Non-Fused Disconnect Switch
Service Entrance Rated, Floor Mount/N3R
Instruction Manual

Thank you for your purchase of the Larson Electronics MPD-DS-FS-NFDS disconnect switch.

WARNING:

READ CAREFULLY BEFORE INSTALLING FIXTURE. RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE.
CRITICAL SAFETY INSTRUCTIONS:

- INSTALLATION SHOULD ONLY BE CONDUCTED BY A QUALIFIED ELECTRICIAN IN ACCORDANCE WITH NEC AND ANY RELEVANT LOCAL BUILDING CODES.
- RISK OF FIRE OR ELECTRIC SHOCK. FIXTURE INSTALLATION REQUIRES KNOWLEDGE OF FIXTURE'S ELECTRICAL SYSTEMS. IF NOT QUALIFIED, CONTACT A QUALIFIED ELECTRICIAN.
- BE CERTAIN ELECTRICAL POWER IS OFF BEFORE AND DURING INSTALLATION AND MAINTENANCE.
- MAKE SURE THE SUPPLY VOLTAGE IS THE SAME AS THE FIXTURE'S RATED VOLTAGE.
- TO PREVENT WIRING DAMAGE OR ABRASION, DO NOT EXPOSE WIRING TO EDGES OF SHEET METAL OR SHARP OBJECTS. SUITABLE FOR DAMP LOCATIONS.

The MPD-DS-FS-NFDS Series from Larson Electronics is a Power Distribution Non-Fused Disconnect Switch that is designed for reliable, safe, and convenient power distribution at industrial work sites. Designed for floor mounting installations, the bottom feed non-fused disconnect switch is protected by a NEMA 3R rated, steel enclosure with a ventilated design.

Mounting

The MPD-DS-FS-NFDS Series can be securely mounted to any flat surface that is capable of supporting the load of the unit. This system has no existing hubs for conduit, but is setup with an open bottom configuration. Do not stand under unit when lifting. Secure unit to flat surface using the flanges on the bottom of the unit. Be sure all applicable local and national building and electrical codes are followed when mounting.

Power

Only a licensed and knowledgeable electrician should complete connections to this unit!

Note: Always check product nameplate or labeling for voltage ratings! Follow all applicable local and National Electrical and building code when installing.

Unit features open bottom configuration for feeding supply power. Be sure to consider your preferred method of bringing in the supply power and connecting equipment when mounting. Complete wiring connections in accordance with the wiring diagram included with your unit. Ensure the unit is properly grounded and that wiring is done according to all applicable local and national electrical/building codes.

See further information specific to the disconnect switch inside the enclosure on following pages of this manual. Refer to the wiring diagram for connection specifics.

DISCONNECT SWITCH OPERATIONS MANAUL

WARNING

HAZARDOUS VOLTAGE
CAN SHOCK, BURN
OR CAUSE DEATH.

Do not attempt to handle, install, use or service this product before reading instruction book

- 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 Larson Electronics, might be performed, or the possible hazardous consequences of each con-ceivable way, nor could Larson Electronics investigate all such ways.
- Anyone using service procedures or tools, whether or not recommended by Larson Electronics, must satisfy him-self 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 a Larson Electronics 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 RELEASE - GENERAL NOTES

The series of SACE Emax X1 air circuit-breakers and SACE Tmax T7-T8 molded-case circuit-breakers can be equipped with PR331/P and PR332/P protection releases. SACE Emax X1 circuit-breakers can also be equipped with the PR333/P protection release.
Every operational requirement is now available thanks to the different performance levels of the protection releases, the modules that can be fitted inside them (PR330/V, PR330/D-M) and the other external accessories.

The following table illustrates the functions and accessories available with the 3 protection relays.

Function/Unit	PR331/P	PR332/P	PR333/P
Current protections (L, S, I, G)	**S**	**S**	**S**
Additional protections (U, OT)	**S**	**S**	**S**
Voltage protections (UV, OV, RV, RP, UF, OF)	**S**(4)	**S**(4)	**S**
Other protections (D, S2, Double protection G)	**-**	**-**	**S**
Harmonics analysis	**-**	**-**	**S**
Temperature protection	**S**	**S**	**S**
MCR Protection	**S**	**S**	**S**
Thermal memory	**S**	**S**	**S**
Residual current protection	**O**	**O**	**O**
Data Logger	**S**	**S**	**S**
Dual setting	**-**	**-**	**S**
Front connector for test unit and temporary power supply	**S**	**S**	**S**
Compatibility with Ekip Connect	**S**	**S**	**S**
Local bus for external accessory units	**S**	**S**	**S**
System bus for cable communication	**O**(2)	**O**(2)	**O**(2)
PR330/V Measuring (internal voltages module)	**O**	**O**	**S**
PR330/R Signalling	**O**	**O**	**O**
PR330/D-M (Internal module for cable communication)	**O**	**O**	**O**
HMI030 (Switchgear display for protection releases installed in SACE circuit-breakers)	**O**	**O**	**O**
Flex Interface (External signalling unit)	**O**	**O**	**O**
PR030/B (separate power supply unit)	**S**	**S**	**S**
Ekip T&P (External unit for power supply, communication and testing via USB)	**T**	**T**	**T**
PR010/T (External unit for tests)	**T**	**T**	**T**

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

Notes:
1. : with PR330/V module,
2. : with PR330/D-M module,
4. : with CB SACE Emax X1

PR33x protection releases provide the following functions (availability of some of the functions depends on the version of the release and on the presence of 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 PR333/P).
7. Analysis up to the 40th harmonic.
8. Power supply and measurements from busbar voltages (with module PR330/V).
9. Power contact configurable by the customer in terms of event, status and signalling delay options (S51/P1).
10. Communication via system bus (with module PR330/D-M).
11. Connection for HMI030 and Flex Interface external signalling and measuring modules.
12. Connection to a PC via wireless Bluetooth (with BT030-USB) or USB (with BT030-USB or Ekip T&P).
13. Serial connection for external modules Flex Interface and HMI030.
14. “Real time” date and time settings.
15. Software applications available for CB and protection release testing and maintenance.

1.1. Compatibility between protection releases and CB

This table summarizes all the possible combinations between the different protection releases and Emax X1 and Tmax T7-T8 circuit-breakers.

CB / Release	PR331	PR332	PR333
T7	X(1)	X(2)	
T8	X(1)	X(2)	
X1	X	X	X

Note:
(1): LSIG version available
(2): PR332/P MM available with SACE Tmax T7 and T8 CB

1.2. Abbreviations and notes

1.2.1. Abbrevations

Abbreviations	Meaning
YO	Opening coil
YC	Closing coil
CB	Circuit-Breaker
CS	Current Sensor
Ekip Connect	Communication software for PC, for electronic devices installed in ABB SACE CB
Emax	Series of ABB SACE air circuit-breakers
Tmax T7-T8	Series of ABB SACE molded-case circuit-breakers
HW	Hardware
In	Rated current of the Rating Plug installed in the circuit-breaker
i-Test	“Info/test” button on protection release
MT	Thermal memory
Pn	Circuit-breaker rated power
Pn_{fase}	Phase rated power
Protection release	Electronic protection and operating unit for ABB SACE circuit-breakers
RMS	Root mean square value
SdZ	Zone selectivity
SW	Software
TC	Trip Coil (opening solenoid)
Rc	Current sensor for residual current reading
Trip	CB opening action generated by protection release
TV	Voltage transformer
Un	Rated voltage of the voltage transformers installed (phase voltage)
SGR	External current sensor for earth fault current reading
Vaux	Auxiliary power supply

1.3. Safety Notes

Read this manual carefully and completely: use of the protection releases should be reserved to qualified and expert personnel only.

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

You must assume that safe usage is impossible if:
1. The protection release shows visible signs of damage.
2. The protection release does not function (e.g. with autotest or by means of the trip test unit).
3. The release has been damaged during transport.

The protection release must be put out of service to prevent accidental use.

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

1.3.1. Notes for dielectric stiffness tests

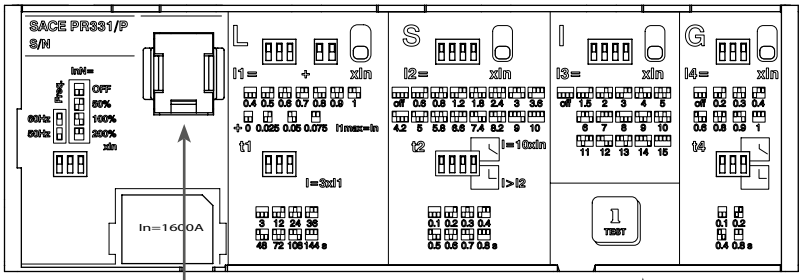
WARNING:
Dielectric strength tests must not be performed on the inputs and outputs of PR332/P and PR333/P.

2. PROTECTION RELEASE PR331/P

2.1. Overview

PR331/P is available in 3 versions, all compatible with various different switchgear and testing accessories:

Values available	PR331/P	PR331/P	PR331/P
	L I	L S I	L S I G



Temporary accessories (test connector)
BT030-USB
PR030/B
PR010/T
Ekip T&P

Switchgear accessories
HMI030
Flex Interface

2.2. Main specifications

PR331/P is an electronic device for SACE Emax X1 and SACE Tmax T7-T8 circuit-breakers with functions for monitoring and for protecting against abnormal currents.

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

Dip switches on the front allow the main protections and settings to be adjusted, while the state of the protection release is indicated by the leds of the front interface.

2.2.1. Protections

Depending on the version, the protections available are as follows:t

Symbol	Protection against
L	overload with inverse long time delay
S	short-circuit with adjustable delay
I	nstantaneous short-circuit
G	earth fault with adjustable delay

The protection release allows the protection MCR (available with the SACE Emax X1 CB) settings to be entered via Ekip Connect and also ensures that fixed protection against sudden short-circuits at high current values (called Iinst protection) is provided.

2.2.2. Functions

PR331/P includes various different functions, depending on the version and configuration chosen:
- Runtime measurement of the phase current and peak factor;
- Autotest: continuous monitoring of the main connections to the release, among which: current sensors, trip coil, rating plug, circuit-breaker state.
- External contact (S51/P1) configurable by the customer, for monitoring one or more state or alarm events.
- Maintenance information and counters: events log, number of operations, estimated contact wear, maintenance log (via Ekip Connect).

2.2.3. Accessories

A set of accessories adds optional functions to the basic version.
- External neutral, current sensor for protecting the external neutral pole (can only be configured for three-pole circuit-breakers).
- PR030/B allows the protection release to be temporarily energized so as to view its state (via the LEDs) and perform installation.
- BT030-USB allows temporary energizing and communication of the protection release for the purpose of supervising, via a PC, information like the Trip log and measurements, and for adjusting settings and functions that are not available using the front dip switches, such as the Thermal Memory.
- PR010/T allows the protection release to be temporarily energized, performance of the protection test and storage of a test report.
- Similarly to BT030-USB, Ekip T&P can be used to temporarily energize and communicate the protection release via PC. Like PR010/T, it also allows the protection release to be tested, again via PC.
- The HMI030 switchgear display expands the monitoring functions of the protection release by displaying the current measurements of all the phases in real time.
- Flex Interface modules allow the alarm or state signals of the protection release to be associated with configurable electromechanical contacts. In addition, they allow a complete network of several units to be created and can also be connected to external modules (e.g. HMI030).

- Ekip Connect is a communication software for PCs or tablets. Compatible with numerous ABB devices, it is supplied with BT030-USB and Ekip T&P modules or is available on the ABB website.

More details are given from page 63 of chapter 4, or in the dedicated manuals.

2.2.4. Compatibility CB

PR331/P can be installed in ABB circuit-breakers of the three-pole, three-pole with external neutral or four-pole type from the SACE Emax X1 or SACE Tmax T7-T8 series (any size).

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

The adjustable protections (L, S, I and G) refer to the In size defined by the interchangeable Rating plug module installed on the actual protection release.

2.2.5. Standards

PR331/P has been designed to operate in accordance with the following international standards:
- IEC 60947-2 Low voltage apparatus. Circuit-breakers. (T7-T8, X1)
- UL 489 Molded-Case Circuit Breaker, Molded-Case Switches and Circuit-Breaker Enclosures (T7-T8)
- UL 1066 Low Voltage Power Circuit Breaker (X1)

2.2.6. 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 PR331/P installed in the circuit-breaker)	IP 30

2.2.7. Electrical characteristics

The protection release is energized:
- Directly by the internal current sensors connected to the busbars of each phase. In this case, the release activates with the circuit-breaker closed and in the presence of a minimum three-phase current value.
- By an external auxiliary power supply. In this case, continuous operation of the unit is guaranteed even with nil current on the busbars or with the circuit-breaker open. The protection release functions can also be increased using external accessories HMI030 and Flex Interface.

To improve the supply condition, ABB recommends use of the auxiliary supply source when there are low load current values and/or distorted signals.

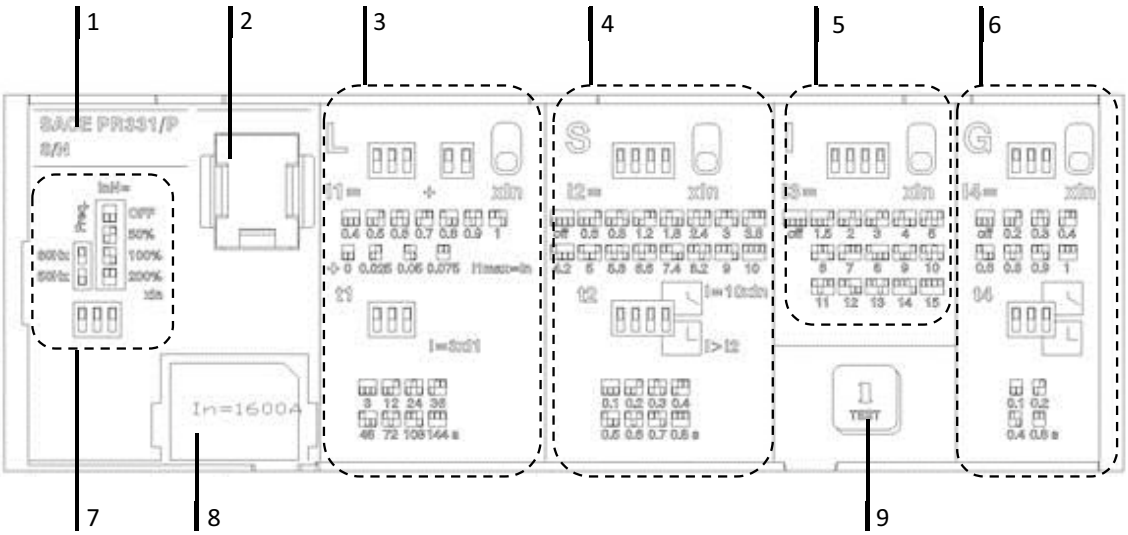
Primary current characteristics	Range
Minimum three-phase busbar current	>80A
Frequency	50/60 Hz ±10%
Peak factor	2,1 @ 2xIn in conformity to IEC 60947 Annex F (Consult ABB for a dedicated analysis if there are higher peak factors)

Auxiliary power supply characteristics	Range
DC voltage (galvanically separated)	24 Vdc ±20%
Maximum ripple	5%
Inrush current @ 24V	~2 A for 5ms
Rated power @ 24V	~2 W

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.

2.3. User interface

PR331/P allows the protections and main settings to be adjusted via the dip switches and has signalling leds for monitoring the state and alarms.



Ref.	Description
1	Serial number of the protection release
2	Test connector
3	Section dedicated to protection L: threshold setting dip switches, time adjustment dip switches and alarm/trip leds
4	Section dedicated to protection S: threshold setting dip switches, time adjustment dip switches and alarm/trip leds
5	Section dedicated to protection I: threshold setting dip switches and trip leds
6	Section dedicated to protection G: threshold setting dip switches, time adjustment dip switches and alarm/trip leds
7	Dip Switches and indications for configuration of rated frequency and neutral protection
8	Rating Plug
9	“i Test” button

IMPORTANT: the dip switches and leds of protection S are available with release versions LSI and LSIG. The dip switches and leds of protection G are available with release version LSIG.

2.3.1. Dip switches

The dip switches on the front of PR331/P are used for adjusting the tripping thresholds of each protection and the tripping time. The available combinations are given alongside each group of dip switches.
The dip switches for regulating the tripping times of protections S (t2) and G (t4) can also be used for selecting the tripping curve:

L	Fixed time tripping curve. The following relation is used: t=k.
↖	Inverse time tripping curve. The relation between the tripping time and over-current is given by the formula: $t=k/I^2$

The dip switch settings can be changed when the protection release is on and without alarms: updating is immediate and the unit need not be restarted.

WARNING: Settings changed by the user when the protection release is in the alarm condition will not be activated until the alarm condition terminates.

An example of the dip-switch setting for the protection L function, with 2000A Rating Plug (In= 2000A) is given below.

I1 = 0,4 + 0.025 x In
I1 = 850A

2.3.2. LED

The following table shows how the LEDs are managed in accordance with the IEC standard 60073 (and clause 4.2.3.2 in particular).

2 to 4 red leds are available for checking the protections: the number of leds depends on the way the protection release and protections installed have been configured.
The led of protection L can also come on in the orange colour, thereby providing further information.

All the led combinations and the corresponding information are given in the table below.

Type of information	Flashing slowly (0,5Hz)		Flashing fast (2Hz)			LED flashing with two 0.5 sec pulses every 2 sec		LED flashing with one pulse every 3 sec	LED on permanently		
	All LEDs	Single LED	All LEDs	Single LED		All LEDs	Single LED	Single LED	All LEDs	Single LED	
	RED	ORANGE	RED	RED	ORANGE	RED	ORANGE	ORANGE	RED	RED	ORANGE
TC error or TC disconnected			☒								
CS error or disconnected	☒										
Rating Plug/Installation error(1)						☒					
Protection timer error				☒							
Last trip (2)										☒	
Test button pressed and no failure detected (3)									☒		
Hardware Trip (4)										☒(5)	☒
L pre-alarm											☒
Configuration error(6)					☒						
Settings inconsistency							☒				
Normal operation of the release (7)								☒			
CB Undefined or CB status error (8)		☒									

(1) Rating plug disconnected or In > Iu.
(2) The led of the protection that has tripped or is being timed comes on to display the information. If it is the last trip, the led remains on for 2 sec or with fixed light if power source is external (from PR030/B).
(3) The information is displayed with all the leds on for as long as the test button remains depressed, or for 2 seconds if it is pressed once.
(4) If enabled, the hardware trip causes the CB to open within 1 sec. It activates in the case of “Cs Error” or “Rating plug Error”, or when the protection of Ne is “ON” in the 3P circuit-breaker without Ne ext (wiring error).
The cause of tripping (CS Error, Rating Plug Error) is displayed in the presence of Vaux and/or PR030/B (connected during the event).
The generic “Hw trip” signal remains in the absence of Vaux and/or PR030/B and is displayed by pressing the “I-test” key.
(5) Orange L led and red I led on.
(6) Installed values differ from those stored by the protection release: installation required (see sect. 2.6.1).
(7) In the absence of other information, “normal operation” is signalled 3s after the protection release has been turned on. In the case of units BT030-USB, Ekip T&P and PR010/T, the “normal operation” signal can be disabled, but in this case, the “unit on” (Alive LED OFF) signal will no longer be activated.
(8) Signalling with the SACE Emax X1 CB, current reading > 0.1 In and CB in Open state.

