



X1 by Emax






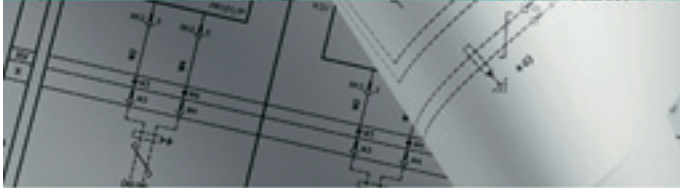
Low voltage power
circuit breakers

1SDC200018D0201 - 2008 Edition





Overview

	Main characteristics and ranges	1
	Installations	2
	Trip units and related accessories	3
	Accessories	4
	Overall dimensions	5
	Circuit diagrams	6

New X1 by Emax. The great little power circ



circuit breaker.

The X1

circuit breaker by

Emax comes from more than 60 years' experience of ABB SACE, a world leader in constructing molded case and power circuit breakers.

Our know-how, appreciated and recognised world-wide, has allowed us to obtain results which will amaze you. X1 by Emax is really small, powerful and safe. In fact, the search for extremely compact dimensions has not in any way affected the reliability and safety standards, because what counts most of all at ABB is the excellence of quality of our products.

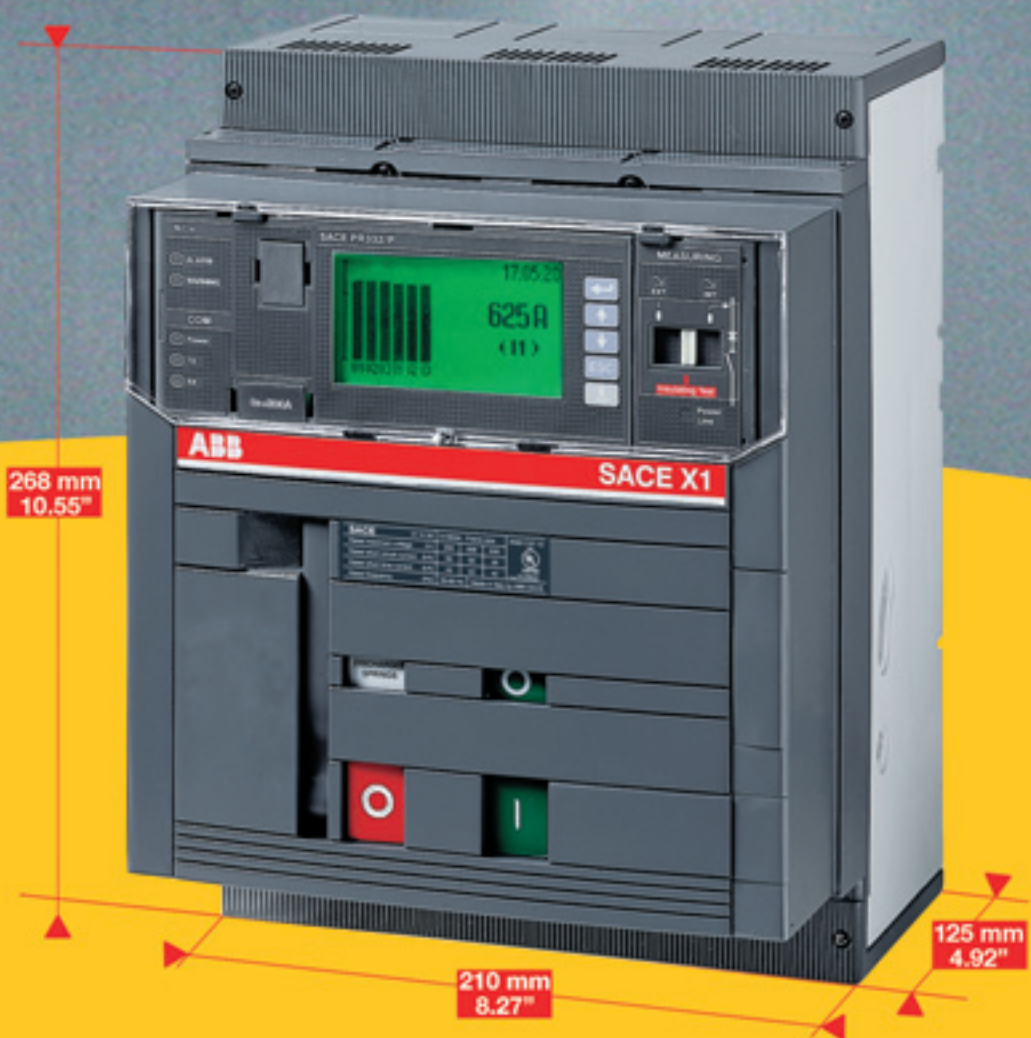
The new X1 by Emax is revolutionary from all points of view. For example, the new rapid accessory fitting system: no wires inside the circuit breaker, rapid and safe connection to the external circuit, and no screws for connection to the external power supply.

New X1 by Emax. Small and powerful.



The performance of a power circuit breaker with extremely compact dimensions. X1 by Emax is the best solution for all those applications where dimensions are an important and determining factor in selecting the circuit breaker, but without necessarily having to give up high rated current, breaking capacity or short-time withstand current values.

Its performances are really astonishing when put in relation to its dimensions. Rated current I_u up to 800 A. Performances proven by reliability, safety and ABB SACE's high quality standards.



268 mm
10.55"

210 mm
8.27"

125 mm
4.92"



New X1 by Emax. Small is better.

The decidedly compact dimensions offer enormous benefits in terms of easier installation and wiring cabling – the space for curving the wires cables or for busbar passage definitely becomes greater. Furthermore, the smaller dimensions allow optimisation of installations, making them decidedly slimmer, also thanks to new and extremely effective installation solutions.

For the first time, a power circuit breaker can be installed on a back plate and in a horizontal position, both in the fixed and draw out version. Moreover, with the new racking-in system of the moving part, its operation becomes even safer because it prevents accidental or unwarranted and potentially hazardous operations.





New X1 by Emax. Small and intelligent.

X1 by Emax has three brand-new latest generation electronic trip units available: PR331/P, PR332/P and PR333/P, which are definitely to the fore in the present panorama of protection trip units for low voltage circuit breakers. The basic version, PR331/P, is fitted with dip-switches for setting the protection thresholds and, for each protection function, has a LED for signalling that the protection has tripped. On the other hand, PR332/P and PR333/P are fitted with a large graphic display which allows all the information needed (settings of the protection functions, alarms and electrical values) to be displayed simply and clearly. Apart from the "classic" protection functions, all three trip units offer advanced functions, such as the exclusive Data Logger function, which allows all the events and values prior to a fault to be recorded for subsequent analysis.





by

emax

SACE PR332(P)

WARNING

COM

- Power
- TX
- RX

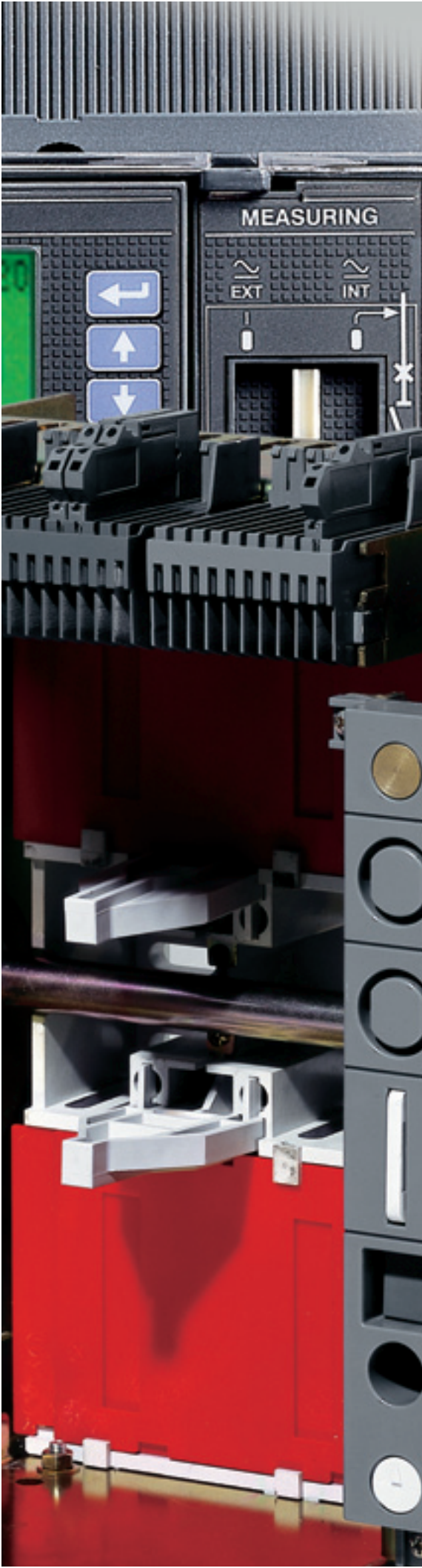
In-800A



ABB



SACE X1



Main characteristics

Contents

Emax family circuit breakers in accordance with IEC 60947-2

Fields of application..... 1/2

Emax X1 UL power circuit breakers 1/4

Construction characteristics

Structure of the circuit breaker 1/6

Operating mechanism 1/7

Operating and signalling parts..... 1/8

Cradles of draw out circuit breakers 1/9

Versions and connections..... 1/10

Electronic trip units

General characteristics..... 1/11

Versions available 1/13

Rating plugs 1/14

Compliance with Standards

A design dedicated to Quality and respect for the environment 1/15



Emax family circuit breakers in accordance with IEC 60947-2

Fields of application

1

		X1			E1		E2			
Automatic circuit breakers		X1B	X1N	X1L	E1B	E1N	E2B	E2N	E2S	E2L
Poles	[No.]	3-4			3 - 4		3 - 4			
4p CB neutral current-carrying capacity	[% Iu]	100			100		100			
Iu	(40 °C) [A]	630-800-1000-1250-1600	630-800-1000-1250-1600	630-800-1000-1250-1600	800-1000-1250-1600	800-1000-1250-1600	1600-2000	1000-1250-1600-2000	800-1000-1250-1600-2000	1250-1600
Ue	[V~]	690	690	690	690	690	690	690	690	690
Icu	(220...415V) [kA]	42	65	150	42	50	42	65	85	130
Ics	(220...415V) [kA]	42	50	150	42	50	42	65	85	130
Icw	(1s) [kA]	42	42	15	42	50	42	55	65	10
	(3s) [kA]				36	36	42	42	42	-
Automatic circuit breakers with full-size neutral conductor		Standard version			Standard version		Standard version			
Poles	[No.]	Standard version			Standard version		Standard version			
4p CB neutral current-carrying capacity	[% Iu]	Standard version			Standard version		Standard version			
Iu	(40 °C) [A]	Standard version			Standard version		Standard version			
Ue	[V~]	Standard version			Standard version		Standard version			
Icu	(220...415V) [kA]	Standard version			Standard version		Standard version			
Ics	(220...415V) [kA]	Standard version			Standard version		Standard version			
Icw	(1s) [kA]	Standard version			Standard version		Standard version			
	(3s) [kA]	Standard version			Standard version		Standard version			
Switch-disconnectors		X1B/MS			E1B/MS	E1N/MS	E2B/MS	E2N/MS	E2S/MS	
Poles	[No.]	3-4			3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	
Iu	(40 °C) [A]	1000-1250-1600			800-1000-1250-1600	800-1000-1250-1600	1600-2000	1000-1250-1600-2000	1000-1250-1600-2000	
Ue	[V~]	690			690	690	690	690	690	
Icw	(1s) [kA]	42			42	50	42	55	65	
	(3s) [kA]				36	36	42	42	42	
Icm	(220...440V) [kA]	88.2			88,2	105	88,2	121	143	
Automatic circuit breakers for applications up to 1150 V AC *		X1B/E					E2B/E	E2N/E		
Poles	[No.]	3-4					3 - 4	3 - 4		
Iu	(40 °C) [A]	630-800-1000-1250-1600					1600-2000	1250-1600-2000		
Ue	[V~]	1000					1150	1150		
Icu	(1150V) [kA]	20					20	30		
Ics	(1150V) [kA]	20					20	30		
Icw	(1s) [kA]	20					20	30		
Switch-disconnectors for applications up to 1150 V AC *		X1B/E MS					E2B/E MS	E2N/E MS		
Poles	[No.]	3-4					3 - 4	3 - 4		
Iu	(40 °C) [A]	1000-1250-1600					1600-2000	1250-1600-2000		
Ue	[V~]	1000					1150	1150		
Icw	(1s) [kA]	20					20	30		
Icm	(1000V) [kA]	40					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]				42		52,5			
	(1000V) [kA]				42		52,5			
Sectionalizing truck					E1 CS		E2 CS			
Iu	(40 °C) [A]				1250		2000			
Grounding switch with making capacity					E1 MTP		E2 MTP			
Iu	(40 °C) [A]				1250		2000			
Grounding truck					E1 MT		E2 MT			
Iu	(40 °C) [A]				1250		2000			

(*) 1000V for Emax X1.

E3					E4			E6	
E3N	E3S	E3H	E3V	E3L	E4S	E4H	E4V	E6H	E6V
3 - 4					3 - 4			3 - 4	
100					50			50	
2500-3200	1000-1250-1600-2000-2500-3200	800-1000-1250-1600-2000-2500-3200	800-1250-1600-2000-2500-3200	2000-2500	4000	3200-4000	3200-4000	4000-5000-6300	3200-4000-5000-6300
690	690	690	690	690	690	690	690	690	690
65	75	100	130	130	75	100	150	100	150
65	75	85	100	130	75	100	150	100	125
65	75	75	85	15	75	100	100	100	100
65	65	65	65	-	75	75	75	85	85
					E4S/f	E4H/f	E6H/f		
Standard version					4	4	4		
					100	100	100		
					4000	3200-4000	4000-5000-6300		
					690	690	690		
					80	100	100		
					80	100	100		
					80	85	100		
					75	75	100		
E3N/MS	E3S/MS	E3V/MS			E4S/MS	E4H/MS	E4H/f MS	E6H/MS	E6H/f MS
3 - 4	3 - 4	3-4			3 - 4	3 - 4	4	3-4	4
2500-3200	1000-1250-1600-2000-2500-3200	800-1250-1600-2000-2500-3200			4000	3200-4000	3200-4000	4000-5000-6300	4000-5000-6300
690	690	690			690	690	690	690	690
65	75	85			75	100	85	100	100
65	65	65			75	75	75	85	85
143	165	286			165	220	220	220	220
E3H/E					E4H/E		E6H/E		
3 - 4					3 - 4		3 - 4		
1250-1600-2000-2500-3200					3200-4000		4000-5000-6300		
1150					1150		1150		
30 (*)					65		65		
30 (*)					65		65		
30 (*)					65		65		
E3H/E MS					E4H/E MS		E6H/E MS		
3 - 4					3 - 4		3 - 4		
1250-1600-2000-2500-3200					3200-4000		4000-5000-6300		
1150					1150		1150		
50					65		65		
105					143		143		
E3H/E MS					E4H/E MS		E6H/E MS		
3 - 4					3 - 4		3 - 4		
1250-1600-2000-2500-3200					3200-4000		4000-5000-6300		
750 (3p)-1000(4p)					750 (3p) - 1000 (4p)		750 (3p) - 1000 (4p)		
40					65		65		
105					143		143		
105					143		143		
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		



Emax X1 UL power circuit breakers

1

Common data		
Voltages		
Rated maximum voltage	[V]	635
Rated voltage	[V]	600
Test voltage (1min. at 50/60 Hz)	[kV]	2,2
Frequency f	[Hz]	50 - 60
Number of poles		3 - 4
Versions		Fixed (F) - Draw out (W)



Emax X1 automatic circuit breakers	X1
Level of performance	N - A
Currents	
Frame size	[A] 800
Capacity of neutral pole for four-pole circuit breakers	[%Iu] 100
Rated short circuit current	
240 V ~	[kA] 50
480 V ~	[kA] 50
600 V ~	[kA] 35
Rated short time current	[kA] 42
Overcurrent protection	
Electronic trip units for AC application	-
Trip times	
Make time (max)	[ms] 80
Break time (I<ST current) (max) ⁽¹⁾	[ms] 70
Break time (I>ST current) (max)	[ms] 30
Overall dimensions	
Fixed: H = 268 mm/10.55 in - D = 181 mm/7.12 in	
W (3/4 poles)	[mm] 210/280
W (3/4 poles)	[in] 8.27/11.02
Draw out: H = 343 mm/13.50 in - D = 254 mm/10 in	
W (3/4 poles)	[mm] 284/354
W (3/4 poles)	[in] 11.18/13.94
Weights (circuit breaker complete with trip unit and CS, excluding accessories)	
Fixed 3/4 poles	[kg] 11/14
3/4 pole	[lbs] 24.25/30.86
Draw out 3/4 poles (including fixed part)	[kg] 32/42.6
3/4 pole	[lbs] 70.55/93.92

(1) Without intentional delays.

	X1 N-A
Continuous current rating	[A] 800
Mechanical life with regular ordinary maintenance	[No. operations x 1000] 12,5
Operation frequency	[Operations/hour] 60
Electrical life	[No. operations x 1000] 6
	[No. operations x 1000] 3
Operation frequency	[Operations/hour] 30

1SDC200017R010



Emax X1 N-A switch

The Emax X1 N-A switch is derived from the corresponding circuit breaker, of which it maintains the overall dimensions and the possibility of mounting accessories.

This version only differs from the circuit breaker in the absence of the trip unit. The circuit breaker is available in both fixed and draw out, three-pole and four-pole versions. The switch is identified by the code “/MS” (on the label).

		X1N-A/MS
Continuous current rating	[A]	800
Rated voltage	[V]	600
Rated short time current (1s)	[kA]	42

Note: the breaking capacity I_{cu} , by means of external protection relay, with 500ms maximum timing, is equal to the value of I_{cw} (1s).



Construction characteristics

Structure of the circuit breaker

The structure of the Emax X1 power circuit breaker is extremely compact, considerably reducing overall dimensions. Furthermore, another very important characteristic of X1 is the possibility of installing it both in vertical or lying down position. Thus, it's possible to reduce in a consistent manner the switchgear dimensions. For example, thanks to a very low width, the number of the circuit breakers in the switchgear's column can be increased by making a lying installation.





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 geared motor, supplied on request.

The opening springs are charged automatically during the closing operation.

With the operating mechanism fitted with closing coil and shunt trips and the geared motor for charging the springs, the circuit breaker can be operated by remote control and, if required, managed by a supervision and control system.



The following operating cycles are possible without recharging the springs:

- starting with the circuit breaker open (O) and the springs charged:
closing-opening
- starting with the circuit breaker closed (I) and the springs charged:
opening-closing-opening.

The operating mechanism is fitted with a mechanical and electrical anti-pumping device.

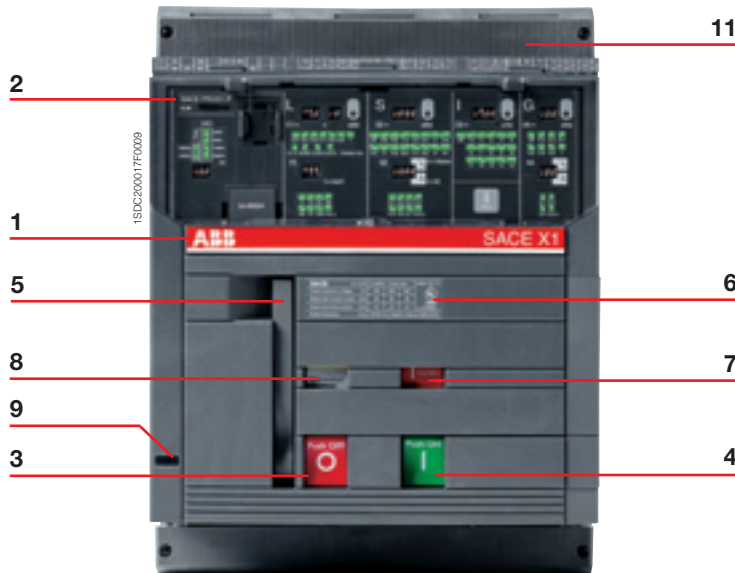


Construction characteristics

Operating and signalling parts

1

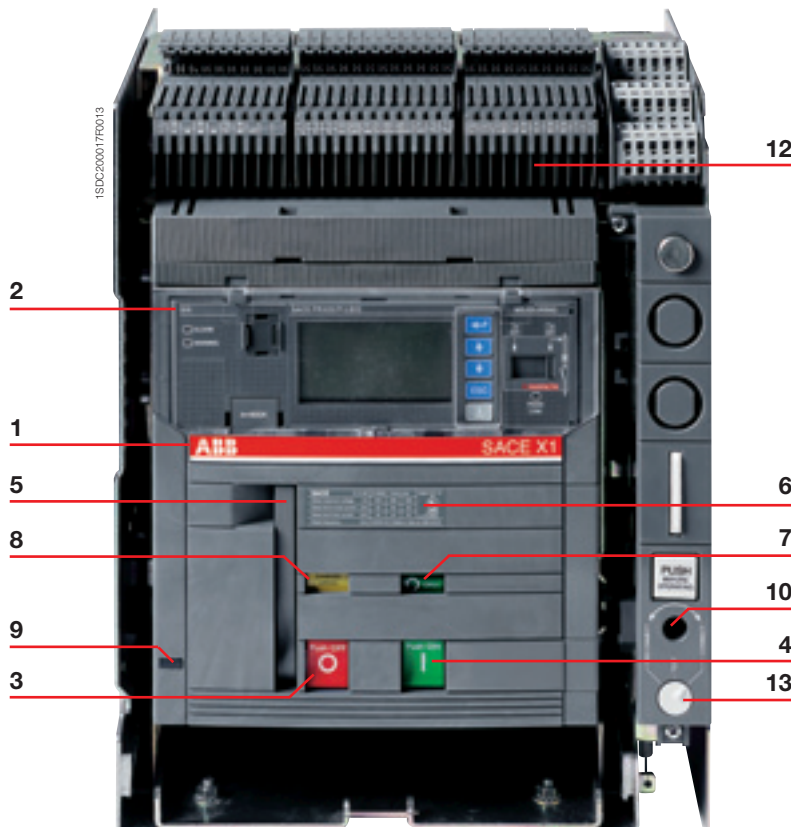
Fixed version



Caption

- 1 Trademark and size of circuit breaker
- 2 PR331/P, PR332/P or PR333/P trip units
- 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 signalling of overcurrent releases tripped (TRIP RESET)
- 10 Racking-in/out device (for draw out version only)
- 11 Terminal box (for fixed version only)
- 12 MP sliding contacts (for draw out version only)
- 13 Circuit breaker position indicator: racked-in/ test isolated /racked-out / connected/test isolated/disconnected (for draw out version only)

Draw out version



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, whereas the auxiliary contacts are connected.



Construction characteristics

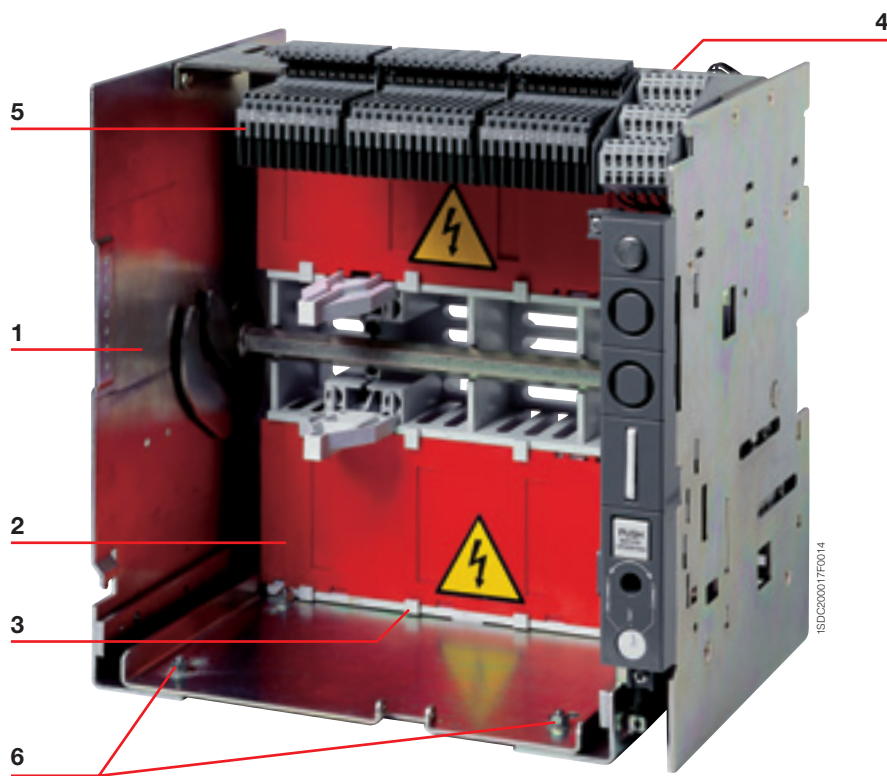
Cradles of draw out circuit breakers

The cradles of draw out circuit breakers have shutters for segregating the fixed contacts when the circuit breaker is racked out of the compartment. These can be locked in their closed position using padlock devices.

Caption

- 1 Sheet steel supporting structure
- 2 Safety shutters (protection rating IP20)
- 3 Terminal support base
- 4 Terminals (rear, front)
- 5 FP sliding contacts
- 6 Fastening points*

* To fix the fixed part on the back plate, use the four rear holes



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Versions and connections

Emax X1-A is available in fixed and draw out, three-pole or four-pole versions.

X1-A offers terminals made of silverplated copper bars, with the same sizes, regardless of the continuous current rating of the circuit breakers.

The availability of various types of terminals makes it possible to build switchboard against the wall, or switchgear to be accessed from behind with rear connections.

Furthermore, new horizontal rear terminals give Emax X1 maximum flexibility, allowing horizontal terminals to be changed to vertical ones and vice versa.

For fixed version, the following terminals are available:

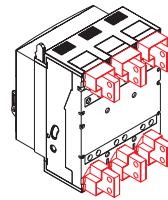
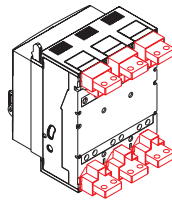
- rear terminals (horizontal, vertical and adjustable)*
- front terminals

For draw out version:

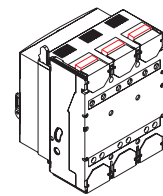
- rear terminals (horizontal/vertical)*

* It is possible to realise a varied combination of terminals (upper terminals different from the lower ones)

Fixed circuit breaker

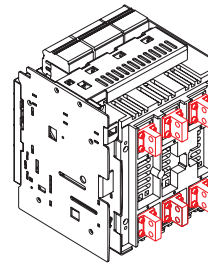
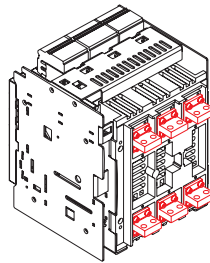


Rear terminals (horizontal or vertical)



Front terminals

Draw out circuit breaker



Adjustable rear terminals (horizontal or vertical)



Electronic trip units

General characteristics

The overcurrent protection for AC installations uses three types of electronic trip unit series: PR331/P, PR332/P and PR333/P.

The basic series, PR331/P, offers the whole set of standard protection functions, complete with a user-friendly interface. It allows discrimination of which fault caused the trip by means of the new led indications.

PR332/P and PR333/P trip units are of new concept modular architecture. It is now possible to have a complete series of protections, accurate measurements, signalling or dialogue functions, designed and customisable for all application requirements.

The protection system is made up of:

- 3 or 4 new generation current sensors (Rogowsky coil);
- external current sensors (i.e. for external neutral, or source ground return protection);
- a protection unit selected among PR331/P, PR332/P or PR333/P with optional communication module via Modbus or Fieldbus plug network (PR332/P and PR333/P only), as well as via a wireless connection;
- an opening solenoid, which acts directly on the circuit breaker operating mechanism (supplied with the protection unit).



Electronic trip units

General characteristics


General specifications of the electronic trip units include:

- operation without the need for an external power supply
- microprocessor technology
- high precision
- sensitivity to the true R.M.S. value of the current
- trip cause indication and trip data recording
- interchangeability among all types of trip units
- setting for neutral configurable:
 - OFF-50%-100%-200% of phase setting

The main performance features of the electronic trip units are listed below.

1

PR331/P



PR331/P

Protection **L** **I** **MCR***

PR331/P


Protection **L** **S** **I** **MCR***

PR331/P

Protection **L** **S** **I** **G** **MCR***

* optional

PR332/P



PR332/P

Protection **L** **I** **MCR***

PR332/P

Protection **L** **S** **I** **MCR***

PR332/P

Protection **L** **S** **I** **G** **MCR***

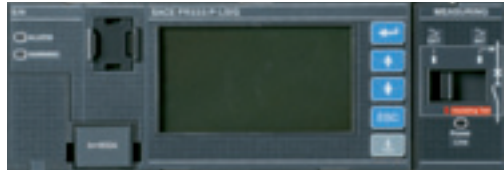
For all versions **U** **OT** **M**

Modules available:

PR330/V - Measuring	opt. UV OV RV RP UF OF
PR330/D-M and PR330/R - Communication and implementation	opt.

* optional

PR333/P



PR333/P

Protection **L** **S** **I** **MCR***

PR333/P

Protection **L** **S** **I** **G** **MCR***

For all versions **OT** **D** **U** **UV** **OV** **RV** **RP** **M** **UF** **OF**

Modules available:

PR330/D-M and PR330/R - Communication and implementation	opt.
--	------

* optional



Electronic trip units

Versions available

1

Features		PR331/P	PR332/P	PR333/P
Protection functions				
L	Protection against overload with inverse long time-delay trip	■	■	■
S	Selective protection against short circuit inverse or definite short time-delay trip	■	■	■
S	Second selective protection against short circuit inverse or definite short time-delay trip			■
I	Protection against instantaneous short circuit with adjustable trip current threshold	■	■	■
G	Protection against ground fault	residual	■	■
		source ground return	■	■
MCR	Protection against closing under short circuit	with AUX - MCR	with AUX - MCR	with AUX - MCR
D	Protection against directional short circuit with adjustable time-delay			■
U	Protection against phase unbalance		■	■
OT	Protection against overtemperature (check)		■	■
UV	Protection against undervoltage		with PR330/V	■
OV	Protection against overvoltage		with PR330/V	■
RV	Protection against residual voltage		with PR330/V	■
RP	Protection against reverse active power		with PR330/V	■
M	Thermal memory for functions L and S	■	■	■
UF	Underfrequency		with PR330/V	■
OF	Overfrequency		with PR330/V	■
Measurements				
	Currents (phases, neutral, ground fault)		■	■
	Voltage (phase-phase, phase-neutral, residual)		with PR330/V	■
	Power (active, reactive, apparent)		with PR330/V	■
	Power factor		with PR330/V	■
	Frequency and peak factor		with PR330/V	■
	Energy (active, reactive, apparent, meter)		with PR330/V	■
	Harmonics analysis (display of wave forms and harmonics module)			■
Event marking and maintenance data				
	Event marking with time stamp	opt. ⁽¹⁾	■	■
	Chronological event storage	opt. ⁽¹⁾	■	■
	Counting the number of operations and contact wear		■	■
Communication with supervision system and centralised control				
	Remote parameter setting of the protection functions, unit configuration, communication		with PR330/D-M	with PR330/D-M
	Transmission of measurements, states and alarms from circuit breaker to system		with PR330/D-M	with PR330/D-M
	Transmission of events and maintenance data from circuit breaker to system		with PR330/D-M	with PR330/D-M
Watchdog				
	Alarm and trip for release overtemperature		■	■
	Check of trip status	■	■	■
Interface with the user				
	Presetting parameters by means of dip switches	■		
	Presetting parameters by means of keys and LCD viewer		■	■
	Alarm signals for functions L, S, I and G	■	■	■
	Alarm signal of all the following protections: undervoltage, overvoltage, residual voltage, active reverse of power, phase unbalance, overtemperature, inversion of cyclical sense of the phases (only for PR333)		with PR330/V	■
	Complete management of pre-alarms and alarms for all the self-control protection functions		■	■
	Enabling password for use with consultation in "READ" mode or consultation and setting in "EDIT" mode	■	■	
	Correct control of phase cycle			■
Load control				
	Load connection and disconnection according to the current passing through the circuit breaker		■	■
Zone discrimination				
	Can be activated for protection functions S, G and (PR333/P only) D		■	■

(1) with communication unit BT030 or PR010T



Electronic trip units

Rating plugs

Rating plugs

Type of circuit breaker	Rated current I_n	In [A]	
		600	800
X1N	800	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

1



Compliance with Standards

A design dedicated to Quality and respect for the environment

Quality, environment, health and safety have always been ABB SACE's major commitment. This commitment involves every function of the company, and has allowed us to achieve prestigious recognition internationally.

The company's quality management 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 is also certified in compliance with ISO 14001 standard for the environment, OHSAS 18001 for health and safety in the workplace and SA800 for social responsibility.

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 in carrying out periodic environmental audits of leading suppliers.

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



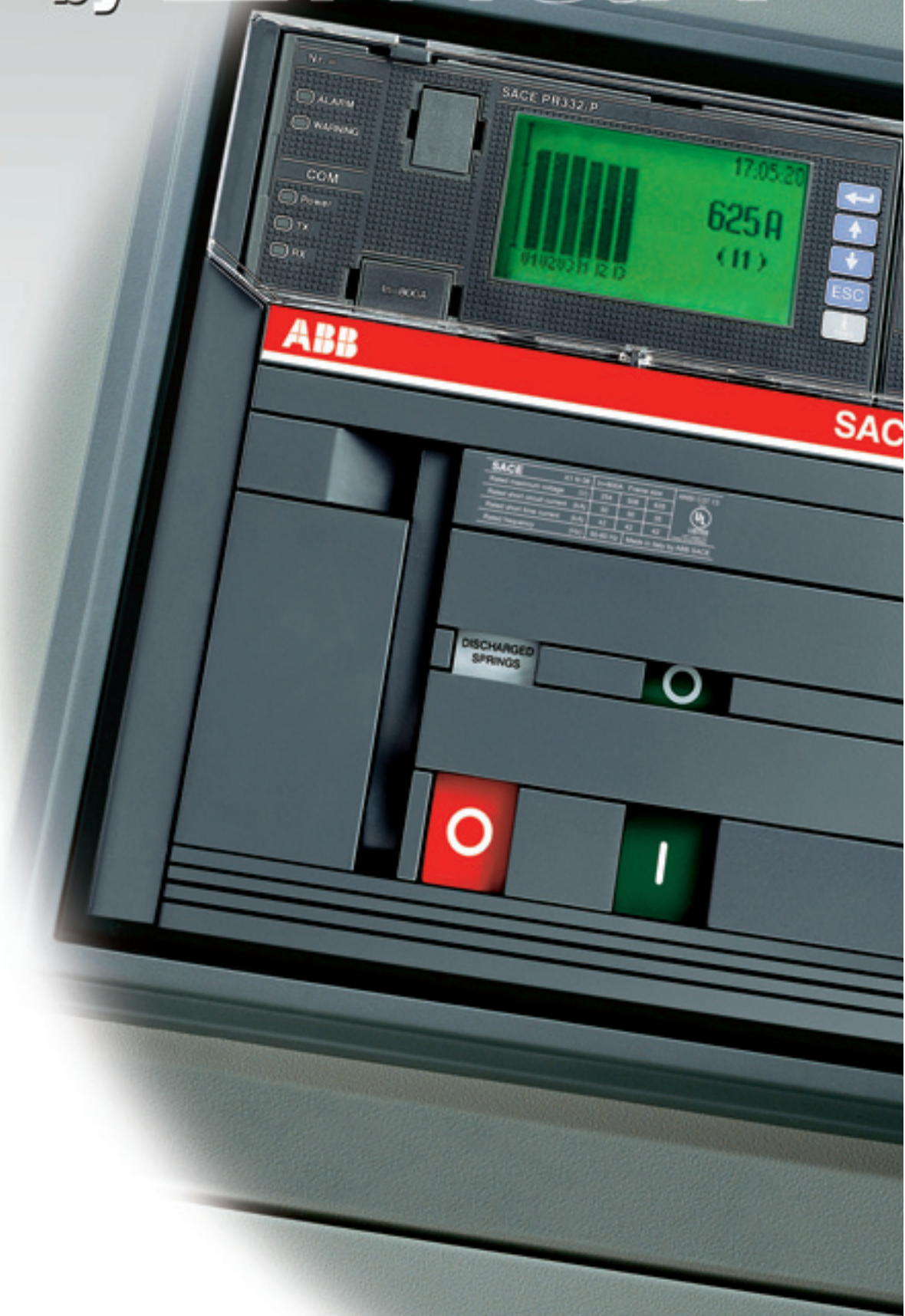
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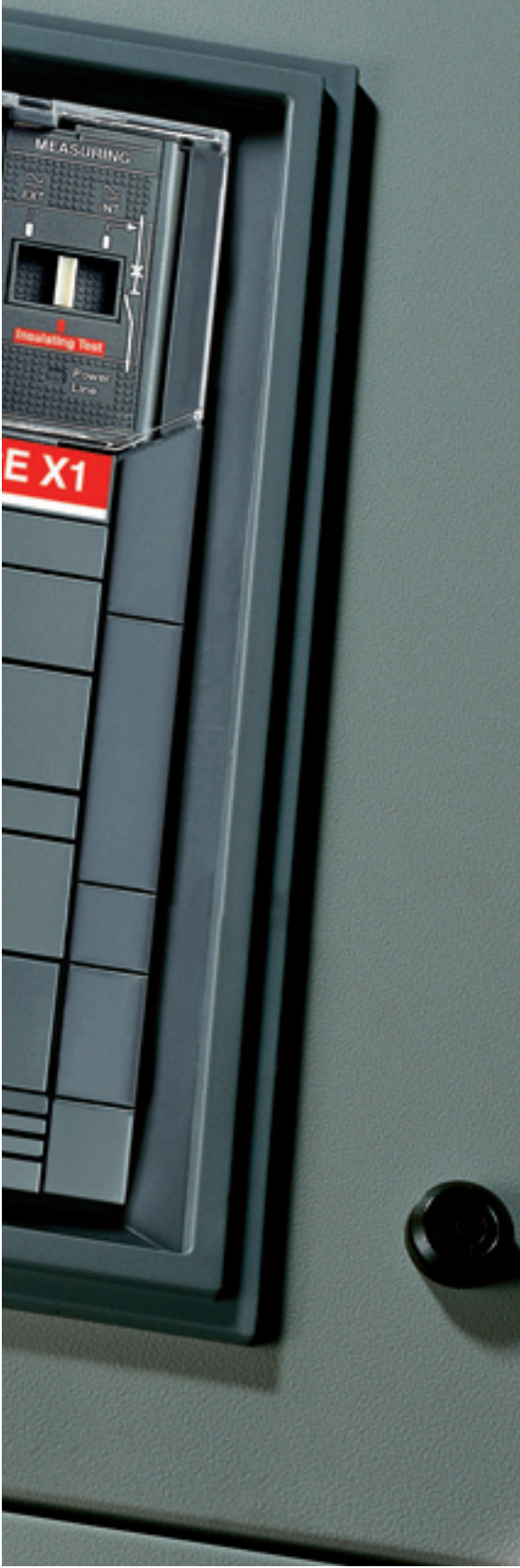




by

Emax





Contents

Installation in switchgear

Extremely reduced volumes 2/2

Selecting the type of circuit breaker 2/3

Derating at different altitudes 2/5



Installation in switchgear

Extremely reduced volumes

The Emax X1 circuit breakers have been built according to modular design criteria for easier installation and integration in low voltage electrical switchgear, thanks to a significant reduction in their overall installation dimensions, particularly in width and depth.

This allows the realization of switchgear dimensions particularly reduced, characteristic which makes the Emax X1 especially suitable where spaces saving is needed: for example in applications as on boards of ships, in mines, on drilling platforms and windmill turbine.

Installation

The new Emax X1, in the fixed and draw out versions, can be installed on a back plate both in the vertical and horizontal position, without jeopardising the rated characteristics of the circuit breaker. In the vertical position, the circuit breaker can also be installed flat, fixing it by means of shoulders provided as standard.

Emax circuit breakers can also be supplied through either top or bottom terminals, without jeopardizing the apparatus functionality.

Those characteristics allow maximum flexibility of use and make it easier the installation in switchgear.



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Installation in switchgear

Selecting 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 and the type of utilisation or, more generally, whether it includes neutral.

Fixed or draw out version

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

The draw out 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.

The moving part of a circuit breaker in draw out version may be in three position inside the fixed part: racked-in, test isolated and racked-out.

“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, whereas the auxiliary contacts are connected.





Installation in switchgear

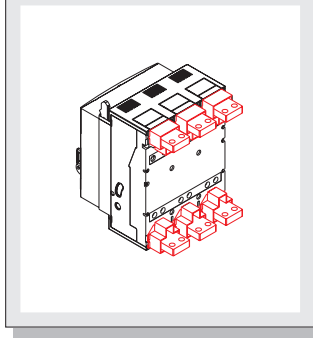
Selecting the type of circuit breaker

Connecting the main circuit breaker circuits

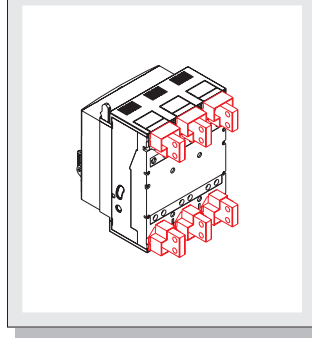
When designing switchgear, it is always necessary to find the most rational connections between the circuit-breaker and main busbar system and from the busbars to the users. Emax X1 offers switchgear manufacturers a range of options to satisfy different circuit breaker connection requirements. The circuit breakers can be fitted with various combinations of top and bottom terminals. The figures below provide some indications for terminal selection.

Switchgear with access from the rear:

Horizontal rear terminals

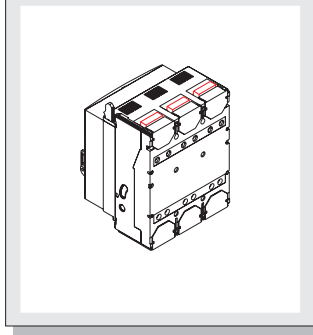


Vertical rear terminals



Wall-mounted switchgear, with access from the front only:

Front terminals



2



Derating at different altitudes

Emax X1 power circuit breakers as well as the other sizes in the Emax family, do not undergo any changes in their rated performance up to an altitude of 6600 ft (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 operating voltage and the rated uninterrupted current.

