428	40304	40436		
LSIG	40300	40432	40308	40440	52711	52779

E2B 16

Withdrawable(W) - MP

Iu (40 °C) = **1600 A** Icu (415 V) = **42 kA** Icw (1 s) = **42 kA**

MP = Moving part						
LI	39386	39474				
LSI	39389	39477	39395	39483		
LSIG	39392	39480	39398	39486	52706	52774

E2N 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icu (415 V) = **65 kA** Icw (1 s) = **55 kA**

MP = Moving part						
LI	39969	40057				
LSI	39972	40060	39978	40066		
LSIG	39975	40064	39981	40069	52709	52777

E2L 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icu (415 V) = **130 kA** Icw (1 s) = **10 kA**

MP = Moving part						
LI	40518	40606				
LSI	40521	40609	40527	40615		
LSIG	40524	40612	40530	40618	52712	52780

E2B 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icu (415 V) = **42 kA** Icw (1 s) = **42 kA**

MP = Moving part						
LI	39562	39650				
LSI	39565	39653	39571	39659		
LSIG	39568	39656	39574	39662	52707	52775

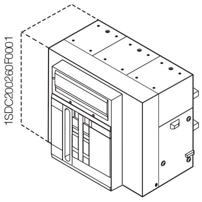
E2N 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icu (415 V) = **65 kA** Icw (1 s) = **55 kA**

MP = Moving part						
LI	40145	40211				
LSI	40148	40214	40154	40220		
LSIG	40151	40217	40157	40223	52710	52778

Fixed parts .... page 9/40 Terminals .... page 9/41 Dialogue unit .... page 9/42 Current transformers .... page 9/43



	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E3S 12

Fixed (F)

Iu (40 °C) = **1250 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	40889	40949				
LSI	40891	40951	40895	40955		
LSIG	40893	40953	40897	40957	52683	52747

E3H 12

Fixed (F)

Iu (40 °C) = **1250 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41489	41549				
LSI	41491	41551	41495	41555		
LSIG	41493	41553	41497	41557	52688	52752

E3S 16

Fixed (F)

Iu (40 °C) = **1600 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41009	41069				
LSI	41011	41071	41015	41075		
LSIG	41013	41073	41017	41077	52684	52748

E3H 16

Fixed (F)

Iu (40 °C) = **1600 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41609	41669				
LSI	41611	41671	41615	41675		
LSIG	41613	41673	41617	41677	52689	52753

E3S 20

Fixed (F)

Iu (40 °C) = **2000 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41129	41189				
LSI	41131	41191	41135	41195		
LSIG	41133	41193	41137	41197	52685	52749

E3H 20

Fixed (F)

Iu (40 °C) = **2000 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41729	41789				
LSI	41731	41791	41735	41795		
LSIG	41733	41793	41737	41797	52690	52754

E3L 20

Fixed (F)

Iu (40 °C) = **2000 A** Icu (415 V) = **130 kA** Icw (1 s) = **15 kA**

HR = Horizontal rear terminals						
LI	42089	42149				
LSI	42091	42151	42095	42155		
LSIG	42093	42153	42097	42157	52693	52757

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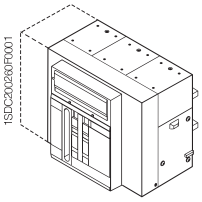


	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E3N 25
Fixed (F)

Iu (40 °C) = **2500 A** Icu (415 V) = **65 kA** Icw (1 s) = **65 kA**

HR = Horizontal rear terminals						
LI	40649	40709				
LSI	40651	40711	40655	40715		
LSIG	40653	40713	40657	40717	52681	52745

E3S 25
Fixed (F)

Iu (40 °C) = **2500 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41249	41309				
LSI	41251	41311	41255	41315		
LSIG	41253	41313	41257	41317	52686	52750

E3H 25
Fixed (F)

Iu (40 °C) = **2500 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41849	41909				
LSI	41851	41911	41855	41915		
LSIG	41853	41913	41857	41917	52691	52755

E3L 25
Fixed (F)

Iu (40 °C) = **2500 A** Icu (415 V) = **130 kA** Icw (1 s) = **15 kA**

HR = Horizontal rear terminals						
LI	42209	42269				
LSI	42211	42271	42215	42275		
LSIG	42213	42273	42217	42277	52694	52759

E3N 32
Fixed (F)

Iu (40 °C) = **3200 A** Icu (415 V) = **65 kA** Icw (1 s) = **65 kA**

HR = Horizontal rear terminals						
LI	40784	43373				
LSI	40786	43375	40790	43379		
LSIG	40788	43377	40792	43381	52682	52746

E3S 32
Fixed (F)

Iu (40 °C) = **3200 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

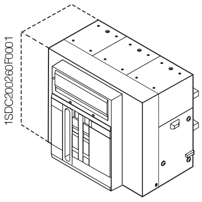
HR = Horizontal rear terminals						
LI	41369	41429				
LSI	41371	41431	41375	41435		
LSIG	41373	41433	41377	41437	52687	52751

E3H 32
Fixed (F)

Iu (40 °C) = **3200 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	41969	42029				
LSI	41971	42031	41975	42035		
LSIG	41973	42033	41977	42037	52692	52756

Fixed parts .... page 9/40 **Terminals** .... page 9/41 **Dialogue unit** .... page 9/42 **Current transformers** .... page 9/43





	PR111/P 1SDA0.....R1 3 Poles	4 Poles	PR112/P 1SDA0.....R1 3 Poles	4 Poles	PR113/P 1SDA0.....R1 3 Poles	4 Poles

E3S 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	40934	40994				
LSI	40936	40996	40940	41000		
LSIG	40938	40998	40942	41002	52715	52783

E3H 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41534	41594				
LSI	41536	41596	41540	41600		
LSIG	41538	41598	41542	41602	52720	52788

E3S 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41054	41114				
LSI	41056	41116	41060	41120		
LSIG	41058	41118	41062	41122	52716	52784

E3H 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41654	41714				
LSI	41656	41716	41660	41720		
LSIG	41658	41718	41662	41722	52721	52789

E3S 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41174	41234				
LSI	41176	41236	41180	41240		
LSIG	41178	41238	41182	41242	52717	52785

E3H 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41774	41834				
LSI	41776	41836	41780	41840		
LSIG	41778	41838	41782	41842	52722	52790

E3L 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icu (415 V) = **130 kA** Icw (1 s) = **15 kA**

MP = Moving part						
LI	42134	42194				
LSI	42136	42196	42140	42200		
LSIG	42138	42198	42142	42202	52725	52793

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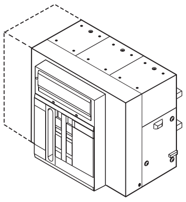


1SDC200260F0001

						
	PR111/P		**PR112/P**		**PR113/P**	
	1SDA0.....R1		**1SDA0.....R1**		**1SDA0.....R1**	
	3 Poles	**4 Poles**	**3 Poles**	**4 Poles**	**3 Poles**	**4 Poles**

E3N 25
Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icu (415 V) = **65 kA** Icw (1 s) = **65 kA**

MP = Moving part						
LI	40694	40754				
LSI	40696	40756	40700	40760		
LSIG	40698	40758	40702	40762	52713	52781

E3S 25
Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41294	41354				
LSI	41296	41356	41300	41360		
LSIG	41298	41358	41302	41362	52718	52786

E3H 25
Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	41894	41954				
LSI	41896	41956	41900	41960		
LSIG	41898	41958	41902	41962	52723	52791

E3L 25
Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icu (415 V) = **100 kA** Icw (1 s) = **15 kA**

MP = Moving part						
LI	42254	42314				
LSI	42256	42316	42260	42320		
LSIG	42258	42318	42262	42322	52726	52794

E3N 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icu (415 V) = **65 kA** Icw (1 s) = **65 kA**

MP = Moving part						
LI	40829	40874				
LSI	40831	40876	40835	40880		
LSIG	40833	40878	40837	40882	52714	52782

E3S 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

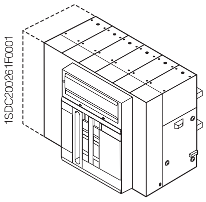
MP = Moving part						
LI	41414	41474				
LSI	41416	41476	41420	41480		
LSIG	41418	41478	41422	41482	52719	52787

E3H 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icu (415 V) = **100 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	42014	42074				
LSI	42016	42076	42020	42080		
LSIG	42018	42078	42022	42082	52724	52792

Fixed parts .... page 9/40 **Terminals** .... page 9/41 **Dialogue unit** .... page 9/42 **Current transformers** .... page 9/43





	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E4H 32
Fixed (F)

Iu (40 °C) = **3200 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals						
LI	42450	43417				
LSI	42452	43419	42456	43423		
LSIG	42454	43421	42458	43425	52696	52762

E4S 40
Fixed (F)

Iu (40 °C) = **4000 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

HR = Horizontal rear terminals						
LI	42330	42390				
LSI	42332	42392	42336	42396		
LSIG	42334	42394	42338	42398	52695	52760

E4H 40
Fixed (F)

Iu (40 °C) = **4000 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals						
LI	42555	42615				
LSI	42557	42617	42561	42621		
LSIG	42559	42619	42563	42623	52697	52763

E4H 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	42495	42540				
LSI	42497	42542	42501	42546		
LSIG	42499	42544	42503	42548	52728	52797