WARNING: the leds only function if the protection release is on: make sure that the minimum power supply conditions have been complied with in order to read the signals.

2.3.3. iTest button

The itest button can be used for different functions:
- with the protection release off, it allows the last event recorded to be checked (when pressed for about 1 second). The function is guaranteed for 48 hours after switch-off (absence of internal or external power supply).
- with the protection release energized by PR030/B alone and with the CB open, it allows installation on the CB to be performed (see sect. 2.6.1).
- with the protection release energized by PR030/B and the CB closed, it allows performance of the LED test (when pressed for 3 seconds) and the trip coil operation test (when pressed for 7 seconds) with consequent opening of the CB.
- It allows the Trip signal to be reset (when pressed for about 1 second) after a trip, with the protection release on.

WARNING: in the case of operating temperatures between -40°C and -25°C, in versions where this is envisaged, the information only remains stored for 24 hours.

2.3.4. Test connector

The front test connector allows PR030/B modules to be connected for temporary powering of the protection release, and BT030-USB, PR010/T, Ekip T&P for powering, communication and testing via PC (or via the protection release itself, in the case of PR010/T). Consult the chapters dedicated to the accessory modules for further details.

2.4. Protection functions

Depending on the model, PR331/P handles up to 5 independent protection functions.
The current signal from the current sensors is processed by the protection release which, depending on the protection parameter settings, indicates alarms, performs delay processes and sends commands.

All the adjustable protections process according to the true root mean square value of the current values read by means of the current sensors.
Each protection has an alarm led, which comes on in the case of delays (flashing) or trips (fixed) and goes out if the current is not dangerous.

WARNING: when activated, the protections must guarantee the following rule:
I_1(protection L) < I_2(protection S) and I_2(protection S) < I_3(protezione I).
When the release is on, an incorrect protection threshold setting is signalled by the front leds (inconsistent settings)**.**

The protection release has a "backup-protection" function. If the first command transmitted to the trip coil fails to immediately open the circuit-breaker (partial TC failure), further trip commands are sent until it opens (absence of current and CB open).

2.4.1. Protection L

Protection L is the only adjustable protection that cannot be disabled since it provides self-protection against circuit-breaker overloads.
- The type of curve setting is t=k/I2 and the tripping time is calculated according 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.

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]

Protection L has 3 operation conditions established by the primary 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 setting in progress.
$0.9\ xI_1 < I_f < (1.05...1.2)\ xI_1$	Prealarm L signal, all settings possible. No opening time setting in progress.
$(1.05...1.2)\ xI_1 < I_f$	Alarm L signal, no setting possible. Opening time setting in progress.

WARNING: the protection L threshold range ensures that:
- the protection release is not in the alarm condition for current values below 1.05 xI_1;
- the protection release is in the alarm condition for current values over 1.2 xI_1.

2.4.1.1. Thermal memory L

The thermal memory function can be enabled to protect the cables. It is based on the "τL" parameter defined as trip time of the curve (t1) selected @1.25xI1. This function can be enabled through PR010/T, or Ekip Connect.
Protection release trip time is certainly 100% of the selected value after a time interval τL has elapsed since the last overload or last trip, or else trip time will be reduced depending on the overload and time elapsed.

PR331/P has two instruments for processing the thermal memory. The first only operates when energized (it also records overloads that have not lasted long enough to trip the CB), while the second operates even when not energized, reducing any trip times in the case of immediate reclosing and activating the moment the circuit-breaker trips.

WARNING: the thermal memory function is enabled by default in the UL version.

2.4.2. Protection S

The protection, which can be disabled, can be the fixed time (t=k) or inverse time ($t=k/I^2$) type.

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: 1.7In)
- I_2 , t_2= protection S parameters set by the user, given in [In] and [s]

2.4.2.1. Thermal memory S

The thermal memory function can be enabled for cable protection when 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".

2.4.3. Protection I

This protection can be disabled; it is of the fixed time (t=k) type, and is designed for a nil intentional delay.

2.4.4. MCR protection

Available with the SACE Emax X1 CB, this protection is useful for protecting the installation against CB closing upon short-circuit. It remains activated for a limited time, calculated from the moment the CB closes, and uses the same algorithm as protection I. Using Ekip Connect, the customer can activate it, adjust the tripping threshold and enter the trip time.

WARNING: this protection is an alternative to protection I and functions in the presence of an auxiliary supply.

2.4.5. Protection G

The protection, which can be disabled, can be the fixed time (t=k) or inverse time ($t=k/I^2$) type.

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: 3.7In)
- I_4, t_4= protection G parameters set by the user, given in [In] and [s]

PR331/P is able to provide earth fault protection, created inside the protection release, by vectorally adding together the phase and neutral currents. The fault current is defined by the following formula:

$$\vec{I}_G = \vec{I}_1 + \vec{I}_2 + \vec{I}_3 + \vec{I}_N$$

If there is no fault in the circuit, the modulo-sum of these currents is always nil.
Vice versa, the fault current will acquire an increasingly higher value, depending on the entity of the fault.

WARNING: protection G is disabled for current values exceeding 8In (for $I_4 \geq 0{,}8In$), higher than 6In (for $0{,}5In \leq I_4 < 0{,}8In$) and higher than 4In (for $I_4 < 0{,}5In$)

WARNING: in the absence of Vaux, the minimum threshold accepted is 0.25In with rating plug= 400A and 0.2In for all the other sizes. If the entered value fails to comply with this limitation, the SW overrides the threshold until it reaches the minimum value accepted and the leds display the "Inconsistent settings" error.

2.4.6. Neutral Protection

Unit PR331/P allows the current signal of the neutral pole to be processed with different ratios in relation to the phase values. The following values can be set for this protection: I_nN =Off - 50% - 100% - 200% * I_n**.** The neutral protection is set by default at a current value equal to 50% of the phase regulation.

Regulation of the neutral value (InN) must conform to the following formula: (I_1 x I_nN) ≤ Iu.
With four-pole circuit-breakers, the protection release performs the test automatically 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 protection release 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 can be: 50-100-200%.
With CB E1B800 (Iu=800A), Rating plug 800A (In=800A) and I1=1In, the I_nN can be: 50-100%.

The I_1=1I_n setting is the maximum setting of the protection against overload. The real permissible maximum setting must take account of derating due to the temperature, terminals used and the altitude.

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, connect T5-T6 to the sliding contacts, as shown in the wiring diagrams.

WARNING: Failure to comply with the setting limits of "I1" and "InN" may result in damage to the circuit-breaker and consequent risks even for the operator.

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

2.4.7. 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 requiring shorter reaction times than those guaranteed 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.

2.4.8. Summary table of protections

Protection	Disabling	Trip threshold		Trip time	Trip threshold tolerance (2)	Trip time tolerance (2)
L (t=k/I^2)	☐	**I1** =	0.4 - 0.425 - 0.45 - 0.475 - 0.5 - 0.525 - 0.55 - 0.575 - 0.6 - 0.625 - 0.65 - 0.675 - 0,7 - 0.725 - 0.75 - 0.775 - 0.8 - 0.825 - 0.85 - 0.875 - 0.9 - 0.925 - 0.975 - 1 x In	t1 = 3 - 12 - 24 - 36 - 48 - 72 - 108 - 144 s (1) @I_f=3I1	Release between 1.05 and 1.2 x I1	± 10% $I_f \leq 6$ x In ± 20% $I_f > 6$ x In
S (t=k)	☒	**I2** =	1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 5 - 6 - 7 - 8 - 8.5 - 9 - 9.5 - 10 x In	Where $I_f > I2$ t2 = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8 s	± 7% $I_f \leq 6$ x In ± 10% $I_f > 6$ x In	The best of the two data: ± 10% o ± 40 ms
S (t=k/I^2)	☒	**I2** =	1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4 - 5 - 6 - 7 - 8 - 8.5 - 9 - 9.5 - 10 x In	t2 = 0.1 - 0.2 - 0.3 - 0.4 - 0.5 - 0.6 - 0.7 - 0.8 s @ 10 In	± 7% $I_f \leq 6$ x In ± 10% $I_f > 6$ x In	± 15% $I_f \leq 6$ x In ± 20% $I_f > 6$ x In
I (t=k)	☒	**I3** =	1,5 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 x In	≤ 30 ms	± 10%	
MCR (t=k)	☒	6,0xIn ≤ I_5 ≤15xIn step 0,1xIn		@I_f>I_5 ≤ 30ms(3)	±10%	
G (t=k)	☒	**I4** =	0,2 - 0,3 - 0,4 - 0,6 - 0,8 - 0,9 - 1 x In	Where $I_f > I4$ t4 = 0.1 - 0.2 - 0.4 - 0.8 s	± 7%	The best of the two data: ± 10% o ± 40 ms
G (t=k/I^2)	☒	**I4** =	0,2 - 0,3 - 0,4 - 0,6 - 0,8 - 0,9 - 1 x In	Minimum trip time t4 = 0.1 - 0.2 - 0.4 - 0.8 s	± 7%	± 15%

(1) The minimum value of this trip is 1s regardless of the type of curve set (self-protection).
(2) These tolerances apply in the following conditions:
- Self-energized protection release in service conditions (no start-up) with 2 or 3 supplied phases and/or in presence of auxiliary supply. .
- operating temperature within the -25° ...70° range
- primary current values within the operating limits (see par. 1.2.7)

(3) The interval of time for which the protection is activated can be selected via Ekip Connect, and is calculated from the moment the CB closes.

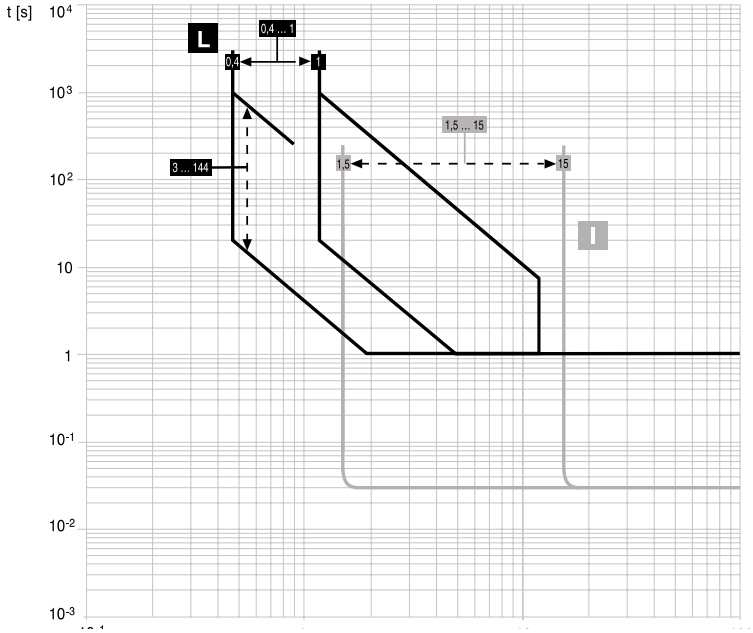
For all cases not covered by the above hypotheses, the following tolerances apply:

Protection	rip 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%	

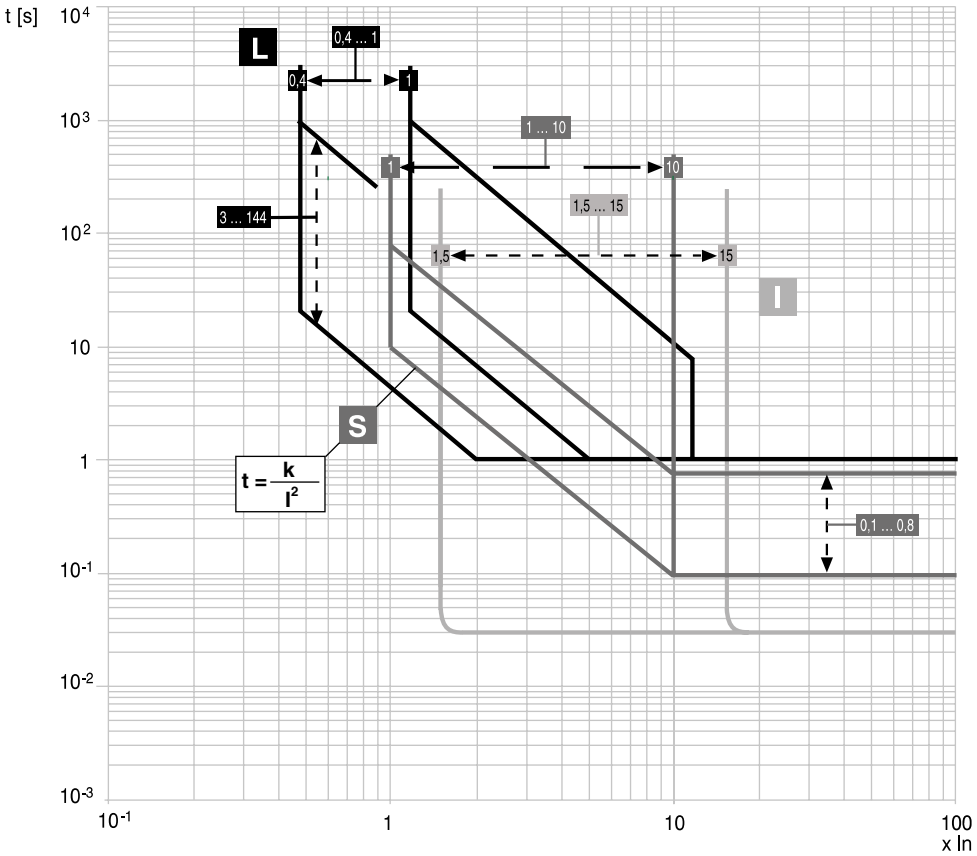
2.4.9. Trip curves

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

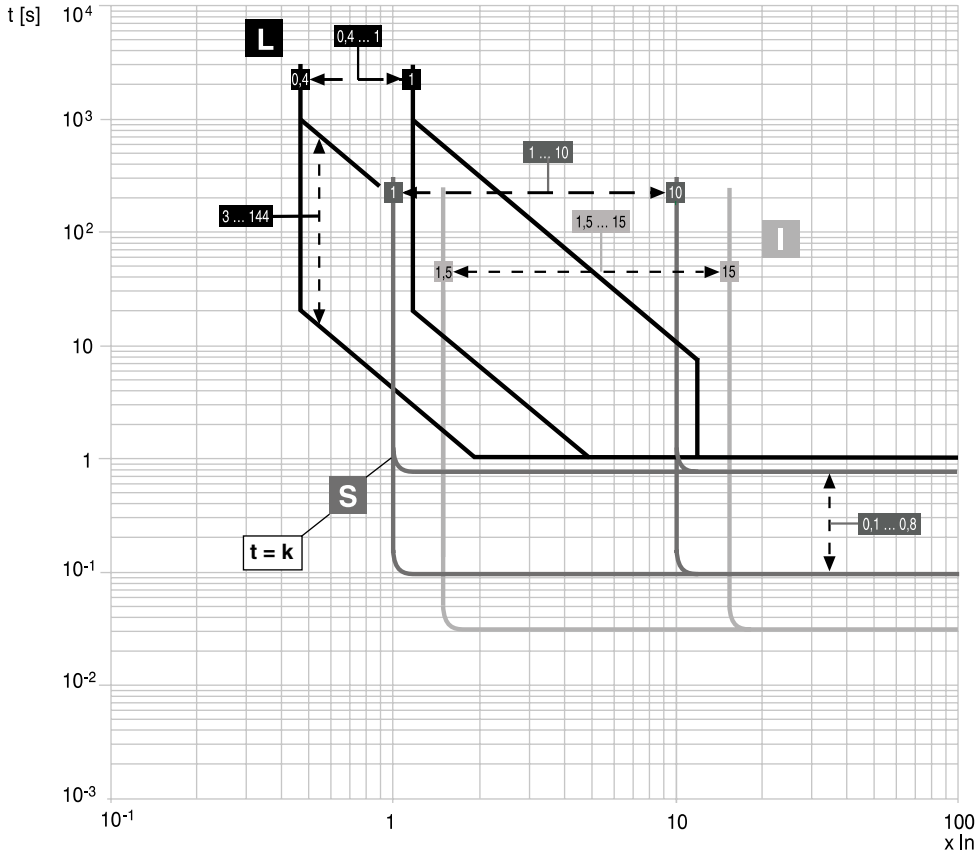
2.4.9.1. Trip curves for functions L-I



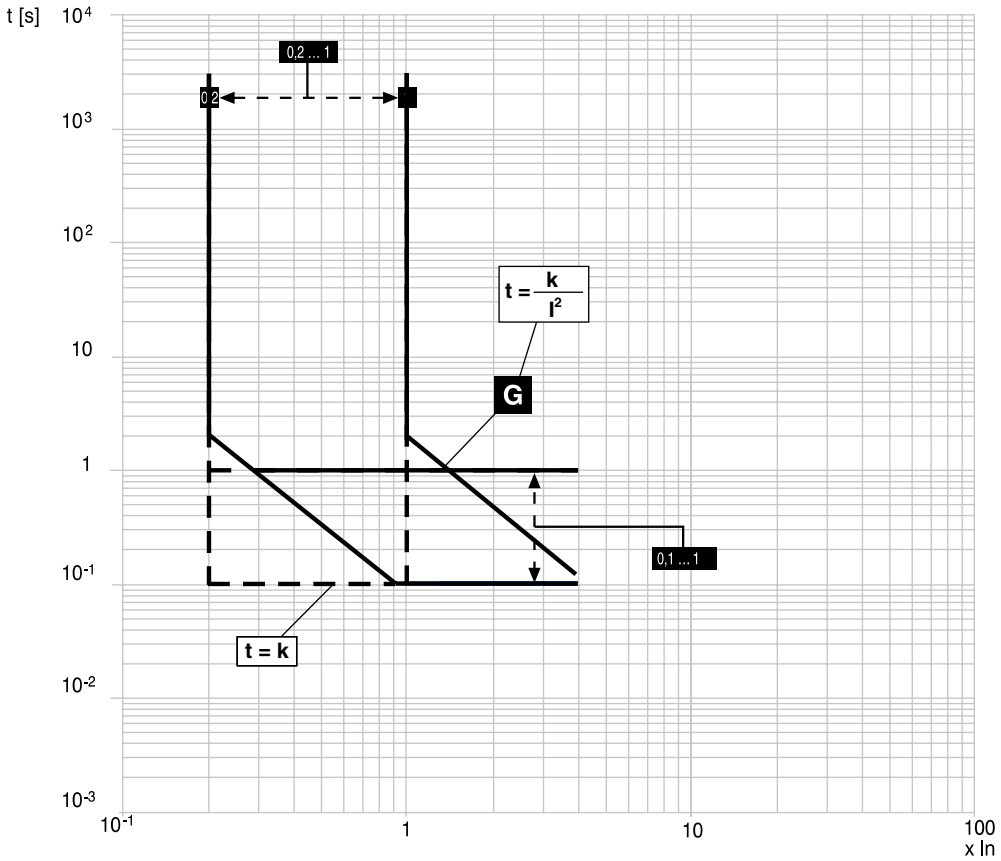
2.4.9.2. Trip curves for functions L-S(t =k/I²)-I



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



2.4.9.4. Trip curves for function G



2.5. Main functions

2.5.1. Measurement

The current measuring (ammeter) function is available in all versions of the PR331/P unit.
This function is accessible by means of test unit BT030-USB, Ekip T&P (connected to a PC) and PR010/T, or by means of HMI030.
The measurement tolerance margins are:

Type of measurement	Range of values measured by the protection release	Standard operation range	
		Range	Tolerance %
Phase and neutral current	0,05 ... 16 In	0,3 ... 6 In	± 1,5
Earth fault current	0,05 ... 4 In	0,3 ... 4 In	± 1,5

PR331/P can periodically record the maximum current reading: this function must be enabled by means of test unit BT030-USB or Ekip T&P, and requires auxiliary voltage.

