PXR10, PXR20, PXR25

Electronic trip unit
Power Xpert Release PXR
for NZM... circuit breakers

Powering Business Worldwide

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Original operating manual
The German-language edition of this document is the original operating manual.

Translation of the original operating manual
All editions of this document other than those in German language are translations of the original operating manual.

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Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally retriggered.
- Verify isolation from the supply.
- Ground and short-circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (IL) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalizing. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O connection so that a cable or wire breakage on the signal side does not result in undefined states in the automation device.
- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD 384.4.41 S2 (VDE 0100 part 410).
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the technical data, otherwise this may cause malfunction and dangerous operation.
- Emergency-Stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency switching off devices must not cause restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state, desk-top devices or portable devices only when the housing is closed.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency switching off devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, etc.).
- During operation, and depending on their degree of protection, variable frequency drives may have live, uninsulated, moving, and/or rotating parts, as well as hot surfaces.
- The impermissible removal of the required cover, improper installation or incorrect operation of the motor or variable frequency drive can cause the failure of the device and serious injury and/or material damage.
- Comply with all applicable national accident prevention regulations (e.g. BGV A3) when working with energized variable frequency drives.
- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- All transport, installation, commissioning and maintenance work must only be carried out by trained personnel (observe IEC 60364, HD 384 or DIN VDE 0100 and national accident prevention regulations).
- If applicable, systems in which variable frequency drives are installed must be equipped with additional monitoring and protective devices in accordance with the applicable safety regulations, e.g., the German Equipment and Product Safety Act, accident prevention regulations, etc. Making changes to the variable frequency drives by using the operating software is allowed.
- Keep all covers and doors closed during operation.
- When designing the machine, the user must incorporate mechanisms and measures that limit the consequences of a drive controller malfunction or failure (an increase in motor speed or the motor's sudden stop) so as to prevent hazards to people and property, e.g.:
  - Additional stand-alone devices for monitoring parameters that are relevant to safety (speed, travel, end positions, etc.)
  - Electrical and non-electrical safety devices (interlocks or mechanical locks) for mechanisms that protect the entire system
  - Due to the possibility of there being capacitors that are still holding a charge, do not touch live device parts or terminals immediately after disconnecting the variable frequency drives from the supply voltage. Heed the corresponding labels on the variable frequency drives

Table of contents

0 About this manual

This manual covers the PXR10, PXR20 and PXR25 electronic trip units of the NZM digital circuit breaker as well as the relevant accessories.

The manual describes the various versions of the product series, as well as their installation and operation.

0.1 List of revisions

Publication date	Page	Keyword	new	modified	deleted
01/22	23	Advanced metered data specifications	✓		
	29	Advanced protection functions	✓		
	44	Relay Configuration (→ Table 22)		✓	
	50	Testing (remote) of the circuit-breaker via USB/PXPM		✓	
	57	Real-time data register (→ Table 25)		✓	
	69	Setting group 0: “System group” (→ Table 26)		✓	
	72	Setting group 1: “protection group” (→ Table 27)		✓	
	79	Group 5: Advanced protection functions (→ Table 29)	✓		
	–	Setpoint values for group 3: “CAM” group			✓
	88	Remote control (→ Table 35)		✓	
	97	Industrial Ethernet Communication Adapter Modules (ECAM)	✓		
	104	Real-time data register – EtherNet/IP™ (→ Table 49)		✓	
	111	Setting group 0: “System group” – EtherNet/IP™ (→ Table 50)		✓	
	113	Setting group 1: “Protection group” – EtherNet/IP™ (→ Table 51)		✓	
	119	Group 5: Advanced protection functions – EtherNet/IP™ (→ Table 53)		✓	
	124	Remote control – EtherNet/IP™ (→ Table 58)		✓	
	134	Real-time data register – EtherCAT® (→ Table 67)		✓	
	141	Setting group 0: “System group” – EtherCAT® (→ Table 68)		✓	
	143	Setting group 1: “Protection group“ – EtherCAT® (→ Table 69)		✓	
	149	Advanced protection functions (→ Table 71)	✓		
	165	Real-time data register – PROFINET (→ Table 87)		✓	
	172	Setting group 0: “System group” – PROFINET (→ Table 88)		✓	
	174	Setting group 1: “Protection group” – PROFINET (→ Table 89)		✓	
	179	Group 5: Advanced protection functions – PROFINET (→ Table 91)	✓		
07/19		First edition	–	–	–

0.2 Target group

This manual is intended for authorized personnel who are qualified to install, commission and service an NZM circuit breaker.

CAUTION

The installation must be carried out by a qualified electrician.

ELECTRIC HAZARD! DANGER OF DEATH!

Work on or assembly of this product may only be carried out by qualified electricians or otherwise qualified personnel.

0.2.1 Abbreviations and symbols

The following abbreviations are used in this manual:

Table 1: Abbreviations used

Abbreviation	Meaning
ARMS	Arc Flash Reduction Maintenance System™
ECAM	Ethernet communication adapter module
G	Ground fault (= ground-fault protection I_g)
I	Instantaneous (= instantaneous short-circuit protection I_i)
I_g	Ground-fault trip
I_i	Non-delayed instantaneous trip
I_n	Rated operational current
I_r	Overload release
I_{sd}	Short-time delayed short-circuit release
L	Long delay (= overload protection I_r)
PXPM	"Power Xpert Protection Manager" (software)
PXR	"Power Xpert Release"
RTU	Remote terminal unit
S	Short delay (= short-time delayed short-circuit protection I_{sd})
t_g	Ground-fault delay time
t_r	Time-lag
t_{sd}	Duration of short-time delay
ZSI	Zone selective interlocking

The abbreviation PXR:
For the PXR10, PXR20 and PXR25 versions, the abbreviation PXR is used if a statement applies equally to all three.

The symbols used in this manual have the following meanings:

▶ indicates an action to be taken.

0.2.2 Safety warning concerning property damage

CAUTION

Indicates a potentially hazardous situation that may result in property damage.

0.2.3 Safety warning concerning personal injury hazards

CAUTION

Indicates a potentially hazardous situation that may result in moderate or minor injury

WARNING

Indicates a potentially hazardous situation that may result in death or serious injury

DANGER

Indicates an imminently hazardous situation that will result in death or serious injury

0.2.4 Tips

Indicates useful tips.

0.3 Additional documents

For further information, please consult the following documentation and/or software:

Title	Type	Address
IL012099ZU "Frame size 2 circuit-breaker base unit"	Instruction leaflet	
IL012100ZU "Frame size 3 circuit-breaker base unit"	Instruction leaflet	
IL012101ZU "Frame size 4 circuit-breaker base unit"	Instruction leaflet	
IL012102ZU "Interface module for circuit breaker"	Instruction leaflet	
IL012103ZU "External communication link for circuit breaker"	Instruction leaflet	
IL012104ZU "Internal communication link for circuit breaker"	Instruction leaflet	
IL012141ZU "Shunt release, undervoltage release, relay module, early-make auxiliary switch"	Instruction leaflet	
IL012143ZU "Shunt release, undervoltage release, relay module, early-make auxiliary switch"	Instruction leaflet	
IL019224E "Connection cable for Modbus TCP and Profibus communication modules"	Instruction leaflet	
"Setting-Specific Representation of Tripping Characteristics and Competent Assessment of their Interaction"	White paper	www.eaton.eu/ecm/groups/public/@pub/@europe/@electrical/documents/content/pct_998455.pdf
"More safety when working on live electrical circuits"	White paper	
"Improved lifecycle management thanks to digital circuit protection"	White paper	
"xSpider" (graphical design system for the planning of low-voltage networks)	Software	www.eaton.com/xspider
"Power Xpert Protection Manager"	Software	www.eaton.com/PXPM

1 Function

1.1 General information

The subsystem of the new NZM circuit breakers (the NZM2, NZM3 and NZM4 series) consists of current sensors and a trip actuator in conjunction with the PXR (Power Xpert Release) electronic trip. The electronic trip units PXR10, PXR20 and PXR25 in particular ensure the protection function of the circuit breaker.

In addition to its main function (= protection), the PXR electronic trip unit makes it possible

- to check the protection functions of the circuit breaker (and to log them using the PXPM software),
- to access the circuit breaker information,
- and to adjust the circuit breaker settings.

1.2 Technical background

The PXR trip unit analyzes signals transmitted by Rogowski current sensors. As soon as the current and/or time-delay thresholds are exceeded, the PXR trip unit will cause the circuit breaker to trip.

The automatic overload and short-circuit tripping characteristics for a given circuit breaker depend on

- the specific PXR trip unit version,
- the rated operational current I_n,
- and the protection settings selected by the user.

The current protection functions do not require any external control voltage.

The PXR trip unit consists of a micro-controller module that performs rms current measurements as well as calculations for the protection functions.

It shall not be removed or replaced.

The current sensors are integrated in the circuit breaker and consist of two coils per phase: an iron-core coil (for self-supply) and a Rogowski coil for current measurement.

As soon as a current flows through the circuit breaker, the iron-core coil will generate a secondary current that supplies the PXR trip unit. At the same time, the Rogowski coil emits signals that make it possible to determine the current flowing through the circuit breaker.

The mechanical action required to initiate the tripping of the NZM circuit breaker is carried out by means of a low-energy trip element. This trip element is an integral part of the circuit breaker mechanism. This also includes a toggle lever for manual “opening” and “closing”.

All wiring is done via the interface or relay module,
→ chapter 7, “Auxiliary wiring terminals”, page 41.

The wiring diagrams in the instruction leaflets show how certain trip unit functions are connected to external circuits.

See instruction leaflet IL012102ZU.

1.3 Standards, guidelines, approvals

All PXR electronic trip units have passed IEC 60947-2 testing, which also includes an EMC test according to Annex F and Annex J.
All trip units comply with the EU’s low-voltage and EMC directives (CISPR11, class A and B) and carry the CE mark.

The PXR trip units are also certified for use in the NZM...NA series circuit breakers by Underwriters Laboratories Inc. (UL) and the Canadian Standards Association (CSA).

Further information on the NZM digital circuit breakers can be found on the Eaton website:

www.eaton.com/digitalNZM

2 Design

The PXR trip unit housing is located in the lower part of the NZM circuit breaker and contains the protection functions for the electronic components, as well as an interface for configuring the protection settings and monitoring functions.

Some functions are only available on certain versions of the PXR trip unit.

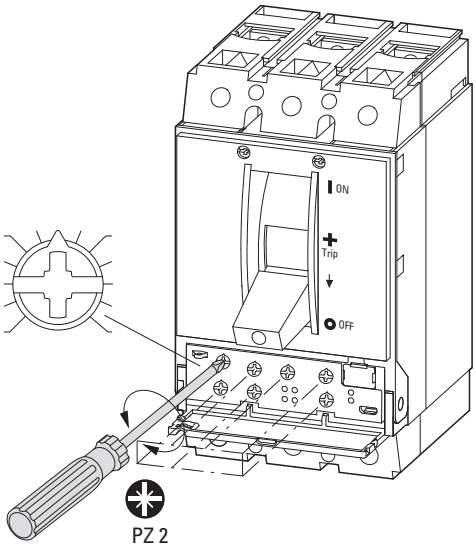


Figure 1: NZM circuit breaker with PXR trip unit

Please note:

The operator interfaces of the trip units differ from one another:

The PXR10 and PXR20 versions are fitted with rotary switches, while on the PXR25 version, an LCD display is used for indicating and adjusting the settings.

2.1 Operator interface

2.1.1 Rotary switch on the PXR10 and PXR20 trip units

Depending on the type of trip unit, there are up to seven rotary switches at the front of the unit.

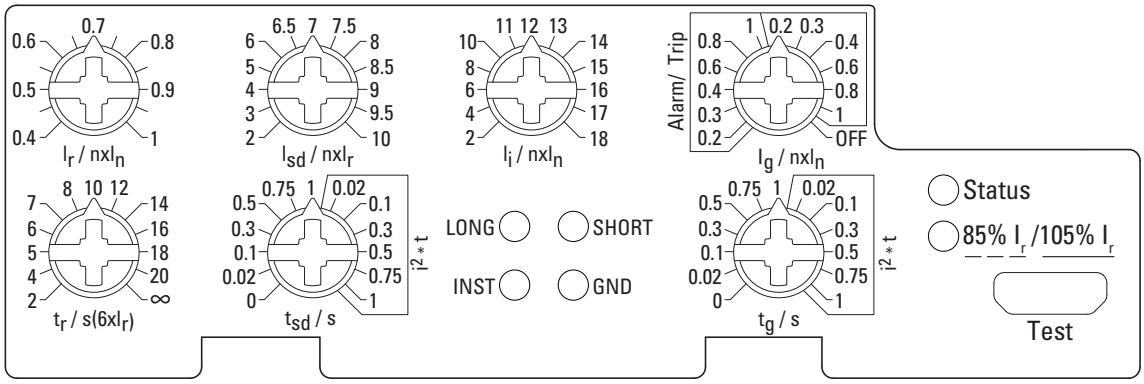


Figure 2: PXR10 and PXR20 overview

Table 2: PXR10 and PXR20 functions

Version	Release	I_r	t_r	I_{sd}	t_{sd}	I_i	I_g	t_g
PXR10	-AX(-NA)	✓	–	–	–	✓	–	–
PXR20	-MX(-NA)	✓	✓	–	–	✓	–	–
	-VX(-NA)	✓	✓	✓	✓	✓	–	–
	-VX-T(-NA)	✓	✓	✓	✓	✓	✓	✓

These rotary switches are used to set the protection settings, in line with the key as indicated. They control the core protection settings. Each rotary switch has 13 positions and is set in such a way that the corresponding tripping characteristic will be reached. The "PICKUP" switches (upper row) set the threshold values for the circuit breaker. The "TIME" switches (t_r, t_{sd}, t_g) in the lower row set the delay time in (milli-)seconds.
By means of a PZ2 screwdriver or a slotted screwdriver the switches can be adjusted so that the arrow points to the selected value. For the time functions t_{sd} and t_g, either the flat or the I^2t- characteristic can be selected. The function I_g can distinguish between "trip", "alarm" and "OFF". If "trip" is selected, the circuit breaker will trip according to the characteristic curve. If the alarm is set, an alarm message will either be transmitted via the corresponding communication register and the **GND** LED, or an alarm message will be sent via the relay module (if used and configured accordingly).

2.1.2 LCD display on the PXR25 trip units

On the PXR25 trip units, the device settings are indicated and adjusted via an LCD display at the front.