E4S 40
Withdrawable (W) - MP

Iu (40 °C) = **4000 A** Icu (415 V) = **75 kA** Icw (1 s) = **75 kA**

MP = Moving part						
LI	42375	42435				
LSI	42377	42437	42381	42441		
LSIG	42379	42439	42383	42443	52727	52795

Withdrawable (W) - MP

Iu (40 °C) = **4000 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	42600	42660				
LSI	42602	42662	42606	42666		
LSIG	42604	42664	42608	42668	52729	52798

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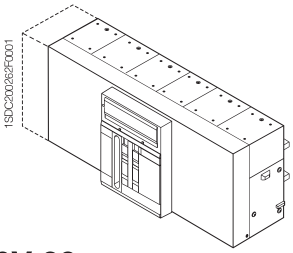
Fixed parts .... page 9/40 **Terminals** .... page 9/41 **Dialogue unit** .... page 9/42 **Current transformers** .... page 9/43

Ordering codes

SACE Emax automatic circuit-breakers



E6V 32

Fixed (F)

Iu (40 °C) = **3200 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals	PR111/P 1SDA0.....R1 3 Poles	PR111/P 4 Poles	PR112/P 1SDA0.....R1 3 Poles	PR112/P 4 Poles	PR113/P 1SDA0.....R1 3 Poles	PR113/P 4 Poles
LI	42914	42946				
LSI	42915	42947	42917	42949		
LSIG	42916	42948	42918	42950	52700	52768

E6V 40

Fixed (F)

Iu (40 °C) = **4000 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals	PR111/P 1SDA0.....R1 3 Poles	PR111/P 4 Poles	PR112/P 1SDA0.....R1 3 Poles	PR112/P 4 Poles	PR113/P 1SDA0.....R1 3 Poles	PR113/P 4 Poles
LI	42979	43039				
LSI	42981	43041	42985	43045		
LSIG	42983	43043	42987	43047	52701	52769

E6H 50

Fixed (F)

Iu (40 °C) = **5000 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals	PR111/P 1SDA0.....R1 3 Poles	PR111/P 4 Poles	PR112/P 1SDA0.....R1 3 Poles	PR112/P 4 Poles	PR113/P 1SDA0.....R1 3 Poles	PR113/P 4 Poles
LI	42675	42735				
LSI	42677	42737	42681	42741		
LSIG	42679	42739	42683	42743	52698	52764

E6V 50

Fixed (F)

Iu (40 °C) = **5000 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals	PR111/P 1SDA0.....R1 3 Poles	PR111/P 4 Poles	PR112/P 1SDA0.....R1 3 Poles	PR112/P 4 Poles	PR113/P 1SDA0.....R1 3 Poles	PR113/P 4 Poles
LI	43099	43159				
LSI	43101	43161	43105	43165		
LSIG	43103	43163	43107	43167	52702	52770

E6H 63

Fixed (F)

Iu (40 °C) = **6300 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals	PR111/P 1SDA0.....R1 3 Poles	PR111/P 4 Poles	PR112/P 1SDA0.....R1 3 Poles	PR112/P 4 Poles	PR113/P 1SDA0.....R1 3 Poles	PR113/P 4 Poles
LI	42795	42855				
LSI	42797	42857	42801	42861		
LSIG	42799	42859	42803	42863	52699	52765

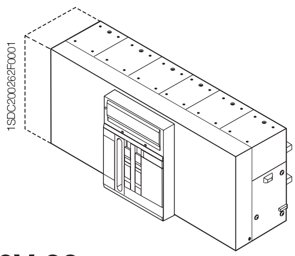
E6V 63

Fixed (F)

Iu (40 °C) = **6300 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals	PR111/P 1SDA0.....R1 3 Poles	PR111/P 4 Poles	PR112/P 1SDA0.....R1 3 Poles	PR112/P 4 Poles	PR113/P 1SDA0.....R1 3 Poles	PR113/P 4 Poles
LI	43219	43279				
LSI	43221	43281	43225	43285		
LSIG	43223	43283	43227	43287	52703	52771

Fixed parts .... page 9/40 Terminals .... page 9/41 Dialogue unit .... page 9/42 Current transformers .... page 9/43





	PR111/P		PR112/P		PR113/P	
	1SDA0.....R1		1SDA0.....R1		1SDA0.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles

E6V 32

Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	42938	42970				
LSI	42939	42971	42941	42973		
LSIG	42940	42972	42942	42974	52732	52803

E6V 40

Withdrawable (W) - MP

Iu (40 °C) = **4000 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	43024	43084				
LSI	43026	43086	43030	43090		
LSIG	43028	43088	43032	43092	52733	52804

E6H 50

Withdrawable (W) - MP

Iu (40 °C) = **5000 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	42720	42780				
LSI	42722	42782	42726	42786		
LSIG	42724	42784	42728	42788	52730	52799

E6V 50

Withdrawable (W) - MP

Iu (40 °C) = **5000 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	43144	43204				
LSI	43146	43206	43150	43210		
LSIG	43148	43208	43152	43212	52734	52805

E6H 63

Withdrawable (W) - MP

Iu (40 °C) = **6300 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	42840	42900				
LSI	42842	42902	42846	42906		
LSIG	42844	42904	42848	42908	52731	52800

E6V 63

Withdrawable (W) - MP

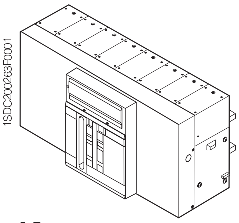
Iu (40 °C) = **6300 A** Icu (415 V) = **150 kA** Icw (1 s) = **100 kA**

MP = Moving part						
LI	43264	43309				
LSI	43266	43311	43270	43315		
LSIG	43268	43313	43272	43317	52735	52806

Fixed parts .... **page 9/**40 **Terminals** .... **page 9/**41 **Dialogue unit** .... **page 9/**42 **Current transformers** .... **page 9/**43

Ordering codes

SACE Emax automatic circuit-breakers with full-size neutral conductor



			
	PR111/P	**PR112/P**	**PR113/P**
	1SDA0.....R1 **4 Poles**	**1SDA0.....R1** **4 Poles**	**1SDA0.....R1** **4 Poles**

E4S/f 40

Fixed (F)

Iu (40 °C) = 4000 A **Icu (415 V) = 80 kA** **Icw (1 s) = 80 kA**

HR = Horizontal rear terminals

	PR111/P	PR112/P	PR113/P
LI	48674		
LSI	48675	48677	
LSIG	48676	48678	52761

E4S/f 40

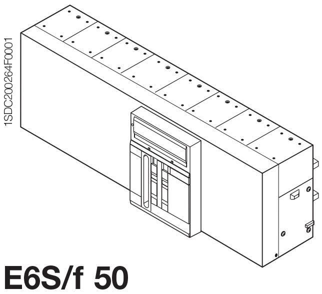
Withdrawable (W) - MP

Iu (40 °C) = 4000 A **Icu (415 V) = 80 kA** **Icw (1 s) = 80 kA**

MP = Moving part

	PR111/P	PR112/P	PR113/P
LI	48695		
LSI	48696	48698	
LSIG	48697	48699	52796

Fixed parts .... page 9/40 Terminals .... page 9/41 Dialogue unit .... page 9/42 Current transformers .... page 9/43



	PR111/P	PR112/P	PR113/P
	1SDA0.....R1 4 Poles	1SDA0.....R1 4 Poles	1SDA0.....R1 4 Poles

E6S/f 50

Fixed (F)

Iu (40 °C) = **5000 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals			
LI	50767		
LSI	50768	50770	
LSIG	50769	50771	52766

E6H/f 63

Fixed (F)

Iu (40 °C) = **6300 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

HR = Horizontal rear terminals			
LI	50788		
LSI	50789	50791	
LSIG	50790	50792	52767

E6H/f 50

Withdrawable (W) - MP

Iu (40 °C) = **5000 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

MP = Moving part			
LI	50781		
LSI	50782	50784	
LSIG	50783	50785	52801

E6H/f 63

Withdrawable (W) - MP

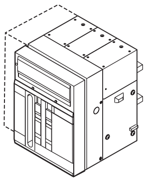
Iu (40 °C) = **6300 A** Icu (415 V) = **100 kA** Icw (1 s) = **100 kA**

MP = Moving part			
LI	50803		
LSI	50804	50806	
LSIG	50805	50807	52802

Fixed parts .... page 9/40 Terminals .... page 9/41 Dialogue unit .... page 9/42 Current transformers .... page 9/43

Ordering codes

SACE Emax switch-disconnectors



	1SDA0.....R1 3 Poles	4 Poles

E1B/MS 08

Fixed (F)

Iu (40 °C) = **800 A** Icw (1s) = **36 kA**

HR = Horizontal rear terminals		
	37528	37555

E1N/MS 08

Fixed (F)

Iu (40 °C) = **800 A** Icw (1s) = **50 kA**

HR = Horizontal rear terminals		
	53803	53804

E1B/MS 12

Fixed (F)

Iu (40 °C) = **1250 A** Icw (1s) = **36 kA**

HR = Horizontal rear terminals		
	37529	37556

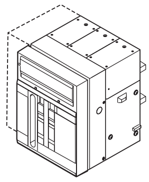
E1N/MS 12

Fixed (F)