2.5.2. Self-monitoring

PR331/P provides certain self-testing functions so as to facilitate failure analysis in the case of faulty operation or incorrect configuration of dip-switches and settings. Faults are signalled by a combination of led lights.

The functions are as follows:

- ❑ Rating Plug validity.
- ❑ Checks to find out whether the current sensors (CS) are connected correctly.
- ❑ Watchdog for proper connection of the Trip Coil (TC).
- ❑ Hw Trip protection. If activated, a CB opening command is transmitted through activation of the TC if sensors are disconnected or if the Rating Plug is not connected/faulty. This function can be activated by means of test unit PR010/T, BT030-USB or Ekip T&P.

2.5.3. Contact S51/P1

PR331/P has an external contact, which can be configured by the customer and is useful for monitoring a series of events, including alarms and protection trips.
The configuration options of the contact, available via PR010/T or Ekip Connect, are:
- Monitoring event/s;
- Contact activation delay;
- Idle state (normally open or closed);
- Trigger configuration (Auto or Single).

The contact is available in all supply configurations and possesses the following electrical characteristics:

Type of contact	
Maximum switching voltage	400 Vac (Peak) / Vdc
Maximum switching current	0.1 Aac (Peak) / Adc
Maximum switching power	40 W
Contact/Circuit insulation	1500 Vac

2.6. Putting into service and recommendations

2.6.1. Installation

Circuit-breakers purchased with the protection release assembled do not require this operation which is, however, necessary in the case of replacement.
Comply with the following instructions if the release on the CB is replaced:
1. With the circuit-breaker open and possibly isolated, connect the protection release to the circuit-breaker itself by connecting all the cables as indicated in the assembly documents.
2. Power the unit with PR030/B only.
3. If there are no other errors apart from the configuration one, press the “i Test” button for a few seconds until all the red leds flash to confirm that installation has taken place.
4. Remove the PR030/B.
5. Power the protection release by means of any supply source (Vaux, PR030/B, PR010/T).
6. Make sure that there are no configuration errors (check that the LEDs are on in the Alive LED ON configuration).
7. The circuit-breaker and protection release can now be put into service.

2.6.2. Connections

WARNING: Strict compliance with the instructions given in this document is required for the connections at the user's charge.
This will ensure compliance with all the international reference standards and guarantee that the protection release functions perfectly even in heavy duty environmental and electromagnetic conditions. Pay particular attention to the earth connection.

2.6.3. CS and TC connection check

WARNING: If the PR331/P has been installed by the user, remember to check (with the CB open and Vaux or PR030/B), prior to putting the circuit-breaker into service, to make sure that the CS and TC cables have been connected correctly. Make the correct connections if this is not the case. If all the red leds come on, it means that there is an error in the CS and/or TC connections

2.6.4. Connection of current sensor for external neutral

WARNING: Remember to set the InN in the appropriate way if the current sensor for the external neutral conductor must be connected to a three-pole circuit-breaker.
During this phase, the circuit-breaker must be open and, if possible, isolated.

2.7. Default parameters

Before the PR331/P is put into service, it is essential for the user to define and carefully adjust the editable parameters to suit his installation requirements.
ABB will apply the adhesive rating plates of all the variables concerning the CB (e.g. Type of CB, Rating Plug size, etc.) so as to provide the user with all the information he needs to define the parameters.

PR331/P is supplied with the following predefined parameters:

#	Protection	Threshold	Time
1	L	1 In	144 s
2	S	Off	0,1 s
3	I	4 In	--
4	G	Off	0,1 s
5	Mains frequency	50 Hz (1)	
6	Neutral sel	(2)	
7	S51/P1	Alarm L	0 s

Note:
(1) = 50 Hz for IEC type CB
60 Hz for UL type CB
(2) = Off for three-pole CB
50% for four-pole CB

2.8. Troubleshooting

2.8.1. Troubleshooting

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

N.B.:

1. Before consulting the following table, check for a few seconds for any optical signals provided by the LEDs.
2. FN indicates the normal operation of the PR331/P.
3. If the following suggestions fail to solve the problem, please contact the ABB customer support 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 è > 0 2. The TC is not connected 3. PR030/B is not connected	1. Normal operation (FN) 2. Check TC connection (see par. 1.6.3) 3. Connect the PR030/B unit
2	Trip times lower than expected	1. Threshold too low 2. Curve too low 3. Incorrect neutral selection	1. Correct threshold 2. Correct curve 3. Correct neutral adjustment
3	Trip times higher than expected	1. Threshold too high 2. Curve too high 3. Curve type "t=k/I^2" 4. Incorrect neutral selection	1. Correct threshold 2. Correct curve 3. Select curve type "t=k" 4. Correct neutral adjustment
4	Rapid trip, with I3=Off	Iinst tripped	FN short-circuit with high I
5	Earth fault current beyond threshold	G function automatically inhibited but no trip occurs	FN
6	Expected trip does not happen	Function OFF	FN enable protection function
7	LEDs irregularly turned on		see par. 1.3.2
8	Unexpected trip		see par. 1.3.2
9	L LED (orange) flashing		FN

2.8.2. In the case of a fault

WARNING: If the PR331/P is suspected of being faulty, if there are signs of malfunctions or it has generated an unexpected trip, we advise you to strictly follow the recommendations below:

1. Press the “i Test” button (within 48 hours of CB opening or within 24 hours if the operating temperature is in the -40°..-25° range) and make a note of the led that comes on, the type of CB, the number of poles, any accessories connected, In, Serial Number. After 48 or 24 hours, depending on the case, the data are not cancelled. Just the LED display is inhibited.
2. Prepare a brief description of the opening (what LEDs were displayed?, when did it happen?, how many times?, was it always under the same conditions? what type of load? what current? is the event reproducible?).
3. Send/communicate all the information collected, together with the circuit diagram for the circuit-breaker, to your nearest ABB Customer Support service.

The more the information given to the ABB Customer Support service is complete and accurate, the easier the technical analysis on the problem encountered will be, enabling us to take all action to help the user without delay.

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.

3. PROTECTION RELEASES PR332/P AND PR333/P

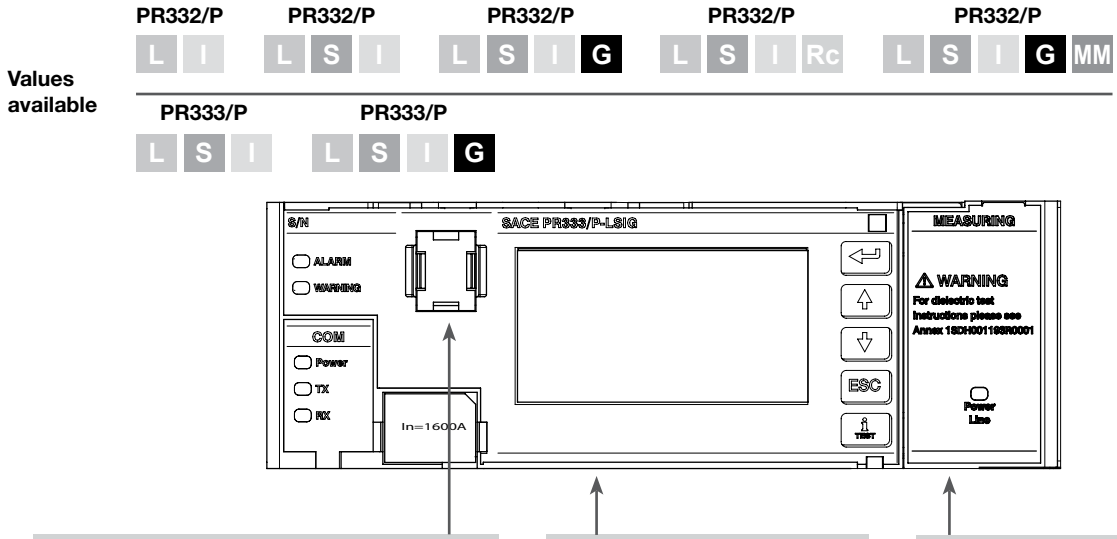
3.1. Introduction

PR332/P and PR333/P 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.

3.2. Overview

PR332/P and PR333/P are available in 7 versions, all compatible with various different internal modules, external accessories and testing devices:



Temporary accessories (test connector)
BT030-USB
PR030/B
PR010/T
Ekip T&P

External accessories
HMI030
Flex Interface
Sensore Rc
Sensore SGR
Sensore Neutro Esterno

Optional internal module
PR330/V
PR330/D-M

3.3. Specifications

Protection releases PR332/P, for SACE Emax X1 and SACE Tmax T7-T8, circuit-breakers, and PR333/P for X1 circuit-breakers are electronic devices with functions for monitoring and for protecting against fault currents.
The units also possess Measuring, Data Storage, Communication, Self-diagnosis, Load Control and Zone Selectivity functions.

The protection release installed in the circuit-breaker is connected to the current sensors for primary current reading, to the Trip Coil for the circuit-breaker opening command and to the CB state contacts.
The sensors provide the primary current measurement and energy for powering the protection release 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 information about the protection release to be accessed. They can also be used for adjusting the protections and settings and for reading the state and alarms. In addition, the presence of alarms is indicated by two front leds.

3.3.1. Protections

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
MM	Instantaneous short-circuit (maintenance mode)
Rc	Residual current

NOTE: protection MCR is available with SACE Emax X1 circuit-breakers. Release PR332/P MM has MM protection but not Rc protection.

PR333/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 PR330/V module allows further protections to be controlled for both protection releases:

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)

In addition, PR332/P and PR333/P provide fixed protection against instantaneous short-circuits at high currents, known as Iinst.

3.3.2. Functions

PR332/P and PR333/P include various different functions, depending on the version and configuration chosen:
- Runtime measurement of the main electrical quantities available: phase current, peak factor, mains frequency, phase-to-phase voltages, power, energy, power factor, harmonic distortion;
- Programmable measurements: periodic storage of maximum and minimum signals, waveforms and datalogger;
- Autotest: continuous monitoring of the main connections to the release, among which: current sensors, trip coil, rating plug, circuit-breaker state.
- Maintenance information and counters: number of operations, estimated contact wear, events log.

3.3.3. Inputs/Outputs

Depending on the versions, PR332/P and PR333/P are equipped with:
- K51/, 5 contacts (2 inputs, 2 outputs and one common contact) for the S, G and D selectivity functions.
- S51/P1, output contact of the Open/Close type configurable by the customer, for monitoring one or more state or alarm events.

The exception is PR332/P MM, which replaces S51/P1 and K51/ with other contacts for the MM function:
- K14/K15, input contact for activating protection MM.
- 95S/98S: output contact which supplies the state of protection MM.

Consult chapter 3.8.4 Zone selectivity, 3.8.5 S51/P1 and 3.8.6 Function MM for further details.

3.3.4. Accessories

A set of modules adds optional functions to the basic version:
- PR330/V: supplied as part of the standard equipment with PR333/P and as an optional with PR332/P, this module allows the primary voltage values to be read and provides energy for powering the protection release even in the absence of external Vaux, nil current or CB open.
- PR330/D-M: allows the protection release to be connected to a communication network for CB reading and operation 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.

A set of accessories adds optional functions to the basic version.
- External neutral, current sensor for protecting the external neutral pole (can only be configured for three-pole circuit-breakers).
- Single-pole sensor for the earth conductor of the main power source (sensor SGR) which, in conjunction with the configuration of protection Gext, adds to the earth fault protection functions.
- External residual current sensor (sensor Rc), which activates residual current protection Rc.
- PR030/B allows the protection release to be temporarily energized so as to view its state (via the LEDs) and perform installation.
- BT030-USB allows temporary energizing and communication of the protection release for the purpose of supervising, via a PC, information like the Trip log and measurements, and for adjusting settings and functions that are not available using the front dip switches, such as the Thermal Memory.
- PR010/T allows the protection release to be temporarily energized, protection testing and storage of a test report.
- Similarly to BT030-USB, Ekip T&P can be used to temporarily energize and communicate the protection release via PC. Like PR010/T, it also allows the protection release to be tested, again via PC.
- The HMI030 switchgear display expands the monitoring functions of the protection release by displaying the current measurements of all the phases in real time.
- Flex Interface modules allow the alarm or state signals of the protection release to be associated with configurable electromechanical contacts. In addition, they allow a complete network of several units to be created and can also be connected to external modules (e.g. HMI030).

- Ekip Connect is a communication software for PCs or tablets. Compatible with numerous ABB devices, it is supplied with BT030-USB and Ekip T&P modules or is available on the ABB website.

More details are given from page 63 of chapter 4, or in the dedicated manuals.

3.3.5. CB compatibility

PR332/P can be installed in ABB circuit-breakers of the three-pole, three-pole with external neutral or four-pole type from the SACE Tmax T7-T8 or SACE Emax X1 series.
PR333/P can be installed in ABB circuit-breakers of the three-pole, three-pole with external neutral or four-pole type from the SACE Emax X1 series.

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

The adjustable protections refer to size In, defined by the interchangeable Rating plug module, installed in the actual protection release.

3.3.6. Standards

PR332/P and PR333/P have been designed to operate in accordance with the following international standards:
- IEC 60947-2 Low voltage apparatus. Circuit-breakers. (T7-T8, X1)
- UL 489 Molded-Case Circuit Breaker, Molded-Case Switches and Circuit-Breaker Enclosures(T7-T8)
- UL 1066 Low Voltage Power Circuit Breaker (X1)

3.3.7. 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 protection release installed in the CB).	IP 30

3.3.8. Electrical characteristics

The protection release is energized:
- Directly by the internal current sensors connected to the busbars of each phase. In this case, the release activates with the circuit-breaker closed and in the presence of a minimum three-phase current value.
- Directly by the PR330/V module. In this case, the release activates in the presence of a minimum three-phase voltage value and, depending on the connection configuration, with the circuit-breaker in all positions or only with the circuit-breaker closed.
- By an external auxiliary power supply. In this case, continuous operation of the unit is guaranteed even with nil current on the busbars or with the circuit-breaker open. The range of protection release functions can also be expanded using external accessories HMI030 and Flex Interface.

NOTE: module PR330/D-M activates in the presence of an external auxiliary power supply or via PR330/V.

Primary current characteristics	**Range**
Minimum three-phase busbar current (Low Power)	> 80A
Minimum three-phase busbar current (Full Power)	> 160A
Rated operating frequency	50/60Hz ±10%
Peak factor	2.1 @ 2xIn, in accordance with IEC 60947 annex F (Consult ABB for a dedicated analysis if there are higher peak factors)

Primary voltage characteristics	**Range**
Three-phase minimum phase-to-phase voltage (Full Power)	> 60V
Three-phase minimum phase-to-phase voltage (Full Power and display lighting)	> 90V

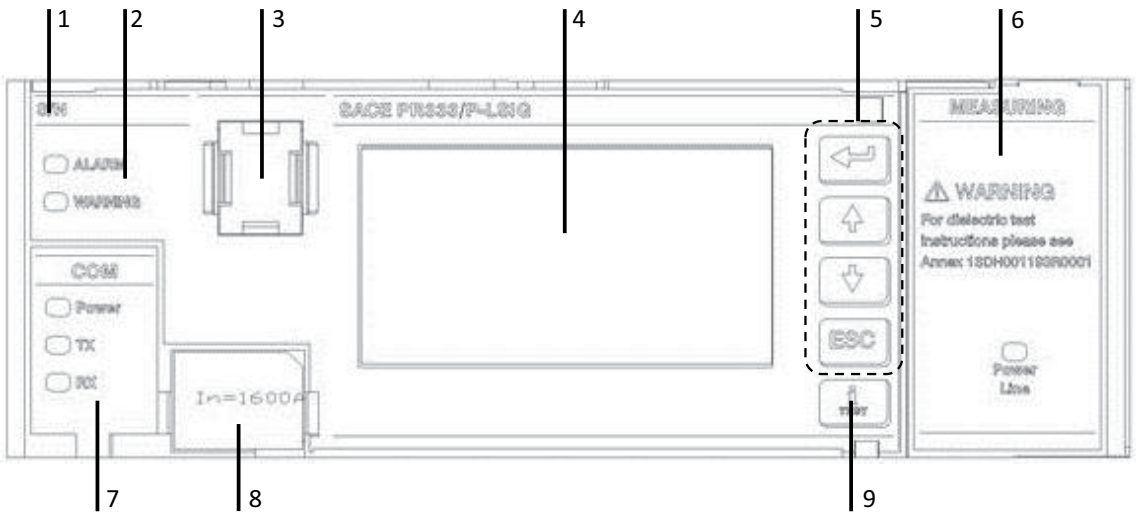
Auxiliary supply characteristics	**Activation of display lighting** (3)
DC voltage (galvanically separated)	24 Vdc ±20%
Maximum ripple	5%
Inrush current @ 24Vdc	~2 A for 5ms
Rated power @ 24Vdc	~3 W

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.

If supplied by primary current or voltage, PR332/P and PR333/P include 3 different operating modes, depending on the level of the supply signals:
- Low Power: this mode guarantees operation of all the protections provided by the protection release, operation of the front LEDs and display energizing 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 protection release, operation of the front LEDs and display energizing in the Full Power mode. Access to the menus is also allowed.
- Full Power and display lighting: this mode includes all the Full Power functions and powers the display lighting system.

3.4. User interface

A graphic display and a push-button panel provide all the available settings and information.



Ref.	Description
1	Serial number of the protection release
2	State led
3	Test connector
4	Graphic display
5	Main push-button panel
6	Label and Led of internal module PR330/V
7	Label and Led of internal module PR330/D-M
8	Rating plug
9	“i Test” button

3.4.1. LEDs

The 2 front leds provide information about the state of the protection release 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

3.4.2. Push-buttons

A push-button panel with 4 buttons is used to access and surf the menus on the display of the protection release. There is also an independent button at the side of the display, with various functions (iTest).

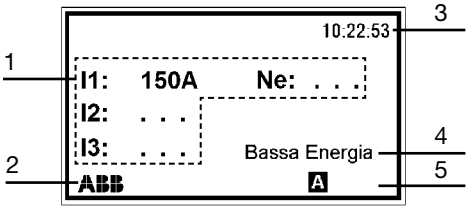
Key	Name	Description
	ESC	- Press ESC from the default page to access the main menu - Press ESC from within the menus to return to the previous level
	ENTER	- Press ENTER from within the menus to access the selected level or parameter - Press ENTER to confirm the option selected
	UP	- Press UP or DOWN from the default page to access the pages with the available measurements (current values and, if the PR330/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 concerning the protection release, the circuit-breaker and the last trip recorded. - Press iTest after the CB has opened owing to an electronic protection, to reset the TRIP state of the protection release (the display is redirected to the default page and the SW register corresponding to Trip is reset) - Press iTest when the protection release is off to obtain a description of the last event that led to the protection release being 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.