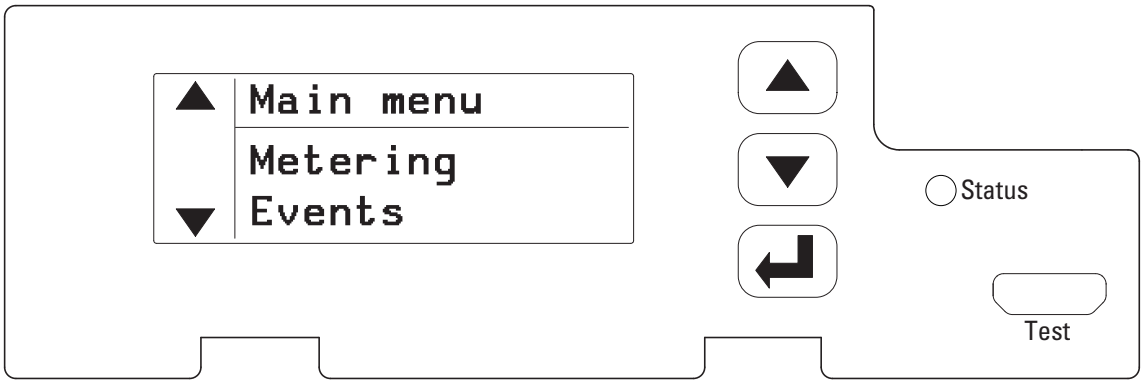


Figure 3: LCD display on the PXR25

Table 3: PXR25 functions

Version	Release	I_r	t_r	I_{sd}	t_{sd}	I_i	I_g	t_g
PXR25	-PX(-NA)	✓	✓	✓	✓	✓	–	–
	-PMX(-NA)	✓	✓	–	–	✓	–	–
	-PX...-TZ(TAZ)(-NA)	✓	✓	✓	✓	✓	✓	✓

Table 4: Settings

	I_r	t_r	I_{sd}	t_{sd}	I_i	I_g	t_g
Settings range	0.4 - 1	2 - 20 s	2 - 10	0 - 1000 ms	2 - 18	0.2 - 1	0 - 1000 ms
Increments	1 A	0.1 s	1 A	10 ms	1 A	1 A	10 ms
Options	I^2t	• ∞ • OFF	• I^2t • Flat	–	–	• Alarm • Trip • OFF	• I^2t • Flat

The LCD display indicates the recorded values and events and can be used to select certain configurations. The default display language is English.

The following languages are pre-installed:

- English
- German
- French
- Italian
- Polish
- Dutch
- Norwegian
- Swedish

→ Additional language packs can be installed via the **Power Xpert Protection Manager** configuration software.

In addition to the display, three indicator and navigation buttons enable the selection of certain configurations and allow users to determine the information to be shown on the display.

Table 5: Indicator/navigation buttons

Button	Description
 Up arrow button	This button is used to move up in the navigation menu, or to set a value to higher.
 Down arrow button	This button is used to move down in the navigation menu, or to set a value to lower.
 Enter button	This button is used to enter the navigation menu, to call up a specific setting or to return to the previous menu item.

Even before the display is active, the trip unit is already in operation and the protection functions are activated. The protection functions are set as absolute values via the display. Depending on the type of trip unit, the main menu will contain different sub-menus. A menu item can be called up by selecting the corresponding sub-menu. To do this, press the up arrow or down arrow button and then the enter button. If no button is pressed for some time, the screensaver will automatically be activated, and will remain on. The screensaver displays a summary of the most important settings and data readings. Use the arrow keys to switch between the different displays in screensaver mode. Press the enter button to return to the main menu. The status LED indicates if the trip unit is ready for operation. During normal operation, this LED will flash green.

Also see → chapter 12, “PXR25 Navigation menu”, page 195 for a graphical representation of the navigation menu.

2.2 Micro-USB connection

The PXR trip unit has a type-B Micro-USB connection based on the USB 2.0 protocol.

Configuration via the "Power Xpert Protection Manager" software

The USB port can be connected to a computer to configure and monitor the PXR trip unit via the Power Xpert Protection Manager software.

External power supply

The USB connection can also be used to power the trip unit from the host side of the USB cable if no other power source is available. For this purpose, a standard portable battery pack can be used, such as the power banks typically used to charge mobile phones. A nominal voltage of 5 V shall not be exceeded. Devices with 12 V or 20 V, according to USB-PD (USB Power Delivery) specification, shall not be used.This connection is intended to be used temporarily while the user configures and monitors the trip unit, activates the trip indicators after a trip, or reads the fault memory.

Table 6: Using the Micro-USB interface

	Description
Standard Micro-USB on USB-A cable	Temporary connection for using the Power Xpert Protection Manager
Standard Micro-USB power bank	To establish a temporary connection for supplying power to the trip unit if the unit is not self-supplying.

2.3 LED Status indication

Flashing

All PXR trip units have a **Status** LED for indicating the device status.

During normal operation, this indicator will flash green (approximately once per second) to indicate that the trip unit is operating normally.

The **Status** LED will flash red if the trip unit has detected an internal fault. This could be a problem with the trip actuator or trip unit, as well as firmware error or a calibration error. In this case, immediate action must be taken to remedy the fault and/or replace the unit.

For troubleshooting, also see
→ chapter 11, “Troubleshooting”, page 193.

LED does not light up

If the status indicator does not light up, either no auxiliary power is available, or the trip unit’s primary supply is insufficient. This therefore does not constitute a malfunction. The **Status** LED will flash again if the auxiliary power supply is activated, or if the load on the circuit breaker rises to a level greater than 15 %.

2.4 Trip reason indicator

PXR10

The PXR10 trip units are not equipped with any indicators.

PXR20

The PXR20 trip units are equipped with up to four trip-reason indicators at the front. These indicators are marked **LONG**, **SHORT**, **INST** and **GND**.

Table 7: PXR20 trip-reason indicators

Trip unit	LONG	SHORT	INST	GND
MX	✓	–	✓	–
VX	✓	✓	✓	–
VX-T	✓	✓	✓	✓

Once the circuit breaker has tripped, the indicator will flash permanently if auxiliary power (24 V DC power) is available. Alternatively, once the circuit breaker has tripped, a standard portable battery pack (power bank) can be used to temporarily supply auxiliary power via the Micro-USB connection of the trip unit.

The indicators and the display can be reset to the OFF position by moving the-toggle or using PXPM software to reset. If the circuit breaker does not have any auxiliary power supply, the indicators will not be active.

The tripping message will also be stored in the event log of the PXR trip unit.

The following table lists the readout reasons that the indicators are able to recognize and indicate.

Table 8: Trip-reason indicators

Indicator	Description
LONG	A overload- or overtemperature-induced shutdown has occurred.
SHORT	The short-time delayed short-circuit protection has been triggered.
INST	The instantaneous short-circuit protection has been triggered, or an inrush-current trip, a high instantaneous trip or a maintenance mode trip has occurred.
GND	An ground-fault trip has occurred.

PXR25

The PXR25 indicates the trip reason via the LCD-display.

2.5 Overload indicator

PXR10, PXR20

The PXR10 and PXR20 trip units are equipped with an orange overload LED for load and overload warnings, which are triggered at 85 % (LED on) and 105 % (LED flashing) of I_r, respectively. Once the current has dropped below the threshold again, the indicator will switch off or return to its previous state. The threshold values are fixed.

PXR25

On the PXR25 trip unit, the threshold values for load and overload warnings can be adjusted via the LCD display.

2.6 Tamper-proof cover

The NZM digital circuit breaker is equipped with a transparent plastic cover. When this cover is closed, the settings can be displayed but not changed. In order to comply with the applicable tamper-proof requirements, any unauthorized changes to the settings can be prevented by inserting a standard seal into the safety hole.

On the PXR25 trip unit, the protection settings are additionally password protected. The PXR25 trip unit cover features openings above the up and down arrow keys. This makes it possible to view the "screensaver" display and the values it depicts. The enter button cannot be pressed while the cover is closed. It is therefore not possible to switch from the screensaver to the main menu while the cover is closed.

3 Protection and measurement functions

3.1 Trip unit functions

The following table lists the available functions for the various PXR trip unit types.

Table 9: Overview of the available functions

PXR version	Release	Overload protection	Short-time delayed short-circuit protection	Instantaneous short-circuit protection	Ground-fault protection	Arc Flash Reduction Maintenance System™	ZSI zone-selective interlocking	Current measurement	THD (Total Harmonic Distortion)	Harmonic content	Data collection incl. Class 1 energy metering	USB interface	Communications enabled	Status LED	Overload LED / indicator	Trip-reason indicator	Interface module	Relay module (optional)
PXR10	-AX	✓	–	✓	–	–	–	✓	–	–	–	✓	–	✓	✓	–	–	–
PXR20	-MX	✓	–	✓	–	–	–	✓	–	–	–	✓	✓	✓	✓	✓	optional	✓
	-VX	✓	✓	✓	–	–	–	✓	–	–	–	✓	✓	✓	✓	✓	optional	✓
	-VX…-T	✓	✓	✓	✓	–	–	✓	–	–	–	✓	✓	✓	✓	✓	optional	✓
PXR25	-PX	✓	✓	✓	–	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	-PX…-TZ(TAZ)	✓	✓	✓	✓	✓[1)]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	-PMX	✓	–	✓	–	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1) NZM3 and NZM4 only

3.2 Protection functions

Table 10: Protection functions

Trip unit	Release	I_r	t_r	I_{sd}	t_{sd}	I_i	I_g	t_g
PXR10	-AX(-NA)	✓	–	–	–	✓	–	–
PXR20	-MX(-NA)	✓	✓	–	–	✓	–	–
	-VX(-NA)	✓	✓	✓	✓	✓	–	–
	-VX…-T(-NA)	✓	✓	✓	✓	✓	✓	✓
PXR25	-PX(-NA)	✓	✓	✓	✓	✓	–	–
	-PXM(-NA)	✓	✓	–	–	✓	–	–
	-PX...-TZ(TAZ)(-NA)	✓	✓	✓	✓	✓	✓	✓

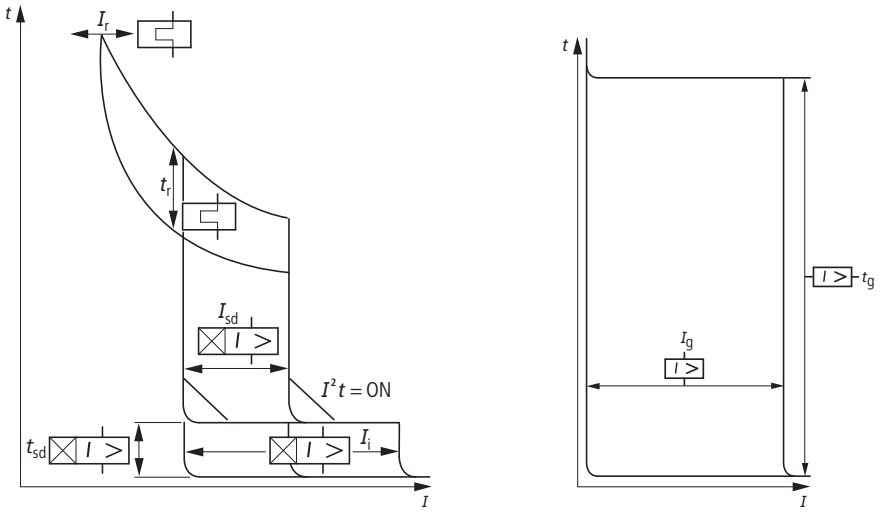


Figure 4: Main LSIG tripping characteristic

L = **l**ong delay (= overload protection I_r)
S = **s**hort delay (= short-time delayed short-circuit protection I_{sd})
I = **i**nstantaneous (= instantaneous short-circuit protection I_i)
G = **g**round fault (= ground-fault protection I_g)

→ To evaluate the tripping characteristics, please refer to the Eaton publication "Setting-specific representation of tripping characteristics and competent assessment of their interaction",

which is available for download on the Eaton website:
www.eaton.eu/ecm/groups/public/@pub/@europe/@electrical/documents/content/pct_998455_de.pdf

→ The xSpider software is available on the Eaton website at

www.xspider.eaton.eu

3.3 Measuring functions

An NZM circuit breaker with PXR trip unit can be used to measure the following values – the scope of the available measurement functions depends on the specific PXR version.

Table 11: Measurement functions of the different PXR versions

Function (value to be measured)	PXR10	PXR20	PXR25
Current	✓	✓	✓
Voltage	–	–	✓
Power	–	–	✓
Energy	–	–	✓
THD (Total harmonic distortion)	–	–	✓
Harmonic content	–	–	✓
Others (e. g. cos φ)	–	–	✓

Table 12: Current and voltage measurements

Measurement[1)]	Unit of measure	Note
Current measurement[2)]		
I_{L1}, I_{L2}, I_{L3}, I_N, I_G	A	
Minimum I_{L1}, I_{L2}, I_{L3}, I_N, I_G	A	Group values are held until reset
Maximum I_{L1}, I_{L2}, I_{L3}, I_N, I_G	A	Group values are held until reset
Voltage measurement		
V_{L1-L2}, V_{L2-L3}, V_{L3-L1}	V	Voltage phase – phase
Minimum V_{L1-L2}, V_{L2-L3}, V_{L3-L1}	V	Group values are held until reset
Maximum V_{L1-L2}, V_{L2-L3}, V_{L3-L1}	V	Group values are held until reset
V_{L1-N}, V_{L2-N}, V_{L3-N}	V	Voltage phase – neutral
Minimum V_{L1-N}, V_{L2-N}, V_{L3-N}	V	Group values are held until reset
Maximum V_{L1-N}, V_{L2-N}, V_{L3-N}	V	Group values are held until reset

1) PXR10 / PXR20: Accuracy of current measurement: 5 % valid for 40 % to 100 % of I_n.
PXR25: Accuracy of measurement: 0.5 %
Current measurement: valid for 10 % to 120 % of I_n at 25 °C (77 °F)
Voltage measurement: valid for 34 - 690 V AC at 25 °C (77 °F)

2) $I < 0.02 * I_n \rightarrow I = 0$ (PXR25) | $I < 0.05 * I_n \rightarrow I = 0$ (PXR10 / PXR20)

The current and voltage data are recorded at a frequency of 3,600 Hz. The values recorded by the measurement functions are calculated at a frequency of 1 Hz. The delay time for internal transmission of these data is approximately 250 ms in the case of Modbus, and up to several seconds in the case CAM communications. Data are transmitted during the specific time periods. CAM transmission intervals of several seconds will cause the loss of real-time data packets, depending on the CAM type. Power data (current, voltage, power) take the form of cumulative data and are thus not affected.

If the internal Modbus RTU is used, no recorded "intermediate data" is lost.

3.4 Power and energy measurements

The following power and energy values can be measured.

Table 13: Power and energy measurements

Measurement[1)]	Unit of measure	Note
Power measurement		
Active power	kW	Updated after approximately 1 second
Apparent power	kVA	Updated after approximately 1 second
Reactive power	kvar	Updated after approximately 1 second
Active power requirement	kW	Fixed window of 5 to 60 minutes
Apparent power requirement	kVA	Fixed window of 5 to 60 minutes
Reactive power requirement	kvar	Fixed window of 5 to 60 minutes
Active power requirement (peak)	kW	Value is held until reset
Apparent power requirement (peak)	kVA	Value is held until reset
Reactive power demand (peak)	kvar	Value is held until reset
Power factor	–	Updated after approximately 1 second
Energy measurement		
Active energy (forward)	kWh	From the source to the load
Active energy (reverse)	kWh	From the load to the source
Net active energy	kWh	"Active energy (forward)" - "active energy (reverse)"
Total active energy	kWh	"Active energy (forward)" + "active energy (reverse)"
Apparent energy	kVAh	
Reactive energy (forward)	kvarh	From the source to the load
Reactive energy (reverse)	kvarh	From the load to the source
Net reactive energy	kvarh	"Reactive energy (forward)" - "reactive energy (reverse)"
Total reactive energy	kvarh	"Reactive energy (forward)" + "reactive energy (reverse)"

1) Accuracy: Class 1 (derived from IEC61557-12)

The power and energy values are calculated and updated internally at a frequency of 1 Hz.