Iu (40 °C) = **1250 A** Icw (1s) = **50 kA**

HR = Horizontal rear terminals		
	53805	53806

Fixed parts .... page 9/40 Terminals .... page 9/41



1SDC200259F0001

	1SDA0.....R1 3 Poles	4 Poles

E1B/MS 08

Withdrawable (W) - MP

Iu (40 °C) = **800 A** Icw (1s) = **36 kA**

MP = Moving part	3 Poles	4 Poles
	37639	37642

E1N/MS 08

Withdrawable (W) - MP

Iu (40 °C) = **800 A** Icw (1s) = **50 kA**

MP = Moving part	3 Poles	4 Poles
	53807	53808

E1B/MS 12

Withdrawable(W) - MP

Iu (40 °C) = **1250 A** Icw (1s) = **36 kA**

MP = Moving part	3 Poles	4 Poles
	37640	37641

E1N/MS 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icw (1s) = **50 kA**

MP = Moving part	3 Poles	4 Poles
	53809	53810

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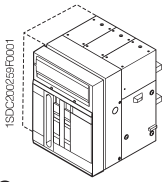
Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax switch-disconnectors



	1SDA0.....R1 3 Poles	4 Poles

E2N/MS 12
Fixed (F)

Iu (40 °C) = **1250 A** Icw (1s) = **55 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	37531	37559

E2B/MS 16
Fixed (F)

Iu (40 °C) = **1600 A** Icw (1s) = **42 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	43472	37557

E2N/MS 16
Fixed (F)

Iu (40 °C) = **1600 A** Icw (1s) = **55 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	37532	37560

E2B/MS 20
Fixed (F)

Iu (40 °C) = **2000 A** Icw (1s) = **42 kA**

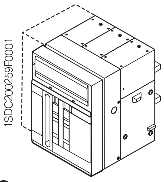
HR = Horizontal rear terminals	3 Poles	4 Poles
	37530	37558

E2N/MS 20
Fixed (F)

Iu (40 °C) = **2000 A** Icw (1s) = **55 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	37533	37561

Fixed parts .... page 9/40 Terminals .... page 9/41



	1SDA0.....R1 3 Poles	4 Poles

E2N/MS 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icw (1s) = **55 kA**

MP = Moving part	3 Poles	4 Poles
	37648	37652

E2B/MS 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icw (1s) = **42 kA**

MP = Moving part	3 Poles	4 Poles
	37646	37643

E2N/MS 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icw (1s) = **55 kA**

MP = Moving part	3 Poles	4 Poles
	37647	37651

E2B/MS 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icw (1s) = **42 kA**

MP = Moving part	3 Poles	4 Poles
	37645	37644

E2N/MS 20

Withdrawable (W) - MP

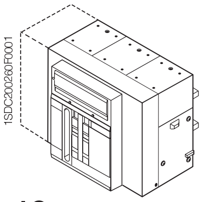
Iu (40 °C) = **2000 A** Icw (1s) = **55 kA**

MP = Moving part	3 Poles	4 Poles
	37649	37650

Fixed parts .... page 9/40 Terminals .... page 9/41

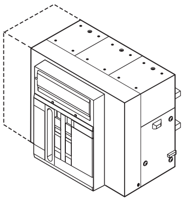
Ordering codes

SACE Emax switch-disconnectors



		1SDA0.....R1 3 Poles	4 Poles
E3S/MS 12 Fixed (F)	Iu (40 °C) = **1250 A** Icw (1s) = **75 kA**		
	HR = Horizontal rear terminals	37536	37564
E3S/MS 16 Fixed (F)	Iu (40 °C) = **1600 A** Icw (1s) = **75 kA**		
	HR = Horizontal rear terminals	37537	37565
E3S/MS 20 Fixed (F)	Iu (40 °C) = **2000 A** Icw (1s) = **75 kA**		
	HR = Horizontal rear terminals	37538	37566
E3N/MS 25 Fixed (F)	Iu (40 °C) = **2500 A** Icw (1s) = **65 kA**		
	HR = Horizontal rear terminals	37534	37562
E3S/MS 25 Fixed (F)	Iu (40 °C) = **2500 A** Icw (1s) = **75 kA**		
	HR = Horizontal rear terminals	37539	37567
E3N/MS 32 Fixed (F)	Iu (40 °C) = **3200 A** Icw (1s) = **65 kA**		
	HR = Horizontal rear terminals	37535	37563
E3S/MS 32 Fixed (F)	Iu (40 °C) = **3200 A** Icw (1s) = **75 kA**		
	HR = Horizontal rear terminals	37540	37568

Fixed parts .... page 9/40 Terminals .... page 9/41



	1SDA0.....R1 3 Poles	4 Poles

E3S/MS 12
Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icw (1s) = **75 kA**

MP = Moving part		
	37657	37664

E3S/MS 16
Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icw (1s) = **75 kA**

MP = Moving part		
	37660	37665

E3S/MS 20
Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icw (1s) = **75 kA**

MP = Moving part		
	37658	37666

E3N/MS 25
Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icw (1s) = **65 kA**

MP = Moving part		
	37656	37653

E3S/MS 25
Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icw (1s) = **75 kA**

MP = Moving part		
	37661	37662

E3N/MS 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icw (1s) = **65 kA**

MP = Moving part		
	37655	37654

E3S/MS 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icw (1s) = **75 kA**

MP = Moving part		
	37659	37663

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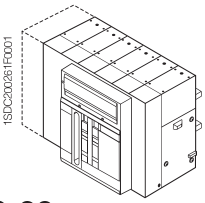
Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax switch-disconnectors



	1SDA0.....R1 3 Poles	4 Poles

E4H/MS 32
Fixed (F)

Iu (40 °C) = **3200 A** Icw (1s) = **100 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	37547	37575

E4S/MS 40
Fixed (F)

Iu (40 °C) = **4000 A** Icw (1s) = **75 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	37546	37574

E4H/MS 40
Fixed (F)

Iu (40 °C) = **4000 A** Icw (1s) = **100 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
	37548	37576

E4H/MS 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icw (1s) = **100 kA**

MP = Moving part	3 Poles	4 Poles
	37682	37679

E4S/MS 40
Withdrawable (W) - MP

Iu (40 °C) = **4000 A** Icw (1s) = **75 kA**

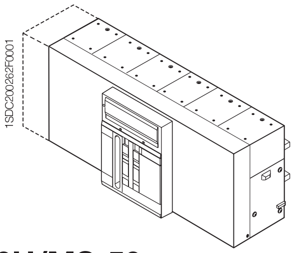
MP = Moving part	3 Poles	4 Poles
	37677	37678

E4H/MS 40
Withdrawable (W) - MP

Iu (40 °C) = **4000 A** Icw (1s) = **100 kA**

MP = Moving part	3 Poles	4 Poles
	37681	37680

Fixed parts .... page 9/40 Terminals .... page 9/41



	1SDA0.....R1 3 Poles	4 Poles

E6H/MS 50
Fixed (F)

Iu (40 °C) = **5000 A** Icw (1s) = **100 kA**

HR = Horizontal rear terminals		
	37549	37577

E6H/MS 63
Fixed (F)

Iu (40 °C) = **6300 A** Icw (1s) = **100 kA**

HR = Horizontal rear terminals		
	37550	37578

E6H/MS 50
Withdrawable (W) - MP

Iu (40 °C) = **5000 A** Icw (1s) = **100 kA**

MP = Moving part		
	37683	37686

E6H/MS 63
Withdrawable (W) - MP

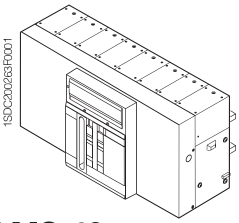
Iu (40 °C) = **6300 A** Icw (1s) = **100 kA**

MP = Moving part		
	37684	37685

Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax switch-disconnectors



1SDA0.....R1
4 Poles

E4S/f MS 40
Fixed (F)

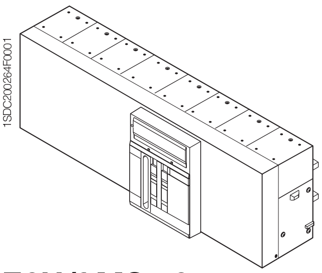
Iu (40 °C) = **4000 A** Icw (1s) = **80 kA**

HR = Horizontal rear terminals	1SDA0.....R1 4 Poles
	48737

E4S/f MS 40
Withdrawable (W) - MP

Iu (40 °C) = **4000 A** Icw (1s) = **80 kA**

MP = Moving part	1SDA0.....R1 4 Poles
	48740



1SDA0.....R1
4 Poles

E6H/f MS 50
Fixed (F)

Iu (40 °C) = **5000 A** Icw (1s) = **100 kA**

HR = Horizontal rear terminals	1SDA0.....R1 4 Poles
	50810

E6H/f MS 63
Fixed (F)

Iu (40 °C) = **6300 A** Icw (1s) = **100 kA**

HR = Horizontal rear terminals	1SDA0.....R1 4 Poles
	50813

E6H/f MS 50
Withdrawable (W) - MP

Iu (40 °C) = **5000 A** Icw (1s) = **100 kA**

MP = Moving part	1SDA0.....R1 4 Poles
	50812

E6H/f MS 63
Withdrawable (W) - MP

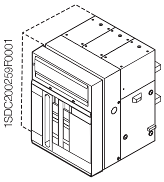
Iu (40 °C) = **6300 A** Icw (1s) = **100 kA**

MP = Moving part	1SDA0.....R1 4 Poles
	50815

Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax automatic circuit-breakers for applications up to 1000V AC



