Technical catalogue

Emax
Low voltage air circuit-breakers

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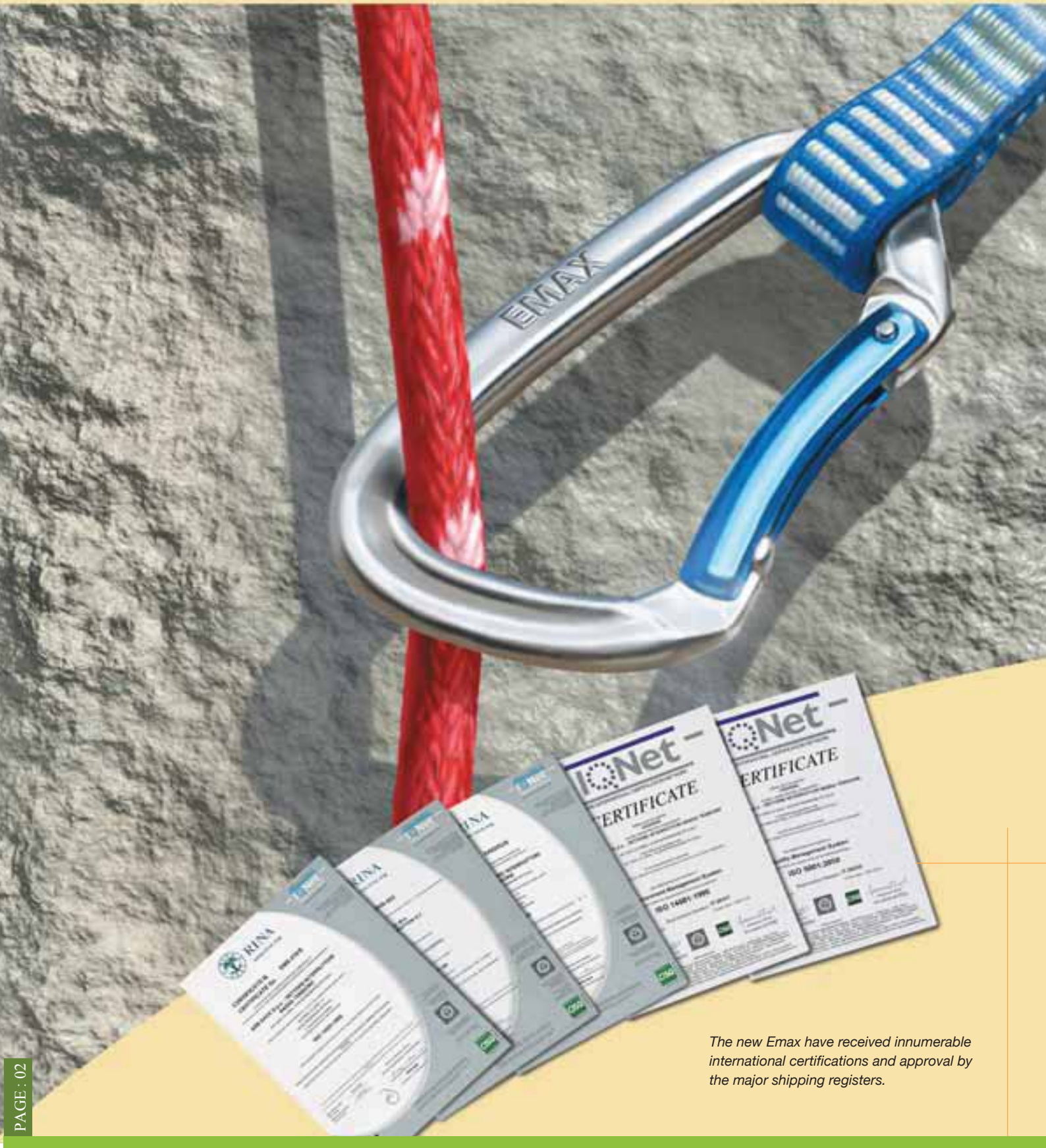
New Emax.
Ensured reliability.

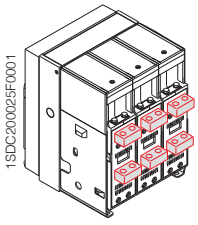


The new Emax have received innumerable international certifications and approval by the major shipping registers.