3.5 Advanced metered data specifications

In addition to the electrical system information metered for line protection, the following data is available for PXR25 trip units only. The metered data can be viewed on the display, PXPM or via communication link (→ table 25).

Table 14: Advanced metered data specifications

Measurement	Unit of measure	Note
Voltage unbalance	V	Difference between the maximum and minimum of the three voltage readings (V_{ab}, V_{bc}, V_{ca})
Current unbalance	A	Difference between the maximum and minimum of the three current readings (Ia, Ib, Ic)
Total harmonic distortion (THD)	%	Voltage, line-to-line (V_{ab}, V_{bc}, V_{ca}) Voltage, line-to-neutral (V_{an}, V_{bn}, V_{cn}) Current (Ia, Ib, Ic, In)
Harmonic content (1st through 35th at 50 Hz) (1st through 29th at 60 Hz)	%	Voltage, line-to-line (V_{ab}, V_{bc}, V_{ca}) Voltage, line-to-neutral (V_{an}, V_{bn}, V_{cn}) Current (Ia, Ib, Ic, In)

3.6 Time/current characteristics

The time/current characteristics of the PXR trip units on the NZM circuit breakers can be found in Eaton's xSpider software via the link listed below.

→ The xSpider software is available on the Eaton website at: www.xspider.eaton.eu

→ Any adjustments to the protection functions should be carried out in accordance with the recommendations of the technician responsible for installing the circuit breakers.

3.7 Voltage tap of the neutral conductor on the PXR25

If a 3-pole circuit-breaker is used in a network with neutral conductor (N-conductor), a voltage tap is necessary to ensure energy metering with maximum accuracy. The voltage tap is connected inside the circuit breaker. Should this not be carried out, the PXR trip unit will assume that the network is 100 % balanced.

If this is not carried out, deviations due to star-point shifts will impair the accuracy of the measurement function. The 3-pole PXR25 circuit breakers are equipped with a pre-configured cable that can be used to tap the voltage of the N conductor. No separate protection is required.

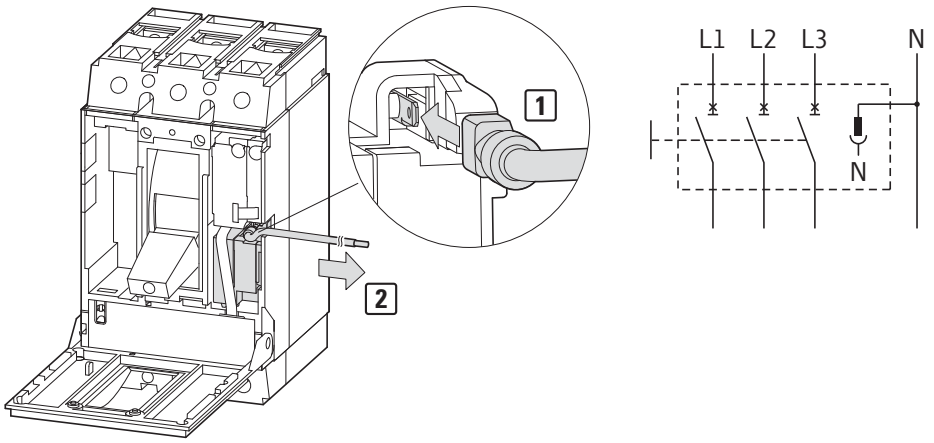


Figure 5: Connecting the N conductor on the NZM2 and NZM3

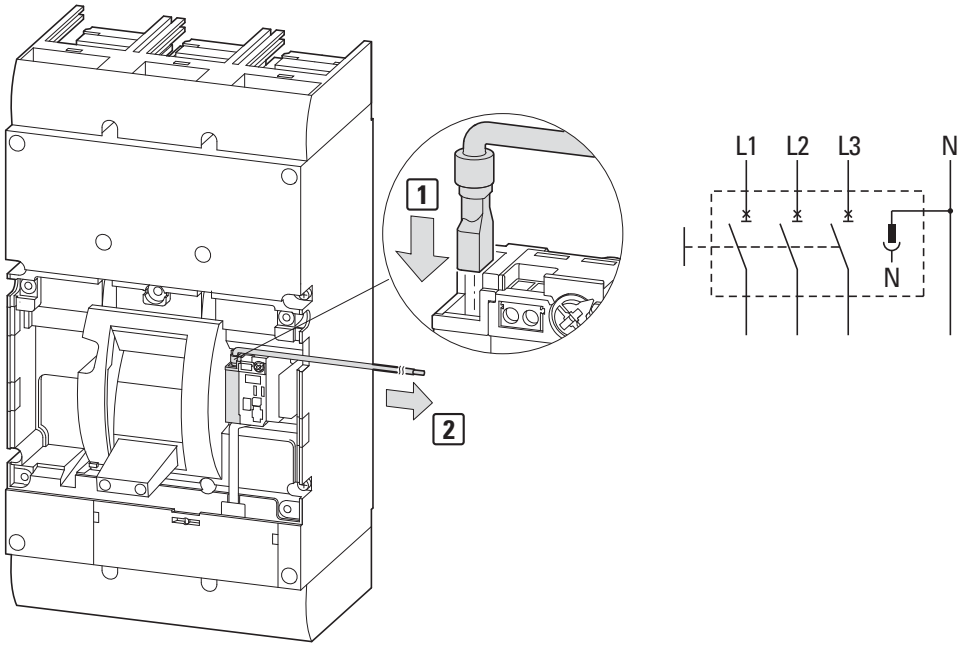


Figure 6: Connecting the N conductor on the NZM4

4 Protection settings

The protection settings of the PXR trip unit are designed so that they can be easily adapted to any application.

The following settings can be configured, independently of one another:

- Overload release I_r,
- Time lag t_r,
- Short-time delayed short-circuit release I_{sd},
- Duration of short-time delay t_{sd},
- Instantaneous trip I_i,
- Ground-fault trip I_g,
- Ground-fault delay time t_g.

The settings can be adjusted using the rotary switches (on the PXR10 and PXR20 trip units) or the display (on the PXR25 trip unit) at the front of the trip unit.
Additional options can be selected via the display (on the PXR25 trip unit only), the navigation buttons, the **Power Xpert Protection Manager** configuration software (on all PXR variants) or the communication link.

The minimum and maximum protection settings vary depending on the frame size, rated operational current and version of the trip unit.

Before putting the circuit breaker into service, the protection settings of each trip unit should be set to the values specified by the technician responsible for installing the circuit breaker.

4.1 Overload release

Each PXR trip unit offers a variety of settings for theoverload release I_r.
The settings range from 40 % to 100 % of the rated operational current I_n.

Depending on the version, the duration of the time lag t_r is up to 20 seconds. The value corresponds to the entire trip time if the current is equal to six times of I_r. The reference value for the duration is the upper end of the tolerance range. This ensures that the maximum duration is not exceeded. If the infinity setting (∞) is selected, the overload release will be deactivated.

As soon as an overload causes the circuit breaker to trip, the **LONG** indicator will light up, provided that auxiliary power is available (on the PXR20), or a message will appear on the display (on the PXR25).

4.2 Overload pre-warning

The overload pre-warning function warns of an overload tripping before it occurs. The function is similar to the thermal motor image of the PKE motor-protective circuit-breaker. With the digital NZM, however, this function is not limited to the motor protection versions. The occurring overload is evaluated and a value in the range from 0 % to 100 % is the output.
The value increases with the overload and decreases as soon as it is no longer present. If the value reaches 100 %, the breaker trips. The speed of the rising is determined by the height of the overload. If an increasing value is detected, countermeasures can be initiated by the user. The function can be read out via the communication connection, see here.

4.3 Thermal memory

In addition to the standard long-delay protection, the long-term memory function ("thermal memory") protects the load circuits against the effects of repeated overloads. The thermal memory is enabled by default and can be configured using the display and navigation buttons or the Power Xpert Protection Manager configuration software.

Example

If a circuit breaker is closed immediately after an overload trip has occurred, and the current again exceeds the threshold value of the overload protection I_r, the thermal memory will automatically reduce the trip time, as it is assumed that the temperature in the load circuit is already higher than normal due to the previous overload. Should an overload occur repeatedly, the thermal memory will trip the circuit breaker at ever shorter intervals.
As soon as the load current falls back to within its normal range, the thermal memory will start to reset. As such, the overload delay time of the next trip will again correspond to the set value. When checking the tripping characteristic, the thermal memory can be disabled in order to obtain accurate test results. It is absolutely essential to reactivate the thermal memory after the testing has been completed! This function enables the circuit breaker to protect both downstream cables (outgoing cables) and equipment as well as its own integrity against excessive heating in the event of repeated overcurrents.

4.4 Short-time delayed short-circuit release

The short-time delayed short-circuit release I_{sd} can be set to 2 to 10 times the threshold value of the overload release I_r.

The duration of the short-time delay t_{sd} is selected in together with one of two short delay slopes, "flat" or I^2t. The duration can be set to a range from 0 seconds (the minimum interval) to 1 second.

Zone selective interlocking (ZSI) may affect the trip times of the short-time delay protection function and thereby accelerate tripping.

For further information, please refer to
→ section 4.11, "Zone selective interlocking (ZSI)", page 32.

As soon as a short-time delayed overload has caused the circuit breaker to trip, the **SHORT** indicator will light up, provided that auxiliary power is available (on the PXR20), or a message will appear on the display (on the PXR25).

4.5 Instantaneous short-circuit release

The instantaneous short-circuit release I_i can be set to 2 to 18 times of the rated operational current I_n. The maximum value depends on the specific circuit breaker, its rated operational current, as well as the trip unit type. The instantaneous short-circuit protection trips the circuit breaker without any time delay.

As soon as an instantaneous short-circuit has caused the circuit breaker to trip, the **INST** indicator will light up, provided that auxiliary power is available (on the PXR20), or a message will appear on the display (on the PXR25).

4.6 Ground-fault settings

If a PXR20 or PXR25 trip unit is equipped with ground-fault protection, the characteristics (e.g. the grounding system, the number of sources, and the number and location of the ground points) of the distribution system must be taken into account, together with the manner in which the circuit breaker will be used in the system.

The versatile PXR trip unit can both detect ground-fault currents and respond to them. A ground-fault alarm ensures early warning in the event of a ground fault, while a ground-fault trip provides protection in this case.

The following three modes of operation can be selected.

Table 15: Settings ground-fault protection

Mode	Description
OFF	The ground-fault detection can be turned off by setting the rotary switch to "OFF".
ALARM	It is possible to set threshold values for alarm-only ground-fault detection. When the alarm mode is selected, threshold values can be set. This set of threshold values is marked "alarm".
TRIP	It is also possible to set threshold values for the ground-fault detection with trip. When detection and trip mode is selected, threshold values can be set. This set of threshold values is marked "trip".

The PXR trip unit allows for the selection of two different ground-fault slopes:

- Flat waveform ("flat")
- I^2t waveform.

The slope should be chosen in accordance with the individual coordination requirements. The I^2t response allows for a shorter time delay than the fixed-time response ("flat").

The time delay t_g and the slope should be selected together. If the selected response time is I^2t, this will be marked separately, while this is is not the case for the "flat" response time. Both have a range of up to 1 second.

As soon as a ground fault causes the circuit breaker to trip, the **GND** indicator will light up, provided that auxiliary power is available (on the PXR20), or a message will appear on the display (on the PXR25).

In addition to ground-fault protection, the PXR trip unit is also equipped with a ground-fault memory function (thermal memory for ground-fault protection) to protect against recurrent loads if an arc to earth occurs. Without this function, the ground-fault protection timer would be reset each time an arc is quenched, and the arc would not necessarily cause the circuit breaker to trip. The ground-fault memory function enables the trip unit to "remember" the ground-fault current. The memory will be erased with time, and the time interval corresponds to 6.25 times of the ground-fault time.

Internal current sensors are used to detect the presence of a ground fault. If the sum of the currents of the individual phases (and, if a four-pole circuit breaker is used, of the neutral conductor in a four-wire network) does not equal zero, an alarm will be triggered in line with the ground-fault protection settings. If a 3-pole circuit breaker is used in a neutral network, the neutral current will not be detected. In this case, a ground-fault trip may occur if the threshold values of the ground-fault release are exceeded.

4.7 Instantaneous release (override)

The PXR trip unit is equipped with a high instantaneous trip function that will trip the circuit breaker in line with the short-circuit rating of the circuit breaker. The function will respond to the peak current level (this is a default setting). This setting is always active, regardless of which settings have been selected for the instantaneous short-circuit protection. It is controlled by a secondary processor for redundant tripping. The **INST** indicator of the instantaneous short-circuit protection indicates this type of trip reason.

4.8 Advanced protection functions

The PXR25 trip units (only) include additional protection features, which can be used to protect equipments during certain system events, such as under/over voltage and phase current anomalies (see table Group 5: Advanced protection functions).

The protection functions have set points and/or time delays which should be matched to the specific needs of the load.

Each protection function is configured by accessing the menu system using the LCD display, Power Xpert Protection Manager configuration software or the communication link.

The protection functions can also be configured to take one of three actions:

- Trip the breaker with alarm (Trip);
- Alarm only, do not trip (Alarm);
- Be totally disabled (Off).

4.8.1 Over Voltage

Line-to-line RMS voltages (V_{ab}, V_{bc}, V_{ca}) are continuously monitored. If any line-to-line voltage is greater than the pickup setpoint for the specified time delay, the configured protection action will be taken.

4.8.2 Under Voltage

If any line-to-line voltage is less than the pickup setpoint for the specified time delay, then the configured protection action will be taken.

Setpoint ranges for under voltage and overvoltage overlap.
If both are used in an application, under voltage pickup should always be set less than over voltage pickup.
If under voltage pickup is set higher than overvoltage pickup and the breaker is closed, the trip unit will see one or both pickup conditions satisfied, it would then begin timing and trip.

4.8.3 Voltage Unbalance

If the difference between the maximum and minimum of any of the three line-to-line voltages is greater than the pickup for the specified time delay, then the configured protection action will be taken. Action will be taken only when at least one line-to-line voltage is greater than 84 V.

The calculation for the voltage unbalance pickup is:

$$\text{Pickup} = \frac{\text{Max}(V_{ab},V_{bc},V_{ca}) - \text{Min}(V_{ab},V_{bc},V_{ca})}{\text{Max}(V_{ab},V_{bc},V_{ca})} \times 100\ \%$$

4.8.4 Current Unbalance

The RMS current in each of the phases (Ia, Ib, Ic) is continuously monitored. Unbalance protection will protect against partial or full loss of one or two phases. If the difference between the maximum and minimum of any of the 3 phase currents is greater than the pickup for the specified time delay, then the configured protection action will be taken.