1SDA0.....R1

E2B/E 16

Iu (40 °C) = 1600 A Icu (1000 V AC) = 20 kA

	48527

Note: to be specified in addition to the code of the standard version E2B 16 circuit-breaker (Ue=690 V AC) page 9/5 and 9/6

E2B/E 20

Iu (40 °C) = 2000 A Icu (1000 V AC) = 20 kA

	48528

Note: to be specified in addition to the code of the standard version E2B 20 circuit-breaker (Ue=690 V AC) page 9/5 and 9/6

E2N/E 12

Iu (40 °C) = 1250 A Icu (1000 V AC) = 30 kA

	4852948529

Note: to be specified in addition to the code of the standard version E2N 12 circuit-breaker (Ue=690 V AC) page 9/5 and 9/6

E2N/E 16

Iu (40 °C) = 1600 A Icu (1000 V AC) = 30 kA

	48530

Note: to be specified in addition to the code of the standard version E2N 16 circuit-breaker (Ue=690 V AC) page 9/5 and 9/6

E2N/E 20

Iu (40 °C) = 2000 A Icu (1000 V AC) = 30 kA

	48531

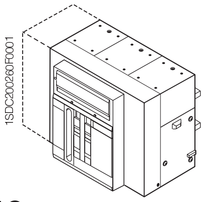
Note: to be specified in addition to the code of the standard version E2N 20 circuit-breaker (Ue=690 V AC) page 9/5 and 9/6

9

Fixed parts .... **page 9/**40 **Terminals** .... **page 9/**41 **Dialogue unit** .... **page 9/**42 **Current transformers** .... **page 9/**43

Ordering codes

SACE Emax automatic circuit-breakers for applications up to 1000V AC



1SDA0.....R1

E3H/E 12

Iu (40 °C) = **1250 A** Icu (1000 V AC) = **50 kA**

48532

Note: to be specified in addition to the code of the standard version E3H 12 circuit-breaker (Ue=690 V AC) page 9/7 and 9/9

E3H/E 16

Iu (40 °C) = **1600 A** Icu (1000 V AC) = **50 kA**

48533

Note: to be specified in addition to the code of the standard version E3H 16 circuit-breaker (Ue=690 V AC) page 9/7 and 9/9

E3H/E 20

Iu (40 °C) = **2000 A** Icu (1000 V AC) = **50 kA**

48534

Note: to be specified in addition to the code of the standard version E3H 20 circuit-breaker (Ue=690 V AC) page 9/7 and 9/9

E3H/E 25

Iu (40 °C) = **2500 A** Icu (1000 V AC) = **50 kA**

48535

Note: to be specified in addition to the code of the standard version E3H 25 circuit-breaker (Ue=690 V AC) page 9/8 and 9/10

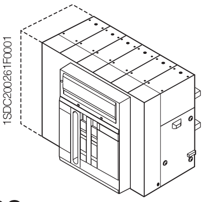
E3H/E 32

Iu (40 °C) = **3200 A** Icu (1000 V AC) = **50 kA**

48536

Note: to be specified in addition to the code of the standard version E3H 32 circuit-breaker (Ue=690 V AC) page 9/8 and 9/10

Fixed parts .... **page 9/**40 **Terminals** .... **pag. 9/**41 **Dialogue unit** .... **page 9/**42 **Current transformers** .... **page 9/**43



1SDA0.....R1

E4H/E 32

Iu (40 °C) = **3200 A** Icu (1000 V AC) = **65 kA**

48537

Note: to be specified in addition to the code of the standard version E4H 32 circuit-breaker (Ue=690 V AC) page 9/11

E4H/E 40

Iu (40 °C) = **4000 A** Icu (1000 V AC) = **65 kA**

48538

Note: to be specified in addition to the code of the standard version E4H 40 circuit-breaker (Ue=690 V AC) page 9/11

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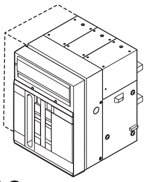
Fixed parts .... page 9/40 Terminals .... page 9/41 Dialogue unit .... page 9/42 Current transformers .... page 9/43

Ordering codes

SACE Emax switch-disconnectors for applications up to 1000V AC



1SDA0.....R1

E2B/E MS 16

Iu (40 °C) = **1600 A** Icw (1 s) = **20 kA**

	48527

Note: to be specified in addition to the code of the standard version E2B/MS 16 circuit-breaker (Ue=690 V AC) page 9/18 and 9/19

E2B/E MS 20

Iu (40 °C) = **2000 A** Icw (1 s) = **20 kA**

	48528

Note: to be specified in addition to the code of the standard version E2B/MS 20 circuit-breaker (Ue=690 V AC) page 9/18 and 9/19

E2N/E MS 12

Iu (40 °C) = **1250 A** Icw (1 s) = **30 kA**

	48529

Note: to be specified in addition to the code of the standard version E2N/MS 12 circuit-breaker (Ue=690 V AC) page 9/18 and 9/19

E2N/E MS 16

Iu (40 °C) = **1600 A** Icw (1 s) = **30 kA**

	48530

Note: to be specified in addition to the code of the standard version E2N/MS 16 circuit-breaker (Ue=690 V AC) page 9/18 and 9/19

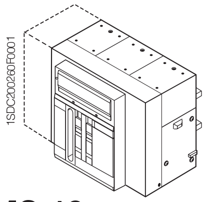
E2N/E MS 20

Iu (40 °C) = **2000 A** Icw (1 s) = **30 kA**

	48531

Note: to be specified in addition to the code of the standard version E2N/MS 20 circuit-breaker (Ue=690 V AC) page 9/18 and 9/19

Fixed parts .... **page 9/**40 **Terminals** .... **page 9/**41



	1SDA0.....R1 3 Poles	4 Poles

E3H/E MS 12
Fixed (F)

Iu (40 °C) = 1250 A **Icw (1 s) = 50 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
Circuit-breaker code	37541	37569
CAdditional code to be specified with the circuit-breaker	48532	48532

E3H/E MS 16
Fixed (F)

Iu (40 °C) = 1600 A **Icw (1 s) = 50 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
Circuit-breaker code	37542	37570
Additional code to be specified with the circuit-breaker	48533	48533

E3H/E MS 20
Fixed (F)

Iu (40 °C) = 2000 A **Icw (1 s) = 50 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
Circuit-breaker code	37543	37571
Additional code to be specified with the circuit-breaker	48534	48534

E3H/E MS 25
Fixed (F)

Iu (40 °C) = 2500 A **Icw (1 s) = 50 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
Circuit-breaker code	37544	37572
Additional code to be specified with the circuit-breaker	48535	48535

E3H/E MS 32
Fixed (F)

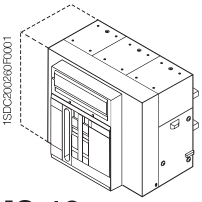
Iu (40 °C) = 3200 A **Icw (1 s) = 50 kA**

HR = Horizontal rear terminals	3 Poles	4 Poles
Circuit-breaker code	37545	37573
Additional code to be specified with the circuit-breaker	48536	48536

Fixed parts .... **page 9/**40 **Terminals** .... **page 9/**41

Ordering codes

SACE Emax switch-disconnectors for applications up to 1000V AC



	1SDA0.....R1 3 Poles	4 Poles

E3H/E MS 12

Withdrawable (W) - MP

Iu (40 °C) = 1250 A Icw (1 s) = 50 kA

MP = Moving part		
Circuit-breaker code	37676	37667
Additional code to be specified with the circuit-breaker	48532	48532

E3H/E MS 16

Withdrawable (W) - MP

Iu (40 °C) = 1600 A Icw (1 s) = 50 kA

MP = Moving part		
Circuit-breaker code	37675	37668
Additional code to be specified with the circuit-breaker	48533	48533

E3H/E MS 20

Withdrawable (W) - MP

Iu (40 °C) = 2000 A Icw (1 s) = 50 kA

MP = Moving part		
Circuit-breaker code	37674	37669
Additional code to be specified with the circuit-breaker	48534	48534

E3H/E MS 25

Withdrawable (W) - MP

Iu (40 °C) = 2500 A Icw (1 s) = 50 kA

MP = Moving part		
Circuit-breaker code	37673	37670
Additional code to be specified with the circuit-breaker	48535	48535

E3H/E MS 32

Withdrawable (W) - MP

Iu (40 °C) = 3200 A Icw (1 s) = 50 kA

MP = Moving part		
Circuit-breaker code	37672	37671
Additional code to be specified with the circuit-breaker	48536	48536

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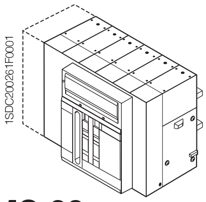
Parti fisse .... pag. 9/40 **Terminali** .... pag. 9/41



1SDA0.....R1

E4H/E MS 32

Iu (40 °C) = **3200 A** Icw (1 s) = **65 kA**

48537

Note: to be specified in addition to the code of the standard version E4H/MS 32 circuit-breaker (Ue=690 V AC) page 9/22

E4H/E MS 40

Iu (40 °C) = **4000 A** Icw (1 s) = **65 kA**

48538

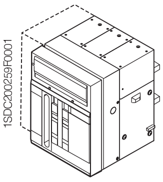
Note: to be specified in addition to the code of the standard version E4H/MS 40 circuit-breaker (Ue=690 V AC) page 9/22

Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax switch-disconnectors for applications up to 1000V DC

	1SDA0.....R1 3 Poles 750V DC	4 Poles 1000V DC



E1B/E MS 08

Fixed (F)