The table below shows these values in relation to altitude.

Altitude	H	[ft]	<6600	9900	13200	16500
		[m]	<2000	3000	4000	5000
Rated service voltage	U_e	[V]	600	600	500	440
Rated current	I_n	[A]	I _n	0.98xI _n	0.93xI _n	0.90xI _n

by Emax





Contents

Protection trip units and trip curves

PR331/P	3/2
PR332/P	3/9
PR333/P	3/23

Accessories for protection trip units

PR330/V Measurement Module	3/34
PR330/D-M Communication Module	3/35
PR330/R actuator module	3/35
PR030/B power supply unit	3/36
Interface from front of HMI030 panel	3/36
PR010/T configuration test unit	3/37

Communication devices and systems

Industrial networking and ABB SACE Emax	3/39
PR330/D-M	3/41
EP010 – FBP	3/41
Measurement, signalling and available data functions	3/42
SD-View 2000	3/43
BT030	3/45
SD-Pocket	3/45
SD-TestBus2	3/46



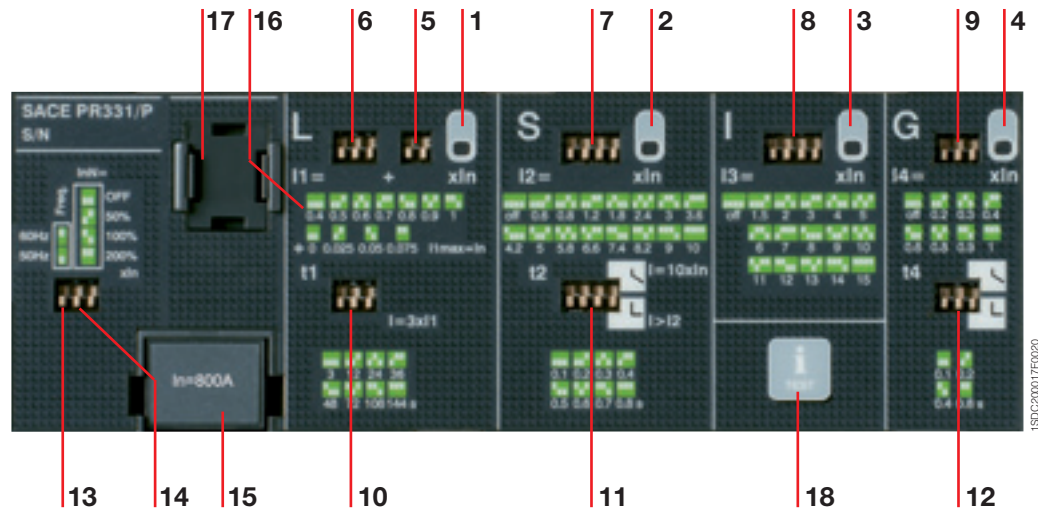
Protection trip units and trip curves

PR331/P

Characteristics

PR331/P is the new basic and complete trip unit for the Emax series. The complete range of protection functions together with the wide combination of thresholds and trip times offered make it suitable for protecting a wide range of alternating current installation. In addition to protection functions the unit is provided with multifunction LED indicators. Furthermore, PR331/P allows connection to external devices enhancing its advanced characteristics like remote signaling and monitoring, or remote supervision display.

3



Caption

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> 1 LED signalling Alarm and prealarm for protection function L 2 LED signalling Alarm for protection function S 3 LED signalling Alarm for protection function I 4 LED signalling Alarm for protection function G 5 DIP switches for fine setting current threshold I1 6 DIP switches for main setting current threshold I1 7 DIP switches for setting current threshold I2 | <ul style="list-style-type: none"> 8 DIP switches for setting current threshold I3 9 DIP switches for setting current threshold I4 10 DIP switches for setting trip time t1 (type of curve) 11 DIP switches for setting trip time t2 (type of curve) 12 DIP switches for setting trip time t4 (type of curve) 13 Indication of the DIP switch position for network frequency 14 Indication of the DIP switch position for Neutral protection setting | <ul style="list-style-type: none"> 15 Rating plug 16 Indication of the DIP switch positions for the various current thresholds values I1 17 TEST connector for connecting or testing the trip unit by means of an external device (PR030/B battery unit, BT030 wireless communication unit and PR010/T unit). 18 Info-test button |
|--|---|---|

Operation and protection functions

Protection functions

The PR331/P trip unit offers the following protection functions:

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

Overload (L)

The inverse long time-delay trip overload protection L is type $I^2t = k$; 25 current thresholds and 8 curves are available.

Each curve is identified by the trip time in relation to the current $I = 3 \times I_1$ ($I_1 =$ 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 independent of the current ($t = k$) or with a constant specific let-through energy ($t = k/I^2$).

15 current thresholds and 8 curves are available, allowing a fine setting. Each curve is identified as follows:

- for curves $t = k$ by the trip time for $I > I_2$
- for curves $t = k/I^2$ by the trip time for $I = 10 \times I_n$ ($I_n =$ rated current of the circuit breaker).

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

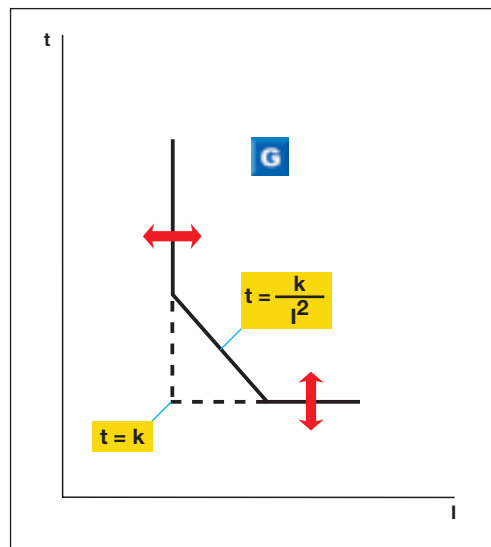
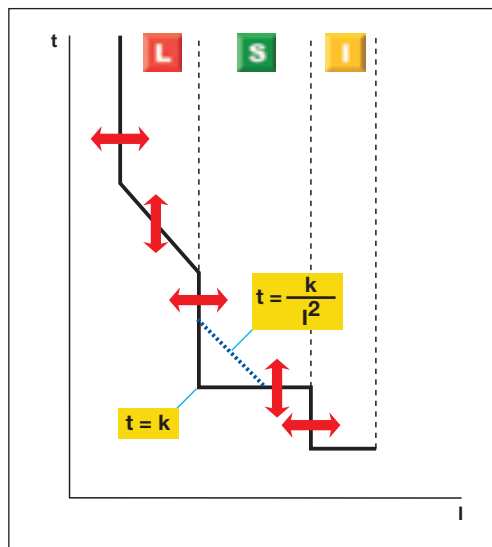
Adjustable instantaneous short circuit (I)

The protection I offers 15 trip thresholds and can be excluded (dip switches in "OFF" position). As an alternative to protection I, by means of PR010/T or via SD-Testbus2 or SD-Pocket software, it is possible to activate the MCR* protection to protect the plant from any closures under short circuit.

Ground fault (G)

The ground fault protection G (which can be excluded) offers 7 current thresholds and 4 curves. Each curve is identified by the time t_4 in relation to current I_4 . As per S protection the trip time can be chosen independent of the current ($t = k$) or with a constant specific let-through energy ($t = k/I^2$).

* said protection is available if there is an AUX-MCR contact (1SDA065235R1)





Protection trip units and trip curves

PR331/P

User interface

The trip unit can be set by using the dip switches on the front.

Up to four LEDs (according to the version) are also available for signalling.

These LEDs (one for each protection) are active when:

- a protection is timing. For protection L the prealarm status is also shown;
- a protection has tripped (the corresponding LED is activated by pressing the “Info/Test” pushbutton);
- a failure in connection of a current sensor or in the opening solenoid is detected. The indication is active when the unit is powered (through current sensors or an auxiliary power supply);
- wrong rating plug for the circuit breaker.

The protection tripped indication works even with the circuit breaker open, without the need for any internal or external auxiliary power supply. This information is available for 48 hours of inactivity after the trip and is still available after reclosing. If the query is made more than 48 hours later it is sufficient to connect a PR030/B battery unit, PR010/T, or a BT030 wireless communication unit.

There is programmable contact in the device, which can be set using PR010/T, SD-Testbus2 or SD Pocket and combined with numerous events.

Communication

By means of the BT030 wireless communication unit, PR331/P can be connected to a pocket PC (PDA) or to a personal computer, extending the range of information available for the user. In fact, by means of ABB SACE's SD-Pocket communication software, It is possible to read the values of the currents flowing through the circuit breaker, the value of the last 20 interrupted currents, and the protection settings.

PR331/P can also be connected to the HMI030 unit, for the remote user interfacing.

Setting the neutral

Protection of the neutral can be set at 50%, 100% or 200% of the phase currents. In particular, setting the neutral at 200% of the phase current is possible if the following inequality is respected: $I_1 \times I_n \times \%N < I_u$. The user can also switch the neutral protection OFF.

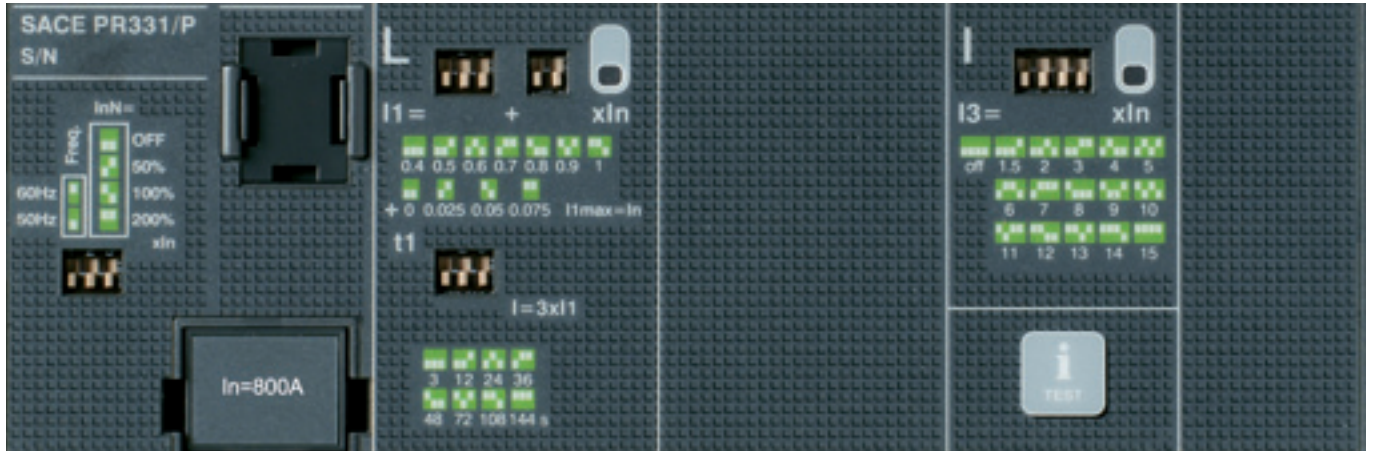
Test Function

The Test function is carried out by means of the info/Test pushbutton and the PR030/B battery unit (or BT030) fitted with a polarized connector housed on the bottom of the box, which allows the device to be connected to the test connector on the front of PR331/P releases.

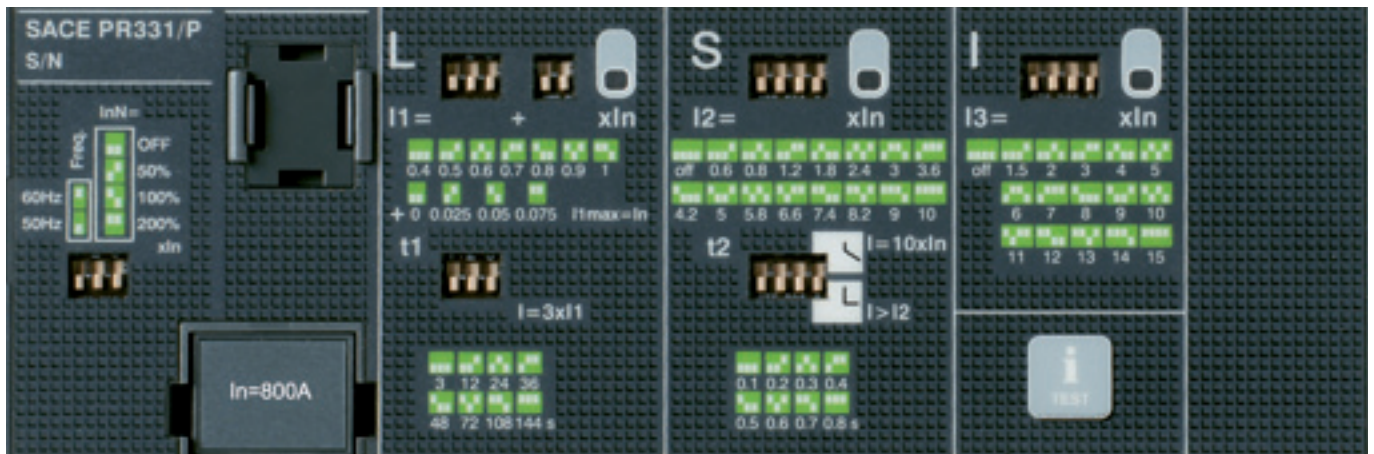
The PR331/P electronic trip unit can be tested by using the PR010/T test and configuration unit by connecting it to the TEST connector.

Versions available

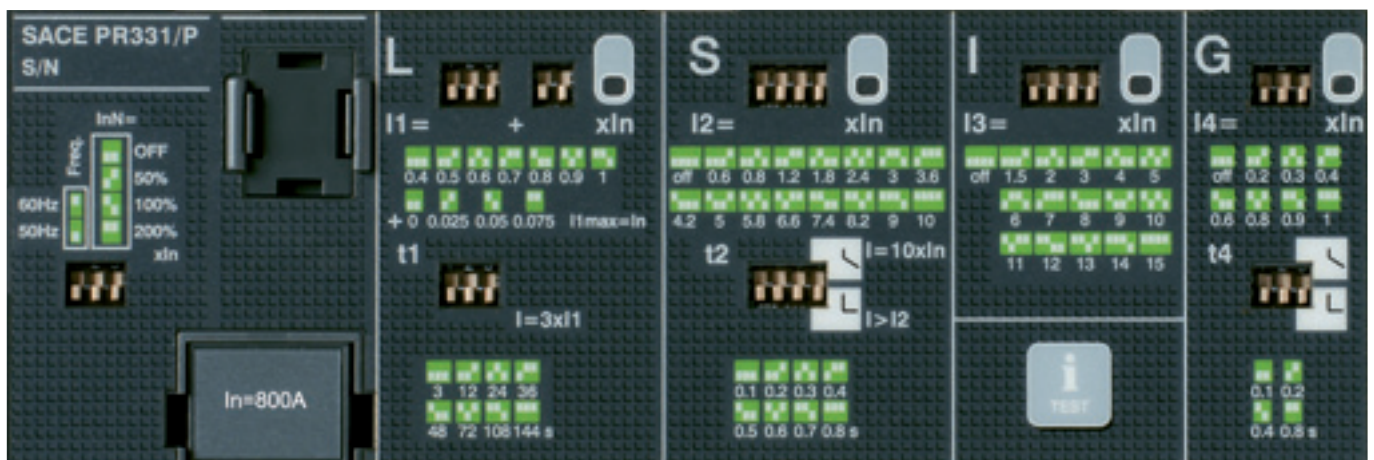
The following versions are available:



PR331/P LI



PR331/P LSI



PR331/P LSI G



Protection trip units and trip curves

PR331/P

Protection functions and setting values - PR331/P

Function	Trip threshold	Trip time*	Can be excluded	Relation t=f(I)
L Overload protection Tolerance ⁽²⁾	I1 = 0.4 - 0.425 - 0.45 - 0.475 - 0.5 - 0.525 - 0.55 - 0.575 - 0.6 - 0.625 - 0.65 - 0.675 - 0.7 - 0.725 - 0.75 - 0.775 - 0.8 - 0.825 - 0.85 - 0.875 - 0.9 - 0.925 - 0.95 - 0.975 - 1 x I _n Trip between 1.05 and 1.2 x I ₁	At current I _f = 3 x I ₁ t ₁ = 3 - 12 - 24 - 36 - 48 - 72 - 108 - 144 s ⁽¹⁾ ± 10% I _f ≤ 6 x I _n ± 20% I _f > 6 x I _n	–	t=k/I ²
S Selective short circuit protection Tolerance ⁽²⁾	I2 = 0.6 - 0.8 - 1.2 - 1.8 - 2.4 - 3 - 3.6 - 4.2 - 5 - 5.8 - 6.6 - 7.4 - 8.2 - 9 - 10 x I _n ± 7% I _f ≤ 6 x I _n ± 10% I _f > 6 x I _n	At current I _f = 10 x I _n t ₂ = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8 s ± 15% I _f ≤ 6 x I _n ± 20% I _f > 6 x I _n	■	t=k/I ²
S Selective short circuit protection Tolerance ⁽²⁾	I2 = 0.6 - 0.8 - 1.2 - 1.8 - 2.4 - 3 - 3.6 - 4.2 - 5 - 5.8 - 6.6 - 7.4 - 8.2 - 9 - 10 x I _n ± 7% I _f ≤ 6 x I _n ± 10% I _f > 6 x I _n	At current I _f > I ₂ t ₂ = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8 s The best of the two data: ± 10% or ± 40 ms	■	t=k
I Instantaneous short circuit protection Tolerance ⁽²⁾	I3 = 1.5 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 x I _n ± 10%	≤ 30 ms	■	t=k
G Ground fault protection Tolerance ⁽²⁾	I4 = 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 0.9 - 1 x I _n ± 7%	I _f =4.47xI ₄ I _f =3.16xI ₄ I _f =2.24xI ₄ I _f =1.58xI ₄ t ₄ =0.1 s t ₄ =0.2 s t ₄ =0.4 s ± 15%	■	t=k/I ²
G Ground fault protection Tolerance ⁽²⁾	I4 = 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 0.9 - 1 x I _n ± 7%	At current I _f > I ₄ t ₄ = 0.1 - 0.2 - 0.4 s The best of the two data: ± 10% or ± 40 ms	■	t=k
MCR Protection against closing under short circuit Tolerance ⁽²⁾	I5 = 6.0 - 6.1 - 6.2 - 6.3 - 6.4 ... 14.5 - 14.6 - 14.7 - 14.8 - 14.9 - 15 x I _n ± 10%	≤ 30 ms	■	t=k

* Referring to the electronics
I_f = fault current
(1) The minimum trip time is 1 s, regardless of the type of curve set (self-protection)
(2) These tolerances are valid in the following conditions:
- self-supplied release at full power (without start-up)
- two- or three-phase power supply
- auxiliary power supply available

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

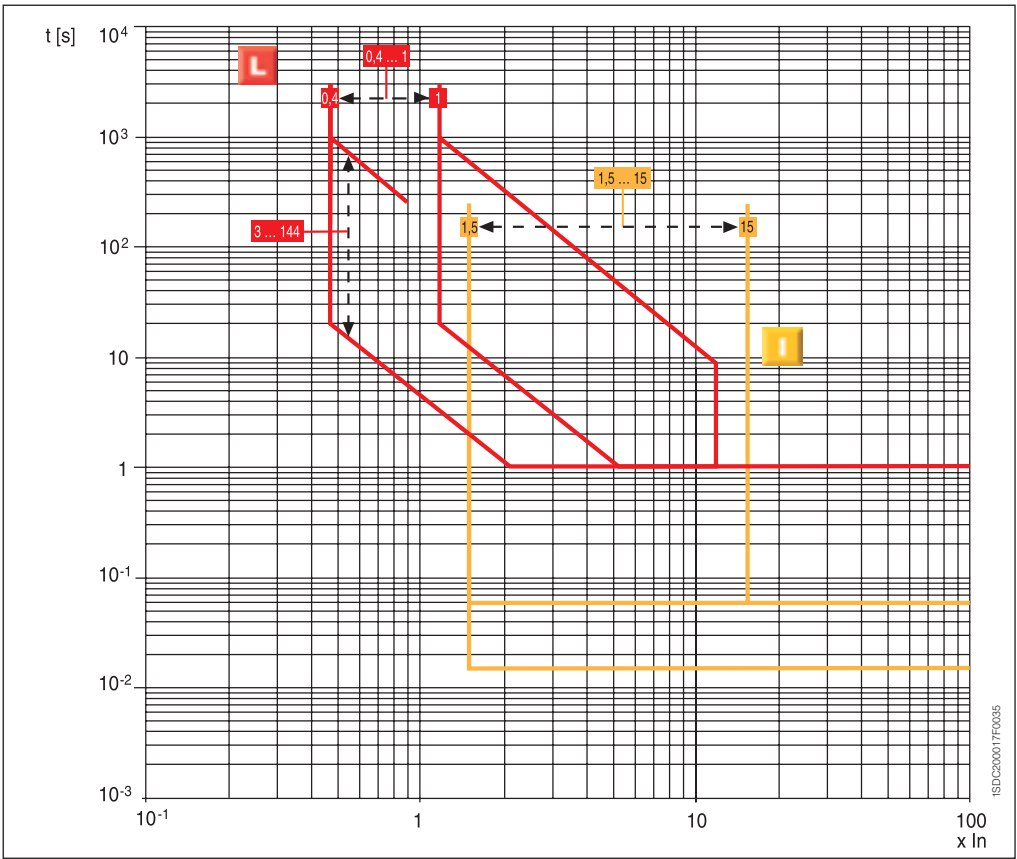
Trip time	
L	± 20%
S	± 20%
I	≤ 60ms
G	± 20%

Power supply

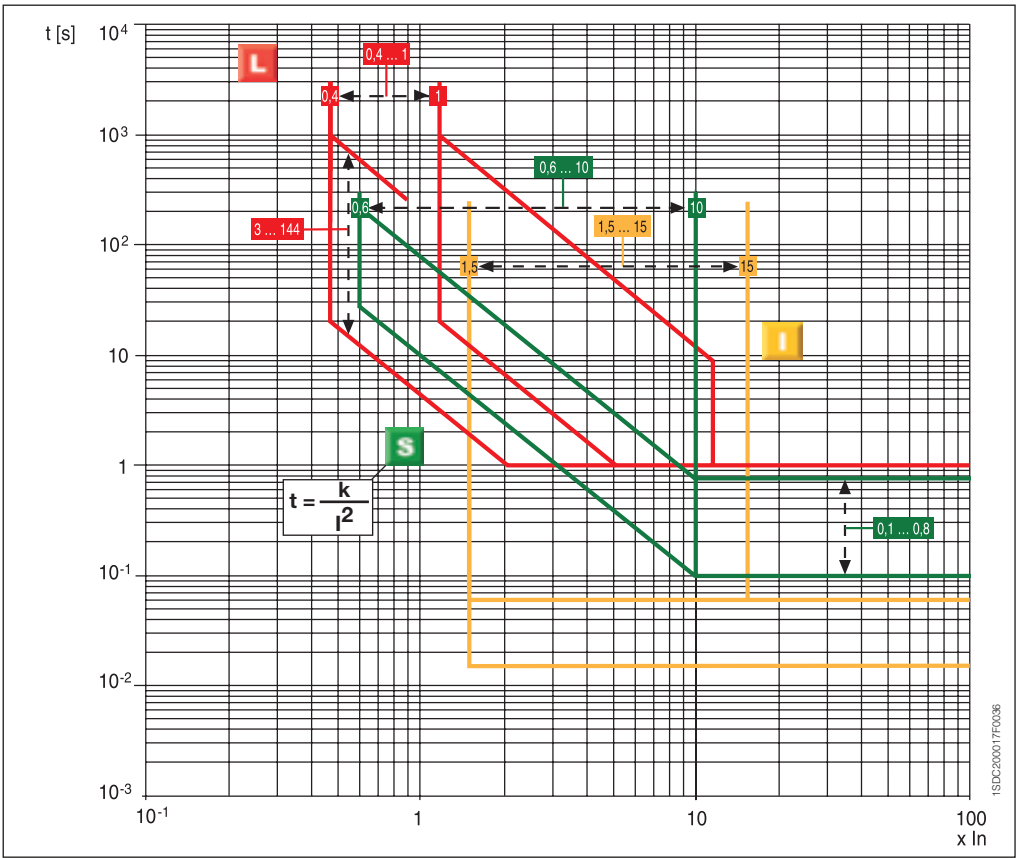
The unit does not require an external power supply either for protection functions or for alarm signaling functions. It is self-supplied by means of the current sensors installed on the circuit breaker. For it to operate, it is sufficient for the three phases to be loaded at 70A. An external power supply can be connected in order to activate additional features, and in particular for connection to external devices as HMI030 and PR021/K.

PR331/P	
Auxiliary power supply (galvanically insulated)	24 V DC ± 20%
Maximum ripple	5%
Inrush current @ 24V	~1 A for 5 ms
Rated power @ 24V	~2 W

Functions L-I



Functions L-S-I



Threshold and trip times tolerancespage 3/6

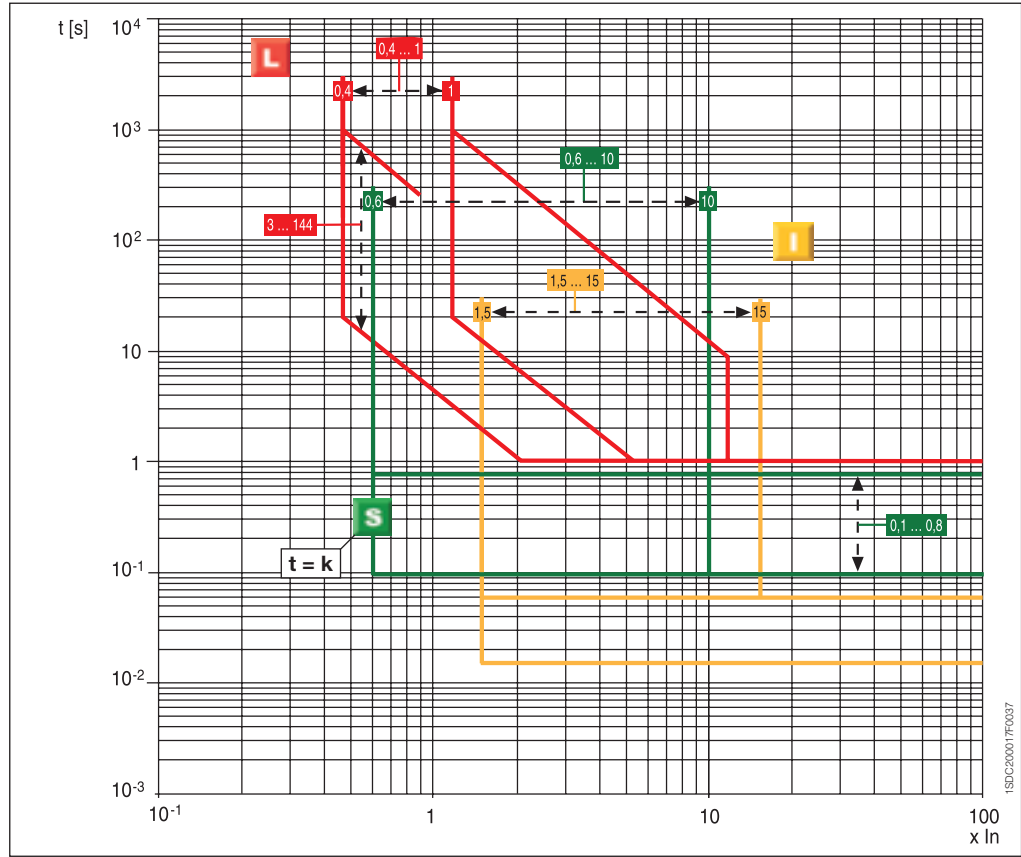


Protection trip units and trip curves

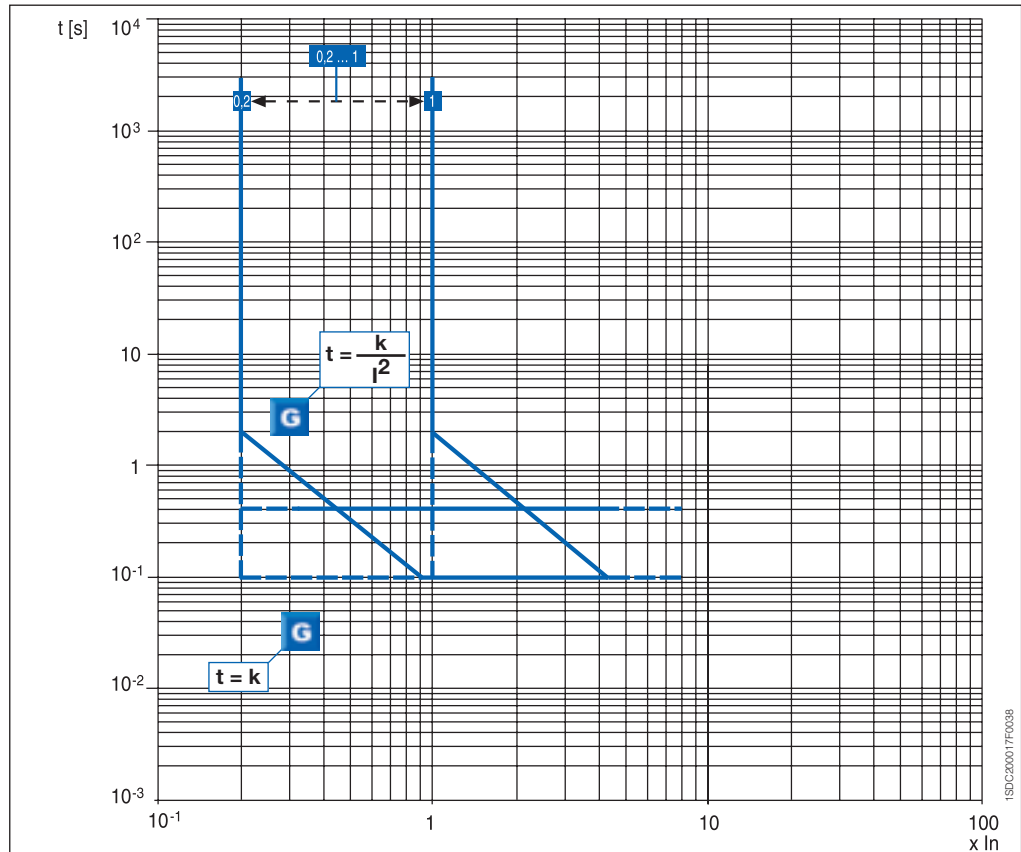
PR331/P

Functions L-S-I

3



Function G



Threshold and trip times tolerances.....page 3/6



Protection trip units and trip curves

PR332/P

Characteristics

The PR332/P trip unit is an advanced and flexible protection system based on a state-of-the-art microprocessor and DSP technology. Fitted with the optional internal PR330/D-M dialogue unit, PR332/P turns into an intelligent protection, measurement and communication device, based on the Modbus® protocol. By means of the PR330/D-M, PR332/P can also be connected to the ABB EP010 Fieldbus plug adapter, which makes it possible to choose among several different networks, such as Profibus and DeviceNet.

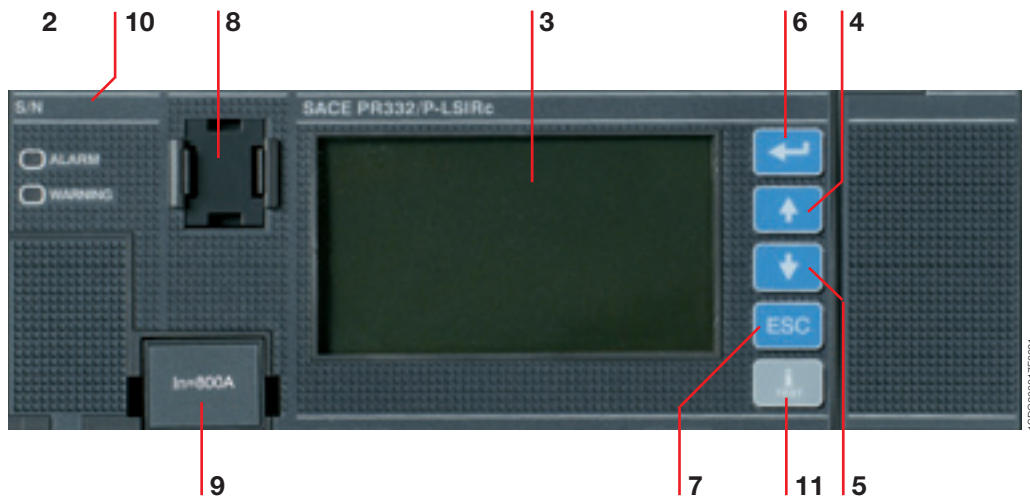
The new PR332/P is the result of ABB SACE's experience in designing protection trip units. The exhaustive range of settings makes this protection unit ideal for general use in any type of installation, from distribution to the protection of motors, transformers, drives and generators.

Access to information and programming using a keyboard and graphic liquid crystal display is extremely simple and intuitive. The interface is common to PR332/P and PR333/P in order to give to the user maximum ease of use. An integrated ammeter and many other additional features are provided over and above the protection functions. These additional functions can be further increased with addition on board of the dialogue, signalling, measurement, and wireless communication units.

Functions S and G can operate with a time delay independent of the current ($t = k$) or with an inverse time delay (constant specific let-through energy: $I^2t = k$), as required. Protection against ground faults can also be obtained by connecting the PR332/P trip unit to an external toroid located on the conductor that connects the transformer star centre to ground (homopolar toroid).

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

3



Caption

- 1 Warning LED
- 2 Alarm LED
- 3 Rear-light graphic display
- 4 Cursor UP button
- 5 Cursor DOWN button
- 6 ENTER button to confirm data or change pages
- 7 Button to exit submenus or cancel operations (ESC)
- 8 Test connector for connecting or testing the release by means of an external device (PR030/B battery unit, BT030 wireless communication unit and PR010/T unit)
- 9 Rating plug
- 10 Serial number of protection trip unit
- 11 Info-test button



Protection trip units and trip curves

PR332/P

3

Operation, protection functions and self-test

Basic Protection functions

The PR332/P trip unit offers the following protection functions (according to the version):

- overload (L)
- selective short circuit (S)
- instantaneous short circuit (I)
- ground fault (G)
- phase unbalance (U)
- self-protection against overtemperature (OT)
- thermal memory for functions L and S
- zone discrimination for functions S and G
- closing under short circuit (MCR)*.

Setting the neutral

In PR332/P, and PR333/P as well, the neutral protection is 50% of the value set for phase protection in the standard version. The neutral protection can be excluded or set to 100%.

In installations where very high harmonics occur, the resulting current at the neutral can be higher than that of the phases. Therefore it is possible to set the neutral protection at 150% or 200% of the value set for the phases. In this case it is necessary to reduce the setting of protection L accordingly. The table below lists the neutral settings for the various possible combinations between type of circuit breaker and the threshold I1 setting.

Start-up function

The start-up function allows protections S, 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 0.1 s to 30 s, in steps of 0.01 s. It is automatically recognized by the PR332/P trip unit, when the peak value of the maximum current exceeds the threshold set by the user. A new start-up becomes possible after the current has fallen below the set threshold, if the trip unit is supplied from an external source.

* said protection is available if there is an AUX-MCR contact AUX-MCR (1SDA065235R1)

Adjustable neutral protection settings			
Circuit breaker model	Threshold I1 settings (overload protection)		
	$0.4 \leq I1 \leq 0.5$	$0.5 < I1 \leq 0.66$	$0.66 < I1 \leq 1(*)$
X1-A	0-50-100-150-200%	0-50-100-150%	0-50-100%

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

Phase unbalance protection U

Protection function U against phase unbalance is used in those situations requiring particularly precise control over missing and/or unbalanced phase currents. With the addition of the PR330/V measuring module, it is possible to determine the unbalance of the phase-to-phase voltages (as an alternative to the phase currents). This function can be excluded.

Protection against over-temperature

The range of PR332/P trip units 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 158°F/70°C or lower than -4°F/-20°C (temperature at which the microprocessor is still able to operate correctly);
- lighting up of the "Alarm" LED when the temperature is higher than 185°F/85°C or lower than -13°F/-25°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 indication of the trip directly on the display, as for the other protections.

Zone discrimination for protections S and G

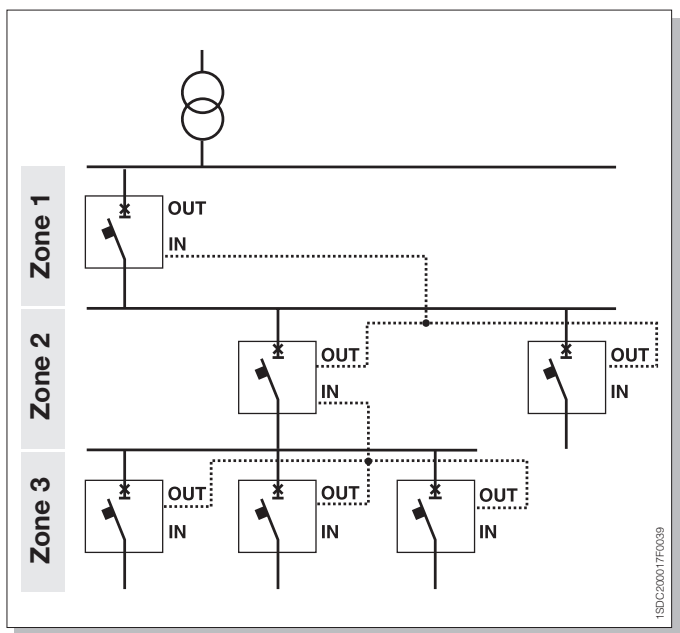
Zone discrimination is one of the most advanced methods for making co-ordination of the protections: by using this protection philosophy, it is possible to reduce the trip times of the protection closest to the fault in relation to the times foreseen by time discrimination, of which zone discrimination is an

evolution. Zone discrimination is applicable to protection functions S and G, even contemporarily and is available as standard on the PR332/P.

The word "zone" is used to refer to the part of an installation between two circuit breakers in series (see picture beside). Protection is provided by connecting all of the zone discrimination outputs of the trip units belonging to the same zone together and taking this signal to the zone discrimination input of the trip units immediately to the supply side.

Each circuit breaker that detects a fault communicates this to the circuit breaker on the supply side using a simple connection wire. Therefore the fault zone is the zone immediately to 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.

ABB SACE provides 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. The zone discrimination function S and G can be activated or deactivated using the keyboard.





Protection trip units and trip curves

PR332/P

Self-diagnosis

The PR332/P range of trip units contains an electronic circuit which periodically checks the continuity of internal connections (opening solenoid and each current sensor, including the Source Ground Return when present).

In the case of a malfunction an alarm message appears directly on the display. The Alarm is highlighted by the Alarm LED as well.

Test Functions

Once enabled from the menu, the “info/Test” pushbutton on the front of the trip unit allows correct operation of the chain consisting of the microprocessor, opening solenoid and circuit breaker tripping mechanism to be checked.

The control menu also includes the option of testing correct operation of the display and signaling LEDs.

By means of the front multi-pin connector it is possible to apply a PR010/T Test unit which allows the functions of the PR331/P, PR332/P and PR333/P ranges of trip units to be tested and checked.

User interface

The human-machine interface (HMI) of the device is made up of a wide graphic display, LEDs, and browsing pushbuttons. The interface is designed to provide maximum simplicity.

The language can be selected from among five available options: Italian, English, German, French and Spanish.

As in the previous generation of trip units, a password system is used to manage the “Read” or “Edit” modes. The default password, 0001, can be modified by the user.

The protection parameters (curves and trip thresholds) can be set directly via the HMI of the device. The parameters can only be changed when the trip unit is operating in “Edit” mode, but the information available and the parameter settings can be checked at any time in “Read” mode.

When a communication device (internal PR330/D-M modules or external BT030 device) is connected, it is possible to set parameters simply by downloading them into the unit (over the network for PR330/D-M, by using the SD-Pocket software and a PDA or a notebook for BT030). Parameterisation can then be carried out quickly and automatically in an error-free way by transferring data directly from DocWin.

There is programmable contact in the device, which can be set using PR010/T, SD-TestBus2 or SD Pocket and combined with numerous events.

Indicator LEDs

LEDs on the front panel of the trip unit are used to indicate all the pre-alarms (“WARNING”) and alarms (“ALARM”). A message on the display always explicitly indicates the type of event concerned.

Example of events indicated by the “WARNING” LED:

- unbalance between phases;
- pre-alarm for overload ($L1 > 90\%$);
- first temperature threshold exceeded ($158^{\circ}\text{F}/70^{\circ}\text{C}$);
- contact wear beyond 80%;
- phase rotation reversed (with optional PR330/V)

Example of events indicated by the "ALARM" LED:

- overload (may begin from $1.05 \times I_n < I < 1.3 \times I_n$, in accordance with the standard IEC 60947-2);
- timing of function L;
- timing of function S;
- timing of function G;
- second temperature threshold exceeded (185°F/85°C);
- contact wear 100%;
- timing of Reverse Power flow protection (with optional PR330/V).

Data logger

By default PR332/P, as well as PR333/P, is provided with the Data Logger function, that automatically records in a wide memory buffer the instantaneous values of all the currents and voltages. Data can be easily downloaded from the unit by means of SD-Pocket or SD-TestBus2 applications and can be transferred to any personal computer for elaboration. The dedicated application "SD-Data logger viewer" shows clearly to the user all the relevant trip information provided by the data logger. The function freezes the recording whenever a trip occurs in case of other events, so that a detailed analysis of faults can be easily performed. SD-Pocket and SD-TestBus2 allow also reading and downloading of all the others trip information.

Data logger is also very useful for network analysis in normal operating conditions.

- Number of analog channels: 8
- Maximum sampling rate: 4800 Hz
- Maximum sampling time: 27 s (@ sampling rate 600 Hz)
- 64 events tracking
- 24 V DC auxiliary supply is required for this function.

When communication module PR330/D-M is present, data can be acquired and transferred through the Modbus network.

Trip information and opening data

In case a trip occurs PR332/P and PR333/P store all the needed information:

- Protection tripped
- Opening data (current)
- Time stamp

By pushing the "info/Test" pushbutton the release shows all these data directly on display.