The Long Delay indicator on the front panel will illuminate.

The calculation for the current unbalance and phase loss pickup is:

$$\text{Pickup} = \frac{\text{Max}\,(I_{ab},I_{bc},I_{ca}) - \text{Min}(I_{ab},I_{bc},I_{ca})}{\text{Max}(I_{ab},I_{bc},I_{ca})} \times 100\ \%$$

4.8.5 Phase Loss

Phase loss protection is used for complete loss of one or two phases.
If the difference between the maximum and minimum of any of the three phase currents is greater than 75 %, for the specified time delay, then the configured protection action will be taken.

4.8.6 Phase Rotation

The phase relationship of the line-to-line voltages is continuously monitored. If the phase sequence is different from the setting, then after the fixed time delay, the configured protection action will be taken. Action will be taken only when at least one line-to-line voltage is greater than 84 V.

4.8.7 Reverse Power

The Power flowing through the breaker is continuously monitored. If the reverse real power is greater than the pickup for the specified time delay, then the protection action will be taken.

4.9 Digital bypass

Should the main processor malfunction, the secondary processor will take over at 1.2 x I_n.

If the value exceeds 1.2 x I_n, the circuit breaker will trip immediately.

4.10 Maintenance mode (Arc Flash Reduction Maintenance System™)

The PXR25 trip units support Eaton's Arc Flash Reduction Maintenance System™ (ARMS). This is also known as the maintenance mode. If enabled, the trip unit will trip the circuit breaker with no intentional delay whenever the configured threshold value is exceeded. If enabled, the maintenance mode will operate independently of the overload and short-circuit protection settings. If the maintenance mode causes the circuit breaker to trip, the message "ARMS trip" will be displayed, provided that auxiliary power is available.

The maintenance mode is configured either via the display and the navigation buttons, or via USB or the communication link. The settings allow for different protection levels.

The following settings are available:

- 2.5 x I_n
- 4 x I_n
- 6 x I_n
- 8 x I_n
- 10 x I_n

A higher protection level may be required if, for example, the circuit breaker protects another load with motors that need to be started, and which generate high inrush currents above the lowest trip-current level.

→ The reduction settings should be determined by an individual with experience in power system analysis.

The maintenance mode offers protection against arc faults with low current values, which due to impedance do not reach the threshold value of the instantaneous short-circuit release. Arc Flash Reduction Maintenance System™ will recognize these currents as an immediate danger and will switch off without any delay, thereby reducing the energy released in the event of an arc fault. This also offers effective protection for maintenance personnel in the vicinity.

Activating the maintenance mode

There are three options for activating the maintenance mode:

- locally via the display,
- remotely via a contact,
- remotely via the communication interface.

The LCD display will indicate if the function is activated, and this information can also be read out via the communication link.

To activate the maintenance mode locally, use the display and the control buttons on the trip unit. If the maintenance mode has been activated locally, remote deactivation is not possible. The maintenance mode can only be deactivated via the same channel through which it was activated (for example, locally if it was activated locally).

The maintenance mode can be activated remotely via a normally open contact (e.g. a door switch) that has been wired to the interface module of the circuit breaker.

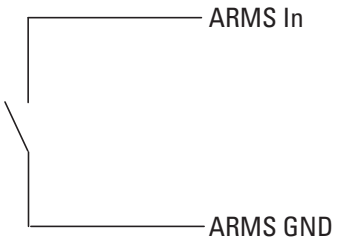


Figure 7: Arc Flash Reduction Maintenance System™ wiring

The maintenance mode can also be activated through the communication interface. This can either be done using a communication module or via the configuration software and the USB port.

If the maintenance mode is activated using one of these methods, the deactivation must also be carried out in the same way.

4.11 Zone selective interlocking (ZSI)

The ZSI function (ZSI = zone selective interlocking) can be activated or deactivated either via the navigation menu, or via the Power Xpert Protection Manager software and a communication link. The ZSI function can be used in conjunction with the short-time protection functions and the ground-fault protection. ZSI ensures that the circuit breaker trips as fast as possible in the event of any faults within its zone of protection, while also enabling safe coordination among all circuit breakers in the system (the main power supply, nodes, feeders and any downstream circuit breakers).

If ZSI is enabled, a fault within the zone of protection will immediately trip the circuit breaker and send a corresponding restraining signal to any upstream trip units to prevent them from tripping instantly. This restraining signal will cause all upstream circuit breakers to continue operating with their own coordination delays, to ensure that the supply is only interrupted locally.

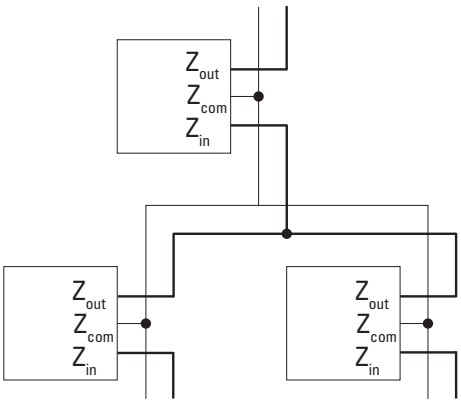


Figure 8: ZSI circuits

The ZSI function is connected to the interface module of the circuit breaker via three wires, which are marked

- Zone In (Z_{in}),
- Zone Out (Z_{out}),
- Zone Common (Z_{com}).

These signals are compatible with all Eaton circuit breakers that have the ZSI function. An output signal will be transmitted each time the ground-fault threshold or the short-time delay threshold is exceeded. This provides maximum selectivity for coordination with larger upstream circuit breakers. Depending on the application, a self-locking jumper may be required for the farthest upstream circuit breaker. If immediate tripping is desired on the last circuit breaker, the Z_{in} wire of that circuit breaker can be left open, while the Z_{out} wire then has to be connected to the Z_{in} of the next upstream circuit breaker. If a time delay is desired on the last circuit breaker, a jumper from the Z_{out} wire of that circuit breaker can be connected to the Z_{in} wire of the same breaker to provide for self-interlocking.

4.12 Event logging and waveform capture

The PXR trip unit records information about events, alarms and trips in various logs. For "ordinary" events, only the reason and a time-stamp (based on the trip unit's real-time clock) will be stored. For more "complex" events, the real-time values (currents and voltages) will additionally be stored. For the most important events, additional information, such as the current and voltage waveforms during the event, will also be stored.

Each log can store a specified number of events and is managed as a first-in-first-out (FIFO) buffer. When saving the information of the most recent event, the information of the oldest event will be deleted if the maximum number of events for the respective log has been exceeded.

Table 16: Event and log matrix

Event	Event code + time stamp	Alarm messages	Tripping	Waveform capture	Alarm waveform	Trip waveform	Note
	200	10	10	1	1	6	quantity stored
User-initiated capture				✓			Initiated via USB or network
Start up - status OK	✓						
Start up - status incorrect	✓						
Event - download setpoints	✓						
Event - enter test mode	✓						
Event - exit test mode	✓						
Event - test complete	✓						
Event - enter maintenance mode	✓						
Event - exit maintenance mode	✓						
Event - opened via communications	✓						Open/trip command via communication channel
Event - closed via communications	✓						
Event - time change (if > 60 seconds)	✓						Previous time is recorded
Alarm - calibration	✓	✓					
Alarm - setpoint fault	✓	✓					
Alarm - low control voltage	✓	✓					
Alarm - RTC error	✓	✓					
Alarm - NV memory error	✓	✓					
Alarm - watchdog timer	✓	✓					
Alarm - overload release (test mode)	✓	✓					
Alarm - ground fault (test mode)	✓	✓					
Alarm - trip-actuator fault	✓	✓					
Alarm - residual life	✓	✓					
Alarm - overload release	✓	✓			✓		
Alarm - ground fault	✓	✓			✓		
Alarm - mechanical error	✓	✓			✓		
Alarm - high load	✓	✓			✓		
Trip - overtemperature	✓		✓				
Trip - making-current release	✓		✓				
Trip - test	✓		✓				
Trip - overload protection	✓		✓			✓	
Trip - short-time delayed	✓		✓			✓	
Trip - instantaneous	✓		✓			✓	
Trip - ground fault	✓		✓			✓	
Trip - maintenance mode	✓		✓			✓	
Trip - neutral conductor	✓		✓			✓	

Table 17: Event codes

Event code and time stamp	Logged event

Alarm snapshot or trip-snapshot	• Current:
	  • I_{L1} (IA)
	  • I_{L2} (IB)
	  • I_{L3} (IC)
	  • I_G (IG)
	  • I_N (IN)
	• Voltage (only on the PXR25):
	  • U_{L1-L2} (VAB)
	  • U_{L2-L3} (VBC)
	  • U_{L3-L1} (VCA)
	  • U_{L1-N} (VAN)
	  • U_{L2-N} (VBN)
	  • U_{L3-N} (VCN)
	• Power: W, var, VA (only on the PXR25)
	• Energy: Wh, Varh, VAh (only on the PXR25)
	• Frequency
	• Power factor
	• Operations counter

User waveform or alarm waveform	Waveform of:
	  • I_{L1} (IA)
	  • I_{L2} (IB)
	  • I_{L3} (IC)
	  • I_G (IG)
	  • I_N (IN)
	Waveform (only on the PXR25) of:
	  • U_{L1-L2} (VAB)
	  • U_{L2-L3} (VBC)
	  • U_{L3-L1} (VCA)
	  • U_{L1-N} (VAN)
	  • U_{L2-N} (VBN)
	  • U_{L3-N} (VCN)
	1 cycle (64 data points)

Trip waveform	Waveform of:
	  • I_{L1} (IA)
	  • I_{L2} (IB)
	  • I_{L3} (IC)
	  • I_G (IG)
	  • I_N (IN)
	Waveform (only on the PXR25) of:
	  • U_{L1-L2} (VAB)
	  • U_{L2-L3} (VBC)
	  • U_{L3-L1} (VCA)
	  • U_{L1-N} (VAN)
	  • U_{L2-N} (VBN)
	  • U_{L3-N} (VCN)
	6 cycles (384 data points)

→ To use event logging in all operating states, an external power supply is required.

4.13 Residual-life indicator

Figure 9: Residual-life indicator ("residual life")

The NZM digital circuit breaker (with PXR25) contains a residual-life indicator ("residual life"), which indicates the degree of wear on the contact system. This is determined by the number of operations and the loads that occur in the process. Residual life is expressed as a percentage. From a starting value of 100 % it decreases with every operation.

CAUTION

If the residual-life indicator reaches a value below 25 %, we recommend replacing the device during the next maintenance interval of the machine or system.

In this condition, the device will still be able to carry the rated operational current and can safely switch off at least one further overcurrent.

→ To use the residual-life indicator in all operating states, an external power supply is required.

→ If you have any questions or feedback regarding the residual-life indicator, please contact your local Eaton technical support.

5 Communication functions

The circuit breakers with PXR trip units may be used with an internal Modbus RTU module for serial communication.
Additionally an external communication adapter module (ECAM) may also be used to convert Modbus RTU into industrial ethernet based protocols. In order for the communication function to be enabled, the communication modules need to be connected via the interface module.

In the case of the PXR25 trip units, the interface module is included as standard. In the case of the PXR20 trip units, an interface module can be optionally installed.

→ It is not possible to use an interface module with the PXR10 trip units.

5.1 Integrated Modbus communication module

An integrated Modbus communication module is available as an optional accessory for the PXR20 and PXR25 trip units. This Modbus module also has to be connected to the interface module. The trip unit will respond to messages from the Modbus master using the RTU (remote terminal unit) protocol via an RS485 connection. The Modbus port can be configured using the display and the navigation keys, or using the Power Xpert Protection Manager software.

Table 18: Modbus default settings

	Default settings (as delivered)	**Options**
Slave address	002	001 - 247
Baud rate	19,200 bit/s	• 9,600 bit/s • 19,200 bit/s • 38,400 bit/s • 57,600 bit/s
Parity	even	• even • odd • no parity
Number of stop bits	1	• 1 • 2

The trip unit uses Modbus function codes 02, 03, 04, 06, 08, and 16 and supports up to 122 registers (244 bytes) in a single Modbus transaction.

→ For a detailed overview of all Modbus registers, see → chapter 9, "Modbus RTU – integrated Modbus port specification", page 53.

The integrated Modbus communication module is a CISPR11, class A equipment.

> *CAUTION*
>
> This product has been designed for environment A.
> Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.

5.2 External communication adapter modules

Circuit breakers with PXR20 or PXR25 trip units are designed for flexible and modular systems that include communication adapter modules (CAMs). These modules allow the trip unit to communicate with a fieldbus network.

The following modules support different networks.

Table 19: Communication adapter modules

Protocol	Module / connection cable	Instruction leaflet
EtherNet/IP™	PXR-ECAM-IP	IL012384ZU
EtherCAT®	PXR-ECAM-ECT	IL012384ZU
PROFINET	PXR-ECAM-PNET	IL012384ZU
SmartWire-DT	PXR-RCAM-SWD	IL050032ZU

The modules are mounted in a decentralized manner on a DIN rail and wired to the PXR trip unit via the internal communication module (PXR-RCAM-MRTU-I) of the circuit breaker. The fieldbus is wired to a Modbus RTU interface on the module.

→ See also manual MN05006001Z (“SmartWire-DT® modules”).

6 System components

6.1 External power supply

The auxiliary power supply to the PXR trip unit enables its full functionality, even if the circuit breaker is open, or if the circuit breaker is operating with a load that is so low (less than 15 % of I_n) that the current transformers are unable to provide sufficient power for the trip unit's own power supply.

An external power supply is required for the following functions:

- Communication link,
- Relay module functionality,
- Residual-life indicator (only on the PXR25)
- Event logging

The auxiliary power supply has to be connected to the interface module of the circuit breaker.

The current protection functions do not require any auxiliary power supply.

Table 20: External power supply requirements

	Value
Rated control voltage U_s	24 V DC
Tolerance	±20 %
Maximum current consumption	0.1 A
Fuse protection	2 A

6.2 Electromagnetic compatibility

The electromagnetic compatibility of electronic components in circuit-breakers is certified according to the product standard IEC/EN60947-2.

The configurations tested are standard configurations of typical applications. However, in practical applications, electromagnetic interferences cannot be completely excluded under worst case conditions. In such critical applications, the immunity of switch gear and control gear can be further improved. EATON recommends in such critical applications the use of a snap-on ferrite (e.g. type WE 74271132 by Würth Electronic). The ferrite should be installed on the external 24 V DC power line in close proximity to the circuit-breaker.

6.3 Real-time clock

The PXR trip unit is equipped with an integrated real-time clock for displaying the year, month, day, day of the week, hour, minute and second.
This clock can be set and read using the Power Xpert Protection Manager (→ section 6.4, "Power Xpert Protection Manager (PXPM)") or any of the communication channels, as well as via the display (in the case of the PXR25 trip unit). The clock makes it possible to add a time stamp to events that are recorded in the historical memory.

