Annex to the technical catalogue

Emax DC

Low voltage Switch-disconnectors and Automatic circuit-breakers for Direct Current Applications

1SDC200012D0201

Index

SACE Emax DC automatic circuit-breakers

The SACE Emax range of low voltage automatic circuit-breakers is being enriched by the new serie SACE Emax DC of automatic circuit-breakers for direct current applications in compliance with the international standard IEC60947-2.
Thanks to the exclusive technology of the new electronic SACE PR123/DC e PR122/DC the SACE Emax DC range allows to cover all installation and automatic protection needs up to 1000V / 5000A DC.
By connecting three breaking poles in series it is possible to achieve a rated insulation voltage of 750V DC, while with four poles in series the limit rises 1000V DC.
The automatic circuit-breakers of SACE Emax DC range maintain the overall dimensions and fixing points of the standard range circuit-breakers; they can be fitted with the various terminal kit san all accessories common to the SACE Emax range.
The withdrawable circuit-breakers should be used together with the special version fixed parts for applications at 750/1000 DC.

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

			E2		E3		E4		E6
Performance levels			**B**	**N**	**N**	**H**	**S**	**H**	**H**
Rated uninterrupted current (at 40 °C) Iu		[A]	**800**		**800**				
		[A]	**1000**		**1000**				
		[A]	**1250**		**1250**				
		[A]	**1600**	**1600**	**1600**	**1600**	**1600**		
		[A]			**2000**	**2000**	**2000**		
		[A]			**2500**	**2500**	**2500**		
		[A]					**3200**	**3200**	**3200**
		[A]							**4000**
		[A]							**5000**
Rated ultimate breaking capacity under short-circuit Icu									
500 V DC		[kA]	35	50	60	85	75	100	100
750 V DC		[kA]	25	35	50	65	65	85	85
1000 V DC		[kA]	25	35	35	65	50	65	65
Rated service breaking capacity under short-circuit Ics	**[%Icu]**	[kA]	100%	100%	100%	100%	100%	100%	100%
Rated short-time withstand current Icw (0.5s)									
500 V DC		[kA]	35	50	35	65	75	100	100
750 V DC		[kA]	25	35	35	65	65	85	85
1000 V DC		[kA]	25	35	35	65	50	65	65
Rated making capacity under short-circuit Icm	**[%Icu]**	[kA]	100%	100%	100%	100%	100%	100%	100%
Utilization category (according to CEI EN 60947-2)			B	B	B	B	B	B	B
Isolation behaviour (according to CEI EN 60947-2)			■	■	■	■	■	■	■
Overcurrent protection									
Electronic trip units for DC applications			■	■	■	■	■	■	■
Operating times									
Closing time (max)		[ms]	80	80	80	80	80	80	80
Breaking time for I<Icw (max) (1)		[ms]	70	70	70	70	70	70	70
Breaking time for I>Icw (max)		[ms]	30	30	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	404/530	566/656	566/656	782/908
Withdrawable: H = 461 mm - D = 396.5 mm - W (3/4 poles)		[mm]	324/414	324/414	432/558	432/558	594/684	594/684	810/936
Weights									
Fixed 3/4 poles		[kg]	50/61	50/61	66/80	66/80	97/117	97/117	140/160
Withdrawable 3/4 poles (including fixed part)		[kg]	50/61	50/61	66/80	66/80	147/165	147/165	210/240

(1) Without intentional delays.

SACE Emax Switch-disconnectors for applications up to 1000V DC

ABB SACE has developed the SACE Emax/E MS range of switch-disconnectors for applications in direct current up to 1000V in compliance with the international IEC 60947-3 Standard. These non-automatic circuit-breakers are specially suitable for use as bus ties or main isolators in direct current systems, such as in applications involving electric traction.
The range covers all installation needs up to 1000V DC /6300A.
They are available in fixed and withdrawable, three-pole and four-pole versions.
By connecting three breaking poles in series, it is possible to achieve a rated insulation voltage of 750V DC, while with four poles in series the limit rises to 1000V DC.
The switch-disconnectors of the SACE Emax/E MS range maintain the overall dimensions and fixing points of the standard range circuit-breakers. They can be fitted with the various terminal kits and all the accessories common to the SACE Emax range.They cannot,of course, be associated with the electronic releases, CSs and accessories for determining currents and for AC applications.
The withdrawable circuit-breakers should be used together with the special version fixed parts for applications at 750/1000V DC.

		E1B/E MS		E2N/E MS		E3H/E MS		E4H/E MS*		E6H/E MS*	
Rated current (at 40 °C) Iu	[A]	**800**		**1250**		**1250**		**3200**		**5000**	
	[A]	**1250**		**1600**		**1600**		**4000**		**6300**	
	[A]			**2000**		**2000**					
	[A]					**2500**					
	[A]					**3200**					
Poles		3	4	3	4	3	4	3	4	3	4
Rated service voltage **Ue**	[V]	750	750	750	750	750	750	750	750	750	750
Rated insulation voltage **Ui**	[V]	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Rated impulse withstand voltage **Uimp**	[kV]	12	12	12	12	12	12	12	12	12	12
Rated short-time withstand current Icw **(1s)**	[kA]	20	20*	25	25*	40	40*	65	65	65	65
Rated making capacity **Icm**											
750 V DC	[kA]	42	42	52.5	52.5	105	105	143	143	143	143
1000 V DC	[kA]		42		52.5		105		143		143

Note: the breaking capacity Icu, by means of external protection relay, with 500 ms maximum timing, is equal to the value of Icw (1s).

* The performances at 750 V are:
for E1B/E MS Icw=25kA
for E2N/E MS Icw=40kA
for E3H/E MS Icw=50kA

SACE Emax DC: Direct Current Applications

The main application of direct current are:

1. Emergency supply or auxiliary services: the use of direct current is due to the need to employ a back-up energy source which allows the supply of essential services such as protection services, emergency lighting, alarm systems, hospital and industrial services, data-processing centres etc., using accumulator batteries

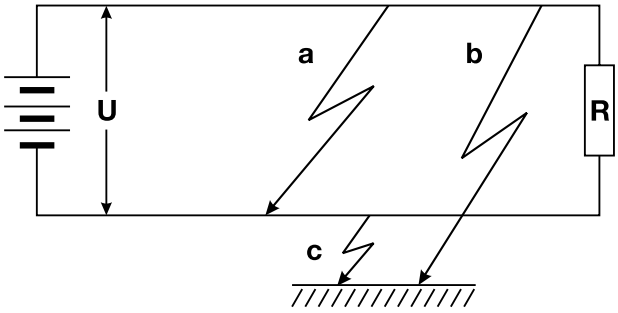
2. Electrical traction: the advantages offered by the use of dc motors in terms of regulation and of single supply lines lead to the widespread use of direct current for railways, underground railways, trams, lifts and public transport in general

3. Particular industrial installations: there are some electrolytic process plants and applications which have a particular need for the use of electrical machinery

4. Navy, Alternative Energy Convertion, …

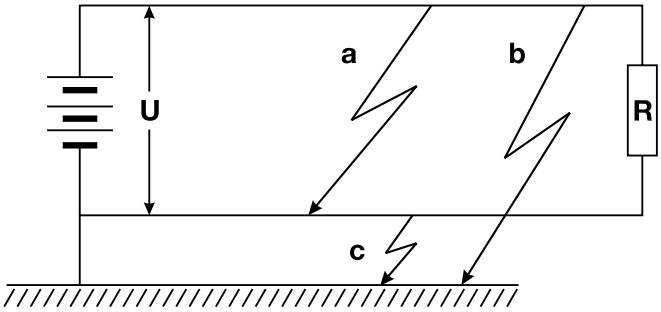
Here below the typical distribution systems used in direct current are descripted*:

Both Polarities Insulated from Earth



- **Fault a:** the fault, without negligible impedance, between the two polarities sets up a short-circuit current to which both polarities contribute to the full voltage, according to which the breaking capacity of the breaker must be selected
- **Fault b, c:** the fault between the polarity and earth has no consequences from installation functioning point of view

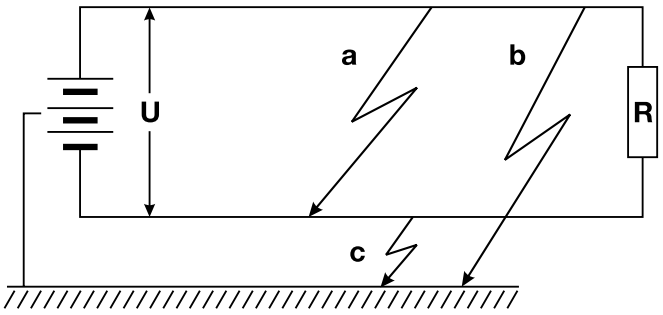
One polarity connected to earth



- **Fault a:** the fault between the two polarities sets up a short-circuit current to which both polarities contribute to the full voltage U, according to which the breaking capacity of the breaker is selected.
- **Fault b:** the fault on the polarity not connected to earth sets up a current which involves the over-current protection according to the resistance of the ground.
- **Fault c:** the fault between the polarity connected to earth and earth has no consequences from the point of view of the function of the installation.

All the poles of the breaker necessary for protection must be connected in series on the non-earthed polarity

Median Point connected to Earth



- **Fault a:** the fault between the two polarities sets up a short-circuit current to which both polarities contribute to the full voltage U, according to which the breaking capacity of the breaker is selected.
- **Fault b:** the fault between the polarity and earth sets up a short-circuit current less than that of a fault between the two polarities, as it is supplied by a voltage equal to 0.5 U.
- **Fault c:** the fault in this case is analogous to the previous case, but concerns the negative polarity.

The breaker must be inserted on both polarities.

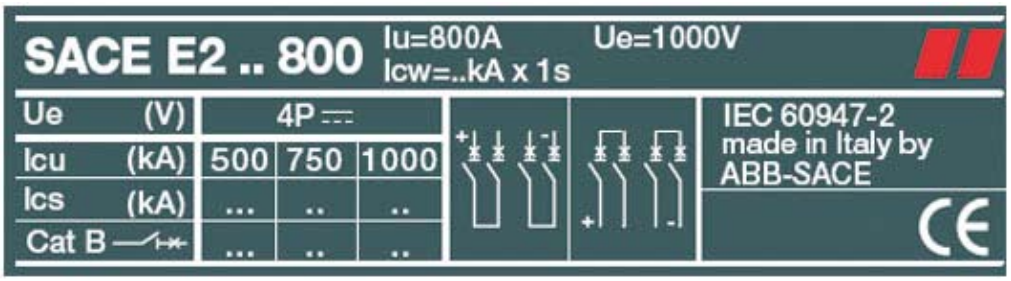
SACE Emax DC: Direct Current Applications

Circuit Breaker Selection

To correctly select the devices for the protection of a direct current network the following factors must be considered:

- The type of network - earthing connection
- Rated Current
- Voltage Current
- The prospective short-circuit current at the point of installation

Here below the rating plate of an Emax DC air circuit breaker for direct current application



Characteristics

The PR122/DC is the new electronic protection release for the SACE Emax DC serie suitable for direct current installation wherein the basic protections are enough.

The PR122/DC offers the following protection functions:

- overload (L)
- selective short-circuit (S)
- thermal memory for S and L (cable protection)
- instantaneous short-circuit (I)
- overtemperature protection (OT)
- zone selectivity for S
- load Control (K)

Protection functions and setting values - PR122/DC

Function		Trip threshold	Threshold steps	Trip Time	Time Step	Poss. excl.	Relation t=f(I)	Thermal memory	Zone selectivity
L	Overload protection	I1= 0.4….1 x In	0.01 x In	With current I = 3 x I1 t1= 3 s....102 s	3 s (1)	–	IEC60255-8	■	–
	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= 0.6….10 x In	0.1 x In	With current I > I2 t2= 0.05 s….0.8 s t2sel= 0,04 s…..0,2 s	0.01 s 0,01 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= 0.6….10 x In	0.1 x In	With current I = 10 x In t2= 0.05 s….0.8 s	0.01 s	■	t=k/I²	■	–
	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….10 x In	0.1 x In	Instantaneous	–	■	t=k	–	–
	Tolerance (2)	± 10%		≤ 30 ms					
OT	Protection against overtemperature	may not be set	–	Instantaneous	–	–	temp=k	–	–

(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)
- trip time set ≥ 100 ms

(3) Non intervention time

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

	Trip threshold	Trip time
L	Release between 1.05 and 1.25 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
Others		± 20%

Power Supply

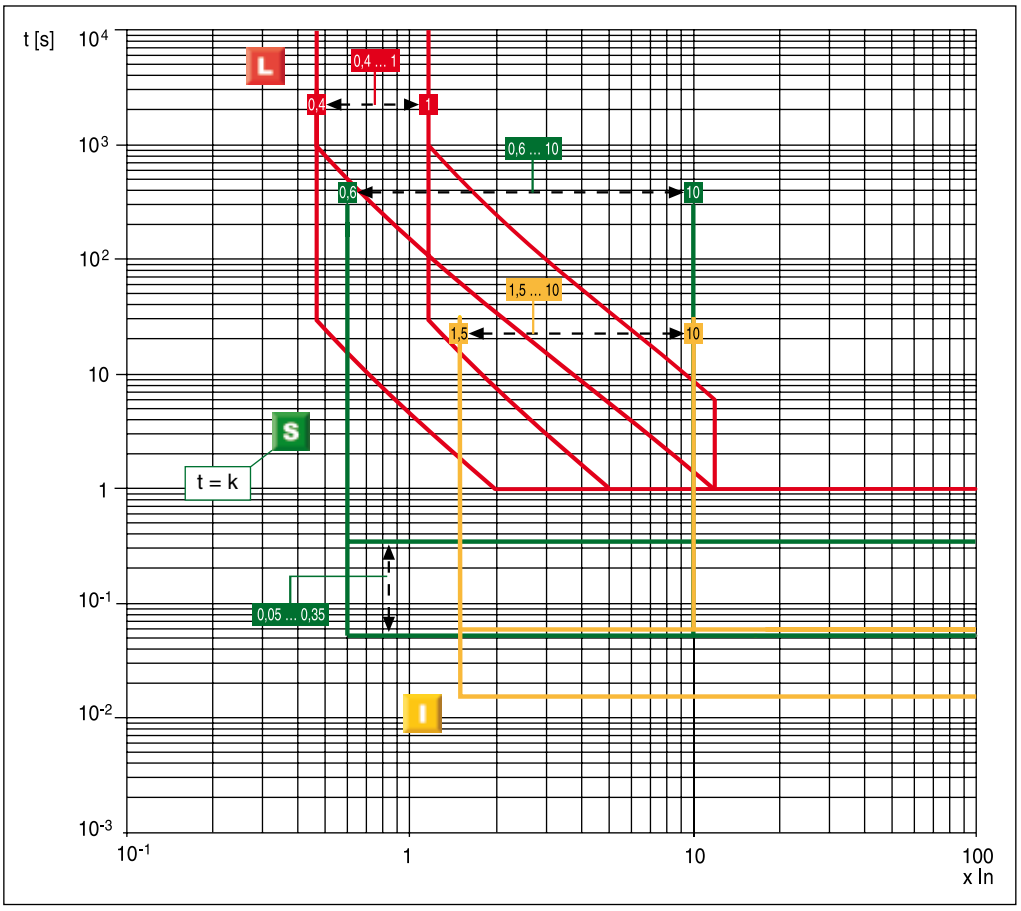
The PR122/DC release requires an auxiliary power supply; the power supply could be derived from the Measurement Module PR120/V always supplied as standard in PR122/DC (only for power supply, no voltage and power based protection/measurements available on PR122/DC.