No auxiliary power supply is needed. The information is available to user for 48 hours with the circuit breaker open or without current flowing.

The information of the latest 20 trips are stored in memory.

The information about the last 20 trips remains recorded in the memory and can be recovered by connecting a PR030/B battery unit or a BT030 wireless communication unit or a PR010/T test and configuration unit or an auxiliary power supply.

Load control

Load control makes it possible to engage/disengage individual loads on the load side before the overload protection L is tripped, thereby avoiding unnecessary trips of the circuit breaker on the supply side. This is done by means of contactors or switches (externally wired to the trip unit), controlled by the PR332/P through the contacts of an external unit.

The current thresholds and trip times are smaller than those available for selection with protection L, so that load control can be used to prevent overload tripping.

An external accessory unit is required for Load Control. The function is only active when an auxiliary power supply is available.



Protection trip units and trip curves

PR332/P

Measurement function

The current measurement function (ammeter) is present on all versions of the PR332/P unit.

The display shows histograms showing the currents of the three phases and neutral on the main page. Furthermore, the most loaded phase current is indicated in numerical format. Ground fault current, where applicable, is shown on a dedicated page.

The ammeter can operate either with self-supply or with an auxiliary power supply voltage. The display is rear-lit and the ammeter is active even at current levels lower than 160A.

Accuracy of the ammeter measurement chain (current sensor plus ammeter) is no more than 1.5% in the current interval of 0.3 - 6 I_n.

- Currents: three phases (L1, L2, L3), neutral (Ne) and ground fault;
- Instantaneous values of currents during a period of time (data logger);
- Maintenance: number of operations, percentage of contact wear, opening data storage (last 20 trips and 80 events).

When the optional PR330/V is connected (see the accessory section) the following additional measurement function are present:

- Voltage: phase-phase, phase-neutral and residual voltage;
- Instantaneous values of voltages during a period of time (data logger);
- Power: active, reactive and apparent;
- Power factor;
- Frequency and peak factor;
- Energy: active, reactive, apparent, counter.

3

Versions available

The following versions are available:



PR332/P LI-LSI-LSIG

Protection functions and setting values - PR332/P

Function	Trip threshold	Threshold step	Trip time *	Time Step	Can be excluded	Relation t=f(I)	Thermal memory	Zone discriminat.
L Overload protection	$I_1 = 0.4 \dots 1 \times I_n$ Trip between 1.05 ... 1.2 x I1	0.01 x I _n	At current $I_f = 3 \times I_1$ $t_1 = 3 \text{ s} \dots 144 \text{ s}^{(1)}$ ± 10% $I_f \leq 6 \times I_n$ ± 20% $I_f > 6 \times I_n$	3 s	–	$t = k/I^2$	■	–
	Tolerance ⁽²⁾	$I_1 = 0.4 \dots 1 \times I_n$ 1.05 ... 1.2 x I1 <small>(in accordance with IEC 60255-3)</small>	0.01 x I _n At current $I_f = 3 \times I_1$; $t_1 = 3 \text{ s} \dots 144 \text{ s}$ ± 20% $I_f > 6 \times I_1$ ± 30% $2 \times I_1 \leq I_f \leq 6 \times I_1$ I _n	3 s	–	$t = t(\alpha)$ $\alpha = 0.02 - 1 - 2$	–	–
S Selective short circuit protection	$I_2 = 0.6 \dots 10 \times I_n$	0.1 x I _n	At current $I_f > I_2$ $t_2 = 0.05 \text{ s} \dots 0.8 \text{ s}^{(2)}$ $t_{2sel} = 0.04 \text{ s} \dots 0.25 \text{ s}$ The best of the two data: ± 10% o ± 40 ms	0.01 s 0.01 s	■	t=k	–	■
	Tolerance ⁽²⁾	± 7% $I_f \leq 6 \times I_n$ ± 10% $I_f > 6 \times I_n$	At current $I_f = 10 \times I_n$ $t_2 = 0.05 \text{ s} \dots 0.8 \text{ s}$ ± 15% $I_f \leq 6 \times I_n$ ± 20% $I_f > 6 \times I_n$	0.01 s	■	$t = k/I^2$	■	–
I Instantaneous short circuit protection	$I_3 = 1.5 \dots 15 \times I_n$	0.1 x I _n	≤ 30 ms	–	■	t=k	–	–
G Ground fault protection	$I_4 = 0.2 \dots 1 \times I_n$	0.02 x I _n	At current $I_f > I_4$ $t_4 = 0.1 \text{ s} \dots 1 \text{ s}$ $t_{4sel} = 0.04 \text{ s} \dots 0.25 \text{ s}$ The best of the two data: ± 10% o ± 40 ms	0.05 s 0.05 s	■	t=k	–	■
U Tolerance ⁽²⁾	$I_4 = 0.2 \dots 1 \times I_n$ ± 7%	0.02 x I _n	$t_4 = 0.1 \text{ s} \dots 1 \text{ s}$ ± 15%	0.05 s	■	$t = k/I^2$	–	–
MCR Protection against closing under short circuit	$I_3 = 6.0 - 6.1 - 6.2 - 6.3 - 6.4 \dots 14.5 - 14.6 - 14.7 - 14.8 - 14.9 - 15 \times I_n$	–	≤ 30 ms	–	■	t=k	–	–
OT Tolerance ⁽²⁾	± 10%	–	–	–	–	–	–	–
OT Protection against overtemperature	fixed defined by ABB	–	Instantaneous	–	–	temp=k	–	–
U Phase unbalance protection	$I_6 = 2\% \dots 90\%$	1%	$t_6 = 0.5 \text{ s} \dots 60 \text{ s}$ The best of the two data: ± 20% o ± 100 ms	0.5 s	■	t=k	–	–
U Tolerance ⁽²⁾	± 10%	–	–	–	–	–	–	–

* Referring to the electronics

I_f = fault current

(1) The minimum trip value is 1 s, regardless of the type of curve set (self-protection)

(2) These tolerances are valid in the following conditions:

- self-supplied release at full power and/or auxiliary power supply (without start-up)
- two- or three-phase power supply
- trip time set ≥ 100 ms

(3) No intervention time

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

Trip time	
L	± 20%
S	± 20%
I	≤ 60ms
G	± 20%
Others	± 20%



Protection trip units and trip curves

PR332/P

Additional Protection functions and setting values - PR332/P with PR330/V

Function	Trip threshold	Threshold steps	Trip Time *	Time Step	Can be excluded	Relation t=f(I)	Thermal memory	Zone discriminat.
UV Undervoltage protection Tolerance ⁽¹⁾	U8= 0.5....0.95 x Un ± 5%	0.01 x Un	At current U < U8 t8= 0.1 s....5 s The best of the two figures: ± 20% or ± 100 ms	0.1 s	■	t=k	-	-
OV Overvoltage protection Tolerance ⁽¹⁾	U9= 1.05....1.2 x Un ± 5%	0.01 x Un	At current U > U9 t9= 0.1 s....5 s The best of the two figures: ± 20% or ± 100 ms	0.1 s	■	t=k	-	-
RV Residual voltage protection Tolerance ⁽¹⁾	U10= 0.1....0.4 x Un ± 5%	0.05 x Un	At current U > U10 t10= 0.5 s....30 s The best of the two figures: ± 10% or ± 100 ms	0.5 s	■	t=k	-	-
RP Reverse power protection Tolerance ⁽¹⁾	P11= -0.3....-0.1 x Pn ± 10%	0.02 x Pn	At current P < P11 t11= 0.5 s....25 s The best of the two figures: ± 10% or ± 100 ms	0.1 s	■	t=k	-	-
UF Underfrequency protection Tolerance ⁽¹⁾	f12= 0.90....0.99 x fn ± 5%	0.01 x fn	At current f < f12 t9= 0.5 s....3 s The best of the two figures: ± 10% or ± 100 ms	0.1 s	■	t=k	-	-
OF Overfrequency protection Tolerance ⁽¹⁾	f13= 1.01....1.10 x fn ± 5%	0.01 x fn	At current f > f13 t10= 0.5 s....3 s The best of the two figures: ± 10% or ± 100 ms	0.1 s	■	t=k	-	-

* Referring to the electronics

(1) These tolerances are valid in the following conditions:

- self-supplied release at full power and/or auxiliary power supply (without start-up)
- two- or three-phase power supply
- trip time set ≥ 100 ms

Power supply

The PR332/P trip unit does not normally require any external power supplies, being self-supplied from the current sensors (CS): to activate the protection and ammeter functions, it is sufficient for three phases to have a current load at least at 70 A.

The unit ensures fully self-supplied operation. When an auxiliary power supply is present, it is also possible to use the unit with the circuit breaker either open or closed with very low current flowing through.

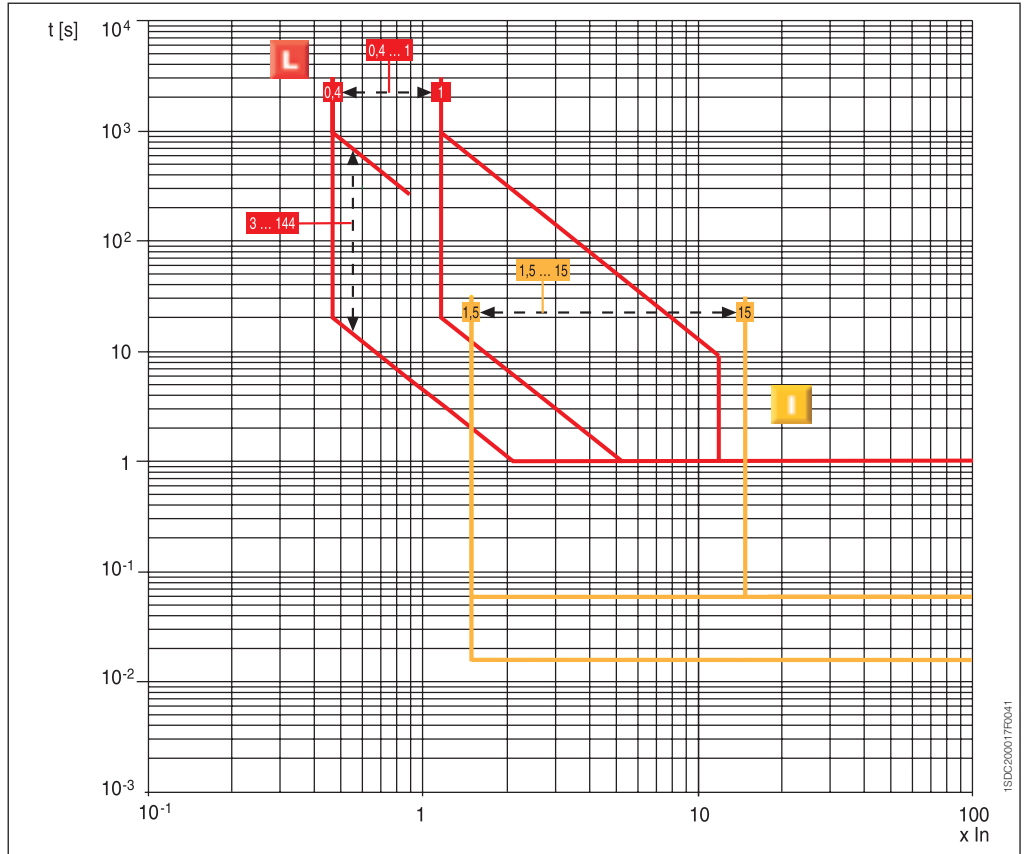
It is also possible to use an auxiliary power supply provided by the PR030/B portable battery unit (always supplied), which allows the protection functions to be set when the trip unit is not self-supplied.

PR332/P stores and shows all the information needed after a trip (protection tripped, trip current, time, date). No auxiliary supply is required for this functionality.

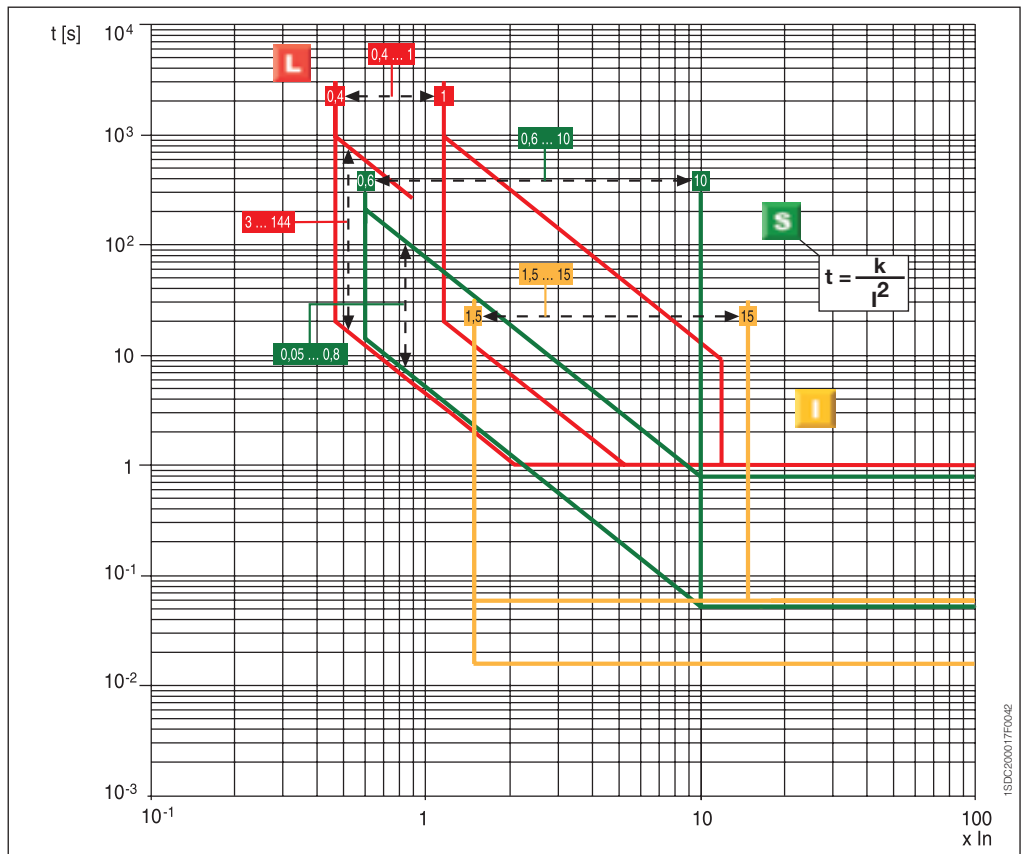
	PR332/P	PR330/D-M
Auxiliary power supply (galvanically insulated)	24 V DC ± 20%	from PR332/P
Maximum ripple	5%	
Inrush current @ 24V	~1 A for 5 ms	
Rated power @ 24V	~3 W	+1 W

(*) PR330/V can give power supply to the trip unit when a three phase voltage is equal or higher to 60V.

Functions L-I



Functions L-S-I



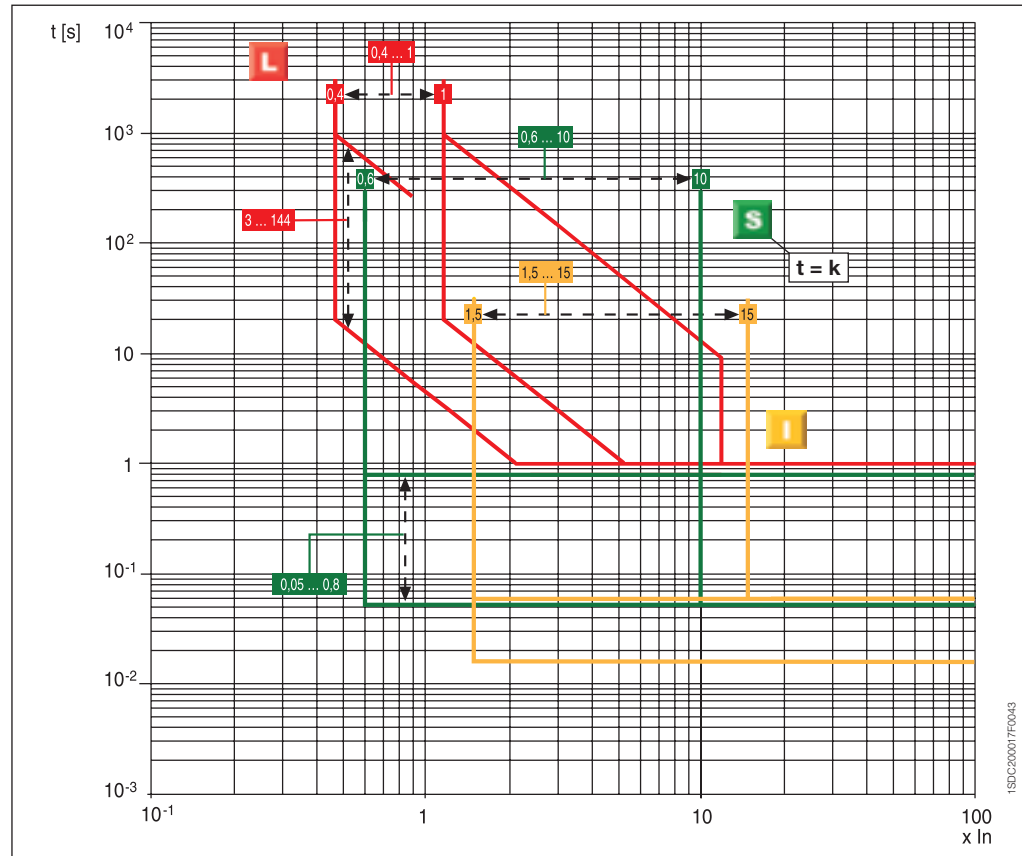
Threshold and trip times tolerances.....page 3/15



Protection trip units and trip curves

PR332/P

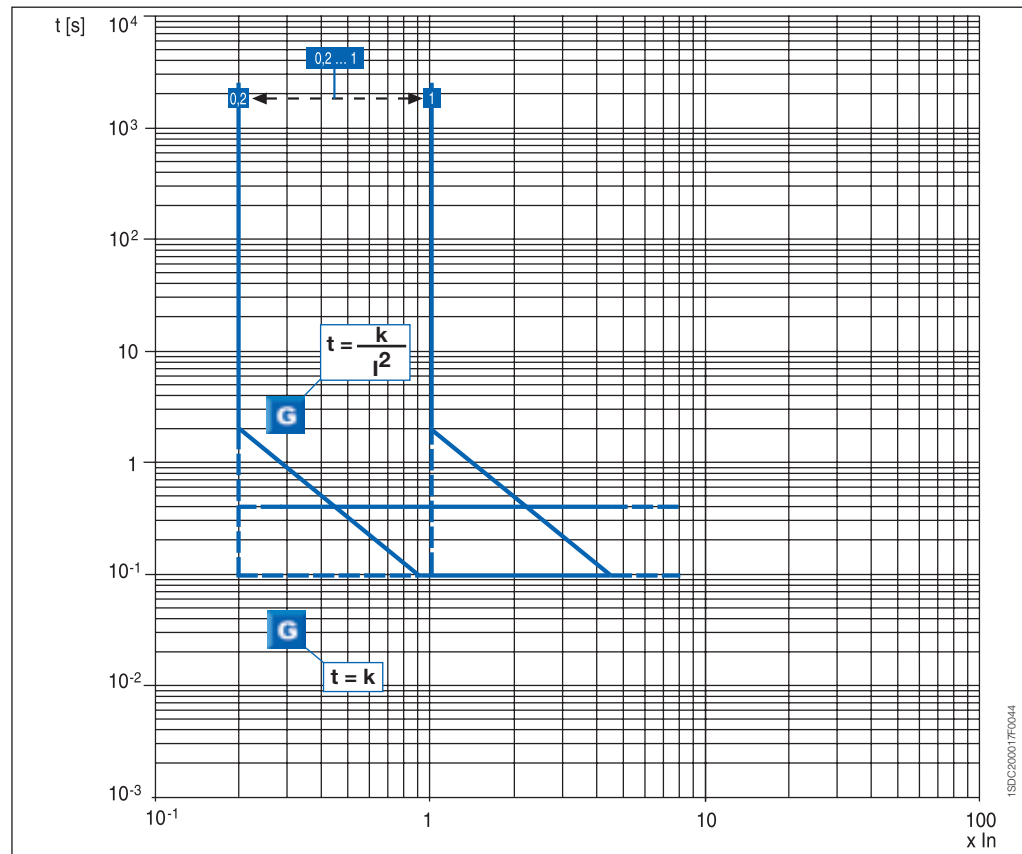
Functions L-S-I



1SDC200017F0043

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Function G

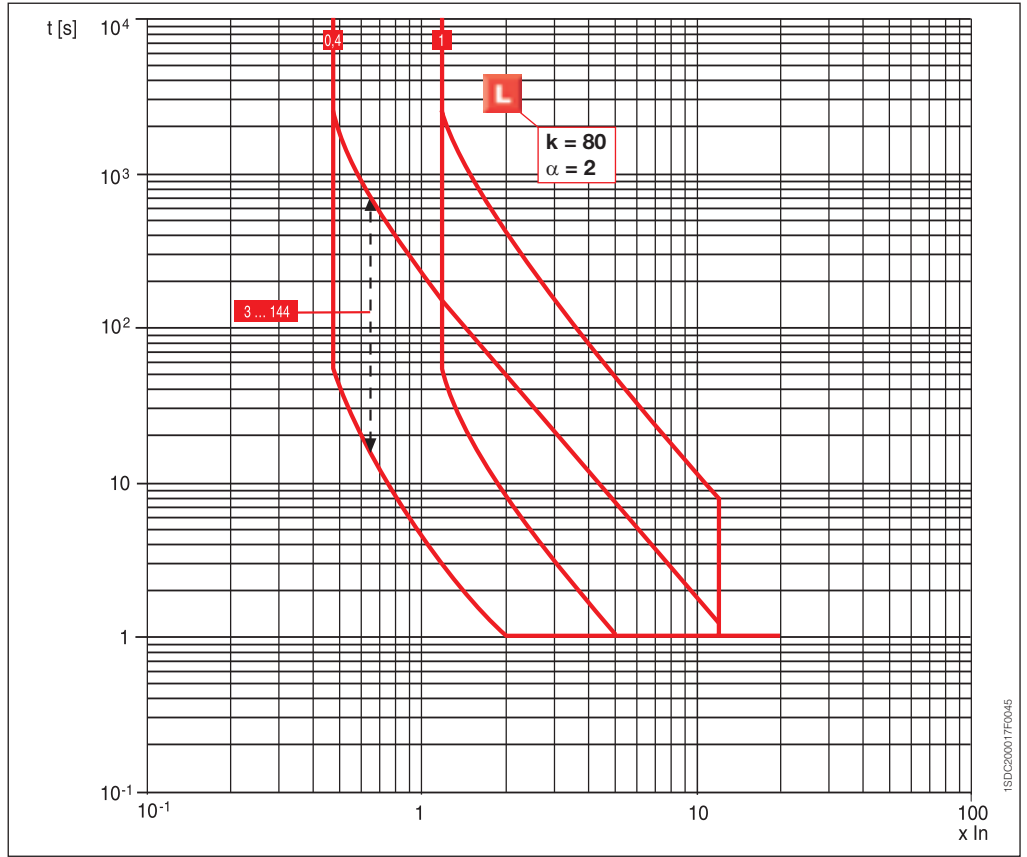


1SDC200017F0044

Threshold and trip times tolerances.....page 3/15

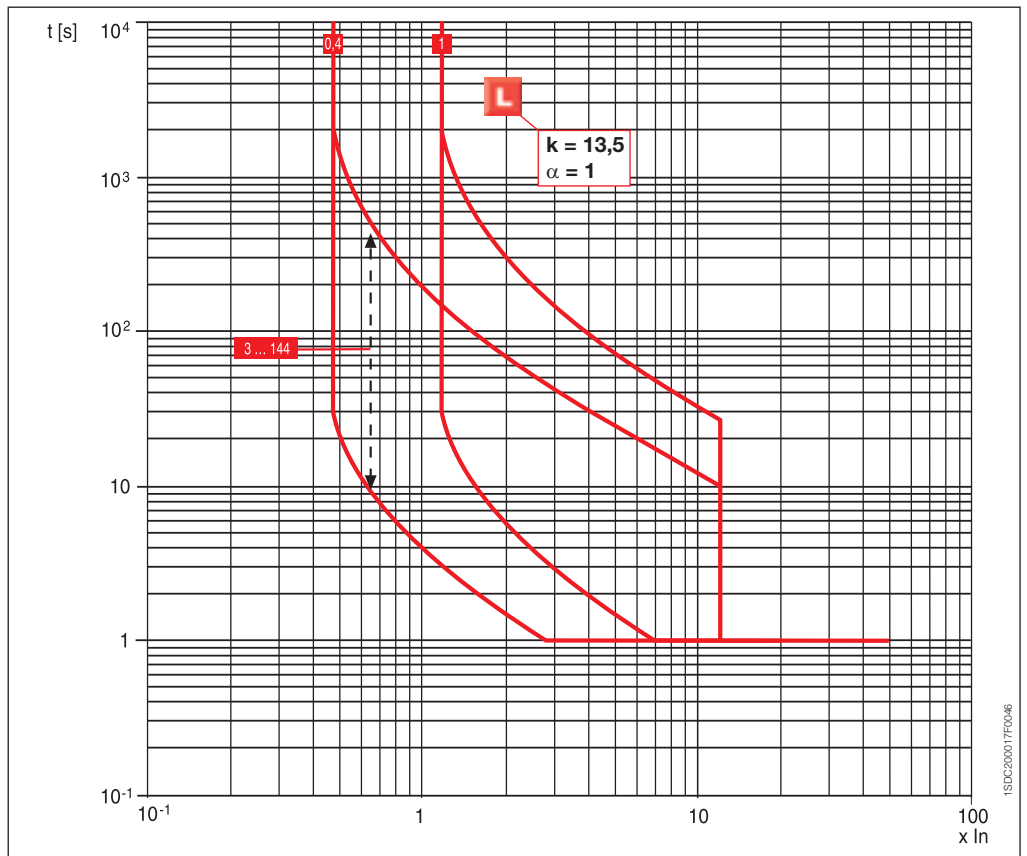
Function L

According to IEC 60255-3



Function L

According to IEC 60255-3





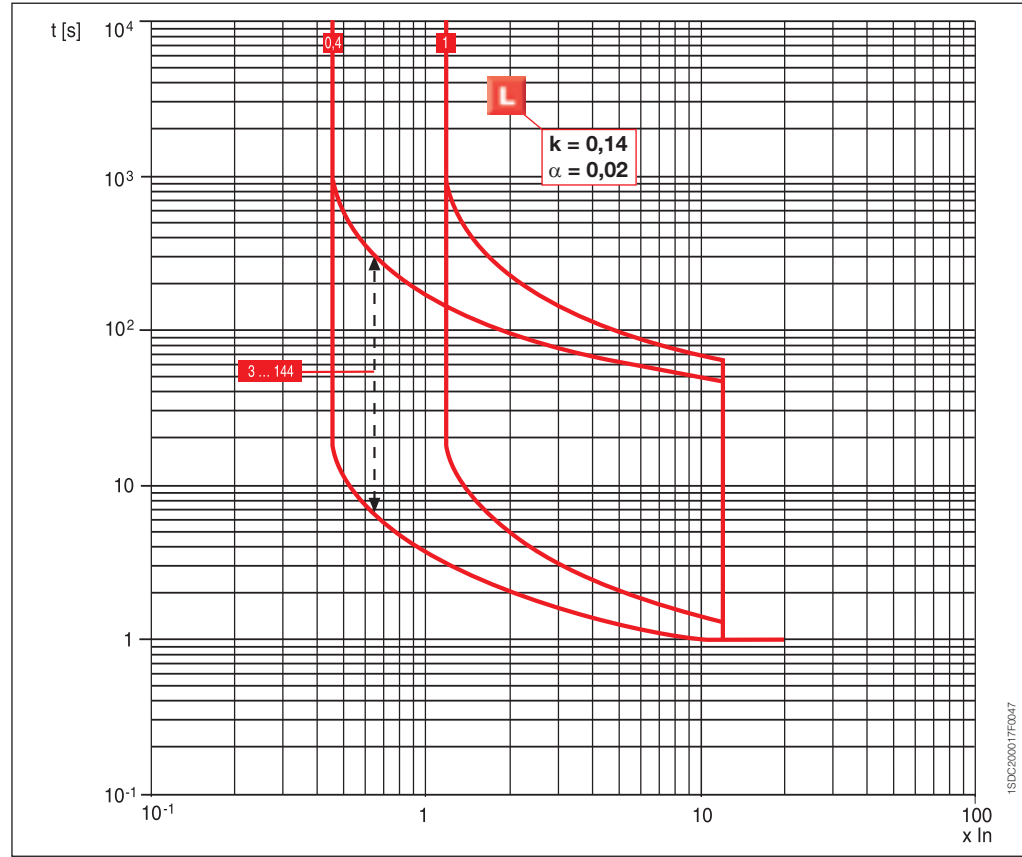
Protection trip units and trip curves

PR332/P

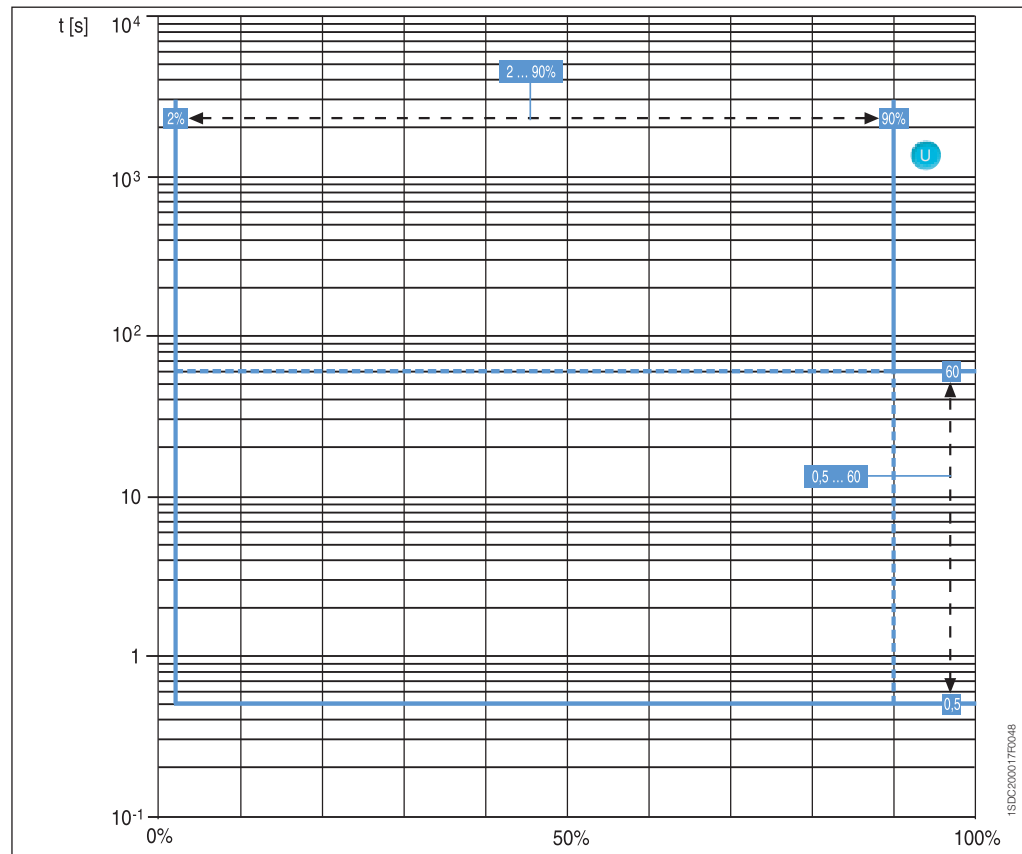
Function L

According to IEC 60255-3

3

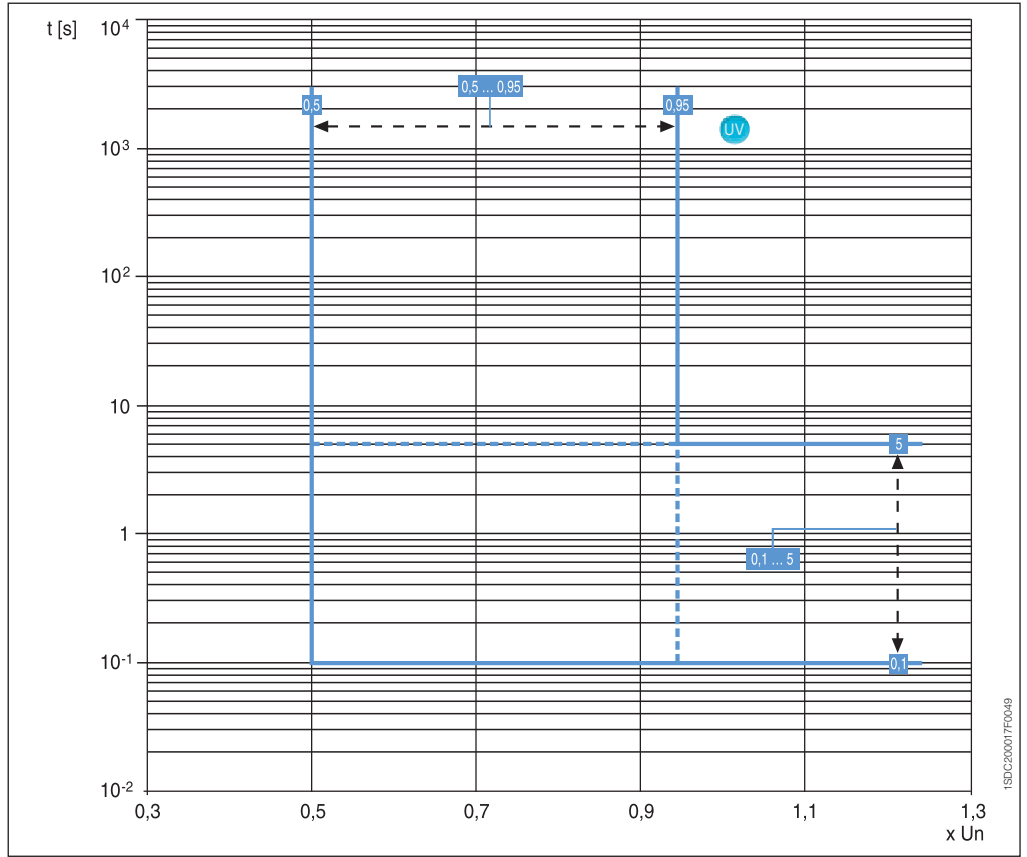


Function U

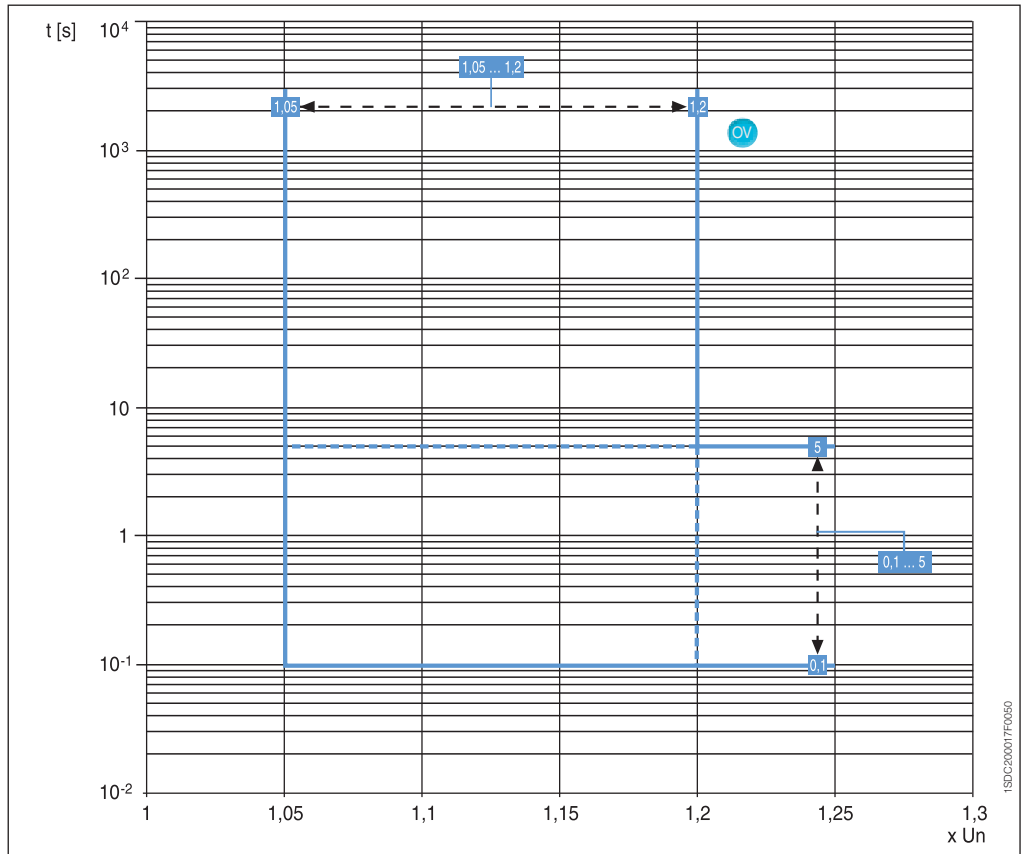


Threshold and trip times tolerances.....page 3/15

Function UV



Function OV



Threshold and trip times
tolerances.....page 3/15

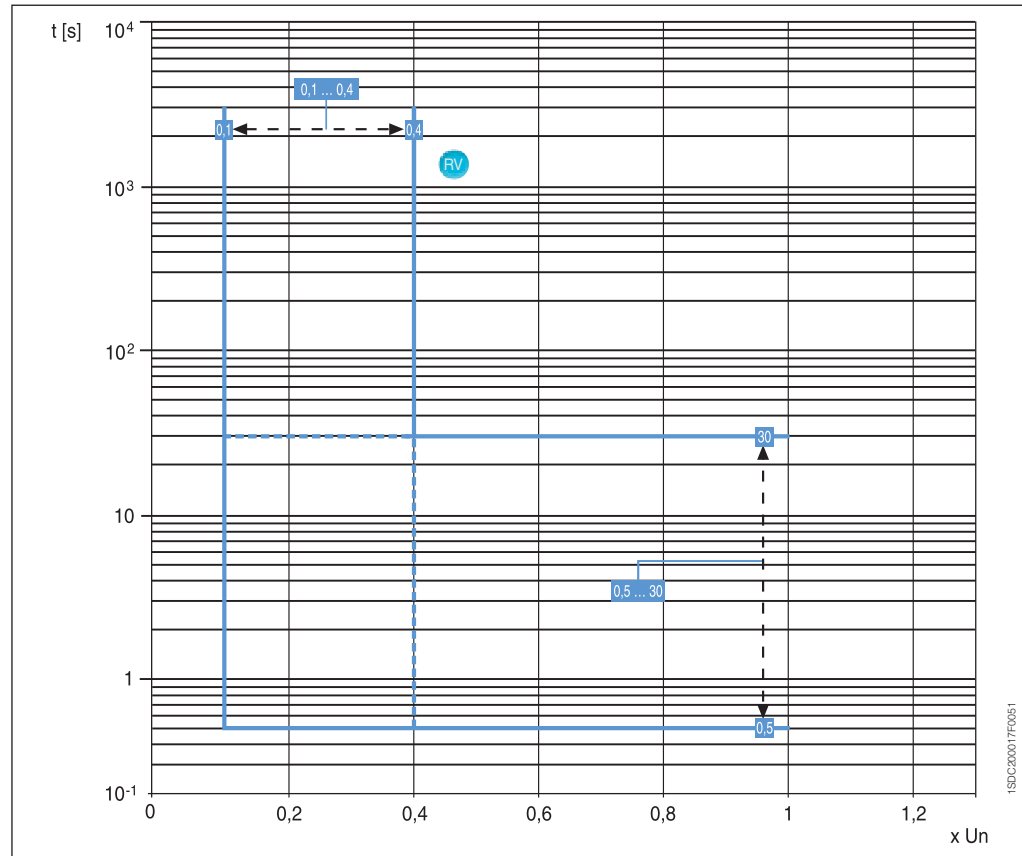


Protection trip units and trip curves

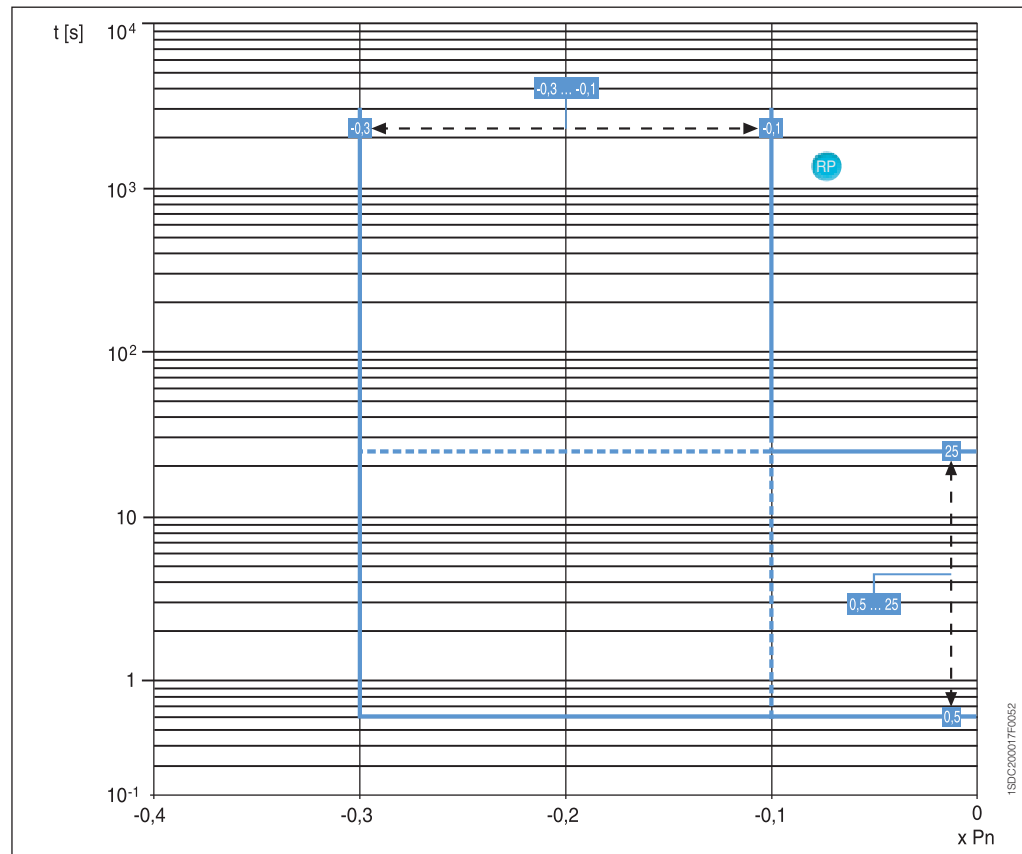
PR332/P

Function L

3



Function U



Threshold and trip times tolerances.....page 3/15



Protection trip units and trip curves

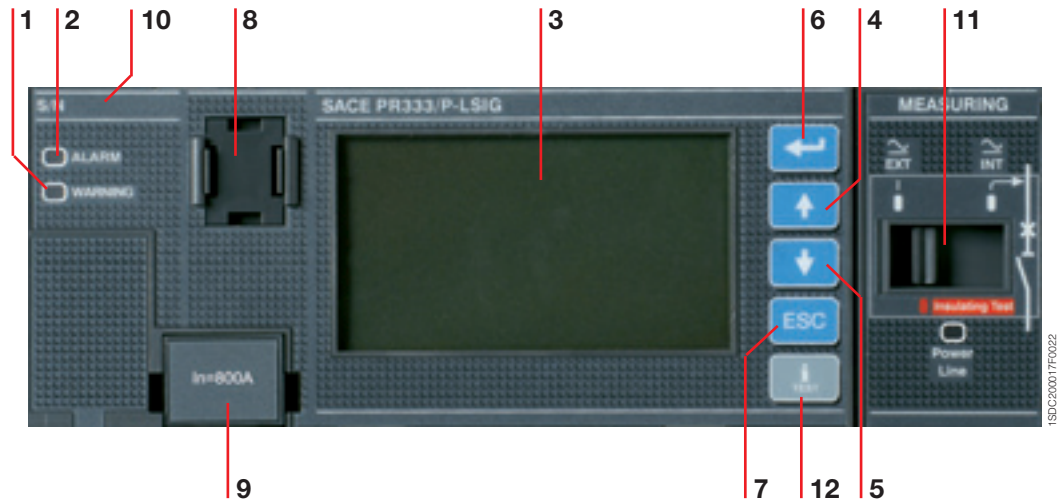
PR333/P

Characteristics

The PR333/P protection trip unit completes the range of trip units available for the Emax X1 family of circuit breakers.