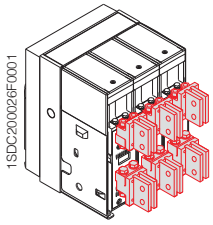
Construction characteristics
Operating and signalling parts

Versions and connections

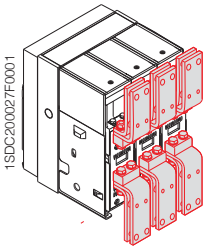
Fixed circuit-breaker



Horizontal rear terminals

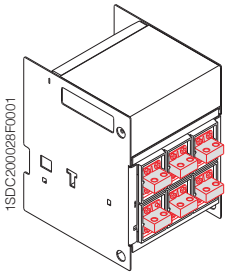


Vertical rear terminals

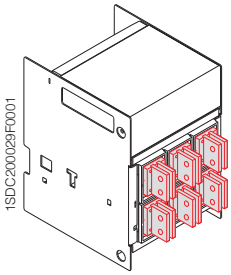


Front terminals

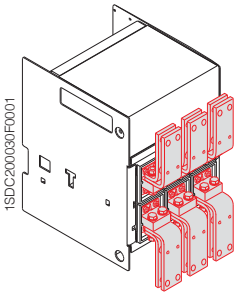
Withdrawable circuit-breaker



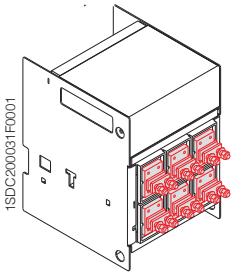
Horizontal rear terminals



Vertical rear terminals



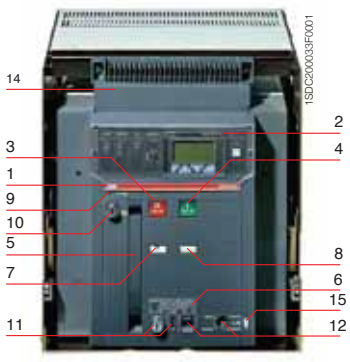
Front terminals



Flat terminals

Fixed version

Withdrawable version



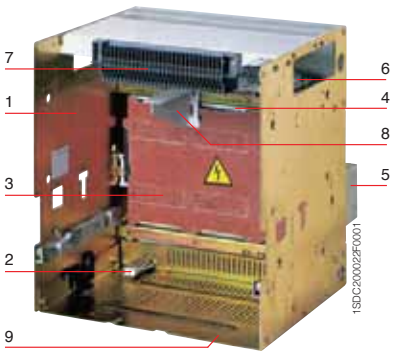
Caption	
1	Trademark and size of circuit-breaker
2	SACE PR121, PR122 or PR123 trip unit
3	Pushbutton for manual opening
4	Pushbutton for manual closing
5	Lever to manually charge closing springs
6	Electrical rating plate
7	Mechanical device to signal circuit-breaker open “O” and closed “I”
8	Signal for springs charged or discharged
9	Mechanical signalling of overcurrent release tripped
10	Key lock in open position
11	Key lock and padlock in racked-in/racked-out position (for withdrawable version only)
12	Racking-in/out device (for withdrawable version only)
13	Terminal box (for fixed version only)
14	Sliding contacts (for withdrawable version only)
15	Circuit-breaker position indicator: racked-in/ test isolated /racked-out / connected/test isolated/disconnected (for withdrawable version only)

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
Fixed parts of withdrawable circuit-breakers

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



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

SACE Emax automatic circuit-breakers

Common data		
Voltages		
Rated service voltage Ue	[V]	690 ~
Rated insulation voltage Ui	[V]	1000
Rated impulse withstand voltage Uimp	[kV]	12
Operating temperature	[°C]	-25....+70
Storage temperature	[°C]	-40....+70
Frequency f	[Hz]	50 - 60
Number of poles		3 - 4
Versions		Fixed - Withdrawable

