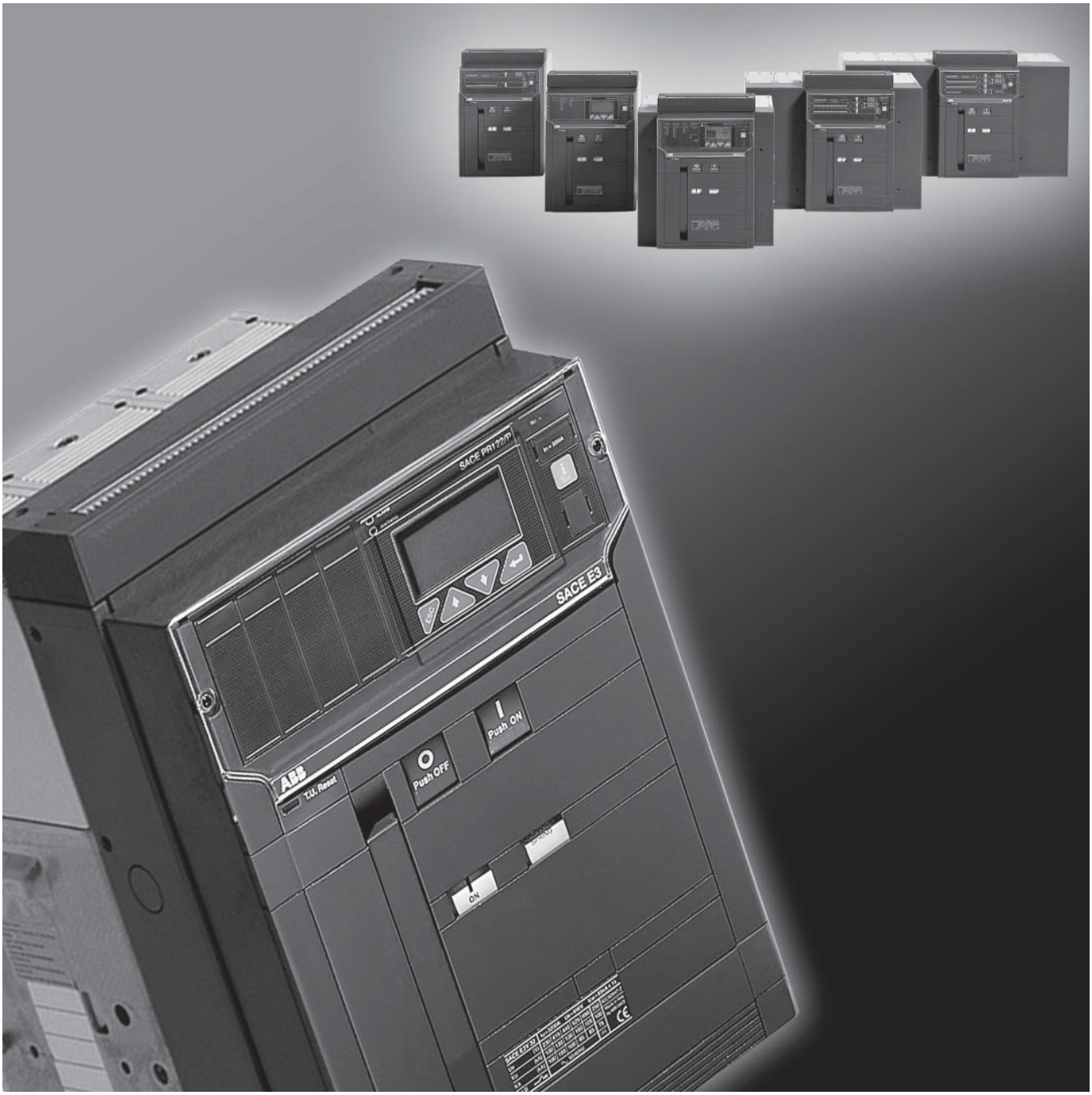
Installation and service instructions

Installation instructions for PR122/P, PR123/P releases and modules

1SDH000460R0102 L6555

Emax



ABB

- READ THIS DOCUMENT AND THE INSTRUCTION MANUAL CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THIS CIRCUIT BREAKER.
- File these instructions with other instruction books, drawings and descriptive data of the circuit breaker.
- Keep this documents available for the installation, operation and maintenance about this equipment. Use of these instructions will facilitate proper maintenance of the equipment.
- Install the Circuit breaker within the design limitations as described in the Installation instructions shipped with the circuit breaker. These circuit breakers are designed to operate within the current and voltage limitations on the switch nameplate. Do not apply these switches to systems with current and/or voltages that exceed these limits.
- Follow your company's safety procedures.
- **Do not remove covers, open doors or work on equipment unless power has been turned off and all circuits de-energized, and after making sure of that with a measuring instrument.**

WARNING:

- Detailed descriptions of standard repair procedures, safety principles and service operations are not included. It is important to note that this documents contain warnings and cautions against certain specific service methods that could cause personal injury to service personnel, damage equipment, or render it unsafe. These warnings do not cover all conceivable ways in which service, whether or not recommended by ABB, might be performed, or the possible hazardous consequences of each conceivable way, nor could ABB investigate all such ways.
- Anyone using service procedures or tools, whether or not recommended by ABB, must satisfy himself thoroughly that neither personal safety, nor equipment safety, will be jeopardized by the service method or tools selected. Should further information be required or specific problems arise that are not sufficiently covered, refer the matter to an ABB service representative.
- This publication is written only for qualified persons and is not intended to be a substitute for adequate training and experience in the safety procedures for this device.
- The purchaser, installer or ultimate user is responsible for ensuring that warning signs are attached and all access doors and operating handles are securely locked when the gear is left unattended, even momentarily.
- All information contained in this document is based on the latest product information available at the time of printing. We reserve the right to make changes at any time and without prior notice.

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1. Protection releases - General notes

The ABB SACE Emax series of air circuit-breakers can be equipped with electronic relays PR122/P and PR123/P.
Every operational requirement is available thanks to the different performance levels of the relays, the additional modules that can be fitted inside them (PR120/V, PR120/K, PR120/D-M, PR120/D-BT) and other external accessories.

The functions and accessories available with the 2 relays are listed in the table below.

Function/Unit	PR122	PR123
Current protections (L, S, I, G)	**S**	**S**
Additional protections (U, OT)	**S**	**S**
Voltage protections (UV, OV, RV, RP, UF, OF)	**S**(4)	**S**
Other protections (D, S2, Double protection G)	**-**	**S**
Harmonics analysis	**-**	**S**
Temperature protection	**S**	**S**
MCR Protection	**S**	**S**
Thermal memory	**S**	**S**
Residual current protection	**O**	**O**
Data Logger	**S**	**S**
Dual setting	**-**	**S**
Front connector for test unit and temporary power supply	**S**	**S**
Compatibility with Ekip Connect	**S**	**S**
Local bus for external accessory units	**S**	**S**
System bus for cable communication	**O**(2)	**O**(2)
Bluetooth wireless communication	**O**(3)	**O**(3)
PR120/V Measuring (internal voltages module)	**O**	**S**
PR120/K Signalling (internal signalling module)	**O**	**O**
PR120/D-M (Internal module for cable communication)	**O**	**O**
PR120/D-BT (Internal module for communication via Bluetooth)	**O**	**O**
HMI030 (Display via switchgear for ABB SACE relay)	**O**	**O**
Flex Interface (External signalling unit)	**O**	**O**
PR030/B (separate power supply unit)	**S**	**S**
Ekip T&P (External unit for power supply, communication and testing via USB)	**T**	**T**
PR010/T (External unit for tests)	**T**	**T**

Key:
S : standard function/unit,
O : optional function/unit,
T : optional unit for temporary connection,
- : function/unit unavailable.

Notes:
1. : with PR120/V module,
2. : with PR120/D-M module,
3. : with internal PR120/D-BT module.

The main features and improvements of the relay PR12x with respect to the earlier PR11x are (depending on the combination of relay-modules):
1. High current reading accuracy (up to 1.5%) 1.5%) and numerous other functions.
2. Continuous control of current sensors and trip coil connection.
3. Recording of the cause for tripping, also in the self-supply condition.
4. Extended neutral selection.
5. High performance event recording (data logger) with 8 analog and 64 digital signals synchronizable with hundreds of events/situations as chosen by the user.
6. Double protection G function with simultaneous reading by two different current sensors (simultaneous use of the double sensor available with PR123/P).
7. Double protection S (available with PR123/P).
8. New residual-current function (Rc).
9. Analysis up to the 40th harmonic.
10. New PR120/V module: supplies power and measures the busbar voltage.
11. New PR120/K module: provides programmable inputs and outputs.
12. New PR120/D-M module: enables communication via RS485.
13. New PR120/D-BT module: enables communication between the relay and PC via Bluetooth.

5. Connection to a PC via wireless Bluetooth (with BT030-USB or PR120/D-BT) or USB (with BT030-USB or Ekip T&P).
6. Serial connection for external modules Flex Interface and HMI030.
7. “Real time” date and time settable by relay of PC (with communication unit).
8. Software applications available for relay maintenance and tests.

1.1. Safety Notes

Read this manual carefully and completely.
The use of this device should be reserved for qualified and expert personnel only.

WARNING: this symbol gives information about operations, actions or circumstances that can cause injuries to the personnel, damage to the unit or economic losses.

You must assume that safe usage is impossible if:
1. the unit shows visible signs of damage.
2. the unit does not function (for example with autotest or with the trip test unit).
3. the unit has been damaged in transit.

If in doubt, about its safe usage, the unit must be put out of service to prevent any accidental use.

WARNING: Prior to servicing and/or replacing, the circuit-breaker must be open.
Also remember to disconnect all power supplies connected.

1.1.1. Notes for dielectric stiffness tests

WARNING:
Dielectric strength tests must not be performed on the inputs and outputs of relays PR122/P and PR123/P.

1.2. Abbreviations and notes

1.2.1. Abbrevations

Abbreviations	Meaning
YO	Opening coil
YC	Closing coil
CB	Circuit-Breaker (for example Emax)
CS	Current Sensor (Current sensor)
Ekip Connect	Communication software for PC, for electronic devices installed in ABB SACE CB
Emax	Series of ABB SACE air circuit-breakers
HW	Hardware
In	Rated current of the Rating Plug installed in the circuit-breaker
i-Test	"i-Test" button on the front of relay
MT	Thermal memory
Pn	Circuit-breaker rated power
Pn_{fase}	Phase rated power
Relè	Electronic protection and control unit for ABB circuit-breakers
RMS	Root mean square value
SdZ	Zone selectivity
SW	Software
TC	Trip Coil (opening solenoid)
TO	Current sensor for residual current reading (Rc)
Trip	CB opening, generated by the release
TV	Voltage transformer (see also VS)
Un	Rated voltage of the voltage transformers installed (phase voltage)
UI/O	External current sensor for earth fault current reading (SGR)
Vaux	Auxiliary power supply
VS	Voltage Sensor (see also VT)

2. SACE PR122/P and PR123/P relays

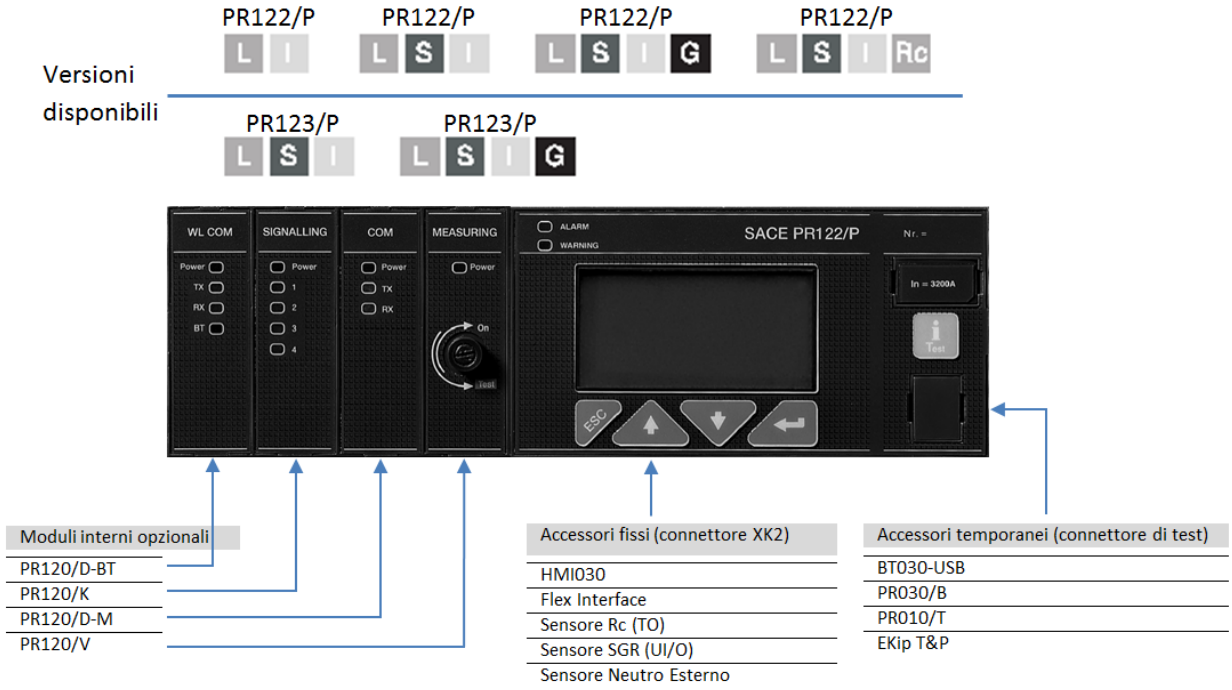
2.1. Introduction

PR122/P and PR123/P relays possess many common characteristics:
- Graphic interface: display, push-buttons and interactive menu.
- HW: connectors and accessory modules.
- SW: basic protection and measuring functions.

Unless different indications are given, the functions and characteristics described in the following chapters are common to both models.

2.2. Identification

The PR122/P and PR123/P units which, in accordance with IEC standards, are available with various protections, default modules and optional equipment, are illustrated in the figure below:



2.3. Specifications

2.3.1. General characteristics

Relays PR122/P and PR123/P are high-performance electronic units for Emax CB. Their function is to monitor and protect against fault current.
The units also possess Measuring, **Data Storage, Communication**, **Self-Test, Load Control and Zone selectivity functions** for Emax circuit-breakers.

The units installed on CB are connected to the current sensors for primary current reading, to the Trip Coil for circuit-breaker opening control and to the state contacts of the CB.
The sensors provide the primary current measurement and the energy for powering the relay, even in the absence of external power supply.
Connected directly to an opening mechanism, the Trip Coil allows the CB to open. The command is transmitted to the Trip coil in accordance with the protection settings.
The state contacts of the CB provide information about the CB's position.

A graphic display and a set of push-buttons allow all the relay's information to be accessed. They can also be used to adjust the protections and settings and to read the state and alarms, the presence of which is indicated by two front leds.

Depending on the version, the adjustable protections available are:

Symbol	Protection against
L	overload with inverse long time delay
S	short-circuit with adjustable delay
I	instantaneous short-circuit
G	earth fault with adjustable delay
U	phase unbalance
OT	temperature off range
MCR	closing on short-circuit
Rc	Residual current

Relay PR123/P includes 2 further basic protections:

Symbol	Protection against
S2	short-circuit with adjustable delay
D	directional short-circuit with adjustable delay

Presence of the PR120/V module allows further protections to be controlled for both relay models:

Symbol	Protection against
UV	undervoltage
OV	overvoltage
RV	residual voltage
RP	reverse active power
UF	underfrequency
OF	overfrequency
U	phase-to-phase voltage unbalance (as an alternative to phase currents)

Relays PR122/P and PR123/P also provide a fixed protection against instantaneous short-circuit at high current values, called linst protection.

Relays PR122/P and PR123/P have 5 dedicated connections (2 digital inputs, 2 digital outputs and a common signal) for the zone selectivity function.

A set of modules and accessories allows optional functions to be added to the basic version:
Internal modules:
- PR120/V: supplied as part of the standard equipment with PR123/P and as an optional with PR122/P, this module allows the primary voltage values to be read and provides energy for powering the relay even in the absence of external Vaux, nil current or CB open.
- PR120/D-M: allows the relay to be connected in a communication network so that the CB can be read and controlled even from remote locations. The module also allows the state of the springs and the CB position (in the case of a withdrawable CB) to be read and the opening and closing coils to be remote controlled.
- PR120/K: module with input and output contacts. Allows alarm or state signals to be associated with programmable electro-mechanical contacts and a digital input to be programmed for various functions.
- PR120/D-BT: for communication with the relay via a PC/PDA (via Bluetooth).

Temporary accessories:
- PR030/B for powering and performing the installation operations.
- BT030-USB for relay powering and communication functions and supervising all the parameters and information via a PC.
- PR010/T allows the relay to be powered, enables the protections to be tested and test reports to be saved.
- Ekip T&P, similarly to BT030-USB, can be used to power and communicate with the relay via a PC. It also allows units like PR010/T to be tested via a PC.

Fixed accessories:
- The HMI030 switchgear display allows the measurements to be viewed on the front of the switchgear itself.
- Flex Interface modules allow alarm or relay state signals to be associated with programmable electromechanical contacts. They also allow a complete network of several units to be created and can also be connected to external modules (e.g. HMI030).
Consult the following chapters or the dedicated manuals for details about each individual unit.

Ekip Connect SW, which is available free of charge from the Internet website or is supplied with the two BT030-USB and Ekip T&P modules, allows the PC and the communication modules for Emax to communicate.

2.3.2. CB compatibility

Relays PR122/P and PR123/P can be installed on CB of the three-pole and three-pole with external neutral type, or any model of four-pole Emax CB.

The CB model establishes the rated uninterrupted current the circuit-breaker is able to support (Iu).

The adjustable protections refer to the In model, defined by the interchangeable Rating plug module installed on the relay.

2.3.3. Standards

Relays PR122/P and PR123/P have been designed to operate in accordance with the following international standard: **IEC 60947-2 Low voltage apparatus. Circuit-breakers.**

2.3.4. Environmental characteristics

Operating temperature (Standard version)	-25°C ... +70°C
Storage temperature	-40°C ... +70°C
Relative humidity	0% ... 98% with condensation
Degree of protection (with release installed in the CB).	IP 30

2.3.5. Electrical characteristics

2.3.5.1. Primary current

The unit guarantees full operation under the following primary current conditions:

Rated operating frequency	50/60 Hz ±10%
Peak factor	2,1 @ 2xIn in compliance with IEC 9472 Annex F. (Consult ABB for a dedicated analysis if there are higher peak factors)

2.3.5.2. Power supply

The relay unit needs a power source: this can be supplied by the current sensors installed on the internal poles of the circuit-breaker, by module PR120/V or by means of Vaux:

- All that's needed to supply the relay by means of the internal current sensors is the presence of minimum three-phase turn-on current.
- The presence of minimum three-phase turn-on voltage is all that's required to power the relay via module PR120/V. The module also allows internal modules PR120/K and PR120/D-BT to be powered.
- Supplied externally by means of a galvanically insulated power supplier, Vaux guarantees uninterrupted operation of the unit (even with nil current or with the circuit-breaker open) and expansion of the accessory functions of the relay, thus allowing internal modules (if installed) and external devices (HMI030 and Flex Interface) to be used.

Primary current characteristics	**Relay Enabling** (1)		**Relay Activation** (2)		**Activation of display lighting** (3)	
CB models	E1, E2, E3	E4, E6	E1, E2, E3	E4, E6	E1, E2, E3	E4, E6
Minimum three-phase busbar current	>100 A (4)	>200 A	>160 A (5)	>320 A	>300	>600
Frequency, Peak factor	See par. 2.3.5.1					

Primary voltage characteristics	**Relay and display powering** (2)	**Activation of display lighting** (3)
Three-phase minimum network voltage (relay)	60V	70V
Three-phase minimum network voltage (relay+PR120/D-BT)	70V	70V
Three-phase minimum network voltage (relay+PR120/K)	70V	90V
Three-phase minimum network voltage (relay+PR120K and PR120/D-BT)	90V	110V

Vaux characteristics	**Activation of display lighting** (3)
DC voltage (galvanically separated)	24 Vdc ±20%
Maximum ripple	5%
Inrush current @ 24Vdc	~10 A for 5ms
Rated power @ 24Vdc	~2 W
Inrush current @ 24Vdc with internal modules connected	~15 A for 5ms
Rated power @ 24Vdc with internal modules connected	~6 W

NOTES:

(1): protections activated and display on in the Low Power configuration (See par. 2.3.5.3 Operating mode).
(2): protections activated and display on in the Full Power configuration (See par. 2.3.5.3 Operating mode).
(3): protections activated, display on in the Full Power configuration and display lighting on.
(4): Emax E1 and E2 Iu=250A: minimum three-phase busbar current >30A.
(5): Emax E1 and E2 Iu=250A: minimum three-phase busbar current >50A.

WARNING: Since the auxiliary voltage needs to be isolated from the ground, "galvanically separated converters" in accordance with the IEC standard 60950 (UL 1950) or the equivalent IEC 60364-41 and CEI 64-8 have to be used to guarantee a current in common mode or leakage current (as defined in IEC 478/1 and CEI 22/3) no greater than 3.5mA.

2.3.5.3. Operating mode

In accordance with the supply conditions described in par. 2.3.5.2, relays PR121/P and PR331/P guarantee operation in three different modes:

- Low Power: this mode guarantees operation of all the protections provided by the relay, operation of the front LEDs and display powering in the Low Power mode, but access to the menus is not allowed.
- Full Power: this mode guarantees operation of all the protections provided by the relay, operation of the front LEDs, display powering in the Full Power mode and access to the menus.
- Full Power and display lighting: this mode includes all the Full Power functions and powers the display lighting system.