It is a high-performance and extraordinarily versatile trip unit, capable of offering a complete set of functions for protection, measurement, signalling, data storage and control of the circuit breaker, and it represents the benchmark in low voltage protection units for circuit breakers. The front interface of the unit, common to PR332/P, is extremely simple thanks to the aid of the liquid crystal graphics display. It can show diagrams, bar graphs, measurements and sine curves for the various electrical values.

PR333/P integrates all the features offered by PR332/P plus a series of evolute functionalities. As well as PR332/P it can be integrated with the additional features provided by internal modules and external accessories.



3

Caption

- | | | |
|--|---|--|
| <ul style="list-style-type: none"> 1 Warning LED 2 Alarm LED 3 Rear-lit graphic display 4 Cursor UP button 5 Cursor DOWN button 6 ENTER button to confirm data or change pages | <ul style="list-style-type: none"> 7 Button to exit submenus or cancel operations (ESC) 8 Test connector for connecting or testing the trip unit by means of an external device (PR030/B battery unit, BT030 wireless communication unit and PR010/T unit) 9 Rating plug | <ul style="list-style-type: none"> 10 Serial number of protection trip unit 11 Switch-disconnector for insulating tests, internal connection or connection to terminal box (external) 12 Info-test button |
|--|---|--|



Protection trip units and trip curves

PR333/P

Protection functions

The PR333/P trip unit offers the following protection functions:

- overload (L),
- selective short circuit (S),
- instantaneous short circuit (I),
- ground fault with adjustable delay (G),
- protection against closing under short circuit (MCR)*,
- directional short circuit with adjustable delay (D),
- phase unbalance (U),
- protection against over-temperature (OT),
- load control (K),
- undervoltage (UV),
- overvoltage (OV),
- residual voltage (RV),
- reverse power (RP),
- underfrequency (UF),
- overfrequency (OF),
- phase sequence (alarm only),

* said protection is available if there is an AUX-MCR contact AUX-MCR (1SDA065235R1)

In addition to PR332/P features, the following improvements are available:

Double selective short circuit protection S

In addition to the standard S protection, PR333/P makes contemporarily available a second time-constant S protection (excludible) that allows two thresholds to be set independently achieving an accurate selectivity even under highly critical conditions.

Double ground fault protection G

While in PR332/P the user must choose among the implementation of G protection through internal current sensors (calculating the vectorial sum of currents) or external toroid (direct ground fault current measuring), PR333/P offers the exclusive feature of the contemporaneous management of both the configuration, by means of two independent ground fault protections curves. The main application of this characteristic is simultaneous activation of restricted and unrestricted ground fault protection. See chapter 6 for details.

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 on the supply or load side 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, whilst keeping the rest of the installation running. If multiple PR332/P or PR333/P trip units are used, this protection can be associated with zone discrimination.

Dual setting of protections

PR333/P can store an alternative set of all the protection parameters. This second set (set B) can replace, when needed, the default set (set A) by means of an external command. The command can be given typically when network configuration is modified, like when a parallel of incoming lines is closed or when an emergency source is present in the system, changing load capability and short circuit levels.

The set B can be activated by:

- communication network, through PR330/D-M (i.e. when the changeover is scheduled);
- directly from user interface of PR333/P;
- an adjustable time interval after closing of the circuit breaker.

Zone discrimination function

The zone discrimination function allows the fault area to be insulated by segregating the system very rapidly only at the level closest to the fault, while leaving the rest of the installation running.

This is done by connecting the trip units together: the trip unit nearest the fault is tripped instantly, sending a block signal to the other trip units affected by the same fault. The zone discrimination function can be enabled if the fixed-time curve has been selected and an auxiliary power supply is present. Zone discrimination can be applied with protections S and G or, alternatively, with protection D.

Measurement functions

The PR333/P trip unit provides a complete set of measurements:

- Currents: three phases (L1, L2, L3), neutral (Ne) and ground fault
- Voltage: phase-phase, phase-neutral and residual voltage
- Power: active, reactive and apparent
- Power factor
- Frequency and peak factor, (Ip/Irms)
- Energy: active, reactive, apparent, counter
- Harmonics calculation: up to the 40th harmonic for frequency $f = 50$ Hz (waveform and module of the harmonics displayed); up to the 35th for frequency $f = 60$ Hz
- Maintenance: number of operations, percentage of contact wear, opening data storage.

The PR333/P 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 P periods (adjustable from 5 to 120 min.) are stored in a non-volatile memory and displayed in a bar graph.

Other Functions

PR333/P integrates all the features (in terms of protection, measurement, signalling and communication) described for PR332/P equipped with PR330/V.

The device also contains a programmable contact that can be set using the PR010/T, SD-TestBus2 or SD-Pocket, and combined with numerous events.



Protection trip units and trip curves

PR333/P

Protection functions and setting values - PR333/P

Function	Trip threshold	Threshold steps	Trip Time *	Time Step	Can be excluded	Relation t=f(I)	Thermal memory	Zone discriminat.
L Overload protection Tolerance ⁽²⁾	$I1 = 0.4 \dots 1 \times I_n$ Trip between $1.05 \text{ e } 1.2 \times I1$	$0.01 \times I_n$	At current $I_f = 3 \times I1$ $t1 = 3 \text{ s} \dots 144 \text{ s}$ $\pm 10\% \text{ If } \leq 6 \times I_n$ $\pm 20\% \text{ If } > 6 \times I_n$	$3 \text{ s}^{(1)}$	–	$t = k/I^2$	■	–
	Tolerance $1.1 \dots 1.25 \times I1$ <small>(in accordance with IEC 60255-3)</small>	$0.01 \times I_n$	At current $I_f = 3 \times I1$; $t1 = 3 \text{ s} \dots 144 \text{ s}$ $\pm 20\% \text{ If } > 6 \times I1$ $\pm 30\% \text{ } 2 \times I1 \leq I_f \leq 6 \times I1 \text{ } I_n$	3 s	–	$t = k (\alpha)$ $\alpha = 0.02 \text{--} 1 \text{--} 2$	–	–
S Selective short circuit protection Tolerance ⁽²⁾	$I2 = 0.6 \dots 10 \times I_n$ $\pm 7\% \text{ If } \leq 6 \times I_n$ $\pm 10\% \text{ If } > 6 \times I_n$	$0.1 \times I_n$	At current $I_f > I2$ $t2 = 0.05 \text{ s} \dots 0.8 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 40 \text{ ms}$	0.01 s	■	$t = k$	–	■
	Tolerance ⁽²⁾ $I2 = 0.6 \dots 10 \times I_n$ $\pm 7\% \text{ If } \leq 6 \times I_n$ $\pm 10\% \text{ If } > 6 \times I_n$	$0.1 \times I_n$	At current $I_f = 10 \times I_n$; $t2 = 0.05 \text{ s} \dots 0.8 \text{ s}$ $\pm 15\% \text{ If } \leq 4 \times I_n$ $\pm 20\% \text{ If } > 4 \times I_n$	0.01 s	■	$t = k/I^2$	■	–
S₂ Selective short circuit protection Tolerance ⁽²⁾	$I2 = 0.6 \dots 10 \times I_n$ $\pm 7\% \text{ If } \leq 6 \times I_n$ $\pm 10\% \text{ If } > 6 \times I_n$	$0.1 \times I_n$	At current $I_f > I2$ $t2 = 0.05 \text{ s} \dots 0.8 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 40 \text{ ms}$	0.01 s	■	$t = k$	–	■
I Instantaneous short circuit protection Tolerance ⁽²⁾	$I3 = 1.5 \dots 15 \times I_n$ $\pm 10\%$	$0.1 \times I_n$	$\leq 30 \text{ ms}$	–	■	$t = k$	–	–
G Ground fault protection Tolerance ⁽²⁾	$I4 = 0.2 \dots 1 \times I_n$ $\pm 7\%$	$0.02 \times I_n$	At current $I_f > I4$ $t4 = 0.1 \text{ s} \dots 0.45 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 40 \text{ ms}$	0.05 s	■	$t = k$	–	■
	Tolerance ⁽²⁾ $I4 = 0.2 \dots 1 \times I_n$ $\pm 7\%$	$0.02 \times I_n$	$t4 = 0.1 \text{ s} \dots 0.45 \text{ s}$ $\pm 15\%$	0.05 s	■	$t = k/I^2$	–	–
MCR Protection against closing in short circuit conditions Tolerance ⁽²⁾	$I3 = 6.0 \text{--} 6.1 \text{--} 6.2 \text{--} 6.3 \text{--} 6.4 \dots 14.5 \text{--} 14.6 \text{--} 14.7 \text{--} 14.8 \text{--} 14.9 \text{--} 15 \times I_n$ $\pm 10\%$	–	$\leq 30 \text{ ms}$	–	■	$t = k$	–	–
D Directional short circuit protection Tolerance ⁽²⁾	$I7 = 0.6 \dots 10 \times I_n$ $\pm 10\%$	$0.1 \times I_n$	At current $I_f > I7$ $t7 = 0.20 \text{ s} \dots 0.8 \text{ s}$	0.01 s	■	$t = k$	–	■
U Phase unbalance protection Tolerance ⁽²⁾	$I6 = 2\% \dots 90\%$ $\pm 10\%$	1%	$t6 = 0.5 \text{ s} \dots 60 \text{ s}$ The best of the two data: $\pm 20\% \text{ o } \pm 100 \text{ ms}$	0.5 s	■	$t = k$	–	–
OT Protection against overtemperature	fixed defined by ABB	–	Instantaneous	–	–	$\text{temp} = k$	–	–
UV Undervoltage protection Tolerance ⁽²⁾	$U8 = 0.5 \dots 0.95 \times U_n$ $\pm 5\%$	$0.01 \times I_n$	At current $U < U8$; $t8 = 0.1 \text{ s} \dots 5 \text{ s}$ The best of the two data: $\pm 20\% \text{ o } \pm 100 \text{ ms}$	0.1 s	■	$t = k$	–	–
	OV Overvoltage protection Tolerance ⁽²⁾	$U9 = 1.05 \dots 1.2 \times U_n$ $\pm 5\%$	$0.01 \times I_n$	At current $U > U9$; $t9 = 0.1 \text{ s} \dots 5 \text{ s}$ The best of the two data: $\pm 20\% \text{ o } \pm 100 \text{ ms}$	0.1 s	■	$t = k$	–
RV Residual voltage protection Tolerance ⁽²⁾	$U10 = 0.1 \dots 0.4 \times U_n$ $\pm 5\%$	$0.05 U_n$	At current $U > U10$; $t10 = 0.5 \text{ s} \dots 30 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 100 \text{ ms}$	0.5 s	■	$t = k$	–	–
	RP Reverse power protection Tolerance ⁽²⁾	$P11 = -0.3 \dots -0.1 \times P_n$ $\pm 10\%$	$0.02 P_n$	At current $P < P11$ $t11 = 0.5 \text{ s} \dots 25 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 100 \text{ ms}$	0.1 s	■	$t = k$	–
UF Underfrequency protection Tolerance ⁽²⁾	$f11 = 0.90 \dots 0.99 \times f_n$ $\pm 5\%$	$0.01 f_n$	At current $f < f12$; $t9 = 0.5 \text{ s} \dots 3 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 100 \text{ ms}$	0.1 s	■	$t = k$	–	–
	OF Overfrequency protection Tolerance ⁽²⁾	$f12 = 1.01 \dots 1.10 \times f_n$ $\pm 5\%$	$0.01 f_n$	At current $f > f13$; $t10 = 0.5 \text{ s} \dots 3 \text{ s}$ The best of the two data: $\pm 10\% \text{ o } \pm 100 \text{ ms}$	0.1 s	■	$t = k$	–

* Referring to the electronics

If = fault current

(1) The minimum trip value is 1 s, regardless of the type of curve set (self-protection)

(2) 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
- trip time set $\geq 100 \text{ ms}$

(3) No intervention time

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

Trip time	
L	$\pm 20\%$
S	$\pm 20\%$
I	$\leq 60 \text{ ms}$
G	$\pm 20\%$
Others	$\pm 20\%$

Power supply

The PR333/P trip unit does not normally require any external power supplies, being self-supplied from the current sensors (CS); to activate the protection and ammeter functions, it is sufficient for the three phases to have a current load at least at 70 A.

The unit ensures fully self-supplied operation. When an auxiliary power supply is present, it is also possible to use the unit with the circuit breaker either open or closed with very low current flowing through.

It is also possible to use an auxiliary power supply provided by the PR030/B portable battery unit (always supplied), which allows the protection functions to be set when the trip unit is not self-supplied.

PR333/P stores and shows all the information needed after a trip (protection tripped, trip current, time, date). No auxiliary supply is required for this functionality.

	PR333/P	PR330/D-M
Auxiliary power supply (galvanically insulated)	24 V DC \pm 20%	from PR333/P
Maximum ripple	5%	
Inrush current @ 24V	~1 A per 5 ms	
Rated power @ 24V	~3 W	+1 W

PR330/V can give power supply to the trip unit when a three-phase voltage is equal or higher to 60V.

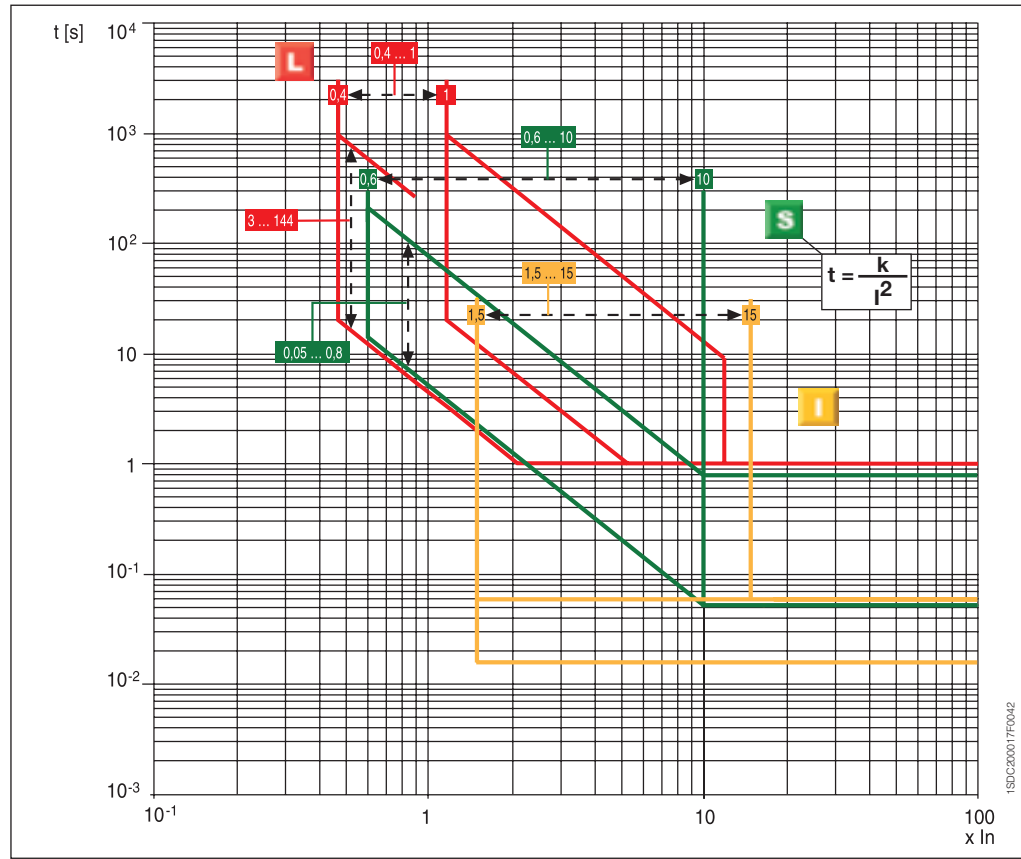


Protection trip units and trip curves

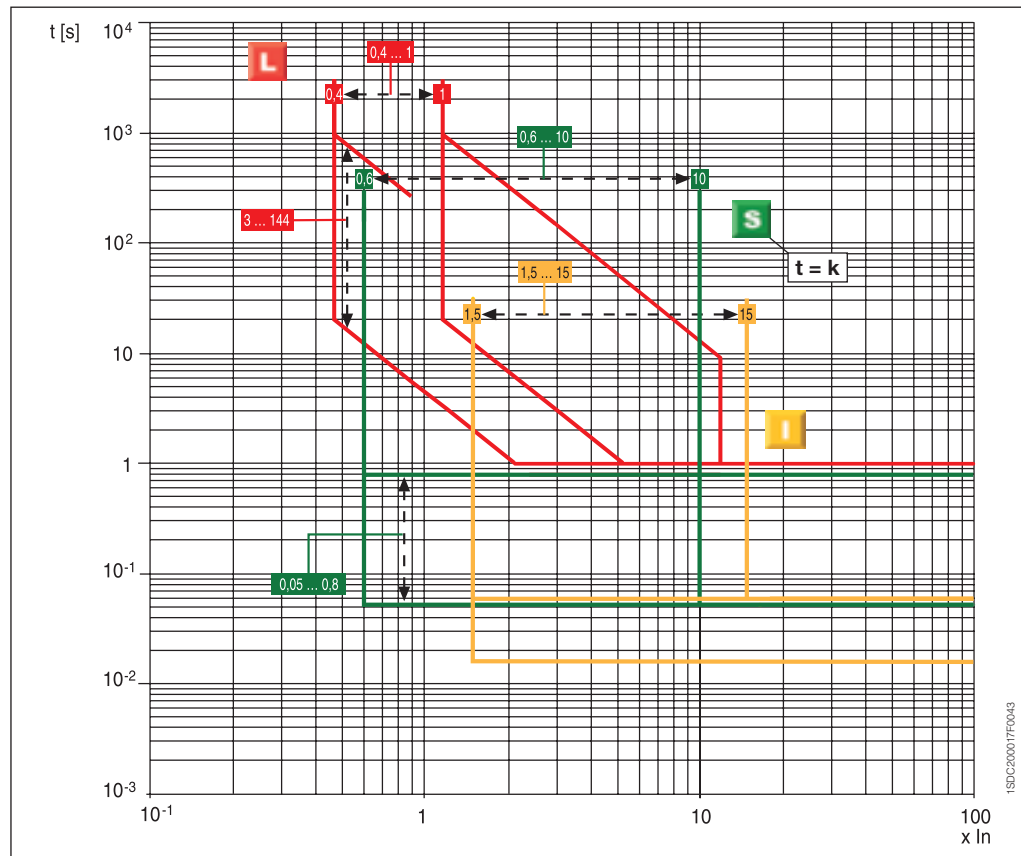
PR333/P

Functions L-S-I

3

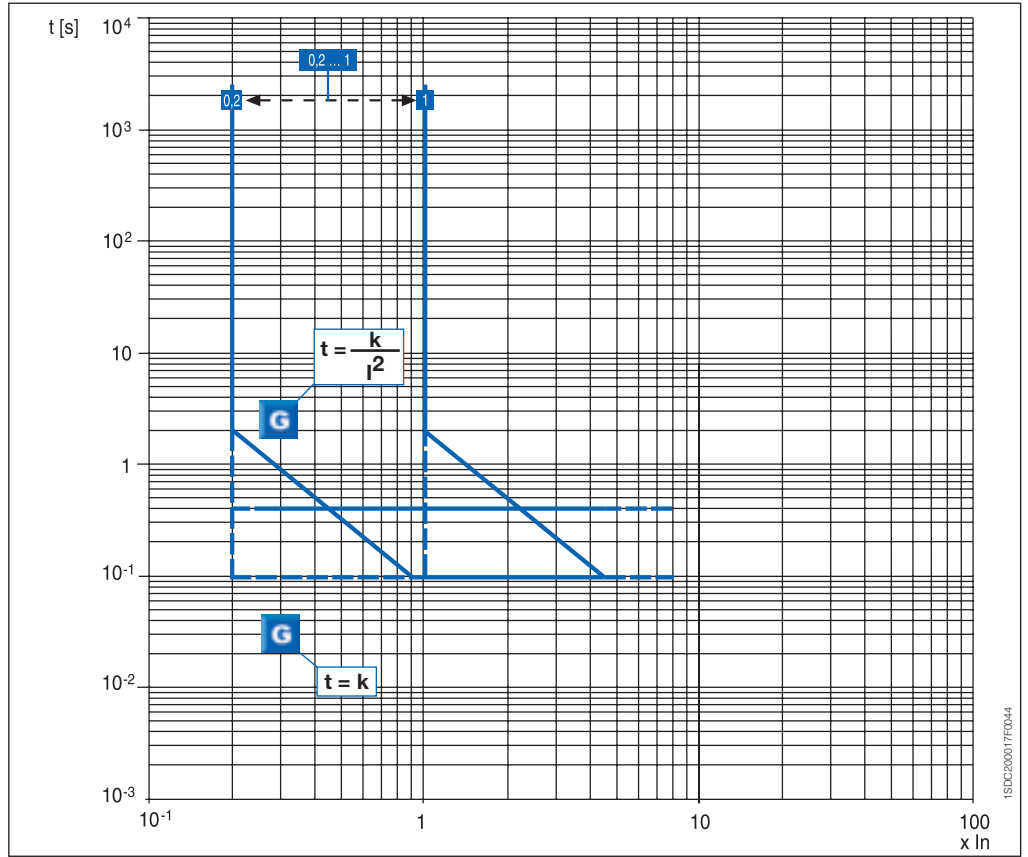


Functions L-S-I



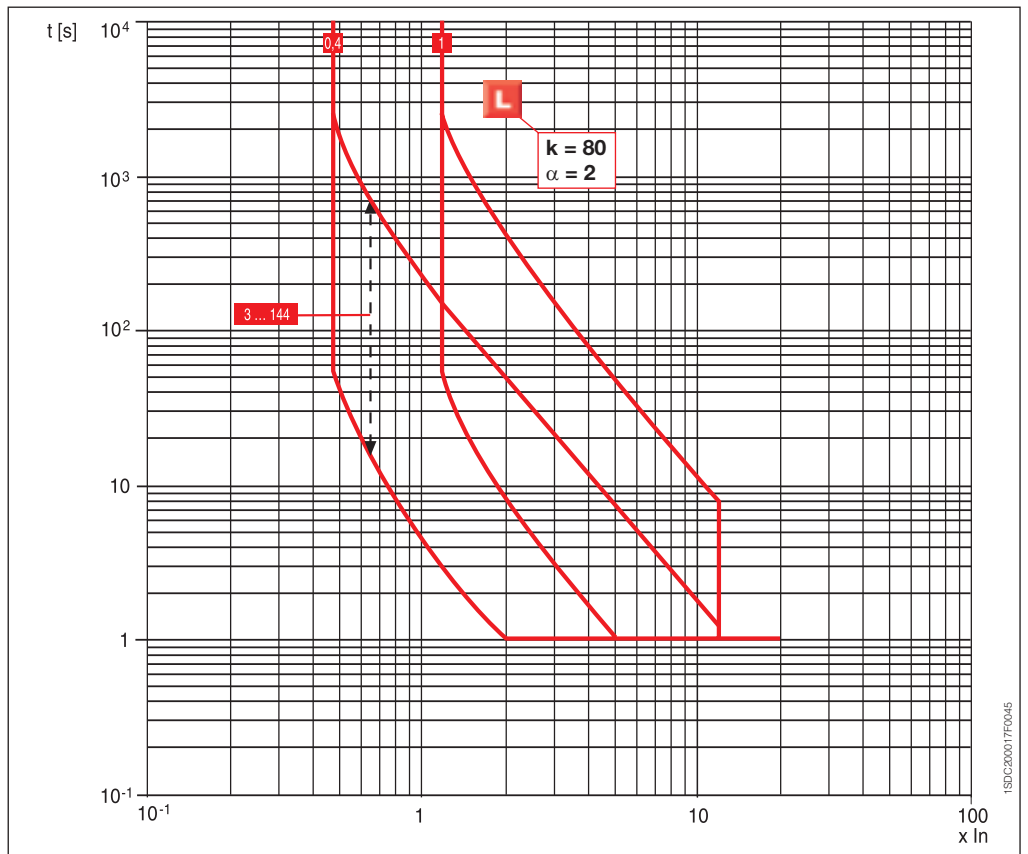
Threshold and trip times tolerances.....page 3/26

Function G



Function L

According to IEC 60255-3



Threshold and trip times tolerances.....page 3/26



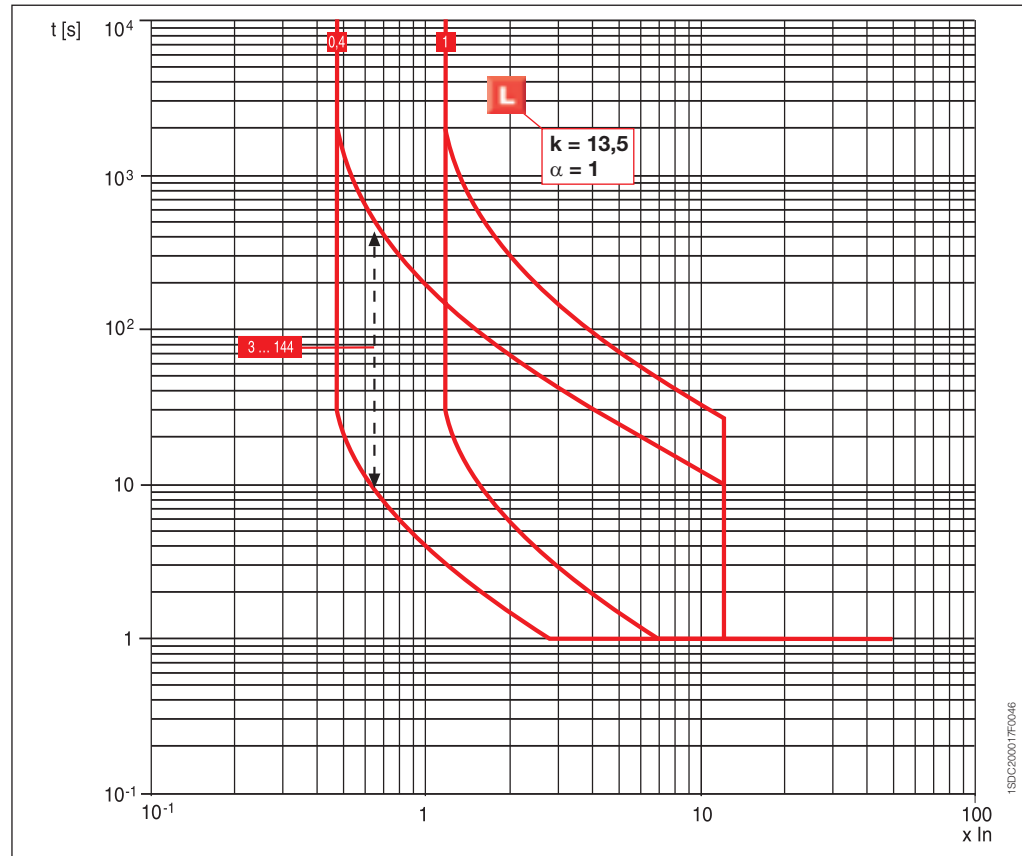
Protection trip units and trip curves

PR333/P

Function L

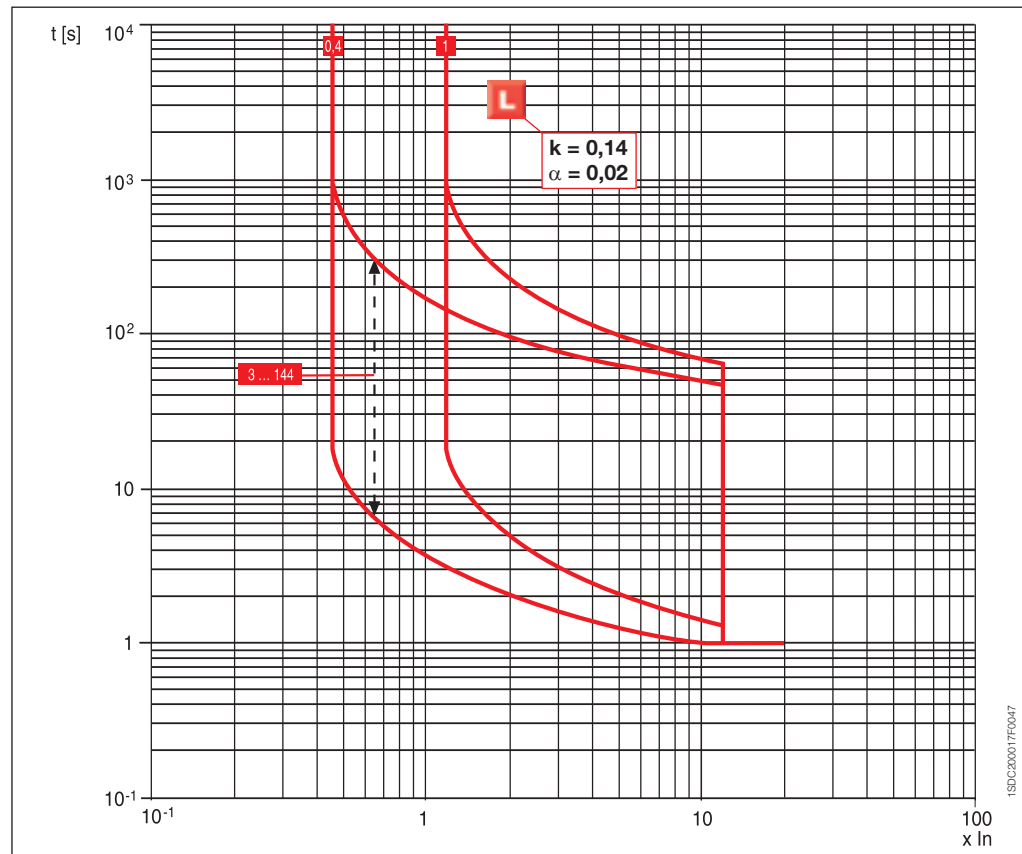
According to IEC 60255-3

3



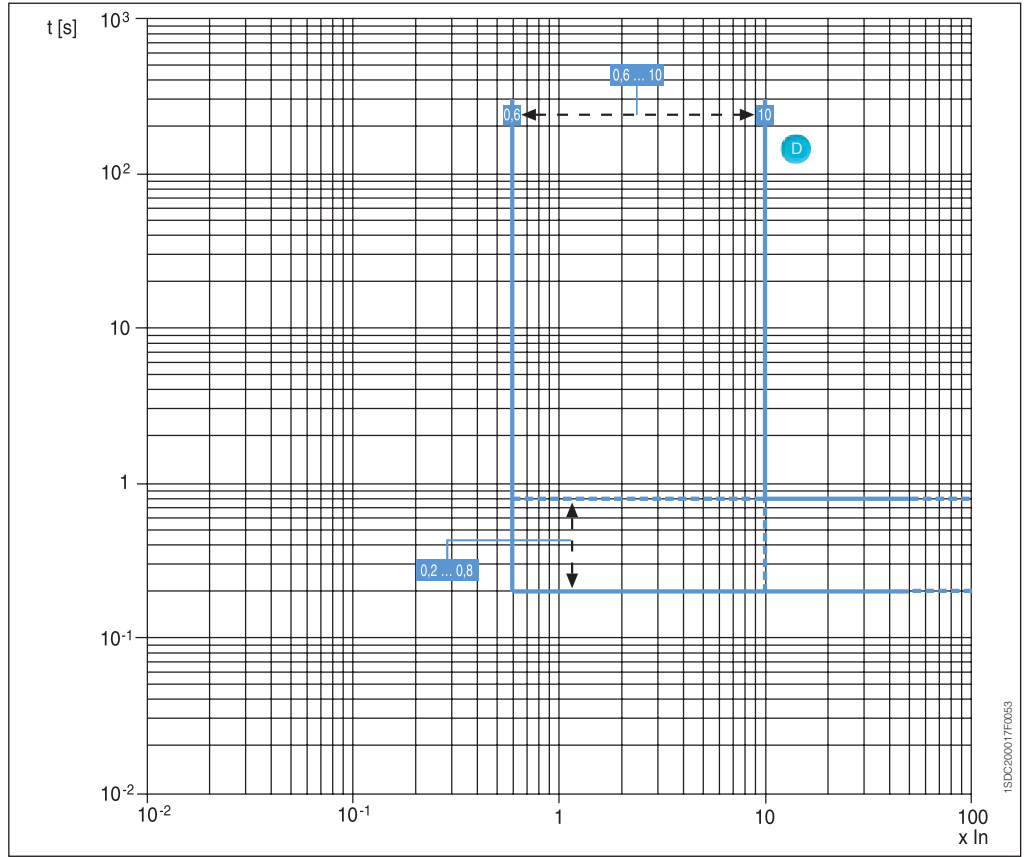
Function L

According to IEC 60255-3

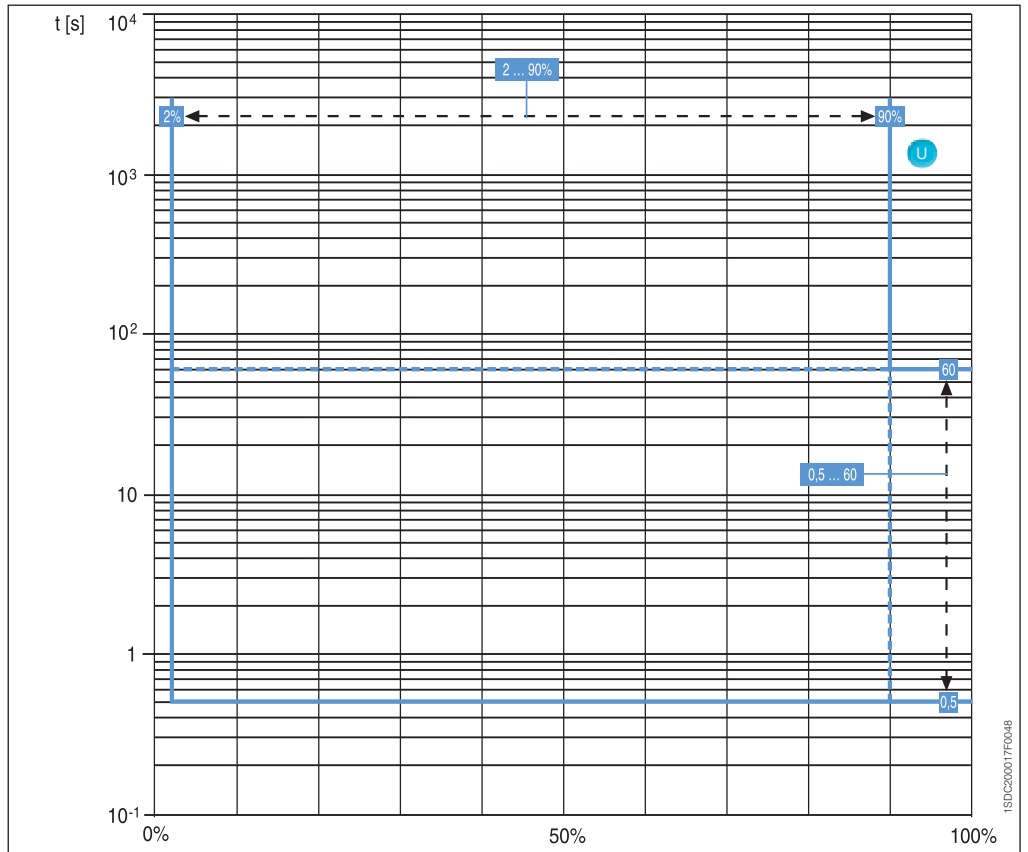


Threshold and trip times tolerances.....page 3/26

Function D



Function U



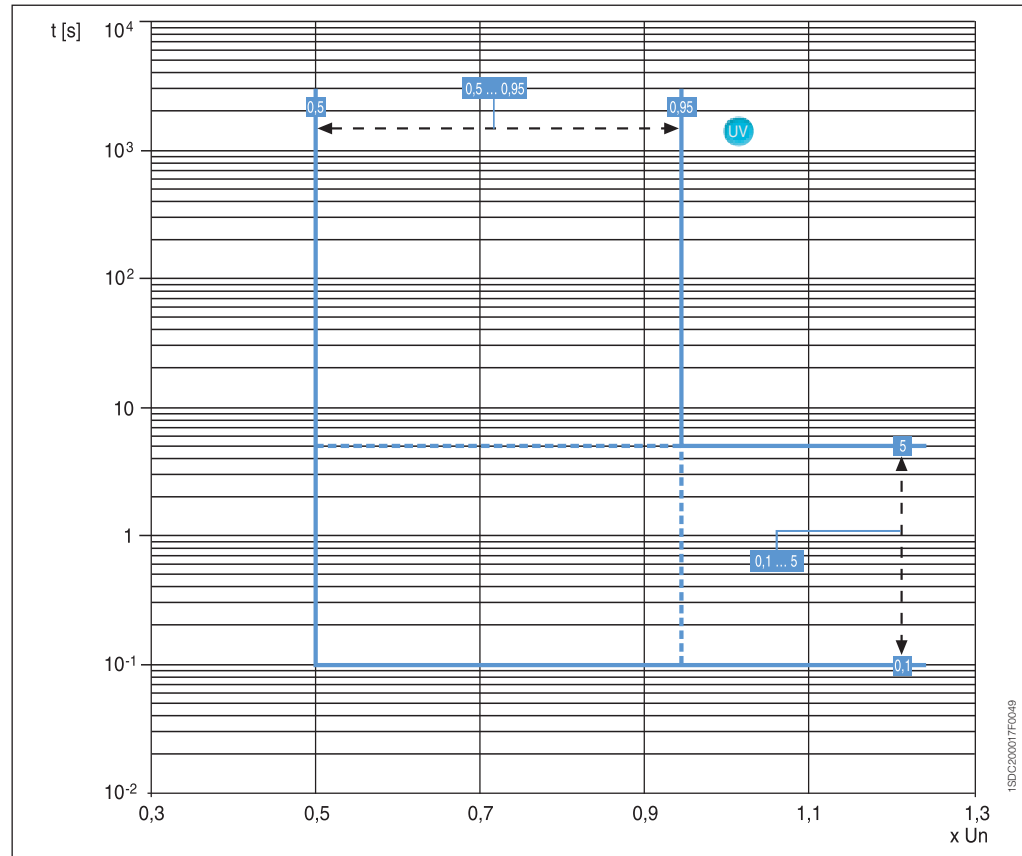
Threshold and trip times tolerances.....page 3/26