		E1		E2				E3					E4			E6	
Performance levels		B	N	B	N	S	L	N	S	H	V	L	S	H	V	H	V
Currents: max rated uninterrupted current (at 40 °C)	[A]	800	800	1600	1000	800	1250	2500	1000	800	800	2000	4000	3200	3200	4000	3200
	[A]	1000	1000	2000	1250	1000	1600	3200	1250	1000	1250	2500		4000	4000	5000	4000
	[A]	1250	1250		1600	1250			1600	1250	1600					6300	5000
	[A]	1600	1600		2000	1600			2000	1600	2000						6300
	[A]					2000			2500	2000	2500						
	[A]								3200	2500	3200						
	[A]									3200							
Neutral pole current-carrying capacity for 4-pole CBs	[%Iu]	100	100	100	100	100	100	100	100	100	100	100	50	50	50	50	50
Rated ultimate breaking capacity under short-circuit Icu																	
220/230/380/400/415 V ~	[kA]	42	50	42	66	85	130	66	75	100	130	130	75	100	150	100	150
440 V ~	[kA]	42	50	42	66	85	110	66	75	100	130	110	75	100	150	100	150
500/525 V ~	[kA]	42	50	42	55	65	85	66	75	100	100	85	75	100	130	100	130
660/690 V ~	[kA]	42	50	42	55	65	85	66	75	85 (2)	100	85	75	85 (2)	100	100	100
Rated service breaking capacity under short-circuit Ics																	
220/230/380/400/415 V ~	[kA]	42	50	42	65	85	130	66	75	85	100	130	75	100	150	100	125
440 V ~	[kA]	42	50	42	65	85	110	66	75	85	100	110	75	100	150	100	125
500/525 V ~	[kA]	42	50	42	55	65	65	66	75	85	85	65	75	100	130	100	100
660/690 V ~	[kA]	42	50	42	55	65	65	66	75	85	85	65	75	85	100	100	100
Rated short-time withstand current Icw (1s)	[kA]	42	50	42	55	65	10	66	75	75	85	15	75	100	100	100	100
(3s)	[kA]	36	36	42	42	50	–	66	65	65	65	–	75	75	75	85	85
Rated making capacity under short-circuit (peak value) Icm																	
220/230/380/400/415 V ~	[kA]	88.2	105	88.2	143	187	286	143	165	220	286	286	165	220	330	220	330
440 V ~	[kA]	88.2	105	88.2	143	187	242	143	165	220	286	242	165	220	330	220	330
500/525 V ~	[kA]	88.2	105	88.2	121	143	187	143	165	220	220	187	165	220	286	220	286
660/690 V ~	[kA]	88.2	105	88.2	121	143	187	143	165	187	220	187	165	187	220	220	220
Utilisation category (according to CEI EN 60947-2)		B	B	B	B	B	A	B	B	B	B	A	B	B	B	B	B
Isolation behaviour (according to CEI EN 60947-2)		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Overcurrent protection																	
Electronic trip units for AC applications		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Operating times																	
Closing time (max)	[ms]	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Breaking time for I<Icw (max) (1)	[ms]	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Breaking time for I>Icw (max)	[ms]	30	30	30	30	30	12	30	30	30	30	12	30	30	30	30	30
Overall dimensions																	
Fixed: H = 418 mm - D = 302 mm W (3/4 poles)	[mm]	296/386		296/386				404/530					566/656			782/908	
Withdrawable: H = 461 mm - D = 396.5 mm W (3/4 poles)	[mm]	324/414		324/414				432/558					594/684			810/936	
Weights (circuit-breaker complete with trip units and CS, excluding accessories)																	
Fixed 3/4 poles	[kg]	45/54	45/54	50/61	50/61	50/61	52/63	66/80	66/80	66/80	66/80	72/83	97/117	97/117	97/117	140/160	140/160
Withdrawable 3/4 poles (including fixed part)	[kg]	70/82	70/82	78/93	78/93	78/93	80/95	104/125	104/125	104/125	104/125	110/127	147/165	147/165	147/165	210/240	210/240

(1) Without intentional delays; (2) The performance at 600V is 100kA.

		E1 B-N			E2 B-N-S				E2 L		E3 N-S-H-V						E3 L		E4 S-H-V		E6 H-V			
Max rated uninterrupted current (at 40 °C)	[A]	800	1000-1250	1600	800	1000-1250	1600	2000	1250	1600	800	1000-1250	1600	2000	2500	3200	2000	2500	3200	4000	3200	4000	5000	6300
Mechanical life with regular ordinary maintenance	[No. operations x 1000]	25	25	25	25	25	25	25	20	20	20	20	20	20	20	20	15	15	15	15	12	12	12	12
Operation frequency	[Operations/hour]	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Electrical life (440 V ~)	[No. operations x 1000]	10	10	10	15	15	12	10	4	3	12	12	10	9	8	6	2	1.8	7	5	5	4	3	2
(690 V ~)	[No. operations x 1000]	10	8	8	15	15	10	8	3	2	12	12	10	9	7	5	1.5	1.3	7	4	5	4	2	1.5
Operation frequency	[Operations/hour]	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	10	10	10	10	10	10