2.4. User interface

A graphic display and a push-button panel provide all the settings and information of the PR122/P and PR123/P relays.

Ref.	Description
1	Pre-alarm indicator LED
2	Graphic display
3	Serial number of the relay
4	Rating plug
5	Position for internal PR120/D-BT module
6	Position for internal PR120/K module
7	Position for internal PR120/D-M module
8	Position for internal PR120/V module
9	Voltage takeoff isolator
10	Main push-button panel
11	Test connector
12	“i Test” button

2.4.1. LEDs

Relays PR122/P and PR123/P have 2 front leds, which provide information about the state of the relay and CB.
Both leds function when the unit is on.

Signal	Colour	State	Description
ALARM	Red	OFF	No protection or delay alarm
		ON (Flashing @1Hz)	Delay in progress for one or more of the following protections: current (L, S, G), voltage (UV, OV, RV), frequency (OF, UF), active power reversal (RP), phase unbalance (U) Alarm for one or more: Contact wear, Temperature Connection error of one or more: Rating Plug, Trip Coil , Key plug error, Current sensors Installation error
		ON (Fixed)	Internal error (ABB assistance required)
WARNING	Yellow	OFF	No CBB error or alarm
		ON (Flashing @0.5Hz)	OT protection in prealarm
		ON (Flashing @1Hz)	OT protection in alarm state
		ON (Fixed)	Protection L prealarm Protection U alarm with trip disabled Distorted wave form with > 2.1 Form factor Contact wear within range: 80%<CW<100% Iw WARNING threshold exceeded CB state error Frequency off range Configuration error Incongruent settings

2.4.2. Push-buttons

A push-button panel with 4 buttons is used to access and surf the menus on the displays of relays PR122/P and PR123/P. There is also an independent button with various different functions (iTest).

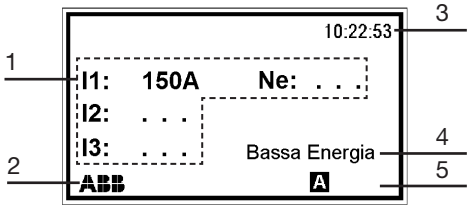
Key	Name	Description
	ESC	- Press ESC from the default page to access the main menu - Press ESC from within the menus to return to the previous level
	ENTER	- Press ENTER from within the menus to access the selected level or parameter - Press ENTER to confirm the option selected
	UP	- Press UP or DOWN from the default page to access the pages with the available measurements (current values and, if the PR120/V module is installed, also the voltage and active, reactive and apparent power values) - Press UP or DOWN within the menus to scroll the menu options - Press UP or DOWN within the parameter or setting areas to change their values
	DOWN	
	iTest	- Press iTest from the default page to access the area with the information pages about the relay, circuit-breaker and last trip recorded. - Press iTest after the CB has opened owing to an electronic protection to reset the TRIP state of the relay (the display is redirected to the default page and the SW register corresponding to Trip is reset) - Press iTest when the relay is off to obtain a description of the last event that led to shut-off (function available within 48h from shut-off).

WARNING: When parameters whose adjustment includes a large number of options or values are edited, the UP or DOWN buttons can be pressed and held down so as to scroll through the options faster and speed up the editing operations.

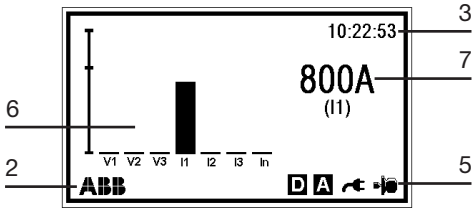
2.4.3. Display

Relays PR122/P and PR123/P are equipped with a 128x64 pixel LCD graphic display where the operator can view measurements and signals, and adjust protections and settings.
The degree of contrast can be adjusted via the menu, in the Settings-Display Contrast section.

The display has 2 operating modes (the conditions are described in par. 2.3.5.3):
- Low Power: the display is fixed and appears as shown in the figure below:



- Full Power: various menus and information areas can be accessed with the buttons in this configuration: the main page is displayed (default page) during normal operation, and appears as shown in the figure below:



The measurements area or the menu area are accessed from the default page. All the options within the menu are displayed as shown in the figure below:

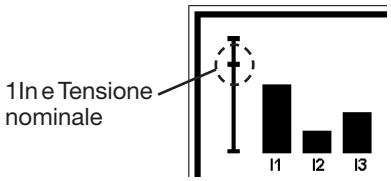
Access to the menus and the push-button panel is active in the Full Power mode. Consult the dedicated chapter for details about how to browse the menus (See par. 2.5 User menus).

Ref.	Description
1	Phase current measurement
2	CB and/or relay alarms (the ABB logo appears in the absence of alarms)
3	Internal relay clock
4	“Low Power“ message
5	Operating icons
6	Graphic ammeter and voltmeter
7	Rms value and highest measured current phase (cyclically updated value)
8	Name of the menu being browsed
9	List of options available in the menu being browsed (the value that appears in black is the one that has been selected)
10	Number of options available in the menu being browsed
11	Value or description of the selected option

2.4.3.1. Graphic ammeter and voltmeter

Graphic ammeter and voltmeter options are available in the default page (the voltmeter is only activated if module PR120/V is installed).

The levels of the available measurements are displayed by a vertical bar.
The current (phase) and voltage (network) values are positioned along the abscissae, with the reference and rated value setting along the ordinate: an intermediate line indicates the 1In value for the current values and the rated voltage for the voltage values.



Example: if the bar corresponding to current I1 exceeds the intermediate line, it means that the measured value is higher than 1In.

2.4.3.2. CB and relay alarms

Information about the state of the relay and CB is always available at the bottom left of the display (See par. 2.4.3 Display Ref.2).

The ABB logo appears in the absence of alarms.
If one or more alarms have occurred, they will be displayed by a message that flashes every 2 seconds. The alarms are displayed in conjunction with an icon showing the type of alarm in question (information, active delay, danger).

Icon	Message	Description
	Configuration	Inconsistent parameters or inconsistent data between key plug and relay
	Prealarm [L] / [T]	Prealarm condition of the specified protection. Example: “Prealarm L”
	Warning Iw	Iw threshold exceeded
	Contact wear	Contact wear prealarm (>80%)
	Date not valid	Incorrect date that must be programmed (new relay)
	CB not defined	“Open/closed” circuit-breaker state inconsistent or incorrect
	Frequency range	Frequency measured beyond declared range (<-10% or >+10%)
	Alarm T	Internal temperature of relay off range (<-25° or >85°)
	Time delay [L] / [S] / [G] / [Gext] / [U] / [UV] / [OV] / [RV] / [RP] / [UF] / [OF] / [S2] / [D]	Time delay condition of the specified protection, which can conclude with an opening command transmitted to the CB. Example: “OV time delay”
	Contact wear	Alarm for contact wear (=100%)
	Harmonic distortion	Alarm for measured harmonic distortion (form factor>2.1)
	[G] / [Gext] / [T] (TRIP OFF)	Alarm of the specified protection, of which the trip function has been disabled. Example: “Gext (TRIP OFF)”
	Alarm [U] / [UV] / [OV] / [RV] / [RP] / [UF] / [OF]	Alarm of the specified protection, of which the trip function has been disabled or if the trip is activated but the CB is already open Example: “Alarm RP“
	Load [LC1] / LC2]	Load control alarm. Example: “Load LC2“
	Sensor [L1] / [L2] / [L3] / [Ne] / [Gext]	Alarm of the specific current sensor (disconnected or faulty). Example: “sensor L3“
	TC disconnected	Trip Coil disconnected or faulty
	Rating Plug	Rating plug absent, disconnected, faulty or of a model superior to the Iu
	Installation	Error following an incorrect installation procedure or failure to install
	Power factor	Power factor module lower than set limit
	Phase cycle	Inverted cyclic direction of the phases (in conjunction with the voltages)
	Local bus	Error in local bus owing to absence of communication or error

The following table describes all the messages that could appear on the display in a pop-up window after an unallowed attempt to configure parameters or settings.

Alarm message	Description
Password error	
Session impossible	A programming session cannot be started due to a contingency (e.g. a timer-controlled delay still elapsing)
Value off range	Value beyond the established limits
Failed 1001/2001	Inconsistency between thresholds of protections L and S (SETA/SETB)
Failed 1002/2002	Inconsistency between thresholds of protections I and S (SETA/SETB)
Failed 1006/2006	Inconsistency between thresholds of protections I and D (SETA/SETB)
Failed 1005/2005	Inconsistency between thresholds of protections L and D (SETA/SETB)
Failed 1009/2009	SdZ incompatible SdZ directional
Failed 1003/2003	Inconsistency between thresholds of protections L and S2 (SETA/SETB)
Failed 1004/2004	Inconsistency between thresholds of protections I and S2 (SETA/SETB)
Failed 3001	Problems with language change
Failed 3002	Problems with toroid RC setting
Failed 3003	Problems with neutral setting
Exception 6	Control momentarily unavailable
Unavailable	Function temporarily unavailable
Invalid date	Date and time not updated. Set them.
Parameters revised	Programming session concluded correctly
Cancelled	Programming session cancelled
Failed	Programming session rejected

2.4.3.3. Operating icons

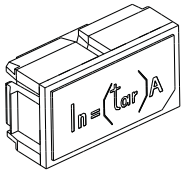
An area with icons showing the operating conditions of the relay is available on the display.
The area is at the bottom right of the display (See par. 2.4.3 Display Ref.5) and includes 4 positions in which the icons can be shown.

Starting from the position on the far right, a description of the available icons is given below:

Position	Icon	Condition	Description
1 (right)		OFF	Datalogger function deactivated
		ON (Fixed)	Datalogger function activated, awaiting an event to record
		ON (Flashing @1Hz)	Datalogger function activated with recording completed and waiting to save data or restart
2		OFF	Dual set deactivated. One single configuration set is available for adjusting the protections
		ON	Dual set activated. Two configuration sets are available for adjusting the protections The icon depicting the operative configuration set ([A] or [B]) is displayed
3		OFF	External Vaux power source absent
		ON	External Vaux power source present
4 (left)		OFF	Editing of parameters and settings via the local mode. No update in progress
		ON	Editing of parameters and settings via the local mode. Update in progress: the icon appears if the users has changed some of the parameters but has not yet completed the operation by selecting CONFIRM. The icon only disappears after the changes ave been confirmed or annulled
		OFF	Editing of parameters and settings via the local mode. No update in progress
		ON	Editing of parameters and settings via the remote mode (only activated if the PR120/D-M module is installed)

2.4.4. Rating Plug

The rating plug defines the rated current In, which is essential for regulating the protections: this is because because the regulation of all the protections refers to In (e.g.: I_1= 0.4 xIn).
The rating plug is installed on the relay on a dedicated front connector and is available to the user.



The relay can be equipped with various Rating Plug models, up to the value Iu (uninterrupted rated current Iu indicaed on the rating plate affixed to the front guard).
Example: CB E1B800 has Iu= 800 A, and can be fitted with a rating plug with In≤ 800A.

The module is interchangeable, with the relay off and the CB open.

The relay continuously checks for the presence of the rating plug and signals its absence or any assembly errors.

WARNING: Replacement of the rating plug with the relay on or the CB closed could lead to faulty relay operation, or undesired opening of the CB.

2.4.5. External connections

Relays PR122/P and PR123/P can be connected to several different external units by means of a test connector on the relay itself, or by means of the terminal box on the upper part of the CB.
Consult the dedicated chapters and the installation documents of the individual modules for further details about operation and installation.

2.4.5.1. Test connector

The connector, which is installed on the front of the relay, allows PR020/B modules to be connected for temporary powering of the relay, and BT030-USB, PR010/T and Ekip T&P for powering, communication and testing via a PC (or via the unit itself in the case of PR010/T).

2.4.5.2. Internal modules

Relays PR122/P and PR123/P can be connected to 4 internal modules. Each module has a dedicated connector on the rear side of the relay.
Some modules have a further connector, connected to internal contacts or to the terminal box of the CB.
All the details concerning the internal modules are given in the dedicated chapters (See par. 2.11 Internal modules).

2.4.5.3. External sensors

Relays PR122/P and PR123/P can be connected to external sensors of 3 different types: external neutral sensor, earth fault current sensor SGR and residual current sensor Rc.
The sensors are connected to the relay by means of the terminal box installed on the CB.

Details about the installation and connection operations are described in the wiring diagrams of the installation, while the associated functions are described in the chapters dedicated to protections Gext (see par. 2.6.9) and Rc (see par. 2.6.10).

2.4.5.4. Power supply of Vaux, Zone Selectivity and fixed external Accessories

The external power supply connections for Vaux, the zone selectivity signals and connections for the Flex Interface or MHI030 fixed external modules are available in the terminal box of the CB.

2.5. User menus

Relays PR122/P and PR123/P come on in the Full Power mode in the presence of the supply conditions described in par. 2.3.5.2, or if supplied by: Vaux, PR030/B, BT030-USB, Ekip T&P or PR010/T.
The operator can browse the menus on the display in the Full Power mode. When powered, the unit displays a default page from whence the operator can access three different areas:
- Measurements Area, by using the UP and DOWN buttons.
- Information Pages, by using the iTest button.
- Menus Area, by using the ESC button to access and quit the menu section.

2.5.1. Measurements Area

One or more pages of relay measurenments are available in this area.
The current measurements page is always activated while the voltage and power measurements pages can be consulted if the PR120/V module is installed.
Consult the chapter about the Measuring functions for further details about the information given in this area (See par. 2.7 Measuring functions**).**

2.5.2. Information Pages

This area contains 3 pages about the main relay and CB details: “protection unit“ page, “Circuit-breaker“ page and “last opening“ page.
Press the iTest button within 5 sec to change page.

2.5.3. Menu Area

The menu area features a tree structure allowing all the information and parameters to be managed with various levels of detail.
The main menu, which the user can access by pressing ESC from the default page, includes 5 options:

Main Menu Option	Description	Paragraph
1. Protections	Reading and adjustment of all the protections available	2.6
2. Measurements	Reading of all the measurements made by the relay, Trip and events	2.7
3. Settings	Reading and editing of the main relay, CB and Module settings	2.9
4. Test	Allows diagnosis and state control tests to be performed	2.10
5. Information	Main relay and CB information readings	--

The various different menus are described in the sections indicated in the table.

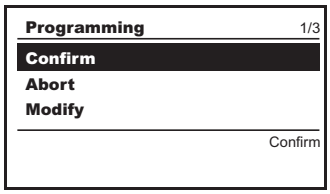
2.5.3.1. Menu browsing

The operator can browse within each level by using the main push-button panel:
- ENTER to access a submenu or confirm an edited parameter
- ESC to quit a submenu or annul the changes made to a parameter
- UP and DOWN to scroll the menu options

The editing menus can only be accessed after the user PW has been entered.

The parameters can be edited by scrolling the options available in the specific menu and by selecting the required option with the ENTER button. Some of the parameters update immediately (such as the date) while others require confirmation (CONFIRM). To accomplish the CONFIRM operation, the operator must quit the menus through to level 1 where there is a new page called PROGRAMMING in which 3 options can be chosen:
- CONFIRM: confirms the changes made
- ANNUL: annuls the changes made
- EDIT: allows the operator to browse the menus again and make further changes to the parameters.

Selection of the first two options accesses a temporary window giving the programming result (parameters updated or operation annulled).



2.6. Protection functions

Relays PR122/P and PR123/P control numerous independent protection functions.
The current, voltage, frequency and temperature signals of the relay are processed by the relay's microprocessor which signals alarms, performs time delay processes and sends commands, depending on the time and protection level settings.

The various adjustable protection types are managed by the relay in different ways:
- The current protections are processed according to the true root mean square value of the current values read by the current sensors.
- The voltage protections are processed according to the true root mean square value of the voltage values read by module PR120/V.
- The frequency protections undergo voltage frequency control.
- Moreover:
- The temperature protection is monitored by means of the relay's internal sensor.

The Iinst fixed protection is also available and can neither be disabled nor adjusted: its tripping thresholds are established by ABB personnel only.

The Protections menu also allows the operator to view and edit all the available parameters.

Protections	Options available	Relay compatibility	
		PR122/P	PR123/P
Protection L	Threshold, Time, Curve, Thermal memory	S	S
Protection S	Enabling, Threshold, Time, Curve, Thermal Memory, Zone selectivity, Startup	S(1)	S
Protection S2	Enabling, Threshold, Time, Thermal Memory, Zone selectivity, Startup	--	S
Protection D	Enabling, Threshold, Time, Trip enabling, Zone selectivity, Startup	--	S
Protection I	Enabling, Threshold, Startup	S	S
Protection MCR	Enabling, Threshold, Operating time slot	S(2)	S(2)
Protection G	Enabling, Threshold, Time, Curve, Trip enabling, Zone selectivity, Startup	S(3)	S(3)

Protections	Options available	Relay compatibility	
		PR122/P	PR123/P
Protection Gext	Enabling, Threshold, Time, Curve, Trip enabling, Zone selectivity, Startup	O(4)	O(4)
Protection Gext(Idn)	Enabling, Threshold, Time	O(5)	O(6)
Protection U	Enabling, Threshold, Time, Curve, Trip enabling	S	S
Protection UV	Enabling, Threshold, Time, Trip enabling	O(7)	S
Protection OV	Enabling, Threshold, Time, Trip enabling	O(7)	S
Protection RV	Enabling, Threshold, Time, Trip enabling	O(7)	S
Protection RP	Enabling, Threshold, Time, Trip enabling	O(7)	S
Protection UF	Enabling, Threshold, Time, Trip enabling	O(7)	S
Protection OF	Enabling, Threshold, Time, Trip enabling	O(7)	S
Protection T	Enabling	S	S
Load protection	Enabling and threshold (1), Enabling and threshold (2), Enabling and threshold (Iw)	S	S
Double protection set	Enabling, Default set, programmed event for set change	--	S
Neutral Protection	Enabling, Threshold	S(8)	S(8)

Key:	Notes:
S : standard protection	1. : function available with versions LSI, LSIG, LSIRc
O : optional function	2. : enabling and parameters available with units PR010/T, Ekip T&P, BT030 or communication via PR120/D-M
	3. : function available with versions LSIG
	4. : function enableable with versions LSIG, and external SGR sensor.
	5. : function enableable with versions LSIG (+ module PR120/V) and LSIRc, and external Rc sensor.
	6. : function enableable with versions LSIG, and external Rc sensor.
	7. : functions available when module PR120/V is installed
	8. : function available with four-pole CB, or three-pole CB in the 3P+N configuration

2.6.1. Notes about Protection Operation

Relays PR122/P and PR123/P are equipped with a “backup-protection” function. If the first command to the trip coil fails to open the circuit-breaker immediately (TC locked), further trip commands are transmitted until the circuit-breaker opens.

If the wave forms of the signals read by the relay are distorted beyond the declared limit (see peak factor), the calculation tolerance of the real root mean square value will increase.

2.6.2. Protection L

The “L” is the only protection that cannot be disabled because it is for self-protection against overloading of the relay itself. The types of trip curves settable are divided into two groups according to the standard they refer to.

Standard trip curve according to IEC 60947-2

Only one type of curve is settable ($t=k/I^2$) as defined by the IEC standard 60947-2.
The tripping time is calculated in relation to the value of If:

- For fault currents If ≤12In, the tripping time of the protection is given by the expression: $t(s)= \frac{9 \cdot t_1}{(I_f / I_1)^2}$. If the calculated value is less than 1 second, the real tripping time is forced to 1 second (t(s)= 1s.).
- For fault currents If >12In, the tripping time is always t(s)= 1s.

Standard trip curve according to IEC 60947-2

3 types of curve settings can be made and are defined by standard IEC60255-3 as A, B and C.
The protection trip time, with inverse time, is given by the expression:

$$t = \frac{k}{(I)^{\alpha} - 1} \bullet b \quad \text{where} \quad I = \frac{I_f}{I_1}$$

NOTES:

- t(s): envisaged tripping time
- I_f : fault current; given in [In] (example: 0.7In)
- I_1 , t_1: protection L parameters set by the user, given in [In] and [s]
- α, k: parameters suggested by standard IEC60255-3, which vary with the type of gradient selected (e.g. for type B gradients: α = 1 and k = 13.5)
- b: parameter introduced by SACE to increase the number of curves with the same gradient. This parameter is automatically calculated by setting parameter t1 (required tripping time with If= 3xI1).

Protection L has 3 operating conditions established by the fault current level I_f and by the setting of the protection itself I_1:

$I_f \leq 0.9\ xI_1$	No alarm, all settings possible. No time delay in progress.
$0.9\ xI_1 < I_f < (1.05...1.2)\ xI_1$	Prealarm L signal, all settings possible. No opening time delay in progress.
$(1.05...1.2)\ xI_1 \leq I_f$	Alarm L signal, no setting possible. Opening time delay in progress.

WARNING: the protection L threshold entry range ensures that:
- the relay does not set to the alarm status for current values of less than 1.05 xI_1;
- the relay will set to the alarm status for current values exceeding 1.2 xI_1.

2.6.2.1. Thermal memory L

The thermal memory function can be enabled for cable protection. It is based on the "τL" parameter, defined as the tripping time of the curve (t1) selected at 1.25xI1. The function can be activated via PR010/T or Ekip Connect.
The tripping time of the relay will certainly be 100% of that selected after time τL has elapsed since the last overload or the last trip, otherwise the tripping time will be reduced in relation to the overload that has occurred or the time that has elapsed.