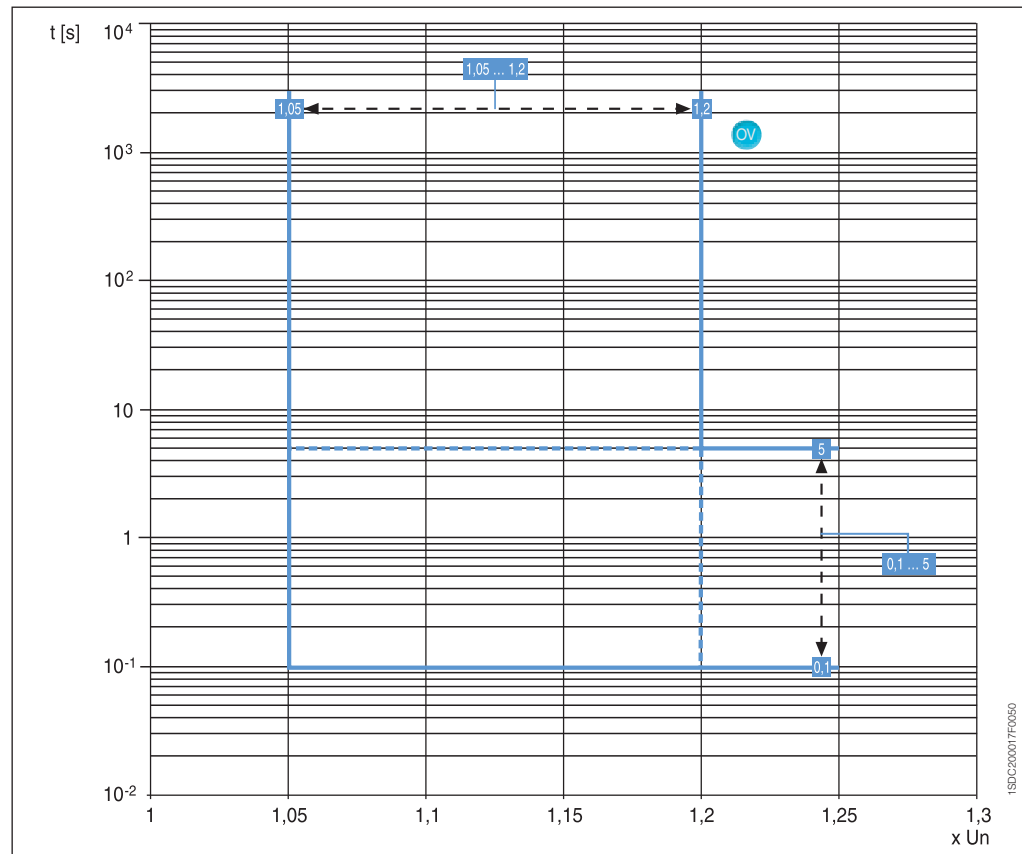
Protection trip units and trip curves

PR333/P

Function UV

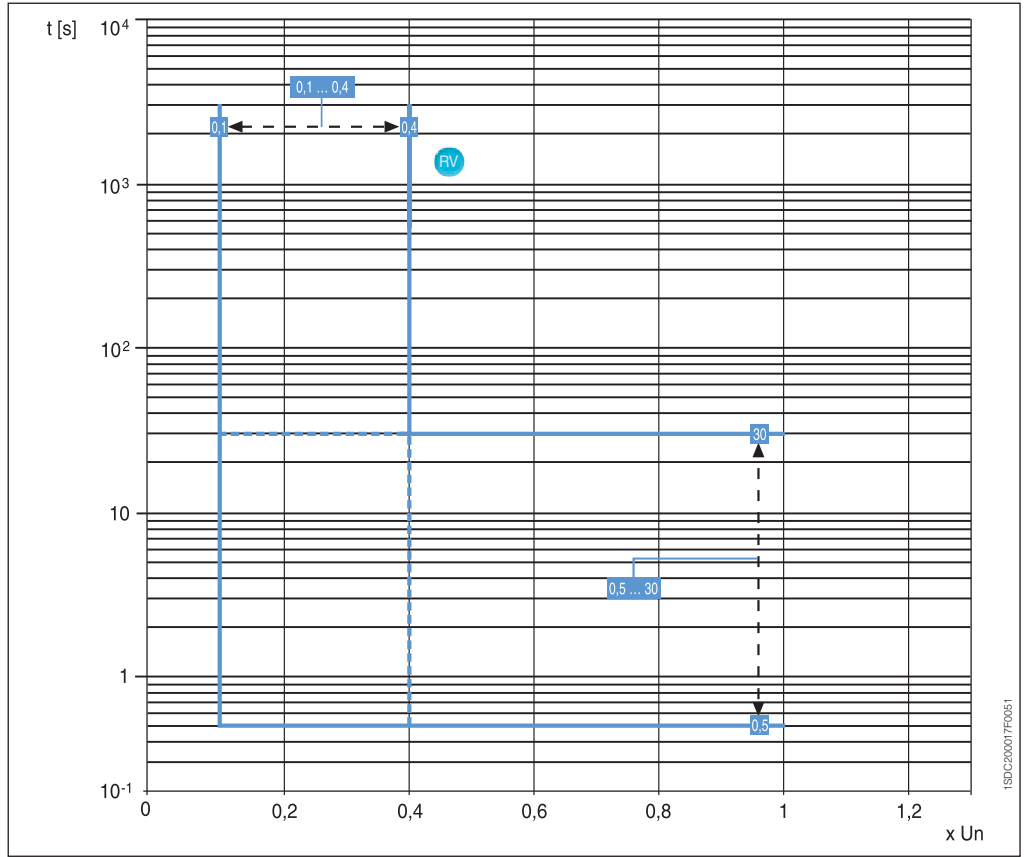


Function OV

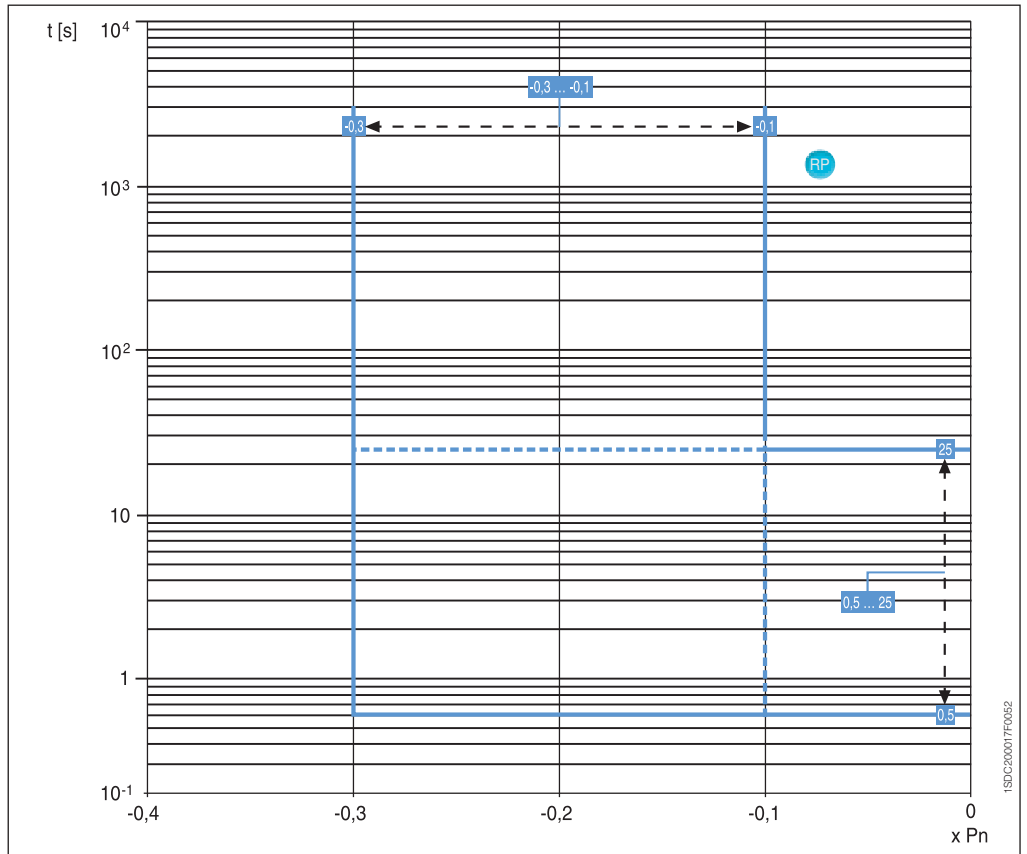


Threshold and trip times tolerances.....page 3/26

Function RV



Function RP





Accessories for protection trip units

Additional internal modules

PR332/P and PR333/P trip units can be enriched with additional internal modules, increasing the capacity of the trip unit and making these units highly versatile.

PR330/V Measurement Module

This optional internal module, installed in PR332/P (standard in PR333/P), allows the trip unit to measure the phase and neutral voltages and to process them in order to achieve a series of features, in terms of protection and measurement. PR330/V module, when is ordered mounted on the circuit breaker, does not require any external connection or voltage transformers since it is connected internally to the upper terminals of X1 circuit breaker (selector in "INT" position) though the internal voltage sockets.

At the ordering stage, the code of the internal voltage socket can be specified in addition to the code of the X1 circuit breaker so as to guarantee the possibility to install even afterwards the PR332/P or PR333/P trip unit equipped with the PR330/V module connected internally to the upper terminals. When necessary, the connection of voltage pick-ups can be moved to any other points (i.e. lower terminals), by using the alternative connection located in the terminal box and switching the voltage selector in "EXT" position. For the dielectric test of the circuit breaker, the selector must be switched to "TEST" position.

PR330/V is also able to energize the PR332/P while line voltage input is above 85V. Voltage transformers shall have burdens between 5VA and 10VA and accuracy class 0.5 or better.

Additional Protections with PR330/V:

- UnderVoltage (UV) protection
- Overvoltage (OV) protection
- Residual voltage (RV) protection
- Reverse power (RP) protection
- Underfrequency (UF) protection
- Overfrequency (OF) protection
- Phase sequence (alarm only) - for PR333/P only

All the above indicated protections can be excluded, although it is possible to leave only the alarm active when required: in this case the release will indicate the "ALARM" status.

Voltage protections UV, OV, RV

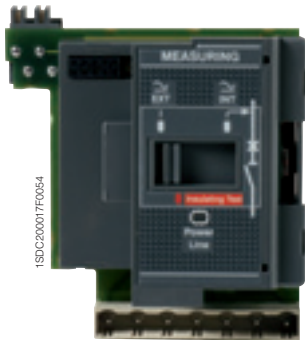
With the PR330/V module, the PR332/P trip unit is able to provide the undervoltage and overvoltage protection (UV, OV) and the residual voltage protection (RV). The residual voltage protection RV identifies interruptions of the neutral (or of the grounding conductor in systems with grounded neutral) and faults that shift the star centre in systems with insulated neutral (e.g. large ground faults). The star centre shift is calculated as a vectorial sum of the phase voltages.

Reverse power protection RP

Reverse power protection is especially suitable for protecting large machines such as motors and generators. The PR332/P with the PR330/V module can analyse the direction of the active power and open the circuit breaker if the direction is opposite to that of normal operation. The reverse power threshold and the trip time are adjustable.

Frequency protections UF, OF

The frequency protections detect the variation of network frequency above adjustable thresholds, generating an alarm or opening the circuit breaker. It is a protection typically needed in an isolated network, i.e. powered by a genset.





1SDC20017F0056

PR330/D-M Communication Module

PR330/D-M communication module is the solution for connecting Emax to a Modbus network, allowing the remote supervision and control of the circuit breaker. It is suitable for PR332/P and PR333/P trip units. As for PR330/V, this module can be added at any time to the protection trip unit and its presence is automatically detected. When ordered separately from the circuit breakers it is supplied complete of all the accessories needed for its installation, such as precabled auxiliary switches and cables for signalling the circuit breaker status (springs, position inserted). Refer to circuit diagram page 7/9 for details about connections.

The list of available functions can be found on page 3/42.

It is provided with three LEDs on the front side:

- Power LED
- Rx/Tx LEDs.

For ordering with the PR330/R actuator unit.



1SDC20017F0056

PR330/R actuator module

The PR330/R actuator module is fitted in the right slot of Emax X1 and it is used for opening and closing the circuit breaker by means of the shunt trips and closing coils by remote control. It is suitable for the PR332/P and PR333/P and must be ordered when the communication module PR330/D-M is available.



Accessories for protection trip units

Additional external modules

PR331/P, PR332/P and PR333/P trip units can be enriched with additional external modules.

PR030/B power supply unit

This accessory, always supplied with the PR332/P and PR333/P range of trip units, 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 or without auxiliary power supply).

PR030/B is also needed for reading trip data if the trip occurred more than 48 hours earlier and the release was no longer powered.

An internal electronic circuit supplies 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 PR030/B accessory is also used to perform the Trip test & Auto test.



1SDC20017F0057

Interface from front of HMI030 panel

This accessory, suitable for all protection trip units, is designed for the installation on the front side of the switchboard. It consists of a graphic display where all the measurements and alarms/ events of the trip unit are shown. The user can browse the measurements by using the navigation push-buttons, similarly to PR332/P, PR333/P, PR122/P and PR123/P. Thanks to the high precision level, the same of the protection trip units, the device can replace the traditional instrumentation, without the need for current/voltage transformers. The HMI030 unit requires only a 24 V DC power supply, as it is connected directly to the protection trip unit via a serial line.



1SDC20017F0058

BT030 Communication unit

BT030 is a device to be connected on Test connector of PR331/P, PR332/P and PR333/P for Emax X1, as well as the PR121/P, PR122/P and PR123/P for Emax E1-E6 . It allows Bluetooth communication among the Protection trip unit and a PDA or a Notebook with a Bluetooth port. BT030 can also be used with Tmax molded case circuit breakers equipped with PR222DS/PD; this device is dedicated to the use with SD-Pocket application.

BT030 can provide the power supply needed to energize itself and the protection trip unit by means of a Li-ion rechargeable battery.



1SDC20017F0059



PR010/T configuration test unit

The PR010/T unit performs the functions of testing, programming and reading parameters for the protection units equipping Emax X1 low voltage power circuit breakers.

In particular, the test function involves the following trip units:

- PR331/P (all versions)
- PR332/P (all versions)
- PR333/P (all versions)

whereas the parameter programming and reading functions are available only for the more advanced trip unit, regard the range of PR332/P and PR333/P trip units.

All of the functions mentioned can be carried out “on board” by connecting the PR010/T unit to the front multi-pin connector on the various protection units. Special interfacing cables supplied with the unit must be used for this connection.

The PR010/T, which HMI interface is made of a touchpad and a multi-line alphanumeric display.

The unit has also two LEDs to indicate, respectively:

- POWER-ON and STAND BY
- battery charge state.

Two different types of test are available: automatic (for PR331/P, PR332/P and PR333/P) and manual.

By connection to a PC (using the USB 512MB supplied by ABB SACE), it is also possible to upgrade the software of the PR010/T unit and upgrade it to the development of new products.

It is also possible to store the most important test results in the unit itself, and to 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 five complete tests can be stored in the memory. The report downloaded onto a PC allows creation of an archive of tests carried out on the installation.

In automatic mode, the PR010/T unit with the PR332/P range tests the following:

- protection functions L, S, I
- G protection function with internal transformer
- G protection function with toroid on the transformer star centre
- monitoring of correct microprocessor operation.

The unit can also test the following protections of PR332/P, equipped with PR330/V, or PR333/P:

- overvoltage protection function OV
- undervoltage protection function UV
- residual voltage protection function RV
- phase unbalance protection function U.

The 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 PR010/T unit includes:

- PR010/T test unit complete with rechargeable batteries
- TT1 test unit
- 100 - 240V AC/12V DC external power supply with cord
- cables to connect the unit and connector
- cable to connect the unit and computer (RS232 serial)
- user manual and USB 512MB containing application software
- plastic bag.



Accessories for protection trip units



1SDC20017F0061

SACE PR021/K signalling unit

The SACE PR021/K signalling unit can convert the digital signals supplied by the PR331, PR332 and PR333 protection unit into electrical signals, via normally open electrical contacts (potential free). The unit is connected to the protection trip unit by means of a dedicated serial line through which all of the information about the activation status of the protection functions flows. The corresponding power contacts are closed based on this information.

The following signals/contacts are available:

- overload pre-alarm L (the alarm signal remains active throughout the overload, until the trip unit is tripped)
- timing and tripping of any protections (the trip signals of the protections remain active during the timing phase, and after the trip unit has tripped)
- protection I tripped
- timing and overtemperature threshold exceeded ($T > 185^{\circ}\text{F}/85^{\circ}\text{C}$)
- two load control contacts (connection and disconnection of a load, or disconnection of two loads)
- trip unit tripped
- dialogue fault on a serial line (connecting the protection and signalling units)
- phase unbalance.

Setting a dip-switch allows up to seven signal contacts to be freely configured in PR332-PR333, including: directional protection D tripped, under- and overvoltage UV and OV tripped, reverse power RP tripped, and others.

Two contacts available on the SACE PR021/K unit (load control) can pilot a circuit breaker shunt trip and closing coil. These contacts allow various applications, including load control, alarms, signals and electrical locks.

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 signalling contacts.

The table below lists the characteristics of the signalling contacts available in the SACE PR021/K unit.

Auxiliary power supply	24 V DC \pm 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)



Communication devices and systems

Industrial networking and ABB SACE Emax

In addition to providing flexible and safe protection of power installations, ABB SACE Emax electronic trip units have an extended range of communication features, which opens the way for connection of circuit breakers to the world of industrial communication.

PR332/P and PR333/P electronic trip units can be fitted with communication modules, which make it possible to exchange data and information with other industrial electronic devices by means of a network.

The basic communication protocol implemented is Modbus RTU, a well-known standard of widespread use in industrial automation and power distribution equipment. A Modbus RTU communication interface can be connected immediately and exchange data with the wide range of industrial devices featuring the same protocol. ABB products featuring the Modbus RTU protocol include:

- low voltage circuit breakers such as Emax
- medium voltage protection devices
- sensors
- automation I/O systems
- power meters and other measurement devices
- intelligent devices such as PLCs
- operator interfaces
- supervision and control systems.

And, if other communication protocols are required, the ABB Fieldbus Plug system is also available: intelligent field bus protocols such as Profibus-DP and DeviceNet thus become immediately available.

The power of industrial networking

The communication network can be used to read all information available in the protection trip unit, from any location connected to the bus and in real time:

- circuit breaker status: closed, open, opened by protection trip unit trip
- all values measured by the protection trip unit: RMS currents, voltages, power, power factor and so on
- alarms and prealarms from protection trip unit, e.g., overload protection alarm (timing to trip or prealarm warning)
- fault currents in case of circuit breaker opening on a protection trip
- number of operations performed by the circuit breaker, with indication of the number of trips per protection type (short circuit, overload, etc.)
- complete settings of the protection trip unit
- estimate of the residual life of circuit breaker contacts, calculated on the basis of interrupted currents.

Remote control of circuit breakers is possible: commands to open, close and reset alarms can be issued to the circuit breaker and protection trip unit. Close commands are executed only after a security check (e.g., that there are no diagnostic alarms active on the trip unit).

It is also possible to change the settings of the protection trip unit remotely by means of the communication bus.

All remote commands can be disabled by a "local" configuration feature, for safety of operators and installation.





Communication devices and systems

Circuit breakers with communication can easily be integrated with automation and supervision systems. Typical applications include:

- supervision of the installation with continuous data logging (values of currents, voltage, power) and event logging (alarms, faults, trip logs). Supervision can be limited to low voltage devices or include medium voltage and possibly other kinds of industrial apparatus;
- predictive maintenance, based on number of operations of each circuit breaker, interrupted currents and estimate of residual equipment life;
- load shedding and demand side management under control of PLC, DCS or computers.

Communication products for ABB SACE Emax X1

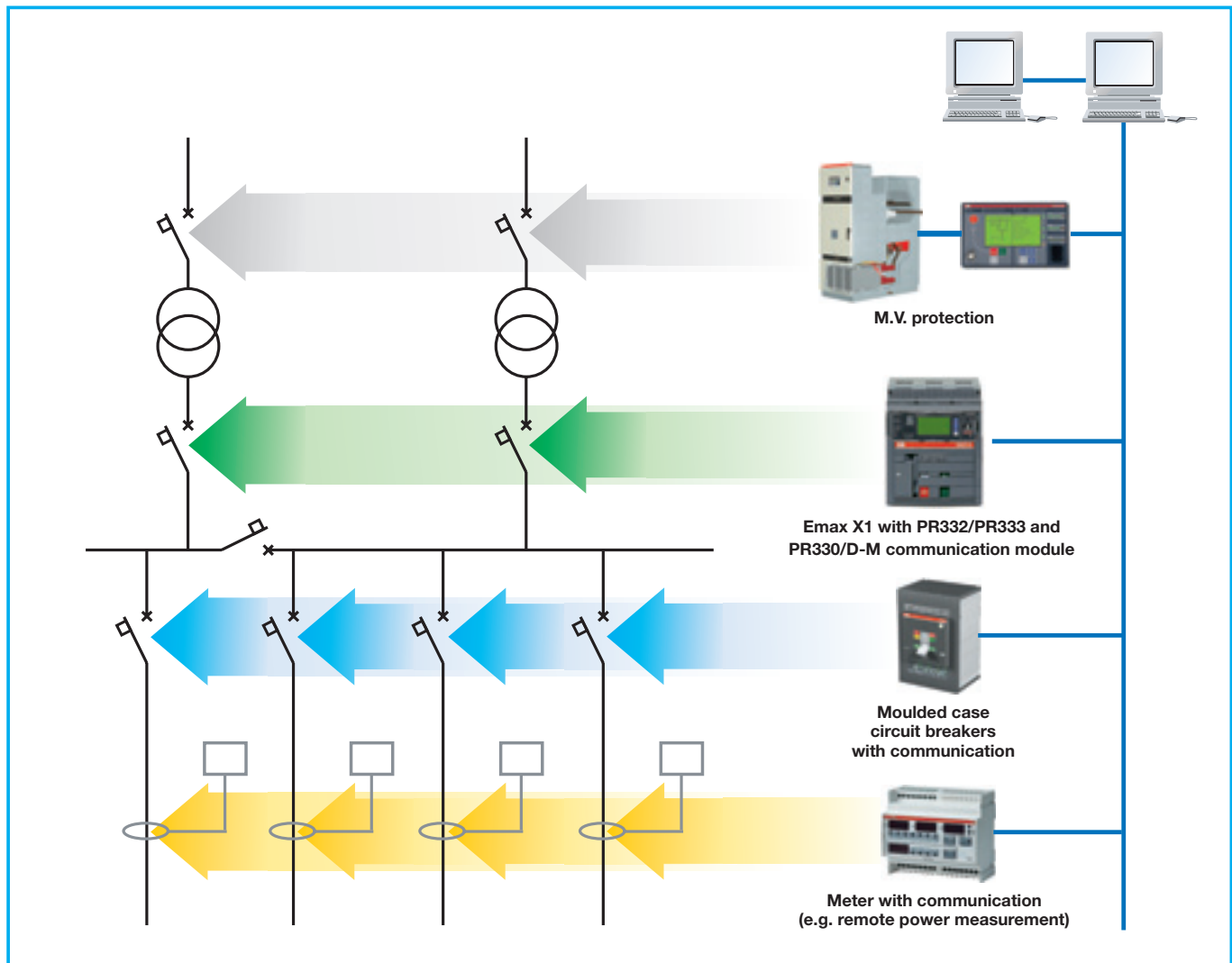
ABB SACE has developed a complete series of accessories for the Emax family of electronic trip units:

- PR330/D-M communication module;
- EP010 - FBP.

Furthermore, a new generation of software dedicated to installation, configuration, supervision and control of protection trip units and circuit breakers is now available:

- SD-View 2000;
- SD-Pocket;
- SD-TestBus2.

System architecture for plant supervision and control



1SDC200017F0603



1SDC200017F0055

PR330/D-M

PR330/D-M is the new communication module for PR332/P and PR333/P protection trip units. It is designed to allow easy integration of the Emax X1 circuit breakers in a Modbus network.

The Modbus RTU protocol is of widespread use in the power as well as the automation industry. It is based on a master/slave architecture, with a band width of up to 19200 kbytes/sec. A standard Modbus network is easily wired up and configured by means of an RS485 physical layer. ABB SACE trip units work as slaves in the field bus network.

All information required for simple integration of PR330/D-M in an industrial communication system are available on the ABB Web page (see www.abb.com).



1SDC200017F0064

EP010 - FBP

EP010 – FBP is the Fieldbus Plug interface between the Emax protection trip units and the ABB Fieldbus Plug system, allowing connection of Emax power circuit breakers to a Profibus, DeviceNet, or AS-I field bus network.

EP010 – FBP can be connected to the new Emax PR332/P and PR333/P protection trip units (the PR330/D dialogue module is required).

The ABB Fieldbus Plug concept is the latest development in industrial communication systems. All devices feature a standard connection socket, to which a set of interchangeable “smart” connectors can be plugged. Each connector is fitted with advanced electronics implementing the communication interface towards the selected field bus. Selecting a communication system is made as easy as selecting and connecting a plug. Communication systems currently available are Profibus-DP, DeviceNet and AS-i. More are being developed.



Communication devices and systems

Measurement, signalling and data functions

Details about functions available on PR332/P, PR333/P trip units with PR330/D-M and EP010 – FBP are listed in the table below:

	PR332/P + PR330/D-M	PR333/P + PR330/D-M	PR332/P + PR330/D-M and EP010	PR333/P + PR330/D-M and EP010
Communication functions				
Protocol	Modbus RTU stand.	Modbus RTU stand.	FBP	FBP
Physical layer	RS-485	RS-485	Profibus-DP or DeviceNet cable	Profibus-DP or DeviceNet cable
Maximum baudrate	19200 bps	19200 bps	115 kbps	115 kbps
Measuring functions				
Phase currents	■	■	■	■
Neutral current	■	■	■	■
Ground current	■	■	■	■
Voltage (phase-phase, phase-neutral, residual)	opt. ⁽¹⁾	■	opt. ⁽¹⁾ ⁽²⁾	opt. ⁽²⁾
Power (active, reactive, apparent)	opt. ⁽¹⁾	■	opt. ⁽¹⁾ ⁽²⁾	opt. ⁽³⁾
Power factor	opt. ⁽¹⁾	■	opt. ⁽⁴⁾	opt. ⁽⁴⁾
Frequency and peak factor	opt. ⁽¹⁾	■	opt. ⁽⁴⁾	opt. ⁽⁴⁾
Energy (active, reactive, apparent)	opt. ⁽¹⁾	■	opt. ⁽⁴⁾	opt. ⁽⁴⁾
Harmonic analysis		■		opt. ⁽⁴⁾
Signalling functions				
LED: auxiliary power supply, warning, alarm	■	■	■	■
Temperature	■	■	■	■
Indication for L, S, I, G and other protection	■	■	■	■
Programmable contact ⁽⁵⁾	■	■	■	■
Available data				
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	■	■	■	■
Trip unit command for fault failure	■	■	■	■
Undervoltage, overvoltage and residual voltage (timing and trip) protection	opt. ⁽¹⁾	■	opt. ⁽¹⁾	■
Reverse power protection (timing and trip)	opt. ⁽¹⁾	■	opt. ⁽¹⁾	■
Directional protection (timing and trip)		■		■
Underfrequency/overfrequency protection (timing and trip)	opt. ⁽¹⁾	■	opt. ⁽¹⁾	■
Phases rotation		■		■
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 open/closed	■	■	■	■
Reset alarms	■	■	■	■
Setting of curves and protection thresholds	■	■	■	■
Synchronize system time	■	■	■	■
Events				
Status changes in circuit breaker, protections and all alarms	■	■	■	■

(1) with PR330/V

(2) no residual voltage

(3) no apparent power available

(4) please ask ABB for further details

(5) Typical contact: MOS photo V_{max} = 48V DC / 30V AC

I_{max} = 50 mA DC / 35 mA AC

SD-View 2000

SD-View 2000 is a “ready-to-use” system, consisting of software for personal computers, which allows complete supervision of the low voltage electrical installation. Putting the SD-View 2000 system into operation is quick and easy. In fact, the software itself guides the user in recognizing and configuring the protection units. The user only needs knowledge of the installation (such as how many circuit breakers are installed and how they are connected to each other). No engineering work on the supervision system is required, since all the pages displayed are already configured in the system, ready to be used.

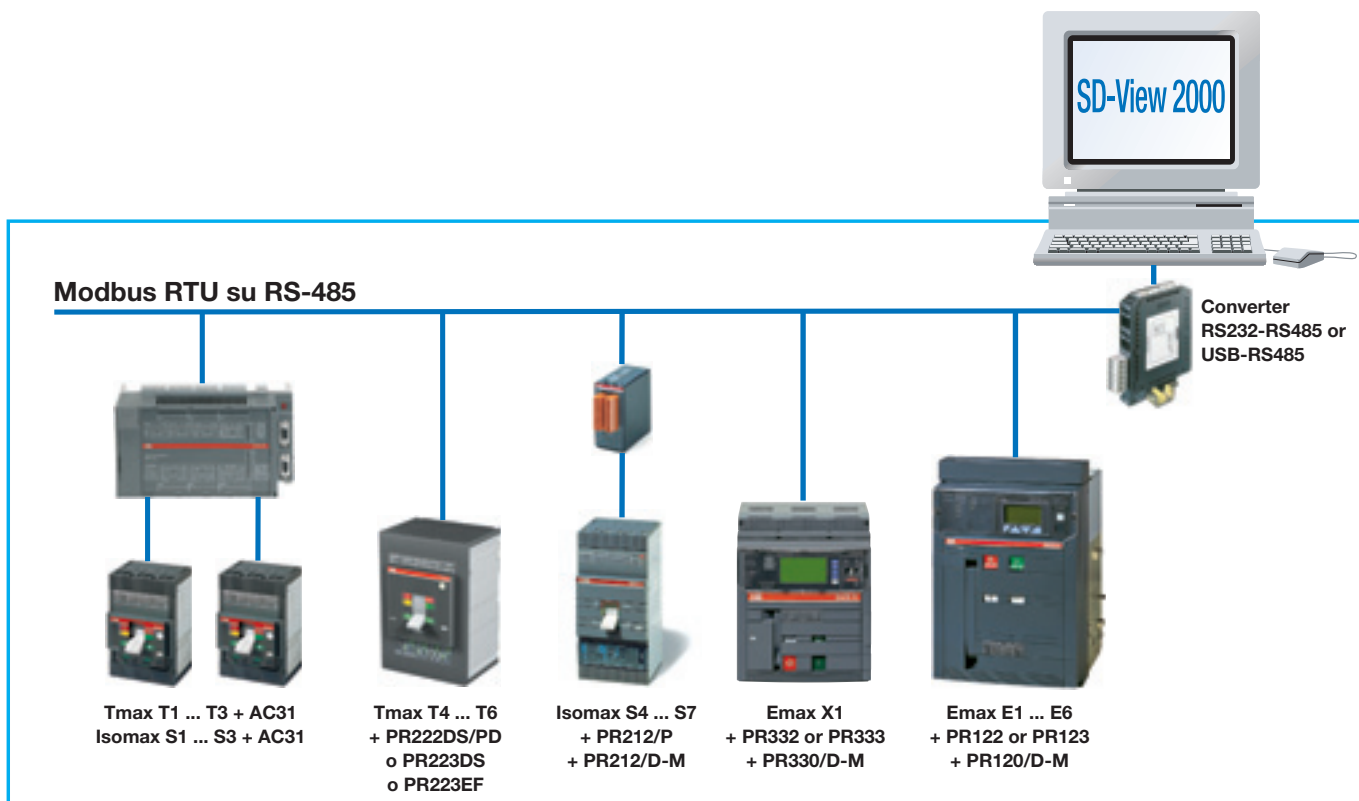
Usage of the software is intuitive and easy to learn for the operator: SD-View 2000 has graphic pages, based on Internet Explorer, which make the system as simple to manage as surfing on the Internet.

System architecture

System architecture is based on the latest developments in personal computer and industrial communication network technology.

SD-View 2000 is able to manage up to 8 serial lines, with a maximum of 31 devices each.

- Up to 8 serial RS485 ports
- Up to 31 devices for each serial port
- 9600 – 19200 Baud
- Modbus RTU protocol



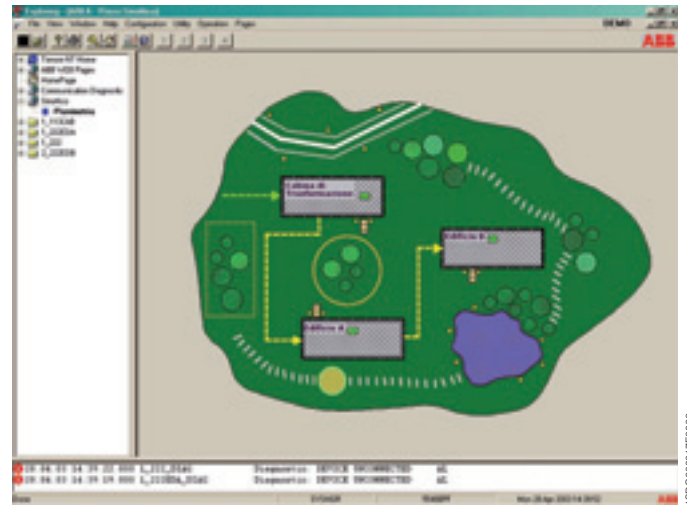


Communication devices and systems

3

Complete supervision of the installation

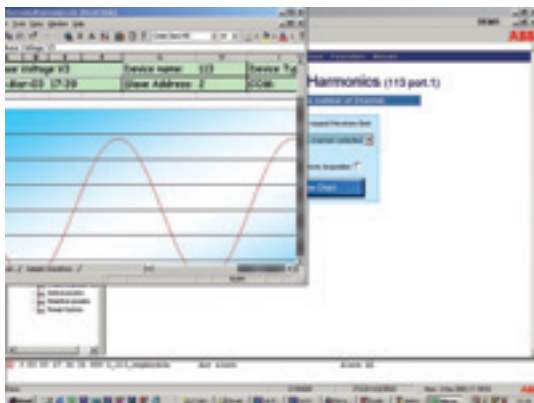
SD-View 2000 is the ideal tool available to system managers, in order to have the situation of the installation under control at all times and to be able to supervision all the functions easily and in real time.



SD-View 2000 allows information from the installation to be received and send commands to the circuit breakers and the relative trip units.

In particular, it is possible to:

- send opening and closing commands to the circuit breakers
 - read the electrical installation values (current, voltage, power factor, etc.)
 - read and modify the trip characteristics of the protection units
 - determine the status of the apparatus (open, closed, number of operations, trip for fault, etc.)
 - determine the abnormal operating situations (e.g. overload) and, in the case of the releases tripping, the type of fault (short circuit, ground fault, etc.)
 - plot by means of graphs the temporal evolution of the installation, through the history log of currents and voltages (with a time span for 15 days)
- Access to the various system functions can be enabled by means of passwords with different levels of authorization. Usage of the system is really simple and the graphic pages relative to each device are particularly intuitive and easy to use.



Devices which can be connected

The circuit breakers with electronic trip units which can be interfaced with SD-View 2000 are:

- Emax X1 power circuit breakers and Tmax T7 molded case circuit breakers fitted with PR332/P or PR333/P trip units with Modbus RTU PR330/D-M communication unit
- Emax power circuit breakers from E1 to E6 fitted with PR122/P or PR123/P trip units with Modbus RTU PR120/D-M communication unit
- Emax power circuit breakers from E1 to E6 fitted with PR112/PD or PR113/PD Modbus trip units
- Tmax molded case circuit breakers from T4, T5, T6 fitted with PR222DS/PD or PR223DS or PR223EF trip units.
- Isomax circuit breakers from S4 to S7 fitted with PR212/P trip unit with Modbus RTU PR212/D-M communication unit.

In addition, SD-View 2000 can acquire current, voltage and power measurements in real time from the MTME-485 multimeters with Modbus communication.

Furthermore, it is possible to interface any power or molded case circuit breaker or switch-disconnector, not fitted with a communication module, with the SD-View 2000 supervision system by means of a PLC type ABB AC31. For the circuit breakers or switch-disconnectors connected in this way, SD-View 2000 shows the status of the apparatus (open, closed, tripped, racket-in or racket-out) in real time and allows it to be operated remotely.

Technical characteristics

Up to 4 serial ports
Up to 31 ABB SACE devices for each serial port
9600 or 19200 baud
Modbus® RTU Protocol

Personal computer requirements

Pentium 1 GHz, 512 MB RAM, 100 GB hard disk, Windows 2000 XP, Internet Explorer 6, Ethernet card, RS232 Serial port, USB port (for the license key), Printer (optional).



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BT030

BT030 is a device to be connected to the Test connector of PR331/P, PR332/P and PR333/P. It allows Bluetooth communication between the protection trip unit and a PDA or a Notebook with a Bluetooth port.

BT030 can also be used with Tmax molded case circuit breakers equipped with PR222DS/P, PR-222DS/PD, PR223DS, PR223EF and PR232/P. This device is dedicated to use with the SD-Pocket and SD-TestBus2 application.

It can provide the auxiliary supply needed to energize the protection trip unit by means of rechargeable batteries.

SD-Pocket

SD-Pocket is an application designed to connect the new protection trip units to a PDA or to a personal computer. This means it is now possible to use wireless communication to:

- configure the protection threshold function;
- monitor measurement functions, including reading of data recorded in data logger (PR332/P or PR333/P);
- verify the status of the circuit breaker (i.e. number of operations, trip data, according to the trip unit connected).

SD-Pocket application scenarios include:

- during start-up of switchgear, with rapid and error-free transfer of the protection parameters to the trip units (also using the dedicated exchange file directly from Docwin);
- during normal installation service, gathering information on the circuit breaker and load conditions (last trip information, runtime currents, and other information).

To use all these functions, it is sufficient to have a PDA with MS Windows Mobile 2003 and BT interface or a personal computer with MS Windows 2000/XP OS and new BT030 Bluetooth interface devices.

SD-Pocket is freeware and it can be downloaded from the ABB SACE's website (<http://www.abb.com>). It is always provided with BT030 Bluetooth interface device, and its use does not require the presence of dialogue units for the trip units.



Communication devices and systems

SD-TestBus2

SD-TestBus2 is the commissioning and diagnostic software of ABB SACE for all Modbus RTU devices.

It can be used during system startup, or to troubleshoot an installed network.

SD-TestBus2 automatically scans the RS-485 bus, detects all connected devices and checks their communication settings. All possible combination of device address, parity and baud rate are checked.

A click on "scan" is enough to spot devices which are not responding, wrong addresses, misconfigured parity bits, and so on. This function is not limited to ABB SACE devices: all standard Modbus RTU devices are detected and their configuration is displayed.

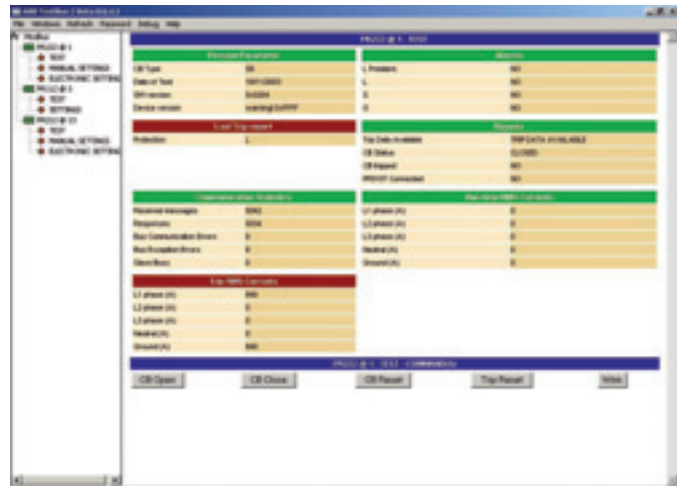
After the scan, the software displays warning messages about potential problems and configuration errors, allowing complete diagnosis of a field bus network.

When ABB SACE's circuit breakers are detected, additional functions can be used to check wirings, send open/ close/reset commands, and retrieve diagnostic information.

This user-friendly tool makes commissioning of Modbus networks a breeze.

SD-TestBus2 can also communicate through a Bluetooth adapter (widcomm compatible) with all the ABB SACE devices equipped with BT030 wireless communication unit.

SD-TestBus2 is freeware and can be downloaded from ABB SACE's website (<http://www.abb.com>).

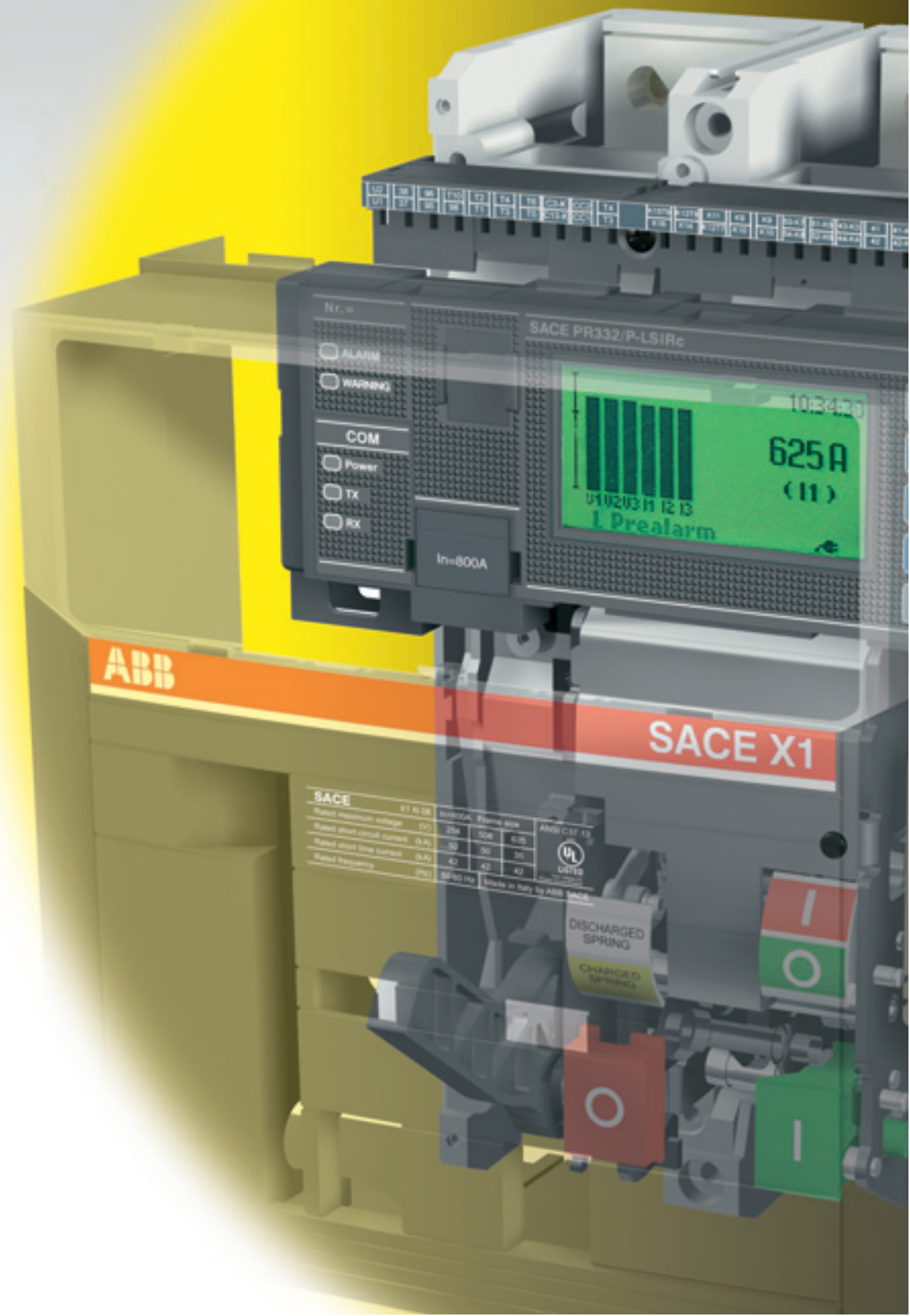


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by

Emax





Contents

Functions of the accessories	4/2
Accessories supplied as standard	4/3
Accessories supplied on request	4/4
Shunt trip and closing coils	4/5
Undervoltage release	4/7
Gearmotor for the automatic charging of closing springs	4/8
Bell alarm	4/8
Auxiliary contacts	4/9
Current sensor and operation counters	4/11
Mechanical locks	4/12
Transparent protective covers	4/13
Sliding contact locks	4/14
Mechanical interlock (MIC)	4/15
Automatic transfer switch - ATS010	4/16



Functions of the accessories

The table below lists a few functions that can 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
Electrical operated	<ul style="list-style-type: none"> • Shunt trip • Closing coil • Gearmotor for automatic charging of the closing springs
Remote signalling or actuation of automatic functions depending on the state (open-closed-tripped) or position (<i>racked-in</i> , <i>test isolated</i> , <i>racked-out</i>) of the circuit breaker	<ul style="list-style-type: none"> • Circuit breaker open-closed auxiliary contacts • Circuit breaker <i>racked-in</i>, <i>test isolated</i>, <i>racked-out</i> auxiliary contacts (draw out circuit breaker only) • Bell alarm • Contact signalling "ready to close" (RTC) • Contact for signalling springs charged
Remote opening for various needs, including: <ul style="list-style-type: none"> – manual emergency control – opening dependent on tripping of other interruption devices or system automation needs ⁽¹⁾ 	<ul style="list-style-type: none"> • Opening or undervoltage release
Automatic opening of the circuit breaker for undervoltage (for example, when operating asynchronous motors)	<ul style="list-style-type: none"> • Instantaneous or time delay undervoltage release ⁽²⁾
Increased degree of protection	<ul style="list-style-type: none"> • IP54 door protection
Mechanical safety locks for maintenance or functional requirements for interlocking two or more circuit breakers	<ul style="list-style-type: none"> • Key lock in open position • Padlock device in open position • Key lock and padlocks in <i>racked-in</i>, <i>test isolated</i>, <i>racked-out</i> position
Automatic switching of power supplies	<ul style="list-style-type: none"> • Mechanical interlock between two circuit breakers • Automatic transfer switch - ATS010

(1) Examples:
 – circuit breakers on Low Voltage side of parallel transformers that must open automatically when the Medium Voltage side device opens.
 – automatic opening for control by external relay (undervoltage, residual current, etc.).