	PR122/DC	PR120/D-M	PR120/K
Auxiliary power supply (galvanically insulated)	24 V DC ± 20%	from PR122/DC	from PR122/DC
Maximum ripple	5%		
Inrush current @ 24V	~10 A for 5 ms		
Rated power @ 24V	~3 W	+1 W	+1 W

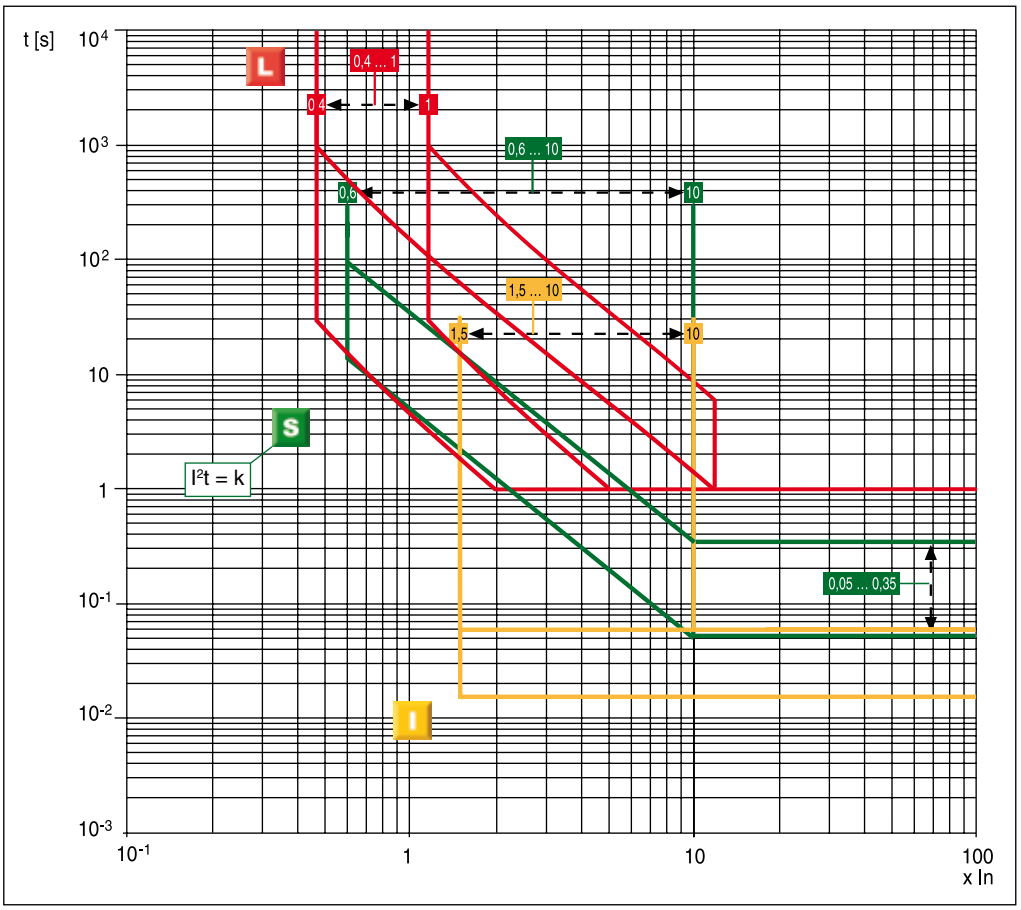
On request it is possible to supply the PR122/DC with a special version of Measurements Module suitable for very low DC rated voltage 24/48V DC, called PR120/LV, typically railway and mine installations.

Power supply from Measurement Module	Minimum Voltage Threshold Enabling Unit PR122/DC
PR120/V	60 V
PR120/LV (24-48 V DC)	18 V

Functions L-S-I



Functions L-S-I



Protection Releases and Trip Curves
PR123/DC

Characteristics
The PR123/DC is the new electronic protection release for the SACE Emax DC serie; 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 direct current installation.

The PR123/DC offers the following protection functions:
- overload (L)
- selective short-circuit (S)
- thermal memory for L and S (cable protection)
- instantaneous short-circuit (I)
- earth fault with adjustable delay (G)
- poles unbalance (U)
- overtemperature protection (OT)
- load control (K)
- undervoltage (UV)
- overvoltage (OV)
- reverse power (RP)
- dual setting
- zone selectivity for S, G
- start-up thresholds for protection S and I

Protection functions and setting values - PR123

	Function	Trip threshold	Threshold steps	Trip Time	Time Step	Can be excluded	Relation t=f(I)	Thermal memory	Zone selectivity
L	Overload protection	I1= 0.4….1 x In	0.01 x In	With current I = 3xI1 t1= 3 s....102 s	3 s (1)	–	IEC60255-8	■	–
	Tolerance (2)	Release between 1.05 and 1.2 x I1		± 10% If ≤ 6 x In ± 20% If > 6 x In					
	Tolerance	I1= 0.4….1 x In Release between 1.05 ... 1.2 x I1	0.01 x In	With current I = 3xI1(4); t1= 3 s....144 s ± 20% If > 5 x I1 ± 30% 2xI1≤ If ≤ 5 x I1	3 s	–	t=k(α) (5) α = 0.2-1-2		
S	Selective short-circuit protection	I2= 0.6….10 x In	0.1 x In	With current I > I2 t2= 0.05 s….0.8 s t2sel= 0.04 s…..0.2 s	0.01 s 0,01 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					
	Tolerance (2)	I2= 0.6….10 x In ± 7% If ≤ 6 x In ± 10% If > 6 x In	0.1 x In	With current I = 10xIn; t2= 0.05 s…0.8 s ± 15% If ≤ 6 x In ± 20% If > 6 x In	0.01 s	■	t=k/I²	■	–
S₂	Selective short-circuit protection	I2= 0.6….10 x In	0.1 x In	t2= 0.05 s….0.8 s	With current I > I2 0.01 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					
I	Instantaneous short-circuit protection	I3= 1.5….10 x In	0.1 x In	Instantaneous	–	■	t=k	–	–
	Tolerance (2)	± 10%		≤ 30 ms					
G	Earth fault protection	I4(6)= 0.2….1 x In	0.02 x In	With current I > I4 t4= 0.1 s…..1 s t4sel= 0.04 s…..0.2 s	0.05 s 0,01 s	■	t=k	–	■
	Tolerance (2)	± 7%		The better of the two figures: ± 10% or ± 40 ms					
	Tolerance (2)	I4= 0.2….1 x In ± 7%	0.02 x In	t4= 0.1 s…..1 s (with I=4xI4) ± 15%	0.05 s	■	t=k/I²	–	–
U	Phase unbalance protection	I6= 5%….90%	5%	t6= 0.5 s…..60 s The better of the two figures:	0.5 s	■	t=k	–	–
	Tolerance (2)	± 10%		± 20% or ± 100 ms					
OT	Protection against overtemperature	cannot be set	–	Instantaneous	–	–	temp=k	–	–
UV	Undervoltage protection	I8= 0.5….0.95 x Un	0.01 x In	With current U < U8; t8= 0,1 s….5 s The better of the two figures:	0.1 s	■	t=k	–	–
	Tolerance (2)	± 5%		± 20% or ± 40 ms					
OV	Overvoltage protection	I9= 1.05….1.2 x Un	0.01 x In	With current U > U9; t9= 0,1 s….5 s The better of the two figures:	0.1 s	■	t=k	–	–
	Tolerance (2)	± 5%		± 20% or ± 40 ms					
RP	Reverse power protection	P11= -0.3….-0.1 x Pn	0.02 Pn	With current P < P11 t11= 0.5 s…..25 s The better of the two figures:	0.1 s	■	t=k	–	–
	Tolerance (2)	± 10%		± 10% or ± 100 ms					

(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)
- trip time set ≥ 100 ms
(3) Non intervention time

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

	Trip threshold	Trip time
L	Release between 1.05 and 1.25 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 15%	± 20%
Others		± 20%

Power Supply

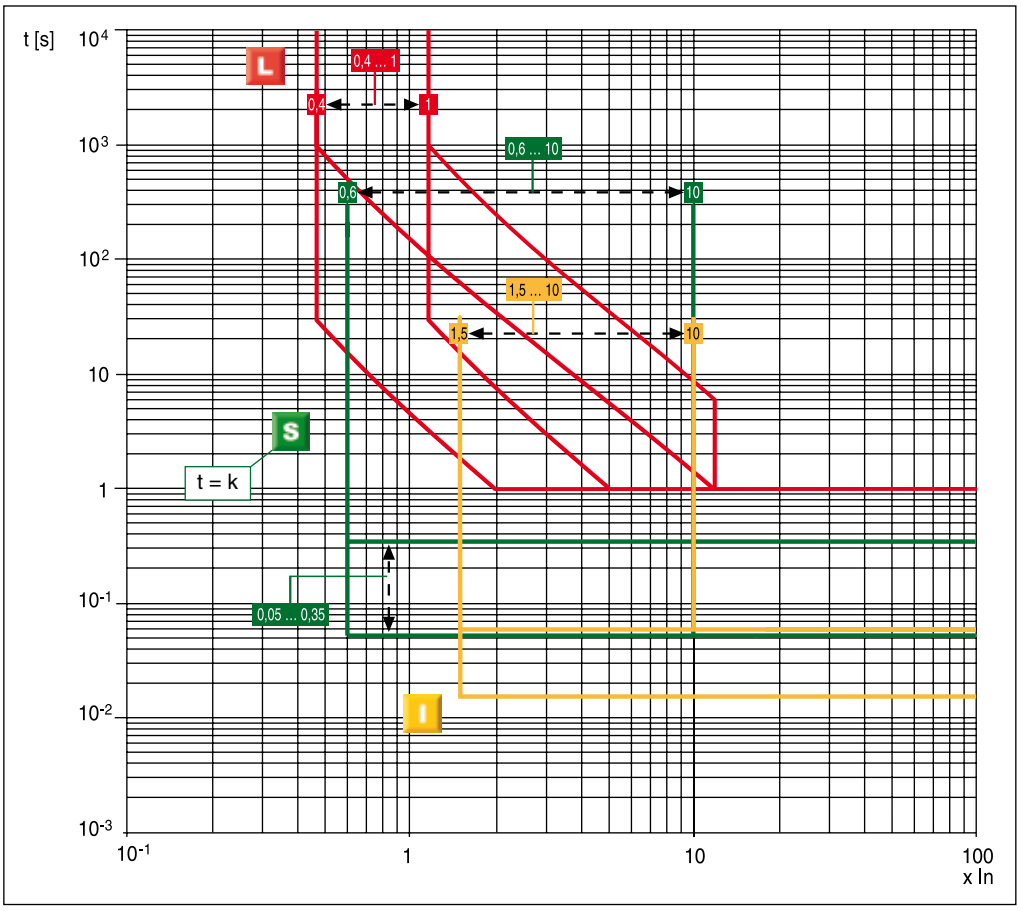
The PR123/DC release requires an auxiliary power supply; the power supply could be derived from the Measurement Module PR120/V always supplied as standard in PR123/DC.

	PR123/DC	PR120/D-M	PR120/K
Auxiliary power supply (galvanically insulated)	24 V DC ± 20%	from PR123/DC	from PR123/DC
Maximum ripple	5%		
Inrush current @ 24V	~10 A for 5 ms		
Rated power @ 24V	~3 W	+1 W	+1 W

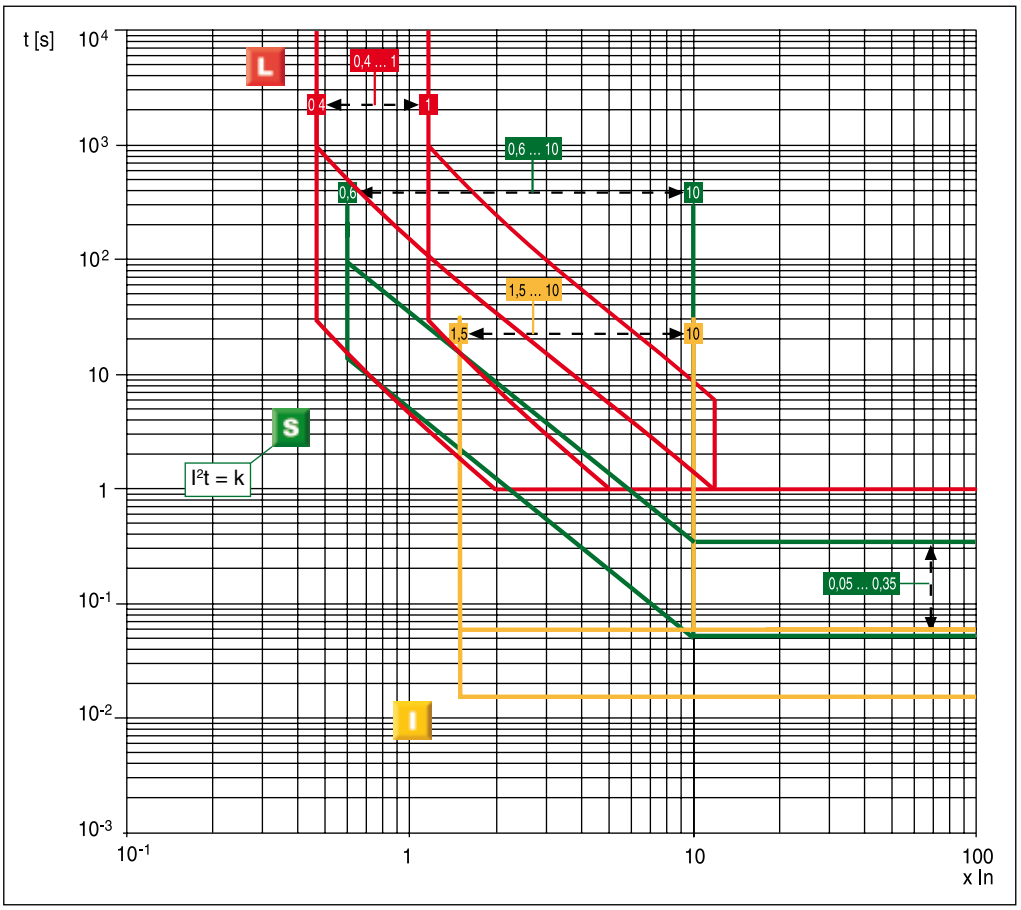
On request it is possible to supply the PR123/DC with a special version of Measurements Module suitable for very low DC rated voltage 24/48V DC, called PR120/LV, typically railway and mine installations.

Power supply from Measurement Module	Minimum Voltage Threshold Enabling Unit PR123/DC
PR120/V	60 V
PR120/LV (24-48 V DC)	18 V