Electronic trip units
General characteristics

The overcurrent protection for AC installations uses three types of electronic trip unit series: PR121, PR122 and PR123.
The basic series, PR121, 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.
PR122 and PR123 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, residual current or source ground return protection);
- a protection unit selected among PR121/P, PR122/P or PR123/P with optional communication module via Modbus or Fieldbus plug network (PR122/P and PR123/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).

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 for circuit-breakers E1, E2, E3 and E4/f, E6/f full-size versions, and E4-E6 with external neutral protection;
  - –OFF-50% for standard E4 and E6.

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

PR121

	PR121/P	PR121/P	PR121/P
Protection	L I	L S I	L S I G

PR122

	PR122/P	PR122/P	PR122/P	PR122/P
Protection	L I	L S I	L S I G	L S I Rc
For all versions		U OT M		

New modules available:

Measuring	opt.	UV OV RV RP UF OF
Communication	opt.	
Signalling	opt.	
Bluetooth (wireless link)	opt.	

PR123

	PR123/P	PR123/P
Protection	L S I	L S I G
For all versions	OT D U UV OV RV RP M UF OF	

New modules available:

Communication	opt.
Signalling	opt.
Bluetooth (wireless link)	opt.

Electronic trip units
Versions available

Features

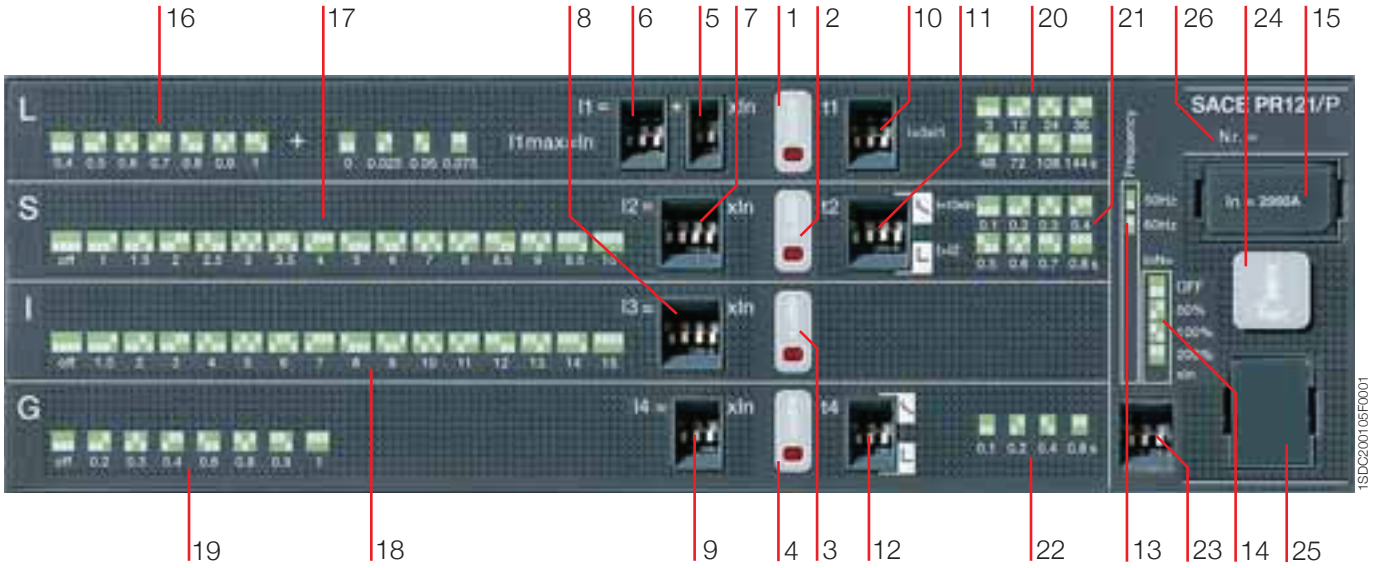
Protection functions		PR121	PR122	PR123
L Protection against overload with inverse long time-delay trip		■	■	■
S Selective protection against short-circuit inverse or definite short time-delay trip		■	■	■
S Second selective protection against short-circuit inverse or definite short time-delay trip				■
I Protection against instantaneous short-circuit with adjustable trip current threshold		■	■	■
G Protection against earth fault	residual	■	■	■
	source ground return		■	■
Rc Residual current (1)			opt.(2)	■
D Protection against directional short-circuit with adjustable time-delay				■
U Protection against phase unbalance			■	■
OT Protection against overtemperature (check)			■	■
UV Protection against undervoltage			opt.(3)	■
OV Protection against overvoltage			opt.(3)	■
RV Protection against residual voltage			opt.(3)	■
RP Protection against reverse active power			opt.(3)	■
M Thermal memory for functions L and S			■	■
UF Underfrequency			opt.(3)	■
OF Overfrequency			opt.(3)	■
Measurements				
Currents (phases, neutral, earth fault)			■	■
Voltage (phase-phase, phase-neutral, residual)			opt.(3)	■
Power (active, reactive, apparent)			opt.(3)	■
Power factor			opt.(3)	■
Frequency and peak factor			opt.(3)	■
Energy (active, reactive, apparent, meter)			opt.(3)	■
Harmonics calculation (display of wave forms and harmonics module)				■
Event marking and maintenance data				
Event marking with the instant it occurred		opt.(4)	■	■
Chronological event storage		opt.(4)	■	■
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			opt.(5)	opt.(5)
Transmission of measurements, states and alarms from circuit-breaker to system			opt.(5)	opt.(5)
Transmission of the events and maintenance data from circuit-breaker to system			opt.(5)	opt.(5)
Watchdog				
Alarm and trip for release overtemperature			■	■
Check of release 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 one of the following protections: undervoltage, overvoltage, residual voltage, active reverse of power, phase unbalance, overtemperature			opt.(3)	■
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			■	■
Load control				
Load connection and disconnection according to the current passing through the circuit-breaker			■	■
Zone selectivity				
Can be activated for protection functions S, G and (PR123 only) D			■	■