(2) The time-delay device is recommended when unwanted operation; due to temporary voltage drops, is to be avoided (for functional or safety reasons).



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

Fixed circuit breaker:

- Flange for switchgear compartment door
- Four auxiliary contacts for electrical signalling of circuit breaker open/closed (for automatic circuit breakers only) (*)
- Terminal box for connecting outgoing auxiliaries
- Mechanical signalling of trip units tripped (*)
- Front terminals
- Support plate for fixing on floor



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Note:

(*) Not supplied with the switch disconnecter.

Draw out circuit breaker:

• **Moving part:**

- 4 auxiliary contacts for electrical signalling of circuit breaker and relative terminals open/closed (only for automatic circuit breakers) (*)
- Block of right-hand sliding contacts to connect the auxiliary contacts (*)
- Block of central sliding contacts to connect the protection trip units (*)
- Mechanical indication of trip (*)

• **Fixed part ⁽¹⁾:**

- Flange for switchgear compartment door
- Rear orientated terminals
- Anti-racking-in lock for circuit breakers with different rated currents
- Racking-out crank handle
- Shutter padlock device



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Note:

(*) Not supplied with the switch disconnecter.

(1) the blocks of sliding contacts for the fixed part are not supplied as standard and must therefore be ordered (see page 4/12)



Accessories supplied on request

All the accessories

Circuit breaker version	Automatic circuit breakers		Switches	
	Fixed	Draw out	Fixed	Draw out
1a) Shunt trip/closing coil (SOR/SCR) and second shunt trip (SOR2)	■	■	■	■
1b) SOR test unit	■	■	■	■
2a) Undervoltage release (UVR)	■	■	■	■
2b) Time-delay device for undervoltage release (UVD)	■	■	■	■
3) Gearmotor for automatic charging of closing springs (M)	■	■	■	■
4a) Bell alarm	■	■		
4b) Bell alarm with remote reset command	■	■		
5a) Electrical signalling of circuit breaker open/closed ⁽¹⁾ (AUX)	■	■	■	■
5b) Electrical signalling of circuit breaker racked-in/isolated for test/racked-out (AUP)		■		■
5c) Contact signalling closing springs charged (AUX-SC)	■	■	■	■
5d) "Ready to close" signalling contact (AUX-RTC)	■	■	■	■
6a) Current sensor for neutral conductor outside circuit breaker	■	■		
6b) Homopolar toroid for main power supply grounding conductor (star centre of the transformer)	■	■		
7) Mechanical operation counter (MOC)	■	■	■	■
8a-b) Lock in open position (key 8a; padlock 8b) (KLC and PLL)	■	■	■	■
8c) Circuit breaker lock in racked-in/isolated for test/racked-out position (KLF FP)		■		■
8d) Accessories for lock in racked-out position (KLF FP)		■		■
8e) Mechanical lock for compartment door	■	■	■	■
8f) Anti racking-out device when the springs are charged (FAIL SAFE)		■		■
9a) Opening and closing pushbuttons protection (TPC)	■	■	■	■
9b) IP54 door protection	■	■	■	■
10) Sliding contact blocks	■	■		
11) Mechanical interlock (MIC)	■	■	■	■
12) Automatic transfer switch - ATS010 ⁽²⁾	■	■	■	■

CAPTION

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

- (1) For circuit breakers, four auxiliary contacts for electrical signalling of circuit breaker open/closed are included in the supply as standard
- (2) Incompatible with the range of circuit breakers for applications up to 1000V AC



Shunt trip and closing coils

1a) Shunt trip and closing coil (SOR/SCR) and second shunt trip (SOR2)

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

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



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Allows remote control opening or closing of the apparatus, depending on the installation position and connection of the releases on the support. The release can, in fact, be used for either of these two applications. Given the characteristics of the circuit breaker operating mechanism, opening (with the circuit breaker closed) is always possible, whereas 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 can be powered permanently ⁽²⁾.

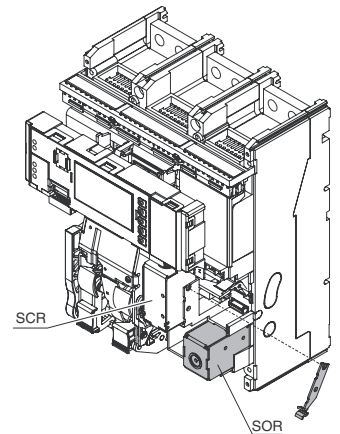
Some installations require very high safety in controlling circuit breaker opening remotely. In particular, the control and shunt trip circuits must be duplicated. To meet these needs, SACE Emax X1 can be equipped with a second shunt trip.

The seat of the second shunt trip is that of the undervoltage release, which is therefore incompatible with this type of installation.

The technical specifications of the second shunt trip remain identical to those of the standard shunt trip.

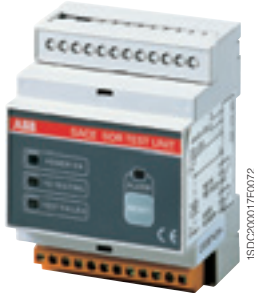
When used as a permanently powered closing coil, it is necessary to momentarily de-energize the closing coil in order to close the circuit breaker again after opening (the circuit breaker operating mechanism has an anti-pumping device).

Characteristics		
Power supply (Un):	24 V AC/DC	240-250 V AC/DC
	30 V AC/DC	380-400 V AC
	48 V AC/DC	415-440 V AC
	60 V AC/DC	
	110-120 V AC/DC	
	120 ... 127 V AC/DC	
Inrush power (Ps):	DC = 300 W	
	AC = 300 VA	
Inrush time ~100 ms	DC = 3.5 W	
	AC = 3.5 VA	
Continuous power (Pc):	DC = 3.5 W	
	AC = 3.5 VA	
Opening time (UVR):	30 ms	
Insulation voltage:	2000 V 50 Hz (for 1 min)	





Shunt trip and closing coils



1b) SOR Test Unit

The SOR control and monitoring Test Unit helps ensure that the various versions of SACE Emax X1 shunt trip are running smoothly, to guarantee a high level of reliability in controlling circuit breaker opening.

Under particularly severe operating conditions or simply for remote control of the circuit breaker, the shunt trip is widely used as an accessory for the SACE Emax series of power circuit breakers.

Keeping all the functions of this accessory is a necessary condition to guarantee a high level of safety in the installation: it is therefore necessary 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 shunt trips 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 are verified.

Continuity is checked cyclically with an interval of 20s between tests. The unit has optic signals via LEDs on the front, which provide the following information in particular:

- POWER ON: power supply present
- SOR TESTING: test in progress
- TEST FAILED: signal following a failed test or lack of auxiliary power supply
- ALARM: signal given 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

Characteristics of device

Auxiliary power supply	24 V ... 250 V AC/DC
------------------------	----------------------

Specifications of the signalling relays

Maximum interrupted current	6 A
Maximum interrupted voltage	250V AC



Undervoltage release

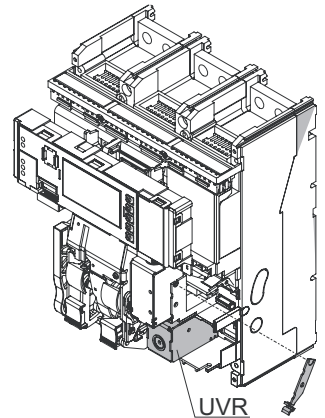
2a) Undervoltage release (UVR)



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The undervoltage release opens the circuit breaker when there is a significant voltage drop or power failure. It can 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 on the supply side of the circuit breaker or from an independent source. The circuit breaker can only be closed when the release is energized (closing is mechanically locked). The release can operate with direct current (V DC) or alternating current (V AC). The circuit breaker is opened with release power supply voltages of 35-70% U_n . The circuit breaker can be closed with a release power supply voltage of 85-110% U_n . It can be fitted with a contact to signal when the undervoltage release is energized (C. aux YU) (see accessory 5d).

Characteristics		
Power supply (U_n):	24 V AC/DC	240-250 V AC/DC
	30 V AC/DC	380-400 V AC
	48 V AC/DC	415-440 V AC
	60 V AC/DC	
	110-120 V AC/DC	
	120 ... 127 V AC/DC	
	220 ... 240 V AC/DC	
Inrush power (P_s):	DC = 300 W	
Inrush time ~100 ms	AC = 300 VA	
Continuous power (P_c):	DC = 3.5 W	
	AC = 3.5 VA	
Opening time (UVR):	30 ms	
Insulation voltage:	2000 V 50 Hz (for 1 min)	



4

With PR332/P (in the presence of PR330/M) and PR333/P trip units, instead of UVR utilization, the opening could be obtained by activating the protection function "UV".

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



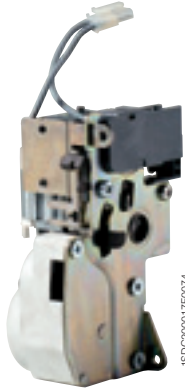
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The undervoltage release can be combined with an electronic time-delay device (UVD) for installation outside the circuit breaker, allowing delayed release tripping with adjustable preset times. Use of the delayed undervoltage release is recommended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

Characteristics	
Power supply (D):	24-30 V DC
	48 V AC/DC
	60 V AC/DC
	110-125 V AC/DC
	220-250 V AC/DC
Adjustable opening time (UVR+UVD):	0.5 - 1 - 1.5 - 2 - 3 s



Gearmotor for the automatic charging of closing springs Signal for trip units tripped



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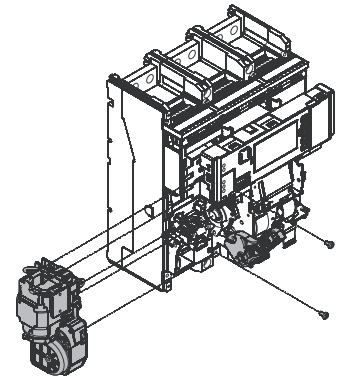
3) Gearmotor for the automatic charging of closing springs (M)

This automatically charges the closing springs of the circuit breaker operating mechanism. After circuit breaker closing, the gearmotor immediately recharges the closing springs.

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.

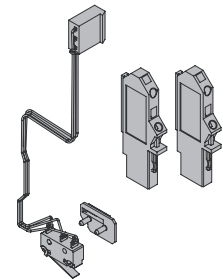
Characteristics	
Power supply	24-30 V AC/DC
	48-60 V AC/DC
	100-130 V AC/DC
	220-250 V AC/DC
	380-415 V AC
Inrush power (Ps):	DC = 300 W
Inrush time ~200 ms	AC = 300 VA
Rated power (Pn):	DC = 100 W
	AC = 100 VA
Charging time:	8-10 s
Insulation voltage:	2000 V 60 Hz (for 1 min)



4

4a) Bell alarm

This enables the remote signaling (electrically, via a change-over contact) of the circuit breaker being opened as a result of the overcurrent releases being tripped. The circuit breaker can be closed again only after restoring the mechanical button that signals the tripping of the release to its normal position.

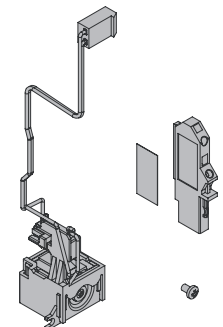


4b) Bell alarm with remote reset command

After the overcurrent releases have been tripped, this enables you to restore the circuit breaker by resetting the mechanical button remotely by means of an electric coil. For ordering with the bell alarm accessory (4a).



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Auxiliary Contacts

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 $U_n < 24\text{ V}$ (digital signals).

Power supply voltage	Resistive load I [A]	
	AC	DC
125 V	–	0.5
250 V	5	0.3
400 V***	3	–

Type of auxiliary contacts	
AUX	4 open/closed changeover contacts*
AUX-SA	1 contact for signalling SA trip
AUX-RTC	1 contact for signalling ready to close
AUX-SC	1 contact signalling closing springs charged
AUP	6 racked-in/test/racked-out contacts**

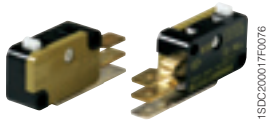
* Standard supply

** for draw out versions (2 racked-in, 2 test isolated, 2 racked-out)

*** AUX-SA and AUX-RTC are available up to 250 V

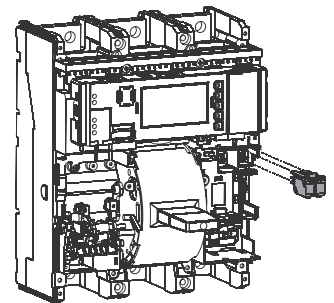
The versions available are as follows:

5a) Electrical signalling of circuit breaker open/closed (AUX)

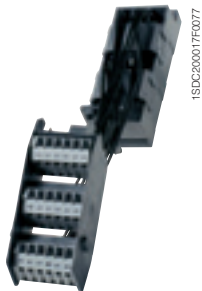


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It is possible to have electrical signalling of the status (open/ closed) of the circuit breaker using four auxiliary changeover contacts. The auxiliary contacts are always provided with 2 terminals to be mounted in the terminal box to carry out wiring. Fifteen supplementary open/closed contacts are also available, installed on the outside of the circuit breaker.



5b) Electrical signalling of circuit breaker racked-in/test isolated/racked out (AUP)



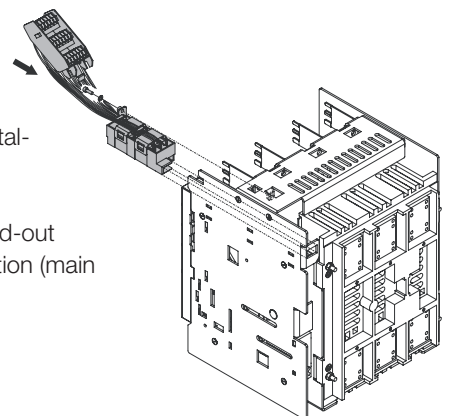
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In addition to mechanical signalling of the circuit breaker position, it is also possible to obtain electrical signalling using 6 auxiliary contacts which are installed on the cradle.

It is only available for draw out circuit breakers, for installation on the cradle.

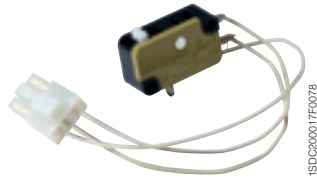
The set is made up of:

- 2 contacts for racked-in signal, 2 contacts for racked-out signal, and 2 contact to signal the test isolated position (main pliers isolated, but sliding contacts connected).





Auxiliary Contacts



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5c) Contact signalling closing springs charged (AUX SC)

This is made up of a microswitch which allows remote signalling of the state of the circuit breaker operating mechanism closing springs (can be supplied only with the spring charging motor).

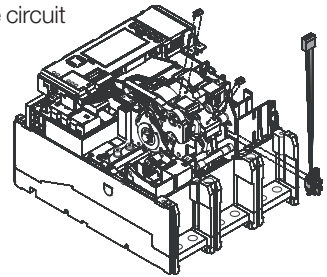


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5d) "Ready to close" signalling contact (AUX-RTC)

Available with wiring directly onto the terminal bag, this signals that the circuit breaker is ready to accept a closing command if the following four conditions are respected:

- circuit breaker open
- closing springs charged
- any undervoltage release energized
- any shunt trip de-energized
- armoured opening solenoid

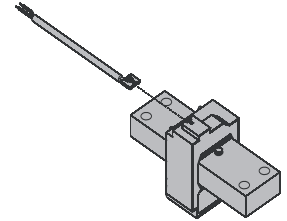




Current sensors and operation counters

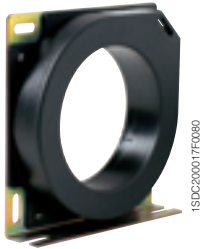
6a) Current sensor for neutral conductor outside circuit breaker

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



6b) Homopolar toroid for the main power supply grounding conductor (star centre of the transformer)

SACE PR332/P and PR333/P electronic trip units can be used in combination with an external toroid located on the conductor, which connects the star centre of the MV/LV transformer (homopolar transformer) to ground. In this case, the ground protection is defined as Source Ground Return. Through two different combinations of connection of its terminals (see chapter 8), the I_n of the same toroid can be set at 100 A, 250 A, 400 A, 800 A.



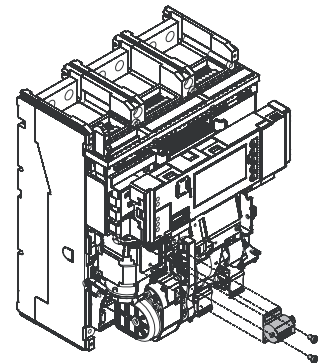
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7) Mechanical operation counter (MOC)

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.



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Mechanical locks



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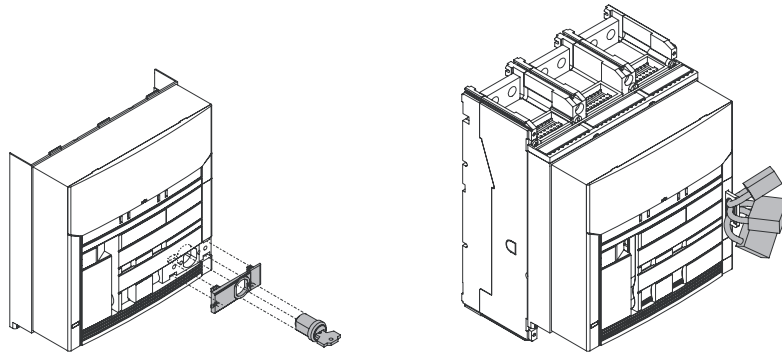
8) Mechanical locks

8a-8b) Lock in open position (KLC and PLL)

Several different mechanisms are available which allow the circuit breaker to be locked in the open position.

These devices can be controlled by:

- 8a - Key (KLC): 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.
- 8b - Padlocks (PLL): up to 3 padlocks (not supplied): \varnothing 8 mm.



4



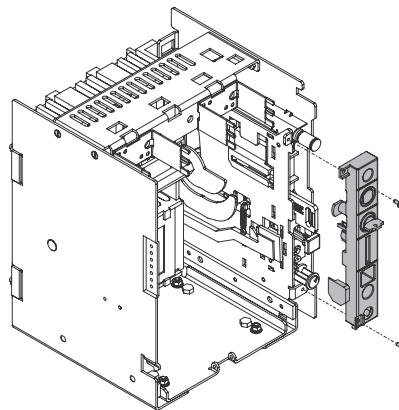
1SDC200017F0083

8c) Circuit breaker lock in racked-in/test isolated/racked-out position (KLF FP)

This device can 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 - \varnothing 4 mm).

It is only available for draw out circuit breakers, to be installed on the fixed part.

The fixed part can be equipped with two different safety locks.



8d) Accessories for lock in racked-out position (KLF FP)

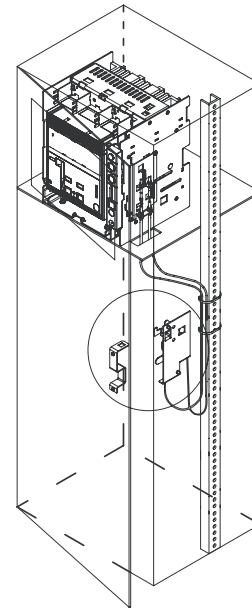
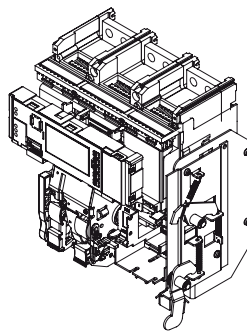
In addition to the circuit breaker lock in the racked-in/test isolated/ racked-out position, this only allows the circuit breaker to be locked in the racked-out positions. It is only available for draw out circuit breakers, to be installed on the fixed part.



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8e) Mechanical compartment door lock

This does not allow compartment door opening with the circuit breaker closed (and circuit breaker racked-in for draw out circuit breakers) and lock circuit breaker closing with the compartment door open. Two versions are available: a door lock made by means of cables and a second type fixed directly on the side of the circuit breaker or of the relative fixed part. The cable door lock must also be fitted with the interlock cable kit and the interlocking plate corresponding to the combined circuit breaker.



Note: Always supplied with the draw out version circuit breaker. It's an alternative to the undervoltage release.

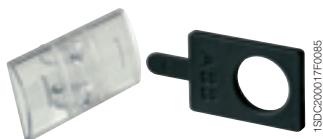
8f) Anti racking-out device when the springs are charged (FAIL SAFE)

This device prevents the moving part of the draw out version circuit breaker from being racked out of the cradle when the springs are charged.

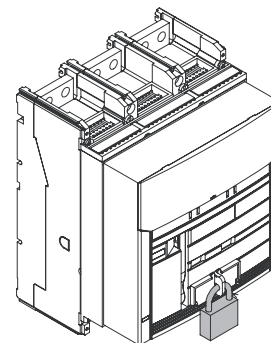
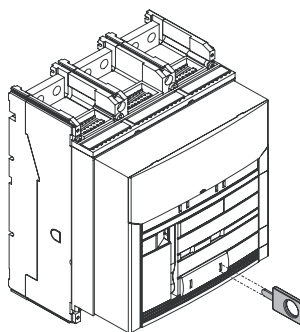
9) Transparent protective covers

9a) Protection for opening and closing pushbuttons

These protections, applied over the opening and closing pushbuttons, prevent any circuit breaker operations unless a special tool is used, or padlock opening (protection for pushbuttons - independent).

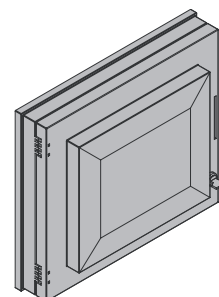


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9b) IP54 door protection

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.

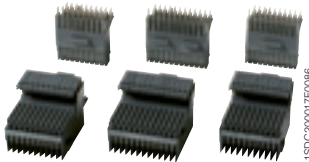




Interlock between circuit breakers

10) Sliding contact blocks

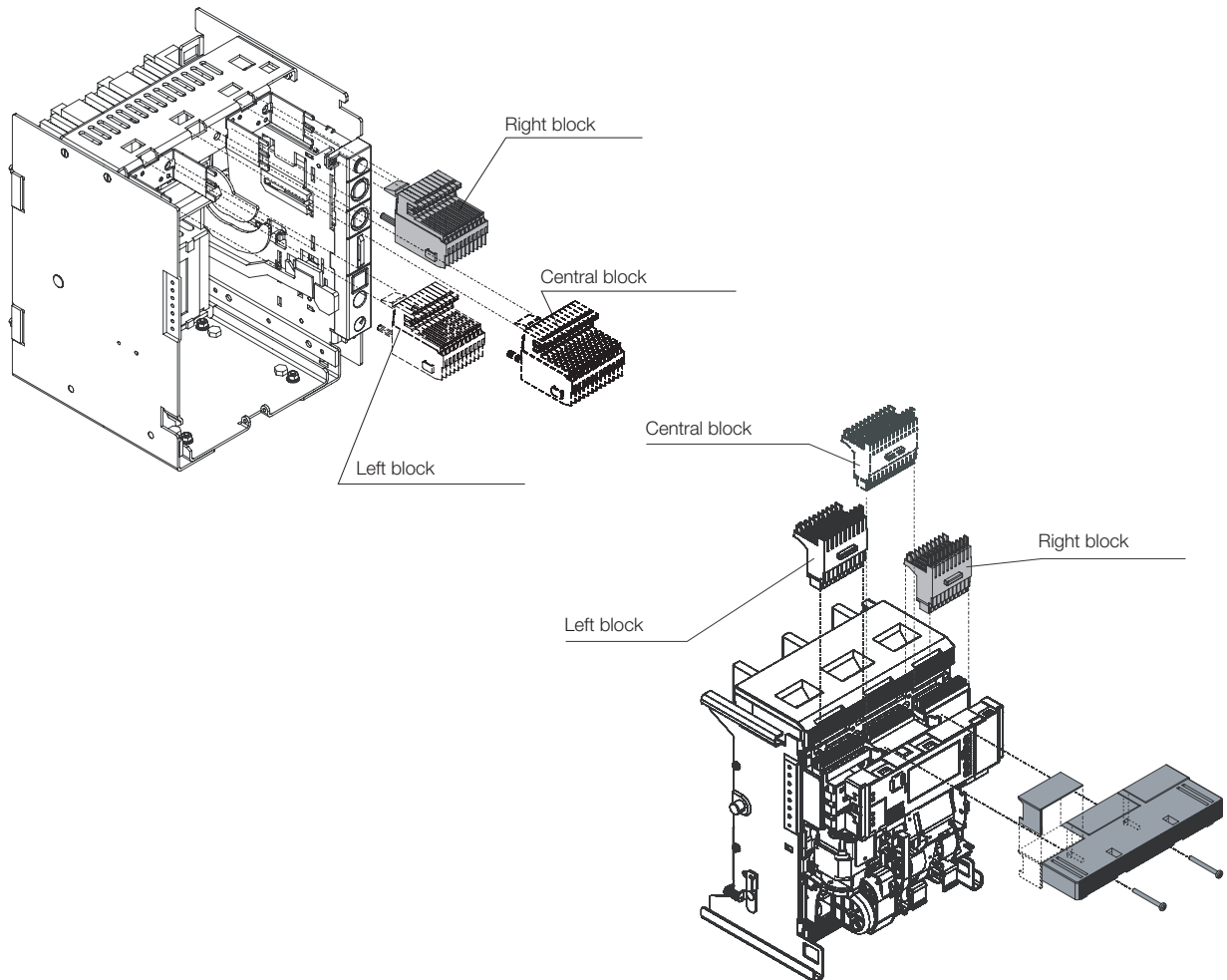
The sliding contact blocks are needed for X1 in the draw out version fitted with electrical accessories or with an electronic trip unit. Their functions is to make the electrical connection of the secondary circuits between the moving and the fixed part. These blocks operate in pairs: one block must be mounted on the moving part and the other on the fixed part. The following table shows the possible combinations between sliding contact blocks and electrical accessories:



Left-hand block	Central block	Right-hand block
Spring charging motor	PR331	Auxiliary contacts
"Closing springs charged" contact	PR332	Shunt trips
"Ready to close" contact	PR333	Closing coils
Release trip signalling		Undervoltage release
TRIP RESET device		PR330/R actuator module

If at least one of the electrical accessories in the above table is mounted on the circuit breaker, the relative pair of blocks must be mounted on the moving part and on the fixed part. The central lock and the right lock are always supplied by default on the movable part of an Emax X1 circuit breaker, while the left lock is only supplied if you order an electrical accessory connected to it. The locks on the fixed part must be ordered specifically.

4



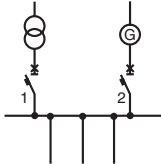
11) Mechanical interlock (MIC)

Note:

See the "Overall dimensions" and "Electrical circuit diagrams" chapters for information about dimensions (fixed and draw out versions) and settings.

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

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

Type of interlock	Typical circuit	Possible interlocks								
<p>Between two circuit breakers One normal power supply and one emergency power supply</p>	 <p>O = Circuit breaker open I = Circuit breaker closed</p>	<p>Circuit breaker 1 can only be closed if 2 is open, and viceversa.</p> <table border="1"> <thead> <tr> <th>1</th> <th>2</th> </tr> </thead> <tbody> <tr> <td>O</td> <td>O</td> </tr> <tr> <td>I</td> <td>O</td> </tr> <tr> <td>O</td> <td>I</td> </tr> </tbody> </table>	1	2	O	O	I	O	O	I
1	2									
O	O									
I	O									
O	I									

The emergency power supply is usually provided 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 reliability and safety of emergency circuits.

Switching from the normal to the emergency power supply can either 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.

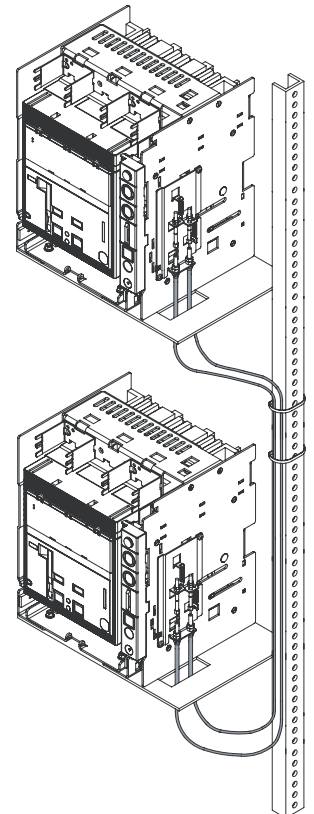
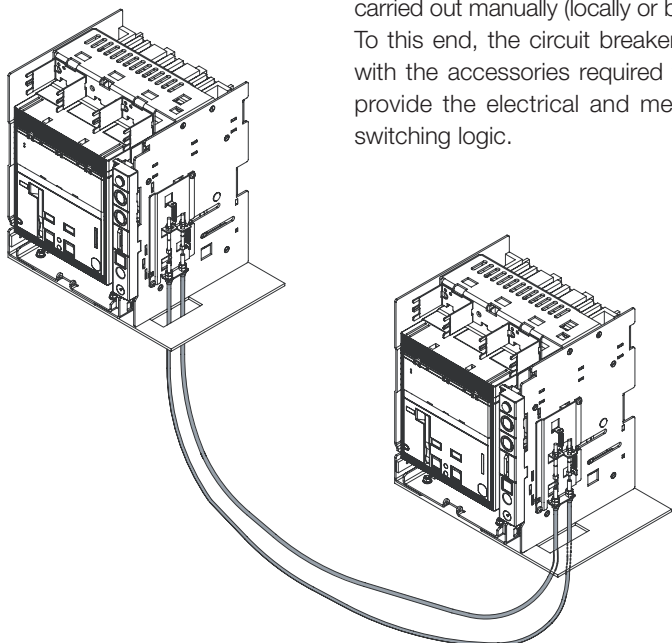
These include:

- the shunt trip
- the closing coil
- the motor operator
- the auxiliary contacts.

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

Mechanical interlocks between two circuit breakers are made by using cables which can be used both for circuit breakers side by side or superimposed.

An Emax X1 circuit breaker (in the fixed or draw out versions) can be interlocked either with another Emax X1, or with a Tmax T7 or an Emax E1-E6.





Automatic transfer switch - ATS010



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12) Automatic transfer switch - ATS010

The ATS010 switching unit (Automatic transfer switch) is the network-generator switching device offered by ABB SACE. It is based on electronic technology conforming with the major 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 and emergency line circuit breakers automatically, allowing great flexibility of setting. In case of an anomaly 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, 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 and 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. All the circuit breakers in the SACE Emax series can be used.

The network sensor built into the SACE ATS010 device makes it possible to detect errors in the network voltage. The three inputs can 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 insertion of voltage transformers (TV), setting a rated voltage for the device that matches their secondary voltage (typically 100V).

Two changeover contacts for each circuit breaker allow direct connection to the shunt trip and closing coils. The circuit breaker connection is completed by wiring the status contacts: Open/Closed, Release tripped, Racked-in (for draw out/plug-in circuit breakers).

That is why the following are included on every circuit breaker connected to the ATS010 unit, in addition to the mechanical interlock accessories:

- spring charging motor,
- opening and closing coil,
- open/closed contact,
- racked-in contact (for draw out versions),
- signal and mechanical lock for protection trip unit 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 operational watchdog system signals any microprocessor malfunctions via a LED on the front of the device.

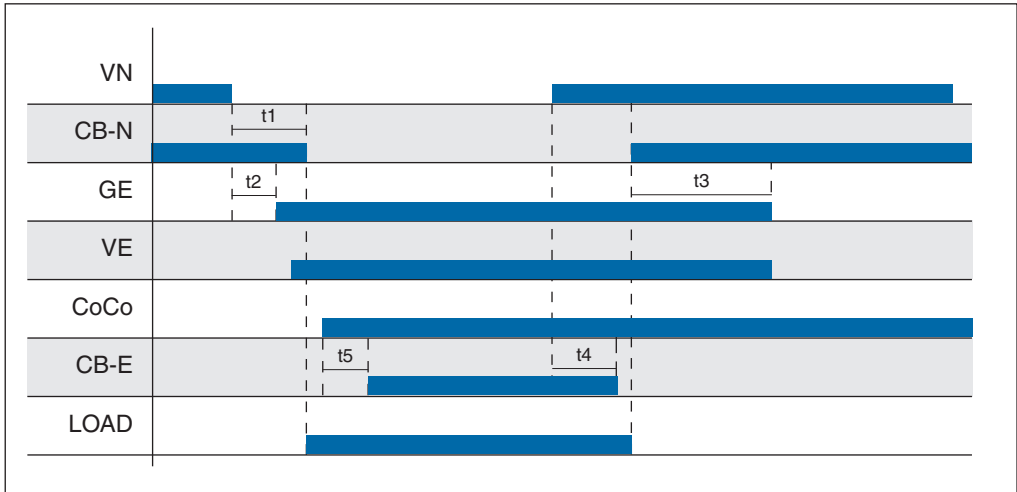
Hardware safety allows integration of an electrical interlock via a power relay, so that there is no need to use an external electrical interlock system. The manual selector on the front of the device can also control the entire switching procedure, even in the event of a microprocessor fault, by working electromechanically on the control trip units.

General specifications	
Rated supply voltage (galvanically insulated from ground)	24V DC \pm 20% 48V DC \pm 10% (maximum ripple \pm 5%)
Maximum absorbed power	5W at 24V DC 10W at 48V DC
Rated power (network present and circuit breakers not controlled)	1.8W at 24V DC 4.5W at 48V DC
Operating temperature	-25 °C...+70 °C
Maximum humidity	90% without condensation
Storage temperature	-25 °C...+80 °C
Degree of protection	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 anomaly (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

Operating sequence

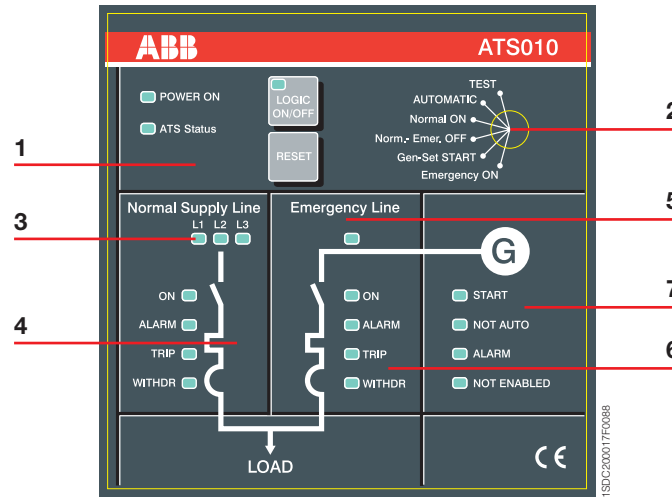


Caption
VN Network voltage
CB-N Normal line circuit breaker closed
GE Generator
VE Emergency line voltage
CoCo Enabling switching to emergency line
CB-E Emergency line circuit breaker closed
LOAD Disconnection of lower priority loads



Automatic transfer switch - ATS010

Front panel

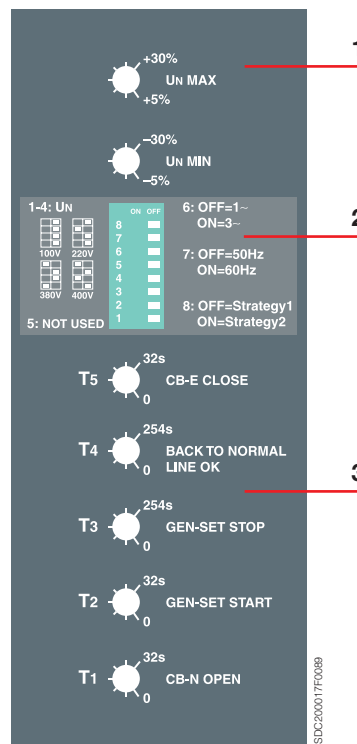


Caption

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

4

Side panel settings



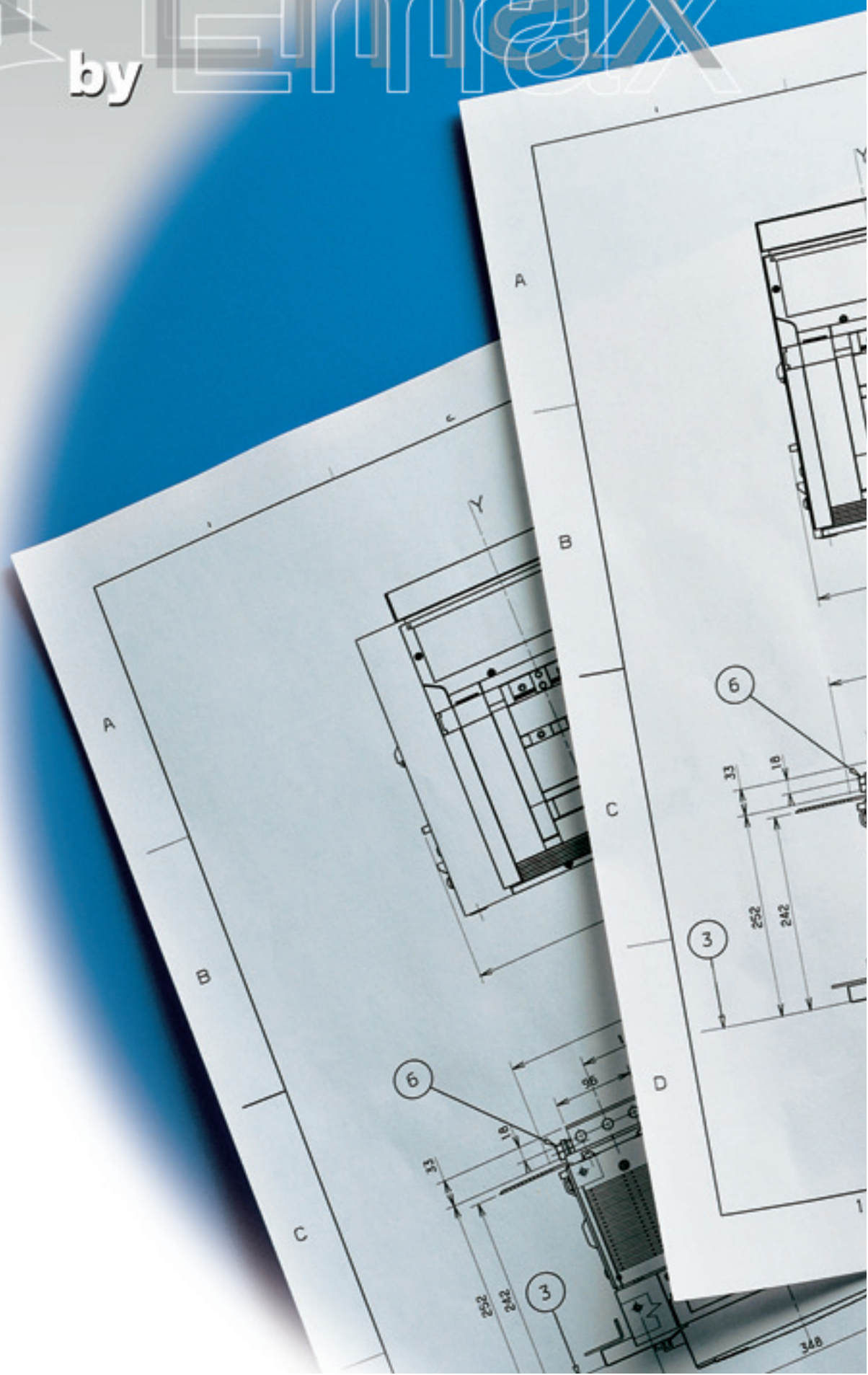
Caption

- 1 Selectors to set the undervoltage and over-voltage thresholds
- 2 Dip-switches to set:
 - rated voltage
 - normal single-phase or three-phase line
 - network frequency
 - switching strategy
- 3 Switching delay time settings for t1...t5