Iu (40 °C) = **800 A** Icw (1 s) = **20 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50617	50607

E1B/E MS 12

Fixed (F)

Iu (40 °C) = **1250 A** Icw (1 s) = **20 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50618	50608

E1B/E MS 08

Withdrawable (W) - MP

Iu (40 °C) = **800 A** Icw (1 s) = **20 kA**

MP = Moving part	3 Poles 750V DC	4 Poles 1000V DC
	50639	50629

E1B/E MS 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icw (1 s) = **20 kA**

MP = Moving part	3 Poles 750V DC	4 Poles 1000V DC
	50640	50630

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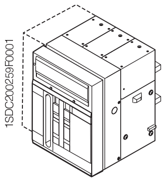
Fixed parts .... page 9/40 Terminals .... page 9/41



1SDA0.....R1	3 Poles 750V DC	4 Poles 1000V DC

E2N/E MS 12
Fixed (F)

Iu (40 °C) = 1250 A Icw (1 s) = 25 kA

HR = Horizontal rear terminals	3 Poles	4 Poles
	50619	50609

E2N/E MS 16
Fixed (F)

Iu (40 °C) = 1600 A Icw (1 s) = 25 kA

HR = Horizontal rear terminals	3 Poles	4 Poles
	50620	50610

E2N/E MS 20
Fixed (F)

Iu (40 °C) = 2000 A Icw (1 s) = 25 kA

HR = Horizontal rear terminals	3 Poles	4 Poles
	50621	50611

E2N/E MS 12
Withdrawable (W) - MP

Iu (40 °C) = 1250 A Icw (1 s) = 25 kA

MP = Moving part	3 Poles	4 Poles
	50641	50631

E2N/E MS 16
Withdrawable (W) - MP

Iu (40 °C) = 1600 A Icw (1 s) = 25 kA

MP = Moving part	3 Poles	4 Poles
	50642	50632

E2N/E MS 20
Withdrawable (W) - MP

Iu (40 °C) = 2000 A Icw (1 s) = 25 kA

MP = Moving part	3 Poles	4 Poles
	50643	50633

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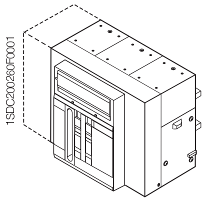
Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax switch-disconnectors for applications up to 1000V DC



1SDA0.....R1	3 Poles 750V DC	4 Poles 1000V DC

E3H/E MS 12

Fixed (F)

Iu (40 °C) = **1250 A** Icw (1 s) = **40 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50622	50612

E3H/E MS 16

Fixed (F)

Iu (40 °C) = **1600 A** Icw (1 s) = **40 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50623	50613

E3H/E MS 20

Fixed (F)

Iu (40 °C) = **2000 A** Icw (1 s) = **40 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50624	50614

E3H/E MS 25

Fixed (F)

Iu (40 °C) = **2500 A** Icw (1 s) = **40 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50625	50615

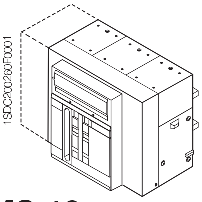
E3H/E MS 32

Fixed (F)

Iu (40 °C) = **3200 A** Icw (1 s) = **40 kA**

HR = Horizontal rear terminals	3 Poles 750V DC	4 Poles 1000V DC
	50626	50616

Fixed parts .... page 9/40 Terminals .... page 9/41



1SDA0.....R1	
3 Poles 750V DC	4 Poles 1000V DC

E3H/E MS 12

Withdrawable (W) - MP

Iu (40 °C) = **1250 A** Icw (1 s) = **40 kA**

MP = Moving part	3 Poles	4 Poles
	50644	50634

E3H/E MS 16

Withdrawable (W) - MP

Iu (40 °C) = **1600 A** Icw (1 s) = **40 kA**

MP = Moving part	3 Poles	4 Poles
	50645	50635

E3H/E MS 20

Withdrawable (W) - MP

Iu (40 °C) = **2000 A** Icw (1 s) = **40 kA**

MP = Moving part	3 Poles	4 Poles
	50646	50636

E3H/E MS 25

Withdrawable (W) - MP

Iu (40 °C) = **2500 A** Icw (1 s) = **40 kA**

MP = Moving part	3 Poles	4 Poles
	50647	50637

E3H/E MS 32

Withdrawable (W) - MP

Iu (40 °C) = **3200 A** Icw (1 s) = **40 kA**

MP = Moving part	3 Poles	4 Poles
	50648	50638

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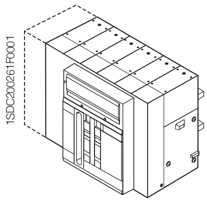
Fixed parts .... **page 9/**40 **Terminals** .... **page 9/**41

Ordering codes

SACE Emax switch-disconnectors for applications up to 1000V DC



1SDA0.....R1
3 Poles
750V DC

E4H/E MS 32
Fixed (F)

Iu (40 °C) = 3200 A **Icw (1 s) = 65 kA**

HR = Horizontal rear terminals	
	50627

E4H/E MS 40
Fixed (F)

Iu (40 °C) = 4000 A **Icw (1 s) = 65 kA**

HR = Horizontal rear terminals	
	50628

E4H/E MS 32
Withdrawable (W) - MP

Iu (40 °C) = 800 A **Icw (1 s) = 65 kA**

MP = Moving part	
	50649

E4H/E MS 40
Withdrawable (W) - MP

Iu (40 °C) = 800 A **Icw (1 s) = 65 kA**

MP = Moving part	
	50650

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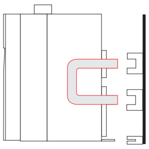
Fixed parts .... page 9/40 Terminals .... page 9/41

Ordering codes

SACE Emax CS sectionalizing truck



	1SDA0.....R1 3 Poles	4 Poles

E1/CS 12
Withdrawable (W) - MP

Iu (40 °C) = **1250 A**

MP = Moving part		
	37752	37753

E2/CS 20
Withdrawable (W) - MP

Iu (40 °C) = **2000 A**

MP = Moving part		
	37762	37769

E3/CS 32
Withdrawable (W) - MP

Iu (40 °C) = **3200 A**

MP = Moving part		
	37763	37768

E4/CS 40
Withdrawable (W) - MP

Iu (40 °C) = **4000 A**

MP = Moving part		
	37764	37767

E6/CS 63
Withdrawable (W) - MP

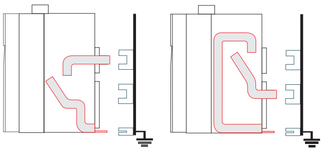
Iu (40 °C) = **6300 A**

MP = Moving part		
	37765	37766

Fixed parts .... page 9/40

Ordering codes

SACE Emax MTP earthing switch



	Earthing of upper clamps 1SDA0.....R1 3 Poles	Earthing of upper clamps 1SDA0.....R1 4 Poles	Earthing of lower clamps 1SDA0.....R1 3 Poles	Earthing of lower clamps 1SDA0.....R1 4 Poles
E1 MTP 12 – **Withdrawable (W) - MP** – Iu (40 °C) = **1250 A** – MP = Moving part	37758	37759	37761	37760
E2 MTP 20 – **Withdrawable (W) - MP** – Iu (40 °C) = **2000 A** – MP = Moving part	37786	37787	37794	37795
E3 MTP 32 – **Withdrawable (W) - MP** – Iu (40 °C) = **3200 A** – MP = Moving part	37789	37788	37796	37797
E4 MTP 40 – **Withdrawable (W) - MP** – Iu (40 °C) = **4000 A** – MP = Moving part	37790	37791	37798	37799
E6 MTP 63 – **Withdrawable (W) - MP** – Iu (40 °C) = **6300 A** – MP = Moving part	37792	37793	37800	37801

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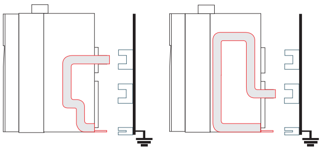
Fixed parts .... page 9/40

Ordering codes

SACE Emax MTP earthing switch

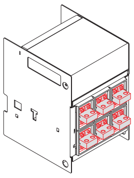
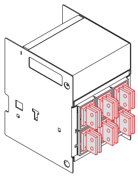
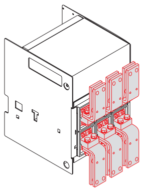
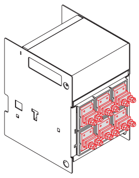


		Earthing of upper clamps		Earthing of lower clamps	
		1SDA0.....R1 3 Poles	4 Poles	1SDA0.....R1 3 Poles	4 Poles
E1 MT 12 Withdrawable (W) - MP	Iu (40 °C) = **1250 A** MP = Moving part	37754	37755	37756	37757
E2 MT 20 Withdrawable (W) - MP	Iu (40 °C) = **2000 A** MP = Moving part	37770	37771	37785	37784
E3 MT 32 Withdrawable (W) - MP	Iu (40 °C) = **3200 A** MP = Moving part	37773	37772	37782	37783
E4 MT 40 Withdrawable (W) - MP	Iu (40 °C) = **4000 A** MP = Moving part	37774	38975	37775	37780
E6 MT 63 Withdrawable (W) - MP	Iu (40 °C) = **6300 A** MP = Moving part	37777	37776	37778	37779