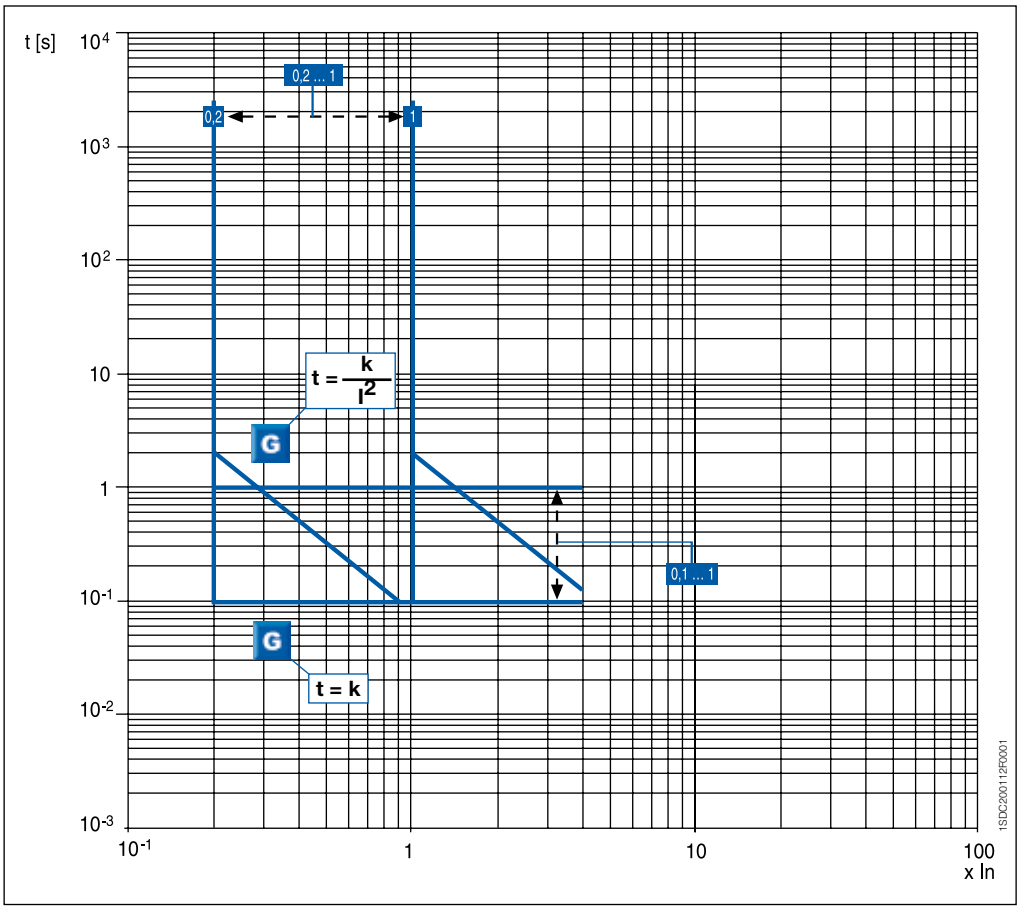
Functions L-S-I



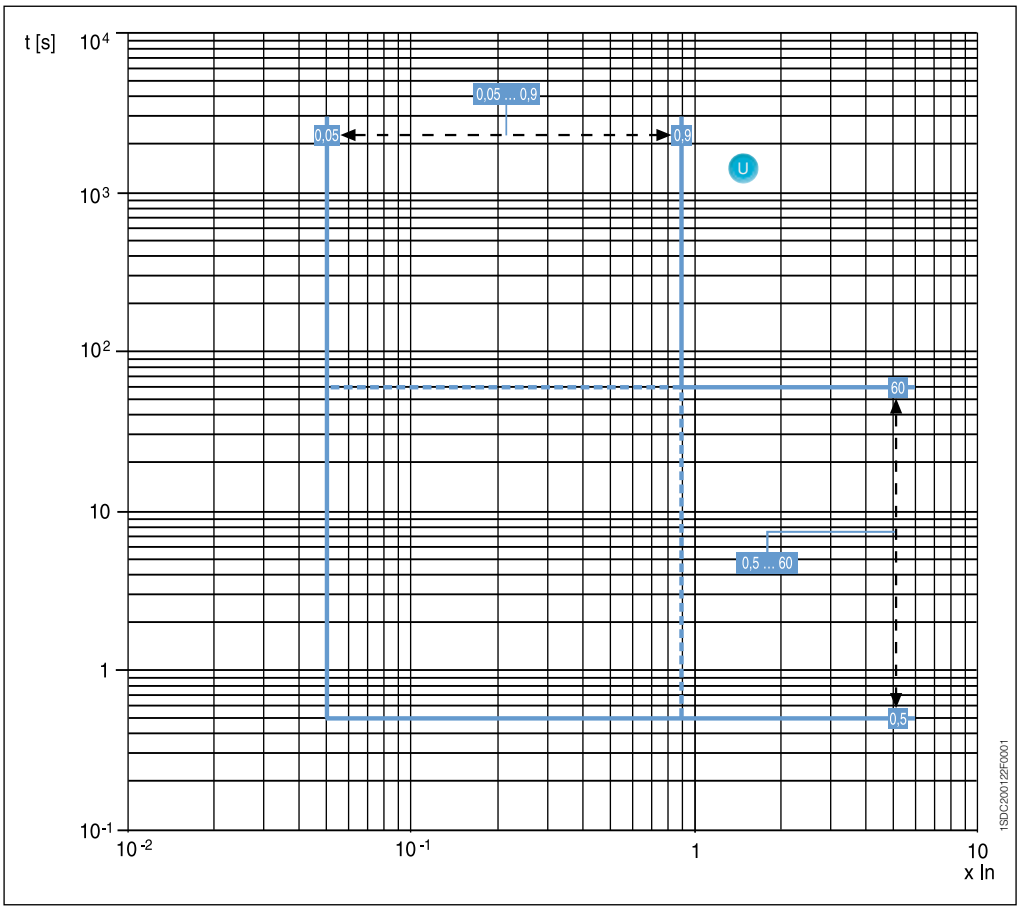
Functions L-S-I



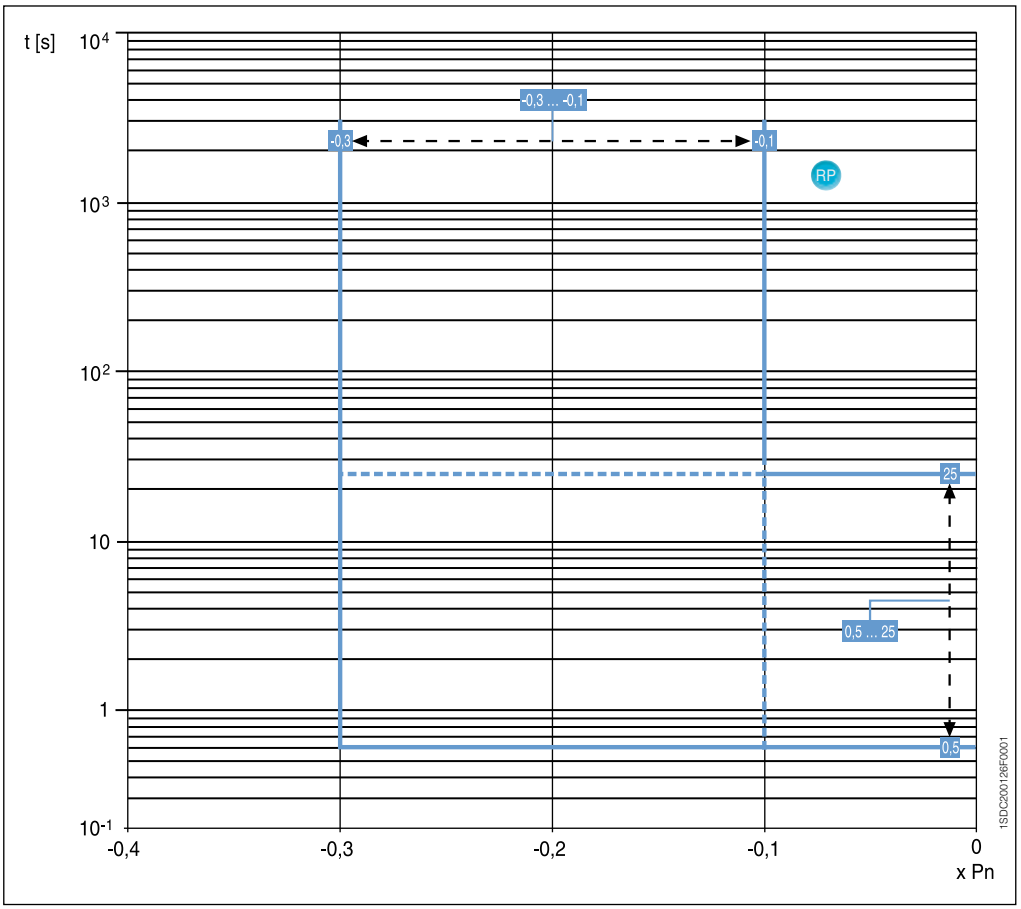
Function G



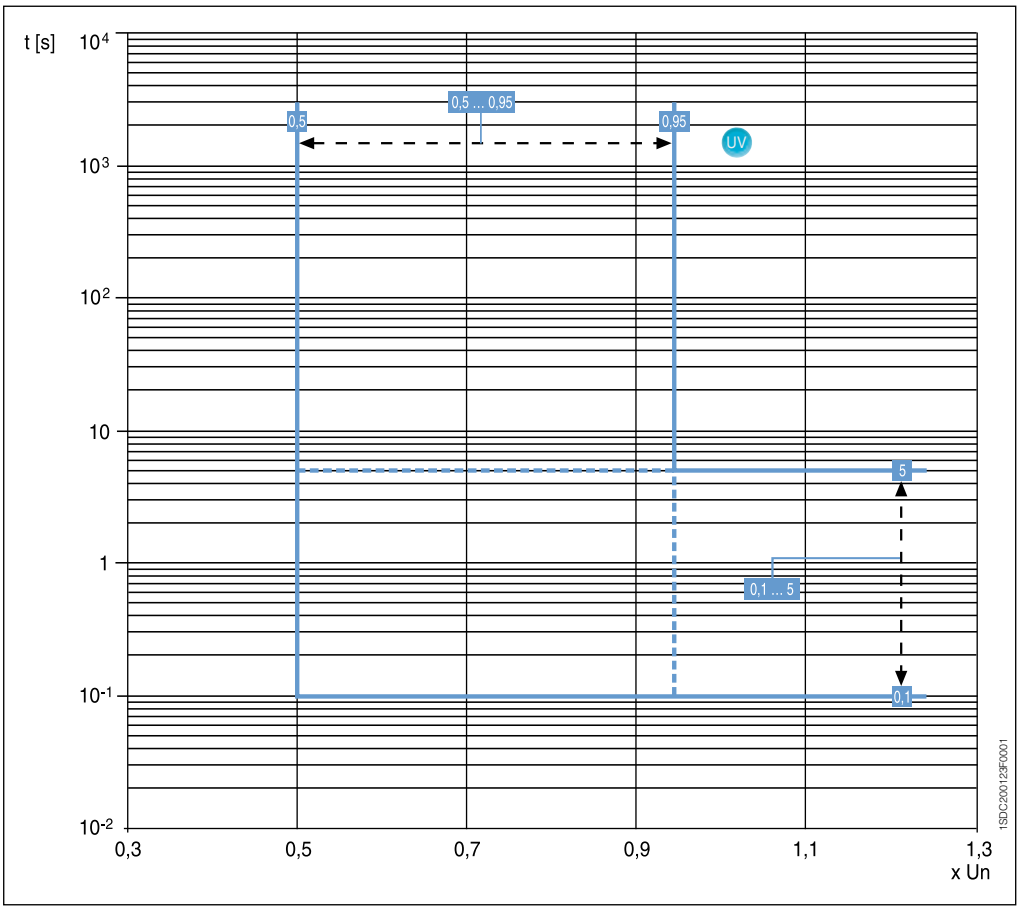
Function U



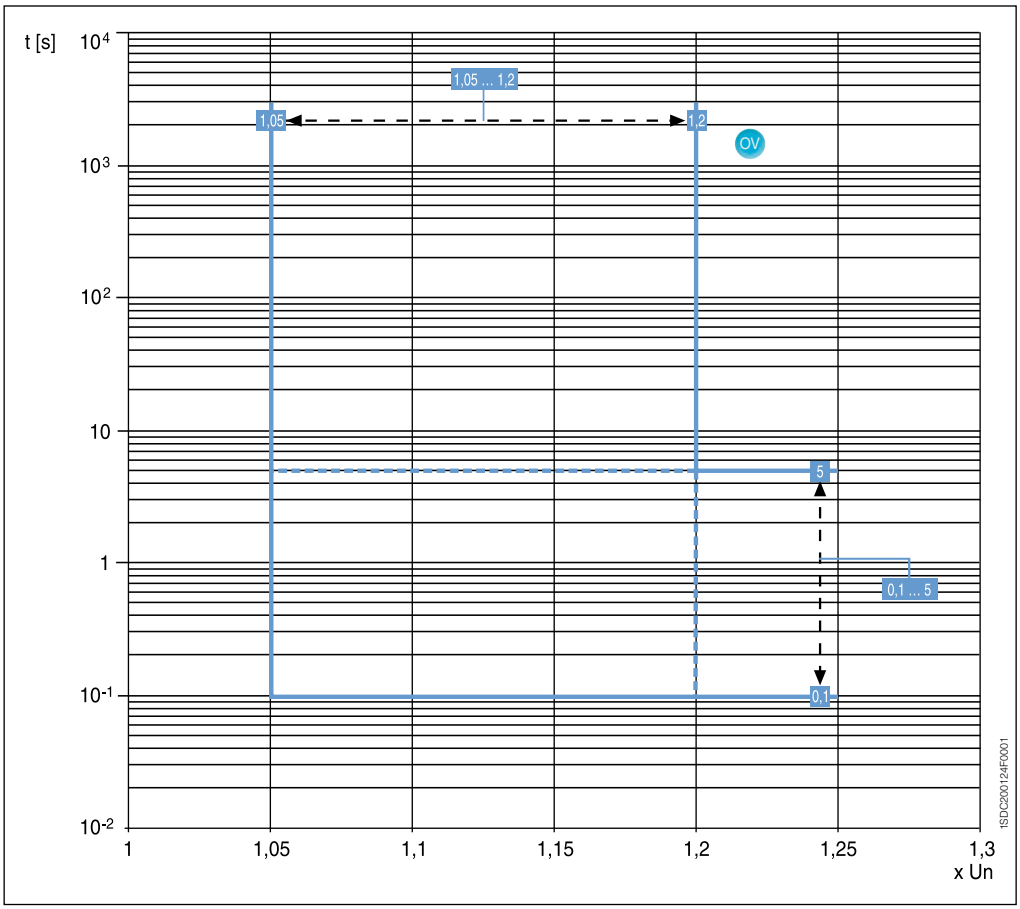
Function RP



Function UV



Function OV


t [s]
10^4
10^3
10^2
10
1
10^-1
10^-2
1,05 ... 1,2
1,05
1,2
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0,1 ... 5
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1,25
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1SDC200124F0001

Protection Releases and Trip Curves

Override Protection

The automatic circuit-breakers of SACE Emax DC range are supplied of an internal back-up protection called **Override Protection** made by the Module PR120/DC always supplied with the PR122/DC and PR123/DC electronic releases.
The Override Protection ensures the protection of the electrical plant against instantaneous short-circuit in case of any loss of power supply of the protection unit PR122/DC and PR123/DC.

The Override protection threshold depends on the circuit breaker size; neither connections nor settings are in user'care.

Optional Modules for Electronic Releases

The electronic releases PR122/DC e PR123/DC can be equipped with the same internal optional modules already available on the electronic devices PR122/P e PR123/P for alternative current application.

Code	Internal	Description	PR123/DC
1SDA058255R1	PR120/K	Internal signalling module (4 output with independent terminals)	■
1SDA058256R1	PR120/K	Internal signalling module (4 output + 1 input with a common terminal)	■
1SDA058254R1	PR120/D-M	Modbus RTU communication module	■
1SDA058252R1(1)	PR120/LV	Measurements module	■
1SDA065223R1(2)	PR120/LV	Measurements module - low voltage	■
(3)	PR120/DC	Override protection module	■

(1) PR120/V Measurements Module always supplied with the releases PR123/DC and PR122/DC
(2) Extracode to be specified with the circuit-breaker code to have the low voltage measuring module PR120/LV
(3) Not to be specified, always supplied with the electronic trip unit

Code	External	Description	PR123/DC
1SDA058258R1	PR030/B	Power supply unit	■
1SDA058259R1	BT030	External communication wireless unit	■
1SDA063143R1	HMI030	Interface from front of panel	■
1SDA048964R1	PR010/T	External test unit	■
1SDA059146R1	PR021/K	External signalling unit	■
1SDA052927R1	ATS010	Automatic transfer switch	■
1SDA060198R1	EP010	ABB Fieldbus plug	■

PR122/DC

The following measurements are available

- Current
- Instantaneous current value over a given time interval
- Maintenance: number of operations, percentage of contact wear, opening data storage (latest 20 trips and 80 events).
- The protection records the historical data of the maximum current read.

PR123/DC

- Current
- Maintenance: number of operations, percentage of contact wear, opening data storage (latest 20 trips and 80 events).
- Voltage
- Instantaneous current/voltage value over a given time interval (data logger).
- Power
- Energy
- The protection records the historical data of the maximum current read, the maximum and minimum voltage, the total maximum and mean value of power.

Measurement Functions

The measurements available on electronic releases PR122/DC and PR123/DC fitted by the Modbus Communication module PR120/D-M and the protocol converter for Profibus and Devicenet FieldBus EP010-FBP are listened on the following table.

	PR122/DC + PR120/D-M	PR123/DC + PR120/D-M	PR122/DC-PR123/DC + PR120/D-M and EP010
Communication functions			
Protocol	Modbus RTU	Modbus RTU	FBP
Physical layer	RS-485	RS-485	Profibus-DP or DeviceNet cable
Maximum baudrate	19200 bps	19200 bps	115 kbps
Measuring functions			
Currents	■	■	■
Ground current	■	■	■
Voltage		■	on demand (1)
Power		■	on demand (1)
Energy		■	on demand (1)
Signalling from functions			
LED: auxiliary power supply, warning, alarm	■	■	■
Temperature	■	■	■
Indication for L, S, I, G and other protection	■	■	■
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		■	■
Fault release mechanism failure	■	■	■
Undervoltage, overvoltage (timing and trip) protection		■	on demand (1)
Reverse power protection (timing and trip)		■	on demand (1)
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 openi/close	■	■	■
Reset alarms	■	■	■
Setting of curves and protection thresholds	■	■	■
Synchronize system time	■	■	■
Events			
Status changes in circuit-breaker, protections and all alarms	■	■	■

(1) please ask ABB for further details

Accessories

The SACE Emax DC family can be fitted by the same electrical and mechanical accessories already available on the standard alternative current family.