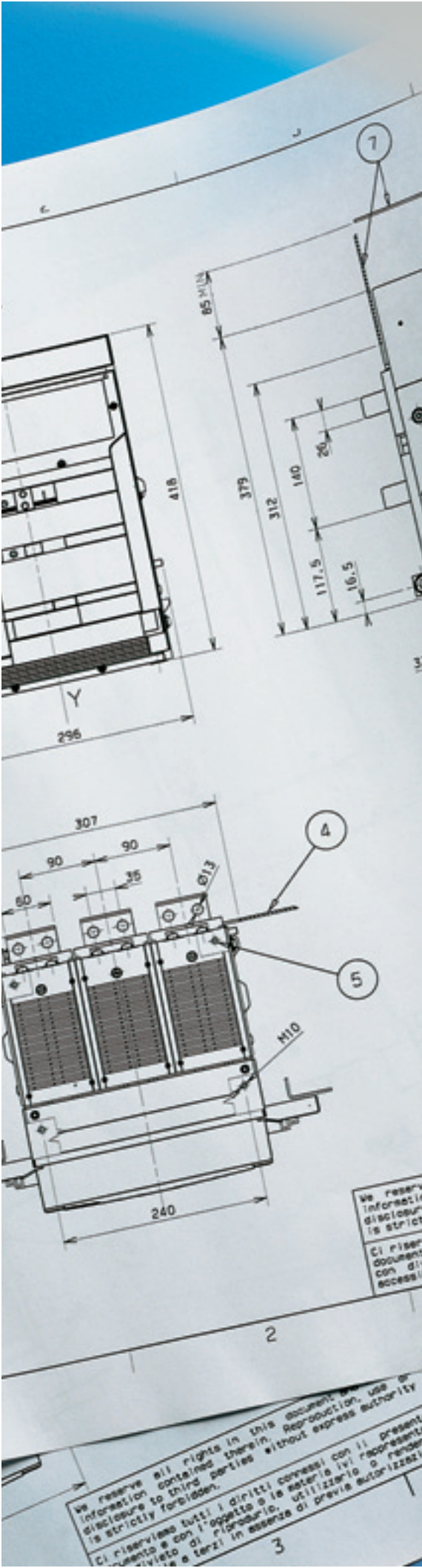
by

Emax





Overall dimensions



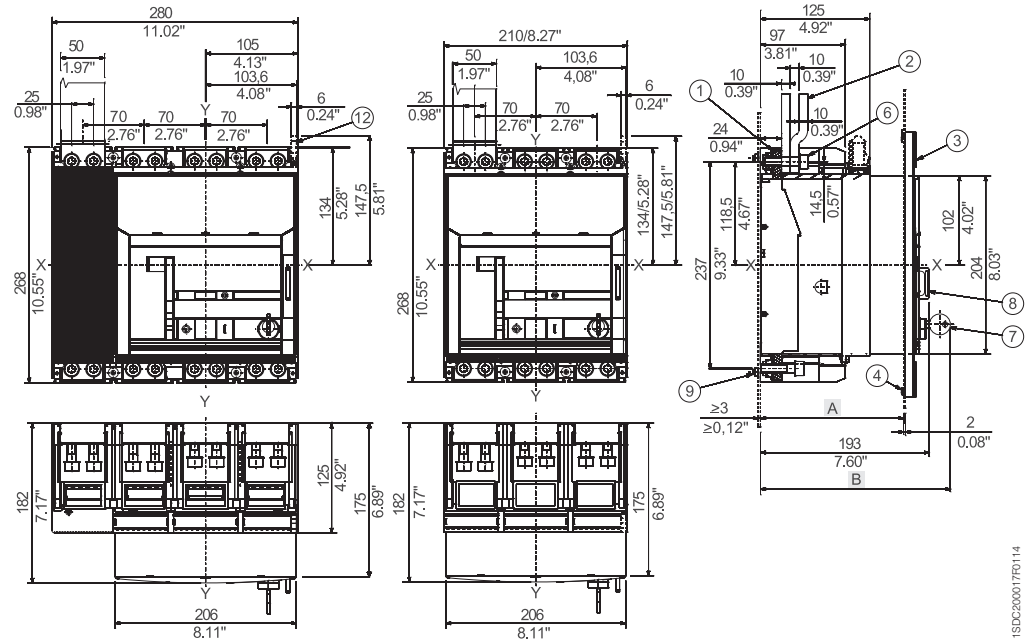
Contents

Fixed circuit breaker	5/2
Draw out circuit breaker	5/4
Mechanical interlock	5/5
Insulation distances	5/6

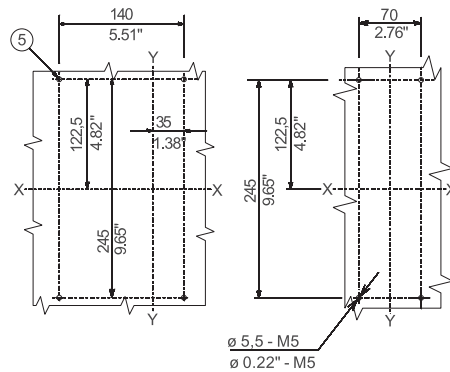
Overall dimensions

Fixed circuit breaker

Basic version with front terminals

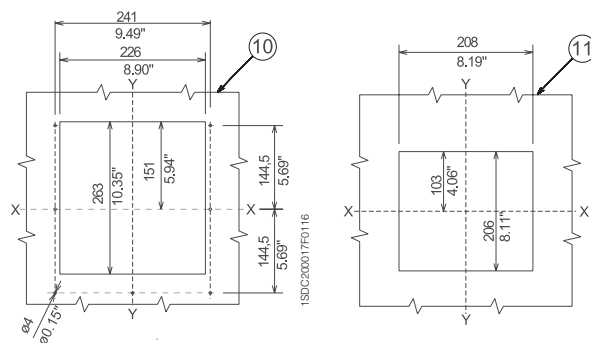


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	With flange	Without flange			
A	125 ... 164 4.92" ... 6.46"	170 6.69"			
B	Standard 208 8.19"	Ronis 216 8.50"	Profalux 224 8.82"	Kirk 245 9.65"	Castell 243 9.57"



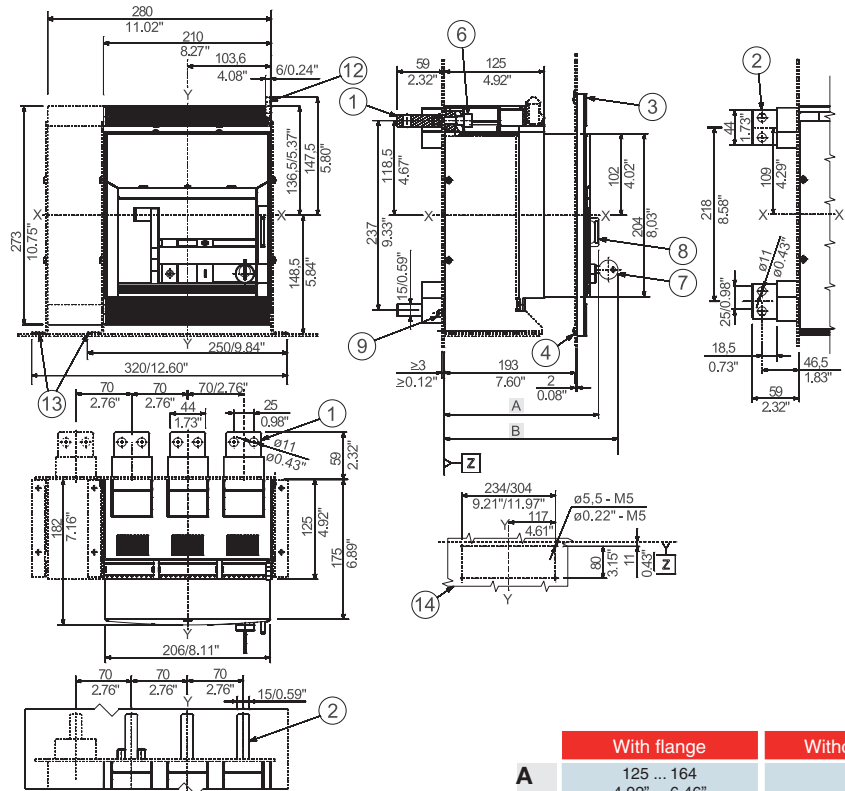
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1SDC200017F0117

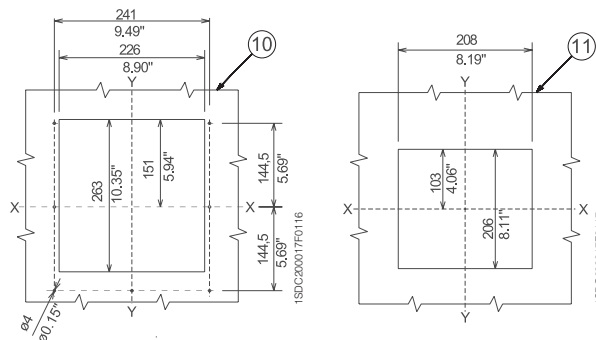
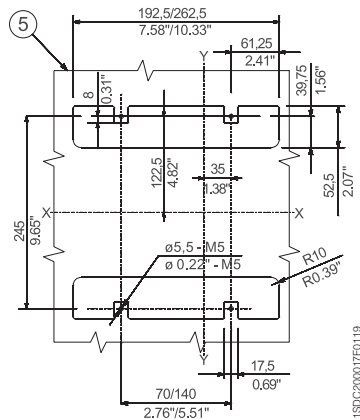
Caption

- ① Front terminals
- ② Busbars
- ③ Flange for the compartment door
- ④ Flange fixing screws
- ⑤ Drilling template for fixing onto support sheet
- ⑥ Tightening torque 18 Nm
- ⑦ Key lock (optional)
- ⑧ Padlock (optional)
- ⑨ Tightening torque 21 Nm
- ⑩ Sheet drilling for compartment door with flange
- ⑪ Sheet drilling for compartment door without flange
- ⑫ Terminal for auxiliary contacts

Version with rear terminals



	With flange	Without flange			
A	125 ... 164 4.92" ... 6.46"	170 6.69"			
B	Standard 208 8.19"	Ronis 216 8.50"	Profalux 224 8.82"	Kirk 245 9.65"	Castell 243 9.57"



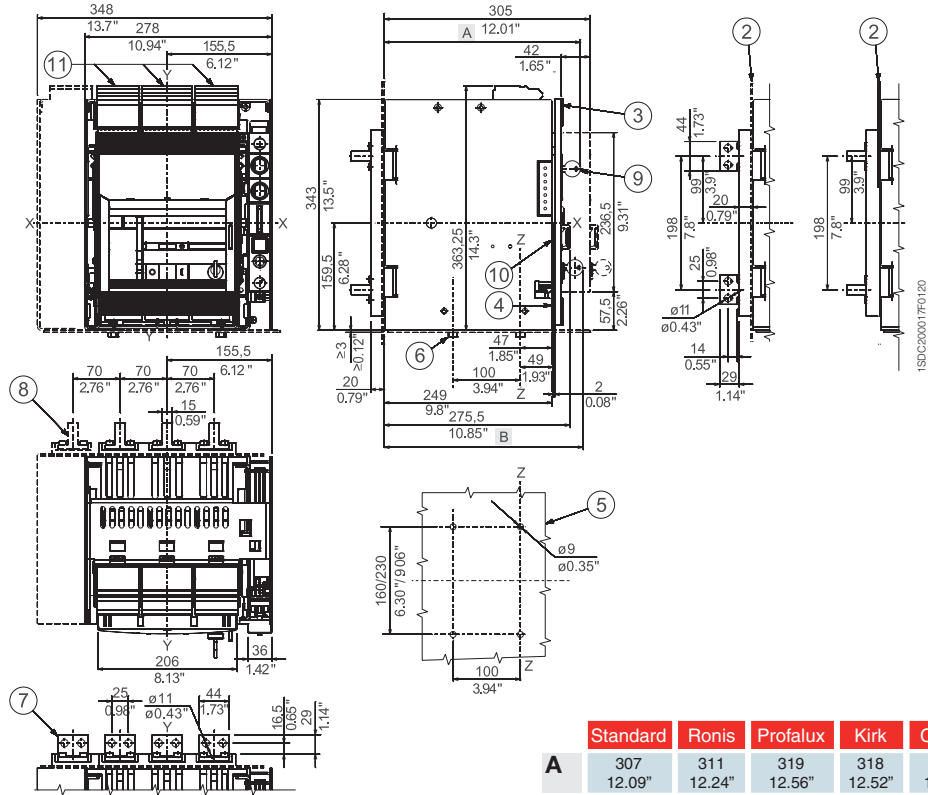
Caption

- ① Rear horizontal terminals
- ② Rear vertical terminals
- ③ Flange for the compartment door
- ④ Flange fixing screws
- ⑤ Drilling template for fixing onto support sheet
- ⑥ Tightening torque 20 Nm
- ⑦ Key lock (optional)
- ⑧ Padlock (optional)
- ⑨ Tightening torque 2.5 Nm
- ⑩ Sheet drilling for compartment door with flange
- ⑪ Sheet drilling for compartment door without flange
- ⑫ Terminal for auxiliary contacts
- ⑬ Fixing shoulders on lower sheet
- ⑭ Drilling template for fixing onto lower sheet

Overall dimensions

Draw out circuit breaker

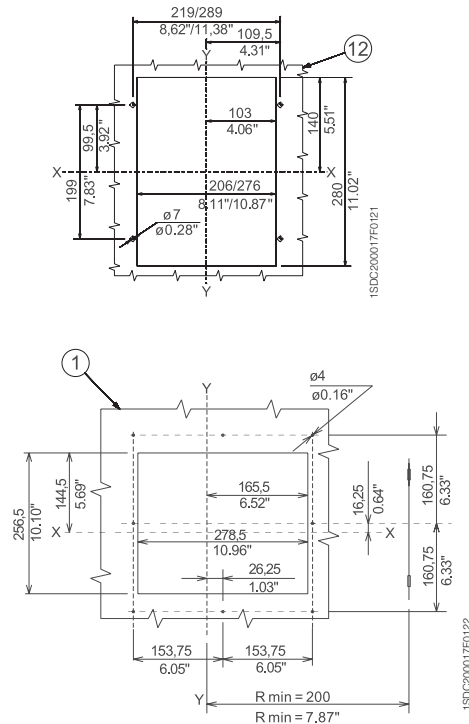
Version with rear adjustable terminals



	Standard	Ronis	Profalux	Kirk	Castell
A	307 12.09"	311 12.24"	319 12.56"	318 12.52"	348 13.70"
B	290 11.42"	298 11.73"	306 12.05"	313 12.32"	311 12.24"

Caption

- ① Sheet drilling for compartment door with flange
- ② Rear segregation for rear terminals VR-HR
- ③ Flange for the compartment door
- ④ Flange fixing screws
- ⑤ Drilling template for fixing onto support sheet
- ⑥ Tightening torque 21 Nm
- ⑦ Rear horizontal terminals
- ⑧ Rear vertical terminals
- ⑨ Key lock (optional)
- ⑩ Padlock (optional)
- ⑪ Auxiliary contact terminal
- ⑫ Rear segregation for rear terminals

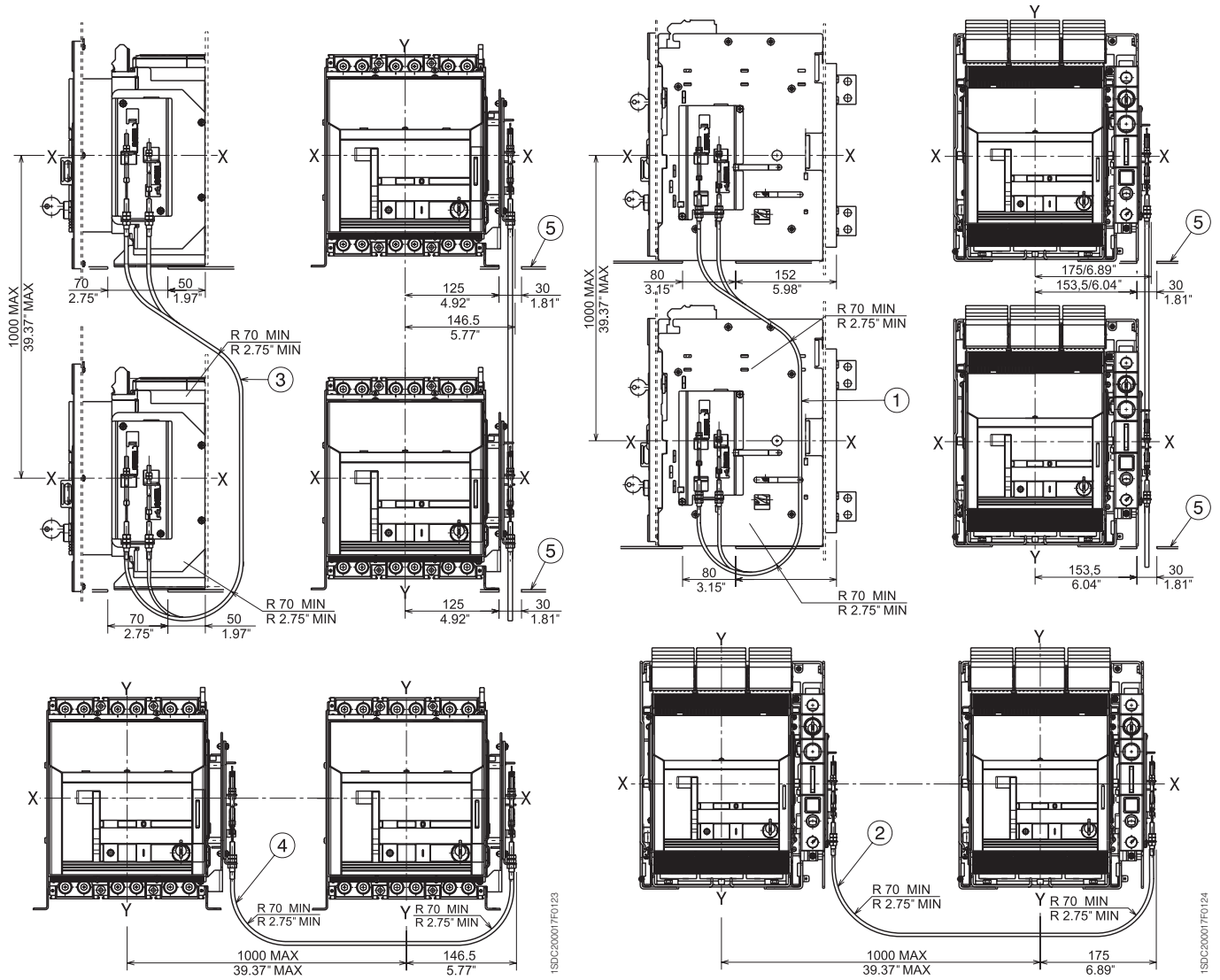




Overall dimensions

Mechanical interlock between Emax X1 and Tmax T7 circuit breakers

Mechanical interlock



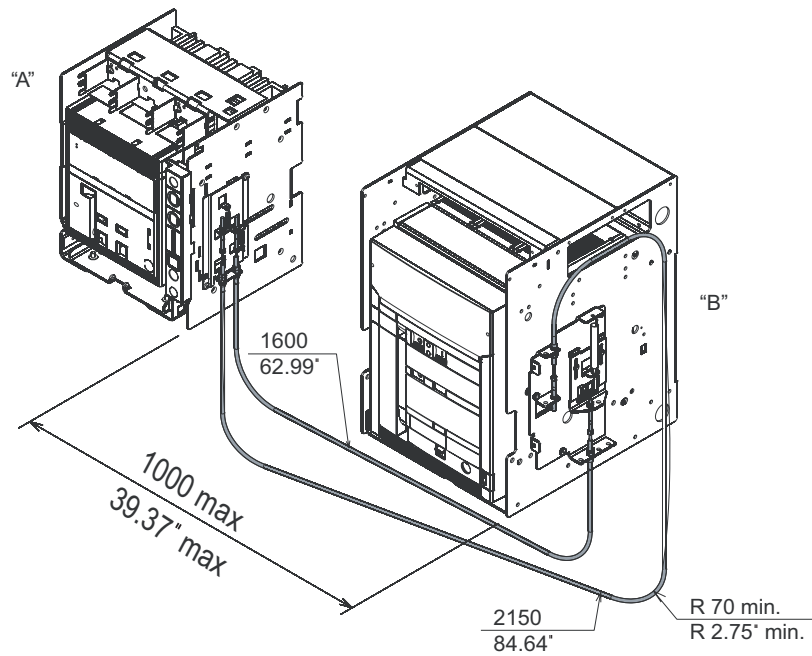
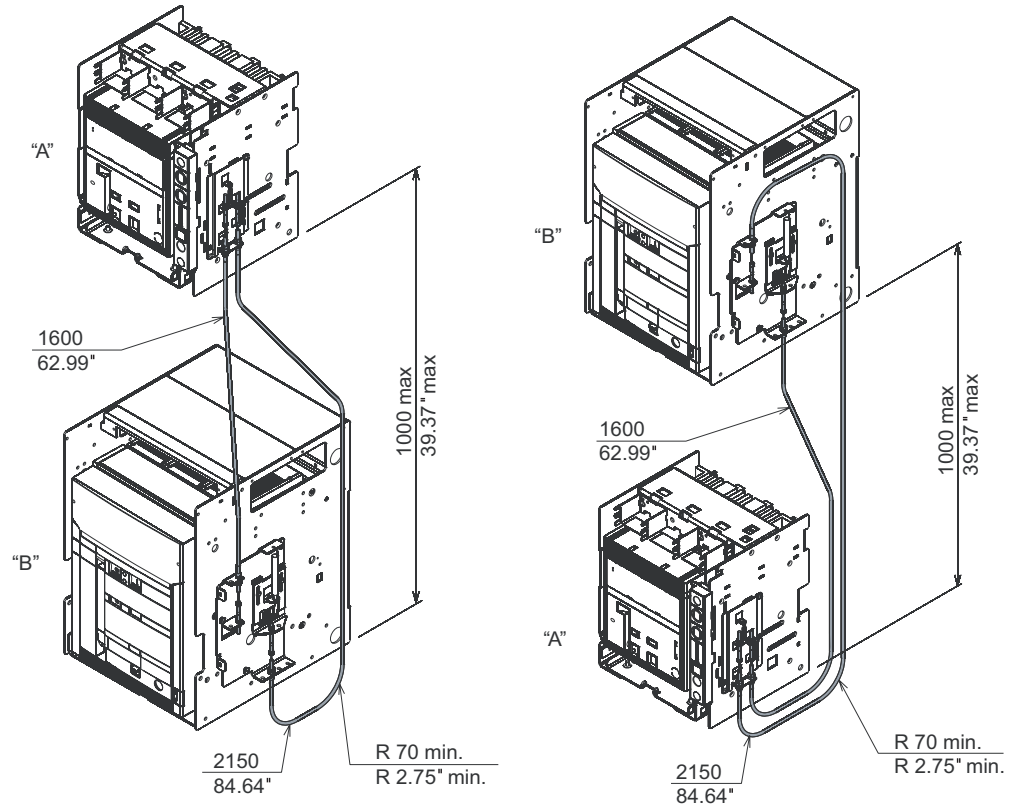
Caption

- ① Mechanical vertical interlock for draw out circuit breakers
- ② Mechanical horizontal interlock for draw out circuit breakers
- ③ Mechanical vertical interlock for fixed circuit breakers
- ④ Mechanical horizontal interlock for fixed circuit breakers
- ⑤ Sheet drilling for wire passage of the mechanical interlock



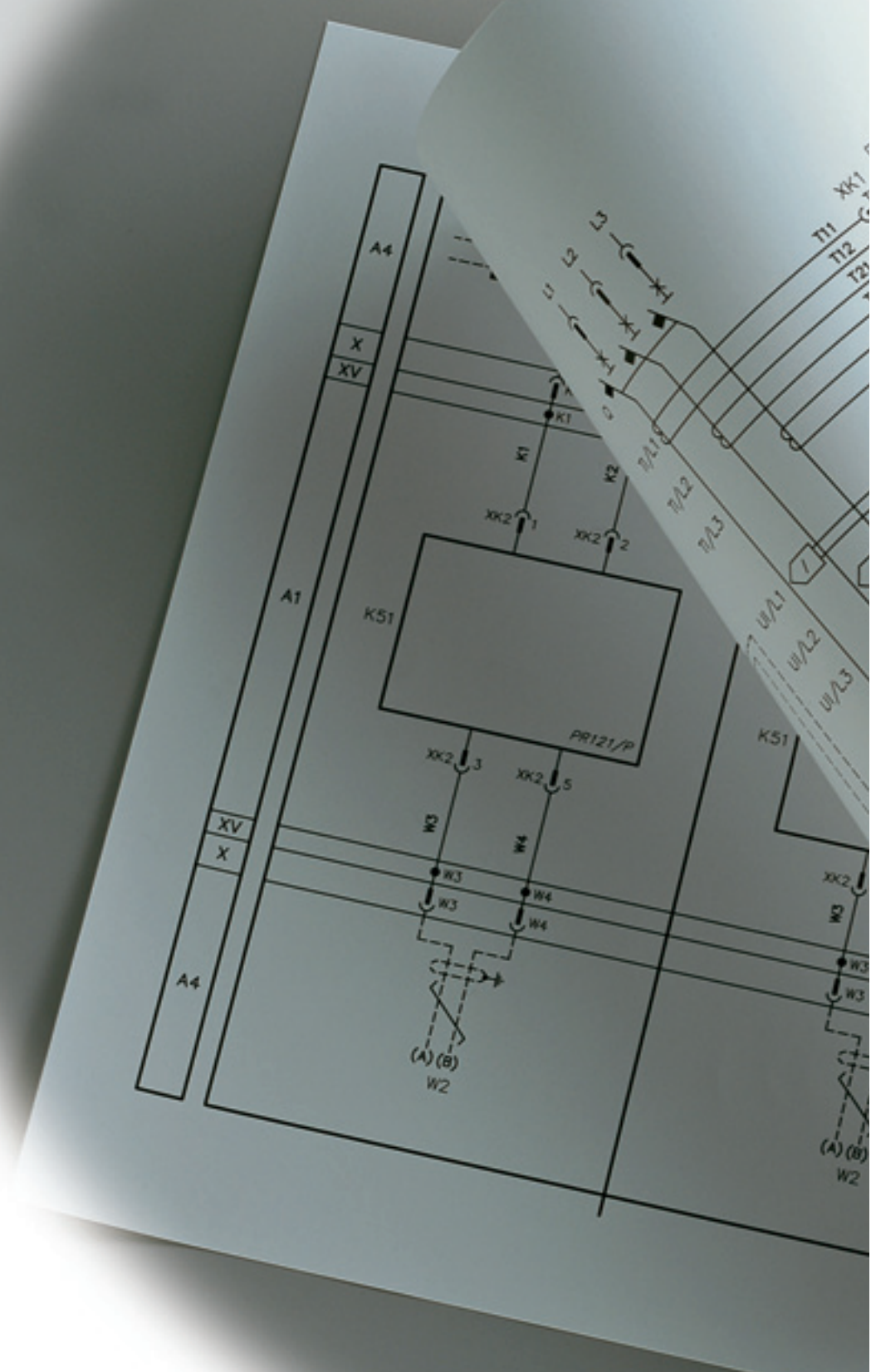
Overall dimensions

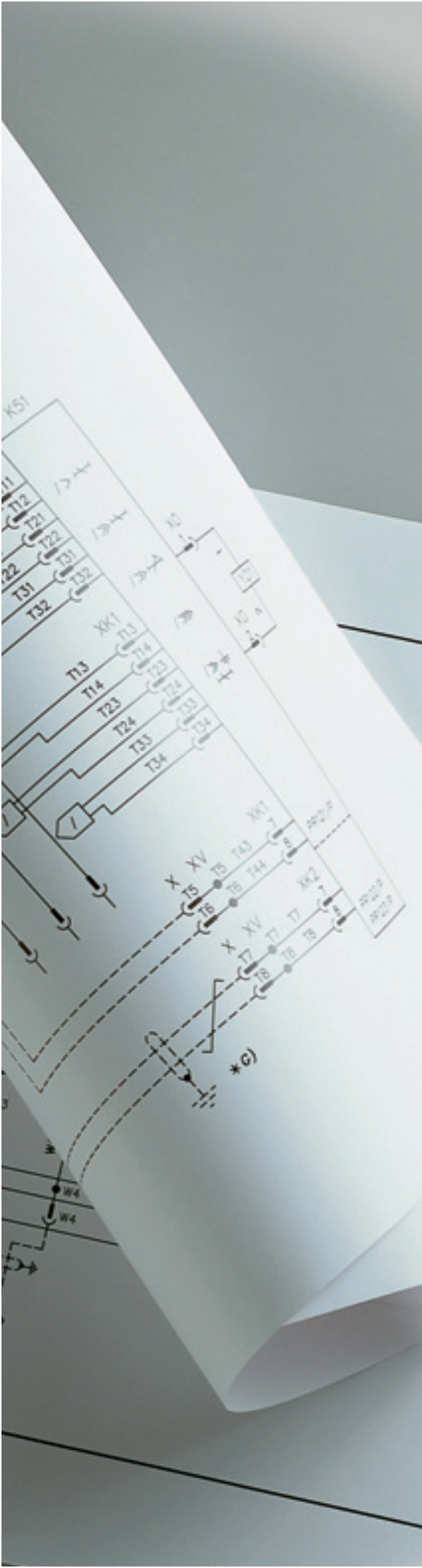
Mechanical interlock between Emax X1 and Emax E1-E6 circuit breakers



"A" (SX)	"B" (DX)
T7-T7M-X1	E1-E2-E3
E1-E2-E3-E4-E6	T7-T7M-X1

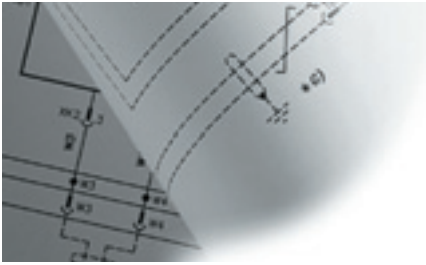
by Emax





Contents

Reading information - Circuit breakers	6/2
Reading information - ATS010	6/5
Circuit diagram symbols (IEC 60617 and CEI 3-14 ... 3-26 Standards)	6/6
Circuit diagrams	
Circuit breakers	6/7
Electrical accessories	6/8
Automatic transfer switch ATS010	6/12



Circuit diagrams

Reading information - Circuit breakers

Warning

Before installing the circuit breaker, carefully read notes F and O on the circuit diagrams.

Operating status shown

The circuit diagram is for the following conditions:

- draw out circuit breaker, open and racked-in
- circuits de-energized
- trip units not tripped
- motor operating mechanism with springs discharged.

Versions

Though the diagram shows a circuit breaker in draw out version, it can be applied to a fixed version circuit breaker as well.

Fixed version

The control circuits are fitted between terminals XV (connector X12-X13-X14-X15 are not supplied).

With this version, the applications indicated in figure 31A cannot be provided.

Draw out version

The control circuits are fitted between the poles of connector X12-X13-X14-X15 (terminal box XV is not supplied).

Version without overcurrent trip unit

With this version, the applications indicated in figures 13A, 14A, 41A, 42A, 43A, 44A, 45A and 62A cannot be provided.

Version with PR331/P electronic trip unit

With this version, the applications indicated in figures 42A, 43A, 44A, 45A cannot be provided.

Version with PR332/P electronic trip unit

With this version, the applications indicated in figure 41A cannot be provided.

Version with PR333/P electronic trip unit

With this version, the applications indicated in figure 41A cannot be provided.

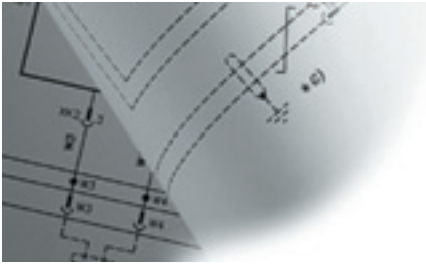
Caption

- = Circuit diagram figure number
- * = See note indicated by letter
- A1 = Circuit breaker accessories
- A3 = Accessories applied to the cradle of the circuit breaker (for draw out version only)
- A4 = Example switchgear and connections for control and signalling, outside the circuit breaker
- A19 = PR330/R actuation unit
- AY = SOR TEST UNIT Test/monitoring Unit (see note R)
- D = Electronic time-delay device of the undervoltage release, outside the circuit breaker
- K51 = PR331, PR332/P, PR333/P electronic trip unit 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 time-delay trip - setting I3
 - G ground fault protection with inverse short time-delay trip - setting I4
- K51/GZin = Zone discrimination: input for protection G or "reverse" direction input for protection D (only with DBin) Uaux and PR332/P or PR333/P trip unit)
- K51/GZout = Zone discrimination: output for protection G or "reverse" direction output for protection D (only DBout) with Uaux. and PR332/P or PR333/P trip unit)
- K51/SZin = Zone discrimination: input for protection S or "direct" input for protection D (only with Uaux. and DFIn) PR332/P or PR333/P trip unit)
- K51/SZout = Zone discrimination: output for protection S or "direct" output for protection D (only with Uaux. and DFout) PR332/P or PR333/P trip unit)
- K51/YC = Closing control from PR332/P or PR333/P electronic trip unit with communication module PR330/D-M and PR330/R actuation unit
- K51/YO = Opening control from PR332/P or PR333/P electronic trip unit with communication module PR330/D-M and PR330/R actuation unit
- M = Motor for charging the closing springs
- Q = Circuit breaker
- Q/1...6 = Circuit breaker auxiliary contacts
- S33M/1...3 = Limit contacts for spring-charging motor
- S43 = Switch for setting remote/local control
- S51 = Contact for electrical signalling of circuit breaker open due to tripping of the overcurrent release. The circuit breaker may be closed only after pressing the reset pushbutton, or after energizing the coil for electrical reset (if available)
- S51/P1 = Programmable contact (as default it signals overload present - start)

S75E/1...2	= Contacts for electrical signalling of circuit breaker in racked-out position (only with draw out circuit breakers)
SC	= Pushbutton or contact for closing the circuit breaker
S75I/1...7	= Contacts for electrical signalling of circuit breaker in racked-in position (only with draw out circuit breakers)
S75T/1..2	= Contacts for electrical signalling of circuit breaker in test isolated position (only with draw out circuit breakers)
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
SR	= Pushbutton or contact for electrical circuit breaker reset
SRTC	= Contact for electrical signalling of circuit breaker open, with springs charged and ready to close
TI/L1	= Current transformer located on phase L1
TI/L2	= Current transformer located on phase L2
TI/L3	= Current transformer located on phase L3
TU	= Isolation voltage 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
UI/O	= Current sensor (Rogowski coil) located on the conductor connecting to ground the star point of the MV/LV transformer (see note G)
W1	= Serial interface with control system (external bus): EIA RS485 interface (see note E)
W2	= Serial interface with the accessories of PR331/P, PR332/P and PR333/P trip units (internal bus)
X12...X15	= Delivery connectors for auxiliary circuits of draw out version circuit breaker
XB1...XB7	= Connectors for the accessories of the circuit breaker
XF	= Delivery terminal box for the position contacts of the draw out circuit breaker (located on the fixed part of the circuit breaker)
XO	= Connector for YO1 trip unit
XR1-XR2	= Connector for power circuits of PR331/P, PR332/P, and PR333/P trip units.
XR5 – XR13	= Connectors for auxiliary circuits of PR331/P, PR332/P and PR333/P trip units.
XV	= Delivery terminal box for the auxiliary circuits of the fixed circuit breaker
YC	= Closing coil
YO	= Opening coil
YO1	= Shunt trip
YO2	= Second shunt trip (see note Q)
YR	= Coil to electrically reset the circuit breaker
YU	= Undervoltage release (see notes B and Q)

Description of figures

- Fig. 1A = Motor circuit to charge the closing springs.
 Fig. 2A = Closing coil circuit.
 Fig. 4A = Shunt trip.
 Fig. 6A = Instantaneous undervoltage release (see notes B and Q).
 Fig. 7A = Undervoltage release with electronic time-delay device, outside the circuit breaker (see notes B and Q)
 Fig. 8A = Second shunt trip (see note Q).
 Fig. 11A = Contact for electrical signalling of springs charged.
 Fig. 12A = Contact for electrical signalling of circuit breaker open, with springs charged, and ready to close.
 Fig. 13A = Contact for electrical signalling of circuit breaker open due to tripping of the overcurrent release. The circuit breaker may be closed only after pressing the reset pushbutton.
 Fig. 14A = Contact for electrical signalling of circuit breaker open due to tripping of the overcurrent release and electrical reset coil. The circuit breaker may be closed only after pressing the reset pushbutton or energizing the coil.
 Fig. 22A = Circuit breaker auxiliary contacts.
 Fig. 23A = 15 additional auxiliary contacts.
 Fig. 31A = First set of contacts for electrical signalling of circuit breaker in racked-in, test isolated, racked-out position.
 Fig. 41A = Auxiliary circuits of PR331/P trip unit (see note F).
 Fig. 42A = Auxiliary circuits of PR332/P and PR333/P trip units (see notes F and N).
 Fig. 43A = Circuits of the measuring module PR330/V of the PR332/P and PR333/P trip units internally connected to the circuit breaker (optional for the PR332/P trip unit; see note U).
 Fig. 44A = Circuits of the measuring module PR330/V of the PR332/P and PR333/P trip units externally connected to the circuit breaker (optional for the PR332/P trip unit; see notes O and U).
 Fig. 45A = Circuits of the PR332/P trip unit with communication module PR330/D-M connected to PR330/V actuation unit (see notes E, F and N).
 Fig. 46A = Circuits of the PR332/P or PR333/P release PR330/V measuring module connected internally to the three-pole circuit breaker with external neutral conductor (optional for PR332/P and standard for PR333/P (see note U).
 Fig. 61A = SOR TEST UNIT Test/monitoring unit (see note R).
 Fig. 62A = Circuits of the PR021/K signalling module (outside the circuit breaker) .



Circuit diagrams

Reading information - Circuit breakers

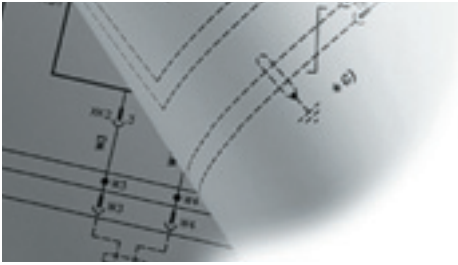
Incompatibilities

The circuits indicated in the following figures cannot be supplied simultaneously on the same circuit breaker:

- 6A – 7A – 8A
- 13A – 14A
- 41A – 42A – 45A

Notes

- A) The circuit breaker is only fitted with the accessories 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 trip unit is energized (there is a mechanical lock on closing).
- E) For the EIA RS485 serial interface connection see document ITSCE - RH0298 regarding MODBUS communication.
- F) The auxiliary voltage U_{aux} allows actuation of all operations of the PR331/P, PR332/P and PR333/P trip units. Having requested a U_{aux} insulated from ground, one must use “galvanically separated converters” in compliance with IEC 60950 (UL 1950) or equivalent standards that ensure a common mode current or leakage current (see IEC 478/1, CEI 22/3) not greater than 3.5 mA, IEC 60364-41 and CEI 64-8.
- G) Ground fault protection is available with the PR332/P and PR333/P trip units by means of a current sensor located on the conductor connecting to ground the star center of the MV/LV transformer.
The connections between terminals 1 and 2 (or 3) of current transformer UI/O and poles T7 and T8 of the X (or XV) connector must be made with a two-pole shielded and stranded cable (see user manual), no more than 15 m long. The shield must be grounded on the circuit breaker side and current sensor side.
- N) With PR332/P and PR333/P trip units, the connections to the zone discrimination inputs and outputs must be made with a two-pole shielded and stranded cable (see user manual), no more than 300 m long. The shield must be grounded on the selectivity input side.
- O) Systems with rated voltage of less than 100V or greater than 690V require the use of an insulation voltage transformer to connect to the busbars.
- P) With PR332/P and PR333/P trip units with communication module PR330/D-M, the power supply for coils YO and YC must not be taken from the main power supply. The coils can be controlled directly from contacts K51/YO and K51/YC with maximum voltages of 60 V DC and 240-250 V AC.
- Q) The second shunt trip 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 U_{aux} of the shunt trip 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. Consequently:
 - 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) The connection cable shield must only be grounded on the circuit breaker side.
- T) The connections between the TO toroidal transformer and the poles of the X13 (or XV) connector of the circuit breaker must be made using a four-pole shielded cable with paired braided conductors (BELDEN 9696 paired type), with a length of not more than 15 m. The shield must be grounded on the circuit breaker side.
- U) The measuring module PR330/V is always supplied with relay PR333/P.



Electric diagrams

Reading information - ATS010

Operating status shown

The diagram shows the following conditions:

- Circuit breakers open and racked in #
- Generator not under alarm
- Closing springs discharged
- Overcurrent releases not tripped *
- ATS010 not supplied
- Generator on automatic operation and not started
- Switching to generator unit enabled
- Circuits de-energized
- Logic enabled by means of appropriate input (terminal 47).

This diagram shows draw out version circuit breakers but is also valid for fixed version circuit breakers: the auxiliary circuits of the circuit breakers do not head to connectors X12-X15 but to terminal box XV; also connect terminal 35 to 38 of the ATS010 device.

* This diagram shows circuit breakers with overcurrent release but is also valid for circuit breakers without overcurrent release: connect terminal 18 with 20 and terminal 35 with 37 of the ATS010 device.

@ This diagram shows four-pole circuit breakers but is also valid for two-pole circuit breakers: only use terminals 26 and 24 (phase and neutral) for the voltmetric connections of the normal power supply of the ATS010 device; also use two-pole auxiliary protection circuit breaker Q61/2 instead of the four-pole one.