Relays PR122/P and PR123/P are fitted with two instruments for processing the thermal memory. The first only operates when the relay is powered (it also records overloads that have not lasted long enough to trip the relay), while the second even functions when the relay is not powered, reducing any trip times in the case of an immediate reclosing and activating moment the circuit-breaker trips.
It is the relay that decides which of the two to use, depending on the various different situations.

WARNING: The thermal memory function can only be set if the standard type of curve has been selected (t=k/I^2)..

2.6.3. Protection S

This protection can be disabled; it can be of the fixed time (t=k) or inverse time (t=k/I^2); in the latter case, the trip time is given by the expression.
The tripping time with inverse time curve is given by the expression: t(s)= $\frac{100 * t_2}{(I_f)^2}$. If the calculated value is less than t_2, the real tripping time is forced to t_2 (t(s)= t_2.)

NOTES:

t(s):	envisaged tripping time
I_f :	fault current; given in [In] (example: 1.4In)
I_2 , t_2:	protection S parameters set by the user, given in [In] and [s]

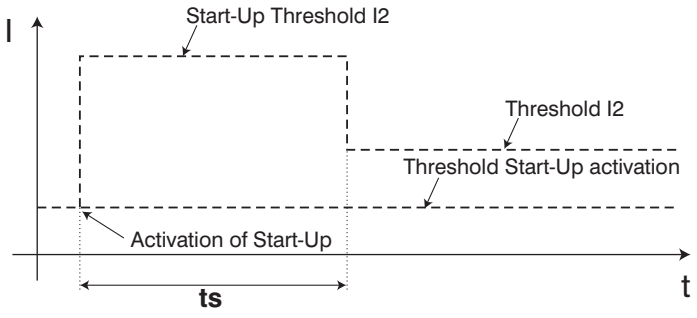
2.6.3.1. Thermal memory S

The thermal memory function can be enabled for cable protection in the case where the curve with inverse time is selected. This is based on the "tS" parameter defined as the trip time of the curve (t2) selected at 1.5xI2. The other characteristics are the same as those for thermal memory L.

2.6.3.2. Start-up threshold S

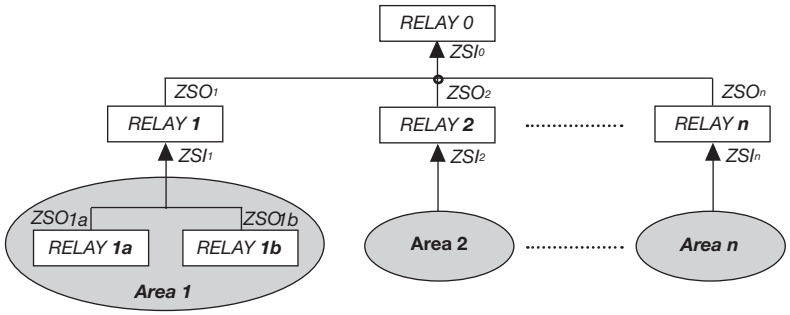
The start-up function can be selected in the case where the curve with fixed time is selected.
The function can be disabled and it is a setting characteristic of the single protection units.

The start-up function enables the protection threshold (S, I and G) to be changed during a time interval lasting "ts", starting from "start-up". The latter must be intended as follows:
- Passage of at least one of the phase currents above the activation threshold of the adjustable Start-Up with Ekip Connect or PR010/T (0.1…10In, by 0.1In steps); A new start-up is possible after the current has dropped below this threshold.



2.6.3.3. Zone S selectivity

The zone selectivity function, guaranteed only if an auxiliary voltage is provided, enables the area of the fault to be isolated, only isolating the part of plant nearest to the fault, while keeping the rest of the plant operational.
This is done by connecting all the zone selectivity outputs of the releases belonging to the same zone to one another (ZSO=K51/SZout) and taking this signal to the zone selectivity input (ZSI=K51/SZin) of the next release on the supply side. If the wiring has been done correctly, all the zone selectivity inputs of the last circuit-breakers in the chain and all the outputs of the circuit-breakers at the head of each chain must be empty.



As a practical example, the figure above shows a fault on the load side of the “Relay 1a” isolated by the latter without the “Relay 1” or the “Relay 0” being affected; a fault immediately downstream from the “Relay 1” will be isolated by the latter without the “Relay 0” being affected, thus ensuring that the Areas 2...n remain operational.

The following logical table is implemented to manage the Zone Selectivity Input (ZSI) and Zone Selectivity Output (ZSO) signals:

Zone selectivity	$I_f > I_2$	ZSI signal	ZSO signal	Trip T
Excluded	NO	0	0	No trip
Excluded	NO	1	0	No trip
Excluded	YES	0	0	t_2 programmed
Excluded	YES	1	0	t_2 programmed
Inserted	NO	0	0	No trip
Inserted	NO	1	1	No trip
Inserted	YES	0	1	$t_{selectivity}$
Inserted	YES	1	1	t_2 programmed

The time t_2 must be set at a value higher than or equal to $t_{selectivity}$ +50 ms, on the CB on the supply side, not required on the first one in the chain.

2.6.4. Protection S2

Relay PR123/P allows two protection S threshold to be set. They are independent of each other but can be activated at the same time.
This function allows a better selectivity level to be obtained than by using a relay without a “double S”.

WARNING: The zone selectivity function with double S is valid with the t=k time setting.

2.6.5. Directional protection D

The PR123/P unit carries out excludable directional protection against short-circuit with adjustable fixed time (t = k) active both with self-powering and with auxiliary supply.

The protection functionality is very similar to protection “S” with fixed time, with the capacity to recognize the current direction during the fault period as well.
The direction of the current enables the determination of whether the fault is on the supply side or the load side of the circuit-breaker. Especially in ring distribution systems, this enables the distribution stretch where the fault occurred to be identified and isolated without interfering with the rest of the installation (using zone selectivity).
To determine the direction of the current, the value of the phase reactive powers has to be higher than 2% of the nominal phase power

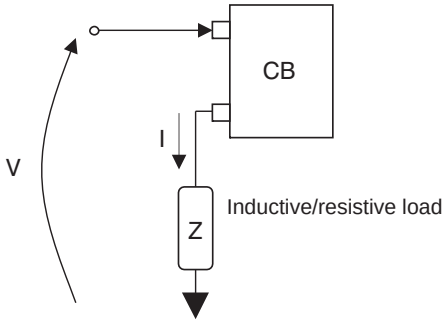
$(P_Q \geq 2\% \cdot P_{nphase})$.

The PR123 enables you to define the power flow in the circuit-breaker from the menu:
from high to low (Top → Bottom),
from low to high (Bottom → Top),
selectable in the menu Modules Measuring Module (PR120/V).

As a result, the currents in the circuit-breaker will be defined as “forward” or “backward” if their are in phase or out of phase with the previously-defined power flow.

Ifault (I_f)		Power flow set Top → Bottom	Power flow set Top → Bottom
Value	**Direction**	**Trip T**	**Trip T**
$I_f < I_7$	Either	No trip	No trip
$I_f > I_7$	High → Low	t_{7FW}	t_{7BW}
$I_f > I_7$	Low → High	t_{7BW}	t_{7FW}

Example:
Once the power flow has been set as “Top → Bottom”, the direction of the figure alongside is:



positive reactive power in → “forward” direction;;

negative reacti ve power in → “backward” direction

If the preset trip times were t_{7FW} = 200 ms and t_{7BW} = 400 ms, in this case the relay would have opened the circuit-breaker after t_{7FW} = 200 ms.

Note:
- With the directional protection D activated, if the direction of the power cannot be determined the relay takes effect considering shorter of the programmed times between t_{7fw} and t_{7bw}.
- This protection works on the basis of the phase currents, not the neutral current.

2.6.5.1. Start-up threshold D

The function behaves in exactly the same way as the protection S.

2.6.5.2. (Directional) zone selectivity D

The Directional Zone Selectivity (SdZ D) function is particularly useful in ring and grid type systems where, in addition to the zone, it is essential to define the direction of the power flow that powers the fault.

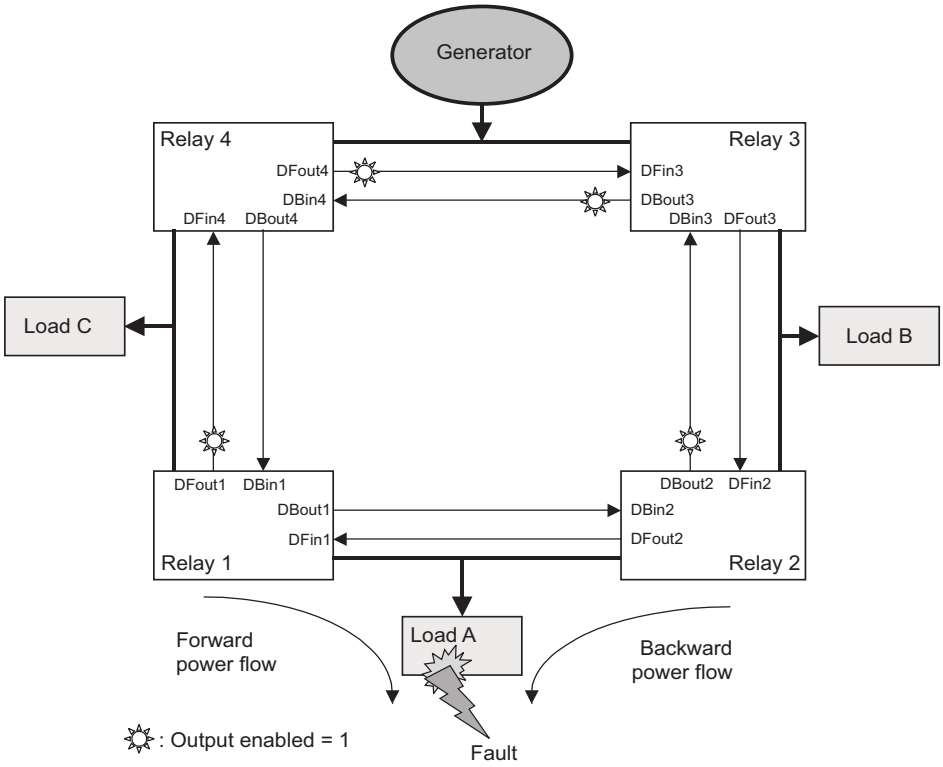
SdZ D can be enabled as an alternative to Zone Selectivity S and G (which must be disabled in order to obtain correct operation) and needs Vaux.

To define the zone and power flow, each relay has two inputs (DFin and DBin) and two outputs (Dfout and DBout), which must be suitably connected to the other relays (see example below).
As in the SdZ S and G, the relays interact with each other, sending cutout signals via the outputs and reading them via the inputs.
The general behavior is summarized in the table below.
(Example with power flow setting “Top → Bottom”).

Ifault (I_f)		Output status		Input status		T trip
Value	**Direction**	**DFout**	**DBout**	**DFin**	**DBin**	
$I_f < I_7$	either	0	0	either	either	No trip
$I_f > I_7$	Top → Bottom	1	0	0	either	t_s
$I_f > I_7$	Top → Bottom	1	0	1	either	t_{7FW}
$I_f > I_7$	Bottom → Top	0	1	either	1	t_{7BW}
$I_f > I_7$	Bottom → Top	0	1	either	0	t_s

If the power flow is in phase with the direction set on the relay, the output DFout is enabled (1).
Vice versa, if the power flow is out of phase, the output DBout is enabled (1).

The typical configuration of the system of circuit-breakers for which the SdZ D is likely to be used is the sort of ring illustrated in the following figure.



If a fault is detected (I fault If beyond the threshold I7) in one of the sections of the system (Load A), the final circuit-breakers for the section in question (Relay1 and Relay2) communicate the presence of the fault to the connected circuit-breakers (Relay4 and Relay3) by setting the output signals DFout or DBout depending on the direction of the current (DFout1=On, DB2out=On). To be more precise, the circuit-breakers that limit the section affected by the fault see the direction of the fault current in different ways (Relay1=forward and Relay2=backward).

The circuit-breakers (Relay1 and Relay2) delimiting the section affected by the fault are tripped with the selectivity time ts, while the circuit-breakers further away from the fault count down the time t7FW (Relay4) and t7BW (Relay3) without opening; in this way, the system is isolated, in the time ts, to exclude the part affected by the fault.
The load A, where the fault has occurred, will be disconnected, but loads B and C will continue to be powered normally.

It should be noted that activation of the DBout3 output by the relay3 will have no effect on the relay4, because the latter is recording not an out-of-phase (backward) fault current, but an in-phase (forward) current with the power flow defined previously by the user (Top → Bottom).

Note:
- With zone selectivity enabled, if the direction of the power flow cannot be ascertained, the relay is tripped considering the lesser of the programmed times between t7fw and t7bw, without enabling any outputs (DFout or DBout).
- If, for some reason, one of the circuit-breakers required to open does not do so, a specific function will activate the opening of the first circuit-breaker immediately upstream from it, after a further 100ms approx. In the above example, if the circuit-breaker does not open with the relay1, only the circuit-breaker with relay4 will open after a time ts+100ms.
- The SdZ D operates on the basis of the phase currents, not of the neutral.

2.6.6. Protection "I"

The protection is enabled/disabled from the menu.
In the case where zone selectivity “S” is active, during the trip of the relay for “I”, the ZSO output signal is activated in any case to guarantee correct operation of the relay on the supply side (and on the load side.

2.6.6.1. Start-up threshold "I"

The function behaves in exactly the same way as the protection “S”.

2.6.7. Protection against closing on short-circuit “MCR”

The MCR function is used to protect the system against closing.
The protection possesses the same functional characteristics as protection **I** (it uses the same control and trip algorithm) and functions if the aforementioned protection I is disabled.

If enabled, the protection functions in the presence of Vaux or PR120/V. It activates the moment the CB closes for a time slot that can be adjusted by the user, after which it deactivates.

This function can be activated through a hand-held PR010/T unit with the ABB SD-Testbus2 communication softwares or through a remote system via a system bus.
Protection “S” protects against short circuits.

2.6.8. Protection “G”

Protection G is performed by the relay with vector analysis of the neutral and phase currents. The fault current is defined by the following formula:

$$\overrightarrow{I_G} = \overrightarrow{I_1} + \vec{I}_2 + \vec{I}_3 + \vec{I}_N$$

In the case when the circuit does not show any fault, the module of the sum of these currents is always nil; vice versa the value of the fault current will take on an increasingly large value depending on the size of the fault. This operating mode is enabled by default.
The protection, which can be disabled, can be the fixed time (t=k) inverse time ($t=k/I^2$)

The tripping time with inverse time curve is given by the expression: $t(s)= \frac{2}{(I_f/I_4)^2}$. If the calculated value is less than t_4, the real tripping time is forced to t_4 ($t(s)= t_4$).

NOTES:
- t(s): envisaged tripping time
- I_f : fault current; given in [In] (example: 0.4In)
- I_4 , t_4: *protection G parameters* set by the user, given in [In] and [s]

The minimum threshold setting for protection G is 0.1In for relays with SW version ≥ 2.05. Adjustment up to 0.1In is available with Vaux present. In the absence of Vaux, the minimum adjustment becomes 0.2In

WARNING: Protection G is disabled for current values of over 8In (for $I_4 \geq$ 0.8In), over 6In (for 0.5In$\leq I_4<$0.8In), over 4In (for 0.2In$\leq I_4<$0.5In) and over 2In (for $I_4<$0.2In).

ATTENZIONE: With Iu≥800A: In the absence of Vaux and with I4<100A, the SW forces the minimum threshold to 100A and “Configuration”error is displayed. With Iu≥250A: In the absence of Vaux and with I4<30A, the SW forces the minimum threshold to 30A and “Configuration”error is displayed.

**WARNING: It is possible to disable the trip control of the protection (“Enable Trip: Off”).
In that case, for the whole duration of the unbalance the CB will not be opened, but only the condition will be signaled by means of the “warning” LED lit up and a warning message.**

2.6.8.1. Zone selectivity “G”

The function behaves in exactly the same way as the protection “S”.

2.6.8.2. Zone selectivity “G”

Zone selectivity “G” can be active at the same time as zone selectivity “S”.

Zone selectivity “G” can be active at the same time as zone selectivity “S”.

2.6.9. Protection "Gext"

Also called “Source Ground return”, this can be carried out when there is the need to check operation of a machine (transformer, generator or motor etc.) which has star-configured windings.
The protection is assured by physically positioning an external toroid on the cable connected from the star center of the machine to the earthing connection point.
The induced current on the winding of the toroid is proportional to the fault current which, in this case, only transits in the above-mentioned toroid

The presence of sensor SGR must be activated via the menu, in the Settings-Circuit-breaker-Earth Protection section.

The minimum threshold setting for protection Gext is 0.1xIn (the In settings are 100, 250, 400, 800A) with SW version ≥ 2.05. Adjustment up to 0.1In is available with Vaux present. In the absence of Vaux, the minimum adjustment becomes 0.2In

Protection Gext possesses the same adjustment characteristics as protection G and is controlled differently by relays PR122/P and PR123/P.
- PR122/P: only one protection can be set: if both are enabled, activation of Gext excludes G.
- PR123/P: available at the same time. Activation of Gext does not exclude G.

WARNING: The external toroid must be connected to the relay with shielded stranded two-wire cable (such as BELDEN 3105A two-wire cable) no longer than 15 m. The shield must be earthed on both the circuit-breaker side and toroid side.

It is indispensable for the star center to be connected openly to earth and for it not to be used as a neutral conductor too (as in the TNC system), making a protection according to the TT system.

2.6.9.1. Start-up threshold “Gext"

The function behaves in exactly the same way as the protection “S”

2.6.9.2. Zone selectivity “Gext"

The function behaves in exactly the same way as the protection “S”.
Moreover, Zone selectivity Gext is controlled in different ways by relays PR122/P and PR123/P.
- PR122/P: similarly to the protection, one single selectivity can be set, either G or Gext. If both are enabled, activation of Gext excludes G.

- PR123/P: selectivity G and Gext are available at the same time. Activation of Gext does not exclude G.

WARNING: With relay PR123/P and if both selectivity G and Gext are activated, input K51/GZin and output K51/GZout are shared: the commands and time settings are determined by the settings of the 2 selectivity options and just one of the two need be activated in order to activate the inputs and outputs (e.g.: output K51/GZout is activated if the fault current exceeds one of the two protection thresholds).

2.6.10. Protection Gext (Idn) / Residual current protection Rc

Protection Rc provides protection against earth faults of the residual current type.
The protection, which can be adjusted, allows the operating threshold and non-trip time settings to be made (the trip fails to occur if the alarm terminates within the set time).

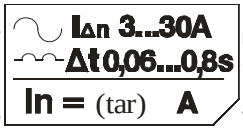
The presence of sensor Rc must be activated via the menu, in the Settings-Circuit-breaker-Earth Protection section.

WARNING: It is essential to enable the protection after the dedicated rating plug has been installed and with the PR120/V module connected to the relay.

The function is available for the pertinent versions of relays PR122/P and PR123/P, and only in the presence of:
- module PR120/V
- external sensor Rc
- relay configured with dedicated rating plug for residual current protection.

Rating plugs for residual current protection have a different label from the ordinary model, indicating the sensitivity range and non-trip time settings that characterize the function.

The protection is controlled in different ways by relays PR122/P and PR123/P:
- PR122/P LSIG: only one protection can be set, either Rc or G: if both are enabled, activation of Rc excludes G.
- PR123/P LSIG: available at the same time. Activation of Rc does not exclude G.



Two toroid models are available. The “small” toroid can be installed on three-pole models E1 and E2, while the “medium” can be installed on four-pole models E1 and E2, and on three-pole model E3.

WARNING: The protection is inhibited for current values over the maximum rated current value of the circuit-breaker model on which the protection unit is installed, according to the following criteria:
- CB E2 : inhibition for current values exceeding 2000A with tolerance [0...+10%]
- CB E3 : inhibition for current values exceeding 3200A with tolerance [0...+10%]

Instructions on how to put the configuration with sensor Rc into service are available in par. 2.12.7.
Details about the sensory chain test with Rc are available in par. 2.10.3.

2.6.11. Protection "U"

The excludable fixed time protection allows phase voltage or current unbalance to be monitored.
Voltage unbalance can only be monitored if module PR120/V is installed.

This fixed time, excludable protection trips when, for the **t6** time setting or longer, an unbalance is detected between two or more phases that is higher than the **I6** threshold setting.

The percentage of current unbalance is calculated in the following way:

% Unbal $= \frac{I_{max} - I_{min}}{I_{max}} \cdot 100$ where I_{max} is the maximum and I_{min} the minimum phase current.

Unbalance percentage is calculated as follows $Voltage\ unbalance = \frac{Max.\ deviation\ from\ mean\ d_i\ (V_{12}, V_{23}, V_{31})}{Mean\ d_i\ (V_{12}, V_{23}, V_{31})}$.

Besides normal time delay and trip operation, the protection setting for voltage monitoring can, with Vaux or powering via the PR120/V module, be in such a state of alarm as to be unable to activate the immediate trip: this is because the voltage fault may persist even when the circuit-breaker is open. In view of the alarm state, the opening command is transmitted immediately when circuit-breaker closing or the passage of current are detected.

The trip command of the protection can be disabled: in this case, CB opening is not controlled and the condition is merely signalled by leds and a message on the display.

WARNING: When the value of the phase current is above 6xIn, the function "U" excludes itself because, in this case, the other protections intervene because the fault is considered as a phase fault.
The protection is not enabled for maximum phase current values lower than 0.3xIn.