CAUTION

The real-time clock is not backed by a battery!
It thus needs to be permanently connected to the external 24 V DC power supply.
Should this power supply be interrupted, the real-time clock has to be set up again.

6.4 Power Xpert Protection Manager (PXPM)

Eaton's free **Power Xpert Protection Manager** (**PXPM**) is a Microsoft® Windows-based software for configuring, controlling and testing the Eaton PXR trip units.

It enables users to create, modify and save the configurations of PXR trip units. The software also makes it possible to reset the trip units, set the date and time, and record the current or voltage waveforms. In addition, tripping tests can also be performed via the PXPM. Some feature of the software may require to obtain a license.

→ The Power Xpert Protection Manager (PXPM) can be downloaded free of charge via the following link:

www.eaton.com/PXPM

7 Auxiliary wiring terminals

7.1 Interface module

Table 21: Presence and installation of the interface module

Trip unit	NZM2(3)(4)-XBSM… interface module
PXR10	the interface module cannot be installed!
PXR20	installation is optional
PXR25	included as standard

The interface module offers various connections and functions.
The number of connections varies depending on the version of the module. Please note that for all circuit breakers with PXR technology, the appropriate modules must be installed, otherwise the full range of circuit-breaker functions cannot be used. The circuit breakers for which each module can be used are outlined in the data sheet of the respective interface module, as well as on the relevant catalogue page (in the form of an overview).

Although the interface module provides the status information, it has to be transferred via communication link or through the relay modules.

The interface module has the following functions and connections, which are illustrated below using three versions as examples:

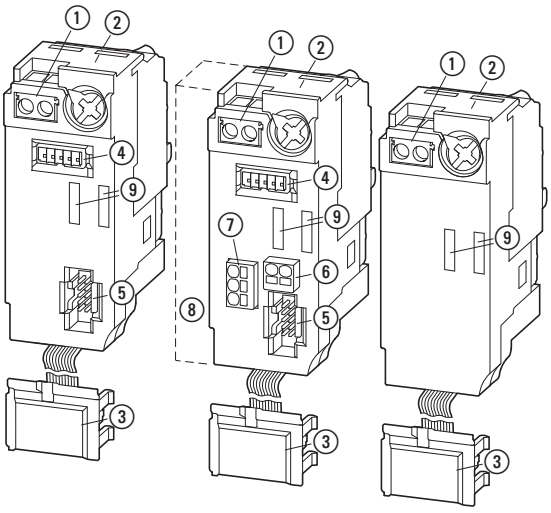


Figure 10: Functions and connections

① 24 V DC terminal (±10 %)
② Detection of the breaker status (I, +, O)
③ Connection to the trip unit
④ CAM connection (not used by PXR-ECAM-PNET, PXR-ECAM-IP, PXR-ECAM-ECT or PXR-RCAM-SWD)
⑤ Connection to the internal communication module
⑥ Arc Flash Reduction Maintenance System™ remote switching (only on the NZM3 and the NZM4)
⑦ ZSI connection
⑧ VN connection for the voltage tap of the neutral conductor (only on the NZM4)
⑨ Status indication of the remote operator

Replacing the interface module

The interface module, which is pre-installed in all PXR25 trip units, rarely needs to be replaced. For all PXR20 devices, the interface module is an optional accessory that is required, among other things, for connecting a communication module. On PXR20 devices it can also be retrofitted.

Voltage tap for the neutral conductor

The VN connection is located on the side of the interface module (only on the 3-pole NZM4 circuit breakers with energy metering (PXR25)). On the 3-pole NZM4 circuit breakers with energy metering (PXR25), the VN module, which occupies slot HIA 4.1, is already pre-installed. The voltage tap for the neutral connector is connected at the VN module. This is necessary to ensure measurements with maximum accuracy. Otherwise the electronic trip unit will not be "familiar" with the star point of the system. The VN module contains a chain of resistors that is calibrated to the overall system.

When replacing the interface module of a 3-pole NZM4 circuit breaker with energy metering (PXR25), do not remove or replace the VN module. It may be removed briefly to replace an old interface module and must then be reinstalled together with the new interface module, → section 3.7, "Voltage tap of the neutral conductor on the PXR25", page 24.

The PXR20 trip units do not have a voltage tap for the neutral conductor, as they do not measure the voltage.

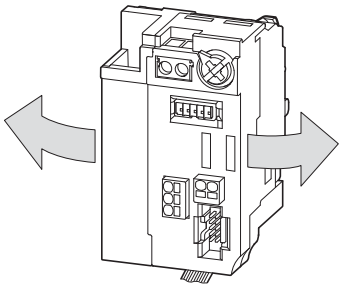


Figure 11: Removing the interface module

7.2 Relay module

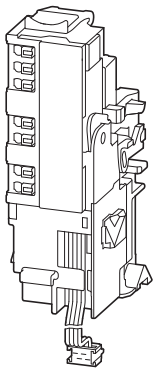


Figure 12: Relay module

The relay module is an optional accessory for circuit breakers with PXR trip unit and is equipped with two relay outputs for command and signaling purposes.

Use of the relay module requires the interface module and a 24VDC power supply. The two relays can be configured via PXR trip unit display, communication link or Power Xpert Protection Manager software.

The relays can be set to respond to various alarm or trip conditions. It is also possible to control them automatically or manually via the communication link. For example a downstream contactor can be "dropped" in order to prevent the circuit breaker from tripping in the event of a slight overload.

The relay functions are dependent on the trip unit variant, meaning that certain functions may or may not be available depending on the trip unit type (→ table 21).

Table 22: Relay configuration

Value	Function	Indication on the display (only on PXR25)	Description
0x0000	Relay OFF		This setting deactivates the relay.
0x0001	Overload release	(0 -> 1): trip - overload (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to an overload. This includes tripping due to the overload characteristic or to excessive temperature. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0002	Neutral conductor trip	(0 -> 1): trip - neutral (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to a neutral conductor trip. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0003	Short-circuit trip	(0 -> 1): trip - short circuit (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to a short circuit. This includes short-time delayed tripping, instantaneous tripping or an override. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0004	Short-time delayed trip	(0 -> 1): trip - short-time delayed (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to a short-time delayed short circuit. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0005	Instantaneous trip	(0 -> 1): trip - instantaneous (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to an instantaneous short circuit. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0006	Ground-fault trip	(0 -> 1): trip - ground fault (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to a ground fault. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0007	Trip due to maintenance mode[1)]	(0 -> 1): trip - Arc Flash Reduction Maintenance System™ (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped due to maintenance mode. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0008	General trip alarm Default setting for relay 1 – for breakers without maintenance mode	(0 -> 1): trip - general trip (1 -> 0): status - device has been reset	The relay will respond if the breaker has tripped (trip reasons 4-10). The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0009	Over Voltage - Trip[1)]	(0 -> 1): trip - Over Voltage (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to an over voltage occurrence, which is greater than the pickup value and longer than the pickup time[2)]. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x000A	Under Voltage - Trip[1)]	(0 -> 1): trip - Under Voltage (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to an under voltage occurrence, which is less than the pickup value and longer than the pickup time[2)]. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.

Value	Function	Indication on the display (only on PXR25)	Description
0x000B	Voltage Unbalance - Trip[1)]	(0 -> 1): trip - Voltage unbalance (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to an unbalanced voltage occurrence (i.e. difference between max and min voltages of all three phases is greater than pickup value, lasting longer than the pickup time[2)]. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x000C	Current Unbalance Trip[1)]	(0 -> 1): trip - Current unbalance (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to an unbalanced current occurrence (i.e. difference between max and min currents of all three phases is greater than pickup value lasting longer than the pickup time[2)]. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x000D	Reverse Power Trip[1)]	(0 -> 1): trip - Reverse power (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to a reverse power occurrence, which is greater than the pickup value and longer than the pickup time[2)]. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x000E	Phase Reversed - Trip[1)]	(0 -> 1): trip - Phase reversed (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to a reversed phase occurrence, which lasted longer than 200 ms[2)]. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x000F	Phase Loss - Trip[1)]	(0 -> 1): trip - Phase loss (1 -> 0): status - device has been reset	The relay will respond if the breaker trips due to a phase loss occurrence (i.e. voltage measurement is greater than 75 % of other phases and lasts longer than the pickup time[2)]). The relay will drop out once the device has been reset or a reset command has been issued via the communication interface.
0x0020	Standard auxiliary contact (HIN)	(0 -> 1): status: device is closed (1 -> 0): status - device is open	The relay will respond if the circuit breaker is in the “closed” contactor state. The contactor states “open” and “tripped” will cause the relay to drop out.
0x0021	Trip-indicating auxiliary switch (HIA)	(0 -> 1): status - device has tripped (1 -> 0): status - device has been reset	The relay will respond if the circuit breaker is in the “tripped” contactor state. Once this is no longer the case, the relay will drop out.
0x0022	Maintenance mode active Default setting for relay 1 – for breakers with maintenance mode	(0 -> 1): safety - maintenance mode is active (1 -> 0): safety - maintenance mode is not active	The relay will respond if the maintenance mode has been activated. The relay will drop out if the maintenance mode has been deactivated.
0x0023	Zone selective interlocking is operational	(0 -> 1): safety - ZSI is active (1 -> 0): safety - ZSI is not active	The relay will respond if zone selective interlocking has been activated (is operational). The relay will drop out if zone selective interlocking has been deactivated.

Value	Function	Indication on the display (only on PXR25)	Description
0x0024	ZSI input signal has been received	(0 -> 1): safety - ZSI input is active (1 -> 0): safety - ZSI input is not active	The relay will respond if the Zin input of zone selective interlocking is active. The subordinate switch will receive a blocking signal. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface. This function can be used to check the ZSI functionality.
0x0025	ZSI output signal has been sent	(0 -> 1): safety - ZSI output is active (1 -> 0): safety - ZSI ouput is not active	The relay will respond if the Zout output of zone selective interlocking is active. This breaker will send a blocking signal. The relay will drop out once the device has been reset or a reset command has been issued via the communication interface. This function can be used to check the ZSI functionality.
0x0028	Relay controls	(0 -> 1): controls - relay is active (1 -> 0): controls - relay is not active	The relay will respond if the trip unit has received the command “close relay” via the communication interface. The relay will drop out if it has received the command “open relay” via the communication interface, or if the external power supply of the breaker has been interrupted.
0x0040	Load alarm 1 Default setting for relay 2 – for breakers without ground-fault protection	(0 -> 1): alarm - load is active (1 -> 0): alarm - load is not active	The relay will respond if load alarm 1 is active. The alarm can be set to between 50 % and 120 % of I_r for motor protection PXR25 trip unit (PMX) and 50 % - 130 % for PXR25 trip unit PX. Load alarm 1 must be set equal or lower than load alarm 2. The relay will drop out again with a hysteresis of 5 % below the set threshold value. Default settings: 85 % (fixed for PXR20)
0x0041	Load alarm 2	(0 -> 1): alarm - overload is active (1 -> 0): alarm - overload is not active	The relay will respond if load alarm 2 is active. The alarm can be set to between 50 % and 120 % of I_r for motor protection PXR25 trip unit PMX and 50 % - 130 % for PXR25 trip unit PX. Load alarm 2 must be set higher than load alarm 1. The relay will drop out again with a hysteresis of 5 % below the set threshold value. Default settings: 105 % (fixed for PXR20)
0x0042	Overtemperature	(0 -> 1): alarm - overtemperature is active (1 -> 0): alarm - overtemperature is not active	The relay will respond if the internal circuit breaker temperature is too high. The relay will respond at 5 °C below the threshold of the overtemperature release. The relay will drop out again with a hysteresis of 5 °C.
0x0043	Ground-fault pre-alarm Default setting for relay 2 – for breakers with ground-fault protection	(0 -> 1): alarm - ground fault is active (1 -> 0): alarm - ground fault is not active	The relay will respond if the adjustable threshold value of between 50 % and 100 % of I_g is exceeded. If the setting “ground-fault alarm” has been selected, the threshold will be set to 100 % of I_g. The relay will drop out again with a hysteresis of 5 %. Default settings: 75 %
0x0044	Thermal memory (trip is imminent)	(0 -> 1): alarm - thermal memory full (75 %) (1 -> 0): alarm - thermal memory normal	The relay will respond if the thermal memory of the breaker is 75 % full. The relay will drop out again with a hysteresis of 5 %.

Value	Function	Indication on the display (only on PXR25)	Description
0x0045	Watchdog	(0 -> 1): alarm - watchdog is active (1 -> 0): alarm - watchdog is not active	The relay will respond if an external power supply is available and the trip unit is functioning normally. The relay will drop out if a fault has occurred that can be detected by the trip unit's internal diagnostics. If the external power supply is interrupted, the relay will also drop out.
0x0047	Internal error	(0 -> 1): alarm - internal error has been detected (1 -> 0): alarm - internal error has been reset	The relay will respond if a fault has occurred that can be detected by the trip unit's internal diagnostics. The relay will drop out, either if the device has been reset, or a reset command has been sent via the communication interface, provided that the fault is no longer present.
0x0048	Settings error	(0 -> 1): alarm - settings error has been detected (1 -> 0): alarm - settings error has been reset	The relay will respond, if a settings error has been detected.
0x0049	Low residual life	(0 -> 1): alarm - residual life is less than x % (adjustable threshold)	The relay will respond if an adjustable threshold value of between 0 % and 50 % of residual life is exceeded (default value: 25 %)
0x004A	Communication error	(0 -> 1): alarm - communication error (1 -> 0): alarm - communication error has been reset	The relay will respond, if an external communication error has been detected. The relay will open if the device has been reset, or a reset command has been sent via the communication interface. If the error continues to persist, the relay will again respond. **Note:** Detects only external communication errors. Internal communication errors are covered by position 18.
0x004B	General alarm	(0 -> 1): alarm - general alarm (1 -> 0): alarm - general alarm has been reset	The relay will respond in the event of an alarm (alarm reasons 12 to 22). The relay will drop out once the alarm is no longer active.
0x004C	Over Voltage - Alarm[1)]	(0 -> 1): alarm - over voltage is active (1 -> 0): alarm - over voltage is not active	The relay will respond in the event of an over voltage alarm. The alarm is triggered by an over voltage occurrence, which is greater than the pickup value and longer than the pickup time[2)]. The relay will drop out once the voltage falls below the setpoint (alarm is no longer active). (see table XX: Group 5).
0x004D	Under Voltage - Alarm[1)]	(1 -> 0): alarm - under voltage is not active	The relay will respond in the event of an under voltage alarm. The alarm is triggered by an under voltage occurrence, which is less than the pickup value and longer than the pickup time[2)]. The relay will drop out once the voltage rises above the setpoint (alarm is no longer active).
0x004E	Voltage Unbalance - Alarm[1)]	(0 -> 1): alarm -Voltage Unbalance is active (1 -> 0): alarm - Voltage Unbalance is not active	The relay will respond in the event of a Voltage Unbalance alarm. The alarm is triggered by an unbalanced voltage occurrence (i.e. difference between max and min voltages of all three phases is greater than pickup value, lasting longer than the pickup time[2)]). The relay will drop out once min and max voltage difference are within setpoint (alarm is no longer active).