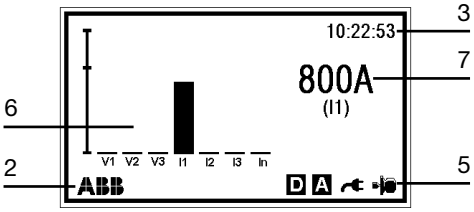
3.4.3. Display

PR332/P and PR333/P are equipped with a 128x64 pixel graphic LCD display where the operator can view measurements and signals, and access the menus with all the settings.
The degree of contrast of the menu display can be adjusted by selecting the Settings menu and Display Contrasto parameter.

The display has 2 operating modes (the conditions are described in par. 1.3.8):
- 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:

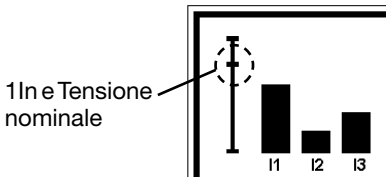
Access to the menus and the push-button panel is active in the Full Power mode. Consult the dedicated chapter for details about how to browse the menus (See par. 1.5 User menus).

Ref.	Description
1	Phase current measurement
2	CB and/or protection release alarms (the ABB logo appears in the absence of alarms)
3	Internal 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

3.4.3.1. Graphic ammeter and voltmeter

Graphic ammeter and voltmeter options are available in the default page (the voltmeter is only activated if module PR330/V is installed).

The levels of the available measurements are displayed by a vertical bar.
The current (phase) and voltage (netwwork) 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.

3.4.3.2. CB and protection release alarms

Information about the state of the protection release and CB is always available at the bottom left of the display (See par. 1.4.3 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 protection release
	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 protection release that has been off for over 48h)
	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 protection release 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

3.4.3.3. Operating icons

An area with icons showing the operating conditions of the protection release is available on the display.
The area is at the bottom right of the display (See par. 1.4.3 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)	D	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	A	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 PR330/D-M module is installed)

3.5. User menus

PR332/P and PR333/P come on in the Full Power mode in the presence of the supply conditions described in sect. 3.3.8 or if supplied by one of the following: 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.

3.5.1. Measurements Area

One or more pages of the measurements taken by the protection release are available in this area.
The current measurements page is always activated while the voltage and power measurements pages can be consulted if the PR330/V module is installed.
Consult the chapter about the Measuring functions for further details about the information given in this area (See par. 1.7 Measuring functions).

3.5.2. Information Pages

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

3.5.3. 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	1.6
2. Measurements	Reading of all the measurements made by the protection release, Trip and events	1.7
3. Settings	Reading and adjustment of the main settings of the protection release, CB and modules	1.9
4. Test	Allows diagnosis and state control tests to be performed	1.11
5. Information	Reading of the main details about the protection release and CB	--

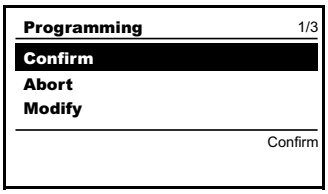
The various different menus are described in the sections indicated in the table.

3.5.3.1. 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).



3.6. Protection functions

PR332/P and PR333/P handle numerous independent protection functions.
The current, voltage, frequency and internal temperature signals are processed by the protection release which, depending on the protection parameter settings, indicates alarms, performs delay processes and sends commands.

The various types of adjustable protections are managed by the protection release 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 PR330/V.
- The frequency protections undergo voltage frequency control.
- Moreover:
- The temperature protection is monitored by means of the internal sensor of the protection release.

The linst 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**	Protection release	
		PR332/P	**PR333/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)
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)
Protection MM	Enabling, Threshold	S(9)	--

Key:
S : standard protection
O : optional function

Notes:
1. : function available with versions LSI, LSIG, LSIRc and LSIG MM
2. : enabling and parameters available with units PR010/T, Ekip T&P, BT030 or communication via PR330/D-M
3. : function available with versions LSIG and LSIG MM
4. : function enableable with versions LSIG, and external SGR sensor.
5. : function enableable with versions LSIG (+ module PR330/V) and LSIRc, and external Rc sensor.
6. : function enableable with versions LSIG, and external Rc sensor.
7. : functions available when module PR330/V is installed
8. : function available with four-pole CB, or three-pole CB in the 3P+N configuration
9. : function available with MM version

3.6.1. Notes about Protection Operation

PR332/P and PR333/P are equipped with “backup-protection”. 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.
The declared tolerance values of the measurements and protections of the protection release could change if the electrical characteristics of the current and voltage signals fail to comply with the limits specified in chapter 3.3.8.

3.6.2. Protection L

Protection L is the only protection that cannot be disabled since it provides self-protection against circuit-breaker overloads. 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 60255-151

3 types of curve settings can be made and are defined by standard IEC60255-151 as A, B and C.
The protection trip time, with inverse time, is given by the expression:

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

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 IEC60255-151, which vary with the type of gradient selected (e.g. for type B gradients: α = 1 and k = 13.5)
- b: parameter included to increase the number of curves with the same slope. 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 protection release does not set to the alarm status for current values of less than 1.05 xI_1;
- the protection release will set to the alarm status for current values exceeding 1.2 xI_1.

3.6.2.1. 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 protection release will certainly be 100% of the selected value 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.

PR332/P and PR333/P have two instruments for processing the thermal memory. The first only operates when the protection release is energized (it also records overloads that have not lasted long enough to trip the CB), while the second operates even when the protection release is not energized, reducing any trip times in the case of immediate reclosing and activating the moment the circuit-breaker trips.
It is the protection release that decides which of the two to use, depending on the situation in question.

WARNING: the thermal memory function is enabled by default in the UL version.
In the IEC version, it can only be activated if the curve is the standard type (t=k/I2).

3.6.3. 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]

3.6.3.1. Thermal memory S

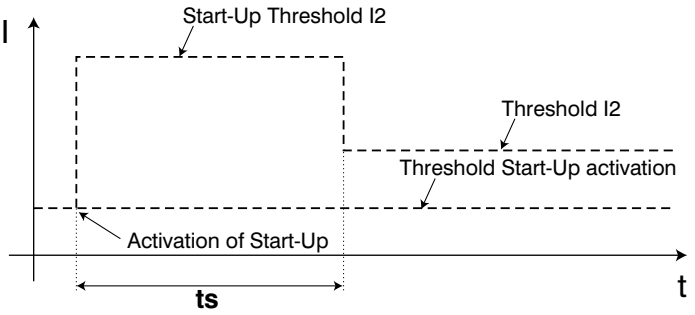
The thermal memory function can be enabled for cable protection in the case where the curve with inverse time is selected. This is based on the "tS" parameter defined as the trip time of the curve (t2) selected at 1.5xI2. The other characteristics are the same as those for thermal memory L.

3.6.3.2. Start-up threshold S

The start-up function can be selected in the case where the curve with fixed time is selected.

The 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.

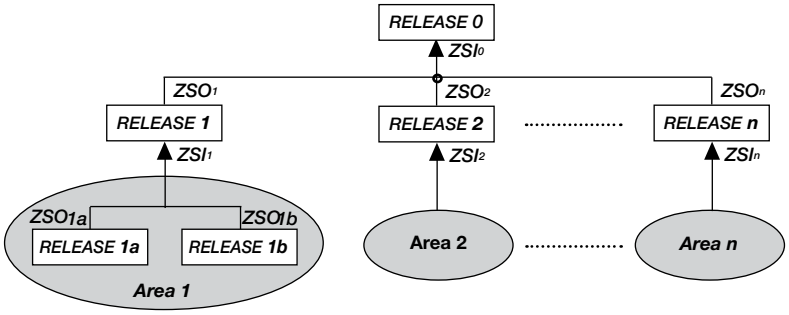


3.6.3.3. Zone S selectivity

NOTE: function not available with PR332/P MM.

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 achieved by connecting all the zone selectivity outputs (ZSO=K51/SZout) of the protection releases belonging to the same zone to each other and by conveying this signal to the zone selectivity input (ZSI=K51/SZin) of the protection release immediately upstream. 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 how a fault on the load side of “Release 1a” will be isolated by this latter without “Release 1” or “Release 0” being tripped. A fault immediately downstream of “Release 1” will be isolated by this latter without “Release 0” being tripped, thus ensuring that Areas 2…n remain operative.

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.

3.6.4. Protection S2

PR333/P allows two protection S thresholds 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 protection release without “double S”.

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

3.6.5. Directional protection D

PR333/P provides excludable directional protection against short-circuits with adjustable fixed time (t=k), active both with self-powering and 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

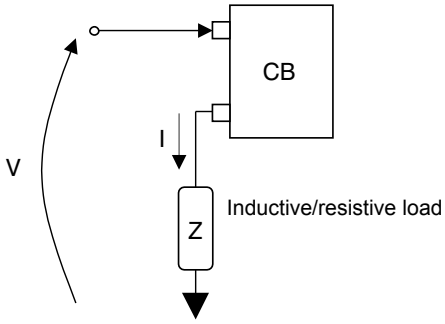
$$(P_Q \geq 2\% \cdot P_{nphase}).$$

The PR333 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 (PR330/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 trip time settings were t7FW = 200 ms and t7BW = 400 ms, the protection release in the case illustrated alongside (fault current= forward) would have opened the circuit-breaker after t7FW = 200 ms.

Note:
- When directional protection D is active and the direction of the power cannot be established, the protection release takes effect by considering the shorter time between t_{7fw} e t_{7bw}.
- This protection works on the basis of the phase currents, not the neutral current.

3.6.5.1. Start-up threshold D

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

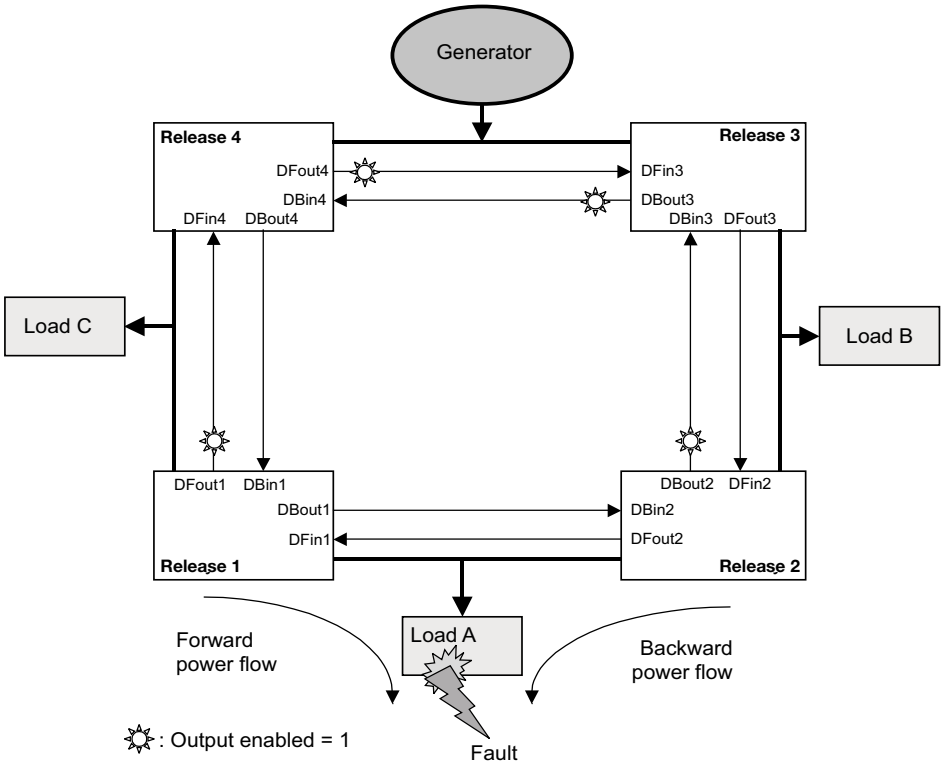
3.6.5.2. (Directional) zone selectivity D

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.
For the purpose of establishing the zone and power flow, each protection release has two inputs (DFin and DBin) and two outputs (Dfout and DBout), which must be connected to the other releases (see example below).
Similarly to SdZ S and G, the releases interact with each other by sending cut-out 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

Output DFout is activated (1) if the power flow is concordant with the direction set in the protection release.
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 (Release1 and Release2) communicate the presence of the fault to the connected circuit-breakers (Release4 and Release3) 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 (Release1=forward and Release2=backward).

The circuit-breakers (Release1 and Release2) 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 (Release4) and t7BW (Release3) 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 Release3 will have no effect on the Release4, 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).

Notes:
- When zone selectivity is active and the direction of the power cannot be established, the protection release takes effect by considering the shorter time between t7fw and t7bw, without activating any output (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 Release1, only the circuit-breaker with Release4 will open after a time ts+100ms.
- The SdZ D operates on the basis of the phase currents, not of the neutral.

3.6.6. Protection "I"

The protection is enabled/disabled from the menu.
If zone selectivity S is active, output signal ZSO is activated in any case during a trip due to protection I, so as to ensure that the protection releases on the supply side function correctly.

3.6.6.1. Start-up threshold "I"

The function behaves in exactly the same way as the protection “S”. The function is not available with release PR332/P MM.

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

The releases installed in the SACE Emax X1 CB allow protection MCR to be activated, which is useful for protecting the installation from closing upon short-circuit.
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 PR330/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 SD-Testbus2 communication softwares or through a remote system via a system bus.
Protection “S” protects against short circuits.

3.6.8. Protection “G”

Protection G is provided by the protection release via vectorial calculation of the neutral and phase currents. The fault current is defined by the following formula:

$$\vec{I}_G = \vec{I}_1 + \vec{I}_2 + \vec{I}_3 + \vec{I}_N$$

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 protection releases with SW version ≥ 2.05 (sw ≥ 1.00 per PR332/P MM).

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

WARNING: In the absence of Vaux, the minimum threshold setting is 0.25In with rating plug= 400A and 0.2In for all the other sizes. If the entered value fails to comply with this limitation, the SW overrides the threshold until it reaches the minimum value accepted and “Configuration” error appears on the display.

**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.**

3.6.8.1. Start-up threshold “G”

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

3.6.8.2. Zone selectivity “G”

NOTE: function not available with PR332/P MM.

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”.

3.6.9. 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.

Protection Gext possesses the same adjustment characteristics as protection G and is controlled differently by protection releases PR332/P and PR333/P:
- PR332/P: only one protection can be set: if both are enabled, activation of Gext excludes G.
- PR333/P: available at the same time. Activation of Gext does not exclude G.

WARNING: The external toroid must be connected to the protection release by means of a corded shielded two-wire cable (e.g. BELDEN 3105A two-wire cable) no more than 15 m in length. The shield must be earthed on both the circuit-breaker side and toroid side.

IThe protection is not available with release PR332/P MM.

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.

3.6.9.1. Start-up threshold “Gext"

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

3.6.9.2. Zone selectivity “Gext"

The function behaves in exactly the same way as the protection “S”.
In addition, zone selectivity Gext is controlled differently by protection releases PR332/P and PR333/P:
- PR332/P: similarly to the protection, one single selectivity can be set, either G or Gext. If both are enabled, activation of Gext excludes G.
- PR333/P: selectivity G and Gext are available at the same time. Activation of Gext does not exclude G.

WARNING: With PR333/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).

3.6.10. Residual current protection Rc

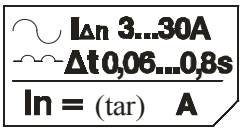
Protection Rc provides protection against earth faults of the residual current type.
The protection, which can be adjusted, allows the operating threshold and non-trip time settings to be made (the trip fails to occur if the alarm terminates within the set time).

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 module PR330/V connected to the protection release.

he function is available with releases PR332/P (versions LSIG and LSIRc) and releases PR333/P (version LSIG) and only in the presence of:
- module PR330/V
- external sensor Rc
- 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 differently by PR332/P and PR333/P:
- PR332/P LSIG: only one protection can be set, either Rc or G: if both are enabled, activation of Rc excludes G.
- PR333/P LSIG: available at the same time. Activation of Rc does not exclude G.

Instructions on how to put the configuration with sensor Rc into service are available in par. 1.12.7.
Details about the sensory chain test with Rc are available in par. 1.11.3.

3.6.11. Protection "U"

The excludable fixed time protection allows phase voltage or current unbalance to be monitored.
Voltage unbalance can only be monitored if module PR330/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 PR330/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.

3.6.12. 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.

3.6.13. 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.

3.6.14. 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.

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

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.

3.6.15. 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.

3.6.16. 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.

3.6.17. Protection "T"

A sensor inside the protection release signals abnormal temperature conditions which could lead to temporary or continuous faults in the electronic components of the unit.

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: If the Trip command of the protection were to be disabled, the protection release would operate, with the circuit-breaker closed, within a temperature range where correct operation of the protections is not guaranteed.

3.6.18. 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 performed by means of contactors or switch-disconnectors controlled by the protection release via contact S51/P1.

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 PR330/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

Contact S51/P1 can be associated with thresholds LC1 and LC2, and the configuration (NO or NC), delay time and latch settings can be entered via the protection release.

3.6.19. Double protection set

PR333/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:
- 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.

3.6.20. Neutral Protection

PR332/P and PR333/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.
With four-pole circuit-breakers, the protection release performs the test automatically 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 protection release 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 of "I1" and "InN" may result in damage to the circuit-breaker and consequent risks even for the operator.

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

3.6.21. Protection MM

The protection, available with PR332/P MM releases, protects against short-circuit.

In order to function, it must be enabled via the display menu and activated by means of a signal supplied to inputs K14/K15:
- Signal High: protection activated;
- Signal Low: protection deactivated.

The release handles output contacts 95S/98s as feedback of the protection state, so as to communicate whether it is activated (contacts closed) or deactivated (contacts open).
The state of the input contacts is available in the Test-MM Test-Input menu.

Further details about the electrical characteristics of the inputs and outputs are available in chapter 3.8.4.

3.6.22. 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.