The ranges	Automatic circuit-breakers		Switch-disconnectors		Isolating truck (CS)	Earthing switch with making capacity (MPT)	Earthing truck (MT)
	Circuit-breakers with full-size neutral		Switch-disconnectors for applications up to 1150V AC				
	Circuit-breakers for applications up to 1150V AC		Switch-disconnectors for applications up to 1000V DC				
Circuit-breaker version	**Fixed**	**Withdrawable**	**Fixed**	**Withdrawable**	**Withdrawable**	**Withdrawable**	**Withdrawable**
1a) Shunt opening/closing release (YO/YC) and second opening release (YO2)	■	■	■	■		■ (YC)	
1b) SOR test unit	■	■	■	■			
2a) Undervoltage release (YU)	■	■	■	■			
2b) Time-delay device for undervoltage release (D)	■	■	■	■			
3) Geared motor for the automatic charging of the closing springs (M)	■	■	■	■		■	
4a) Electrical signalling of electronic releases tripped	■	■					
4b) Electrical signalling of electronic releases tripped with remote reset command		■	■				
5a) Electrical signalling of circuit-breaker open/closed (1)	■	■	■	■		■	
5b) External supplementary electrical signalling of circuit-breaker open/closed	■	■	■	■		■	
5c) Electrical signalling of circuit-breaker racked-in/ test isolated/racked-out		■		■	■	■	■
5d) Contact signalling closing springs charged	■	■	■	■		■	
5e) Contact signalling undervoltage release de-energized (C. Aux YU)	■	■	■	■			
6a) Current transformer for neutral conductor outside circuit-breaker	■	■					
6b) Homopolar toroid for the main power supply earthing conductor (star center of the transformer)	■	■					
6c) Homopolar toroid for residual current protection	■	■					
7) Mechanical operation counter	■	■	■	■		■	
8a) Lock in open position: key	■	■	■	■		■	
8b) Lock in open position: padlocks	■	■	■	■		■	
8c) Circuit-breaker lock in racked-in/racked-out/ test isolated position		■		■	■	■	■
8d) Accessories for lock in racked-out/test isolated position		■		■	■	■	■
8e) Accessory for shutter padlock device		■		■	■	■	■
8f) Mechanical lock for compartment door	■	■	■	■		■	
9a) Protection for opening and closing pushbuttons	■	■	■	■		■	
9b) IP54 door protection	■	■	■	■		■	
10) Interlock between circuit-breakers (2)	■	■	■	■			
11) Automatic transfer switch - ATS010 (3)	■	■	■	■			

CAPTION

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

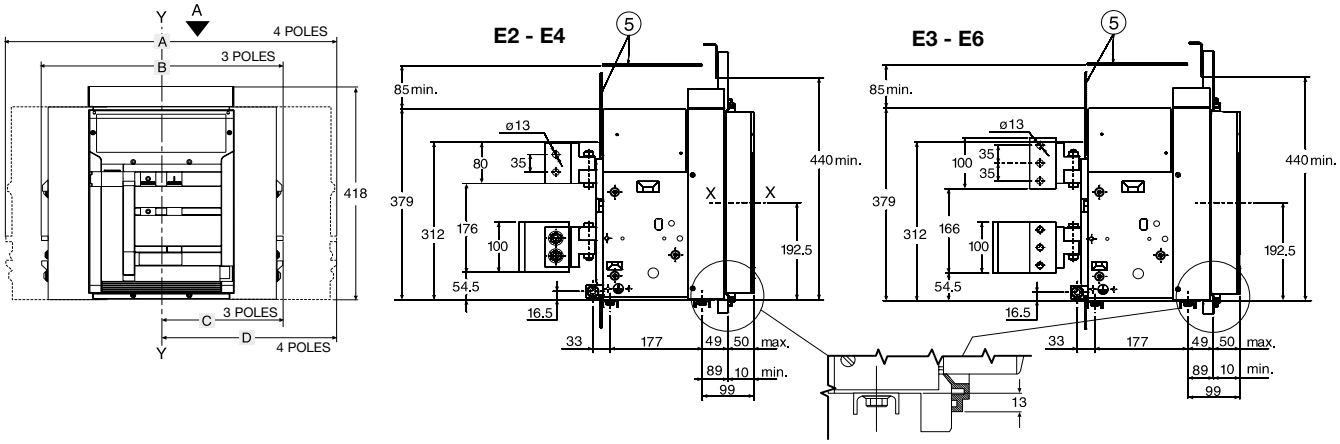
(1) For automatic circuit-breakers, four auxiliary contacts to electrically signal circuit-breaker open/closed are included in the supply as standard.
(2) Incompatible with the E6/f versions with full-size neutral
(3) Incompatible with the range of circuit-breakers for applications up to 1150V AC

For Emax DC circuit-breakers accessories, please refer to the same accessories codes of standard Emax AC circuit-breakers.

Overall dimensions

Fixed circuit-breaker

Basic version
with rear terminals



Caption

① Inside edge of compartment door

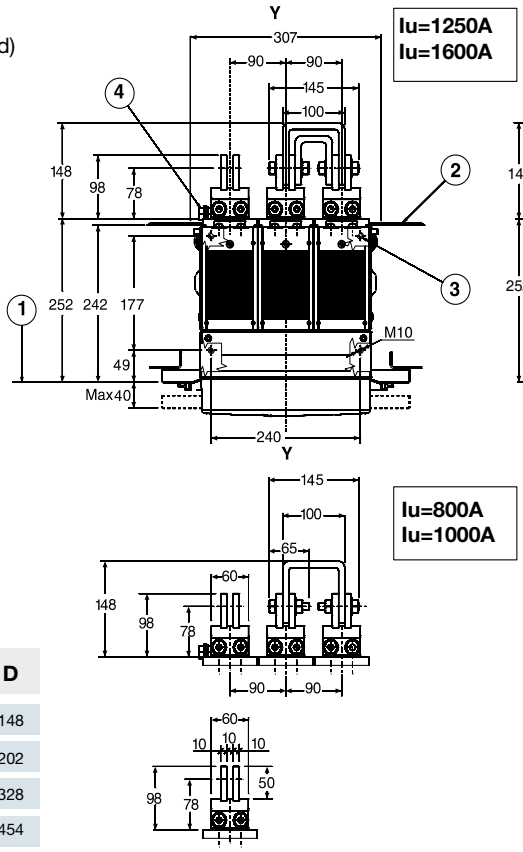
② Segregation (when provided)

③ M10 mounting holes for circuit-breakers (use M10 screws)

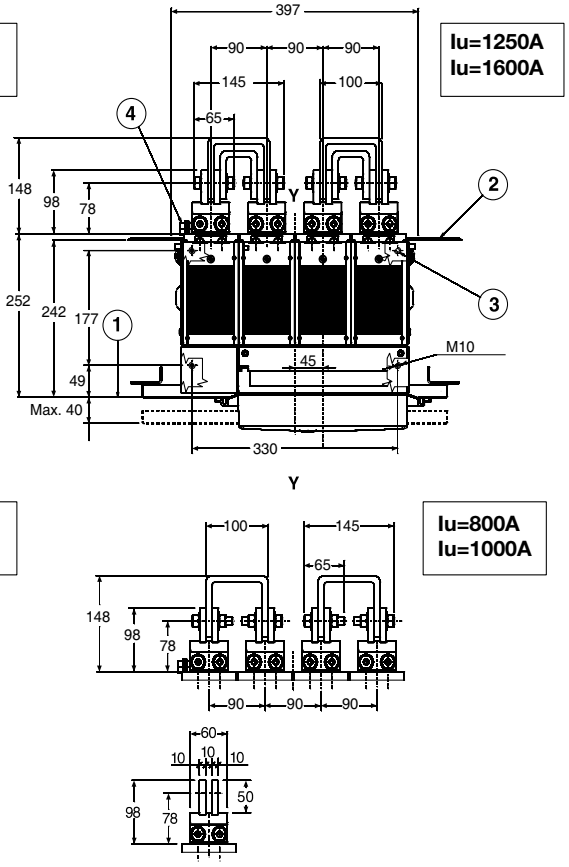
④ 1xM12 screw (E1, E2, E3) or 2xM12 screws (E4, E6) for earthing (included in the supply)