Value	Function	Indication on the display (only on PXR25)	Description
0x004F	Current Unbalance - Alarm[1)]	(0 -> 1): alarm -Current Unbalance is active (1 -> 0): alarm - Current Unbalance is not active	The relay will respond in the event of a Current Unbalance alarm. The alarm is triggered by an unbalanced current occurrence (i.e. difference between max and min currents of all three phases is greater than pickup value, lasting longer than the pickup time[2)]). The relay will drop out once min and max current difference is within setpoint (alarm is no longer active).
0x0050	Reverse Power - Alarm[1)]	(0 -> 1): alarm - Reverse Power is active (1 -> 0): alarm - Reverse Power is not active	The relay will respond in the event of a Reverse Power alarm. The alarm is triggered by a reversed power occurrence, which is greater than the pickup value and longer than the pickup time[2)]. The relay will drop out once reverse power is less than the pickup value (alarm is no longer active).
0x0051	Phase Rotation - Alarm[1)]	(0 -> 1): alarm - Phase Rotation is active (1 -> 0): alarm - Phase Rotation is not active	The relay will respond in the event of a Phase Reversed alarm. The alarm is triggered by a reversed phase occurrence lasting longer than 200 ms[2)]. The relay will drop out once phase sequence is corrected. (alarm is no longer active).
0x0052	Phase Loss - Alarm[1)]	(0 -> 1): alarm - Phase Loss is active (1 -> 0): alarm - Phase Loss is not active	The relay will respond in the event of a Phase Loss alarm. The alarm is triggered when a phase voltage measurement is less than 75 % of other phases for longer than pickup time[2)]. The relay will drop out once phase loss has been restored (alarm is no longer active).

1) Function is not supported by PXR20!
2) See → table 29.

8 Testing the trip unit and the circuit breaker

Testing should be carried out prior to commissioning if the circuit breaker is located in a de-energized system or in a system with withdrawable or plug-in mechanism, and is in the TEST POSITION, DISCONNECTED or WITHDRAWN.

→ Since the time-current settings form the basis for the desired system coordination and protection schemes, the protection settings, if altered during a test sequence, must be reset to their as-found conditions.

WARNING

Do not attempt to install, test, or perform maintenance on the equipment while it is energized.
Direct contact with live parts may result in immediate death or serious injury.
De-energize the circuit and disconnect the circuit breaker before performing any maintenance work or testing. Follow the five safety rules!

CAUTION

Once the device has tripped, the power supply will be interrupted, which may result in unnecessary switching operations of subordinate devices. Testing may be carried out even if the circuit breaker is energized and in service.
Testing that will result in the tripping of the circuit breaker should only be carried out with the circuit breaker in the test or disconnected positions or while the circuit breaker is on a test bench. The system will prevent a test if more than 5 % of the rated current I_n is detected.

A password is required to prevent any unauthorized access that may cause the circuit breaker to trip.

→ **Password:**
The default password is 0000.
This can be changed in the device settings.

8.1 Testing (remote) of the circuit-breaker via USB/PXPM

The protection function uses the **Power Xpert Protection Manager** software to control the testing via the USB communication.

The test mode of the PXPM software allows users to start the trip test, to monitor the process and to record the results. The test results can be printed out and saved in PDF format.

The PXR trip unit has four built in test modes available for use, which are functional test (secondary injection and simulated), current sensor continuity test and open breaker. Secondary injection test can be configured to optionally open the breaker.

Both functional tests, secondary injection and simulated, as well as current sensor continuity require a paid license. A trial of five tests is offered with the free version of the software.

8.1.1 Functional Test – Secondary Injection (License Required)

Secondary injection utilizes a separate circuit that injects a signal in parallel with the output of the current sensor, representing the output of the sensor. All the built-in protection circuitry, and routines respond per the settings in the breaker. The PXPM software initiates the testing of long delay trip, short delay trip, instantaneous trip, maintenance mode, and ground (earth) fault trip via the USB communication. The software allows for testing on any phase, including neutral. The trip unit's display, or communications can be used to observe the current being injected, and the elapsed time until trip.
Complete testing of the trip unit can be accomplished when a current sensor continuity test is used in conjunction with secondary injection test.
The complete testing of the breaker may be an acceptable alternative to a primary injection test of the breaker. Secondary injection testing and current sensor continuity testing when used in place of primary injection testing will result in less wear on the breaker.

Tip: If the trip unit is equipped with ground fault protection, and another function is being tested, temporarily turn off the ground fault functionality in the settings of the trip unit. Failure to do so may result in unintentional ground trip during testing. Remember to turn it back on after completing the testing.

8.1.2 Functional Test – Simulated (License Required)

Simulated functional testing sets values within the trip unit to the level desired via PXPM. Simulation can be helpful to verify various points on the time current curve, and operation of the breaker based on different situations. Simulation mode is also helpful for verifying correct communications settings, and scaling when used in conjunction with an operator interface, PLC, SCADA, or other devices that are reading the real-time data from the PXR trip unit.

8.1.3 Current Sensor Continuity Test (License Required)

The current sensor test utilizes a separate circuit to create a signal that is directed through the Rogowski coil. This signal will verify continuity and functionality of the Rogowski coil.

8.1.4 Open Breaker Test

The open breaker test will exercise the electrical and mechanical hardware required to physically open the breaker.

8.2 Testing the ground-fault releases - primary injection

Most local and national building codes require that all ground fault protection systems be subjected to performance testing when first installed.
Such testing must be performed in accordance with the applicable local and national regulations.

You can also use the **Power Xpert Protection Manager** software to save and print a copy of the circuit-breaker settings for your testing records.

8.3 Testing

When beginning a test session, parameter values for "As Found" are captured. Selecting various test options, setting the current to be injected, executing the tests, and recording the results can be done in multiple passes within one test session. Parameter values for "As Left" are captured when the test operation is stopped. Any difference between "As Found" and "As Left" parameter values will be highlighted.

The Generate Report function will record the testing results in a PDF file. The user can input information regarding the customer and breaker's location, environment, condition, etc. as part of the report. The report includes the settings and results of all tests run during that session.

9 Modbus RTU – integrated Modbus port specification

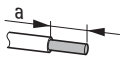
The internal Modbus communication module is an optional accessory for digital NZM circuit breakers with PXR technology.

This module enables the communication between the release and a Modbus RTU fieldbus.

If supplied with a voltage of 24 V DC, the trip unit can communicate as a slave device via the Modbus A, Modbus B and Modbus COM contacts.

The Modbus cable has to comply with the following specifications:

- at least one pair of twisted wires (signal cable Modbus A, Modbus B)
- at least one ground wire (Modbus COM)
- HF-compatible shielding (including HF-compatible grounding)
- compatibility with the respective environmental conditions (temperature, humidity, chemical resistance, etc.)
- The cross section of the wire is as follows:

	**a = 6 mm (a = 0.24 ″)**
	0.15 - 0.5 mm^2 AWG26 - AWG20
	0.20 - 0.5 mm^2 AWG26 - AWG20
	0.25- 0.5 mm^2 AWG26 - AWG21
	2.0 x 0.4 mm

The wiring is done as follows:

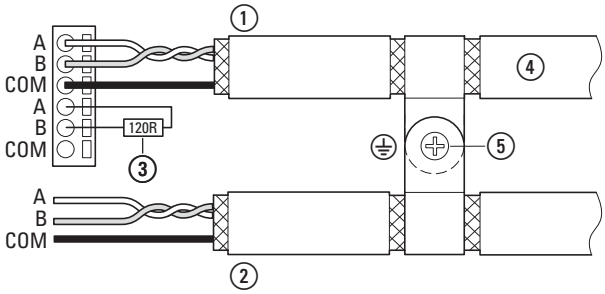


Figure 13: Wiring

① Modbus RTU input cable
② Modbus RTU output cable
③ Bus termination resistor (for the final node)
④ Modbus RTU-compatible cable: triple wire; two twisted signal wires; one shielded COM wire
⑤ HF-compatible functional grounding

9.1 Indication/configuration of the Modbus parameters

The **Power Xpert Protection Manager** software and the Modbus communication link can be used to display and configure the setpoints of the Modbus module via USB commands on the LCD display.

The Modbus communication settings are stored in registers 404000 to 404003 and can be read by means of the function codes 03 or 04, as listed in → table 23. The Modbus settings can be changed by writing these four registers one after the other with function code 06. If the data written in these registers are outside the range, the trip unit will return the exception code 03.

Table 23: Modbus settings

Setting value	Modbus register number	Data range
Slave ID	404000	001 - 247 (default setting: 2)
Baud rate	404001	00: 9,600 bit/s 01: 19,200 bit/s (= default setting) 02: 38,400 bit/s 03: 57,600 bit/s
Parity	404002	00: none 01: odd 02: even (= default setting)
Stop bit	404003	00: 1 bit (= default setting) 01: 2 bits

9.2 Network communication protocol

- The release will only recognize the Modbus RTU communication module.
- The trip unit is able to support a maximum of 122 registers (244 data bytes) in a single Modbus transaction.
- The release will only react to a limited number of Modbus function codes. These are function codes 02, 03, 04, 06, 08 and 16. Function codes 03 and 04 are used interchangeably to obtain register data.

For further information on Modbus RTU protocol please consult the following website:

https://modbus.org/specs.php

9.3 Modbus register map

- There are seven different release types in the NZM digital circuit breaker family. As a result, the devices access the registers differently, since not all versions support all functions.
- Release type -AX does not support an internal Modbus connection; register access is therefore not possible.
- Release types -VX...-T and -PX...-TZ and -TAZ support the ground-fault protection function. For these types, the ground-fault setpoints of group 1 (ground current I_g) can be accessed in the real-time data.
- Release types -PX, -PMX, -PX...TZ and -PX...-TAZ support voltage measurement and are thus equipped for extended measurement data. For these types, the voltage-related objects (voltage, power, energy, and the power factor), as well as advanced data measurement (voltage/current unbalance, THD and harmonic content) can be used in the real-time data.
- Release type -PX...-TAZ supports the maintenance mode. For this type, the maintenance mode setpoints can be accessed in group 0 and in the "Remote Control" group.

9.3.1 Input status (discrete inputs)

The input status bits 101001 to 101032 can be accessed via function code 02. The statuses are defined in → table 24.

The first 16 bits (1001 to 1016) indicate the current status, while the last 16 bits (1017 to 1032) indicate whether the corresponding status is valid.

Table 24: Input status

Input	Description or value	Input	Description or value
1001	The breaker is in the closed position	1017	The breaker is in the closed position and is valid
1002	Unacknowledged trip condition	1018	Unacknowledged trip condition is valid
1003	Active or unacknowledged alarm	1019	Active or unacknowledged alarm is valid
1004	0	1020	0
1005	Maintenance mode is active	1021	Maintenance mode is active and valid
1006	Test mode is active	1022	Test mode is active and valid
1007	0	1023	0
1008	0	1024	0
1009	Clockwise phase sequence (ABC)	1025	Clockwise phase sequence (ABC) is valid
1010	Overload mode is active (an overload is present)	1026	Overload mode is active and valid (an overload is present)
1011	Zone selectivity (ZSI) is active	1027	Zone selectivity (ZSI) is active and valid
1012	0	1028	0
1013	Ground-fault protection type is “source ground”	1029	Ground-fault protection type is “source ground” and valid
1014	0	1030	0
1015	0	1031	0
1016	0	1032	0

9.3.2 Real-time data object register

Data that are subject to real-time changes, such as current, voltage and power, are displayed in → table 25.

Real-time data can be obtained either in IEEE floating-point or fixed-point format. For data displayed in fixed-point format, each result is presented as a multiplication of the real-time data with a scaling factor. Energy objects can only be obtained in fixed-point format (FP).

Registers for which the IEEE floating-point value is not specified are only supported in fixed-point format.

Each data object occupies two registers (4 bytes), with the exception of certain energy objects. These energy objects in question occupy four registers (8 bytes), indicated as Signed 64 or Unsigned 64 (format column). As these objects can be changed in real time, the complete data object must be obtained in a single transaction to avoid any “data cracks”. Any attempt to access a partial data object will return the exception code 04.

Register numbers 404609 and 404610 must also be obtained in a single transaction. Any attempt to access one single register (among these two) will return the exception code 04.

For more information on the exception codes, see → section 9.3.13, "Exception codes", page 96.