(1) requires a homopolar toroid for residual current protection; (2) the RC function is available with PR122LSIRc or with PR122 LSIG and module PR120/V; (3) with PR120/V;
(4) with BT030 communication unit; (5) with PR120/D-M

Protection trip units and trip curves
PR121/P

Characteristics

PR121/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. Fur thermore, PR121/P allows connection to external devices enhancing its advanced characteristics like remote signalling and monitoring, or remote supervision display.



Caption

1 LED signalling Alarm 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
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
15 Rating plug
16 Indication of the DIP switch positions for the various current thresholds values I1
17 Indication of the DIP switch positions for the various current threshold values I2
18 Indication of the DIP switch positions for the various current threshold values I3
19 Indication of the DIP switch positions for the various current threshold values I4
20 Indication of DIP switch positions for the various time settings t1
21 Indication of DIP switch positions for the various time settings t2
22 Indication of DIP switch positions for the various time settings t4
23 DIP switch for setting network frequency and neutral protection setting
24 Trip cause indication and trip test pushbutton
25 Test connector for connecting or testing the trip unit through an external device (PR030/B battery unit, BT030 wireless communication unit and SACE PR010/T unit)
26 Serial number of protection trip unit

Electronic trip units
Versions available

Operation and protection functions

Protection functions

The PR121 trip unit offers the following protection functions:
- overload (L)
- selective short-circuit (S)
- instantaneous short-circuit (I)
- earth fault (G).

Overload (L)

The inverse long time-delay trip overload protection L is type $I^2t = k$; 25 current thresholds and 8 curves are available. Each curve is identified by the trip time in relation to the current I = 3 x I1 (I1 = set threshold).

Selective short-circuit (S)

The selective short-circuit protection S can be set with two different types of curves with a trip time 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 > I2
- for curves $t = k/I^2$ by the trip time for I = 10xIn (In = rated current of the circuit-breaker).