Caption

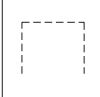


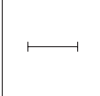
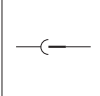


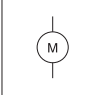

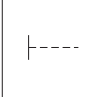
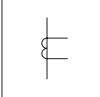

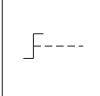



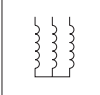

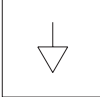


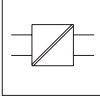






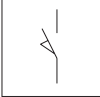

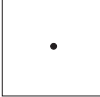


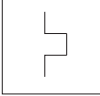
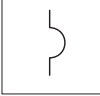

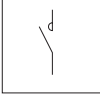
A	= ATS010 device for automatic switching of two circuit breakers
K1	= Auxiliary contact type VB6-30-01 for presence of emergency power supply voltage
K2	= Auxiliary contact type VB6-30-01 for presence of normal power supply voltage
K51/Q1	= Overcurrent relay of the emergency power supply line *
K51/Q2	= Overcurrent relay of the normal power supply line *
KC1-KC2	= BC6-30 type auxiliary contacts for closing the circuit breakers
KO1-KO2	= BC6-30 type auxiliary contacts for opening the circuit breakers
M	= Motor for closing spring charging
Q/1	= Auxiliary contact of the circuit breaker
Q1	= Emergency line power supply circuit breaker
Q2	= Normal line power supply circuit breaker
Q61/1-2	= Thermomagnetic circuit breakers for isolation and protection of the auxiliary circuits @
S11...S16	= Signal contacts for the inputs of the ATS010 device
S33M/1	= Limit switch contact of the closing springs
S51	= Contact for electrical signalling of circuit breaker open due to overcurrent release trip *
S75I/1	= Contact for electrical signalling of draw out version circuit breaker racked in #
TI/...	= Current transformers for overcurrent release power supply
X12-X15	= Connectors for the auxiliary circuits of the draw out version circuit breaker
XF	= Delivery terminal box for the position of the draw out version circuit breaker
XV	= Delivery terminal box for the auxiliary circuits of the fixed version circuit breaker
YC	= Closing coils
YO	= Shunt trip

Note:

A) For the auxiliary circuits of the circuit breakers see the relative diagrams. The applications indicated in the following figures are compulsory: 1A - 2A - 4A - 13A (only if the overcurrent release is supplied) - 22A - 31A (only for draw out version circuit breakers).

Circuit diagrams

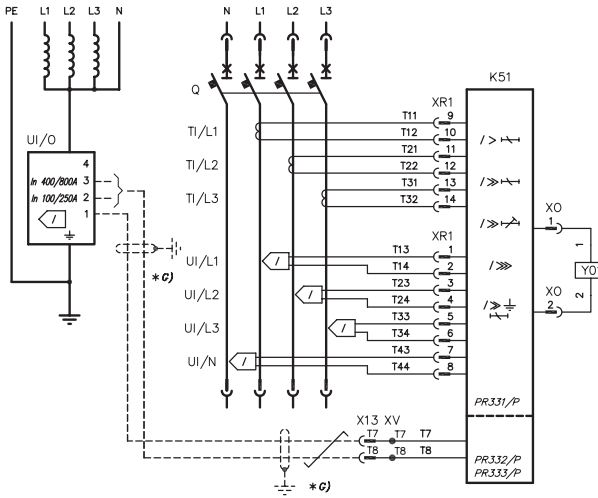
Circuit diagram symbols (IEC 60617 and CEI 3-14 ... 3-26 Standards)

	Shield (may be drawn in any shape)		Terminal		Position switch (limit switch) change-over break before make contact
	Delay		Plug and socket (male and female)		Circuit breaker-disconnector with automatic release
	Mechanical connection (link)		Motor (general symbol)		Switch-disconnector (on-load isolating switch)
	Manually operated control (general case)		Current transformer		Operating device (general symbol)
	Operated by turning		Voltage transformer		Instantaneous overcurrent or rate-of-rise relay
	Operated by pushing		Winding of three-phase transformer, connection star		Overcurrent relay with adjustable short time-lag characteristic
	Equipotentiality		Make contact		Overcurrent relay with inverse short time-lag characteristic
	Converter with galvanic separator		Break contact		Overcurrent relay with inverse long time-lag characteristic
	Conductors in a screened cable (i.e., 3 conductors shown)		Change-over break before make contact		Ground fault overcurrent relay with inverse short time-lag characteristic
	Twisted conductors (i.e., 3 conductors shown)		Position switch (limit switch), make contact		Fuse (general symbol)
	Connection of conductors		Position switch (limit switch), break contact		Current sensing element
	Thermal effect		Electromagnetic effect		Mechanical interlock between two devices
	Contactor (closing contact)				

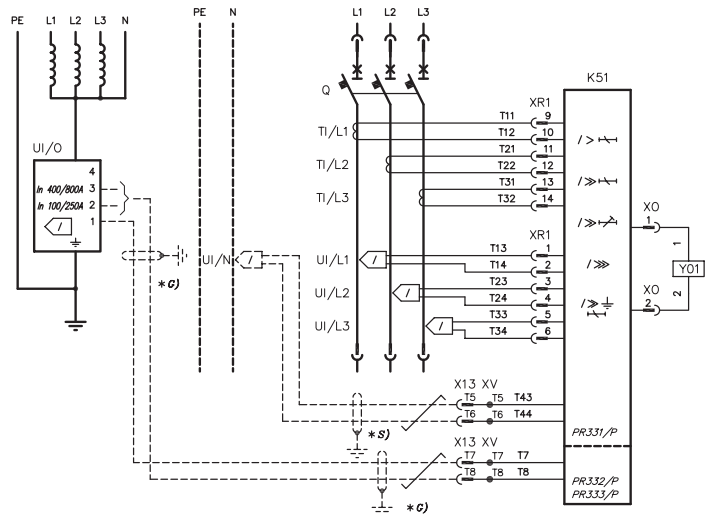
Circuit diagrams

Circuit breakers

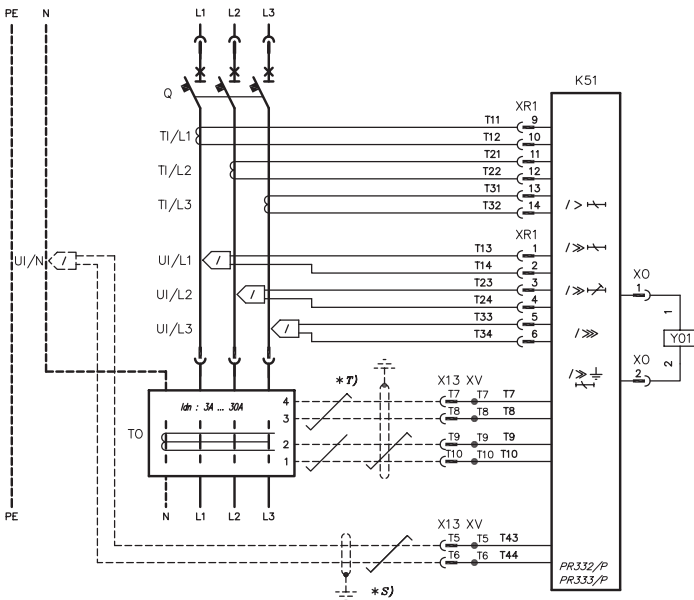
Operating status



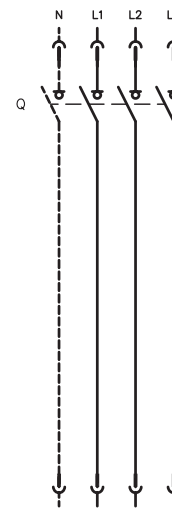
Four-pole circuit breaker with PR331/P, PR332/P or PR333P electronic trip unit



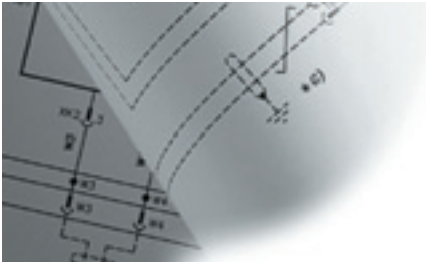
Three-pole circuit breaker with PR331/P, PR332/P or PR333P electronic trip unit



Three-pole circuit breaker with PR331/P, PR332/P or PR333/P electronic trip unit



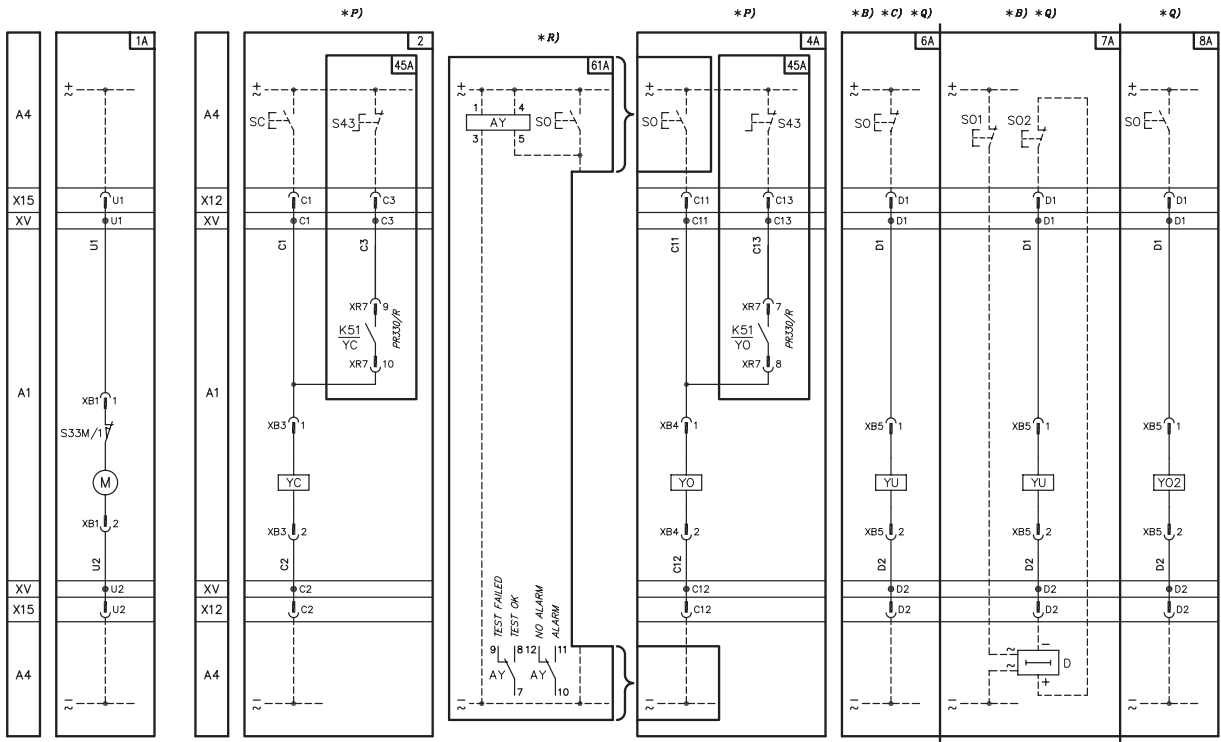
Three- or four-pole switch-disconnector



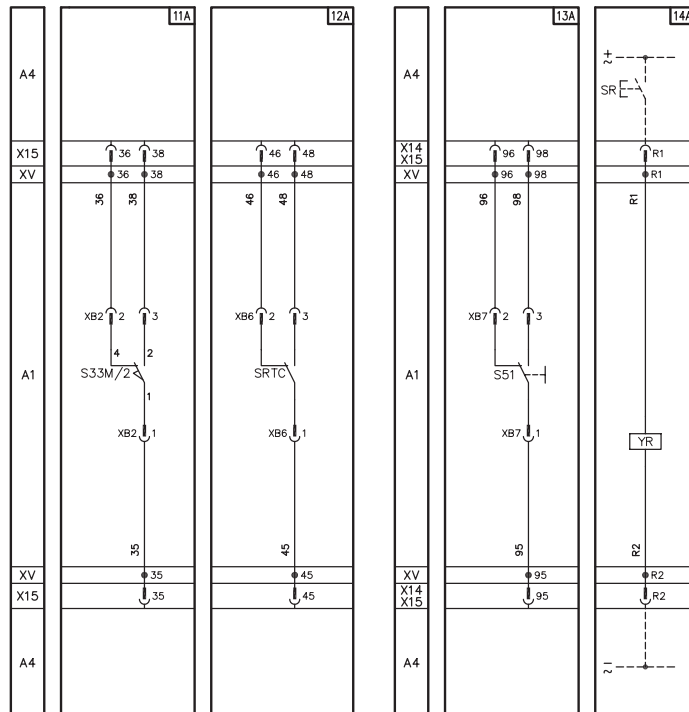
Circuit diagrams

Electrical accessories

Motor operator, shunt trip, closing coil and undervoltage releases

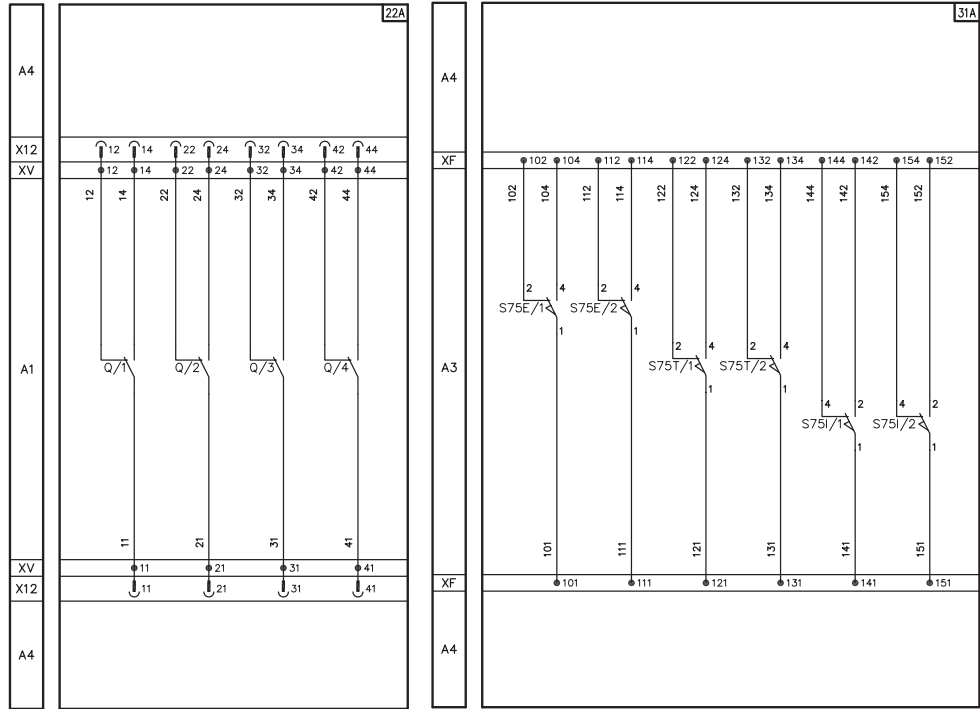


Signalling contacts

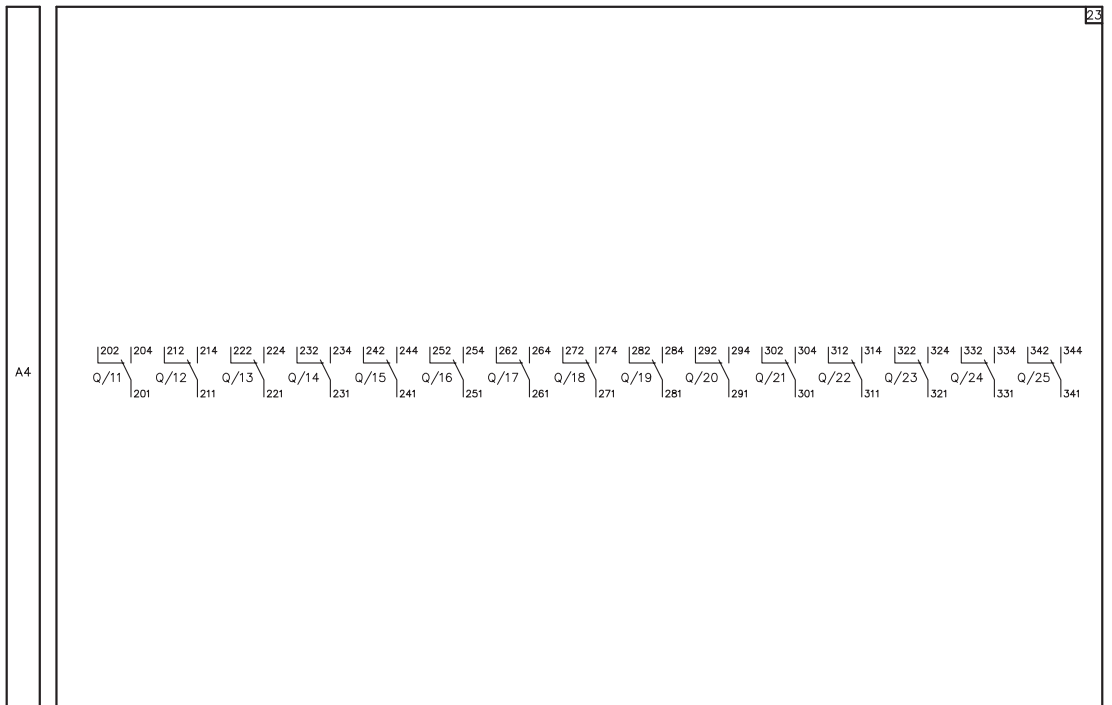


6

Signalling contacts



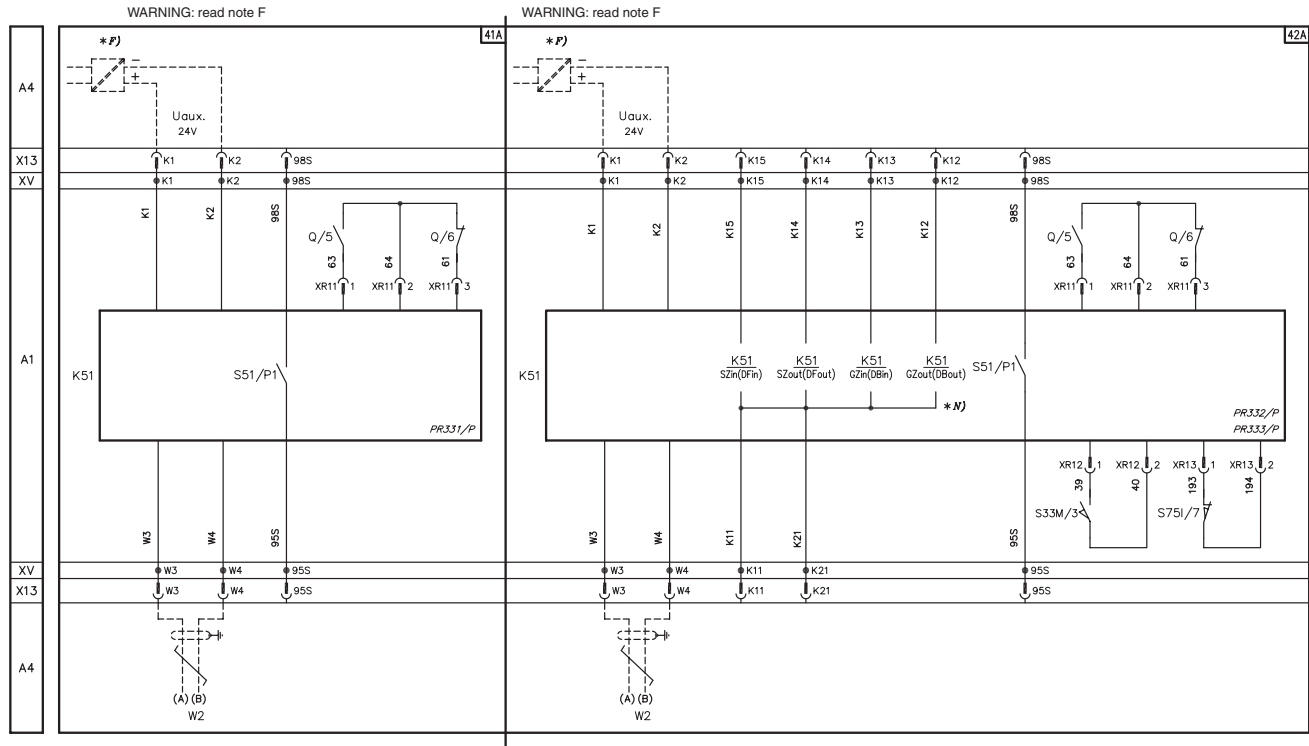
15 additional auxiliary contacts



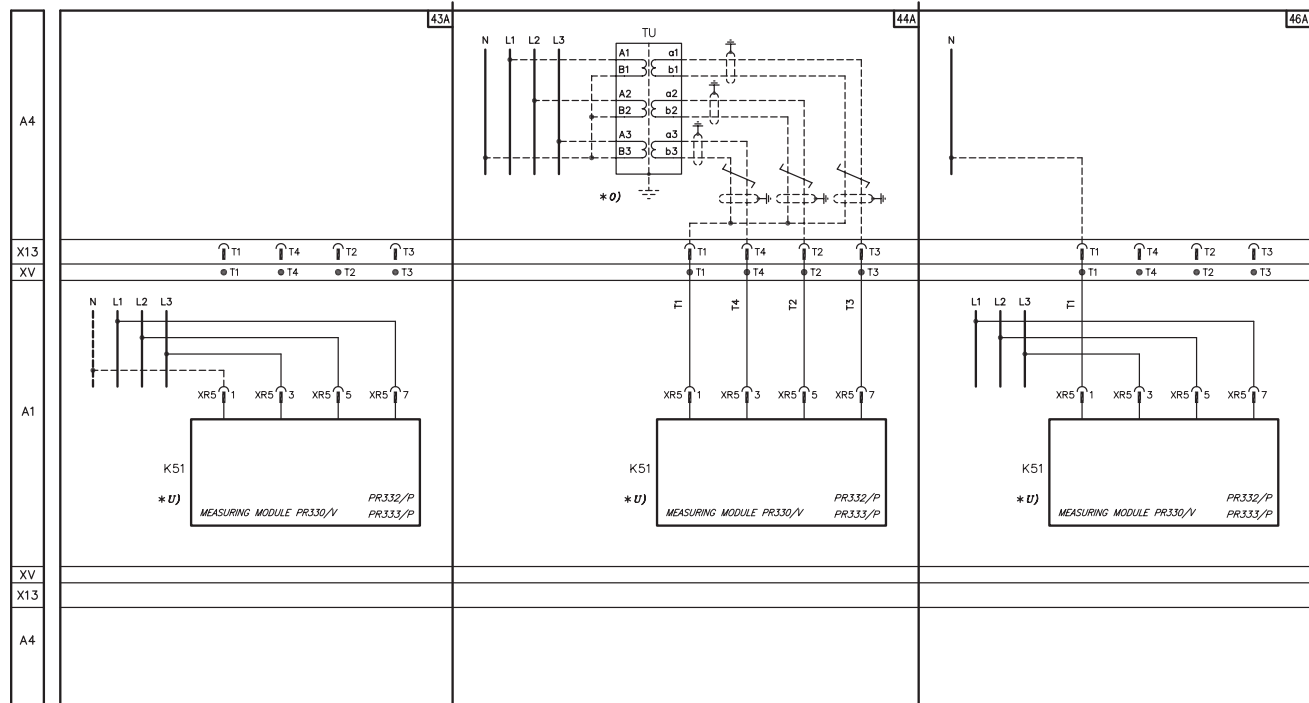
Circuit diagrams

Electrical accessories

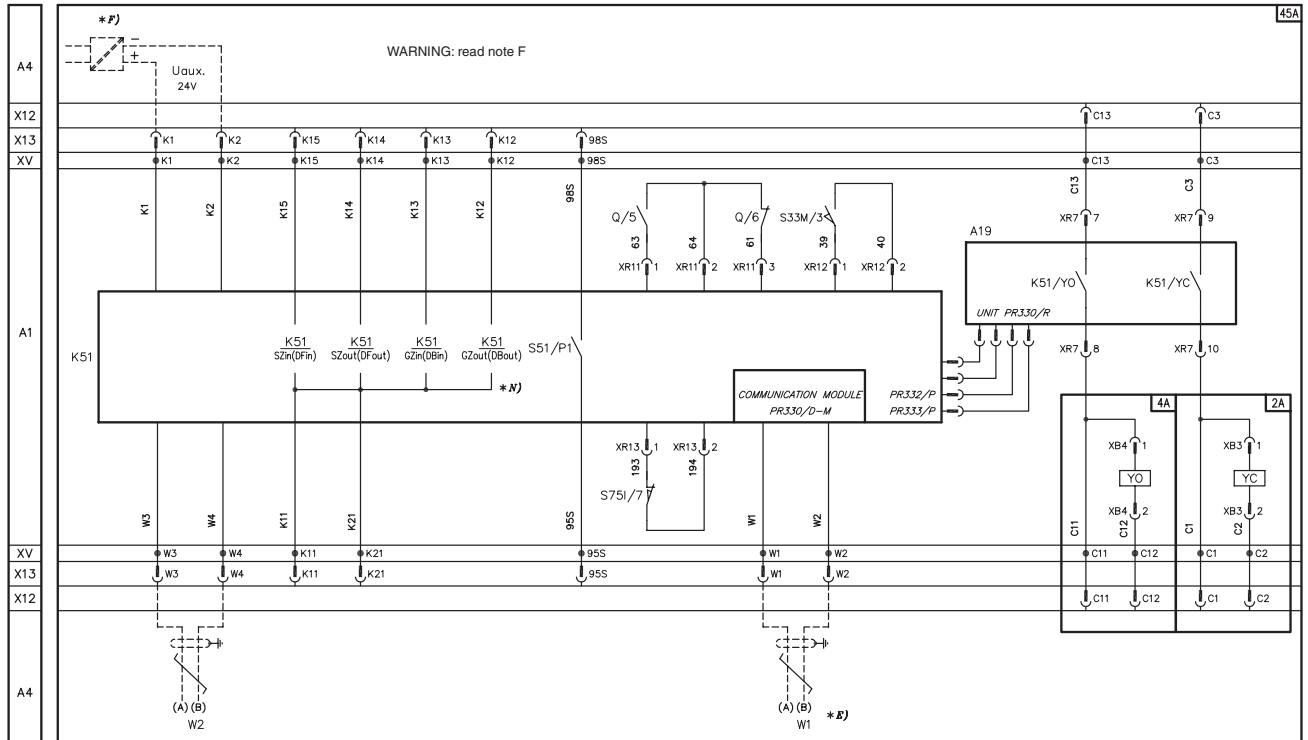
Auxiliary circuits of the PR331, PR332 and PR333 trip units



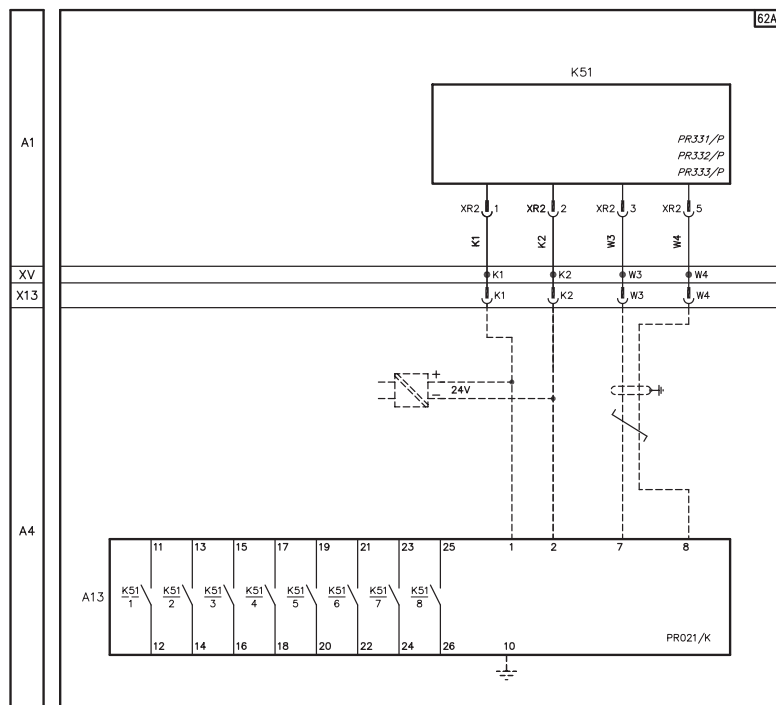
Measuring module PR330/V



PR332/P and PR333/P electronic trip units connected to PR330/R actuation unit and PR330/D-M dialogue unit



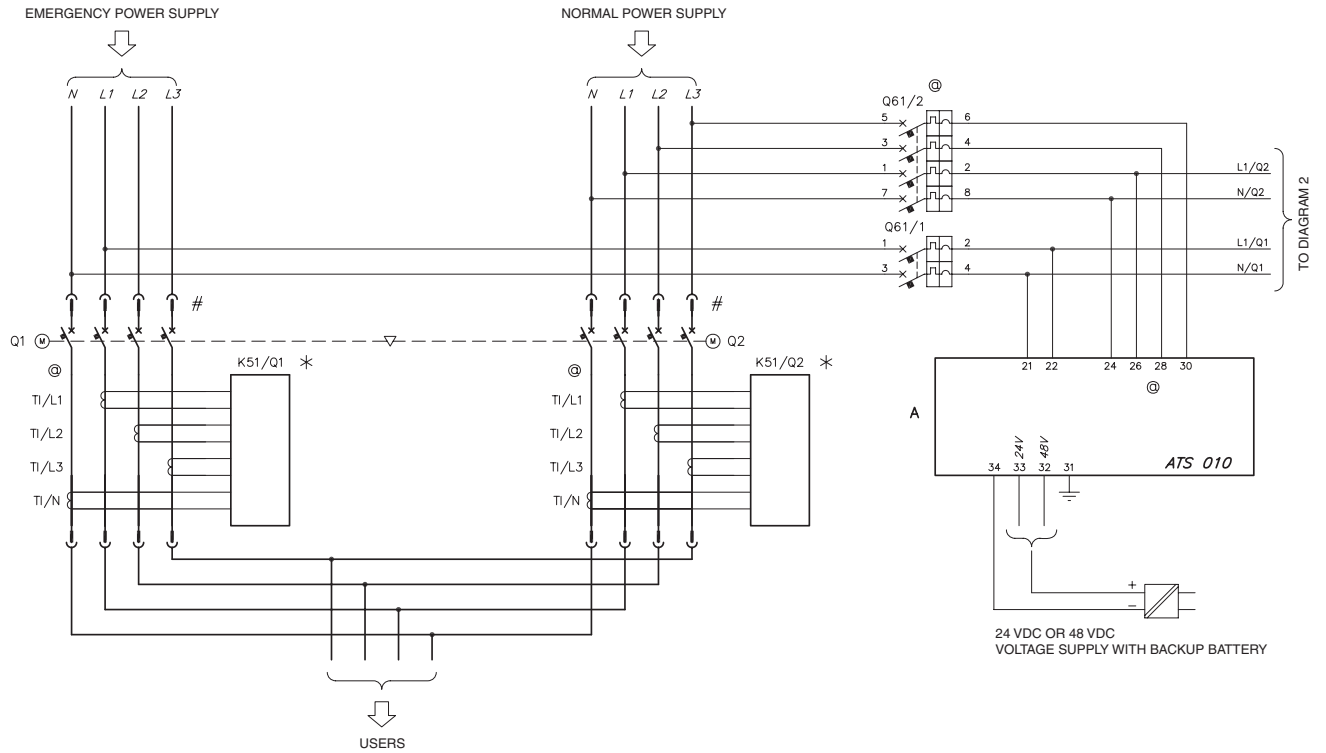
PR021/K signalling unit



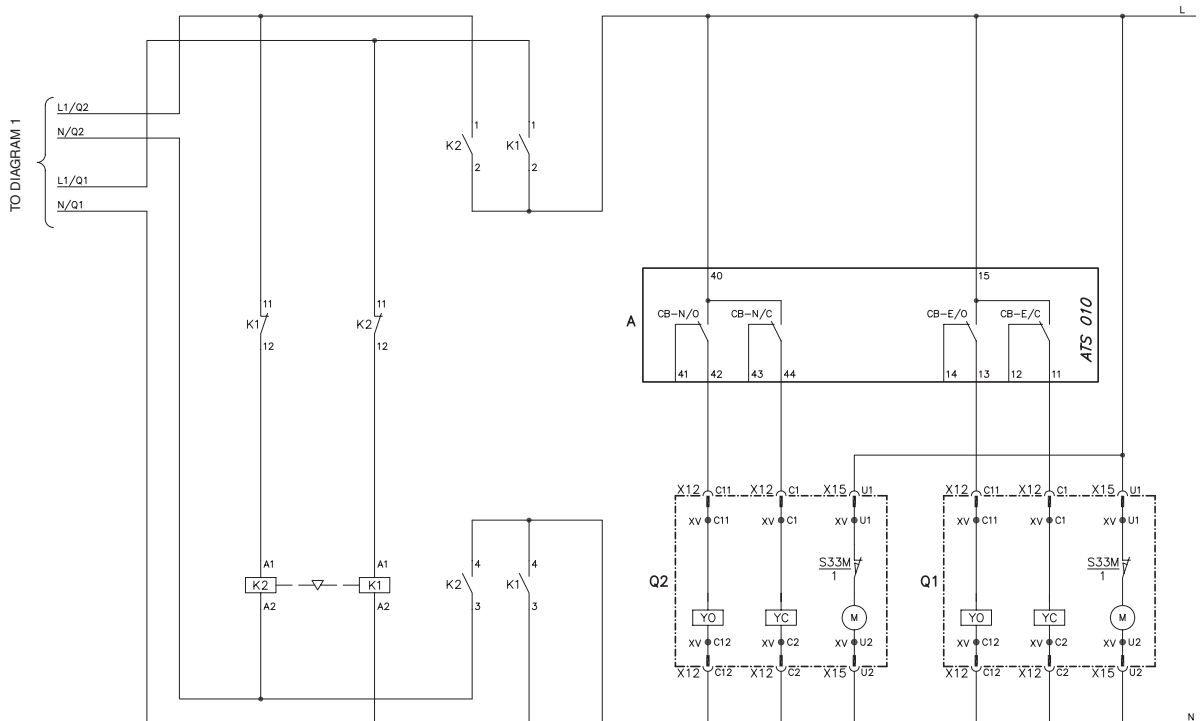
Circuit diagrams

Automatic transfer-switch ATS010

ATS010 for the automatic transfer switch of two circuit breakers

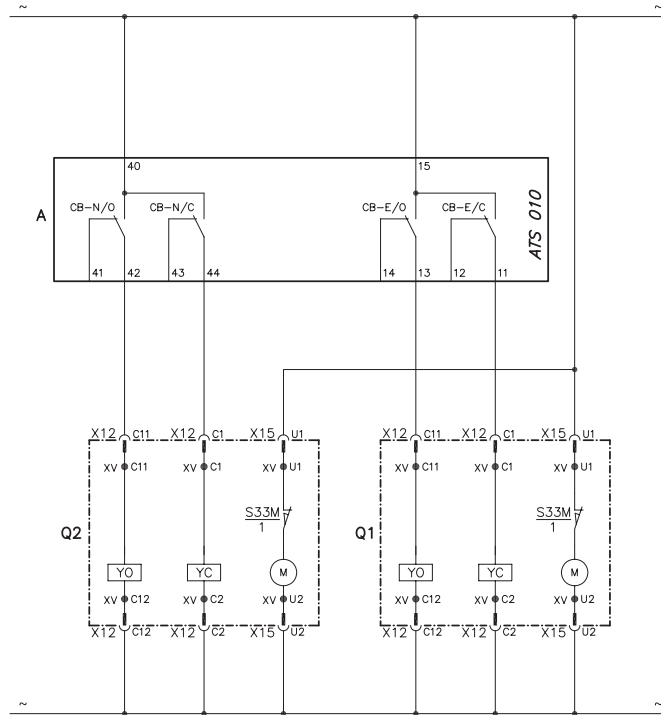


Without safety auxiliary voltage supply

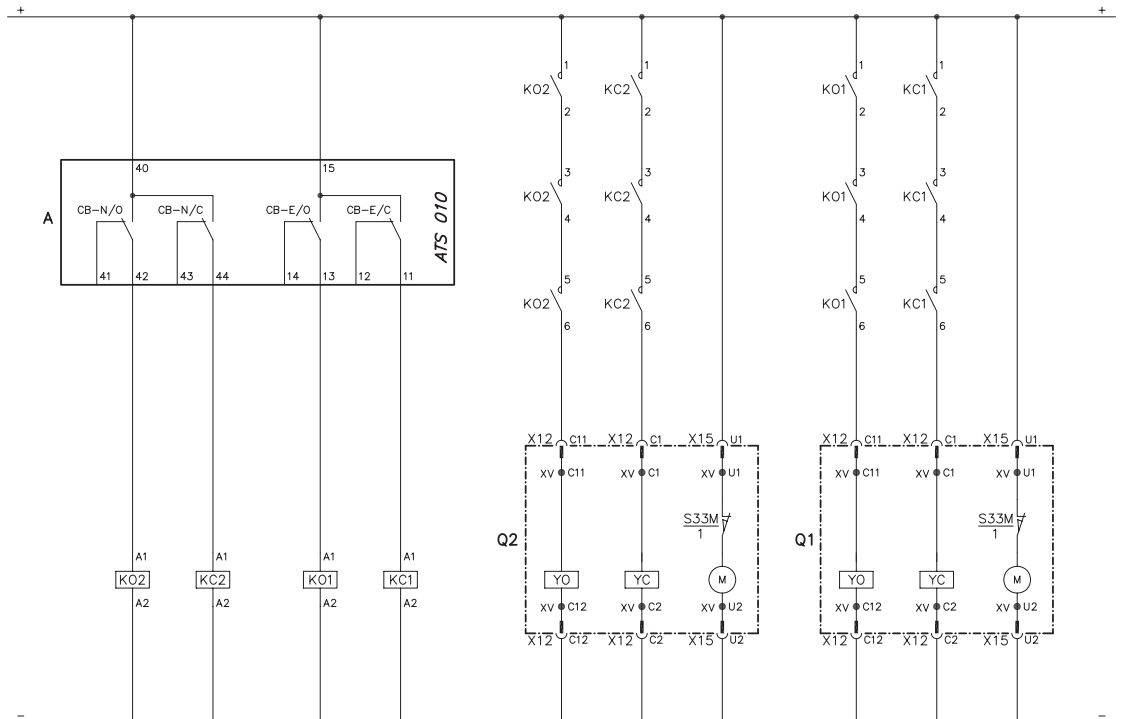


6

With auxiliary safety power supply in AC



With auxiliary safety power supply in DC



Circuit diagrams

Automatic transfer switch ATS010

Automatic transfer switch ATS010

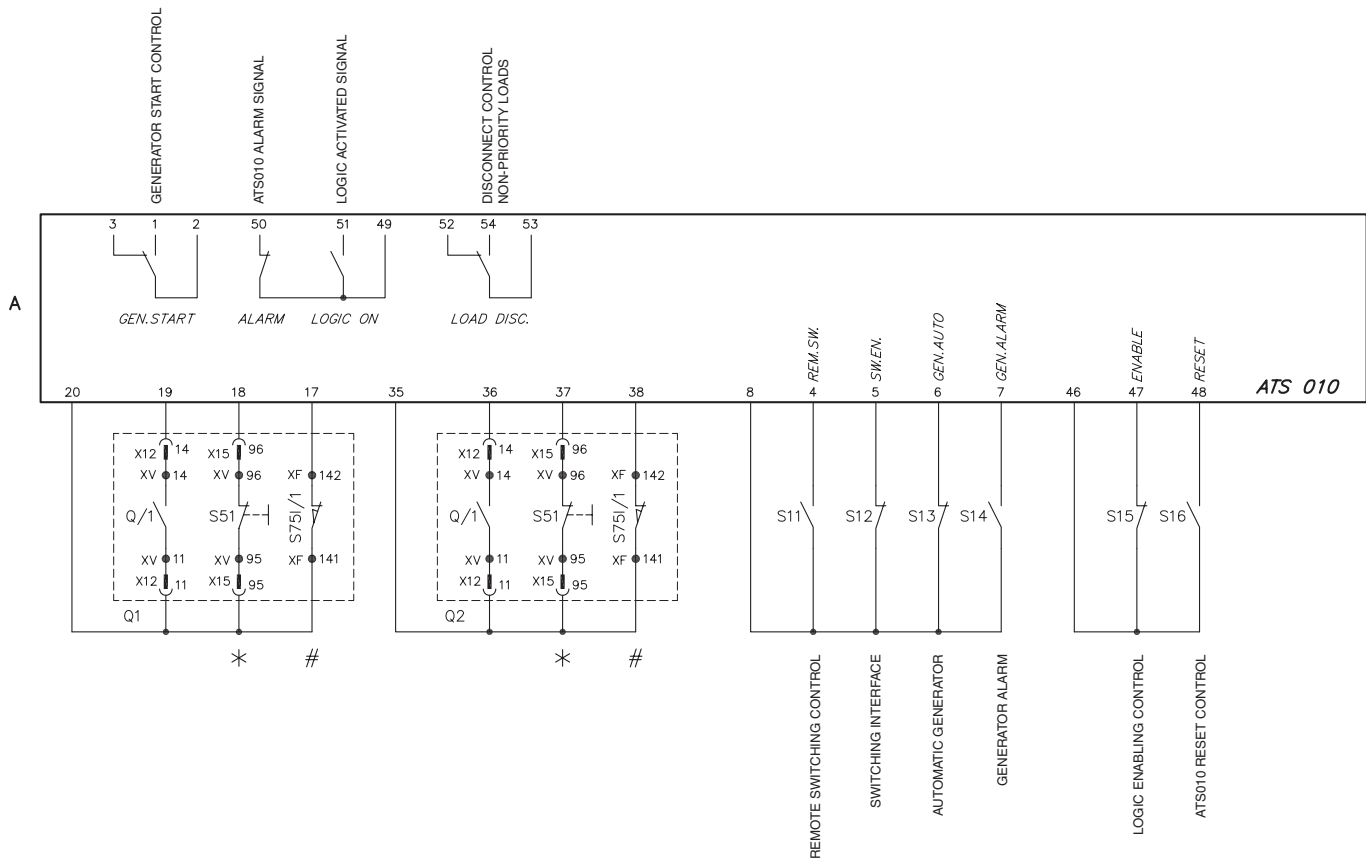




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Due to possible developments of standards as well as of materials, the characteristics and dimensions specified in the present catalog may only be considered binding after confirmation by ABB SACE.