Table 25: Real-time data register

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
404609	406145	0x1200	0x1800	Cause of status (→ table 38, → table 39): High byte = primary status Low byte = secondary status	–	Encoded	–	Yes	Yes
404611	406147	0x1202	0x1802	I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
404613	406149	0x1204	0x1804	I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
404615	406151	0x1206	0x1806	I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
404617	406153	0x1208	0x1808	I_G (IG)	A	Unsigned 32	10	Yes	Yes
404619	406155	0x120A	0x180A	I_N (IN)	A	Unsigned 32	10	Yes	Yes
404623	406159	0x120E	0x180E	U_{L1-L2} (VAB)	V	Unsigned 32	10	–	Yes
404625	406161	0x1210	0x1810	U_{L2-L3} (VBC)	V	Unsigned 32	10	–	Yes
404627	406163	0x1212	0x1812	U_{L3-L1} (VCA)	V	Unsigned 32	10	–	Yes
404631	406167	0x1216	0x1816	U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
404633	406169	0x1218	0x1818	U_{L2-N} (VBN)	V	Unsigned 32	10	–	Yes
404635	406171	0x121A	0x181A	U_{L3-N} (VCN)	V	Unsigned 32	10	–	Yes
404651	406187	0x122A	0x182A	Active 3-phase power	W	Signed 32	1	–	Yes
404653	406189	0x122C	0x182C	Reactive 3-phase power	Var	Signed 32	1	–	Yes
404655	406191	0x122E	0x182E	Apparent 3-phase power	VA	Unsigned 32	1	–	Yes
404659	406195	0x1232	0x1832	Power factor	–	Signed 32	100	–	Yes
404661	406197	0x1234	0x1834	Frequency	Hz	Unsigned 16	10	–	Yes
404697	406233	0x1258	0x1858	Peak active power demand	W	Signed 32	1	–	Yes
404719	406255	0x126E	0x186E	Product ID	–	Unsigned 32	–	Yes	Yes
404721	406257	0x1270	0x1870	Frequency	Hz	Unsigned 16	100	–	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
–	406259	–	0x1872	Active energy (forward)	kWh	Unsigned 32	1	–	Yes
–	406261	–	0x1874	Active energy (reverse)	kWh	Unsigned 32	1	–	Yes
–	406263	–	0x1876	Active energy combined (= forward + reverse)	kWh	Unsigned 32	1	–	Yes
–	406271	–	0x187E	Apparent energy	kVAh	Unsigned 32	1	–	Yes
–	406305	–	0x18A0	Active energy (forward)	Wh	Unsigned 64	1	–	Yes
–	406309	–	0x18A4	Active energy (reverse)	Wh	Unsigned 64	1	–	Yes
–	406313	–	0x18A8	Active energy combined (= forward + reverse)	Wh	Signed 64	1	–	Yes
–	406329	–	0x18B8	Apparent energy	VAh	Unsigned 64	1	–	Yes
404797	406333	0x12BC	0x18BC	Peak reactive power demand	Var	Signed 32	1	–	Yes
404799	406335	0x12BE	0x18BE	Peak apparent power demand	VA	Unsigned 32	1	–	Yes
404845	406381	0x12EC	0x18EC	Active power demand	W	Signed 32	1	–	Yes
404847	406383	0x12EE	0x18EE	Reactive power demand	Var	Signed 32	1	–	Yes
404849	406385	0x12F0	0x18F0	Apparent power demand	VA	Unsigned 32	1	–	Yes
404851	406387	0x12F2	0x18F2	Minimum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
404853	406389	0x12F4	0x18F4	Maximum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
404855	406391	0x12F6	0x18F6	Minimum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
404857	406393	0x12F8	0x18F8	Maximum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
404859	406395	0x12FA	0x18FA	Minimum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
404861	406397	0x12FC	0x18FC	Maximum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
404863	406399	0x12FE	0x18FE	Minimum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
404865	406401	0x1300	0x1900	Maximum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
404867	406403	0x1302	0x1902	Minimum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
404869	406405	0x1304	0x1904	Maximum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
404871	406407	0x1306	0x1906	Minimum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
404873	406409	0x1308	0x1908	Maximum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
404875	406411	0x130A	0x190A	Minimum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
404877	406413	0x130C	0x190C	Maximum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
404879	406415	0x130E	0x190E	Minimum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
404881	406417	0x1310	0x1910	Maximum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
404883	406419	0x1312	0x1912	Minimum value - UL1-N (VAN)	V	Unsigned 32	10	–	Yes
404885	406421	0x1314	0x1914	Maximum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
404887	406423	0x1316	0x1916	Minimum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
404889	406425	0x1318	0x1918	Maximum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
404891	406427	0x131A	0x191A	Minimum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
404893	406429	0x131C	0x191C	Maximum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
404895	406431	0x131E	0x191E	Overload pre-warning	%	Unsigned 32	1	–	Yes
404911	406447	0x132E	0x192E	Current phase unbalance	%	Unsigned 32	100	–	Yes
404913	406449	0x1330	0x1930	Voltage phase unbalance	%	Unsigned 32	100	–	Yes
404915	406451	0x1332	0x1932	THD % value - I_{L1} (IA)	%	Unsigned 32	100	–	Yes
404917	406453	0x1334	0x1934	THD % value - I_{L2} (IB)	%	Unsigned 32	100	–	Yes
404919	406455	0x1336	0x1936	THD % value - I_{L3} (IC)	%	Unsigned 32	100	–	Yes
404923	406459	0x133A	0x193A	THD % value - I_N (IN)	%	Unsigned 32	100	–	Yes
404925	406461	0x133C	0x193C	THD % value - U_{L1} (VA)	%	Unsigned 32	100	–	Yes
404927	406463	0x133E	0x193E	THD % value - U_{L2} (VB)	%	Unsigned 32	100	–	Yes
404929	406465	0x1340	0x1940	THD % value - U_{L3} (VC)	%	Unsigned 32	100	–	Yes
404931	406467	0x1342	0x1942	THD % value - U_{L1-N} (VAN)	%	Unsigned 32	100	–	Yes
404933	406469	0x1344	0x1944	THD % value - U_{L2-N} (VBN)	%	Unsigned 32	100	–	Yes
404935	406471	0x1346	0x1946	THD % value - U_{L3-N} (VCN)	%	Unsigned 32	100	–	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
404955	406491	0x135A	0x195A	PXR state flag1 Bit 0: USB cable connected Bit 1: Breaker is ON (HIN) Bit 2: Breaker is Tripped (HIA) Bit 3: Maintenance mode activated via ARMS wiring on interface module Bit 4: Maintenance mode activated via any communication link Bit 5: N/A Bit 6: Maintenance mode activated Bit 7: Auxiliar supply connected to BSM	–	Unsigned 16	1	–	Yes
404959	406495	0x135E	0x195E	Counter - I_{sd}, I_i tripping	–	Unsigned 16	1	Yes	Yes
404961	406497	0x1360	0x1960	Counter - I_r, I_g tripping	–	Unsigned 16	1	Yes	Yes
404963	406499	0x1362	0x1962	Operations counter	–	Unsigned 16	1	Yes	Yes
404965	406501	0x1364	0x1964	Counter - I_{sd} tripping	–	Unsigned 16	1	Yes	Yes
404967	406503	0x1366	0x1966	Counter - I_i tripping	–	Unsigned 16	1	Yes	Yes
404969	406505	0x1368	0x1968	Counter - bypass tripping	–	Unsigned 16	1	Yes	Yes
404971	406507	0x136A	0x196A	Counter - I_r tripping	–	Unsigned 16	1	Yes	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
404973	406509	0x136C	0x196C	Counter - I_g tripping	–	Unsigned 16	1	Yes	Yes
404975	406511	0x136E	0x196E	Counter - trips total	–	Unsigned 16	1	Yes	Yes
404977	406513	0x1370	0x1970	Counter - test mode tripping	–	Unsigned 16	1	Yes	Yes
404979	406515	0x1372	0x1972	Counter - number of openings via the communication interface	–	Unsigned 16	1	Yes	Yes
404981	406517	0x1374	0x1974	Counter - external actuation[1)]	–	Unsigned 16	1	Yes	Yes
404983	406519	0x1376	0x1976	Time of last actuation (year, month, day, hour, minute, second)	–	Unsigned 16	–	Yes	Yes
405009	406545	0x1390	0x1990	Operating time[2)] in minutes	min	Unsigned 16	1	Yes	Yes
405011	406547	0x1392	0x1992	Operating time[2)] in hours	h	Unsigned 16	1	Yes	Yes
405013	406549	0x1394	0x1994	Operating time[2)] in days	d	Unsigned 16	1	Yes	Yes
405015	406551	0x1396	0x1996	Residual life[3)]	points	Unsigned 16	–	Yes	Yes
405025	406561	0x13A0	0x19A0	Harmonics are for: 0 - I_{L1} (IA) 1 - I_{L2} (IB) 2 - I_{L3} (IC) 4 - I_N (IN) 5 - U_{L1} (VA) 6 - U_{L2} (VB) 7 - U_{L3} (VC) 8 - U_{L1-N} (VAN) 9 - U_{L2-N} (VBN) 10 - U_{L3-N} (VCN)	–	Unsigned 16	1	–	Yes
405027	406563	0x13A2	0x19A2	Item harmonics [0]	%	Unsigned 16	100	–	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
405029	406565	0x13A4	0x19A4	Item harmonics [1]	%	Unsigned 16	100	–	Yes
405031	406567	0x13A6	0x19A6	Item harmonics [2]	%	Unsigned 16	100	–	Yes
405033	406569	0x13A8	0x19A8	Item harmonics [3]	%	Unsigned 16	100	–	Yes
405035	406571	0x13AA	0x19AA	Item harmonics [4]	%	Unsigned 16	100	–	Yes
405037	406573	0x13AC	0x19AC	Item harmonics [5]	%	Unsigned 16	100	–	Yes
405039	406575	0x13AE	0x19AE	Item harmonics [6]	%	Unsigned 16	100	–	Yes
405041	406577	0x13B0	0x19B0	Item harmonics [7]	%	Unsigned 16	100	–	Yes
405043	406579	0x13B2	0x19B2	Item harmonics [8]	%	Unsigned 16	100	–	Yes
405045	406581	0x13B4	0x19B4	Item harmonics [9]	%	Unsigned 16	100	–	Yes
405047	406583	0x13B6	0x19B6	Item harmonics [10]	%	Unsigned 16	100	–	Yes
405049	406585	0x13B8	0x19B8	Item harmonics [11]	%	Unsigned 16	100	–	Yes
405051	406587	0x13BA	0x19BA	Item harmonics [12]	%	Unsigned 16	100	–	Yes
405053	406589	0x13BC	0x19BC	Item harmonics [13]	%	Unsigned 16	100	–	Yes
405055	406591	0x13BE	0x19BE	Item harmonics [14]	%	Unsigned 16	100	–	Yes
405057	406593	0x13C0	0x19C0	Item harmonics [15]	%	Unsigned 16	100	–	Yes
405059	406595	0x13C2	0x19C2	Item harmonics [16]	%	Unsigned 16	100	–	Yes
405061	406597	0x13C4	0x19C4	Item harmonics [17]	%	Unsigned 16	100	–	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
405063	406599	0x13C6	0x19C6	Item harmonics [18]	%	Unsigned 16	100	–	Yes
405065	406601	0x13C8	0x19C8	Item harmonics [19]	%	Unsigned 16	100	–	Yes
405067	406603	0x13CA	0x19CA	Item harmonics [20]	%	Unsigned 16	100	–	Yes
405069	406605	0x13CC	0x19CC	Item harmonics [21]	%	Unsigned 16	100	–	Yes
405071	406607	0x13CE	0x19CE	Item harmonics [22]	%	Unsigned 16	100	–	Yes
405073	406609	0x13D0	0x19D0	Item harmonics [23]	%	Unsigned 16	100	–	Yes
405075	406611	0x13D2	0x19D2	Item harmonics [24]	%	Unsigned 16	100	–	Yes
405077	406613	0x13D4	0x19D4	Item harmonics [25]	%	Unsigned 16	100	–	Yes
405079	406615	0x13D6	0x19D6	Item harmonics [26]	%	Unsigned 16	100	–	Yes
405081	406617	0x13D8	0x19D8	Item harmonics [27]	%	Unsigned 16	100	–	Yes
405083	406619	0x13DA	0x19DA	Item harmonics [28]	%	Unsigned 16	100	–	Yes
405085	406621	0x13DC	0x19DC	Item harmonics [29]	%	Unsigned 16	100	–	Yes
405087	406623	0x13DE	0x19DE	Item harmonics [30]	%	Unsigned 16	100	–	Yes
405089	406625	0x13E0	0x19E0	Item harmonics [31]	%	Unsigned 16	100	–	Yes

Register number		Modbus address [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
405091	406627	0x13E2	0x19E2	Item harmonics [32]	%	Unsigned 16	100	–	Yes
405093	406629	0x13E4	0x19E4	Item harmonics [33]	%	Unsigned 16	100	–	Yes
405095	406631	0x13E6	0x19E6	Item harmonics [34]	%	Unsigned 16	100	–	Yes

Power objects are presented as fixed-point values in either the two-register fixed-point data format or the four-register coding format.
The two-register format is displayed in kilowatt hours.

The structure of the four-register format and the calculation of the energy values are outlined below.

Energy register 0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 1 of the mantissa								Byte 0 of the mantissa							

Energy register 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 3 of the mantissa								Byte 2 of the mantissa							

Energy register 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 5 of the mantissa								Byte 4 of the mantissa							

Energy register 3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
a = technical unit								b = mantissa factor							

The energy value (four-register energy value) is calculated as follows:

$$\text{Energy} = 2^{a} \times \text{48-bit energy value} \times 10^{b}$$

9.3.3 Set points registers

The set points registers are arranged in four groups (groups 0, 1, 2 and 5).

Each group can be conceived as a binary array of information that is obtained by accessing the Modbus register. Register 403001 is a R/W register that is used to select the respective group (default: group 0). The high byte contains the desired group number, while the low byte must contain the value 255 (0x0FF). The setting register can be read out with function codes 03 or 04. Function code 06 can be used to write to register 403001. For trip units that support settings, the settings of groups 0, 1, 2 and 5 should be written one after the other using function code 06. Before reading or writing the settings, the appropriate group should be selected by writing to register 403001. Prior to writing the settings, the correct password must be entered, and the settings have to be written within 10 seconds of the password check.