3.6.23. Summary table of protection functions for PR332 and PR333/P

Current protections	PR332/P	PR333/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 $\leq I_1 \leq$ 1xIn step 0,01xIn	3s $\leq t_1 \leq$ 144s(1), step 3s @I_f=3I_1	Releasebe-tween 1,05 and 1,2 xI1	±10%, $I_f \leq$ 6In ±20%, $I_f >$ 6In
S (t=k)	☒	☒	☒	☐	☒	☒	☐	0,6xIn $\leq I_2 \leq$10xIn step 0,1xIn 0,6xIn $\leq I_{2\ start\text{-}up}$ $\leq$10xIn step 0,1xIn	I_f>I2 0,05s $\leq t_2 \leq$ 0,8s, step 0,01s 0,10s $\leq t_{2\ start\text{-}up} \leq$ 30s, step 0,01s 0,04s $\leq t_{2\ sel} \leq$ 0,2s, step 0,01s	±7%, $I_f \leq$ 6In ±10%, $I_f >$ 6In	The best of the two data±10% or 40ms
S (t=k/I^2)	☒	☒	☒	☐	☐	☐	☒	0,6xIn $\leq I_2 \leq$10xIn step 0,1xIn	0,05s $\leq t_2 \leq$ 0,8s, step 0,01 s @I_f=10In	±7%, $I_f \leq$ 6In ±10%, $I_f >$ 6In	±15%, $I_f \leq$ 6In ±20%, $I_f >$ 6In
S2 (t=k)	☐	☒	☒	☐	☒	☒	☐	0,6xIn $\leq I_2 \leq$10xIn step 0,1xIn	@I_f>I_2 0,05s $\leq t_2 \leq$ 0,8s, step 0,01s 0,10s $\leq t_{2\ start\text{-}up} \leq$ 30s, step 0,01s 0,04s $\leq t_{2\ sel} \leq$ 0,4s, step 0,05s	±7%, $I_f \leq$ 6In ±10%, $I_f >$ 6In	The best of the two data ±10% or 40ms
D (t=k)	☐	☒	☒	☐	☒	☒	☐	0,6xIn $\leq I_7 \leq$10xIn step 0,1xIn	@I_f>I_7 0,20s $\leq t_7 \leq$ 0,8s, step 0,01s 0,10s $\leq t_{7\ start\text{-}up} \leq$ 30s, step 0,01s 0,13s $\leq t_{7\ sel} \leq$ 0,5s, step 0,01s	±10%	The best of the two data±10% or 40ms
I (t=k)	☒	☒	☒	☐	☐	☒	☐	1,5xIn $\leq I_3 \leq$15xIn step 0,1xIn 1,5xIn $\leq I_{3\ Start\text{-}Up} \leq$ 15x In	$\leq$ 30 ms 0,1s $\leq t_{3\ start\text{-}up} \leq$ 30s, step 0,01s @ I_f>I_3	±10%	
MCR (t=k)	☒	☒	☒	☐	☐	☐	☐	6,0xIn $\leq I_5 \leq$15xIn step 0,1xIn	@I_f>I_5 $\leq$ 30ms(3)	±10%	
G(4) (6) (t=k)	☒	☒	☒	☒	☒	☒	☐	0,1xIn $\leq I_4 \leq$1xIn step 0,02xIn	0,1s $\leq t_4 \leq$ 1s, step 0,05 s 0,1s $\leq t_{4\ start\text{-}up} \leq$ 1s, step 0,02s 0,04s $\leq t_{4\ sel} \leq$ 0,2s, step 0,01s @ I_f>I_4	±7%	The best of the two data±10% or 40ms

Current protections	PR332/P	PR333/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)
G(4) (6) ($t=k/I^2$)	☒	☒	☒	☒	☐	☐	☐	$0,1xIn \le I_4 \le 1xIn$ step 0,02xIn $0,2xIn \le I_{4\ Start\text{-}Up} \le 1x\ I_4$	$0,1s \le t_4 \le 1s$, step 0,05s (minimum trip time) @I_f>4In	±7%	±15%
Gext (6) (t=k)	☒	☒	☒	☒	☒	☒	☐	$0,1xIn \le I_4 \le 1xIn$ step 0,02xIn	@I_f>I_4 $0,1s \le t_4 \le 1s$, step 0,05 s $0,1s \le t_{4\ start\text{-}up} \le 30s$, step 0,02s $0,04s \le t_{4\ sel} \le 0,2s$, step 0,01s	±7%	The best of the two data±10% or 40ms
Gext (6) ($t=k/I^2$)	☒	☒	☒	☒	☐	☐	☐	$0,1xIn \le I_4 \le 1xIn$ step 0,02xIn	$0,1s \le t_4 \le 1s$, 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)
U (t=k)	☒	☒	☒	☒	☐	☐	☐	$2\% \le I_6 \le 90\%$ step 1%	$0,5s \le t_6 \le 60s$, step 0,5s	±10%	The best of the two data±10% or 40ms
OT (temp=k)	☒	☒	☐	☒	☐	☐	☐	Fixed, defined by ABB	Instantaneous	± 5°C	
Iinst	☒	☒	☐	☐	☐	☐	☐	Automatic, defined by ABB	Instantaneous		
UV (t=k)	☒	☒	☒	☒	☐	☐	☐	$0,5xUn \le U_8 \le 0,95xUn$ step 0,01xUn	$0,1\ s \le t_8 \le 5\ s$, step 0,1 s	± 5%	The best of the two data±10% or 40ms
OV (t=k)	☒	☒	☒	☒	☐	☐	☐	$1,05xUn \le U_9 \le 1,2xUn$ step 0,01xUn	$0,1\ s \le t_9 \le 5\ s$, step 0,1 s	± 5%	The best of the two data±10% or 40ms
RV (t=k)	☒	☒	☒	☒	☐	☐	☐	$0,1xUn \le U_{10} \le 0,4xUn$ step 0,05 Un	$0,5\ s \le t_{10} \le 30\ s$, step 0,5 s	± 5%	The best of the two data±10% or 40ms
RP (t=k)	☒	☒	☒	☒	☐	☐	☐	$-0,3xPn \le P_{11} \le -0,1xPn$ step 0,02 Pn	$0,5\ s \le t_{11} \le 25\ s$, step 0,1 s	± 5%	The best of the two data± 10% o 40 ms
UF	☒	☒	☒	☒	☐	☐	☐	$0,9fn \le f_{12} \le 0,99fn$ step 0,01 fn	$0,5\ s \le t_{12} \le 3\ s$, step 0,1 s	± 5%	The best of the two data±10% or 40ms
OF	☒	☒	☒	☒	☐	☐	☐	$1,01fn \le f_{13} \le 1,1fn$ step 0,01 fn	$0,5\ s \le t_{13} \le 3\ s$, 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
MM(7) (t=k)	☒	☐	☒	☐	☐	☐	☐	$1,5xIn \le I_5 \le 4xIn$ step 0,1xIn	≤ 30 ms @ I_f>I_5	±10%	

(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:
- energized protection release in service conditions (without start-up) with 2 or 3 phases energized and/or in the presence of auxiliary supply.
- Preset trip time ≥ 100 ms.
- Temperatura e correnti entro i limiti di funzionamento.

(3) The interval of time for which the protection is activated can be selected via Ekip Connect, and is calculated from the moment the CB closes.

(4) Protection G can be automatically disabled by the release on the basis of the current measured. Per le casistiche 1.6.8.

(5) Max trip time.

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

(7) Available with PR332/P MM.

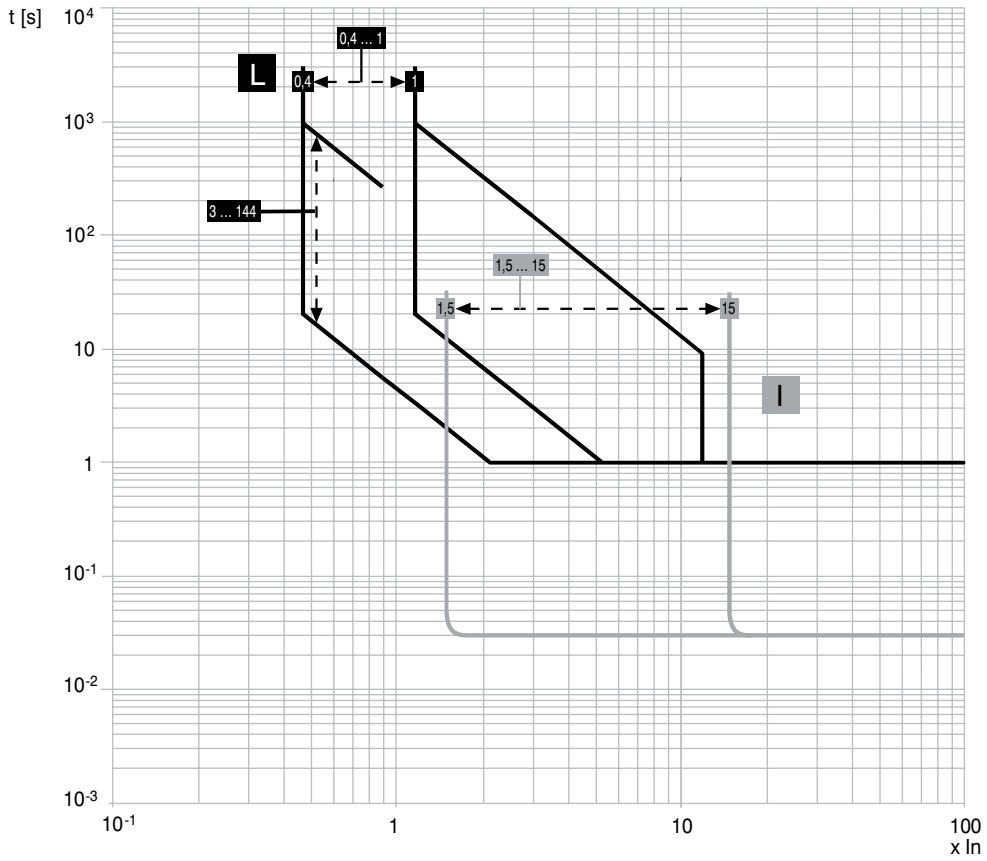
For all cases not covered by the above hypotheses, the following tolerance values apply:

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%

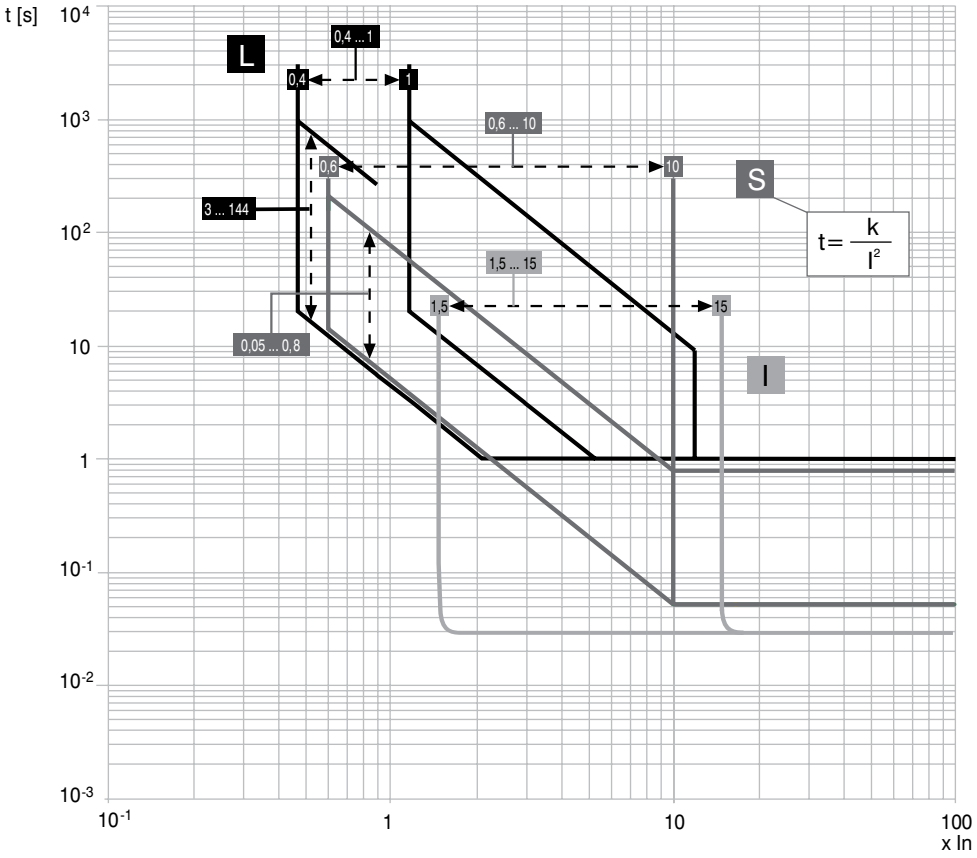
3.6.24. Trip curves

The trip curves given are for guidance and only show a sub-group of the possible selections.
The graphs do not include the curves of protection functions with the the same principle: S2 (S), MCR and MM (I), Gext (G).

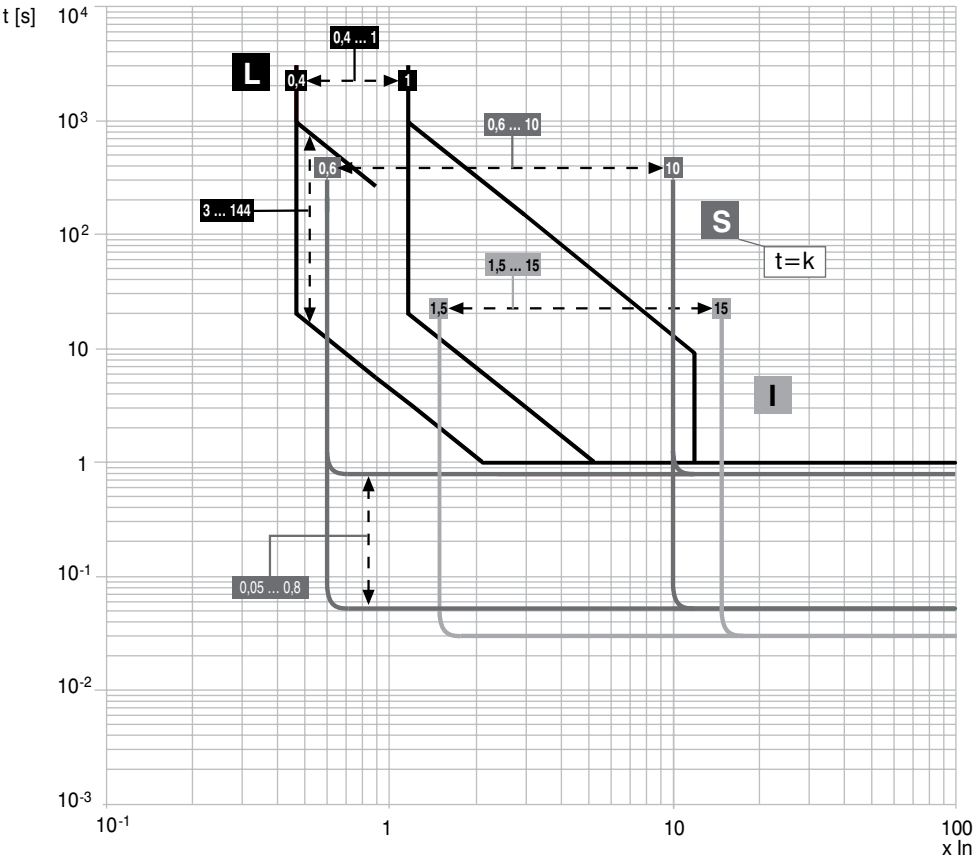
3.6.24.1. Trip curves for functions L-I



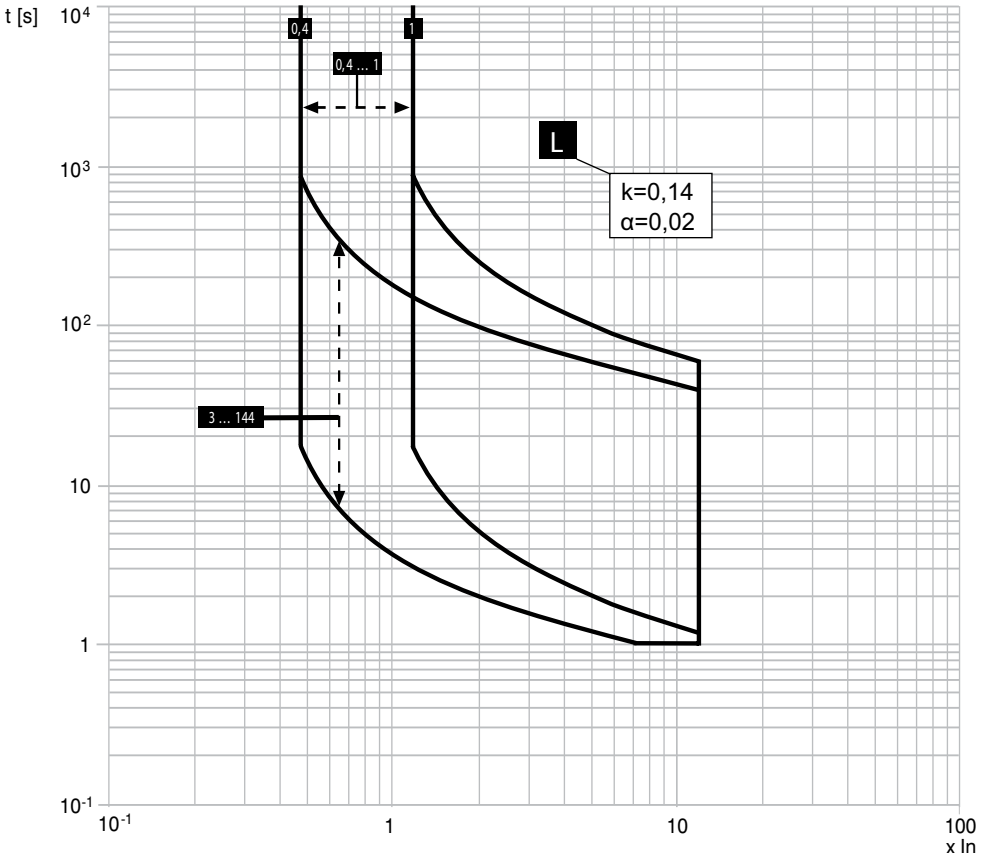
3.6.24.2. Trip curves for functions L-S(t=k/I²)-I



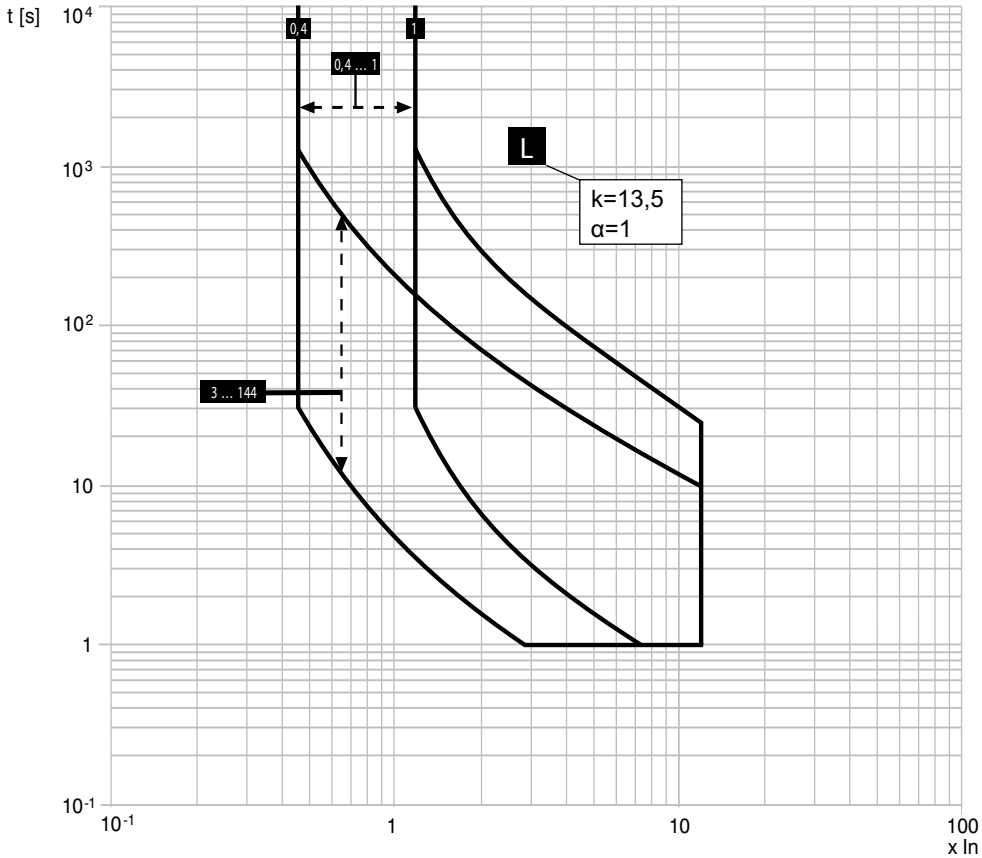
3.6.24.3. Trip curves for functions L-S(t=k)-I