⑤ Insulating wall or insulated metal wall

E2 III
View A

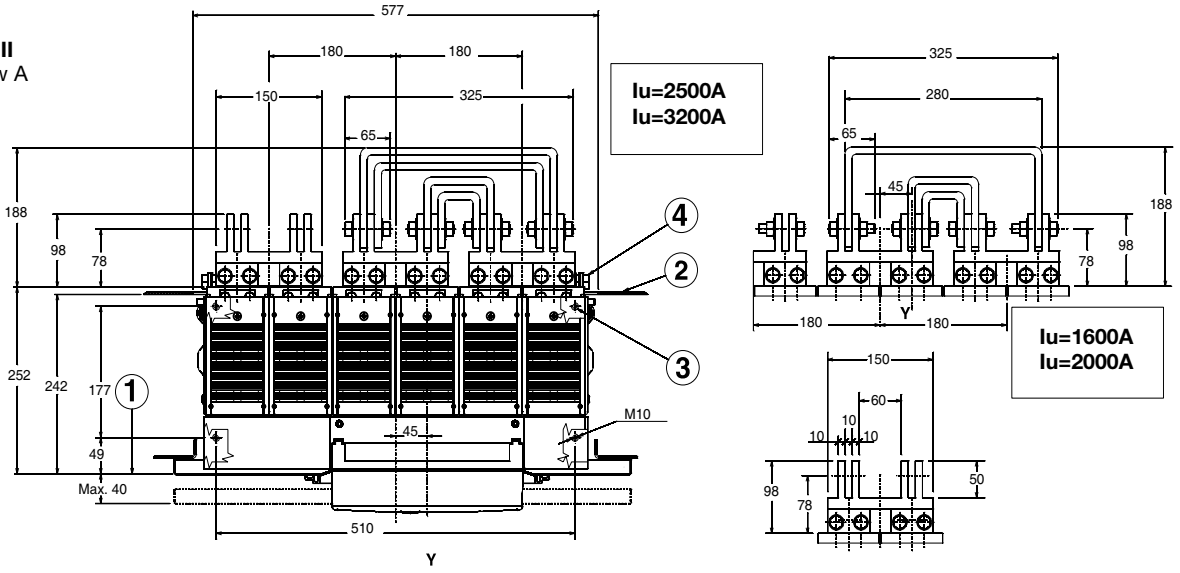


E2 IV
View A

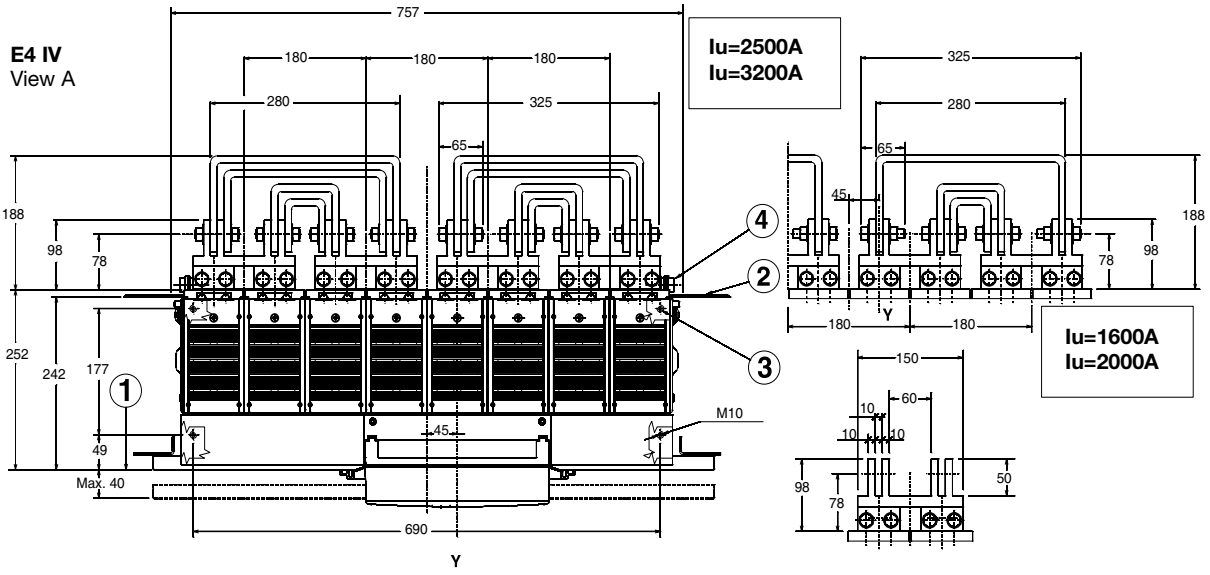


	A	B	C	D
E2	386	296	148	148
E3	530	404	202	202
E4	746	566	238	328
E6	1034	782	328	454

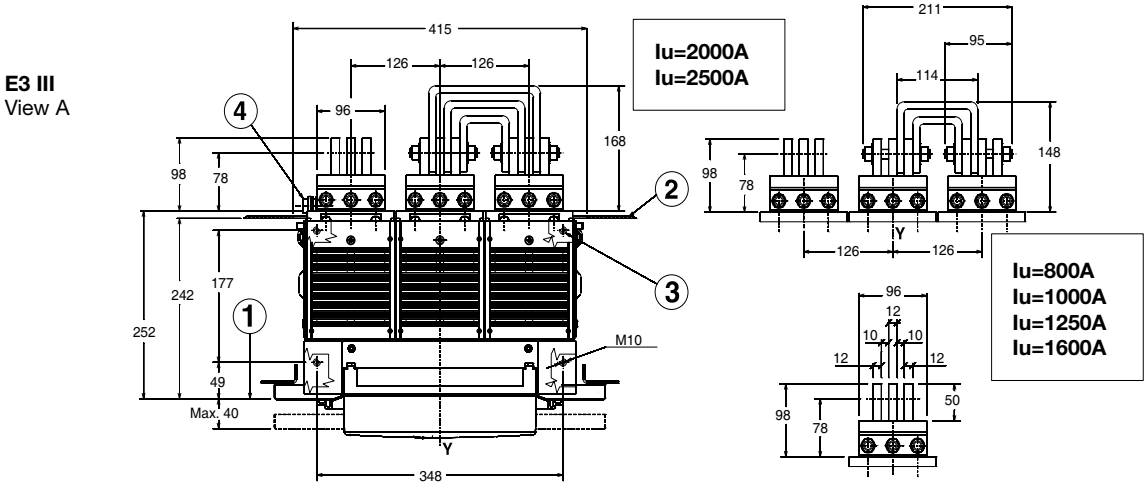
E4 III
View A



E4 IV
View A



E3 III
View A

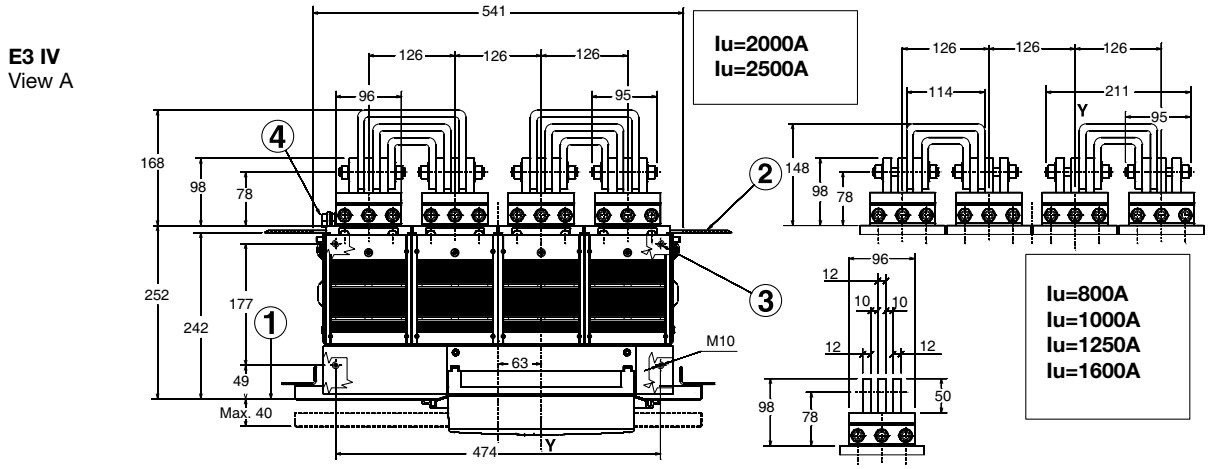


Overall dimensions

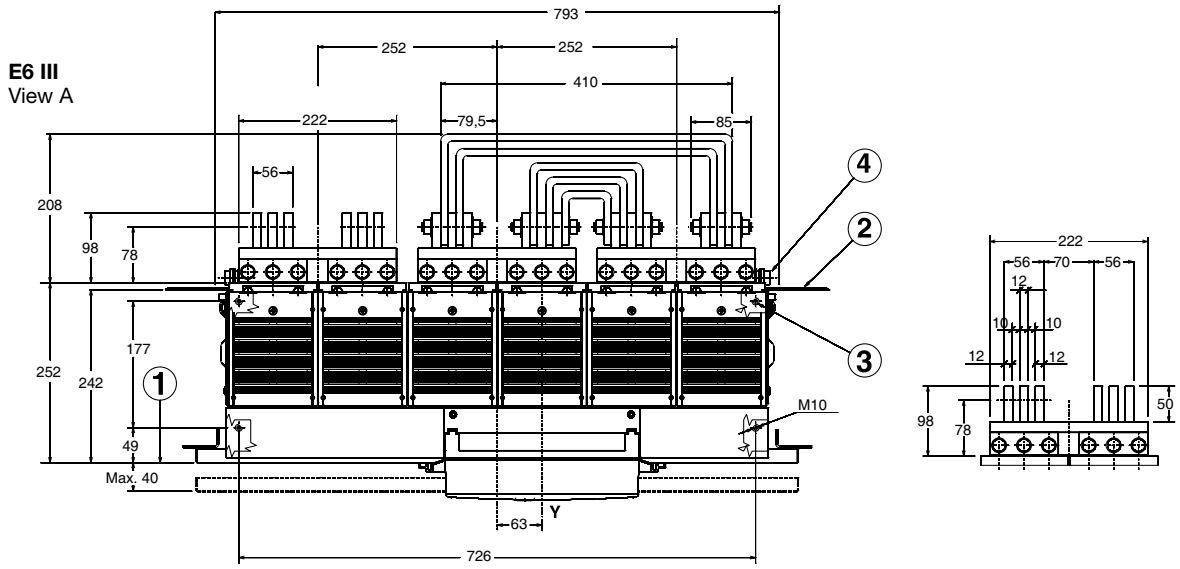
Fixed circuit-breaker

Basic version
with rear terminals

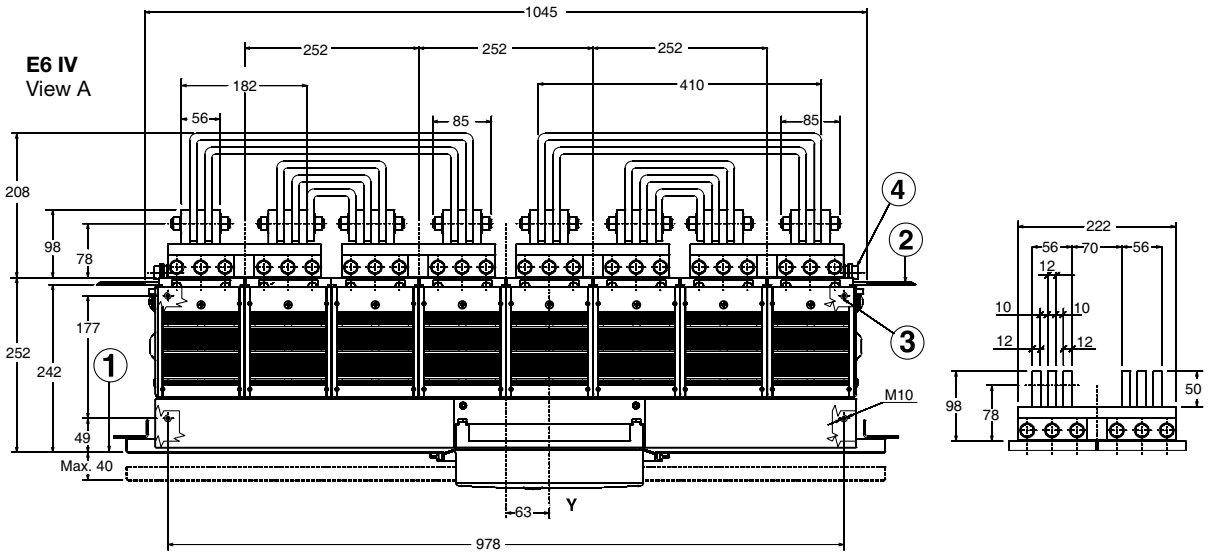
E3 IV
View A



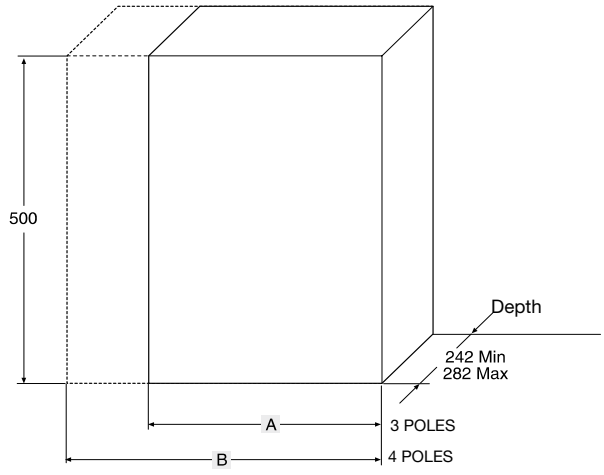
E6 III
View A



E6 IV
View A

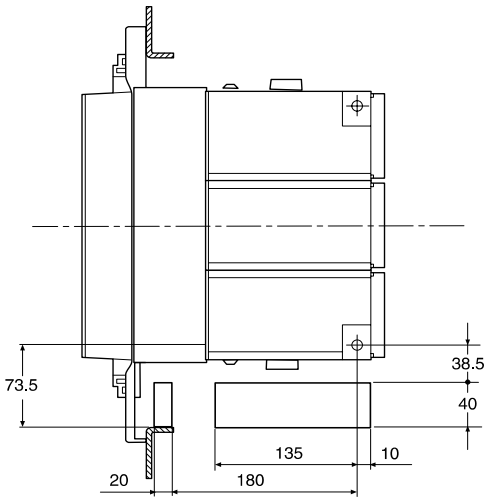


Compartment dimensions

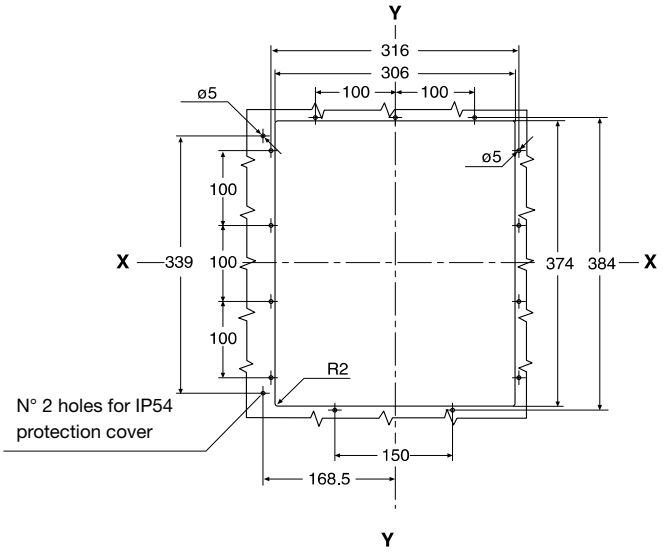


	A	B
E2	400	490
E3	500	630
E4	700	880
E6	1000	1260

Through-holes for flexible cables for mechanical interlocks



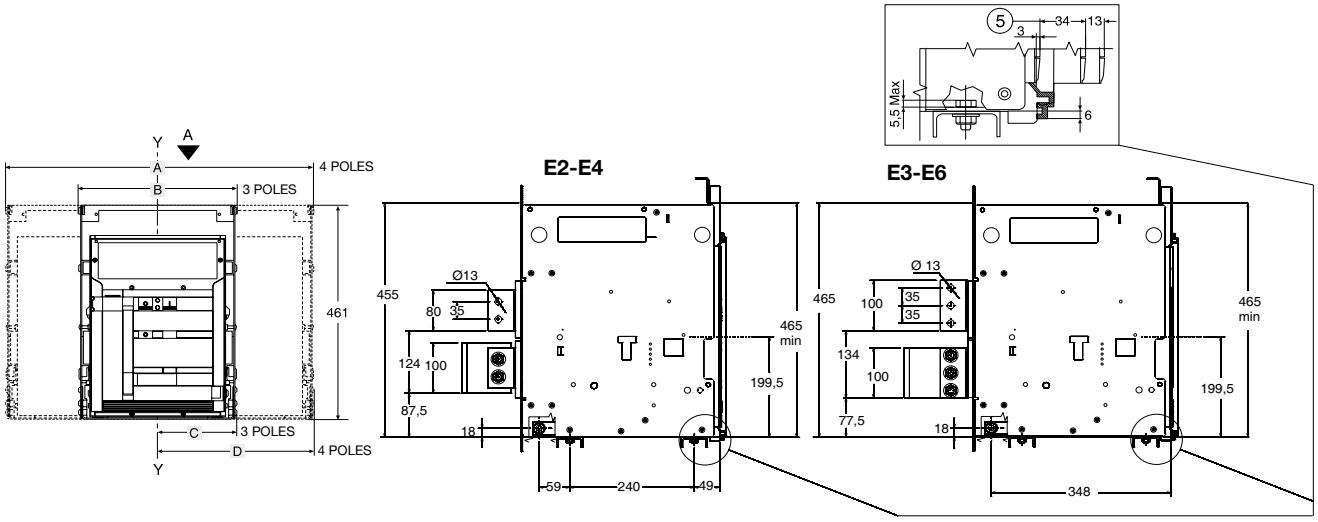
Drilling of compartment door



Overall dimensions

Withdrawable circuit-breaker

Basic version with rear terminals



Caption

① Inside edge of compartment door

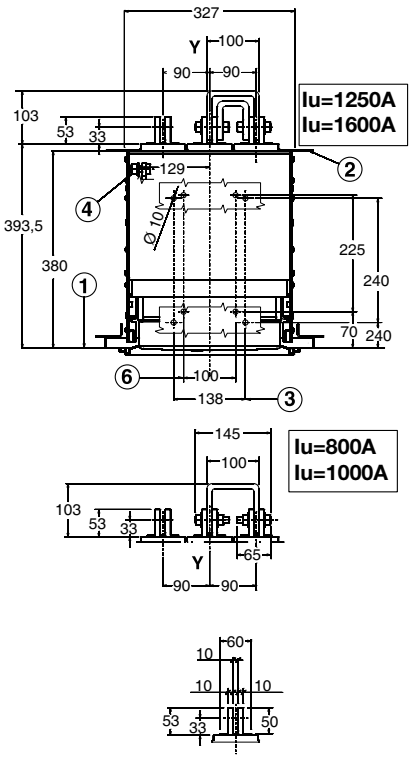
② Segregation (when provided)

③ M10 mounting holes for circuit-breakers (use M10 screws)

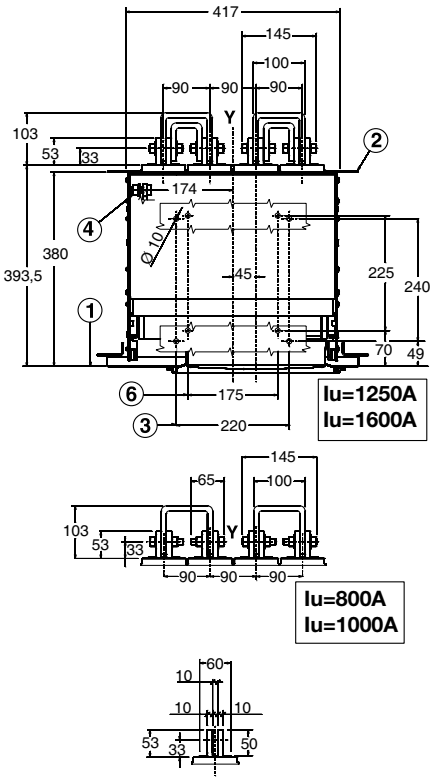
④ 1xM12 screw (E1, E2, E3) or 2xM12 screws (E4, E6) for earthing (included in the supply)