2.6.12. Protection "UV"

The excludable, fixed time (t=k), adjustable protection is activated with both self-supply and auxiliary power:
When the minimum phase voltage drops below the set threshold U_8 the protection counts down the preset time interval t_8 and then opens.

As already described for protection U, the function acts in the same way if an Alarm occurs (opening depending on the state of the CB and the presence of current) and the trip can be disabled.

2.6.13. Protection "OV"

The excludable, fixed time (t=k), adjustable protection is activated with both self-supply and auxiliary power:
When the maximum phase voltage exceeds the set threshold U_9 the protection counts down the preset time interval t_9 and then opens.

As already described for protection U, the function acts in the same way if an Alarm occurs (opening depending on the state of the CB and the presence of current) and the trip can be disabled.

2.6.14. Protection "RV"

The excludable, fixed time (t=k), adjustable protection is activated with both self-supply and auxiliary power:
When the residual voltage exceeds the set threshold U_{10} the protection counts down the preset time interval t_{10} and then opens.
The residual voltage U_0 is calculated by vectorially summing the phase voltages. It is therefore defined by the following formula.

$$\overrightarrow{U_0} = \overrightarrow{U_1} + \overrightarrow{U_2} + \overrightarrow{U_3}$$

This protection is available on 4-pole or 3-pole CBs with neutral voltage available (see circuit diagram 48). On 3-pole CBs, presence of neutral voltage must be set by the "neutral voltage present" parameter.

As already described for protection U, the function acts in the same way if an Alarm occurs (opening depending on the state of the CB and the presence of current) and the trip can be disabled.

2.6.15. Protection "RP"

The excludable, fixed time (t=k), adjustable protection is activated with both self-supply and auxiliary power:
When the total reverse active power (sum of the power of the 3 phases) exceeds the set reverse active power threshold P_{11} the protection counts down the preset time interval t_{11} and then opens.
The minus sign ('-') in front of the threshold and power indicates reverse power. The threshold is indicated as a percentage of "Pn", where "Pn" is the rated power of the circuit-breaker (3 Vn*In).

As already described for protection U, the function acts in the same way if an Alarm occurs (opening depending on the state of the CB and the presence of current) and the trip can be disabled.

2.6.16. Protection "UF" and "OF"

The frequency protections detect variations in the network frequency above (f_{12}, t_{12}) or below (f_{13}, t_{13}) an adjustable threshold, thereby generating an alarm or opening the circuit-breaker.

2.6.17. Protection "T"

There is a sensor inside the PR122/P and PR123/P unit that monitors the temperature of the unit.
This enables the signalling of any abnormal temperature conditions, which could cause temporary or continuous malfunctions of the unit's electronic components.

This protection has two states of operation:

State of "WARNING TEMPERATURE" with ***–25°C < temp. < -20°C*** or ***70°C < temp. < 85°C*** :

the display is turned off and the "WARNING" LED flashes at 0.5Hz

State of "ALARM TEMPERATURE" with ***temp. ≤ –25°C*** or ***temp. ≥ 85°C*** :

the display is turned off, the "WARNING" and "ALARM" Leds flash at 2Hz and the Trip is activated (if enabled by means of the "Over Temper. Trip = On" parameter).

In the event of Warning and Alarm, the display is turned off, to preserve its functionality;
The monitored temperature is not visible on the display.

The protection is always active, both with auxiliary supply and in self-supply.

WARNING: Disabling the Trip control of the protection means that the PR122/P unit could work, with the circuit-breaker closed, in a range of temperatures where correct operation of the electronics is not guaranteed.

2.6.18. Load control function

Single loads can be enabled/disabled on the load side before the overload protection L intervenes and trips the circuit-breaker on the supply side. This is done by contactors or switch-disconnectors (wired outside the release), controlled by the PR122/P by means of contacts on the PR120/K module or on the PR021/K external unit.

The current thresholds are lower than those available with the protection L, so that the load control can be used to prevent tripping due to overloads. The function is active when an auxiliary power supply is present, or supply from PR120/V (see par. 15.1.4).
The operating logic involves the activation of three contacts when the preset thresholds LC1, LC2 and I_w are exceeded.
Thresholds LC1 and LC2 are expressed as a percentage of I_1 (current threshold specified for protection L) while the "warning current" I_w is expressed as an absolute value. The allowable values are given in the following table:

Threshold LC1	50%...100% x I1 step 1% I1
Threshold LC2	50%...100% x I1 step 1% I1
Threshold Iw	0,3 ...10,0 x In step 0,05 In

From the PR122/P you can associate each of the PR120/K or PR121/K contacts with a configuration (NO or NC), a delay and the eventual latch.

2.6.19. Double protection set

Relay PR123/P allows a second set of protections to be configured.
Activation of the "Dual Set" function in the Settings-Dual set menu allows the operator to configure a second set of all the available protections, called Set B. The event for automatic set change-over can also be associated in the settings menu.
If Dual Set is enabled, the protections menu will present a new level, where the Set to be viewed or whose parameters must be edited can be selected. (Set A and Set B)

The operator can switch from set A to set B when there is a change in the network configuration or when there is an emergency capable of changing the load capacity and short-circuit levels.
The automatic event that can be selected by the user for automatic set change-over can be:
- Activation of the digital input of module PR120/K (activation of the input enables the change of state).
- Change of state of the CB (when there is a change of state from open to closed, the second protection set is activated for a programmed time). This function also includes adjustment of the time the second set must remain activated after closing. The main set returns after this time has elapsed).
- Presence of Vaux (the second set of protections activates in the presence of Vaux).

The set can also be edited by the user via the display or by means of a communication module.

2.6.20. Neutral Protection

Relays PR122/P and PR123/P allow the current signal of the neutral pole to be processed with different ratios in relation to the value of the phases. The following values can be set for this protection: I_nN =Off - 50% - 100% - 150% - 200% * I_n.
The adjustments can be made via the menu in the Settings-Circuit-breaker-Neutral Protection section.

Regulation of the neutral value (I_nN) must conform to the following formula: (I_1 x I_nN) ≤ Iu.
The relay performs the test automatically for four-pole circuit-breakers and transmits a fault signal following failure to conform to this formula. If the circuit-breaker is the three-pole type with external neutral, no tests will be performed by the relay and correction of the settings is at the user's charge.
E.g.: With CB E1B800 (Iu=800A), Rating plug 400A (In=400A) and I1=1In, the I_nN setting could be: 50-100--150-200% .
With CB E1B800 (Iu=800A), Rating plug 800A (In=800A) and I1=1In, the I_nN could be: 50-100%.

The I_1=1I_n setting is the maximum setting of the protection against overload. The real permissible maximum setting setting must take account of derating due to the temperature, the terminals used and the altitude, or In (rating plug)≤ 50% of the size of the circuit-breaker.

WARNING: In some installations, where particularly high harmonics occur, the current circulating on the neutral may be higher than that of the phases.

WARNING: For three-pole circuit-breakers without external neutral, the Neutral protection setting must be OFF, otherwise the sensor presence error will be signalled (Error CS).
In these cases, short-circuit T5-T6 on the sliding contacts, as shown in the wiring diagrams.

WARNING: Failure to comply with the setting limits for "I_1" and "I_nN" can cause circuit-breaker damage with consequent risks even for the operator.

WARNING: the protection setting is automatically 100% when the current value exceeds 15.5xIn on the neutral.

2.6.21. Protection against instantaneous short-circuit “Iinst”

The purpose of this protection is to maintain the integrity of the circuit-breaker and installation in the case of particularly high current values requiring shorter reaction times than those provided by the instantaneous short-circuit-protection.
The protection cannot be disabled. It has a single fixed time protection curve and the threshold level is exclusively at the charge of ABB personnel.

2.6.22. Summary table of the protection function settings for PR122 and PR123/P

Current protections	PR122/P	PR123/P	Disabling	Disabling of TRIP only	Zone selectivity	Start-up threshold	Thermal memory	Trip Threshold	Trip time	Trip threshold tolerance (2)	Trip time tolerance (2)
L all curves: t=k/I2 and IEC 60255-3	☒	☒	☐	☐	☐	☐	☒	0,4xIn ≤ I_1 ≤ 1xIn step 0,01xIn	3s ≤ t_1 ≤ 144s(1), step 3s @I_f=3I_1	Releasebe-tween 1,05 and 1,2 xI1	±10%, I_f ≤ 6In ±20%, I_f > 6In
S (t=k)	☒	☒	☒	☐	☒	☒	☐	0,6xIn ≤ I_2 ≤10xIn step 0,1xIn 0,6xIn ≤ $I_{2\ start\text{-}up}$ ≤10xIn step 0,1xIn	I_f>I2 0,05s ≤ t_2 ≤ 0,8s, step 0,01s 0,10s ≤ $t_{2\ start\text{-}up}$ ≤ 30s, step 0,01s 0,04s ≤ $t_{2\ sel}$ ≤ 0,2s, step 0,01s	±7%, I_f ≤ 6In ±10%, I_f > 6In	The best of the two data±10% or 40ms
S (t=k/I^2)	☒	☒	☒	☐	☐	☐	☒	0,6xIn ≤ I_2 ≤10xIn step 0,1xIn	0,05s ≤ t_2≤ 0,8s, step 0,01 s @I_f=10In	±7%, I_f ≤ 6In ±10%, I_f > 6In	±15%, I_f ≤ 6In ±20%, I_f > 6In
S2 (t=k)	☐	☒	☒	☐	☒	☒	☐	0,6xIn ≤ I_2 ≤10xIn step 0,1xIn	@I_f>I_2 0,05s ≤ t_2≤ 0,8s, step 0,01s 0,10s ≤ $t_{2\ start\text{-}up}$ ≤ 30s, step 0,01s 0,04s ≤ $t_{2\ sel}$ ≤ 0,4s, step 0,05s	±7%, I_f ≤ 6In ±10%, I_f > 6In	The best of the two data ±10% or 40ms
D (t=k)	☐	☒	☒	☐	☒	☒	☐	0,6xIn ≤ I_7 ≤10xIn step 0,1xIn	@I_f>I_7 0,20s ≤ t_7≤ 0,8s, step 0,01s 0,10s ≤ $t_{7\ start\text{-}up}$ ≤ 30s, step 0,01s 0,13s ≤ $t_{7\ sel}$ ≤ 0,5s, step 0,01s	±10%	The best of the two data±10% or 40ms
I (t=k)	☒	☒	☒	☐	☐	☒	☐	1,5xIn ≤ I_3 ≤15xIn step 0,1xIn 1,5xIn ≤ $I_{3\ Start\text{-}Up}$ ≤ 15x In	≤ 30 ms 0,1s ≤ $t_{3\ start\text{-}up}$ ≤ 30s, step 0,01s @ I_f>I_3	±10%	
MCR (t=k)	☒	☒	☒	☐	☐	☐	☐	6,0xIn ≤ I_5 ≤15xIn step 0,1xIn	@I_f>I_5 ≤ 30ms(3)	±10%	
G(4) (6) (t=k)	☒	☒	☒	☒	☒	☒	☐	0,1xIn ≤ I_4 ≤1xIn step 0,02xIn	0,1s ≤ t_4 ≤ 1s, step 0,05 s 0,1s ≤ $t_{4\ start\text{-}up}$ ≤ 1s, step 0,02s 0,04s ≤ $t_{4\ sel}$ ≤ 0,2s, step 0,01s @ I_f>I_4	±7%	The best of the two data±10% or 40ms
G(4) (6) (t=k/I^2)	☒	☒	☒	☒	☐	☐	☐	0,1xIn ≤ I_4 ≤1xIn step 0,02xIn 0,2xIn ≤ $I_{4\ Start\text{-}Up}$ ≤ 1x I_4	0,1s ≤ t_4 ≤ 1s, step 0,05s (minimum trip time) @I_f>4In	±7%	±15%
Gext (6) (t=k)	☒	☒	☒	☒	☒	☒	☐	0,1xIn ≤ I_4 ≤1xIn step 0,02xIn	@I_f>I_4 0,1s ≤ t_4 ≤ 1s, step 0,05 s 0,1s ≤ $t_{4\ start\text{-}up}$ ≤ 30s, step 0,02s 0,04s ≤ $t_{4\ sel}$ ≤ 0,2s, step 0,01s	±7%	The best of the two data±10% or 40ms
Gext (6) (t=k/I^2)	☒	☒	☒	☒	☐	☐	☐	0,1xIn ≤ I_4 ≤1xIn step 0,02xIn	0,1s ≤ t_4 ≤ 1s, step 0,05s (minimum trip time) @I_f>4In	±7%	±15%
Rc (Idn)	☒	☒	☐	☐	☐	☐	☐	Idn =3-5-7-10-20-30A	0,06-0,1-0,2-0,3-0,4-0,5-0,8s(3)	-20% ÷ 0	0,06s(5)

Current protections	PR122/P	PR123/P	Disabling	Disabling of TRIP only	Zone selectivity	Start-up threshold	Thermal memory	Trip Threshold	Trip time	Trip threshold tolerance (2)	Trip time tolerance (2)
U (t=k)	☒	☒	☒	☒	☐	☐	☐	2% ≤ I_6 ≤ 90% step 1%	0,5s ≤ t_6 ≤ 60s, step 0,5s	±10%	The best of the two data±10% or 40ms
OT (temp=k)	☒	☒	☐	☒	☐	☐	☐	Fixed, defined by ABB SACE	Instantaneous	± 5°C	
Iinst	☒	☒	☐	☐	☐	☐	☐	Automatic, defined by ABB SACE	Instantaneous		
UV (t=k)	☒	☒	☒	☒	☐	☐	☐	0,5xUn ≤ U_8 ≤ 0,95xUn step 0,01xUn	0,1 s ≤ t_8 ≤ 5 s, step 0,1 s	± 5%	The best of the two data±10% or 40ms
OV (t=k)	☒	☒	☒	☒	☐	☐	☐	1,05xUn ≤ U_9 ≤ 1,2xUn step 0,01xUn	0,1 s ≤ t_9 ≤ 5 s, step 0,1 s	± 5%	The best of the two data±10% or 40ms
RV (t=k)	☒	☒	☒	☒	☐	☐	☐	0,1xUn ≤ U_{10} ≤ 0,4xUn step 0,05 Un	0,5 s ≤ t_{10} ≤ 30 s, step 0,5 s	± 5%	The best of the two data±10% or 40ms
RP (t=k)	☒	☒	☒	☒	☐	☐	☐	- 0,3xPn ≤ P_{11} ≤ -0,1xPn step 0,02 Pn	0,5 s ≤ t_{11} ≤ 25 s, step 0,1 s	± 5%	The best of the two data± 10% o 40 ms
UF	☒	☒	☒	☒	☐	☐	☐	0,9fn ≤ f_{12} ≤ 0,99fn step 0,01 fn	0,5 s ≤ t_{12} ≤ 3 s, step 0,1 s	± 5%	The best of the two data±10% or 40ms
OF	☒	☒	☒	☒	☐	☐	☐	1,01fn ≤ f_{13} ≤ 1,1fn step 0,01 fn	0,5 s ≤ t_{13} ≤ 3 s, step 0,1 s	± 5%	The best of the two data±10% or 40ms
LC1/LC2 load Control	☒	☒	☒	☐	☐	☐	☐	50%÷100% step 1%xI_1			
Warning Iw	☒	☒	☒	☐	☐	☐	☐	0,3÷10I_n step 0,05xI_n		± 10%	10÷40 ms

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

(2) These tolerances are based on the following assumptions:
- Self-powered relay (no start-up) with 2 or 3 supplied phases and/or in presence of auxiliary supply.
- Preset trip time ≥ 100 ms.
- Temperatura e correnti entro i limiti di funzionamento.

(3) No-trip time.

(4) **La protezione G può essere disabilitata automaticamente dal relè in funzione della corrente misurata. Per le casistiche see par. 2.6.8.**

(5) Max trip time.

(6) La soglia minima delle protezioni G e Gext, in assenza di Vaux diventa 0,2In.

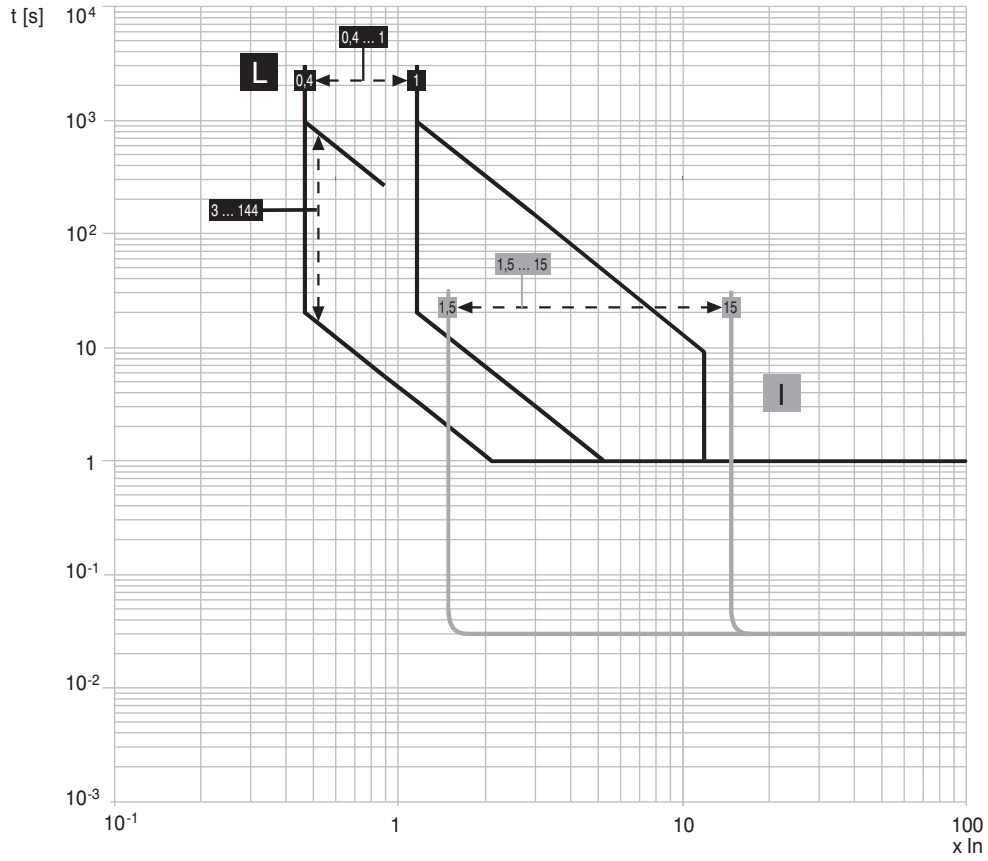
For all cases not covered by the above hypotheses, the following tolerance values apply:

Protection	Trip threshold	Trip time
L	Release between 1,05 e 1,25 x I1	± 20%
S	± 10%	± 20%
I	± 15%	≤ 60ms
G	± 10%	± 20%
Others		± 20%

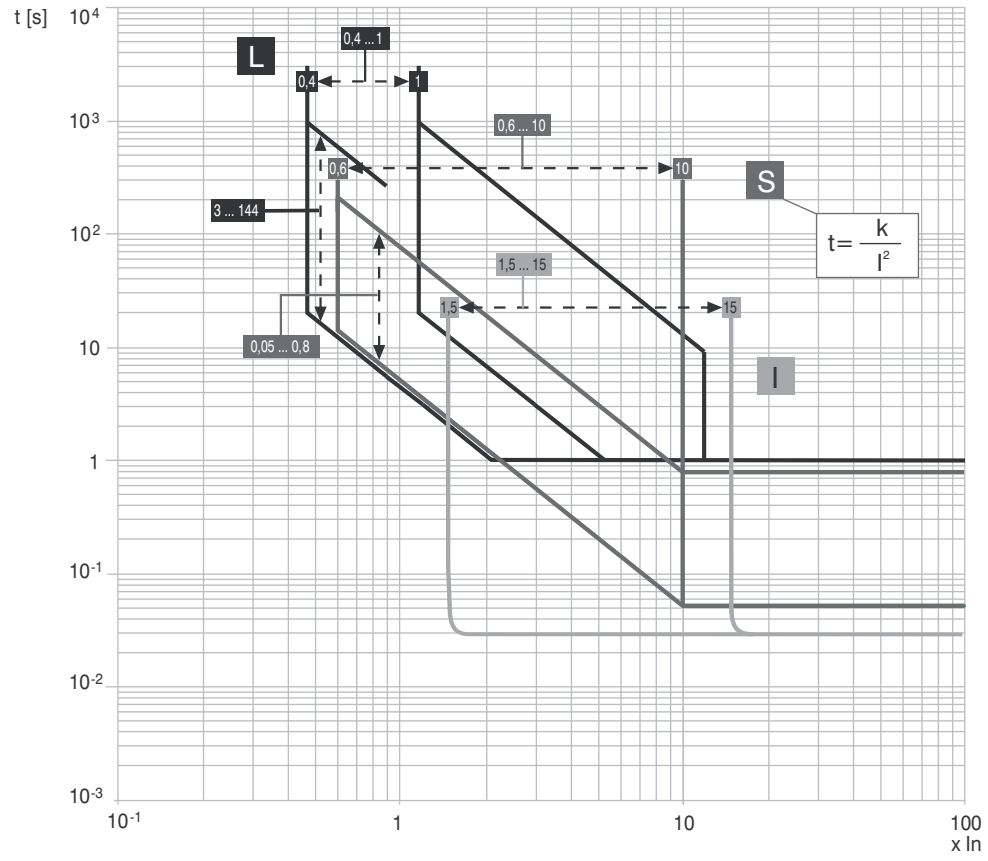
2.6.23. Trip curves

The trip curves given are for guidance and only show a sub-group of the possible selections.