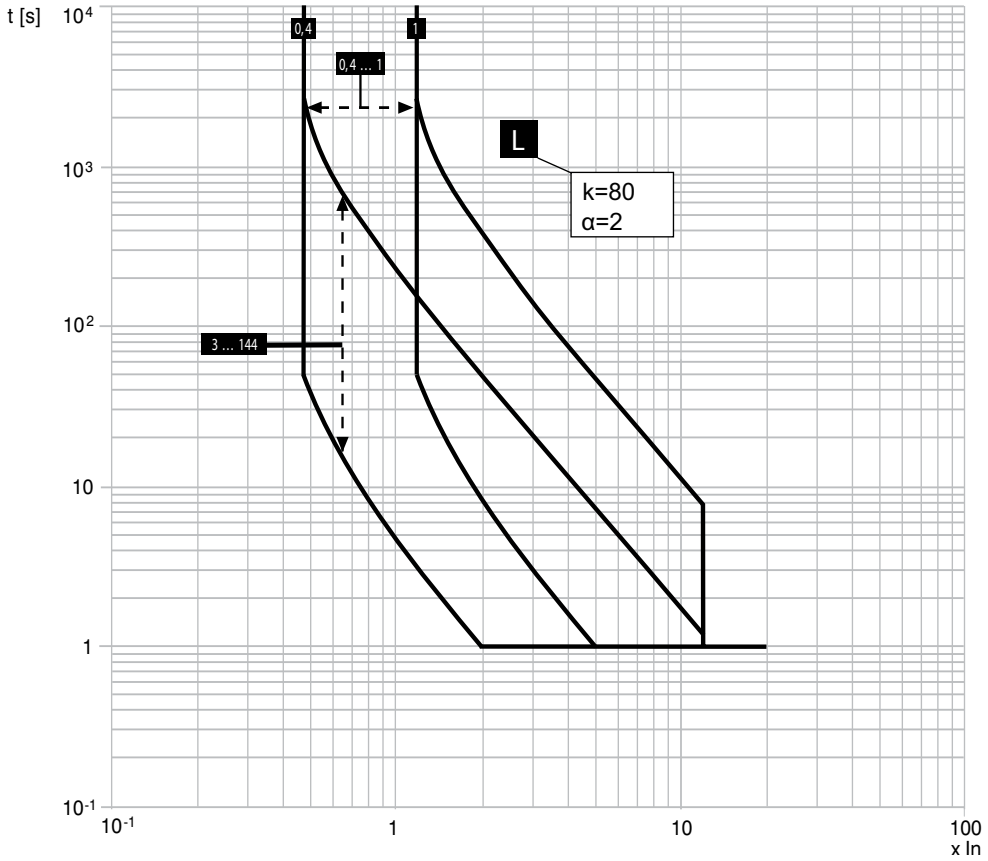
3.6.24.4. Trip curves for function L in accordance with IEC 60255-151 (type A)



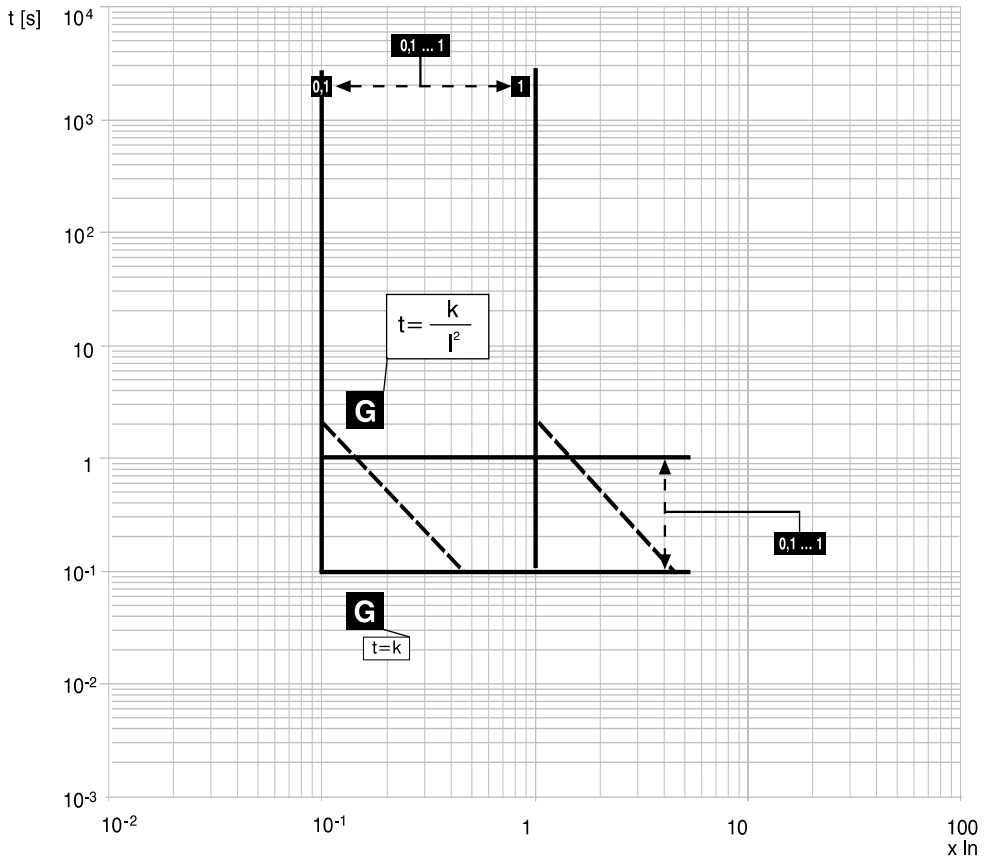
3.6.24.5. Trip curves for function L in accordance with IEC 60255-151 (type B)



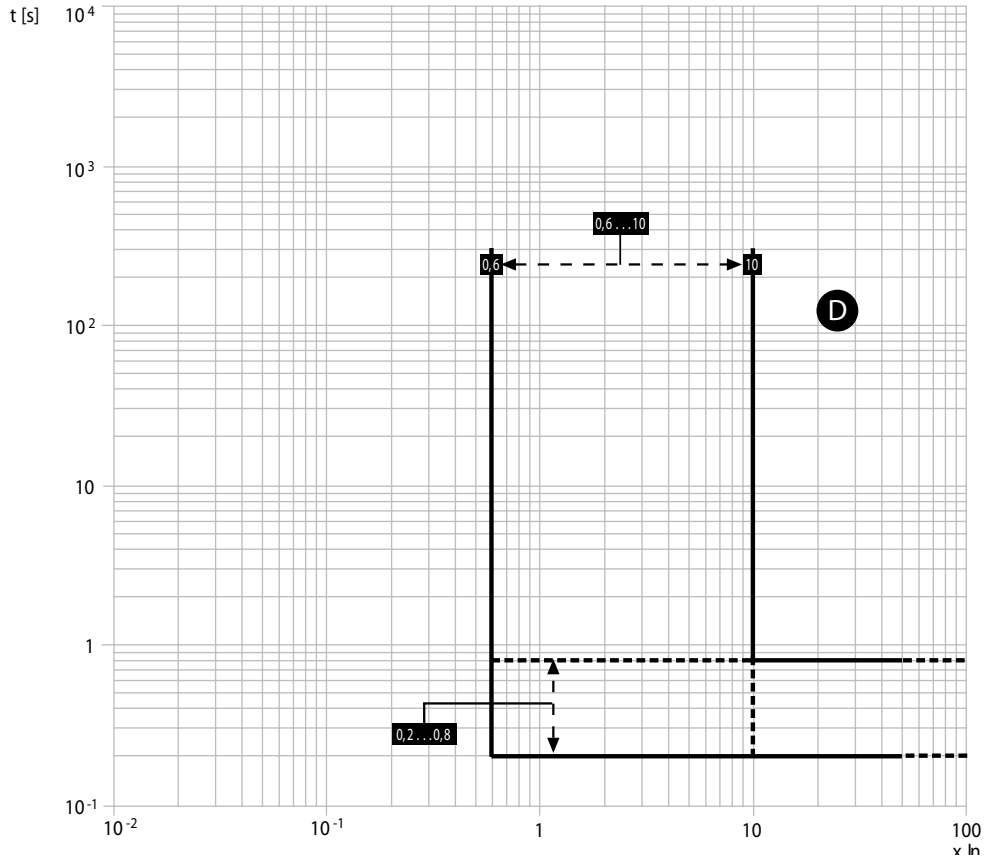
3.6.24.6. Trip curves for function L in accordance with IEC 60255-151 (type C)