Fixed parts............. page 9/40

Ordering codes

SACE Emax MT earthing truck

HR  VR  F  FL 

			750 V DC	1000 V DC
	1SDA0.....R1 3 Poles	4 Poles	1SDA0.....R1 3 Poles	4 Poles

E1
Withdrawable (W) - PF

PF = Fixed part				
HR	37821	37826	50660	50651
VR	37872	37877	50664	50654
F	37922	37927		
FL	37972	37977	50668	50657

E2
Withdrawable (W) - PF

PF = Fixed part				
HR	37822	37827	50661	50652
VR	37873	37886	50665	50655
F	37923	37928		
FL	37973	37978	50669	50658

E3
Withdrawable (W) - PF

PF = Fixed part				
HR	37823	37828	50662	50653
VR	37874	37878	50666	50656
F	37924	37929		
FL	37974	37979	50670	50659

E4
Withdrawable (W) - PF

PF = Fixed part				
HR	37824	37829	50663	
VR	37875	37879	50667	
F	37925	37930		
FL	37975	37980	50671	

E4/f
Withdrawable (W) - PF

PF = Fixed part				
HR		48702		
VR		48707		
F		48712		
FL		48717		

E6
Withdrawable (W) - PF

PF = Fixed part				
HR	37825	37830		
VR	37876	37880		
F	37926	37931		
FL	37976	37981		

E6/f
Withdrawable (W) - PF

PF = Fixed part				
HR		50816		
VR		50821		
F		50826		
FL		50831		

Ordering codes

Conversion kit for fixed circuit-breaker and fixed parts

Conversion kit

for fixed circuit-breaker and fixed parts

Kit for converting fixed circuit-breaker with horizontal rear terminals to vertical rear terminals	1SDA0.....R1 3 Poles	4 Poles
E1	38052	38057
E2	38053	38058
E3	38054	38059
E4	38055	38060
E6	38056	38061
E4/f	–	48720
E6/f	–	50833

Note:
Each kit fits both upper and lower applications. To convert a complete fixed part, order 2 kits.
For instructions, see page 9/51.

Kit for converting fixed circuit-breaker with horizontal rear terminals to front terminals	1SDA0.....R1 3 Poles	4 Poles
E1	38062	38067
E2	38063	38068
E3	38064	38069
E4	38065	38070
E6	38066	38071
E4/f	–	48719
E6/f	–	50834

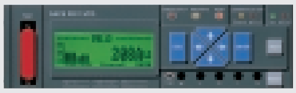
Note:
Each kit fits both upper and lower applications. To convert a complete circuit-breaker, order 2 kits.
For instructions, see page 9/51.

Kit for converting fixed parts with horizontal rear terminals to front terminals	1SDA0.....R1 3 Poles	4 Poles
E1	38062	38067
E2	45031	45035
E3	45032	45036
E4	45033	45037
E6	45034	45038
E4/f	–	48718
E6/f	–	50837

Note:
Each kit fits both upper and lower applications. To convert a complete circuit-breaker, order 2 kits.
For instructions, see page 9/51.

Ordering codes

Modbus® RTU and Lon® Talk dialogue unit



	PR112/PD		PR113/PD
	1SDA0.....R1		1SDA0.....R1

Dialogue unit
PR112/PD-PR113/PD

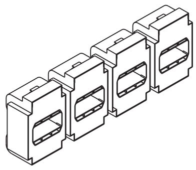
	Modbus® RTU	LON® Talk	Modbus® RTU
LSI	52659	52661	–
LSIG	52660	52662	52663

Note: to be specified only in addition to the code of the automatic circuit-breaker, with analogous overcurrent release (PR112/P and PR113/P).
To order the release separately, see page 9/50.
For instructions, see page 9/51.

9

Ordering codes

Current transformers



1SDC200265F0001

	1SDA0.....R1 3 Poles	4 Poles

E1-E2

In=250A	52574	52579
In=400A	52575	52580
In=800A	52576	52581
In=1000A	52577	52582
In=1250A	52578	52583
In=1600A	53811	53812

Note: to be specified only in addition to the code of the automatic circuit-breaker.
To order the transformers separately, see page 9/50. For instructions, see page 9/51.

E3

In=250A	52584	52591
In=400A	52585	52592
In=800A	52586	52593
In=1000A	52587	52594
In=1250A	52588	52595
In=1600A	52589	52596
In=2000A	52590	52597
In=2500A	53813	53814

Note: to be specified only in addition to the code of the automatic circuit-breaker.
To order the transformers separately, see page 9/50. For instructions, see page 9/51.

E4

In=2000A	52598	52600
In=3200A	52599	52601

Note: to be specified only in addition to the code of the automatic circuit-breaker.
To order the transformers separately, see page 9/50. For instructions, see page 9/51.

E4/f

In=2000A		52602
In=3200A		52603

Note: to be specified only in addition to the code of the automatic circuit-breaker.
To order the transformers separately, see page 9/50. For instructions, see page 9/51.

E6

In=3200A	52604	52606
In=4000A	52605	52607
In=5000A	53815	53816

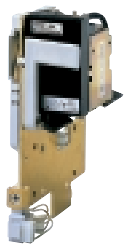
Note: to be specified only in addition to the code of the automatic circuit-breaker.
To order the transformers separately, see page 9/50. For instructions, see page 9/51.

Neutral setting 100% In		43474

Note: to be specified only in addition to the code of the automatic circuit-breaker.

1SDA0.....R1

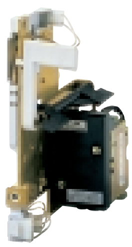
Electrical accessories



Shunt opening release - YO (1a)

E1/6	24V DC	
E1/6	30V AC / DC	38287
E1/6	48V AC / DC	38288
E1/6	60V AC / DC	38289
E1/6	110...120V AC / DC	38290
E1/6	120…127V AC / DC	38291
E1/6	220…240V AC / DC	38292
E1/6	240…250V AC / DC	38293
E1/6	380…400V AC	38294
E1/6	440…480V AC	38295

Note: The shunt opening release (YO) and closing release (YC) share the same construction and are therefore interchangeable. Their function is determined by the position in which they are mounted on the circuit-breaker.



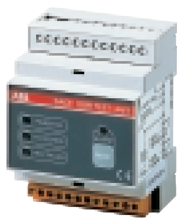
Second shunt opening release - YO2 (1a)

E1/6	24V DC	50157
E1/6	30V AC / DC	50158
E1/6	48V AC / DC	50159
E1/6	60V AC / DC	50160
E1/6	110...120V AC / DC	50161
E1/6	120…127V AC / DC	50162
E1/6	220…240V AC / DC	50163
E1/6	240…250V AC / DC	50164
E1/6	380…400V AC	50165
E1/6	440…480V AC	50166

Note: supplied with special release support.

Shunt closing release - YC (1a)

E1/6	24V DC	38296
E1/6	30V AC / DC	38297
E1/6	48V AC / DC	38298
E1/6	60V AC / DC	38299
E1/6	110...120V AC / DC	38300
E1/6	120…127V AC / DC	38301
E1/6	220…240V AC / DC	38302
E1/6	240…250V AC / DC	38303
E1/6	380…400V AC	38304
E1/6	440…480V AC	38305

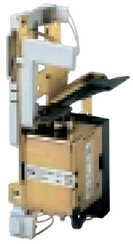


SOR Test Unit - (1b)

E1/6	50228

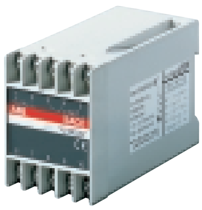
9

1SDA0.....R1



Undervoltage release - YU (2a)

E1/6	24V DC	38306
E1/6	30V AC / DC	38307
E1/6	48V AC / DC	38308
E1/6	60V AC / DC	38309
E1/6	110...120V AC / DC	38310
E1/6	120…127V AC / DC	38311
E1/6	220…240V AC / DC	38312
E1/6	240…250V AC / DC	38313
E1/6	380…400V AC	38314
E1/6	440…480V AC	38315



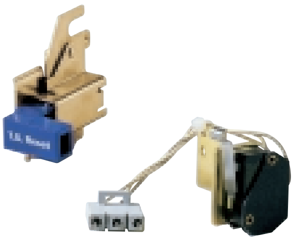
Electronic time-delay device for undervoltage release - D (2b)

E1/6	24...30V AC / DC	38316
E1/6	48V AC / DC	38317
E1/6	60V AC / DC	38318
E1/6	110...127V AC / DC	38319
E1/6	220…250V AC / DC	38320

Gearmotor for the automatic charging of the closing springs - M (3)

E1/6	24...30V AC / DC	38321
E1/6	48…60V AC / DC	38322
E1/6	100...130V AC / DC	38323
E1/6	220…250V AC / DC	38324

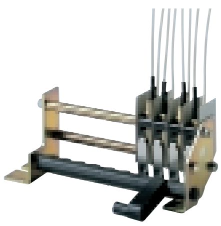
Note: supplied as standard with limit contact and microswitch to signal when the closing springs are charged (accessory 5c).