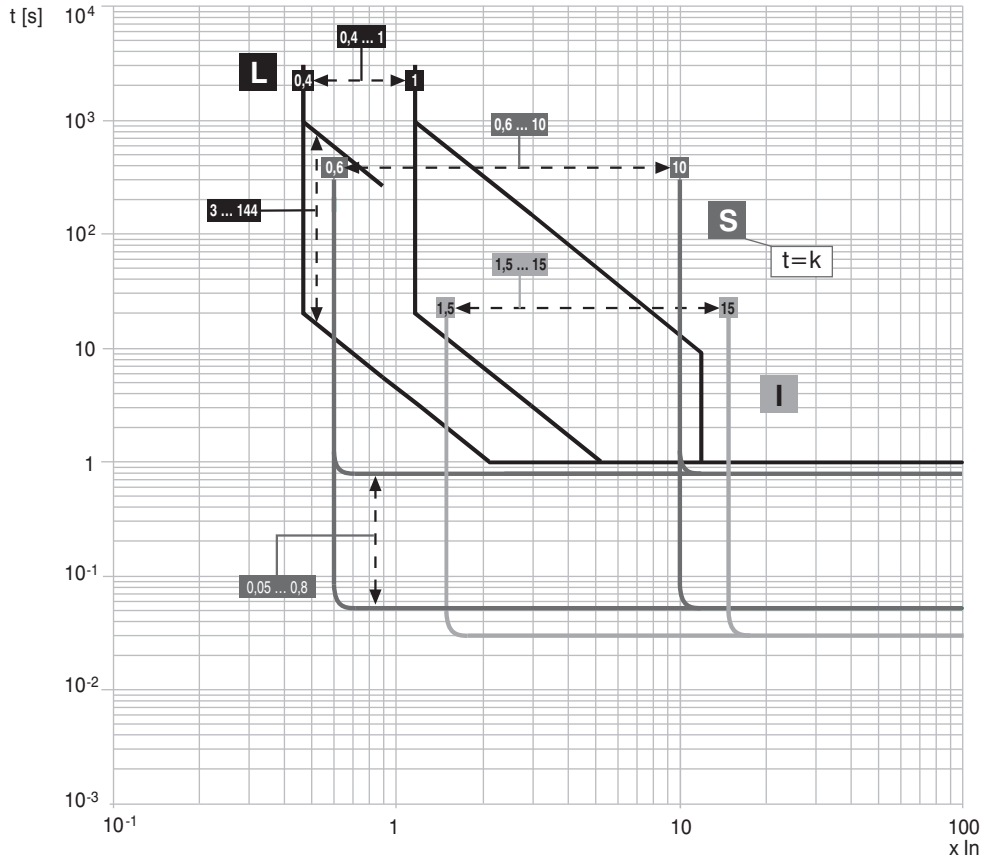
2.6.23.1. Trip curves for functions L-I



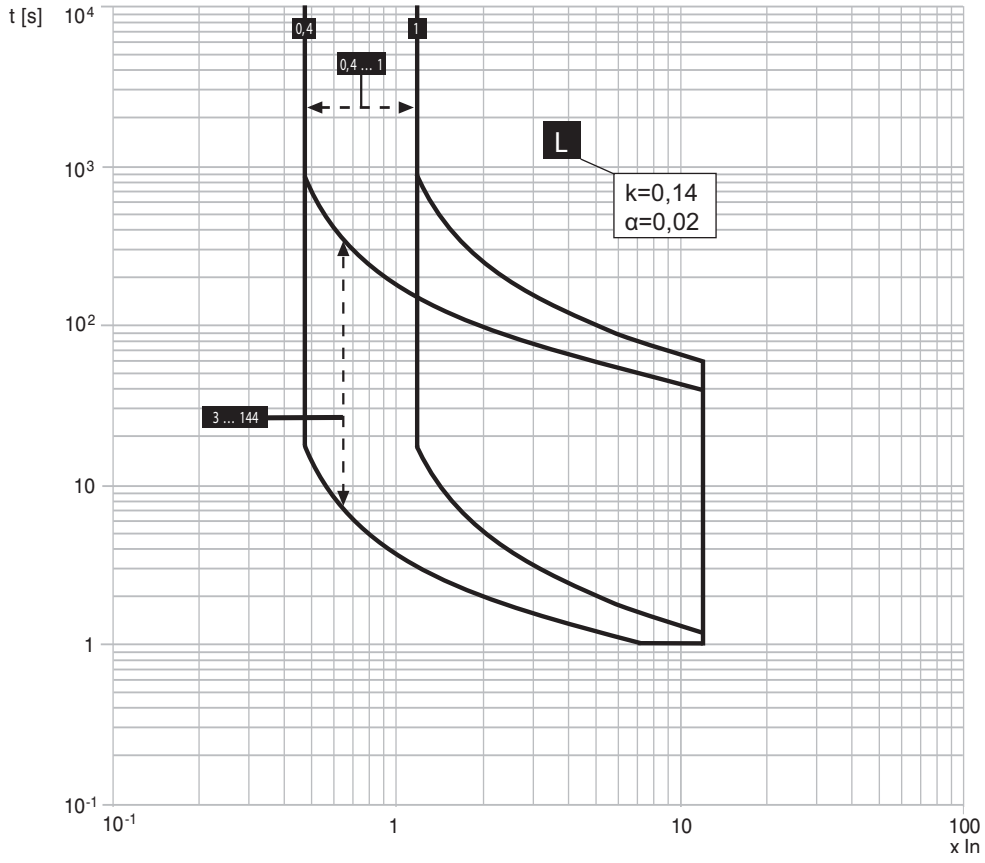
2.6.23.2. Trip curves for functions L-S(t=k/I²)-I



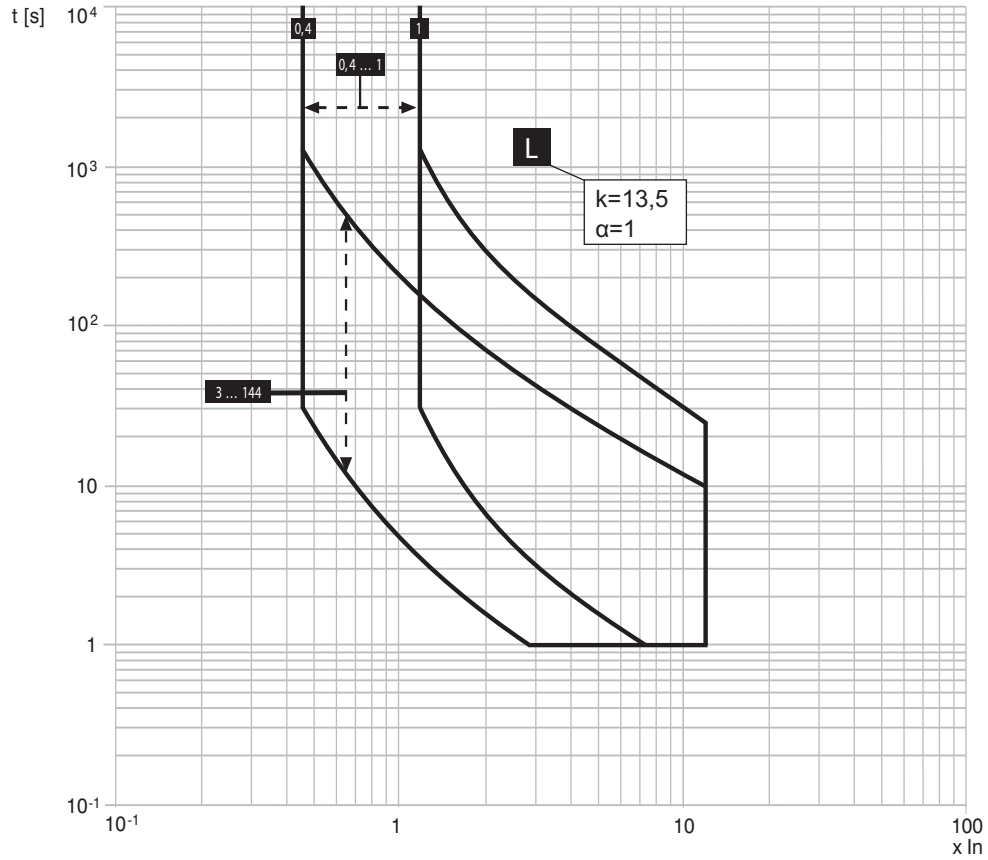
2.6.23.3. Trip curves for functions L-S(t=k)-I



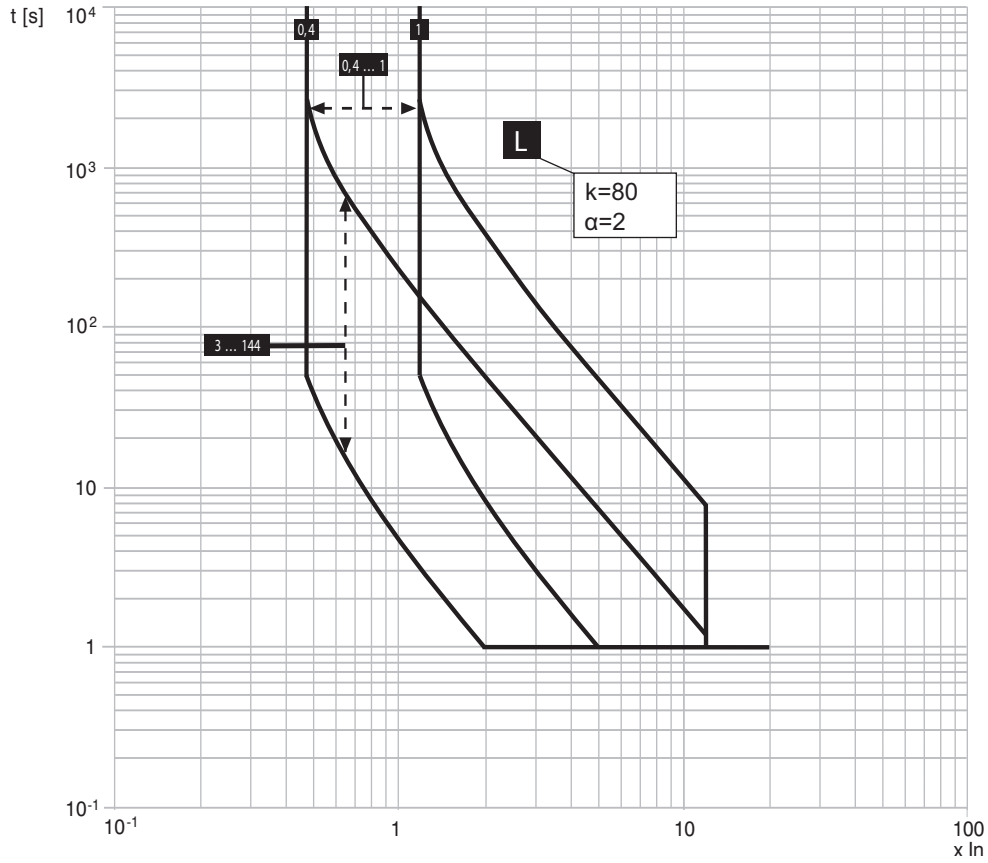
2.6.23.4. Trip curves for function L in accordance with IEC 60255-3 (type A)



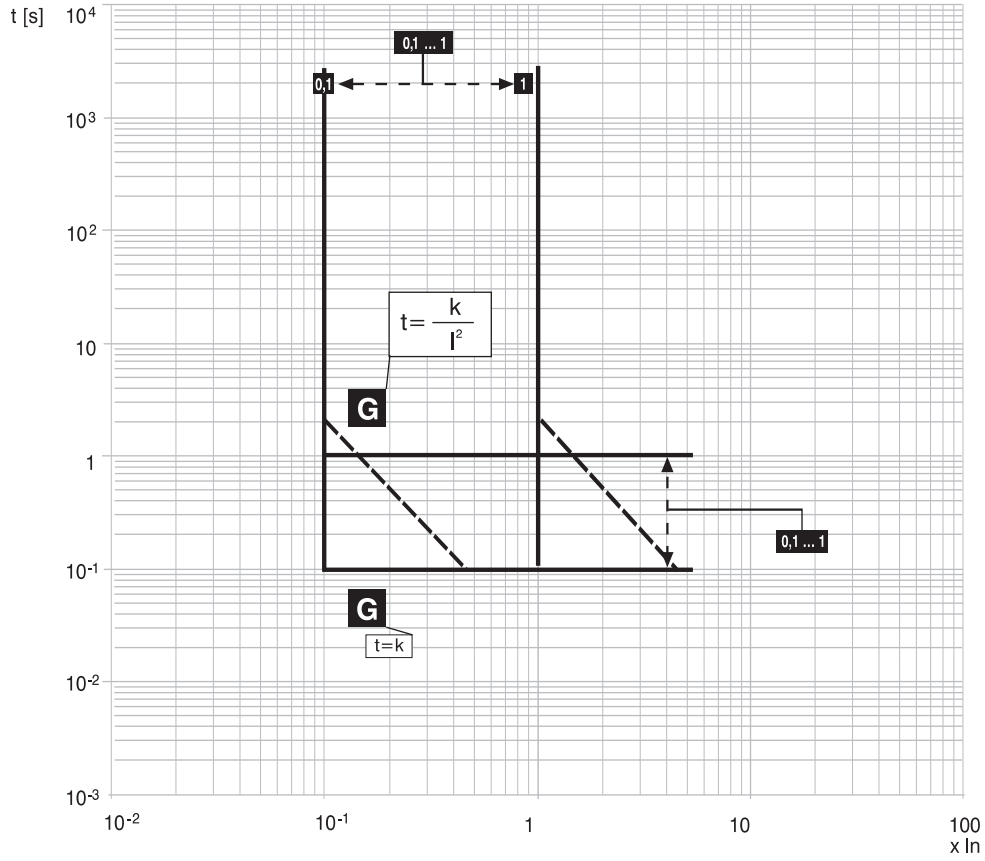
2.6.23.5. Trip curves for function L in accordance with IEC 60255-3 (type B)



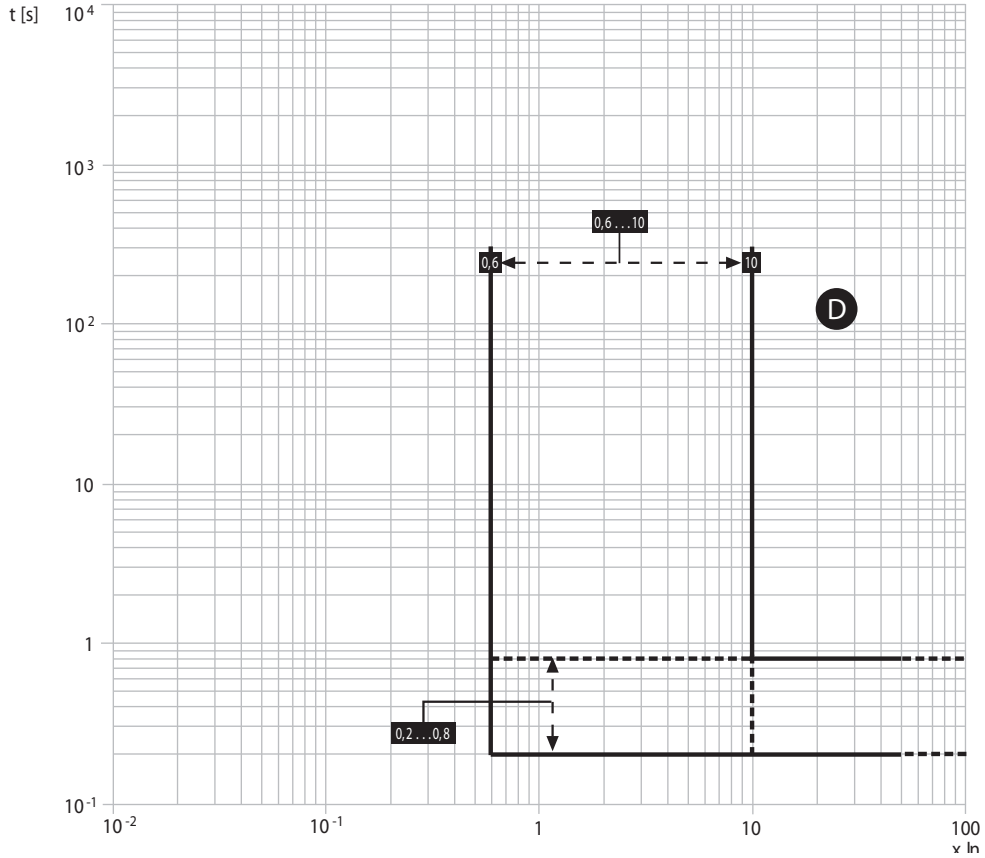
2.6.23.6. Trip curves for function L in accordance with IEC 60255-3 (type C)