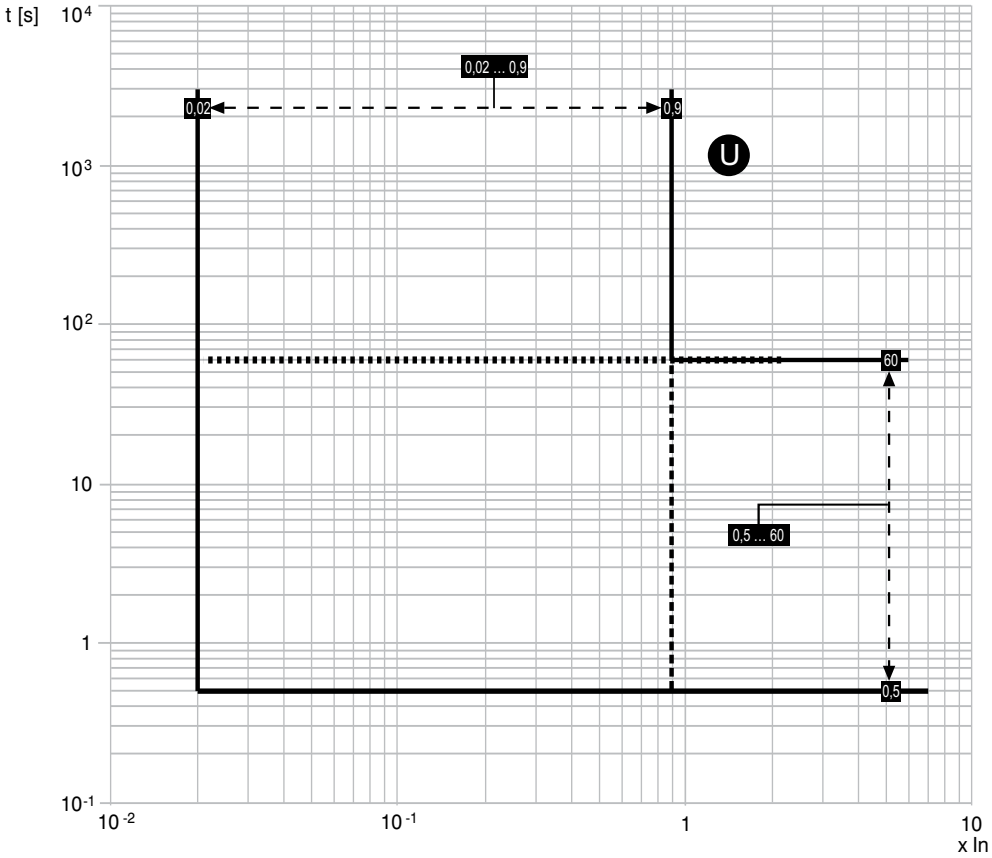
3.6.24.7. Trip curves for function G



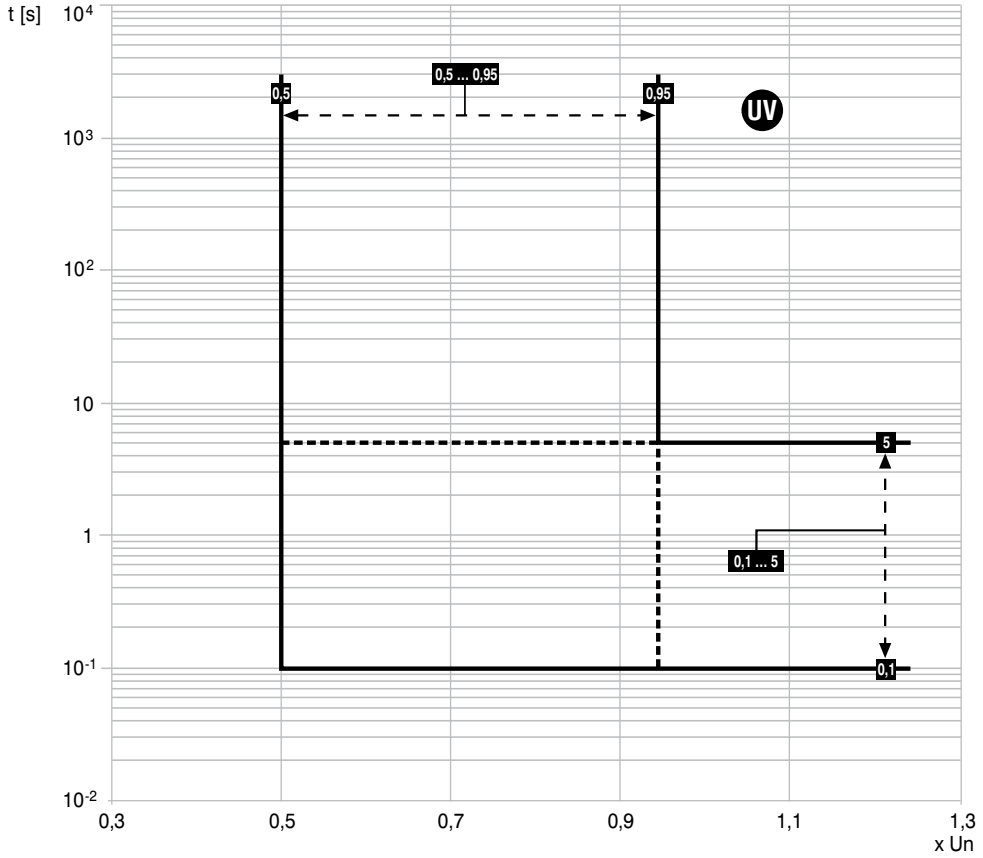
3.6.24.8. Trip curves for function D



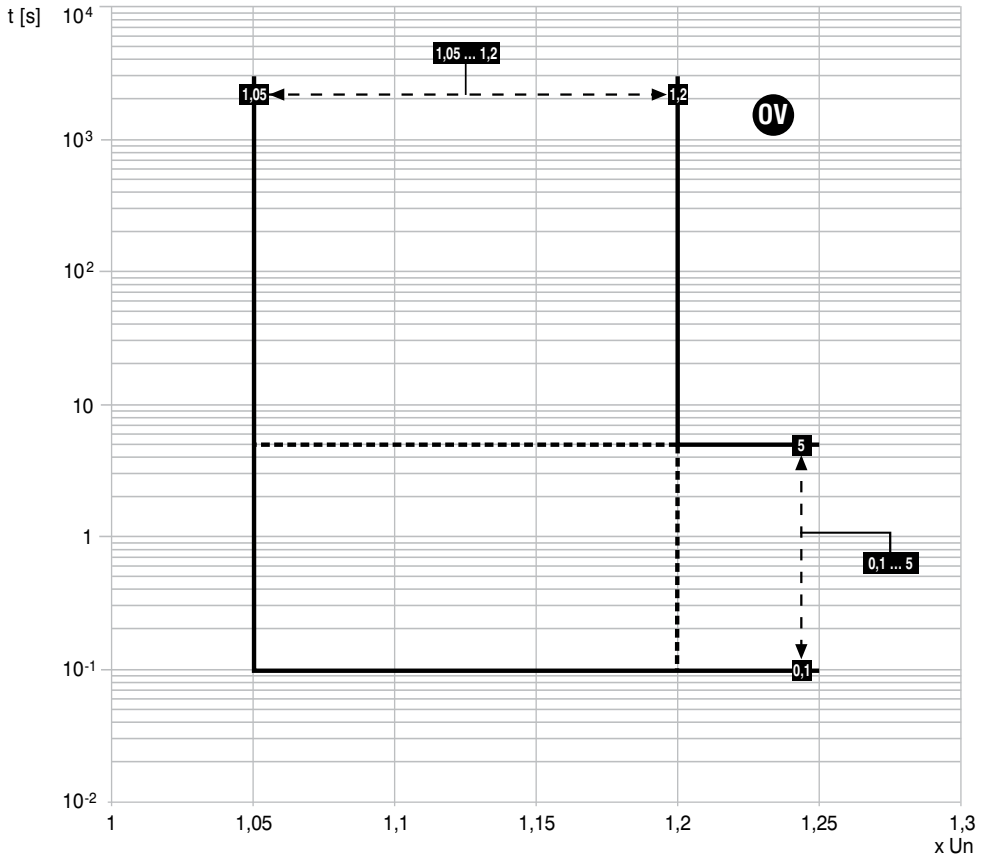
3.6.24.9. Trip curves for function U



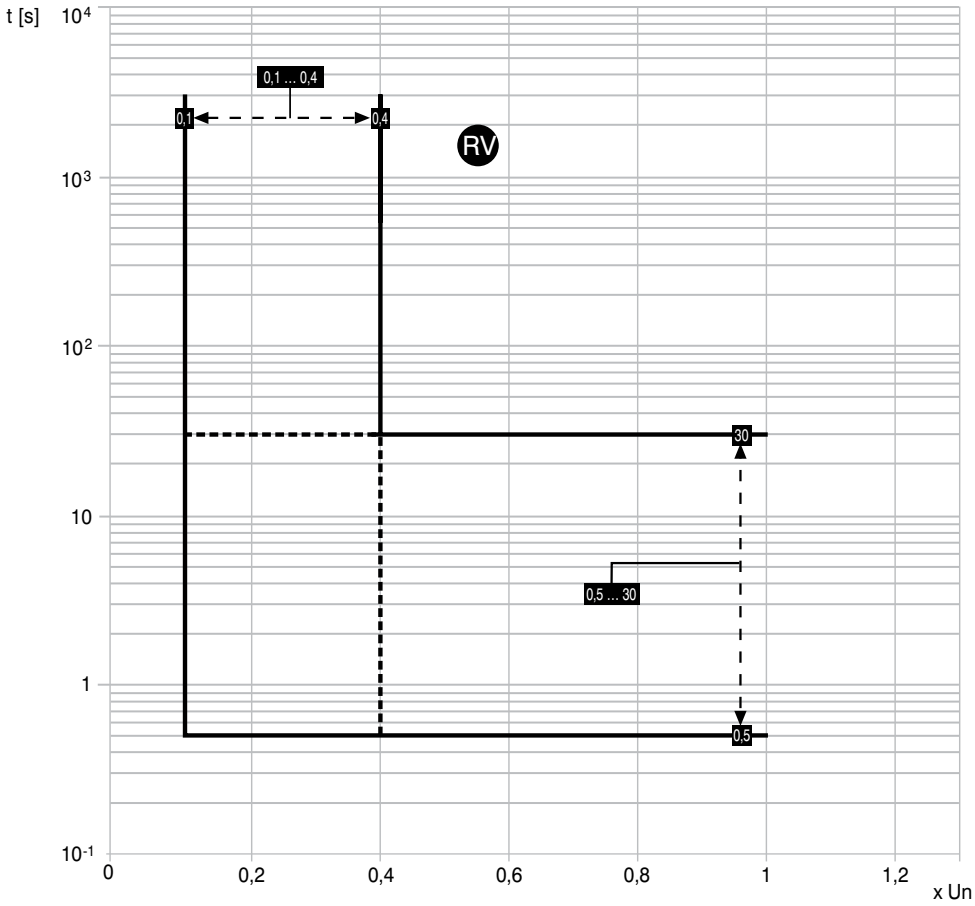
3.6.24.10. Trip curves for function UV



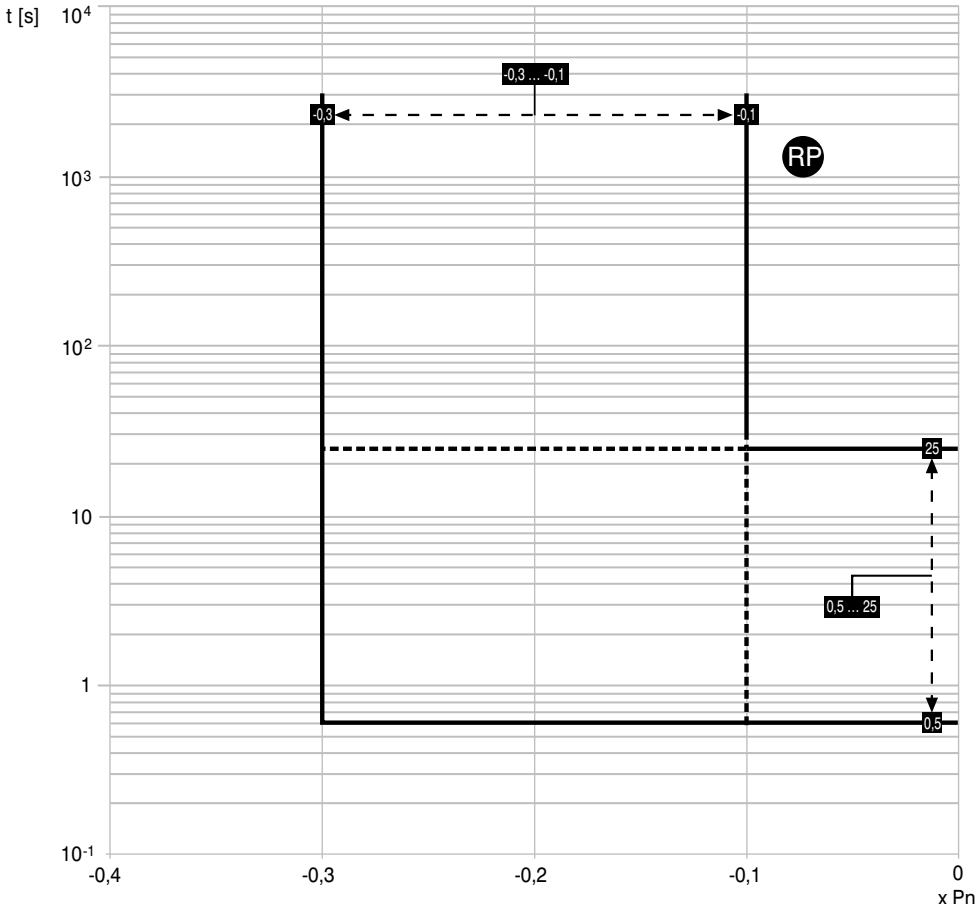
3.6.24.11. Trip curves for function OV



3.6.24.12. Trip curves for function RV



3.6.24.13. Trip curves for function RP



3.7. Measuring functions

PR332/P and PR333/P include various 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.

Configured with the PR330/V module, PR333/P and PR332/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

PR333/P provides a further measuring function:
- Wave forms: network voltages and phase currents, and harmonic analysis.

3.7.1. 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 current and voltage measurements available depend on the version and configuration of the CB and protection release.
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
- LSIG and LSIG MM version of the protection release: Ig measurement available.
- LSIG and version of the protection release and presence of SGR: Ige measurement available.
- LSIG or LSIRc (PR332/P) version of the protection release and presence of sensor Rc: Ige measurement available (to be considered as residual current).

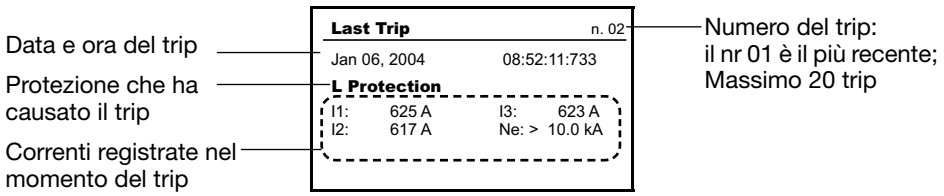
Voltages (In the presence of the PR330/V module):
- Three-pole CB without neutral: network voltages V12, V23, V13 and the total powers available (active, reactive, apparent).
- Three-pole CB, with neutral PRESENT Voltage option: network voltages V12, V23, V13, phase voltages V1, V2, V3, V0 and the powers (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 protection release	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	± 3
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

3.7.2. Trip

The list of trips recorded by the protection release 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 protection release off after 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 protection release.

3.7.3. Events

The list of trips recorded by the protection release 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,...).

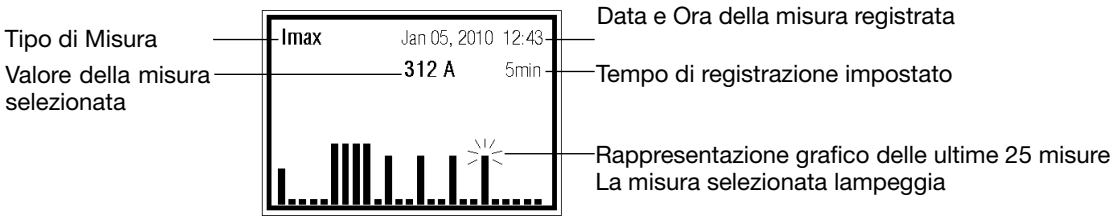
PR332/P and PR333/P are able to record up to 80 events. Use the UP and DOWN buttons to scroll all the events.

3.7.4. Measurements Log register

PR332/P and PR333/P can record various different measurements and allow the recording time between one measurement and the next to be set.
The measurements are available in the Measurements-Log Files-Measurements section:

Name	Available with	Description
I Max	PR333/P; PR332/P	Rms value and maximum current phase
P Max	PR333/P; PR332/P (with PR330/V)	Maximum active power
P Mean	PR333/P; PR332/P (with PR330/V)	Mean active power
V Max	PR333/P; PR332/P (with PR330/V)	Rms value and maximum network voltage phase
V Min	PR333/P; PR332/P (with PR330/V)	Rms value and minimum network voltage phase
Reset measurements	PR333/P; PR332/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.

3.7.5. Power factor

PR333/P and PP332/P (configured with the PR330/V module) provide the overall power factor in the Measurement-Power factor section.

Type of measurement range	Range of values measured by the protection release	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 '…..'.

3.7.6. Energy

PR333/P and PR332/P (with module PR330/V) 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 protection release	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

3.7.7. 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 protection release	Standard operation	
		Range	Tolerance %
Peak factor	0,3 ... 6 In	0,3 ... 6 In	± 1,5

3.7.8. Mains frequency

PR333/P and PR332/P (with module PR330/V) measure the mains 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 protection release	Standard operation	
		Range	Tolerance %
Mains frequency	35 ... 80 Hz	45 ... 66 Hz	± 0,2

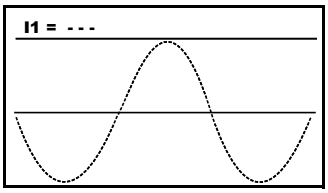
3.7.9. Contact wear

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

3.7.10. Wave forms

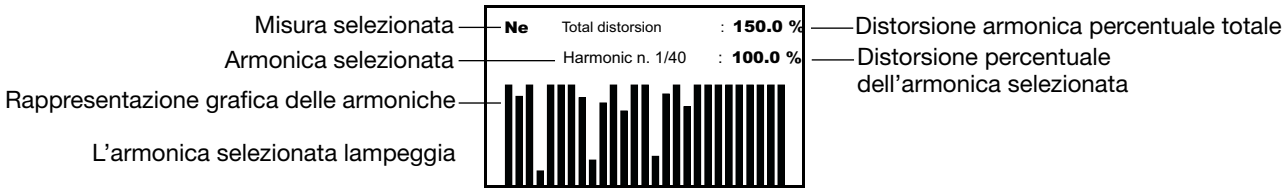
PR333/P provides a further measurement function, which is useful for the harmonic analysis of phase currents and phase-to-phase voltages.

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%.

3.8. Main functions

3.8.1. Watchdog

PR332/P and PR333/P provide certain watchdog functions able to ensure that CB and protection release faults are managed properly. 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 PR330/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.

3.8.2. Circuit-breaker state

PR332/P and PR333/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.

3.8.3. Datalogger

PR332/P and PR333/P, powered with Vaux, possess the 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 module PR330/D-M and external modules BT030-USB, Ekip T&P) and transferred to any personal computer for processing.

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

3.8.3.1. Settings

- All the settings are available in the Settings-Datalogger menu via system bus or test bus, by means of Ekip Connect.
- 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 “none” is selected for the Stop Source, the Datalogger can only be stopped by a stop command from the operator panel, from the system or following a trip generated by the protection release.

By means of Ekip Connect, customized Stop Sources can be set via system bus or test bus to coincide with events (a list of examples is given in the table below)

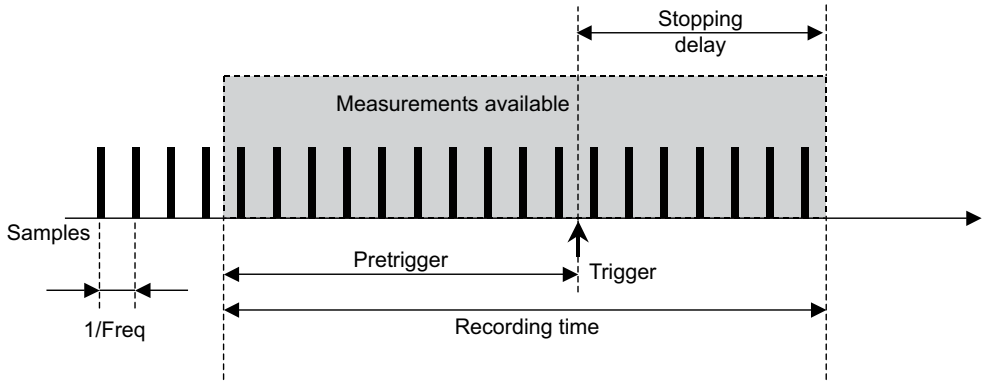
N° (decimal)	Event
1920	Time delay G
2894	sensor L1, L2 or L3 error, or Trip Coil error
2688	LC1 alarm
2049	G alarm
33672	CB connected and springs loaded
1793	Harmonic distortion > 2.1

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.

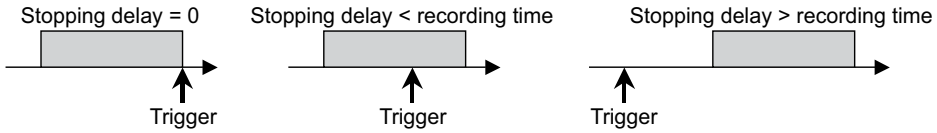
WARNING: If a trip occurs, this data storage process will be stopped after 10 ms, even if a longer stopping delay has been selected.

3.8.3.2. 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:

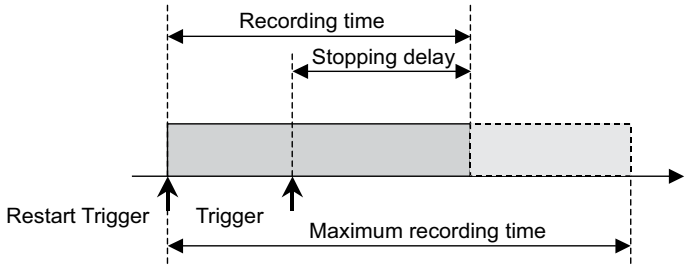


The user can select the sampling frequency, the type of stop trigger event and the stop delay so as to obtain the desired pre-trigger for the selected event.
Depending on the set value, the stop delay can be nil, or less or more than the recorded duration, as shown in the figure below:



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:



3.8.3.3. 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.

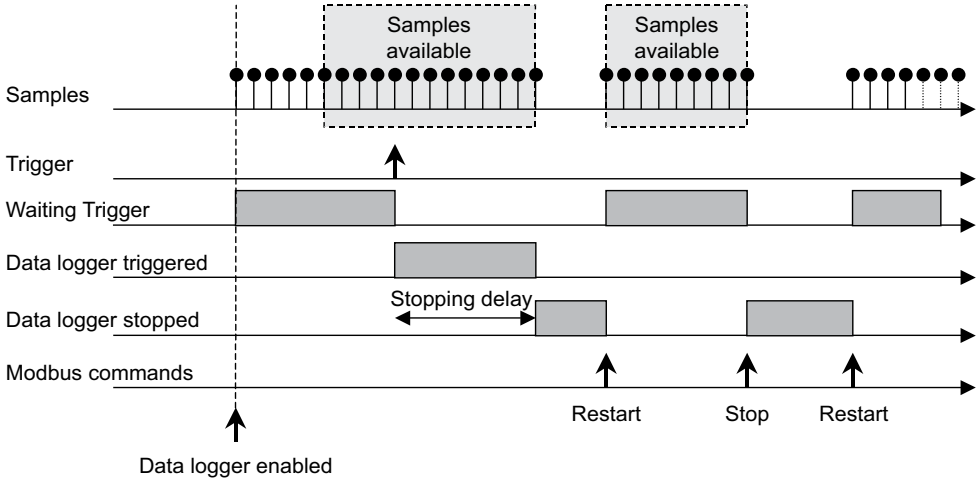
The following information is also stored:
- sample of currents L1, L2, L3, Ne
- V12, V23, V31 voltage samples
- digital inputs/outputs (among 16 possible options, e.g. inputs/outputs for Zone Selectivity, contact status, ...)
- alarms1 (among 16 possible options, e.g. L timing, G alarm, Prealarm)
- allarmi2 (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 protection release for as long as the unit is 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.

3.8.3.4. 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



3.8.4. Zone selectivity

The LSI, LSIG and LSIRc versions of releases PR333/P and PR332/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 selectivity functions only operate if the protection release is powered by Vaux.

The digital output of each selectivity channel can be connected to up to 20 protection releases 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 protection release on the supply side (ZSI side).

The operating mode is described in the chapters dedicated to each zone selectivity function: S (par. 1.6.3.3), G (1.6.8.2) and D (1.6.5.2).

3.8.5. Contact S51/P1

PR332/P and PR333/P have an external contact, which can be configured by the customer and is useful for monitoring a series of events, including alarms and protection trips
The configuration options of the contact, available via PR010/T or Ekip Connect, are:
- Monitoring event/s;
- Contact activation delay;
- Idle state (normally open or closed);
- Trigger configuration (Auto or Single).

The parameters are available in the Settings-Modules-SIGNALLING module-Relay.

The contact is available in all supply configurations and possesses the following electrical characteristics:

Type of contact	
Maximum switching voltage	400 Vac (Peak) / Vdc
Maximum switching current	0.1 Aac (Peak) / Adc
Maximum switching power	40 W
Contact/Circuit insulation	1500 Vac

NOTE: contact S51/p1 is not available for release PR332/P MM.

3.8.6. Function MM

PR332/P MM has a pair of input and output contacts for managing protection MM, described on page <OV>:
- **K14/K15: input for activating protection MM**;

The voltage applied between K14 (+) and K15 (-) establishes the state of the protection:
  - 0..2Vdc protection deactivated.
  - 15..24Vdc protection activated.

Consumption @24Vdc= 3mA max.
- **95S/98S**: the output supplies the state of protection MM:
  - If the protection is active, the contact is closed;
  - If the protection is deactivated, the contact is open.

The electrical characteristics of the output contact are the same as those of contact S51/P1, described in the previous chapter.
Operation of the output contact is guaranteed when the release is on, in the Full Power mode or in the presence of auxiliary supply.

WARNING:
-Upon powering, and if there is already energizing voltage on the input contact, the output contact closes within 100 ms.
-Following a trip through protection MM, the output contact can open temporarily for up to 20ms.

3.9. Settings Menu

The Settings menu contains various different settings for protection release 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 PR333/P).
6. Measurement interval	Adjustment of the measurement interval for the log file
7. Harmonic distortion	Activation of the harmonic distortion control (available with PR333/P)
8. System	Date, time, language, password settings
9. Display Contrast	Adjustment of the display contrast

3.9.1. 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. 1.6.20.
- 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. 1.6.9) and Rc (par. 1.6.10).
- Perform the installation and uninstalling operations for the protection release in the CB. Instructions for correct installation are given in par. 1.12.1 and 1.12.2.

3.9.2. Network frequency

This area allows you to enter the frequency of the installation: 50Hz or 60Hz.
Selection of this parameter allows the protection release to calibrate its protection and measurement functions according to the value chosen by the user.

3.9.3. Modules

PR332/P and PR333/P allow 4 internal modules to be connected and their settings configured.
The following options are available upon access to the Settings-Modules menu:
- 3 menus dedicated to modules PR330/V (MEASURING Module menu), PR330/D-M (COM Module), S51/P1 (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, Contact S51/P1.

3.9.4. Datalogger

PR322/P and PR333/P support the Dataloggger storage function. 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. 1.8.3.

3.9.5. Dual Set

PR333/P allows the user to enable the double 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. 1.6.19.

3.9.6. 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. 1.7.4.

3.9.7. 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.

3.9.8. System

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

3.9.8.1. Language

When selecting the system language, make sure that:
- The protection release is in the local mode (if PR330/D-M is installed);
- the CB is open;
- Vaux 24Vdc and/or busbar voltage by means of PR330/V and/or PR030/B are present.

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

3.9.8.2. Password

PPR332/P and PR333/P are supplied with the default password: 0001.
The password, which is required if all the changes to the protections or settings in the protection release 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. 1.13.

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”.

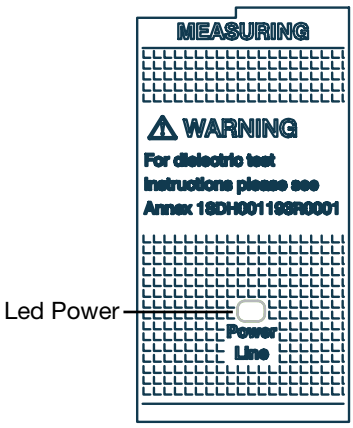
WARNING: The password is valid for up to two minutes from the last time a key was pressed. After that time, it must be entered again so as to validate any changes or to access the menus.

3.9.9. Display contrast

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

3.10. Internal modules

3.10.1. PR330/V - MEASURING Module



Module PR330/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 protection release even in the absence of Vaux, nil current or CB open conditions.