⑥ Insulating wall or insulated metal wall

E2 III
View A

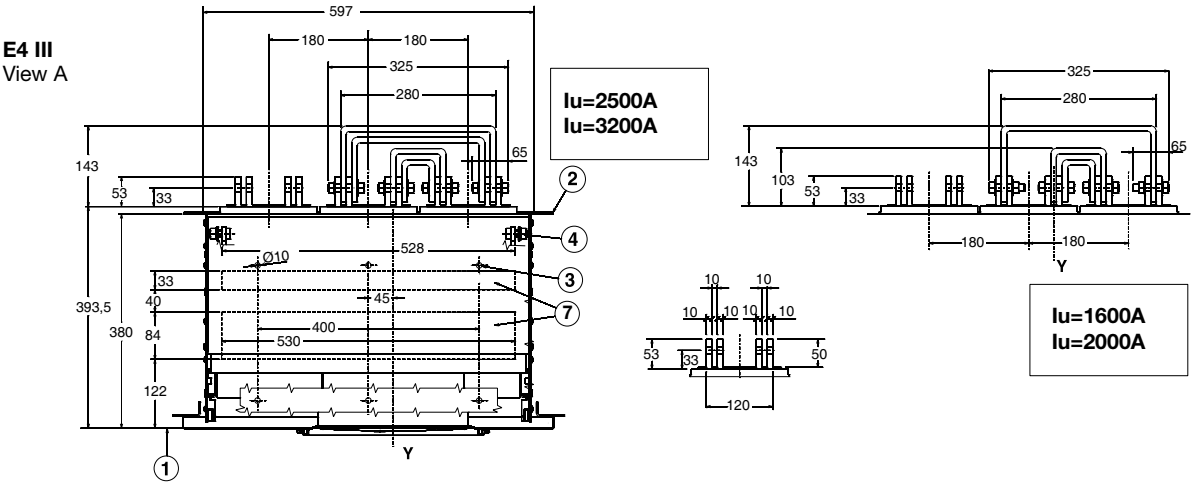


E2 IV
View A

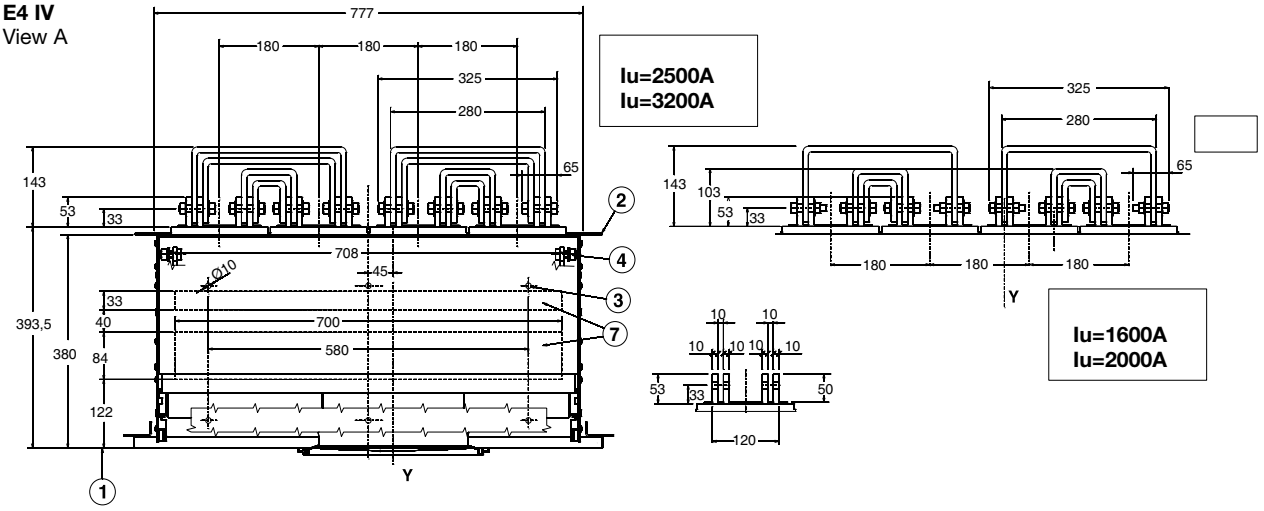


	A	B	C	D
E2	414	324	162	162
E3	558	432	216	216
E4	774	594	252	342
E6	1062	810	342	468

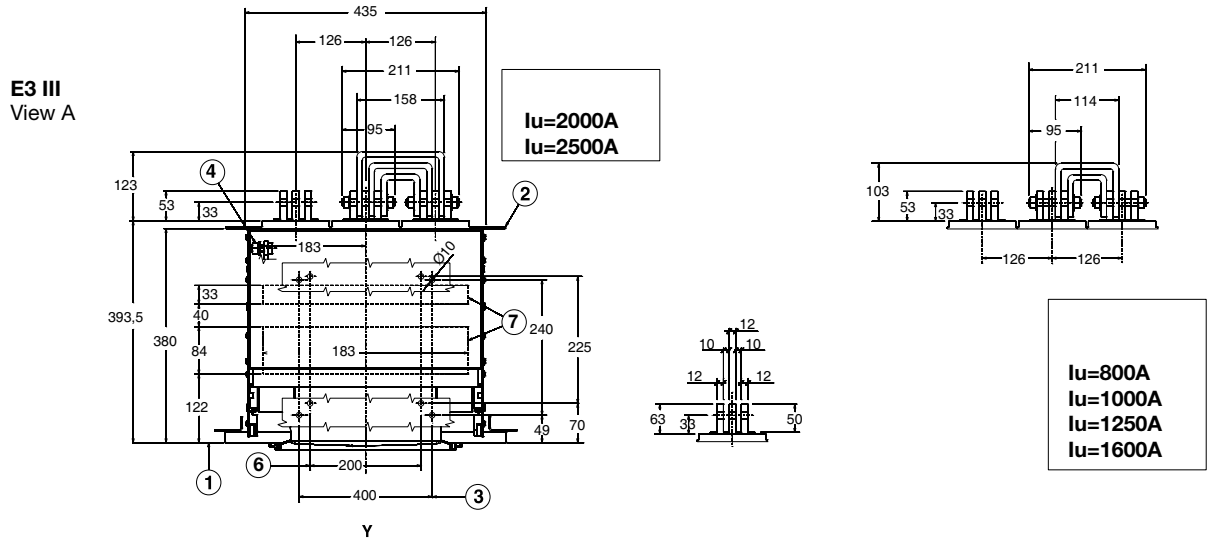
E4 III
View A



E4 IV
View A



E3 III
View A

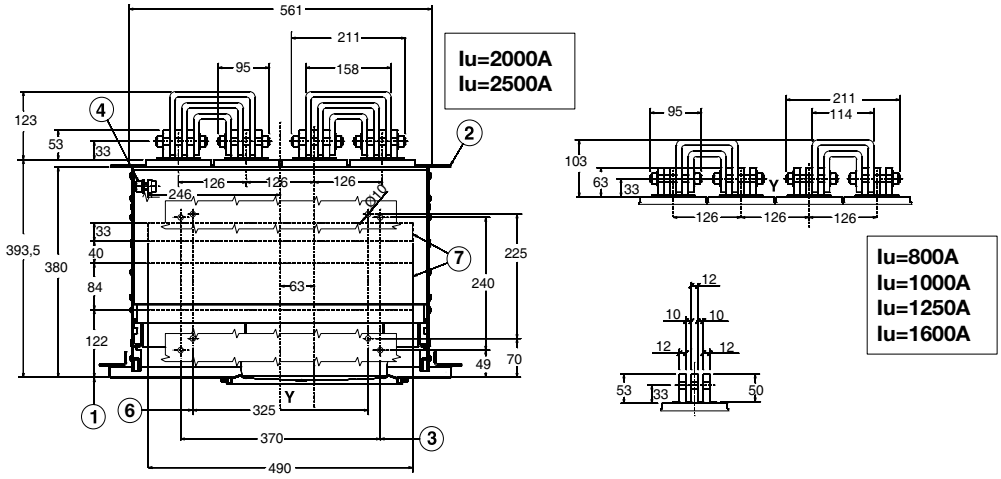


Overall dimensions

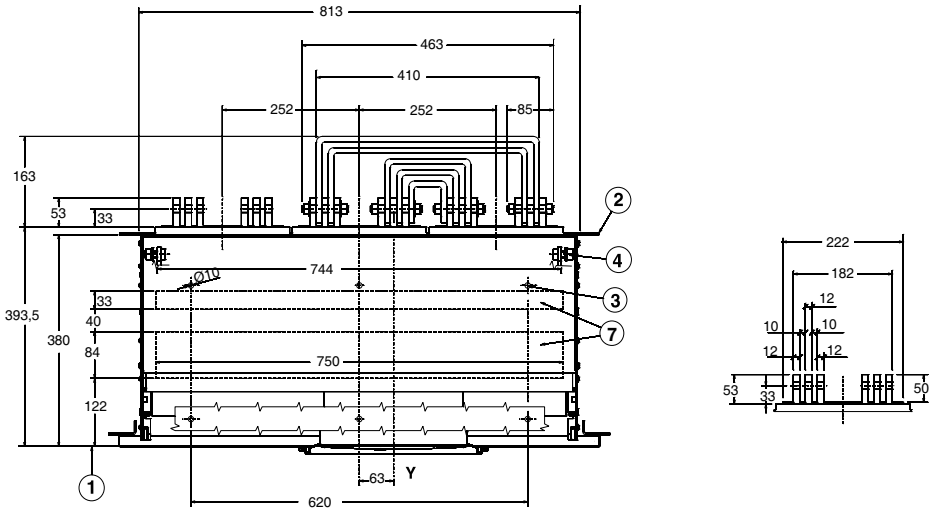
Withdrawable circuit-breaker

Basic version with rear terminals

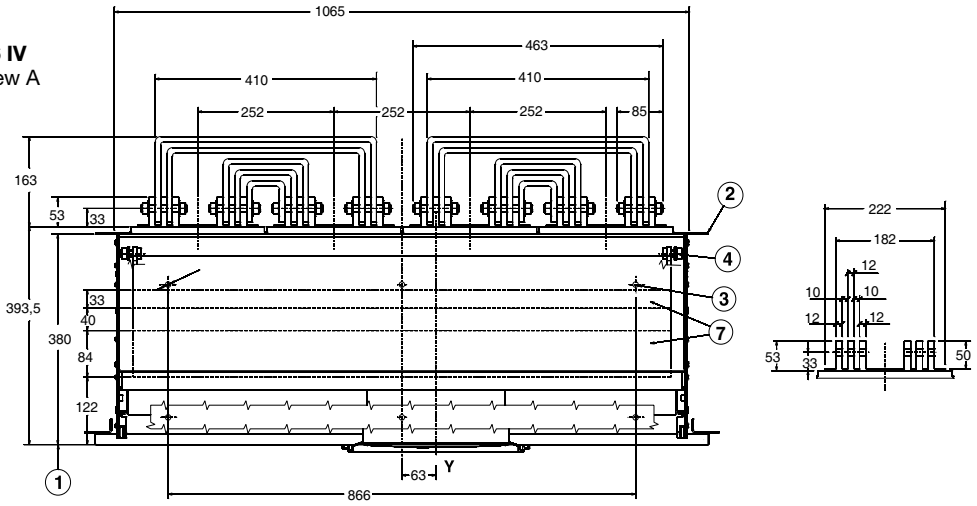
E3IV
View A



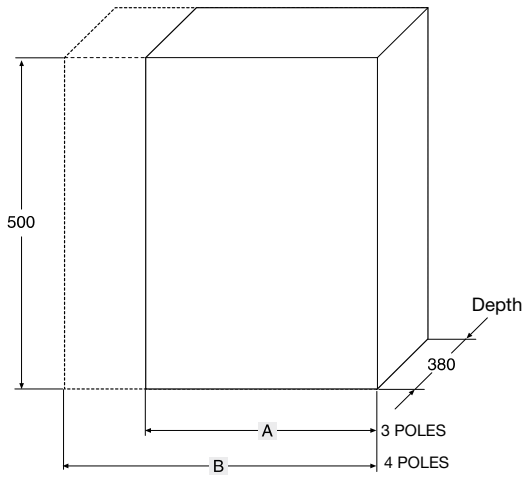
E6 III
View A



E6 IV
View A

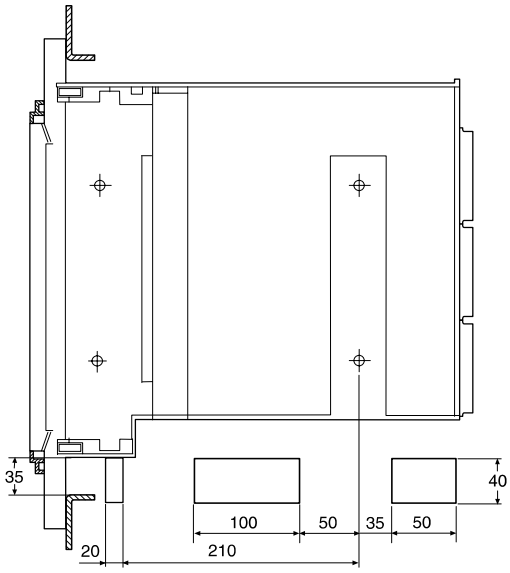


Compartment dimensions

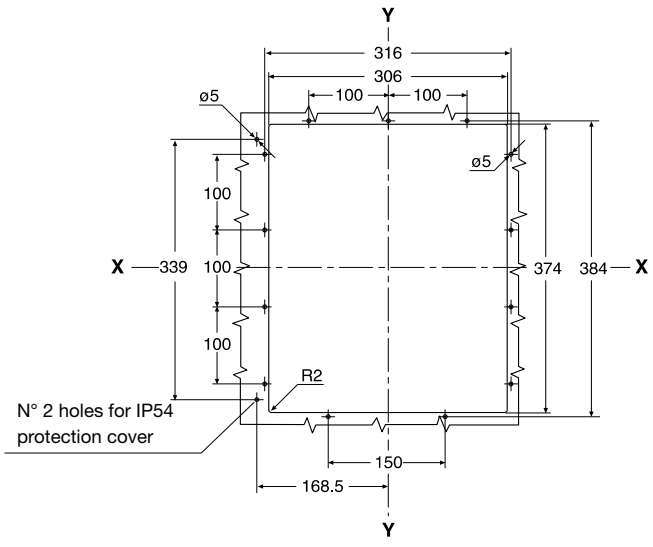


	A	B
E2	400	490
E3	500	630
E4	700	880
E6	1000	1260

Through-holes for flexible cables for mechanical interlocks

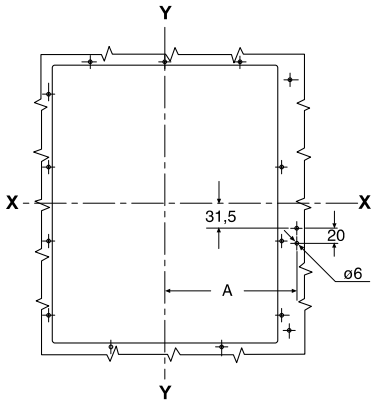


Drilling of compartment door



Mechanical compartment door lock

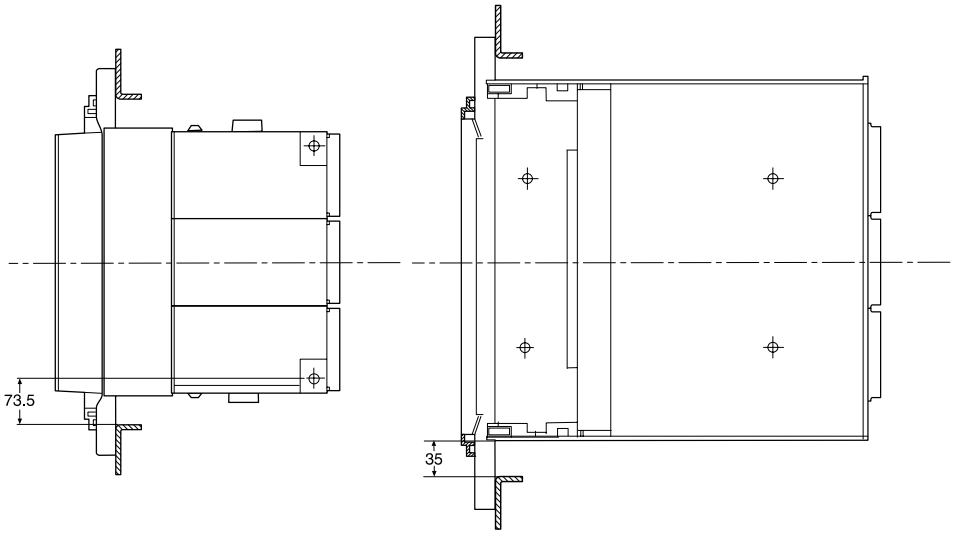
Holes in compartment door



Minimum distance between circuit-breakers and switchboard wall

Fixed version

Withdrawable version



	A	
	3 POLES	4 POLES
E2	180	180
E3	234	234
E4	270	360
E6	360	486

Circuit diagrams

Reading information

Warning

Before installing the circuit-breaker, carefully read note F on the circuit diagrams.

Operating status shown

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

Versions

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

Fixed version

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

Withdrawable version

The control circuits are fitted between the poles of connector X (terminal box XV is not supplied).

Version with PR122/DC electronic release

Version with PR123/DC electronic release

Caption

□	= Circuit diagram figure number
*	= See note indicated by letter
A1	= Circuit-breaker accessories
A3	= Accessories applied to the fixed part of the circuit-breaker (for withdrawable version only)
A4	= Example switchgear and connections for control and signalling, outside the circuit-breaker
D	= Electronic time-delay device of the undervoltage release, outside the circuit-breaker
F1	= Delayed-trip fuse
K51	= PR122/DC, PR123/DC electronic release with the following protection functions: - 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 earth fault protection with inverse short time-delay trip - setting I4
K51/1...8	= Contacts of the PR021/K signalling unit
K51/GZin	= Zone selectivity: input for protection G (only with Uaux. and PR123/DC release)
K51/GZout	= Zone selectivity: output for protection G (only with Uaux. and PR123/DC release)
K51/IN1	= Digital programmable input (available only with Uaux and PR122/DC or PR123/DC release with indicator module PR120/K)
K51/P1...P4	= Programmable electrical signalling (available only with Uaux and PR122/DC or PR123/DC release with indicator module PR120/K)
K51/SZin	= Zone selectivity: input for protection S (only with Uaux. And PR123/DC release)
K51/SZout	= Zone selectivity: output for protection S (only with Uaux. And PR123/DC release)
K51/YC	= Closing control from PR122/DC or PR123/DC electronic release with communication module PR120/D-M
K51/YO	= Opening control from PR122/DC or PR123/DC electronic release with communication module PR120/D-M
M	= Motor for charging the closing springs
Q	= Circuit-breaker
Q/1...27	= 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).
S75E/1...4	= Contacts for electrical signalling of circuit-breaker in racked-out position (only with withdrawable circuit-breakers)
S75I/1...5	= Contacts for electrical signalling of circuit-breaker in racked-in position (only with withdrawable circuit-breakers)
S75T/1..4	= Contacts for electrical signalling of circuit-breaker in test isolated position (only with withdrawable circuit-breakers)
SC	= Pushbutton or contact for closing the circuit-breaker
SO	= Pushbutton or contact for opening the circuit-breaker
SO1	= Pushbutton or contact for opening the circuit-breaker with delayed trip
SO2	= Pushbutton or contact for opening the circuit-breaker with instantaneous trip
SR	= Pushbutton or contact for electrical circuit-breaker reset

W1 = Serial interface with control system (external bus): EIA RS485 interface (see note E)
W2 = Serial interface with the accessories of PR122/DC and PR123/DC releases (internal bus)
X = Delivery connector for auxiliary circuits of withdrawable version circuit-breaker
X1...X7 = Connectors for the accessories of the circuit-breaker
XF = Delivery terminal box for the position contacts of the withdrawable circuit-breaker (located on the fixed part of the circuit-breaker)
XK1 = Connector for power circuits of PR122/DC and PR123/DC releases
XK2 - XK3 = Connectors for auxiliary circuits of PR122/DC and PR123/DC releases
XK4 = Connector signalling open/closet contact
XK5 = Connector for PR120/V module
XO = Connector for YO1 release
XV = Delivery terminal box for the auxiliary circuits of the fixed circuit-breaker
YC = Shunt closing release
YO = Shunt opening release
YO1 = Overcurrent shunt opening release
YO2 = Second shunt opening release (see note Q)
YR = Coil to electrically reset the circuit-breaker
YU = Undervoltage release (see notes B and Q)

Description of figures

Fig. 1 = Motor circuit to charge the closing springs.
Fig. 2 = Circuit of shunt closing release.
Fig. 4 = Shunt opening release.
Fig. 6 = Instantaneous undervoltage release (see notes B and Q).
Fig. 7 = Undervoltage release with electronic time-delay device, outside the circuit-breaker (see notes B and Q)
Fig. 8 = Second shunt opening release (see note Q).
Fig. 11 = Contact for electrical signalling of springs charged.
Fig. 12 = Contact for electrical signalling of undervoltage release energized (see notes B and S).
Fig. 13 = 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. 14 = 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. 21 = First set of circuit-breaker auxiliary contacts.
Fig.22 = Second set of circuit-breaker auxiliary contacts (see note V).
Fig.23 = Third set of supplementary auxiliary contacts outside the circuit-breaker.
Fig. 31 = First set of contacts for electrical signalling of circuit-breaker in racked-in, test isolated, racked-out position.
Fig. 32 = Second set of contacts for electrical signalling of circuit-breaker in racked-in, test isolated, racked-out position.
Fig.42 = Auxiliary circuits of PR122/DC and PR123/DC releases (see notes F, M and V).
Fig. 45 = Circuits of the communication module PR120/D-M of the PR122/DC and PR123/DC releases (optional, see note E).
Fig. 46 = Circuits of the indicator module PR120/K of the PR122/DC and PR123/DC releases - connection 1 (optional; see note V).
Fig. 47 = Circuits of the indicator module PR120/K of the PR122/DC and PR123/DC releases - connection 2 (optional; see note V).
Fig.62 = Circuits of the PR021/K signalling module (outside the circuit-breaker)

Incompatibilities

The circuits indicated in the following figures cannot be supplied simultaneously on the same circuit-breaker:
6 - 7 - 8
13 - 14
22 - 46 - 47

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 release is energized (there is a mechanical lock on closing).
If the same power supply is used for the closing and undervoltage releases and the circuit-breaker is required to close automatically when the auxiliary power supply comes back on, a 30 ms delay must be introduced between the undervoltage release accept signal and the energizing of the closing release. This may be achieved using an external circuit comprising a permanent make contact, the contact shown in fig. 12 and a time-delay relay.

E) MODBUS map is available in the RE1134001 document

F) The auxiliary voltage Uaux allows actuation of all operations of the PR122/DC and PR123/DC releases.Having requested a Uaux insulated from earth, 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.

N) With PR122/DC and PR123/DC releases, the connections to the zone selectivity 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 earthed on the selectivity input side.

P) With PR122/DC and PR123/DC releases with communication module PR120/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 110-120 V DC and 240-250 V AC.

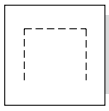
Q) The second opening release may be installed as an alternative to the undervoltage release.

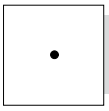
S) Also available in the version with normally-closed contact

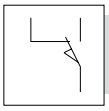
V) If fig. 22 is present (second set of auxiliary contacts) simultaneously as PR122/DC or PR123/DC release, the contacts for the zone selectivity in fig. 42 (K51/Zin, K51/Zout, K51/Gzin and K51/Gzout) are not wired. In addition, the indicator module PR120/K in figures 46 and 47 cannot be supplied.