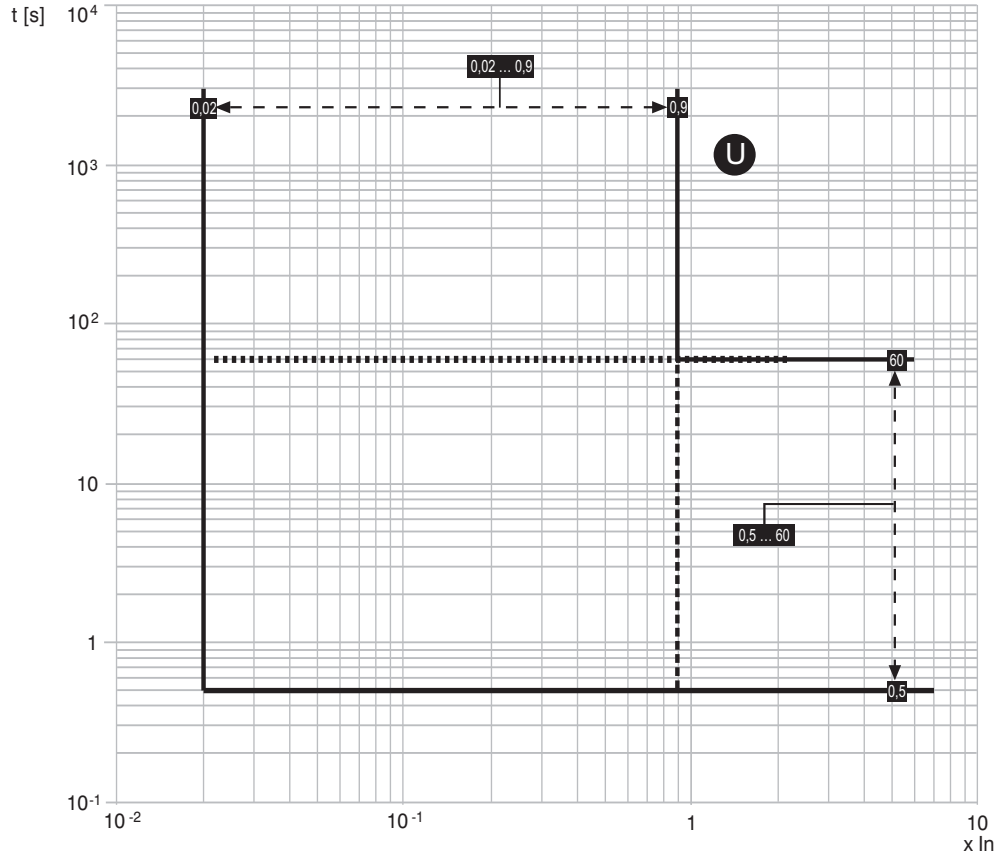
2.6.23.7. Trip curves for function G



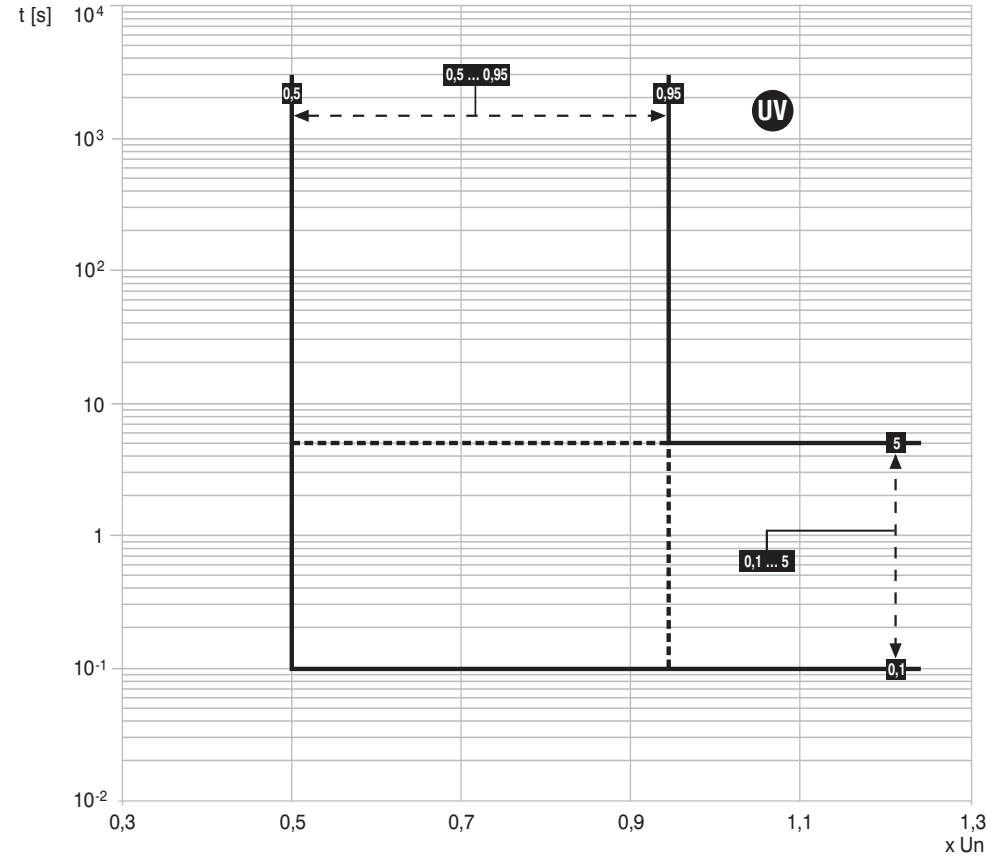
2.6.23.8. Trip curves for function D



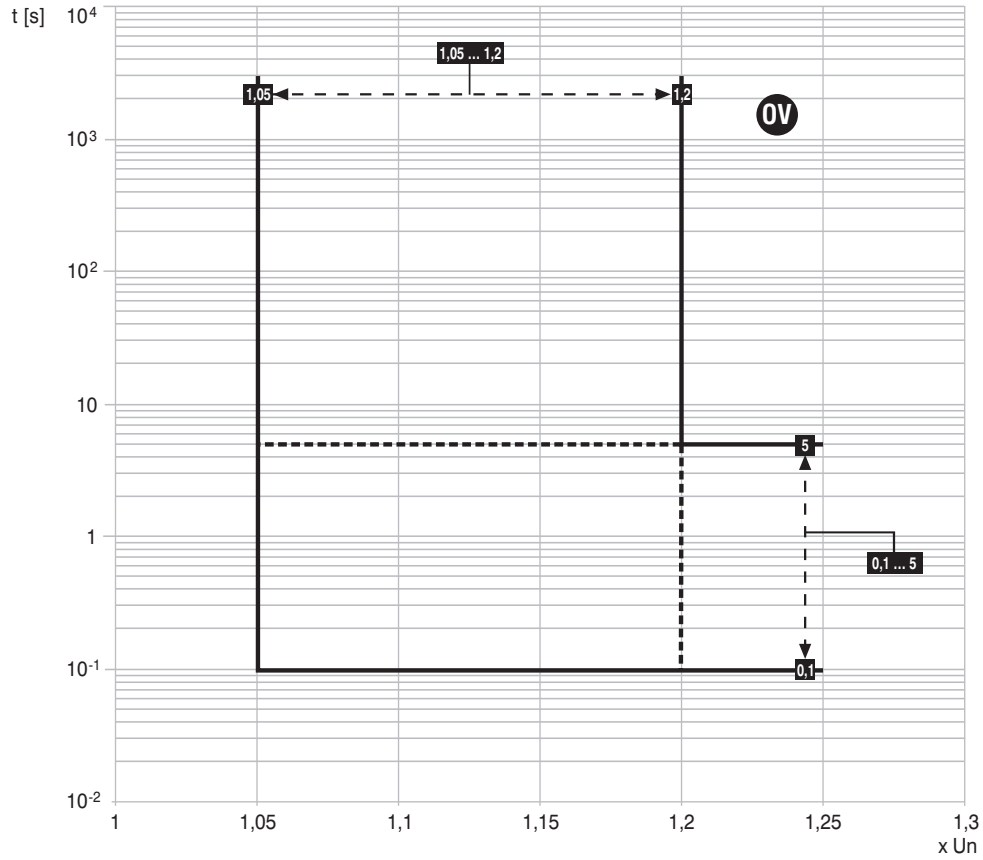
2.6.23.9. Trip curves for function U



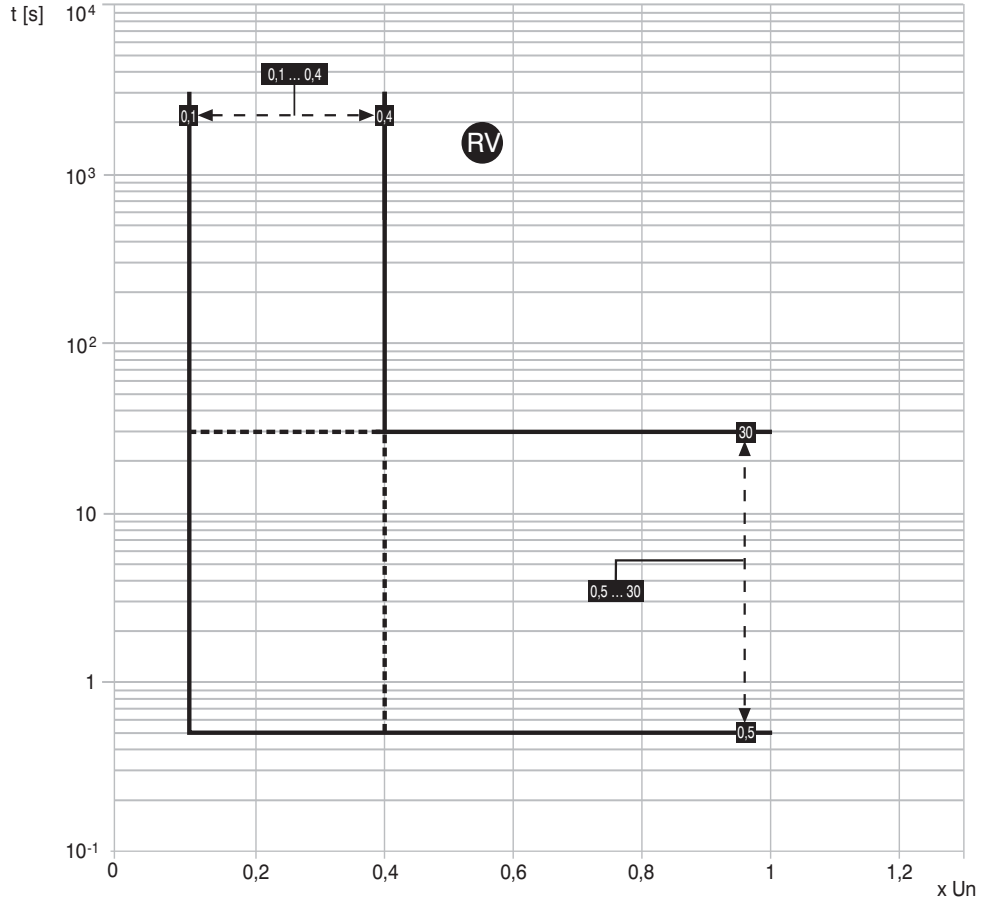
2.6.23.10. Trip curves for function UV



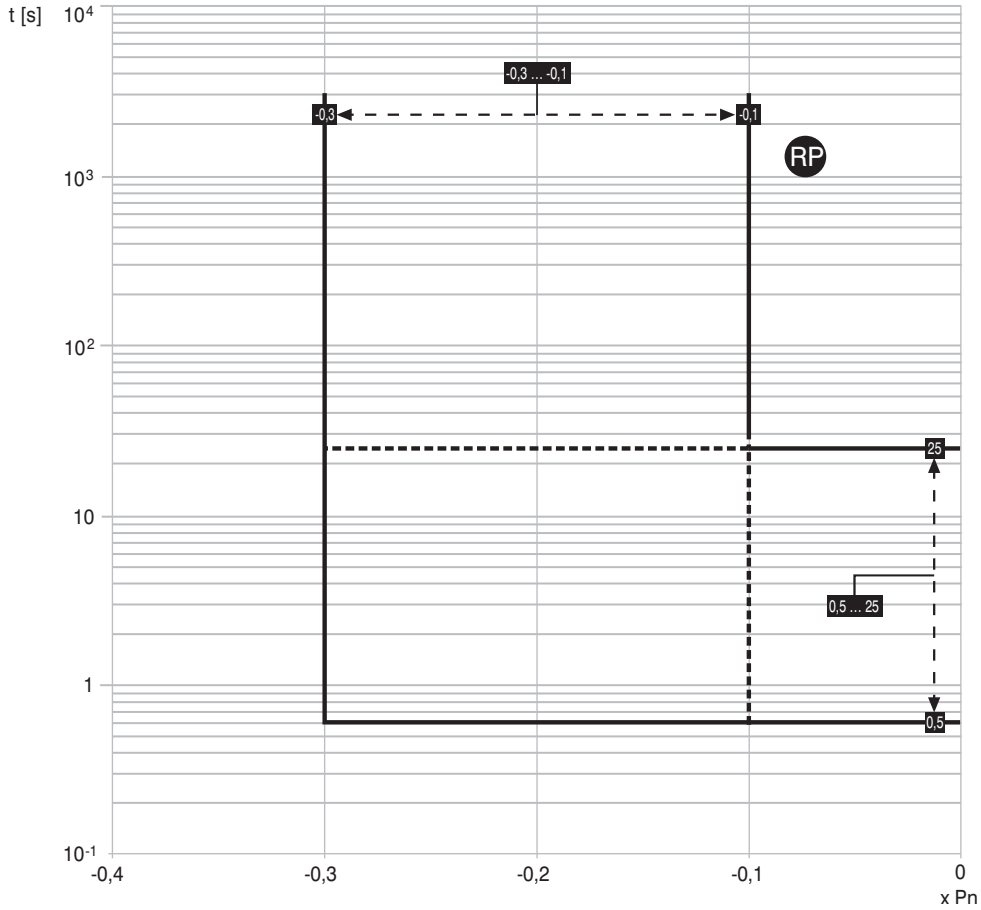
2.6.23.11. Trip curves for function OV



2.6.23.12. Trip curves for function RV



2.6.23.13. Trip curves for function RP



2.7. Measuring functions

Relays PR122/P and PR123/P include various different measuring functions.
The basic measurements available in all models are:
- Currents: three phases (L1, L2, L3), neutral (N) and earth fault
- Trips (last 20) and events (last 80)
- Log register: storage of maximum current reading (with the date and time of recording)
- Peak factors: three phases (L1, L2, L3) and neutral (N)
- Percentage of contact wear.

In the configuration with module PR120/V, relays PR123/P and PR122/P provide further measurements:
- Voltage: line-to-line, line-to-neutral and residual voltage
- Power: active, reactive, apparent
- Log register: storage of maximum and minimum voltage and power readings (with the date and time of recording)
- Power factor
- Energy: active, reactive, apparent
- Network frequency

Relay PR123/P includes a further measurement function:
- Wave forms: network voltages and phase currents, and harmonic analysis.

2.7.1. Runtime measurements: current, voltage, power

The main current, voltage and power measurements can be accessed by using the UP and DOWN buttons from the default page. In the default page, histograms with the currents and voltages appear on the display, while the value and the highest phase are also given in the numerical format.

The available current and voltage measurements depend on the version and configuration of the CB and relay.
Currents:
- Three-pole CB: phase currents I1, I2, I3 are available
- Three-pole CB, configuration with external neutral (3P+N): phase currents I1, I2, I3, Ine are available
- Four-pole CB: phase currents I1, I2, I3, Ine are available
- Relay in the LSIG version: Ig measurement available.
- Relay in the LSIG version and presence of the SGR sensor: Ige measurement available.
- Relay in the LSIG or LSIRc version (PR122/P) and presence of the Rc sensor: Ige measurement available (to be considered as residual current).

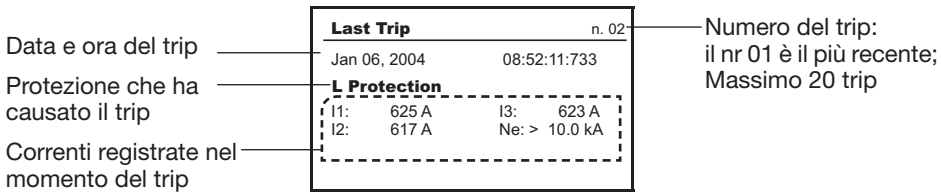
Voltages (In the presence of the PR120/V module):
- Three-pole CB without neutral: network voltages V12, V23, V13 and the total powers available (active, reactive, apparent).
- Three-pole CB, with neutral PRESENT Voltage option: network voltages V12, V23, V13, phase voltages V1, V2, V3, V0 and the powers (active, reactive, apparent) of each phase and total powers available.
- Four-pole CB: network voltages V12, V23, V13, phase voltages V1, V2, V3, V0 and the powers (active, reactive, apparent) of each phase and total powers available.

The runtime measurement tolerance margins are:

Type of measurement range	Range of values measured by the relay	Standard operation	
		Range	Tolerance %
Phase and neutral currents	0,05 ... 16In	0,3 ... 6 In	± 1,5
Internal ground fault current	0,05 ... 16In 4In	0,3 ... 4 In	± 1,5
External ground fault current (external source round return)	0,05 ... 4In	0,3 ... 4 In	± 1,5
Phase-to-phase and phase voltages (measured at the module's input and thus independent of the precisionrelating to the use of any VT	$10V_{conc}$ ... 1,1 x $690V_{conc}$	50 V_{conc} ... 1,1x690 V_{conc}	± 1
Residual voltage(for systems with neutral only)	$10V_{conc}$ ... 1,1 x $690V_{conc}$	50 V_{conc} ... 1,1x690 V_{conc}	± 1
Instantaneous active powersingle phase and total system	0,02 ... 16Pn	0,3 ... 6 Pn	± 2,5
Instantaneous reactive power single phase and total system	0,02 ... 16Pn	0,3 ... 6 Pn	± 2,5
Instantaneous apparent power single phase and total system	0,02 ... 16Pn	0,3 ... 6 Pn	± 2,5

2.7.2. Trip

The list of trips recorded by the relay is available in the Measurements-Log Files-Openings section. Information about the last trip is also available from the main page by pressing the iTest button three times.
Each trip is recorded with useful information enabling it to be identified:



Use the UP and DOWN buttons to scroll all the trips recorded in the Openings menu.

WARNING: After a trip has occurred, the page concerning the recorded trip appears on the display. Press iTest to remove it and go back to the main page.

WARNING: With the relay off after a a trip has occurred, press the iTest button to display the page concerning the recorded trip for a few seconds. The function remains valid for 48h from shut-down thanks to a capacitor inside the relay.

2.7.3. Events

The list of events recorded by the relay is available in the Measurements-Log Files-Events section.
The page of each event is similar to that of the trips, with a description of the event instead of the message about the protection and numbering that refers to the last event recorded (Last, Last-1, Last-2,...).

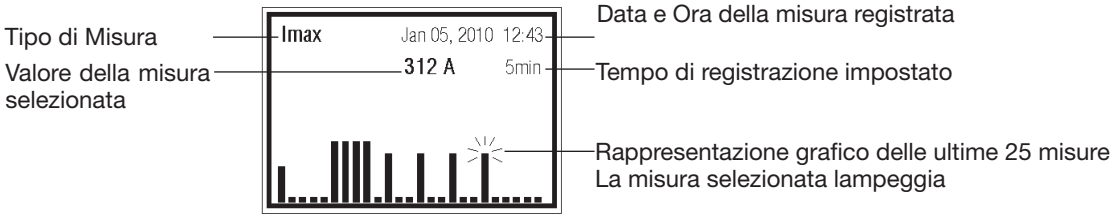
Relays PR122/P and PR123/P are able to record up to 80 events. Use the UP and DOWN buttons to scroll all the events.

2.7.4. Measurements Log register

Relays PR122/P and PR123/P can record various different measurements and allow the recording time to be set between one measurement and the next.
The measurements are available in the Measurements-Log Files-Measurements section:

Name	Available with	Description
I Max	PR123/P; PR122/P	Rms value and maximum current phase
P Max	PR123/P; PR122/P (with PR120/V)	Maximum active power
P Mean	PR123/P; PR122/P (with PR120/V)	Mean active power
V Max	PR123/P; PR122/P (with PR120/V)	Rms value and maximum network voltage phase
V Min	PR123/P; PR122/P (with PR120/V)	Rms value and minimum network voltage phase
Reset measurements	PR123/P; PR122/P	Meter reset command

Each measurement available is shown on the display by a graphic page:



Use the UP and DOWN buttons to scroll all the recordings of each measurement.

Select the Measurement reset command to reset all the recordings.

The recording time can be adjusted in the Settings-Measurement interval menu.

2.7.5. Power factor

Relays PR123/P and PR122/P (configured with the PR120/V module) provide the overall power factor in the Measurements-Power factor section.

Type of measurement range	Range of values measured by the relay	Standard operation	
		Range	Tollerance %
Total power factor	0,1 ... 1	0,5 ... 1	± 2,5

WARNING: If the phase power is less than 2% (0.02xPn_{phase}) the value is not displayed and is substituted by '.....'.

2.7.6. Energy

Relays PR123/P and PR122/P (configured with the PR120/V module) measure total active, reactive and apparent energy of the system. 0.001 MWh, 0.001 MVARh or 0.001MVAh are the minimum values that can be displayed.
The meter can be reset by confirming the "Reset meters" menu item in the page.

Type of measurement range	Range of values measured by the relay	Standard operation	
		Range	Tollerance %
Active energy	0,02 ... 16 Pn	0,3 ... 6 Pn	± 2,5
Reactive energy	0,02 ... 16 Pn	0,3 ... 6 Pn	± 2,5
Apparent energy	0,02 ... 16 Pn	0,3 ... 6 Pn	± 2,5

2.7.7. Peak factor

The peak factor measurement, a ratio between I_{peak} / I_{rms} is available for each current phase.
The measurement is not displayed if the current is less than 0.3xIn and is not available for currents exceeding 6xIn.

Type of measurement range	Range of values measured by the relay	Standard operation	
		Range	Tolerance %
Peak factor	0,3 ... 6 In	0,3 ... 6 In	± 1,5

2.7.8. Mains frequency

Relays PR123/P and PR122/P (with module PR120/V) measure the network frequency. This is calculated on the basis of the voltage (if Umax > 0.1Un).
The measurement is guaranteed after up to 5 s from the frequency variation.

Type of measurement range	Range of values measured by the relay	Standard operation	
		Range	Tolerance %
Mains frequency	35 ... 80 Hz	45 ... 66 Hz	± 0,2

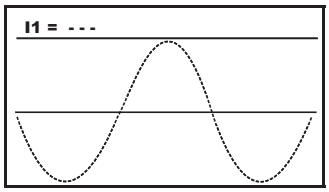
2.7.9. Contact wear

This sub-menu displays the percentage of wear on the CB contacts.

2.7.10. Wave forms

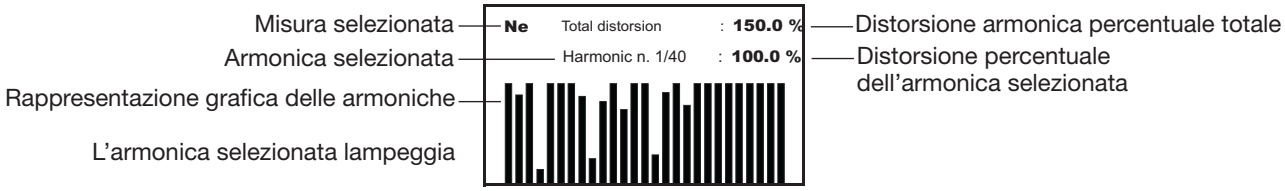
Relay PR123/P provides a further measurement function, which is useful for the harmonic analysis of phase currents and network voltages.

The Measurements-Wave forms menu allows the operator to select from amongst 8 measurements (currents L1, L2, L3, Ne, gt, voltages V12, V23, V31). The graphic representation of the wave form chosen (120 samples) is displayed once the measurement has been selected:



Press ENTER to access the selected wave form menu, where acquisition can be updated (Refresh command) or an area opened for harmonic analysis of the wave form (Harmonics command).

The Harmonics area gives the graphic representation of the module with the 1st to 40th harmonics (up to the 35th for 60 Hz network frequency settings) given in percentage of the fundamental harmonic (1st harmonic), thus always indicated at 100%.



Use the UP and DOWN keys to move to the required bar and read the corresponding percentage value.
The measuring accuracy is 5%.

2.8. Main functions

2.8.1. Watchdog

The PR122/P and PR123/P unit provides some watchdog functions able to guarantee the proper management of relay malfunctions. These functions are as follows:
- Watchdog for presence of Auxiliary power supply with "plug" icon displayed.
- RATING PLUG validity.
- Watchdog for proper connection of the current sensors (CS). If it is enabled, any anomalies are indicated by a special alarm message and the "alarm" LED coming on, and the circuit-breaker opens after 1s.
- Watchdog for proper connection of the Trip Coil (TC). If it is enabled, any anomalies are indicated by a special alarm message and the "alarm" LED coming on; if the PR120/D-M module is installed, this activates the coil opening command (YO), thus opening the CB.
- Watchdog for protection of Hw Trip. If it is enabled, in the event of the sensors being disconnected or a Rating Plug error, a CB opening command is given by the TC being enabled.

2.8.2. Circuit-breaker state

Relays PR122/P and PR123/P detect the state of the circuit-breaker by means of specific wiring in the CB itself. When the presence of current is detected with the circuit-breaker "OPEN", state error is signalled by means of a warning message and the "warning" led comes on.

2.8.3. Datalogger

Relays PR122/P and PR123/P powered with Vaux, possess a Datalogger function: this function can be used for storing and saving the instantaneous values of certain analog measurements (7 analog channels) and digital measurements (64 digital events) in a capacious data buffer.
The data can be easily downloaded from the unit using the available communication units (internal modules PR120/D-M, PR120D-BT and external modules BT030-USB, Ekip T&P) and transferred to any personal computer for processing.

The function can be associated with relay or CB events or states, thus allowing the measurements to be recorded according to the desired installation requirements.
The function can be very useful for recording if a trip occurs as it facilitates the subsequent failure analysis.