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

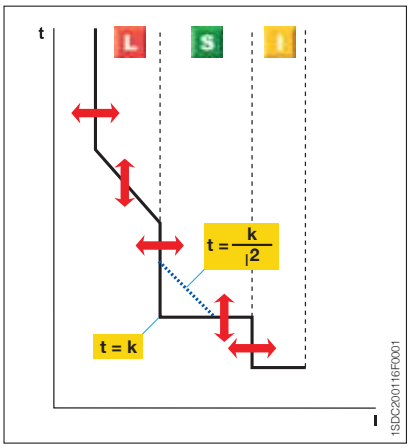
Adjustable instantaneous short-circuit (I)

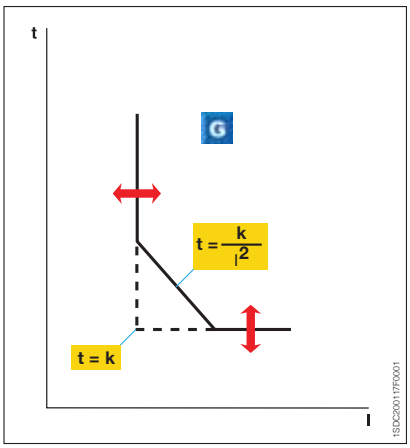
The protection I offers 15 trip thresholds and can be excluded (dip switches in "OFF" position).

Earth fault (G)

The earth fault protection G (which can be excluded) offers 7 current thresholds and 4 curves. Each curve is identified by the time t4 in relation to current I4. As per S protection the trip time can be chosen independent of the current (t = k) or with a constant specific let-through energy ($t = k/I^2$).

Note: the current values above which G is disabled are indicated in the installation manual.





Protection trip units and trip curves
PR121/P

Protection functions and setting values - PR121

Function		Trip threshold	Trip time*	Poss. excl.	Relation t=f(I)
L	Overload protection	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 In	With current If = 3 x I1 t1 = 3 - 12 - 24 - 36 - 48 - 72 - 108 - 144 s (1)	–	$t=k/I^2$
	Tolerance (2)	Release between 1.05 and 1.2 x I1	± 10% If ≤ 6 x In ± 20% If > 6 x In		
S	Selective short-circuit protection	I2= 1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 5 6 - 7 - 8 - 8.5 - 9 - 9.5 - 10 x In	With current If > I2 t2 = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8 s	■	t=k
	Tolerance (2)	± 7% If ≤ 6 x In ± 10% If > 6 x In	The better of the two figures: ± 10% or ± 40 ms		
		I2= 1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 5 6 - 7 - 8 - 8.5 - 9 - 9.5 - 10 x In	With current If = 10 x In t2 = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8 s	■	$t=k/I^2$
	Tolerance (2)	± 7% If ≤ 6 x In ± 10% If > 6 x In	± 15% If ≤ 6 x In ± 20% If > 6 x In		
I	Instantaneous short-circuit protection	I3= 1.5 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 x In	Instantaneous	■	t=k
	Tolerance (2)	± 10%	≤ 30 ms		
G	Earth fault protection	I4= 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 0.9 - 1 x In	With current If > I4 t4 = 0.1 - 0.2 - 0.4 - 0.8 s	■	t=k
	Tolerance (2)	± 7%	The better of the two figures: ± 10% or ± 40 ms		
		I4= 0.2 - 0.3 - 0.4 - 0.6 - 0.8 - 0.9 - 1 x In	t4 = 0.1 @ 4.47 I4, t4 = 0.2 @ 3.16 I4, t4 = 0.4 @ 2.24 I4, t4 = 0.8 @ 1.58 I4	■	$t=k/I^2$
	Tolerance (2)	± 7%	± 15%		

SACE Emax accessories

Shunt opening release - YO (1a)

Shunt closing release - YC (1a)

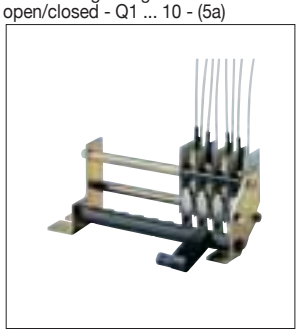
SOR Test Unit - (1b)

Undervoltage release - YU (2a)

Electronic time-delay device for undervoltage release - D (2b)

Geared motor for the automatic charging of the closing springs - M (3)

Electrical signalling of circuit-breaker open/closed - Q1 ... 10 - (5a)

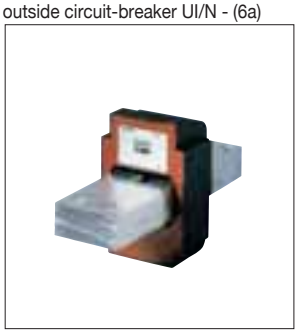


Electrical signalling of circuit-breaker racked-in/test isolated/racked-out S75 - (5c)