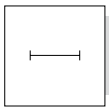
Circuit diagrams

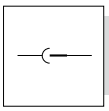
Circuit diagram symbols (IEC 60617 and CEI 3-14 ... 3-26 Standards)

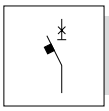

Shield
(may be drawn
in any shape)


Terminal

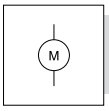

Position switch (limit switch)
change-over break before
make contact


Delay

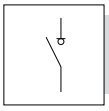

Plug and socket
(male and female)

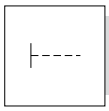

Circuit-breaker-disconnector
with automatic release

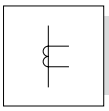

Mechanical connection
(link)

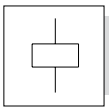


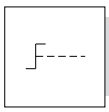
Motor
(general symbol)

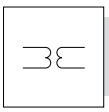

Switch-disconnector
(on-load isolating switch)

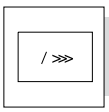

Manually operated
control (general case)

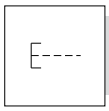

Current transformer

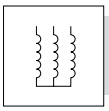

Operating device
(general symbol)

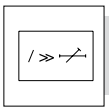

Operated by turning

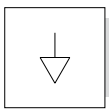

Voltage transformer

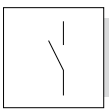

Instantaneous
overcurrent or rate-of-rise
relay

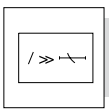

Operated by pushing

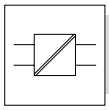

Winding of three-phase
transformer, connection
star

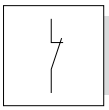

Overcurrent relay with
adjustable short time-lag
characteritic

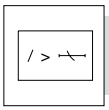

Equipotentiality

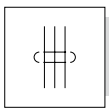

Make contact

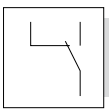

Overcurrent relay with
inverse short time-lag
characteritic

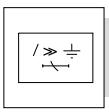

Converter with
galvanic separator


Break contact

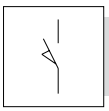

Overcurrent relay
with inverse long time-lag
characteritic

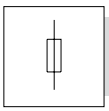

Conductors in a screened
cable (i.e., 3 conductors
shown)

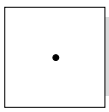

Change-over break before
make contact

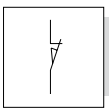

Earth fault overcurrent relay
with inverse short time-lag
characteritic

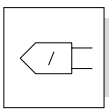

Twisted conductors (i.e., 3
conductors shown)


Position switch (limit switch),
make contact

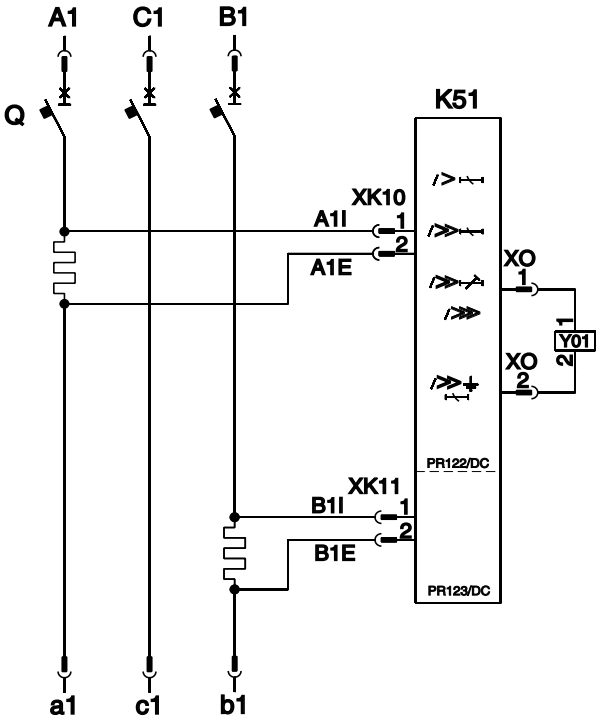

Fuse
(general symbol)


Connection of conductors

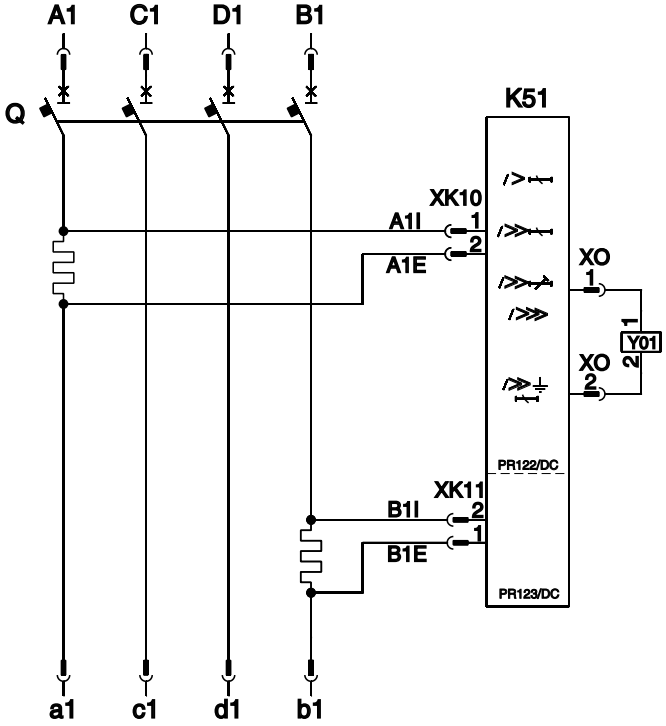

Position switch (limit switch),
break contact


Current sensing
element

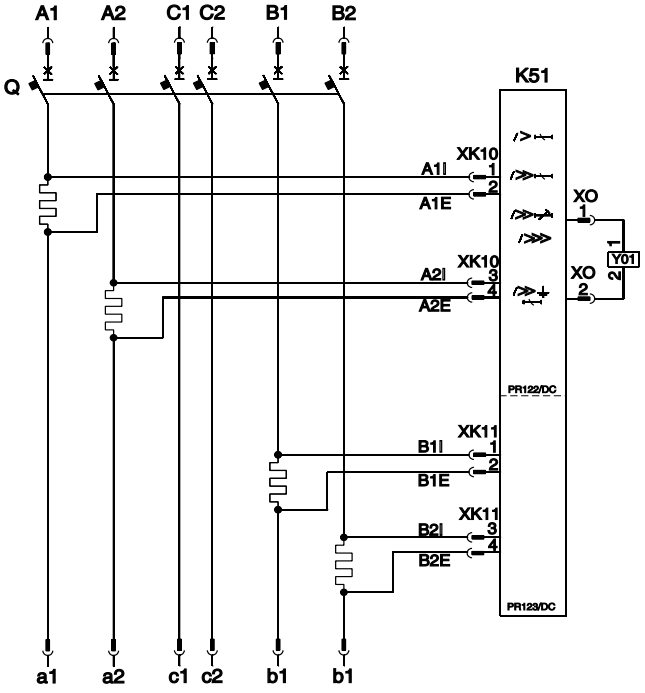
Operating status



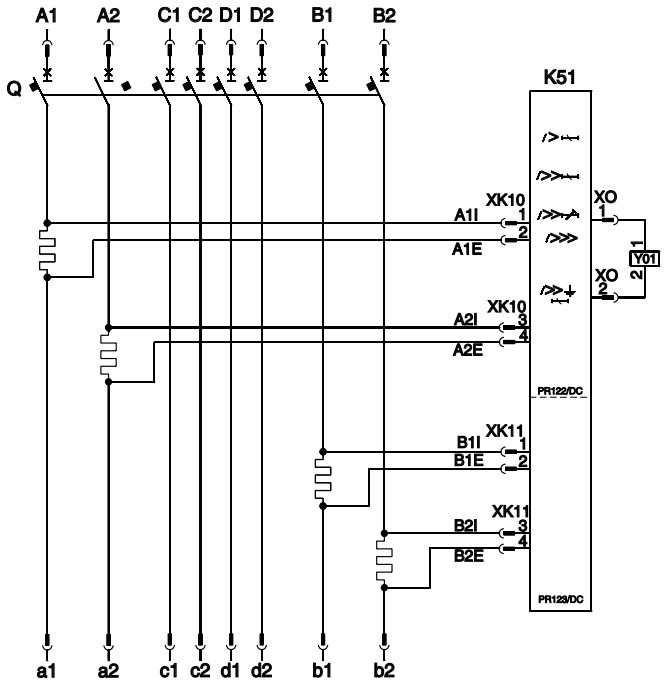
Three-pole circuit-breaker with PR122/DC or PR123/DC electronic releases



Four-pole circuit-breaker with PR122/DC or PR123/DC electronic releases



Three-pole circuit-breaker with PR122/DC or PR123/DC electronic releases

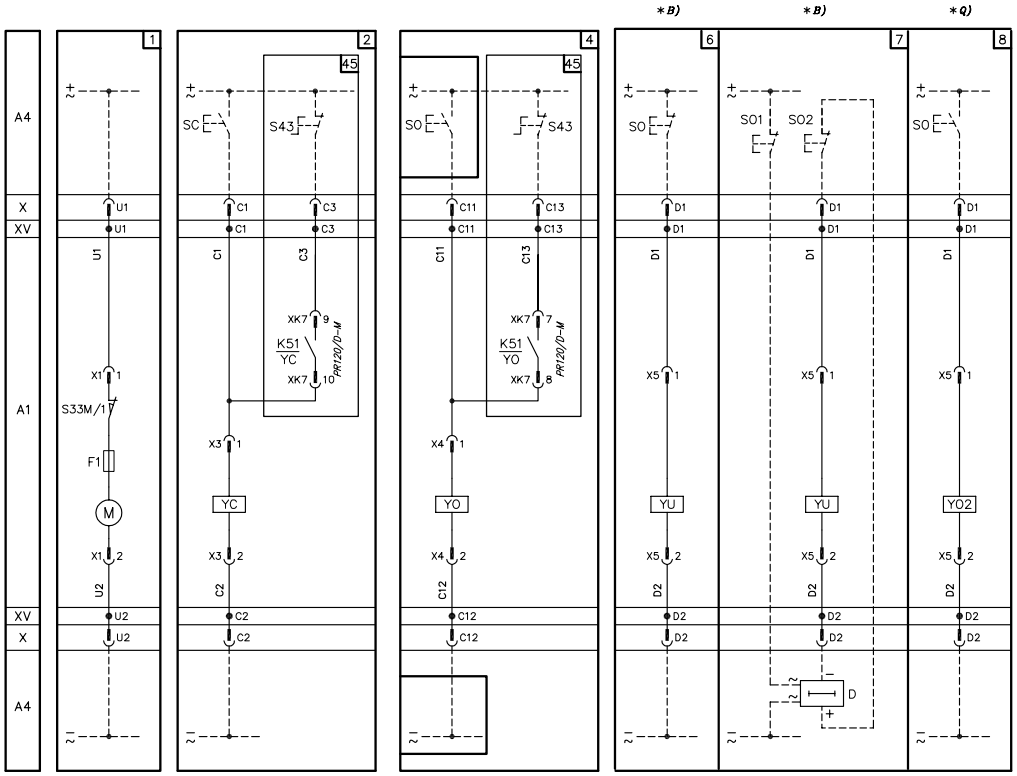


Four-pole circuit-breaker with PR122/DC or PR123/DC electronic releases

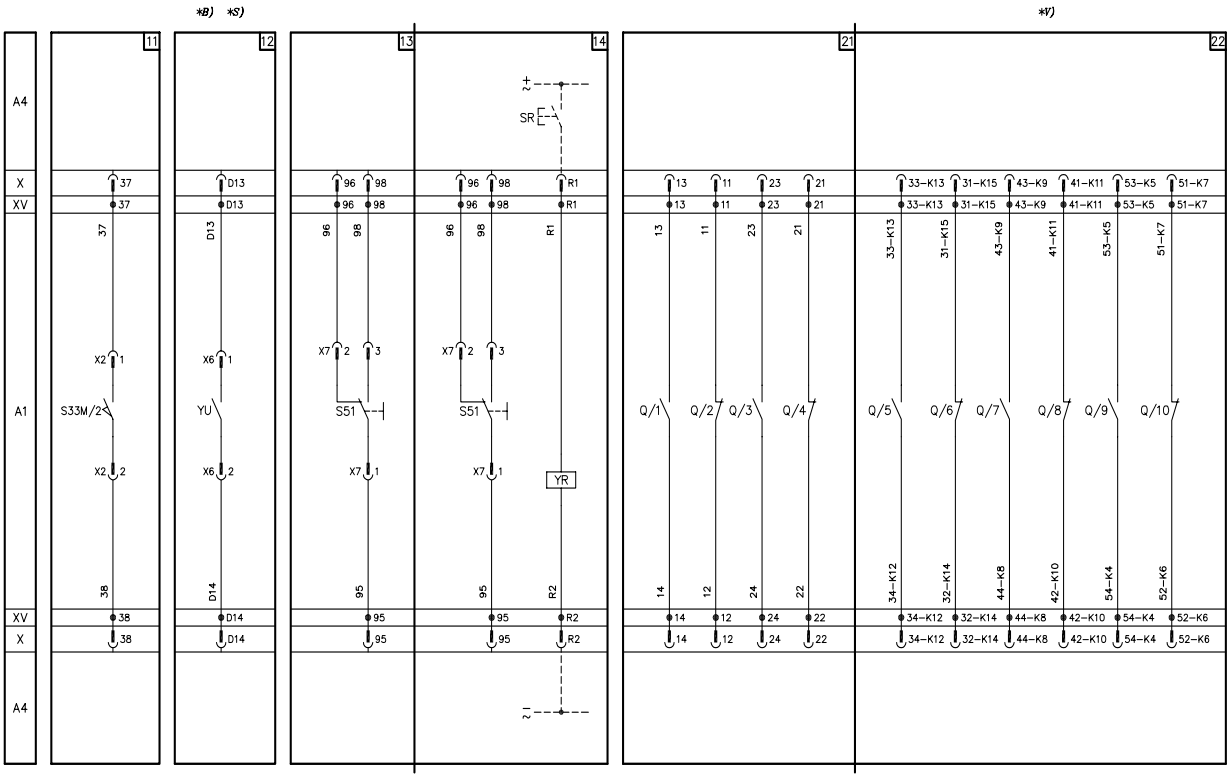
Circuit diagrams

Circuit-breakers

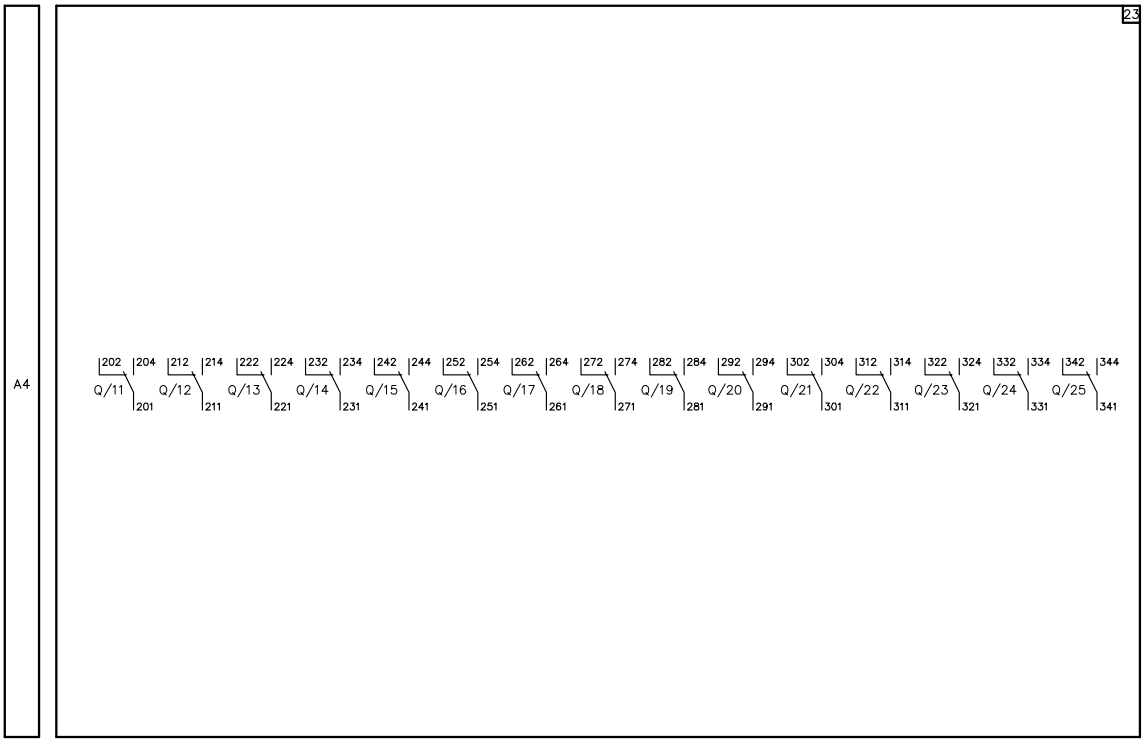
Motor operating mechanism, opening, closing and undervoltage releases