Signalling for overcurrent releases tripped - (4a)

E1/6	Electrical signalling of releases tripped (*) (4a)	38338
E1/6	Mechanical signalling of releases tripped (4b)	38337

(*) Also order the mechanical signal



Electrical signalling of circuit-breaker open/closed - (5a)

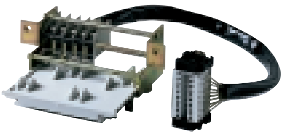
E1/6	4 auxiliary contacts	38326 (a)
E1/6	4 auxiliary contacts for digital signals	50153
E1/6	10 auxiliary contacts (installed)	46523 (b)
E1/6	10 auxiliary contacts (not installed)	38327 (c)
E1/6	10 auxiliary contacts for digital signals	50152 (d)
E1/6	15 supplementary auxiliary contacts	43475 (e)
E1/6	15 supplementary auxiliary contacts (for withdrawable version)	48827 (e)
E1/6	15 supplementary auxiliary contacts for digital signals	50145 (e)
E1/6	15 supplementary auxiliary contacts for digital signals (for withdrawable version)	50151 (e)

Note: (a) order only for MS and MTP versions. Already included with automatic circuit-breakers
(b) available only mounted with automatic circuit-breakers. Cannot be used with PR112 and PR 113 releases.
(c) available only for MS and MTP versions, or separately for automatic circuit-breakers. Cannot be used with PR112 and PR 113 releases.
(d) cannot be used with PR112 and PR 113 releases.
(e) outside the circuit-breaker. Order as an alternative to the various types of mechanical interlocks (accessory 10) and mechanical compartment door lock (accessory 8e).

Ordering codes

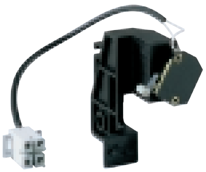
SACE Emax accessories

		1SDA0.....R1 3 Poli	4 Poli



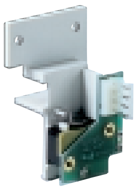
Electrical signalling of circuit-breaker racked-in/test isolated/racked-out - (5b)

		3 Poli	4 Poli
E1/6	5 auxiliary contacts	38361	38361
E1-E2	10 auxiliary contacts	38360	43467
E3	10 auxiliary contacts	43468	43469
E4-E6	10 auxiliary contacts	43470	43470
E1/6	5 auxiliary contacts for digital signals	50146	50146
E1-E2	10 auxiliary contacts for digital signals	50147	50148
E4-6	10 auxiliary contacts for digital signals	50147	50147
E3	10 auxiliary contacts for digital signals	50149	50150



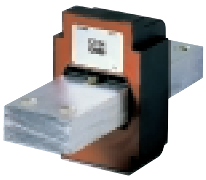
Contact for signalling closing spring charged - (5c)

	1SDA0.....R1
E1/6	38325



Contact for signalling undervoltage release energized - (5d)

E1/6	1 normally-closed contact	38341
E1/6	1 normally-open contact	38340



Current transformer for neutral conductor outside the circuit-breaker - (6a)

E1-E2	In=250A		38269
E1-E2	In=400A		38270
E1-E2	In=800A		38271
E1-E2	In=1000A		50079
E1-E2	In=1250A		38272
E2	In=1600A		38273
E2	In=2000A		38274
E3	In=250A		48952
E3	In=400A		48953
E3	In=800A		38277
E3	In=1000A		50084
E3	In=1250A		38278
E3	In=1600A		38279
E3	In=2000A		38280
E3	In=2500A		38281
E3	In=3200A		38282
E4	In=2000A	Iu N=2000A	48957
E4	In=3200A	Iu N=2000A	38275
E4	In=4000A	Iu N=2000A	38276
E4	In=2000A	Iu N=4000A	53098
E4	In=3200A	Iu N=4000A	53100
E4	In=4000A	Iu N=4000A	53102
E6	In=3200A	Iu N=3200A	48958
E6	In=4000A	Iu N=3200A	38283
E6	In=5000A	Iu N=3200A	38284
E6	In=6300A	Iu N=3200A	38285
E6	In=3200A	Iu N=6300A	53103
E6	In=4000A	Iu N=6300A	53104
E6	In=5000A	Iu N=6300A	53105
E6	In=6300A	Iu N=6300A	53106

Note: Iu N refers to the maximum neutral conductor capacity. The current transformer for the external neutral must be chosen to match the rated current In of the circuit-breaker current transformers.

9

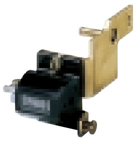
Homopolar toroid for the main power supply earthing conductor - (6b)

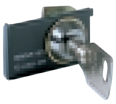
E1/6	In=100A	48067
E1/6	In=250A	48068
E1/6	In=400A	48069
E1/6	In=800A	48070

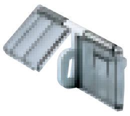
Mechanical accessories

Mechanical operation counter - (7)

E1/6	38345







Lock in open position - (8a)

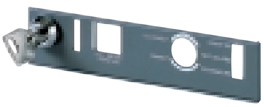
key locks

E1/6	for 1 circuit-breaker (different keys)	38350
E1/6	for sets of circuit-breakers (same keys N.3004222)	38346
E1/6	for sets of circuit-breakers (same keys N.0025431)	38347
E1/6	for sets of circuit-breakers (same keys N.0233424)	38348
E1/6	for sets of circuit-breakers (same keys N.0335452)	38349

padlocks

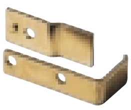
E1/6	38351 (a)

Note: (a) Order as an alternative to the protective cover for opening and closing pushbuttons (accessory 9a)



Circuit-breaker lock in racked-in/test isolated/racked-out position - (8b)

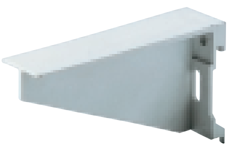
E1/6	for 1 circuit-breaker (different keys)	38356
E1/6	for sets of circuit-breakers (same keys N.3004222)	38352
E1/6	for sets of circuit-breakers (same keys N.0025431)	38353
E1/6	for sets of circuit-breakers (same keys N.0233424)	38354
E1/6	for sets of circuit-breakers (same keys N.0335452)	38355



Accessory for lock in test isolated/racked-out position - (8c)

E1/6	38357

Note: Order to complete the circuit-breaker lock in racked-in/test isolated/racked-out position (accessory 8b)



Accessory for shutter padlock device - (8d)

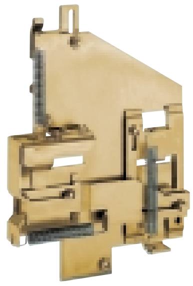
E1/6	38363

9

Ordering codes

SACE Emax accessories

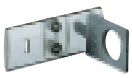
1SDA0.....R1



Mechanical compartment door lock - (8e)

E1/6	45039

Note: – Order with interlock for fixed circuit-breaker/moving part of withdrawable circuit-breaker (accessory 10.2)
– for fixed version, also order the interlock plate 10.4
– order as an alternative to cable interlocks (accessory 10.1), and to the 15 supplementary auxiliary contacts (accessory 5a).



Protection cover for opening and closing pushbuttons - (9a)

E1/6	38343

Note: Order as an alternative to the padlock device in open position (accessory 8a).

IP54 Door protection - (9b)

E1/6	38344

Sealable relay protection - (9c)

E1/6	48721

Mechanical interlock - (10)

For instructions see pages 9/52 and 9/53.

10.1 Interlock cables for fixed circuit-breakers or fixed parts

E1/6	A - horizontal	38329
E1/6	B - horizontal	38330
E1/6	C - horizontal	38331
E1/6	D - horizontal	38332
E1/6	A - vertical	38333
E1/6	B - vertical	38334
E1/6	C - vertical	38335
E1/6	D - vertical	38336

Note: Order one type of cable for each interlock. Order on one of the fixed circuit-breakers or on one of the fixed parts.

10.2 Interlock for fixed circuit-breaker/moving part of withdrawable circuit-breaker

	1SDA0.....R1 3 Poles	 4 Poles
E1-E2	38366	38366
E3	38367	38367
E4	38368	43466
E6	43466	38369

Note: Order one accessory for each fixed circuit-breaker/moving part of withdrawable circuit-breaker.

10.3 Interlock for fixed circuit-breaker/fixed part of withdrawable circuit-breaker

E1/6	Interlock A / B / D	38364
E1/6	Interlock C	38365

Note: Order one accessory for each fixed circuit-breaker/fixed part of withdrawable circuit-breaker.

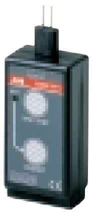
10.4 Interlock plate for fixed circuit-breaker

E1/6	38358

Note: Order only for fixed circuit-breaker.