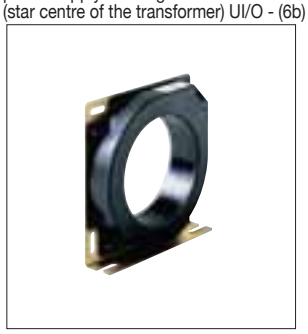
Contact for signalling closing spring charged S33 M/2- (5d)

Contact for signalling undervoltage release de-energized - (5e)

Current sensor for neutral conductor outside circuit-breaker UI/N - (6a)



Homopolar toroid for the main power supply earthing conductor (star centre of the transformer) UI/O - (6b)

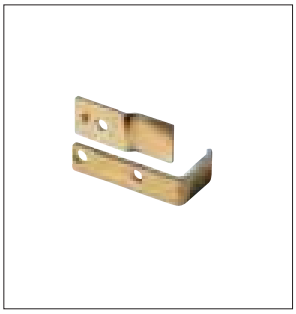


Toroid for residual current protection (1) - (6c)

Mechanical operation counter - (7)

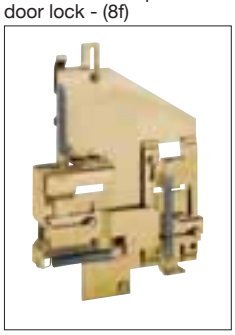
Circuit-breaker lock in racked-in/test isolated/racked-out position - (8c)

Accessory for lock in test isolated/ racked-out position - (8d)

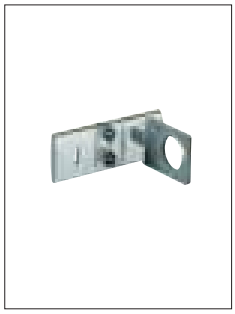


Accessory for shutter padlock device - (8e)

Mechanical compartment door lock - (8f)



Protective cover for opening and closing pushbuttons - (9a)



IP54 door protection - (9b)

Mechanical interlock - (10)

Interlock between circuit-breakers

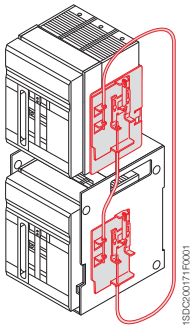
10) Mechanical interlock

This mechanism creates a mechanical interlock between two or three circuit-breakers (even different models and different versions, fixed/withdrawable) using a flexible cable. The circuit diagram for electrical switching using a relay (to be installed by the customer) is supplied with the mechanical interlock.
The circuit-breakers can be installed vertically or horizontally.
An interlock between an Emax (E1÷E6) and a T7/X1 is possible with dedicated cables.

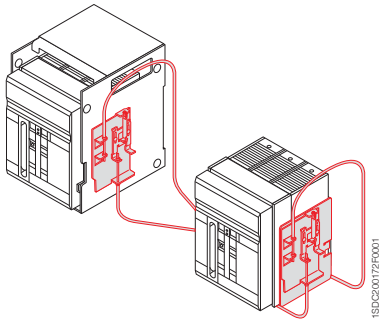
Four types of mechanical interlocks are available:

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

Note:
See the "Overall dimensions" and "Electrical circuit diagrams" chapters for information about dimensions (fixed and withdrawable versions) and settings.



Vertical interlock

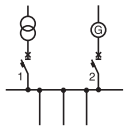
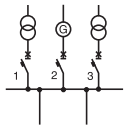
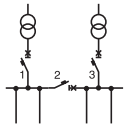
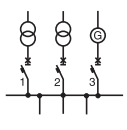


Horizontal interlock

L interlock

It is possible to make the mechanism interlock among three circuit-breakers disposed in "L position".

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

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

1	2
O	O
I	O
O	I

1	2	3
O	O	O
I	O	O
O	O	I
I	O	I
O	I	O

1	2	3
O	O	O
I	O	O
O	I	O
O	O	I
O	I	I
I	I	O
I	O	I

1	2	3
O	O	O
I	O	O
O	I	O
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 opening release
– the shunt closing release
– 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 or three circuit-breakers are made by using cables which can be used both for circuit-breakers side by side or superimposed.

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