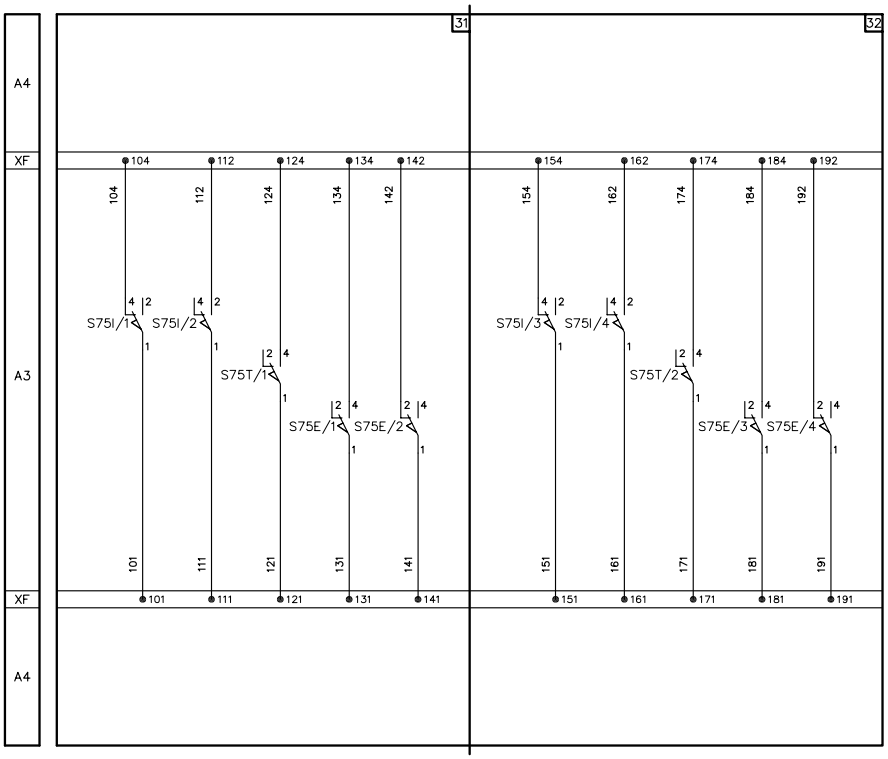


Signalling contacts

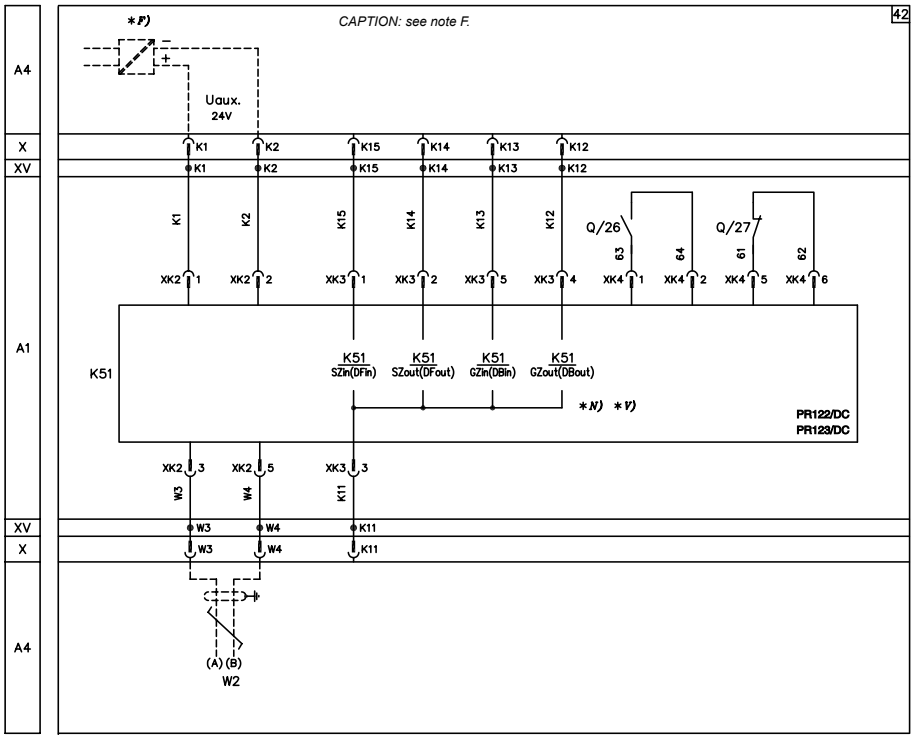


Signalling contacts

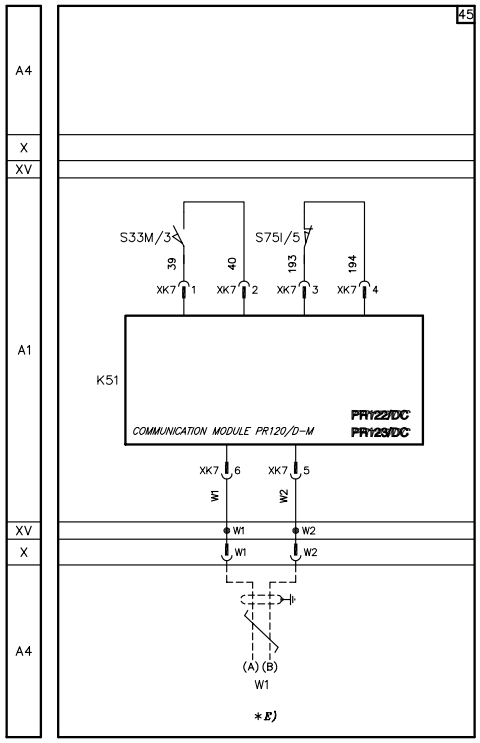




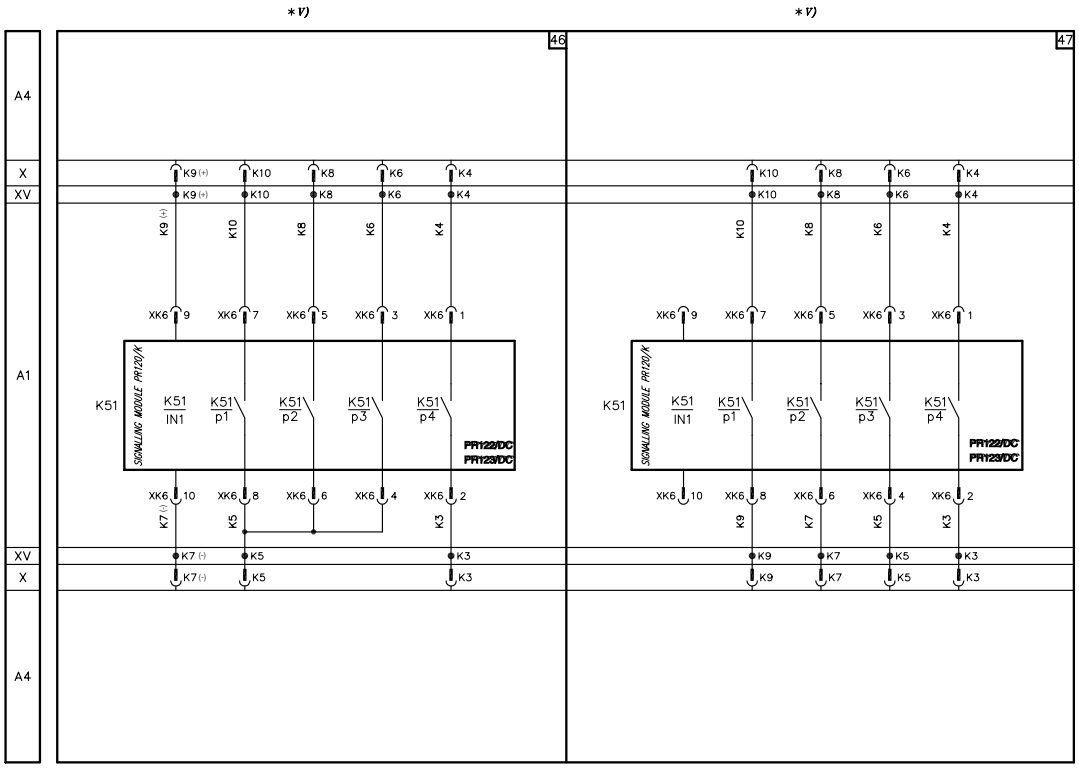
Auxiliary circuits of the PR122/DC and PR123/DC releases



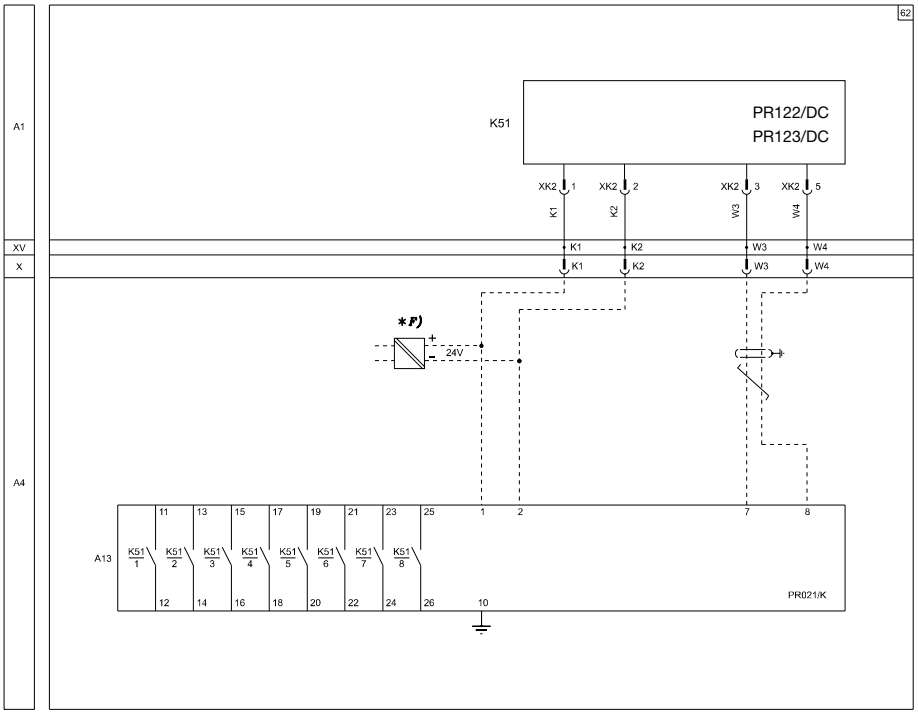
Communication module PR120/D-M



Signalling module PR120/K



PR021/K Signalling unit



Ordering codes

SACE Emax DC automatic circuit-breakers for application up to 1000 V DC

	PR122/DC		PR123/DC	
	1SDA.....R1		1SDA.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles
E2 08 Fixed (F)	**Iu (40 °C) = 800 A**			
VR = Vertical rear terminals				
B	064580	064585	064668	064673
E2 10 Fixed (F)	**Iu (40 °C) = 1000 A**			
VR = Vertical rear terminals				
B	064581	064586	064669	064674
E2 12 Fixed (F)	**Iu (40 °C) = 1250 A**			
VR = Vertical rear terminals				
B	064582	064587	064670	064675
E2 16 Fixed (F)	**Iu (40 °C) = 1600 A**			
VR = Vertical rear terminals				
B	064583	064588	064671	064676
N	064584	064589	064672	064677
E3 08 Fixed (F)	**Iu (40 °C) = 800 A**			
VR = Vertical rear terminals				
N	064600	064609	064688	064697
E3 10 Fixed (F)	**Iu (40 °C) = 1000 A**			
VR = Vertical rear terminals				
N	064601	064610	064689	064698
E3 12 Fixed (F)	**Iu (40 °C) = 1250 A**			
VR = Vertical rear terminals				
N	064602	064611	064690	064699
E3 16 Fixed (F)	**Iu (40 °C) = 1600 A**			
VR = Vertical rear terminals				
N	064603	064612	064691	064700
H	064606	064615	064694	064703
E3 20 Fixed (F)	**Iu (40 °C) = 2000 A**			
VR = Vertical rear terminals				
N	064604	064613	064692	064701
H	064607	064616	064695	064704
E3 25 Fixed (F)	**Iu (40 °C) = 2500 A**			
VR = Vertical rear terminals				
N	064605	064614	064693	064702
H	064608	064617	064696	064705


	PR122/DC		PR123/DC	
	1SDA.....R1		1SDA.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles
E4 16 Fixed (F)	**Iu (40 °C) = 1600 A**			
VR = Vertical rear terminals				
S	064636	064641	064724	064729
E4 20 Fixed (F)	**Iu (40 °C) = 2000 A**			
VR = Vertical rear terminals				
S	064637	064642	064725	064730
E4 25 Fixed (F)	**Iu (40 °C) = 2500 A**			
VR = Vertical rear terminals				
S	064638	064643	064726	064731
E4 32 Fixed (F)	**Iu (40 °C) = 3200 A**			
VR = Vertical rear terminals				
S	064639	064644	064727	064732
H	064640	064645	064728	064733
E6 32 Fixed (F)	**Iu (40 °C) = 3200 A**			
VR = Vertical rear terminals				
H	064656	064659	064744	064747
E6 40 Fixed (F)	**Iu (40 °C) = 4000 A**			
VR = Vertical rear terminals				
H	064657	064660	064745	064748
E6 50 Fixed (F)	**Iu (40 °C) = 5000 A**			
VR = Vertical rear terminals				
H	064658	064661	064746	064749

Extracode	**1SDA.....R1**
P120/LV Low Voltage measuring module 24-48 V DC	065223*

* extracode to be specified with the circuit breaker code to have the low voltage measuring module PR120/LV

Ordering codes

SACE Emax DC automatic circuit-breakers for application up to 1000 V DC

	PR122/DC		PR123/DC	
	1SDA.....R1		1SDA.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles
E2 08 Withdrawable (W) - MP				
Iu (40 °C) = 800 A				
VR = Vertical rear terminals				
B	064590	064595	064678	064683
E2 10 Withdrawable (W) - MP				
Iu (40 °C) = 1000 A				
VR = Vertical rear terminals				
B	064591	064596	064679	064684
E2 12 Withdrawable (W) - MP				
Iu (40 °C) = 1250 A				
VR = Vertical rear terminals				
B	064592	064597	064680	064685
E2 16 Withdrawable (W) - MP				
Iu (40 °C) = 1600 A				
VR = Vertical rear terminals				
B	064593	064598	064681	064686
N	064594	064599	064682	064687
E3 08 Withdrawable (W) - MP				
Iu (40 °C) = 800 A				
VR = Vertical rear terminals				
N	064618	064627	064706	064715
E3 10 Withdrawable (W) - MP				
Iu (40 °C) = 1000 A				
VR = Vertical rear terminals				
N	064619	064628	064707	064716
E3 12 Withdrawable (W) - MP				
Iu (40 °C) = 1250 A				
VR = Vertical rear terminals				
N	064620	064629	064708	064717
E3 16 Withdrawable (W) - MP				
Iu (40 °C) = 1600 A				
VR = Vertical rear terminals				
N	064621	064630	064709	064718
H	064624	064633	064712	064721
E3 20 Withdrawable (W) - MP				
Iu (40 °C) = 2000 A				
VR = Vertical rear terminals				
N	064622	064631	064710	064719
H	064625	064634	064713	064722
E3 25 Withdrawable (W) - MP				
Iu (40 °C) = 2500 A				
VR = Vertical rear terminals				
N	064623	064632	064711	064720
H	064626	064635	064714	064723


	PR122/DC		PR123/DC	
	1SDA.....R1		1SDA.....R1	
	3 Poles	4 Poles	3 Poles	4 Poles

E4 16
Withdrawable (W) - MP

Iu (40 °C) = 1600 A

VR = Vertical rear terminals				
S	064646	064651	064734	064739

E4 20
Withdrawable (W) - MP

Iu (40 °C) = 2000 A

VR = Vertical rear terminals				
S	064647	064652	064735	064740

E4 25
Withdrawable (W) - MP

Iu (40 °C) = 2500 A

VR = Vertical rear terminals				
S	064648	064653	064736	064741

E4 32
Withdrawable (W) - MP

Iu (40 °C) = 3200 A

VR = Vertical rear terminals				
S	064649	064654	064737	064742
H	064650	064655	064738	064743

E6 32
Withdrawable (W) - MP

Iu (40 °C) = 3200 A

VR = Vertical rear terminals				
H	064662	064665	064750	064753

E6 40
Withdrawable (W) - MP

Iu (40 °C) = 4000 A

VR = Vertical rear terminals				
H	064663	064666	064751	064754

E6 50
Withdrawable (W) - MP

Iu (40 °C) = 5000 A

VR = Vertical rear terminals				
H	064664	064667	064752	064755

Extracode

	1SDA.....R1
P120/LV Low Voltage measuring module 24-48 V DC	065223*

* extracode to be specified with the circuit breaker code to have the low voltage measuring module PR120/LV

Ordering codes

SACE Emax FP fixed parts

	750 V DC	1000 V DC
	1SDA.....R1 3 Poles	4 Poles
E2 Withdrawable (W) - FP		
FP = Fixed part		
VR	059895	059906
E3 Withdrawable (W) - FP		
FP = Fixed part		
VR	059896	059907
E4 Withdrawable (W) - FP		
FP = Fixed part		
VR	059897	059137
E6 Withdrawable (W) - FP		
FP = Fixed part		
VR	059140	059143

	1SDA.....R1
Extracode	
Connection kit FP E2-E6 DC	065169**

** extracode to be specified with the standard DC fixed parts for the special rear U connection when used with automatic circuit breakers SACE Emax DC

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

1SDC200012D0201 - 10/2007
Printed in Italy

ABB SACE S.p.A.
An ABB Group company
L.V. Breakers
Via Baioni, 35
24123 Bergamo - Italy
Tel.: +39 035.395.111 - Telefax: +39 035.395.306-433

http://www.abb.com