1SDA0.....R1

Auxiliary units



Automatic transfer- switch ATS010 - (11)

E1/6	ATS010	52927

TT1 Test unit

E1/6	TT1	37121

PR010/T Test and programming unit

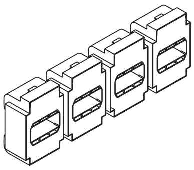
E1/6	PR010/T	48964

PR020/K Signalling unit

E1/6	PR020/K	53337

Ordering codes

Microprocessor-based releases and current transformers (when supplied separately)



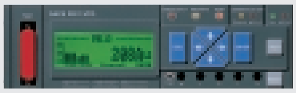
1SDC200265F0001

Microprocessor-based releases

	PR111/P	PR112/P	PR113/P
	1SDA0.....R1	**1SDA0.....R1**	**1SDA0.....R1**
LI	38013		
LSI	38012	38010	
LSIG	38011	38009	52655

Note: codes to use when ordering the releases separately, not mounted on the circuit-breaker

	PR112/PD	PR113/PD
	1SDA0.....R1	**1SDA0.....R1**
Modbus ® RTU		
LSI Modbus	52651	
LSIG Modbus	52652	52656

Note: codes to use when ordering the releases separately, not mounted on the circuit-breaker

LON ® Talk		
LSI Lon	52653	
LSIG Lon	52654	

Note: codes to use when ordering the releases separately, not mounted on the circuit-breaker

Current transformers

		1SDA0.....R1 3 Poles	4 Poles
E1-E2	In=250A	38014	38020
E1-E2	In=400A	38015	38021
E1-E2	In=800A	38016	38022
E1-E2	In=1000A	50072	50566
E1-E2	In=1250A	38017	38023
E2	In=1600A	38018	38024
E2	In=2000A	38019	38025
E3	In=250A	48741	48742
E3	In=400A	48743	48744
E3	In=800A	38026	38032
E3	In=1000A	50074	50567
E3	In=1250A	38027	38033
E3	In=1600A	38028	38034
E3	In=2000A	38029	38035
E3	In=2500A	38030	38036
E3	In=3200A	38031	38037
E4	In=2000A	38038	38041
E4	In=3200A	38039	38042
E4	In=4000A	38040	38043
E4/f	In=2000A	–	48733
E4/f	In=3200A	–	48734
E4/f	In=4000A	–	48735
E6	In=3200A	38044	38048
E6	In=4000A	38045	38049
E6	In=5000A	38046	38050
E6	In=6300A	38047	38051
E6/f	In=5000 A	–	50838
E6/f	In=6300 A	–	50839

Note: codes to use when ordering the current transformers separately.

9

Ordering codes

Order examples

1) Additional codes

Instructions for ordering

Standard version Emax series circuit-breakers are identified by means of commercial codes that may be modified by adding the following variables:

- **Codes for Terminal Kits for fixed circuit-breakers (other than rear horizontal)**
- **Additional codes for Current transformer settings (for current values below rated)**
- **Additional codes for Protection releases with Dialogue Unit**
- **Additional codes for Special version for rated service voltages up to 1000V AC**

The aforementioned types of variables may also be requested on the circuit-breaker itself.
The additional codes indicate variables that are not in addition to, but in replacement of the specifications of the basic circuit-breaker.
That is why these commercial codes may be ordered solely in combination with the circuit-breaker, and not as separate parts.
For releases (which already include a Dialogue unit) and Current transformers ordered as spare parts for replacement by the customer, see the coding section “Microprocessor-based releases and current transformers (when ordered separately)”.

Example n. 1
Codes for Terminal Kits for fixed circuit-breakers (other than rear horizontal)

Emax E3N 3-pole fixed with Vertical rear terminals (VR)	
1SDA040790R1	E3N 3200 PR112/P-LSI-In=3200A 3p F HR
1SDA038054R1	KIT 1/2 3p F HR>F VR E3
1SDA038054R1	KIT 1/2 3p F HR>F VR E3

Example n. 2

Emax E3N 3-pole fixed with Vertical rear (VR) upper and Front (F) lower terminals	
1SDA040790R1	E3N 3200 PR112/P-LSI-In=3200A 3p F HR
1SDA038055R1	KIT 1/2 3p F HR>F VR E4
1SDA038064R1	KIT 1/2 3p F HR>F F E3

Notes for examples 1 and 2
The codes for terminal kits indicate 3 or 4 pieces (for mounting on top or bottom terminals).
To convert a complete circuit-breaker, order 2 identical kits or 2 different kits for mixed terminals.
For mixed solutions, the first code indicates the 3 or 4 terminals to be mounted above, while the second indicates the 3 or 4 terminals to be mounted below.

Example n. 3
Additional codes for Current transformer settings (for current values below rated)

Emax E3N 3200 3-pole fixed with In=2000A	
1SDA040790R1	E3N 3200 PR112/P-LSI-In=3200A 3p F HR
1SDA052590R1	Additional code for Current transformer and cables for E3 - In 2000A - 3 poles

Example n. 4
Additional codes for Protection releases with dialogue unit

Emax E3N 3200 3-pole fixed with PR112/PDM LSI	
1SDA040790R1	E3N 3200 PR112/P-LSI-In=3200A 3p F HR
1SDA052659R1	Additional code for PR112/PDM LSI microprocessor-based release with Modbus dialogue

Example n. 5
Additional codes for Special version for rated service voltages up to 1000V AC

Emax E3H/E 2000 3-pole fixed (version up to 1000V AC)	
1SDA041729R1	E3H 2000 PR111/P-LI-In=2000A 3p F HR
1SDA048534R1	Emax E3H/E20 special version circuit-breaker 1000V AC

2) Mechanical interlocks

Instructions for ordering

All mechanical interlocks for any SACE Emax circuit-breaker is made up of various components, each of which has been coded to ensure the greatest possible flexibility of the accessory.

The accessory components are described below

- **Cables for interlock** (Ref. 10.1 page **9/**48)

One type of cable must be ordered for each interlock.
Flexible cables must be fastened to the fixed circuit-breakers or fixed parts (in the case of withdrawable circuit-breakers) and to the switchboard structures using adhesive plates and self-locking bands.

- **Interlock for fixed circuit-breaker/moving part for withdrawable circuit-breaker** (Ref. 10.2 page **9/**48)

This is the accessory that must be installed on the moving part of the withdrawable circuit-breaker or on the side of the fixed circuit-breaker.
This accessory must be ordered for each fixed circuit-breaker and for each moving part of the withdrawable circuit-breaker.

- **Interlock for fixed circuit-breaker/fixed part of withdrawable circuit-breaker** (Ref. 10.3 page **9/**48)

This is the accessory that must be installed on the fixed part of the withdrawable circuit-breaker or on the interlock plate of the fixed circuit-breaker (which simulates the fixed part of the withdrawable circuit-breaker).
This accessory must be ordered for each fixed circuit-breaker and for each fixed part of the withdrawable circuit-breaker.

- **Interlock plate for fixed circuit-breaker** (Ref. 10.4 page **9/**48)

It must be requested for each fixed circuit-breaker present in the interlock.

For each circuit-breaker used in the interlock, depending on the type of circuit-breaker, the accessories listed in the figures below must be ordered.
A single group of cables ("Cables for interlock" ref. 10.1) must be ordered **for each interlock**.
In particular, either a fixed circuit-breaker or one of the fixed parts must be specified.

The examples beside show a general guide to the types of accessories that must be ordered for the various versions of circuit-breakers and type of interlock:

1. Interlock between two fixed circuit-breakers

10.1 10.2 10.3 10.4	10.2 10.3 10.4

2. Interlock between two withdrawable circuit-breakers

10.1 10.2 10.3 10.4	10.2 10.3 10.4	10.2 10.3 10.4

3. Interlock between three fixed circuit-breakers

PF	10.1 10.3	10.3
PM	10.2	10.2

4. Interlock between three withdrawable circuit-breakers

PF	10.1 10.3	10.3	10.3
PM	10.2	10.2	10.2

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Example n. 6

An interlock is to be made between two Type A circuit-breakers. In particular, the following are to be interlocked:

– a SACE E3 3-pole fixed circuit-breaker
– with a SACE E4 4-pole withdrawable circuit-breaker;

the circuit-breakers are placed horizontally in the switchboard.

Below are listed the codes to use when ordering:

Pos	Code	Description
100	**SACE E3 fixed circuit-breaker**	
	1SDA038329R1	Type A interlock cables for fixed circuit-breakers or fixed parts - horizontal E1/6
	1SDA038367R1	Interlock for fixed circuit-breaker/moving part of withdrawable circuit-breaker E3
	1SDA038364R1	Interlock for fixed CB / fixed part of withdrawable CB - Interlock Type A/B/D E1/6
	1SDA038358R1	Interlock plate for fixed circuit-breaker E1/6
200	**SACE E4 moving part of withdrawable circuit-breaker**	
	1SDA043466R1	Interlock for fixed c.-breaker/moving part of withdrawable c.-breaker 4p E4 / 3p E6
300	**Fixed part SACE E4**	
	1SDA038364R1	Interlock for fixed CB / fixed part of withdrawable CB - Interlock Type A/B/D E1/6

Example n.7

Here, an interlock is desired between three Type C vertical circuit-breakers with the following circuit-breakers:

– SACE E2 3-pole withdrawable circuit-breaker
– SACE E3 3-pole fixed circuit-breaker
– SACE E6 4-pole fixed circuit-breaker

In this case, use the following codes when ordering:

Pos	Code	Description
100	**SACE E2 moving part of withdrawable circuit-breaker**	
	1SDA038366R1	Interlock for fixed circuit-breaker/moving part of withdrawable circuit-breaker E1-E2
200	**SACE E2 Fixed part**	
	1SDA038335R1	Type C interlock cables for fixed circuit-breakers or fixed parts - vertical E1/6
	1SDA038365R1	Interlock for fixed CB / fixed part of withdrawable CB - Type C Interlock E1/6
300	**SACE E3 fixed circuit-breaker**	
	1SDA038367R1	Interlock for fixed CB / moving part of withdrawable CB - Interlock E3
	1SDA038365R1	Interlock for fixed CB / fixed part of withdrawable CB - Type C Interlock E1/6
	1SDA038358R1	Interlock plate for fixed circuit-breaker E1/6
400	**SACE E6 fixed circuit-breaker**	
	1SDA038369R1	Interlock for fixed CB / moving part of withdrawable CB - Interlock 4p E6
	1SDA038365R1	Interlock for fixed CB / fixed part of withdrawable CB - Type C Interlock E1/6
	1SDA038358R1	Interlock plate for fixed circuit-breaker E1/6