2.8.3.1. Settings

All the settings are available in the Settings-Datalogger menu. In detail:
- Function enabling: allows the operator to activate or shut down the function.
- Sampling frequency: frequency selection determines the number of measurement samples as well as the maximum recording time.
- Stop source: the stop source establishes the event to which interruption of measurement storage must be associated.
- Stop delay: used for entering a storage delay.
- Restart and Stop: storage interruption and forced start commands.

The maximum data recording times depend on the selected frequency and are illustrated in the following table:

Frequency	Recording time
600 Hz	27,3 s
1200 Hz	13,6 s
2400 Hz	6,8 s
4800 Hz	3,4 s

WARNING: Selecting sampling frequency is an important step. In fact, presence of high-order harmonic waves may cause aliasing on processing of collected data. Use maximum frequency when a harmonic distortion is available, otherwise data processing may give results which do not match actual system conditions.

ONE one of the following Stop Sources can be selected:
- None
- Any alarm
- L timing
- Any trip

WARNING: If you select “None” for the stop event, the data logger can be stopped only by a stop command from the operator panel, from the system or following a trip generated by the relay.

You can set customized Stop Sources from the system, to coincide with events (a list of examples is given in the table below)

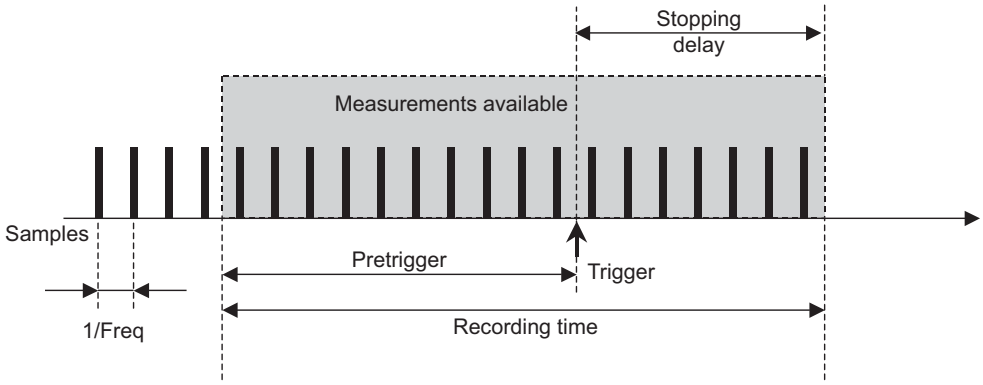
N° (decimal)	Event
1920	Time delay G
2894	sensor L1, L2 or L3 error, or Trip Coil error
2688	LC1 alarm
2049	G alarm
33672	CB connected and springs loaded
1793	Harmonic distortion > 2.1

You can combine the status bits with logical functions “and” or “or” within the same group of events (bytes). Consult the Modbus Interface document for further details.
The stopping delay can be set from 0.00 [s] to 10.00 [s] with 0.01 [s] steps.

WARNING: If a trip occurs, this data storage process will be stopped after 10 ms, even if a longer stopping delay has been selected.

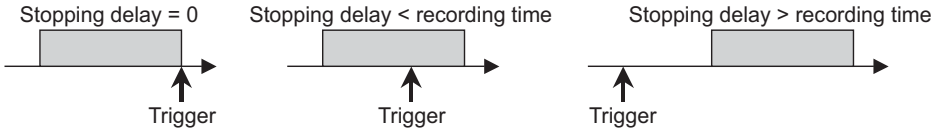
2.8.3.2. Recording time windows

The data logger’s measurements are recorded in a time window, the duration of which is defined and synchronized by an event (trigger/stop event) of your choice.
The following figure displays the time window, the trigger and the samples available in gray:



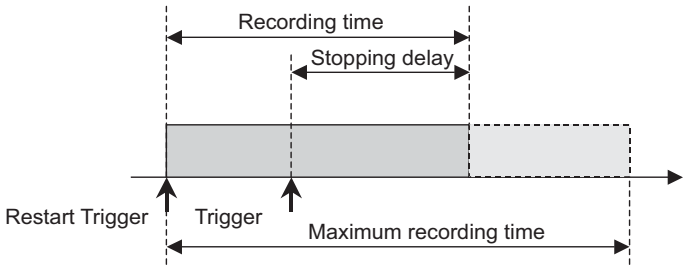
The user can select the sampling frequency, the type of stop trigger event and the stop delay so as to obtain the desired pre-trigger for the selected event.

Depending on the set value, the stop delay can be nil, or less or more than the recorded duration, as shown in the figure below:



WARNING: If datalogger parameters are changed whilst the datalogger is active, the storage that is in progress will be terminated and new storage will start on the basis of the new parameters (following a trigger restart command).

Recording time may be lower than maximum time attainable when the sum of stopping delay and time elapsing between a restart trigger and a trigger is lower than the maximum value, as described in the figure below:



By connecting to the release's outside bus, you can set certain data logger parameters, triggers or commands, or read certain types and sequences of data in its memory.

The combinations of devices and the consequent software combinations that enables these functions are as follows:

2.8.3.3. Access to saved data from the system

When the event associated with the stop event occurs or a stop command is received, the following data are saved in the recording block:
- Data logger Trigger, which indicates the type of stop event (trigger) that has prompted the stoppage of the data logger;
- Time-stamp of the stop event (trigger) (day/hour + minutes/seconds/milliseconds)(4 words);
- Data logger max file, which indicates which is the max file with consistent data;
- Data logger max address, which indicates the max address number of a block with consistent data.

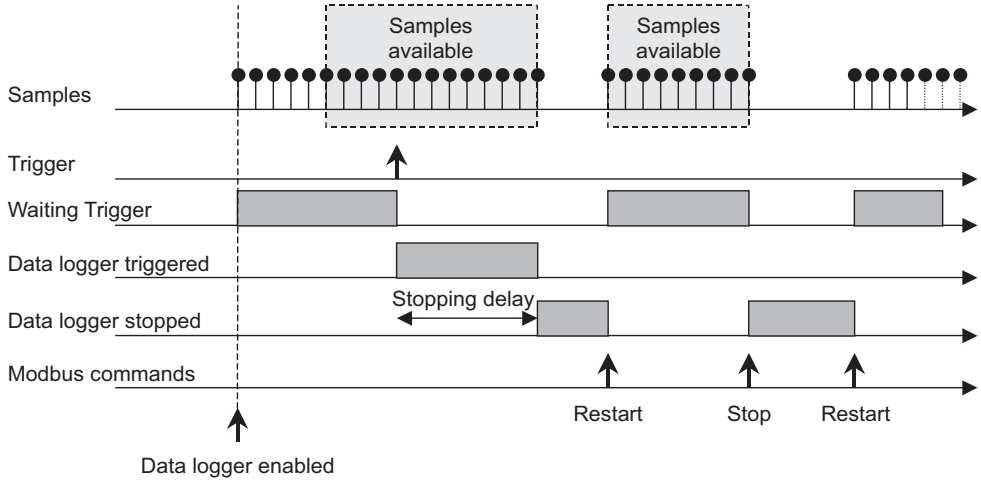
The following information is also stored:
- sample of currents L1, L2, L3, Ne
- V12, V23, V31 voltage samples
- digital inputs/outputs (among 16 possible options, e.g. inputs/outputs for Zone Selectivity, PR120/K contact status, ...)
- alarms1 (among 16 possible options, e.g. L timing, G alarm, Prealarm)
- allarmi2 (tra 16 possibili. Es: UF timing, OV timing, Frequency error, RP timing)
- trips (among 16 possible options, e.g. tripping of L, S, I, G, UV, OF, ...).

The recordings are available in the relays for as long as the unit remains on (the data are lost in the absence of Vaux).
Using Ekip Connect SW, the operator can perform a Download so that all the information in the recording can be stored in a single file (.abb format) and consulted with SD-DataViewer SW.

The next recording will be enabled following a Restart Trigger command.

2.8.3.4. Example of data logger operation

The following figure shows an example of how a trigger works, the data logger's function, the effect of the stopping delay and of the restart and subsequent stop commands on the data saving procedure



2.8.4. Zone selectivity

Relays PR122/P and PR123/P possess inputs and outputs for the Zone Selectivity function.

Name	Type	Description
K51/SZin (K51/DFin)	Digital input	Zone selectivity: input for protection S or "direct" "forward" input for protection D
K51/Gzin (K51/DBin)	Digital input	Zone selectivity: input for protection G or "reverse" "backward" direction input for protection D
K51/SZout (K51/DFout)	Digital output	Zone selectivity: output for protection S or "direct" "forward" output for protection D
K51/GZout (K51/DBout)	Digital output	Zone selectivity: output for protection G or "reverse" "backward" output for protection D

The various different zone selectivity functions only operate if the relay is equipped with Vaux.

The digital output of each selectivity channel can be connected to up to 20 relays on the supply side in the selectivity chain.

The maximum length of cable for zone selectivity, between two units, is 300 meters. Use corded shielded two-wire cable (per esempio cavo bifilare BELDEN 8762/8772). The shield must only be earthed on the circuit-breaker of the supply-side relay (ZSI side).

The operating mode is described in the chapters dedicated to each zone selectivity function: S (par. 2.6.3.3), G (2.6.8.2) and D (2.6.5.2).

2.9. Settings Menu

The Settings menu contains various different settings concerning relay operation and for configuring the installation in the correct way.
9 options are available:

Settings Menu Options	Description
1. Circuit breaker	Enabling and adjustment of the Neutral protection, earth protection and the installation commands
2. Mains frequency	Adjustment of the frequency of the installation
3. Modules	Monitoring and setting of the internal module characteristics
4. Data Logger	Enabling and adjustment of the Datalogger function
5. Dual setting	Enabling and setting of the dual set function (available with PR123/P).
6. Measurement interval	Adjustment of the measurement interval for the log file
7. Harmonic distortion	Activation of the harmonic distortion control (available with PR123/P)
8. System	Date, time, language, password settings
9. Display Contrast	Adjustment of the display contrast

2.9.1. Circuit-breaker

This area allows you to:
- Enable the Neutral protection (ON/OFF) and adjust its control level (50%- 100% - 200%). All the details about the operating mode are given in the description of the Neutral protection, in par. 2.6.19.
- Enable the presence of a sensor on the earth protection line (SGR or Rc). A further option for selecting the sensor model (100,250,250,800) will be available if the selected sensor is the SGR type. Functions and case reports on use of the earth protections are illustrated in the chapters that describe protections Gext (par. 2.6.9) and Rc (par. 2.6.10).
- Perform the installation and uninstalling operations for the relay on the CB. Instructions for correct installation are given in par. 2.12.1 and 2.12.2.

2.9.2. Network frequency

This area allows you to enter the frequency of the installation: 50Hz or 60Hz.
Selection of this parameter enables the relay to calibrate its protection and measurement functions as a consequence.

2.9.3. Modules

Relays PR122/P and PR123/P can be connected to 4 internal modules.
The following options are available upon access to the Settings-Modules menu:
- 3 menus dedicated to modules PR120/V (MEASURING Module menu), PR120/D-M (COM Module), PR120/K (SIGNALLING Module). The menus are available once the modules have been correctly connected and installed.
- Menu for setting the presence/absence of a unit on the Local Bis. Enabling activates a presence monitoring function regarding a unit on the local bus so as to ascertain whether the connection is correct and to signal any communication alarms.

All the details are given in the chapters with the characteristics of internal modules PR120/V, PR120/D-M, PR120/K.

2.9.4. Datalogger

Relays PR122/P and PR123/P support Dataloggger storage functions. On accessing the Settings-Datalogger menu, the operator can edit all the parameters of the function and enable or inhibit recording in the manual mode. More details in par. 2.8.3.

2.9.5. Dual Set

Relay PR123/P allows the user to enable the dual protection function. All the parameters of the function can be enabled and edited on access to the Settings-Dual Set menu. More details in par. 2.6.18.

2.9.6. Measurement Interval

The storage time for the measurements log file can be adjusted in the Settings-Measurement Interval menu. Further details about the measurements function are given in par. 2.7.4.

2.9.7. Harmonic distortion

The harmonic distortion monitoring function can be activated in the Settings-Harmonic Dist. menu: if activated and if the value is more thann 2.1, a fault will be signalled on the display.

2.9.8. System

The date and time of the relay, the Language and Password can be adjusted in the Settings-System menu.

2.9.8.1. Language

When selecting the system language, make sure that:
- the relay is set to the local mode (if PR120/D-M is installed);
- the CB is open;
- Vaux 24Vdc and/or busbar voltage by means of PR120/V and/or PR030/B are present.

The relay will not allow the language to be changed in the absence of one of the above conditions.

2.9.8.2. Password

Relays PR122/P and PR123/P are supplied with the default password: 0001.
The password, which is required if all the modifications to the protections or settings in the relay are to be saved, can be changed in the Settings-System-New Password menu.
The values that can be used in the password range from 0000 to 9999. The default password is given in par. 2.13.

To change the PW, first enter the old one, then select the 4 new figures: the value of each figure can be chosen with the UP and DOWN keys. Use ENTER to confirm the figure and pass on to the next one.
The password is checked after the fourth figure has been entered. The procedure will change from the “READ” state to the “EDIT” state if the password is correct.

The password prompt is disabled by setting the value of the password to [0000] (in the “System Configuration” menu). It is therefore always possible to switch from “READ” to “EDIT”.

WARNING: The password is valid for up to two minutes from the last time a key was pressed. After that time, it must be entered again so as to validate any changes or to access the menus.

2.9.9. Display contrast

The degree of contrast on the display can be adjusted in the Settings-Display Contrast menu.

2.10. Test Menu

The Test menu provides various options for checking the relay and CB.
Up to 7 options are available:

Name	Description
1. CB status	allows the user to view the CB state read by the relay.
2. Auto Test	allows the display and led test to be performed
3. Trip test	allows an opening command to be transmitted to the CB
4. Gext(Idn) test	allows the operation of the Rc sensor to be checked
5. Zone selectivity	verification of the zone selectivity inputs and outputs
6. COM module	allows the contacts and controls of the CB to be checked
7. SIGNALLING module	allows the inputs and contacts of the module to be checked

The test menus of the modules and sensor Gext (Idn) are available if the accessories are connected and configured correctly in the relay.

2.10.1. Autotest

When autotest is activated, the display and leds will perform a test procedure allowing the user to check the state of the display and operation of the leds themselves.
The procedure lasts several seconds and the sequence is as follows:

Phase	ALARM and WARNING leds	Display
1	On and fixed	ABB logo, the words “ABB Sace Spa“ and a message with the name of the relay, “PR122/P“ or “PR123/P“
2	Off	Flashing backlighting (only if Vaux is present)
3	Normal operation	Contrast from 100% (display dark) to 0% (display light), after which the ABB words and logo reappear

The test result and assessment are at the user's discretion. Inform ABB if faults occur (Leds fail to function, display areas that fail to function correctly).

2.10.2. Trip test

The state of CB opening can be checked by activating the trip test.
The relay transmits a command to the TC, which activates a CB opening mechanism. A positive test result is shown by the circuit-breaker opening.

WARNING: To perform the trip test, there must be no current circulating and the CB must be closed (failing this, the Exception 6 error will appear).

2.10.3. Rc Test

The test option for the Rc sensor is available if the Rc sensor is present and correctly configured in the other menus of the relay.

To test the Rc sensor, select the Gext (Idn) test option from the test menu: the Rc test page will appear. Press the “iTest” key again to perform the test.
A positive result will be indicated by the circuit-breaker opening within the previous entered time limits.

The test page for the Rc protection can also be accessed by pressing the “iTest” key for 7 seconds from the default page.

2.10.4. Zone selectivity

The menu is divided as to type of selectivity (S and G). For both selectivity types, the user can:
- View the state of the inputs
- Force and release the outputs

WARNING: The override test for the selectivity outputs must be performed with the CB open: the Exception 6 error will appear if the CB is closed or undefined.
If the CB is withdrawable, perform the test in the inserted or test position.

State assessment is at the user's discretion.

2.10.5. COM module

The option is available if the PR120/D-M module is present and configured correctly.
Within the menu, the operator can:
- View the state of the springs and the position of the CB
- Send CB opening and closing commands (by means of the opening and closing coils)

WARNING: The commands will activate if the module has been connected to the opening and closing coils correct, and is in the Inserted position.
The test result is at the user's charge: the relay only transmits commands. It does not check the change in state.

Further details about the module are given in par. 2.11.2.

2.10.6. SIGNALLING module

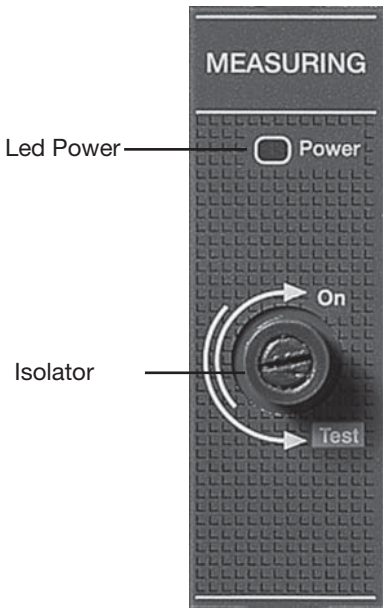
The option is available if the PR120/K module is present and configured correctly.
Within the menu, the operator can:
- View the state of the input of the module
- Send the contact autotest command (the contacts and leds in the module are activated and disabled in succession).

Checking the inputs and autotest sequence are at the user's discretion.

Further details about the module are given in par. 2.11.3.

2.11. Internal modules

2.11.1. PR120/V - MEASURING Module



Module PR120/V allows the primary voltages to be read and processed by implementing a series of protection and measuring functions.
The module also provides energy for powering the relay even in the absence of Vaux, with nul current or with the CB open.

PR120/V can function with direct connection to the bars of the CB for phase voltage values of up to 690V. Operation is guaranteed by an external voltage transformer for higher voltage values and up to 1150V.

The module comes with a “Power” LED and a sealable isolator for dielectric stiffness tests.

The menu in the relay allows various different parameters to be adjusted:
- Rated voltage selection
- TV presence signalling
- Selection of the primary and secondary voltages of the TV
- Power flow setting
- Neutral enabling (only available with three-pole CB)

A further two parameters are available in the menu when the module is installed in PR123/P:
- Phase sequence: sequence control enabling and thresholds
- Cos φ measured: control enabing and threshold of the Cos φ measured module.

2.11.1.1. Power supply

The PR122/P and PR123/P units are powered by the MEASURING module via the busbar voltage.
The powering stage is capable of operating starting from a voltage of 80 Vrms two-phase phase to phase up to 897 Vrms (1.3 * 690 Vrms) three-phase phase to phase at its input (coming directly from the busbars or from a transformer secondary).

The minimum powering characteristics for the relay in the various configurations are described in par. 2.3.5.2.

2.11.1.2. PR120/V parameters

All the parameters of the PR120/V can be adjusted in the Settings-Modules menu

Parameter	Values	Notes
Voltage transformer	Absent/Present	In the absence of the TV, the primary voltage measurement on the display is the one read on the bars. If the TV is present, the measurement on the display considers the transformation ratio of the TV established by the primary and secondary voltage settings.
Rated Voltage	100V - 115V - 120V - 190V - 208V - 220V - 230V - 240V - 277V - 347V - 380V - 400V - 415V - 440V - 480V - 500V - 550V - 600V - 660V - 690V	List available with TV Absent
Primary Voltage	100V - 115V - 120V - 190V - 208V - 220V - 230V - 240V - 277V - 347V - 380V - 400V - 415V - 440V - 480V - 500V - 550V - 600V - 660V - 690V - 910V - 950V - 1000V - 1150V	List available with TV Present
Secondary voltage	100V - 110V - 115V - 120V - 200V - 230V	List available with TV Present
Power flow	Bottom → Top Top → Bottom	Protection D setting
Signals (only with PR123/P)	Enabling status (ON/OFF) Threshold (123/321)	
	Enabling status (ON/OFF) Threshold (from 0,5 to 0,95; step 0,01)	

2.11.1.3. Voltage transformer

In the case of three-phase systems with a rated voltage greater than 690 Vrms phase to phase, a step-down transformer (with a transformation ratio of less than 1).
Proper operation is only guaranteed for star/star or delta/delta configurations.

The allowable primary and secondary rated voltages that must be set on the unit are specified.

Standard single transformers:

Mechanical characteristics	
Fixture	DIN rail EN 50022
Material	self-extinguishing thermoplastic
Degree of protection	IP30
Electrostatic protection	shielded towards EARTH

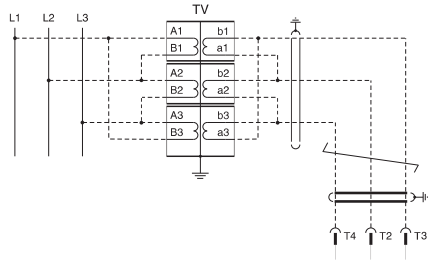
Electrical characteristics	
Precision class	cl. 0,5
Performance	≥10VA...≤20 VA
Overload	20% permanent
Insulation	4 kV between inputs and outputs
	4 kV between inputs and outputs
	4 kV between inputs and inputs
Operating frequency range	from 50 Hz to 60 Hz, ± 10%

The following is a summary table of standard VT connections according to the type of plant.
The VTs must have a performance coming between the values of 10 and 20VA inclusive, 4 kV insulation between the primary and secondary.