PR330/V can function with direct connection to the bars of the CB for phase voltage values of up to 690V. It is obligatory to use an insulation voltage transformer for connection to the busbars in systems with over 690V rated voltage (up to 1150V) or with a PR330/V module connected by external sockets.

The module comes with a “Power” LED, which indicates whether the energy from primary voltages is sufficient to supply the protection release, and a sealable disconnector for dielectric strength tests.

The menu in the protection release allows various different parameters to be adjusted:
- Selezione tensione nominale
- 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 PR333/P:
- Phase sequence: sequence control enabling and thresholds
- Cos φ measured: control enabing and threshold of the Cos φ measured module.

3.10.1.1. Power supply

Powering of the release by the MEASURING Module takes place via 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 supply specifications are described in sect. 3.3.8.

3.10.1.2. PR330/V parameters

All the parameters of the PR330/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 PR333/P)	Enabling status (ON/OFF) Threshold (123/321)	
	Enabling status (ON/OFF) Threshold (from 0,5 to 0,95; step 0,01)	

3.10.1.3. Voltage transformer

In the case of three-phase systems with a rated voltage greater than 690 Vrms phase to phase or with a PR330/V module connected by external sockets, 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

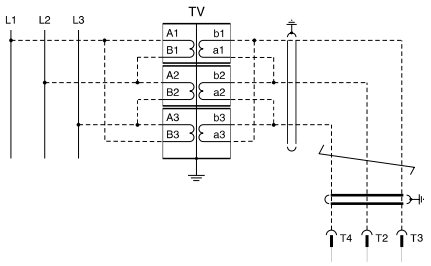
Electrical characteristics	
Precision class	cl. 0,5
Performance	≥10VA...≤20 VA
Overload	20% permanent
Insulation	4 kV between inputs and outputs
	4 kV between inputs and outputs
	4 kV between inputs and inputs
Operating frequency range	from 50 Hz to 60 Hz, ± 10%

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.

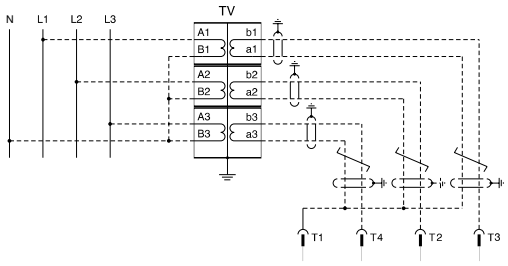
Installation system	**"VT Standard" type transformer (Star/Star)**	**"VT Standard" type transformer (Delta/Delta)**
	Application diagram	**Application diagram**
TN-C	B	A
TN-S	B	A
IT with neutral	B	A
IT	n.c	A
TT with neutral	A	B
TT without neutral	n.c	A

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 - PR330/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 must not be performed on the inputs and outputs of the protection release and on the secondary lines of any VT connected.

3.10.1.4. Dielectric strength tests

To perform the dielectric tests, it is obligatory to disconnect Measuring module PR330/V, as described below and in document 1SDH001193R0001.

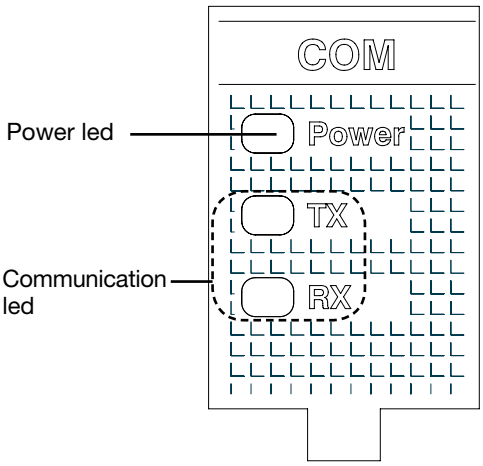
If dielectric tests are performed on the auxiliary circuits of the circuit-breaker:
1. If the circuit-breaker is the withdrawable type, it must be brought to the withdrawn position.
2. If the circuit-breaker is the fixed type, disconnect the circuits in the terminal box.

If dielectric tests are performed on the main circuits:
1. In the case of a fixed circuit-breaker and module PR330/V with external voltage taps, remove the voltage taps of the module (T1,T2,T3,T4) from the terminal box. In the case of module PR330/V with internal voltage taps, follow sequence A-B-C-D-E and comply with the instructions in document 1SDH001193R0001, i.e. remove the escutcheon plate from the circuit-breaker, connector 1 and connector 2 for the internal voltage taps.
If the external neutral is present, also remove the relative connection T1 in the terminal box

2. If the circuit-breaker is the withdrawable type, it must be brought to the withdrawn position.

NOTE: check the relative S/N to find out whether a measuring module has internal or external voltage taps: if the last letter is A or B, the module has external voltage taps. If the last letter is C or D, the module has internal voltage taps.

3.10.2. Module PR330/D-M - COM



Communication module PR330/D-M is dedicated to connecting the protection release to a Modbus network for remote supervisory and control activities for 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 protection release allows various different parameters to be adjusted:
- Protection release configuration (local/remote)
- Communication parameters (baudrate, address, parity)

The communication function with PR330/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 PR330/D-M is given in the Modbus System Interface for PR122-3 and PR332-3 (1SDH000556R0001).

3.10.2.1. PR330/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 protection release. Only supervision is allowed in the remote mode. Remote: all changes to the parameters must be made in the remote mode. Only supervision and modification of the Local/Remote parameter can be performed via the menu in the protection release.
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.

3.11. **Test Menu**

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

Name	Description
1. CB status	allows the user to view the CB state read by the protection release.
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/MM Test module	allows output S51/P1 or 95S/98S to be checked and, if present, the state of K14/K15

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

3.11.1. 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 “PR332/P“ or “PR333/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).

3.11.2. Trip test

The state of CB opening can be checked by activating the trip test.
The protection release sends a command to the CT, which activates a CB opening mechanism. Opening of the circuit-breaker denotes a positive test result.

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).

3.11.3. Rc Test

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

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.

3.11.4. Zone selectivity

The tests commands are available with LSI and LSIG version releases. 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.

3.11.5. COM module

The option is available if the PR330/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 protection release only sends commands. It does not check the change of state.

Further details about the module are given in par. 1.10.2.

3.11.6. Modulo SIGNALLING

If the release is equipped with S51/P1, the autotest command of the contact is also available: activation causes the contact to close for 1s (verification is at the user's discretion).

3.11.7. MM Test

The test menu is available with the MM version release. 2 possible options can be selected:
- Auto Test causes contacts 95s/98s to close for 1s.
- Input allows the state of inputs K14/K15 to be verified: On for > 15 VDC voltage values, Off for < 2 VDC voltage values.

The verifications and test setup are at the user's discretion and must comply with the maximum limits of the inputs and outputs.

3.12. Putting into service and recommendations

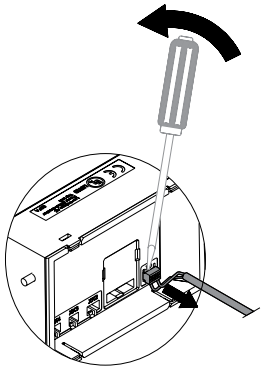
3.12.1. Installation

Circuit-breakers purchased with the protection release assembled do not require this operation which is, however, necessary in the case of replacement.
Comply with the following instructions if the release on the CB is replaced:

1. With the circuit-breaker open and possibly isolated, install the protection release on the circuit-breaker
2. Power the protection release with PR030/B only
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. Energize the protection release from any other source
11. Check for the absence of configuration errors.

3.12.2. Uninstalling

To complete the procedure for uninstalling a PR332/P or PR333/P unit, follow the steps below:



1. With the circuit-breaker open and/or isolated, power the protection release with 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 PR332/P or PR333/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 re-transmitted to the new protection release to be installed in the same circuit-breaker.

3.12.3. 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 ensure compliance with all the international reference standards and guarantee that the protection release functions perfectly even in heavy duty environmental and electromagnetic conditions.
Pay particular attention to the types of cable, the connections to earth and the maximum distances.

3.12.4. CS and TC connection test

WARNING: If PR332/P has been installed by the user, it is important, before closing the CB, to check the last line on the display when the protection release is turned on for the first time via a PR030/B battery module. No CS and/or TC disconnected messages must appear; if they do, do not close the circuit-breaker and make the correct connections.

3.12.5. 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.

3.12.6. TV connections

All the application and functional details for correct use of the TV are described in par. 1.10.1.3.

3.12.7. How to put the Rc sensor into service

If PR332/P and PR333/P are to be provided with the Rc function, comply with the instructions below:
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 protection release as shown in the circuit diagram
5. Energize the protection release via PR030/B, then proceed with the installation operations in the following sequence: 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. 1.11 Menù Test); check for correct operation.

3.13. Default parameters

Before PR332/P and PR333/P are put into service, it is essential for the user to define and carefully adjust the editable parameters to suit the installation requirements.
ABB 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 PR330/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 protection release into service.

PR332/P and PR333/P are supplied 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 PR333/P)	Off	6 In	50 ms	K	--	Off: 0,04 s	--
D (only for PR333/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					
S51/P1	On	Alarm-L					
MM	On	2,5 In					

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

3.14. Troubleshooting

3.14.1. 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 that the protection release is operating normally.
3. In the case where the suggestions proposed do not lead to a solution of the problem, please contact the ABB 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. 1.4.3 2. FN, see par. 1.3.7 and see par. 1.6.17
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 PR330/V 2. Voltage parameter configuration error	1. Check connections between VT and PR330/V 2. Set correct parameters
10	"⚠ Local Bus" message on display	No communication between PR333/P and Flex Interface or HMI030	1. If not present, disable PR021/K, see par. 1.9.3 2. Check bus connection 3. Check external device
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. 1.6.11
14	No display of the opening data	Vaux missing,the buffer capacitor is discharged	FN, see par. 1.7.2
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	PR333/P in alarm situation	FN
17	"⚠ Temp. sensor" or "⚠ Start-up" message	Possible fault inside the protection release	Contact ABB
18	Invalid date	1. First installation 2. Information lost due to power failure	Change date, see par. 1.9.8
19	Untimely trip		See par. 1.4.3.2
20	LED lighting		See par. 1.4.1
21	The language cannot be changed	1. The protection release is configured in the remote mode 2. CB not open 3. Vaux or PR330/V or PR030/B not installed	1. Set locally 2. Open CB 3. Power the protection release
22	The activation contact of protection MM is not closed	Protection MM has not been enabled or K14/15 has no incoming signal	Check the menu to make sure that the protection is enabled and use a tester to check that voltage and polarity at the ends of K14 and K15 are correct

3.14.2. In the case of a fault

WARNING: If you suspect that the protection release is faulty, functions incorrectly or has generated an unwanted trip, you are strongly advised to strictly comply with the following instructions in 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.

4. ACCESSORIES

4.1. External neutral

This is a current sensor for the external neutral pole of the circuit-breaker, designed to provide neutral protection for three-pole circuit-breakers. Further details about connection of the external neutral are available from the website http://www.abb.com/ abblibrary/ DownloadCenter/ in document 1SDH000529R0513.

4.2. SGR sensor

SGR is a single-pole current sensor for earth fault protection with external sensor (Gext), available for the LSIG version of PR332/P and PR333/P releases.
The presence, size and protection parameters of protection Gext must be selected when the release is configured (consult the description of protection Gext in this manual). Further details about sensor connection are available in the website http://www.abb.com/abblibrary/DownloadCenter/ in document 1SDH000460R0507.

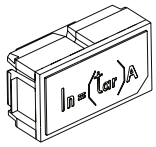
IMPORTANT: Sensor SGR (and the relative Gext protection) are an alternative to sensor Rc (and relative protection).

4.3. RC toroid

RC is the external residual current sensor for protection Rc, available for the LSIG and LSIRc versions of PR332/P and the LSIG version PR333/P releases.
Module PR330/V and the specific Rating Plug Rc must be present in order to install this sensor (consult the description of protection Rc in this manual).
Further details about sensor connection are available in the website http://www.abb.com/abblibrary/DownloadCenter/ in document 1SDH000529R0514.

IMPORTANT: Sensor Rc (and the relative protection) are an alternative to sensor SGR (and relative Gext protection).

4.4. Rating Plug



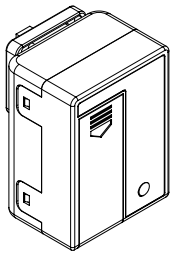
The rating plug defines the rated current In, which is essential for regulating the protections. This is because the regulation of all the protections refers to In (e.g.: I1= 0.4 xIn).
The rating plug is installed in the protection release, on a dedicated front connector and is available to the user.
The protection release can be equipped with various different Rating Plug models, up to value Iu (uninterrupted rated current Iu of the CB given on the rating plate of 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 protection release off and the CB open.

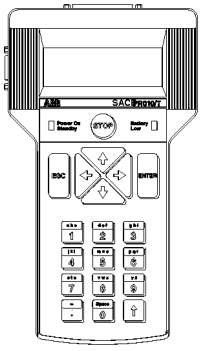
The protection release continuously checks for the presence of the rating plug and signals its absence or any assembly errors.

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

4.5. PR030/B



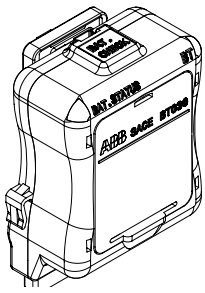
PR030/B is an external unit allowing the protection release to be energized so that Installation, Autotest and Trip Test can be performed, along with verifications with the CB open. The unit is connected to the protection release by means of the front service connector.



4.6. PR010/T

PR010/T allows the parameters and logs recorded by the protection release to be verified. It also allows the operation of the thresholds and trip times of protection functions L-S-I-G to be checked.
The unit is supplied in a case containing the connection cables, external power supplier and rechargeable batteries, cable and SW for PC.
The SW in the PC allows several files corresponding to the devices with which it is possible to interface, to be loaded into PR010/T. It also allows test reports to be downloaded. This means that the corresponding files must be uploaded before PR010/T can be used with the protection release. The unit is connected to the protection release by means of the front service connector via a dedicated cable.
Consult the Operation Manual of the unit (RH0025) for further details.

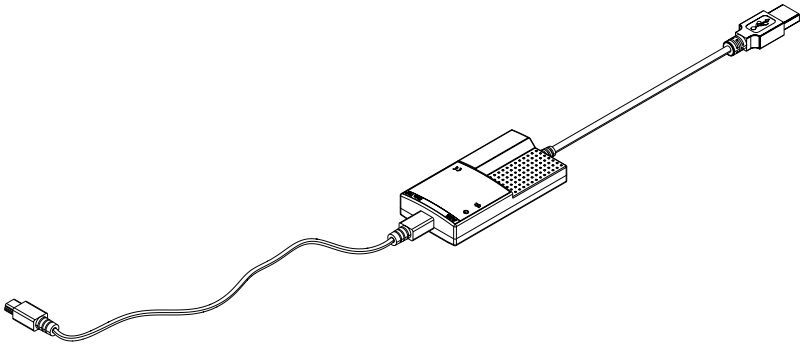
4.7. BT030-USB



Using BT030-USB, the protection release can communicate with a PC in the wireless mode or via USB, thereby adding to the range of information available to the user.
Communication is enabled via Ekip Connect SW, the installation package of which is in the BT030-USB set.
This set also includes the USB cable and batteries for use in the wireless configuration.
The unit is connected to the protection release by means of the front service connector.

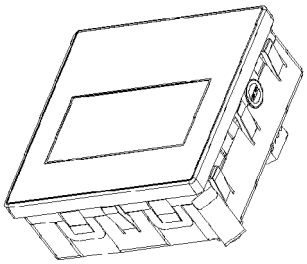
4.8. EKIP T&P

Ekip T&P allows protection release energizing, communication and testing via a PC by means of a USB adapter.
Similarly to BT030-USB, communication is enabled via Ekip Connect SW, the installation package of which is in the Ekip T&P set.
The set includes the USB module and a series of adapters for various types of protection releases.



WARNING: Ekip T&P must only be used with the dedicated cable, compatible with PR33x/P protection releases (the picture below is for explanatory purposes only). Consult the Ekip Connect SW Operation Manual (1SDH000891R0001) for further details.

4.9. HMI030



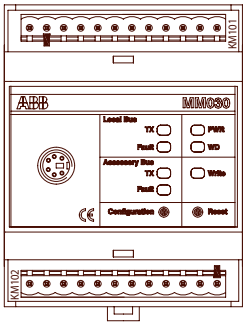
Protection releases PR33x/P can be connected to the front external unit of HMI030 switchgear so as to display the current values measured.
HMI030 connects to the connector on the rear side, on the protection release, the external connection of which is provided by the contacts on the terminal box in the CB.

Auxiliary power supply for the protection release and HMI030 is required for this function.

HMI030 power supply	
Auxiliary power supply	24 V DC +/-20%
Maximum ripple	5%
Rated power @ 24 V	1,2W

Consult the Operation Manual of the unit (1SDH000573R0001) for further details.

4.10. Flex interface



Flex interfaces are electronic units that can be installed on DIN rail, with analog and/or digital inputs and outputs, which can be connected to the protection release via Local Bus Local.

The Flex Interface family comprises module MM030 (connected on one side to the Local Bus of the protection release and on the other side to all the modules installed) and the modules of the AD series.
If connected to MM030, the HMI030 module is also part of the Flex Interface family.
All the configurations and connection solutions are described in the dedicated operation manuals (as shown in the attached table).

Auxiliary power supply for the protection release and Flex Interface is required for this function.

Device	Characteristics	Description	Notes	Reference documentation
MM030		Controls exchanges of information between the protection release and accessories of the Flex Interface family		1SDH000622R0001
AD030 DO	8 digital outputs	Receives information from MM03 and operates its digital outputs as a consequence		1SDH000672R0001
AD030 AO	4 analog outputs	Receives information from MM03 and operates its analog outputs as a consequence		1SDH000672R0001
AD030 MI	mixed inputs: 2 analog and 2 digital	Repeats the digital inputs following a request from the MM03		1SDH000672R0001
HMI030	Display	Displays the data received from the protection release or MM030	note 1: after having been configured in the appropriate way, it can be connected to the protection release or straight to MM030	1SDH000573R0001
			note 2: the HMI030 can be connected to MM030 from MM030 software releases 2.0 onwards	

4.10.1. Notes about the HMI030 and Flex Interface connection

Protection release connection to the HMI030 or Flex Interface units must be made with corded shielded two-wire cable (e.g. BELDEN 3105A) no more than 15 m in length. The shield must be earthed on both the circuit-breaker and unit sides.

4.11. Ekip Connect

Ekip Connect is a software application for personal computers equipped with the Microsoft Windows® operating system, which allows data to be exchanged with one or more ABB low voltage devices.

Ekip Connect can be connected to ABB low voltage circuit-breakers equipped with electronic protection release for the purpose of:
- Putting the CB into service.
- Monitoring the state of all the available signals.
- Reading information (alarms, measurements, parameters).
- Changing the configuration parameters, especially for protection releases without display.
- Executing commands.
- Identifying faults in the protection release and communication network.
- Performing tests.

Operating tests in switchboards are facilitated since the parameters and test reports can be saved.

Ekip Connect is free of charge and is either supplied on an installation CD or can be obtained from the Internet address http://bol.it.abb.com in the section “Work Tools - Software for moulded case and air circuit-breakers”.