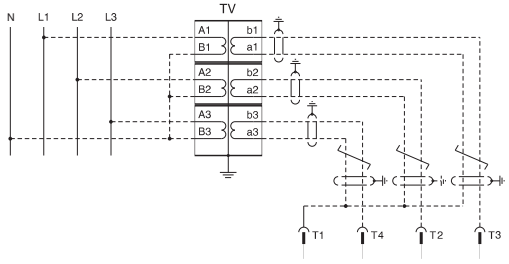
Installation system	**"VT Standard" type transformer (Star/Star)**	**"VT Standard" type transformer (Delta/Delta)**
	Application diagram	**Application diagram**
TN-C	B	A
TN-S	B	A
IT with neutral	B	A
IT	n.c	A
TT with neutral	A	B
TT without neutral	n.c	A

Note for B diagram:
- for TN-C systems the connection must be made to PEN
- for TN-S systems the connection must be made to N for configurations with neutral or PE for configurations without neutral; if the PE is used, the current thereon could be around a dozen mA. If a customer considers this value too high or has a residual current protection which risks being tripped, then application diagram A must be used.
- for IT and TT systems with neutral, the connection must be made to N.

Application diagram A



Application diagram B



WARNING: The maximum length of the VT - PR120/V wiring must not exceed 15 meters.
Use corded shielded two-wire cable (e.g. BELDEN 3105A two-wire cable).
The shield must be connected to earth on both sides.

WARNING: Dielectric strength tests are not allowed on the inputs and outputs of the releases or on the secondary lines of any connected VTs.

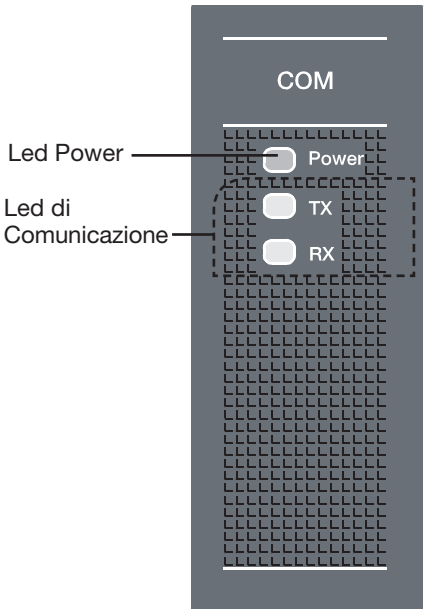
2.11.1.4. Dielectric strength tests

Before performing the dielectric strength test it is essential to turn the isolator into the Test position mode by turning the screw anticlockwise until you reach the end of stroke position.

WARNING: After performing a dielectric strength test, restore the isolator to its original position by turning it clockwise until you reach the opposite end of stroke, because all the voltage protections are disabled while the isolator is in the test position.
At the end of the procedure, make sure that the Power line LED is on.

WARNING: Dielectric strength tests are not allowed on the inputs and outputs of the releases or on the secondary lines of any connected VTs.

2.11.2. Module PR120/D-M - COM



Dedicated communication module for connecting the relay to a Modbus net, and for remote supervisory and control activities on the circuit-breakers.
The module also allows you to:
- Read certain states of the CB, with reference to the springs and to the position if the CB is withdrawable.
- There are contacts for managing CB opening and closing commands by means coils YO and YC.

The module functions with Vaux present.

The module has a “Power” led, which indicates that it is on, and two “Tx“ and “Rx“ communication led to indicate data reception/transmission.

The menu in the relay allows various different parameters to be adjusted:
- Relay configuration (local/remote)
- Communication parameters (baudrate, address, parity)

The communication function with PR120/D-M - COM responds to the Modbus RTU protocol, using a physical interface of the RS485 type.

All the information required for correct management of the communication with PR120/D-M is given in the Modbus System Interface document for the Emax relay (1SDH000566R0002).

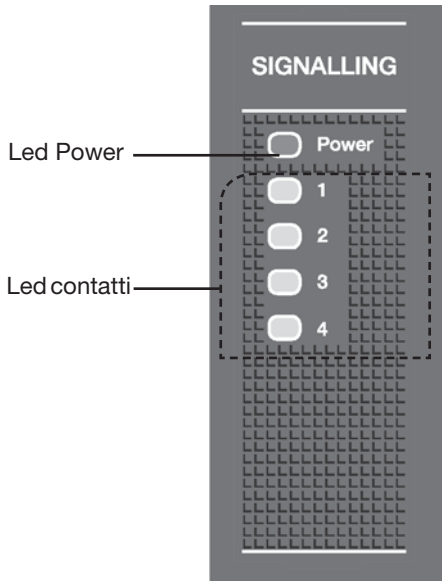
2.11.2.1. PR120/D-M parameters

All the communication parameters can be adjusted in the Settings-Modules menu.

Parameter	Values	Notes
Local/remote	Local/remote	Local: all changes to the parameters must be made via the menu in the relay. Only supervision is allowed in the remote mode. Remote: all changes to the parameters must be made in the remote mode. Only supervision is allowed via the menu in the relay.
Serial address	1...247; step 1	To avoid conflict in a communication network, it is important to ensure that the unit is not configured with the same address.
Baudrate	9600 / 19200bit/s	
Physical protocol	8,E,1 - 8,0,1 - 8,N,2 - 8,N,1	
Addressing	Modbus standard ABB	

The parameters can also be edited by means of the PR010/T, BT030-USB and Ekip T&P units.

2.11.3. Module PR120/K - SIGNALLING



The module enables the local signalling of alarms and circuit-breaker trips.
The module controls:
- Contacts: up to 4 programmable output contacts (K51/p1, K51/p2, K51/p3 and K51/p4.)
- Inputs: 1 digital input contact.

There are two possible configurations for the SIGNALLING module:
- default configuration: 1 digital input, 3 contacts with pole in common, 1 independent contact;
- alternative configuration: 4 independent contacts. In this case, the digital input is wired.
The two configurations are alternative to each othe.

The module functions with Vaux or is powered by PR120/V.

The module has a “Power” led, which indicates that it is on, and 4 contact leds “1“, “2”, “3” and “4“, which show the state of the 4 available contacts (Led on = contact made).

The menu in the relay allows various different parameters to be adjusted so as to configure contacts and input:
- Contact configuration (signal source, activation delay, idle state, self-latching function).
- Input configuration (polarity, function, delay)

2.11.3.1. PR120/K parameters

All the parameters of the contacts and inputs can be adjusted in the Settings-Modules menu.

Contact name	Parameter/Function	Values	Notes
Relay n. 1 Relay n. 2 Relay n. 3 Relay n. 4	Signal source	None/Prealarm L/Time delay L/ Time delay S/Opening L/Opening S /Opening G/Opening I/Each opening/Customized	Comply with the indications given for datalogger events for the customized configuration (See par. 2.8.3).
	Delay	0...100s; step 0,01s	Deliberate delay before activating the contact
	NO/NC	NO / NC	Contact normally-open (NO) or normally-closed (NC)
	Latch	ON / OFF	With the contact “ON”, once it has been activated it stays switched. A specific reset action is needed to reset it
Input	Polarità	Active low/Active high	Consider the input activated for low or high signals
	Function	Generic	- No associated action
		Outside trip	- Releases the CB
		Reset trip	- Resets the data after a trip
		Set B	- Switches from set A to set B (for PR123/P only)
		Local	- Forces the local status of the protection (local/remote)
		Signal reset	- Programmable contact reset
		Energy reset	- Energy meter reset
	Delay	0...100s; step 0,01s	- Performs action after t is set

The parameters can also be edited by means of the PR010/T, BT030-USB and Ekip T&P units.

2.11.3.2. Characteristics of the signalling contacts

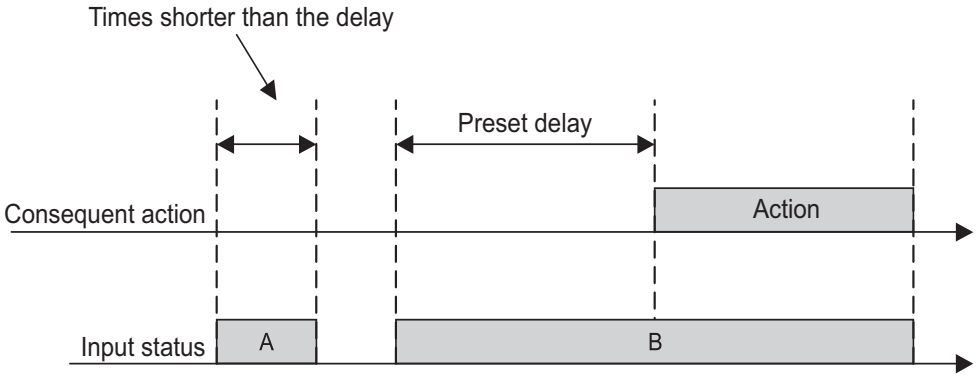
The following data are defined for resistive loads (cos φ = 1)

Parameter	Value	
Type of contact	Single pole (SPST)	
Max switching voltage	130 VDC	380 VAC
Max switching current	5 A	8 A
Max switching power	175 W	2000 VA
Breaking capacity at 35 VDC	5 A	----
Breaking capacity at 120 VDC	0,2 A	----
Breaking capacity at 250 VAC	----	8 A
Breaking capacity at 380 VAC	----	5,2 A
Contact/coil insulation		4000 Vrms
Contact/contact insulation		1000 Vrms

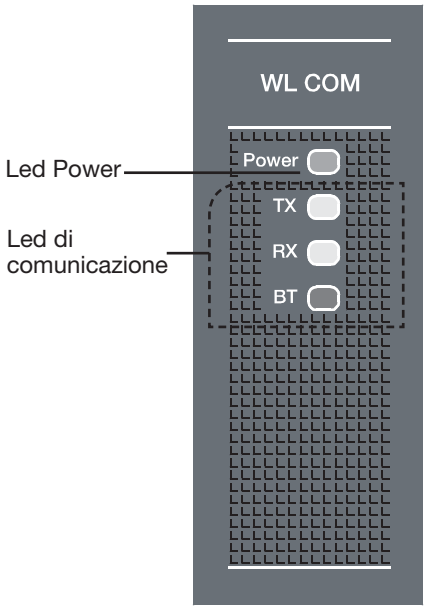
2.11.3.3. Digital input

The unit allows the digital input to be associated with the various different functions:
The digital input is activated by means of a DC voltage, which must be within the 0-5Vdc range in order to be considered low and in the 15-28Vdc range to be considered high.

The figure shows two cases, A and B, in which the input's status is active; in case A the input does not stay valid beyond the enabling delay so the associated action does not take place, whereas in case B the action takes place after the preset delay.



2.11.4. Module PR120/D-BT - WL COM



Communication module PR120/D-BT is dedicated to connecting the relay to a Wireless network for remote supervisory and control activities on the circuit-breakers. Communication is based on the Bluetooth standard and allows communuication between the relay and a portable PC with Bluetooth port. In order for the connection to be correct, remember that the module's range of action is 10 meters in free air.

The module functions when at least one power supply is present, from amongst: Vaux, supply via module PR120/V, supply via battery module PR030/B

The module has a "Power" led, which indicates that it is on, and three "Tx", "Rx" and "BT" communication leds to indicate data reception/transmission and Bluetooth connection activated.

Further details about how to make a correct Bluetooth connection are available in the ABB Ekip Connect SW operation manual (1SDH000891R0002)

2.12. Putting into service and recommendations

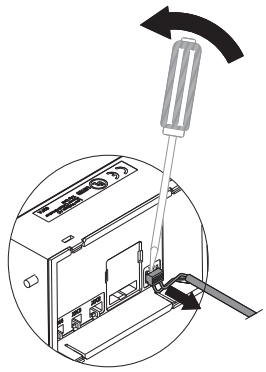
2.12.1. Installation

Circuit-breakers purchased with the relay unit assembled do not require this operation which is, however, necessary in the case of replacement.
To complete the procedure for installing a PR122/P or PR123/P unit, follow the steps below:

1. With the circuit-breaker open and preferably isolated, install the protection unit on the circuit-breaker
2. Power the unit ONLY from the PR030/B
3. If there are no other errors, the display will show the message Configuration (configuration error) accompanied by the yellow LED coming on permanently (warning)
4. Enter the unit's "Settings" menu
5. Select "Circuit-breaker"
6. Select "Unit installation"
7. Input the password
8. Select "Install" and press "ENTER"
9. When the red led flashes on and off and the message Installation (installation error) is displayed, remove the PR030/B
10. Power the relay from any other source.
11. Check for the absence of configuration errors.

2.12.2. Uninstalling

To complete the procedure for uninstalling a PR122/P or PR123/P unit, follow the steps below:



1. With the circuit-breaker open and/or isolated power the unit from the PR030/B
2. Enter the unit's "Settings" menu
3. Select "Circuit-breaker"
4. Select "Unit installation"
5. Input the password
6. Select "Uninstall" and press "ENTER"
7. Remove the PR030/B
8. Remove the PR123/P unit from the circuit-breaker
9. The remove the TC connector, proceed as indicated in the figure alongside.

The uninstalling procedure is not strictly necessary for operation but is strongly recommended as it allows allows circuit-breaker parameters such as contact wear and others that would otherwise be lost, to be stored. The data in question are then transmitted to the new PR123/P unit installed on the same circuit-breaker.

2.12.3. Connections

WARNING: For the connections provided by the user, it is recommended that you comply strictly with the recommendations contained in this document. This will enable us to satisfy all the international reference standards and guarantee perfect operation of the relay even under severe environmental and electromagnetic conditions. Pay particular attention to the types of cable, the connections to earth and the maximum distances.

2.12.4. CS and TC connection test

WARNING: If the PR122/P was installed by the user, it is important, before closing the CB, to check the last line on the display when the relay is turned on for the first time via a PR030/B battery unit. No CS and/or TC disconnected messages must appear; if they do, do not close the circuit-breaker and make the correct connections.

2.12.5. Current sensor connection for external neutral

WARNING: If you want to connect the current sensor for the external neutral conductor to a three-pole circuit-breaker, remember to set I_nN. accordingly. During this procedure, the circuit-breaker must be open and preferably isolated.

2.12.6. TV connections

All the application and functional details for correct use of the TV are described in par. 2.11.1.3.

2.12.7. How to put the Rc sensor into service

If relays PR122/P and PR123/P are to be provided with the Rc function, comply with the indications below to update the unit:
1. Disconnect all power supplies;
2. Comply with the instructions in document 1SDH000616R0001: install the supplied rating plug and XK2 cable for the RC application.
3. Install the toroid on the busbars as shown in the 1SDH000601R0001 document;
4. Connect the toroid to the relay as shown in the wiring diagram.
5. Power the unit through PR030/B and proceed to installation according to the following path: settings, CB, earth protection, external toroid, RC. Confirm the changes;
6. Check that no failures are indicated;
7. Set threshold and times of Rc protection;
8. Conduct an Rc test (see par. 2.10 Menù Test); check for correct operation.

2.13. Default settings

Before the PR122/P and PR123/P are put into service, it is essential for the user to define and carefully adjust the editable parameters to suit his installation requirements.
ABB SACE will apply the adhesive rating plates of all the variables concerning the CB (e.g. Type of CB, Rating Plug size, etc.), thereby allowing the user to find the information he needs when defining the parameters.

When the PR120/V module is installed, the user must adjust the installation voltage properly.

WARNING: Apart from this, it is absolutely essential for the user to change the password and carefully define each editable parameter before putting the relay into service.

The PR122/P and PR123/P is supplied by ABB SACE with the following predefined parameters

Protection	On/Off	Thresholds	Time	Curve	T.M.	ZS	Trip
L	--	1 In	144 s	I^2t	Off	--	--
S	Off	6 In	50 ms	K	--	Off: 0,04 s	--
S2 (only for PR123/P)	Off	6 In	50 ms	K	--	Off: 0,04 s	--
D (only for PR123/P)	Off	6 In	0,2 s - 0,2 s			Off: 0,13 s	--
I	On	4 In	--	--	--	--	--
G	Off	0,2 In	0,4 s	K	--	Off: 0,04 s	On
U (currents)	Off	50 %	5 s				Off
OT	--						Off
K LC1	Off	50 % I1					
K LC2	Off	75 % I1					
UV	Off	0.9 Un	5 s				Off
OV	Off	1,05 Un	5 s				Off
RV	Off	0,15 Un	15 s				Off
RP	Off	- 0,1 Pn	10 s				Off
UF	Off	0,9 Fn	3 s				Off
OF	Off	1,1 Fn	3 s				Off
Language	--	Engl					
Net Frequency	--	50 Hz					
Local Bus unit	Off						
Neutral sel.	--	*					
Toroid Selec.	--	None					
Ext. ground tor.	Off	100 A					
Rated Voltage	--	380V					
S startup	Off	6 In	100 ms				
I startup	Off	4 In	100 ms				
G startup	Off	1 In	100 ms				
Password	--	0001					
Measuring interval	--	60 min					
Iw	Off	3 In					
Power direction	--	top → bottom					
Warning: harmonic distortion	Off						
MCR	Off	6 In	40 ms	--	--	--	--
Start up activation threshold		0,1In					

Note:
* = OFF for three-pole versions
* = 50% for four-pole versions
* = 100% for full size versions

2.14.1. Troubleshooting

The following table lists a series of typical service conditions, to help you understand and solve hypothetical faults or malfunctions.

Note:
1. Before consulting the following table, check for any error messages appearing for some seconds on the display.
2. FN indicates the normal operation of the PR123/P.
3. In the case where the suggestions proposed do not lead to a solution of the problem, please contact the ABB SACE assistance service.
4. If possible, use the external communication units and supply a report downloaded by means of Ekip Connect.

N°	Situation	Possible causes	Suggestions
1	The trip test cannot be run	1. The busbar current is > 0 2. The TC is not connected	1. FN 2. Check the messages on the display
2	Trip times lower than expected	1. Threshold too low 2. Curve too low 3. Thermal memory enabled 4. Incorrect Neutral Selection 5. The SdZ is inserted	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Correct Neutral Selection 5. Exclude if not necessary
3	Trip times higher than expected	1. Threshold too high 2. Curve too high 3. Curve I^2t inserted 4. Incorrect Neutral Selection	1. Correct threshold 2. Correct curve 3. Exclude if not necessary 4. Correct Neutral Selection
4	Rapid trip, with I3=Off	Iinst tripped	FN with short-circuit with high I
5	High earth I, but no trip happens	1. Incorrect selection of the sensor 2. Function G prevented with I>4In	1. Set int. or ext. sensor 2. FN
6	Display off	1. Vaux missing and the current and/or voltage are below the minimum value. 2. Temperature off range	1. FN, see par. 2.3.5.2 2. FN, see par. 2.3.4 and see par. 2.6.17
7	The display is not back-lit	Current and/or voltages below the limit for lighting the display	FN
8	Reading of I incorrect	Current below the minimum threshold that can be displayed	FN
9	Reading of V, W and power factor incorrect	1. Connection error between VT and PR120/V 2. Voltage parameter setting error	1. Check connections between VT and PR120/V 2. Set correct parameters
10	"⚠ Local Bus" message on display	No communication between PR123/P and Flex Interface	1. If not present, disable PR021/K, see par. 2.9.3 2. Check bus connection 3. Check Flex Interface
11	Message "" instead of expected data	Function disabled or data off range	FN
12	The expected trip does not occur	Trip function disabled	FN enable trip if necessary
13	No activation of the Unbalance U protection	Values of I out of range	FN, see par. 2.6.11
14	No display of the opening data	Vaux missing,the buffer capacitor is discharged	FN, see par. 2.7.2
15	The password is not requested	The password has been disabled	FN, re-enter the password with a value other than 0000
16	Impossible to change any parameter	PR123/P in alarm situation	FN
17	"⚠ Temp. sensor" or "⚠ Start-up" message	Possible failure inside relay	Contact ABB Sace
18	Invalid date	1. First installation 2. Information lost due to power failure	Change date, see par. 2.9.8
19	Untimely trip		See par. 2.4.3.2
20	LED lighting		See par. 2.4.1
21	The language cannot be changed	1. Relay remotely set 2. CB not open 3. Vaux or PR120/V or PR030/B not installed	1. Set locally 2. Open CB 3. Power the relay

2.14.2. In the case of a fault

WARNING: If you suspect that the PR123/P is faulty, if has a malfunction or has generated an unwanted trip, it is advisable to follow the recommendations below very carefully from the Measurements menu ⟶ Historicals ⟶ Trip:

1. Make a note of the type of protection that has tripped by accessing the LAST TRIP page if there is an external power supply (Vaux or battery) or by pressing “i Test” if in self-powering mode.
2. Note down the type of circuit-breaker, number of poles, any accessories connected, In, Serial Number (see par. 14.4) and the SW version.
3. Prepare a brief description of the opening (what LEDs and/or indications were displayed? when did it happen?, how many times ?, was it always under the same conditions? what type of load? what voltage? what current? is the event reproducible?)
4. Send/communicate all the information collected, together with the circuit diagram for the circuit-breaker, to your nearest ABB Customer Support service.

The completeness and accuracy of the information given to the ABB Assistance service will facilitate technical analysis of the problem encountered, and will allow us to carry out all actions useful for the user rapidly.

WARNING: Letting a switch run with a fault that has not been remedied may lead to an apparatus malfunction or shutdown. Remove the apparatus immediately until it can be inspected or repaired if this situation may lead to personal injury, damage or is otherwise critical.

2.15. External units

Relays PR122/P and PR123/P can be connected to external units for temporary functions or to expand the functions and facilitate use:
- PR030/B
- BT030-USB
- PR010/T
- Ekip T&P
- HMI030
- Flex Interface

The Ekip Connect communication SW is also available. It is supplied with BT030-USB and Ekip T&P modules and can also be used with PR120/D-M.

Full details about the performance and use of the units listed above are given in Operation Manual 1SDH000460R0002.

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.

1SDH000460R0102 L6555

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