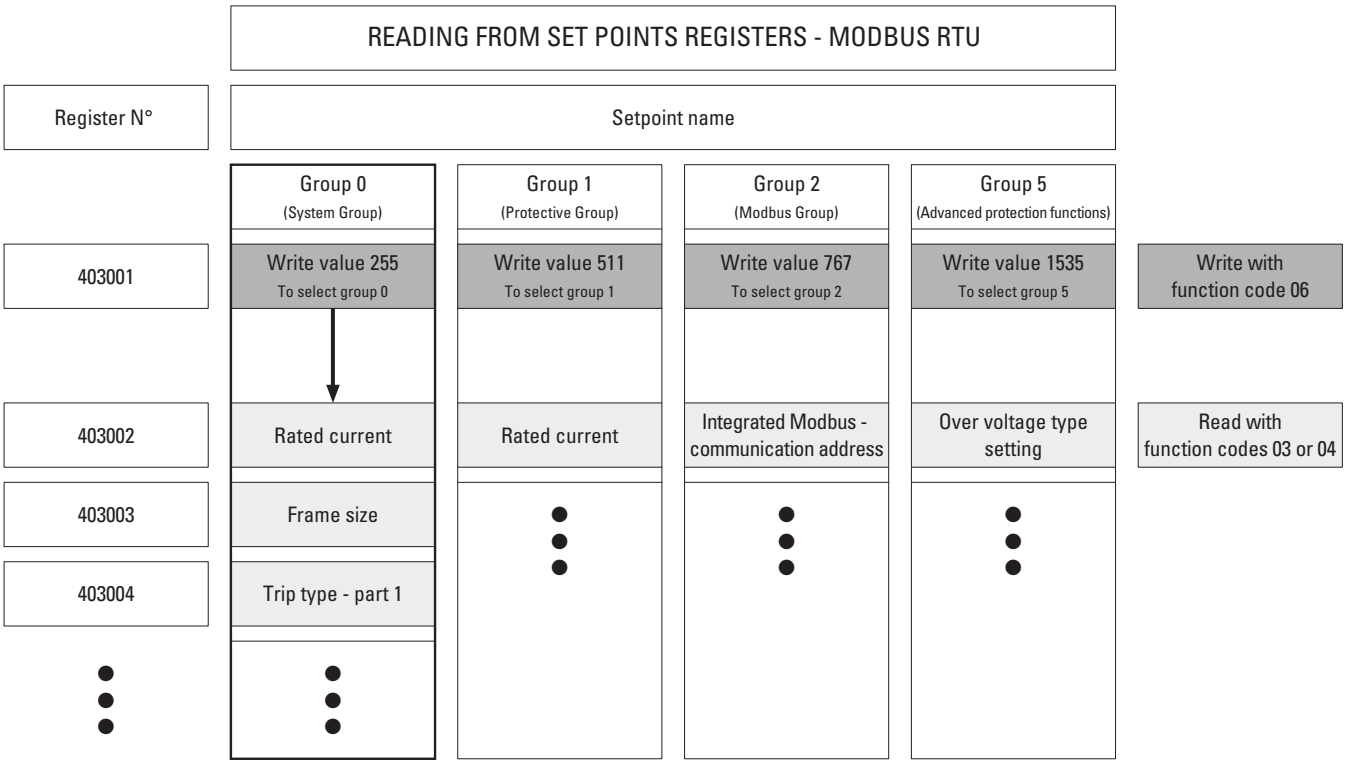


Figure 14: Reading from set points registers – Modbus RTU

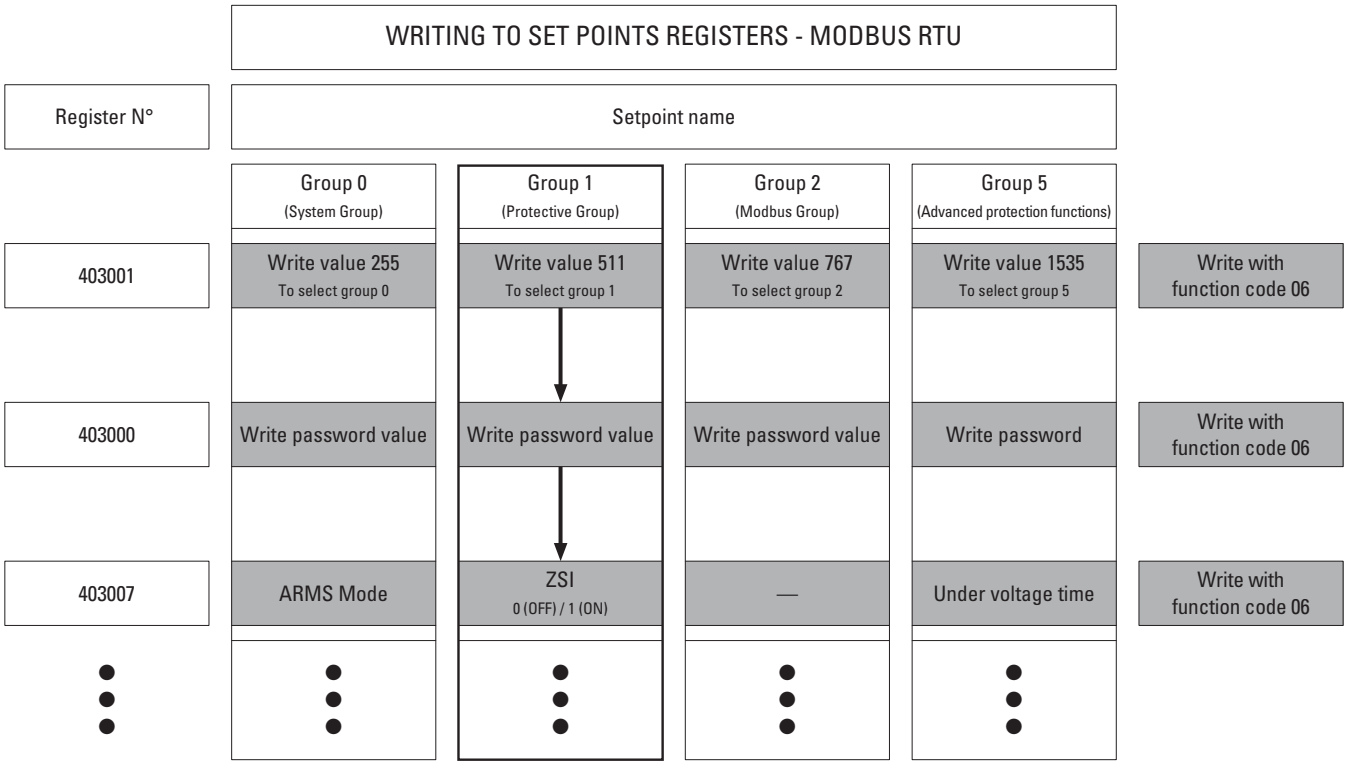


Figure 15: Writing to set points registers – Modbus RTU

The setting groups are assigned as follows:

- Group 0: System group
- Group 1: Protective group
- Group 2: Modbus group
- Group 5: Advanced protection functions

Table 26: Setting group 0: "System group" – Modbus RTU

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403000	0x0BB7	15 - 0		Password	W	–	0000 (default setting)	–
403001	0x0BB8	15 - 0	0xFFFFFF	Group 0 = system	R/W		0x00FF	–
403002	0x0BB9	12 - 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
403003	0x0BBA	2 - 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
403004	0x0BBB	3 - 0	0x000F	Trip type version – part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short-circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403005	0x0BBC			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	–
403006	0x0BBD	8	0x0100	Maintenance mode: state	R	Encoded	0: off 1: on	–
		BBE	0x0001	Maintenance mode: remote control	R/W	Encoded	0: off 1: on	–
403007[1)]	0x0BBE	2 - 0	0x0007	Maintenance mode: Trip setting	R/W	Encoded	1: 2.5 x I_n 2: 4 x I_n 3: 6 x I_n 4: 8 x I_n 5: 10 x I_n[2)]	A
403009[1)]	0x0BC0	0	0x0001	Direction of incoming supply	R/W	Encoded	0: forward 1: reverse **Note:** only available on the PXR25	
403010[1)]	0x0BC1	0	0x0001	Sign convention	R/W	Encoded	Sign convention: 0: IEC 1: IEEE 2: IEEE old	
403011[1)]	0x0BC2			Power demand window	R/W	Encoded	Power demand: 0: fixed 1: sliding	
403012[1)]	0x0BC3			Power demand interval	R/W	Encoded	Power demand: 5 - 60 min (1 min increments)	
403015	0x0BC6			Configuration of relay 1	R/W	Encoded	Configuration of relay 1 and relay 2: → table 22, page 44	
403016	0x0BC7			Configuration of relay 2	R/W	Encoded		
403018[1)]	0x0BC9			Phase sequence – phase L1 (A)	R/W	Encoded	Phase L1 (A) 0: counterclockwise 1: clockwise	
403021[1)]	0x0BCC		0xBCC	Alarm - Residual Life	R/W	Encoded	Range: 50 - 100, step size 1, default value: 75 Alarm level value 100 ≙ 0 % residual life Alarm level value 75 ≙ 25 % residual life Formula for conversion: Alarm level expressed as a percentage = 100 - point value	

1) PXR25 only!
2) For 630 A and 600 A frame size 3 breakers, maximum trip setting is 8 x I_n.

In setting group 0, the maintenance mode setting (register 403006) can be divided into two parts. The high byte is read only, and is used for the status indication of the maintenance mode, the comprehensive results of the maintenance mode rotary switch, the secondary terminal, and the communication settings. The low byte can be configured and is used to indicate the maintenance mode settings via the communication port (e.g. Modbus, ECAM or USB).

The respective protection settings may vary according to the size, type and rated operational current of the release.

Table 27: Setting group 1: "protection group" – Modbus RTU

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403000	0x0BB7	15 – 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
403001	0x0BB8	15 – 0	0xFFFFFF	Group 1 = protection	R/W	–	0x01FF	–
403002	0x0BB9	12 – 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
403003	0x0BBA	2 – 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
403004	0x0BBB	3 – 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short-circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 4-pole device = 1 3-pole device = 0 Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
403005	0x0BBC			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403006	0x0BBD	0	0x0001	Thermal memory (overload protection)	R/W	Encoded	Activates/deactivates the thermal memory of the overload protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. Reactivate the thermal memory after testing: 0: switched off 1: switched on	–
403007	0x0BBE	0	0x0001	ZSI	R/W	Encoded	ZSI, zone-selectivity: If enabled for releases with ground-fault protection, ZSI is implemented for both the short-time delayed short-circuit release and for ground-fault protection. If enabled for releases without ground-fault protection, ZSI is only implemented for the short-time delayed short-circuit release. 0: switched off 1: switched on	–
403008	0x0BBF	0 – 1	0x0003	Overload release - waveform	R/W	Encoded	Waveform of the overload release 2: I^2t (default setting)	–

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403009	0x0BC0			Settings - overload release (I_r)	R/W	Unsigned 16	Settings – overload (I_r = x * I_n): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 40: 0.4 45: 0.45 50: 0.5 55: 0.55 60: 0.6 65: 0.65 70: 0.7 75: 0.75 80: 0.8 85: 0.85 90: 0.9 95: 0.95 100: 1.0 The following applies to the NZM PXR25: General value range: 20 - 1600 (in increments of 1 (1 A)) **Caution:** The value range depends on the type: (e.g. a 250-A switch can be set in the range from 40 % to 100 % of I_n (value range: 100 - 250)	A
403010	0x0BC1			Settings - overload delay time (t_r)	R/W	Unsigned 16	Settings - overload delay time (t_r = x [s]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 40: 4 50: 5 60: 6 70: 7 80: 8 100: 10 120: 12 140: 14 160: 16 180: 18 200: 20 32767: ∞ (overload protection deactivated)	s

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403011[1)]	0x0BC2			Load alarm 1	R/W	Unsigned 16	Load alarm 1 level (AL1 = n % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 1 must be set equal or lower than load alarm 2. 85 % fixed value for PXR20 trip units	%
403012	0x0BC3	0	0x0001	Short-time delayed short-circuit release - waveform	R/W	Encoded	Waveform of the short-time delayed short-circuit release 0: flat (default setting) 1: I^2t	–
403013	0x0BC4			Settings - short-time delayed short-circuit release (I_{sd})	R/W	Unsigned 16	Settings – short-time delayed short-circuit release (I_{sd} = n x I_r): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2.0 30: 3.0 40: 4.0 50: 5.0 60: 6.0 65: 6.5 70: 7.0 75: 7.5 80: 8.0 85: 8.5 90: 9.0 95: 9.5 100: 10.0 The following applies to the NZM PXR25: The value range [20 - 100] corresponds to 2 to 10, in increments of 0.1 (1 for values)	A

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403014	0x0BC5			Settings - delay time of the short-time delayed short-circuit release (t_{sd})	R/W	Unsigned 16	Settings - delay time of the short-time delayed short-circuit release (t_{sd} = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 100] corresponds to 0 to 1,000 ms.	ms
403015	0x0BC6			Settings - instantaneous short-circuit release (I_i)	R/W	Unsigned 16	Settings - instantaneous short-circuit release (I_i = n x I_n) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 30: 3 40: 4 50: 5 60: 6 70: 7 80: 8 90: 9 100: 10 110: 11 120: 12 140: 14 160: 16 180: 18 The following applies to the NZM PXR25: The value range [20 - 180] corresponds to 2 to 18, in increments of 0.1 (1 for values)	A
403016	0x0BC7	0	0x0001	Type of ground-fault detection	R	Unsigned 16	Type of ground-fault detection: 0: differential current detection	–
403017	0x0BC8	0 – 1	0x0003	Settings - functioning of the ground-fault protection	R/W	Encoded	Type of ground-fault protection 0: trip 1: alarm 2: OFF	–

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403018	0x0BC9	0	0x0001	ground-fault release - waveform	R/W	Encoded	ground-fault release - waveform: 0: flat 1: I^2t	–
403019	0x0BCA			Settings - ground-fault release (I_g)	R/W	Unsigned 16	Settings - ground-fault release ($I_g = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 0.2 30: 0.3 40: 0.4 60: 0.6 80: 0.8 100: 1.0 The following applies to the NZM PXR25: The value range [20 - 100] corresponds to 0.2 to 1.0, in increments of 0.1 (10 for values)	A
403020	0x0BCB			Settings - delay time of the ground-fault release (t_g)	R/W	Unsigned 16	Settings – delay time of the ground-fault release ($t_g = x$ [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 1000] corresponds to 0 to 1,000 ms.	ms
403021	0x0BCC			Thermal memory (ground-fault protection)	R/W	Encoded	Activates/deactivates the thermal memory of the ground-fault protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. Must be reactivated after testing! 0: switched off 1: switched on	–

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403022	0x0BCD			Settings - neutral protection	R/W	Unsigned 16	Adjusts the neutral protection of an NZM PXR25 breaker with a "/VAR" variably adjustable neutral conductor 0 = 0 % 60 = 60 % 100 = 100 % (default setting) The lower setting affects the LSI protection functions of the switch, but not the ground-fault protection function ("G"). **Note:** L = **l**ong delay (= overload protection I_r) S = **s**hort delay (= short-time delayed short-circuit protection I_{sd}) I = **i**nstantaneous (= instantaneous short-circuit protection I_i) G = **g**round fault (= ground fault protection I_g)	%
403023[1)]	0x0BCE			Load alarm 2	R/W	Unsigned 16	Load alarm 2 level (AL2 = x % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 2 must be set higher than load alarm 1. 105 % fixed value for PXR20 trip units	%
403024	0x0BCF			Pre-alarm of the ground-fault release	R/W	Encoded	If the ground-fault protection function is set to "trip" (see register 403017), a pre-alarm can also be set. ($GF_{pre\text{-}alarm}$ = x % x I_g) 50 - 100 (in increments of 5 %)	%

1) Function is not supported by PXR20!

Table 28: Setting group 2: "Modbus" group – Modbus RTU

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Value	Unit
403000	0x0BB7	15 - 0	0xFFFF	Password	W	Encoded	0000 (default setting)	–
403001	0x0BB8	15 - 0	0xFFFF	Group 2 = on-board Modbus	R/W	Encoded	0x02FF	–
403002	0x0BB9	15 - 0		Integrated Modbus - communication address	R/W	Encoded	001 - 247 (default setting 002)	–
403003	0x0BBA	15 - 0		Integrated Modbus - baud rate	R/W	Encoded	00: 9,600 bit/s 01: 19,200 bit/s (default setting) 02: 38,400 bit/s 02: 57,600 bit/s	–
403004	0x0BBB	15 - 0		Integrated Modbus - parity	R/W	Encoded	00: none 01: odd 02: even (default setting)	–
403005	0x0BBC	15 - 0		Integrated Modbus - stop bit	R/W	Encoded	00: 1 bit (default setting) 01: 2 bits	–

Table 29: Setting goup 5: Advanced protection functions[1)] – Modbus RTU

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403000	0x0BB7	15 – 0		Password	W	Encoded	0000 (default setting)	–
403001	0x0BB8		0xFFFFFF	Group 5: Advanced protection functions[1)]	R/W	Encoded	0x05FF	–
403002	0x0BB9	1 – 0		Over voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
403003	0x0BBA			Over voltage pickup	R/W	Unsigned	180 - 850 (in increments of 1 V)	V
403004	0x0BBB			Over voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
403005	0x0BBC	1 – 0		Undervoltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
403006	0x0BBD			Undervoltage pickup	R/W	Unsigned	60 - 690 (in increments of 1 V)	V
403007	0x0BBE			Undervoltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
403008	0x0BBF	1 – 0		Voltage unbalance type setting	R/W		0 = Trip 1 = Alarm 2 = OFF	–

Register number	Modbus Address [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
403009	0x0BC0			Voltage unbalance pickup	R/W	Unsigned	Voltage unbalance level = n % x Max line-to-line voltage 5 - 25 (in increments of 1 %)	%
403010	0x0BC1			Voltage unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
403011	0x0BC2	1 – 0		Current unbalance type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
403012	0x0BC3			Current unbalance pickup	R/W	Unsigned	Current unbalance level = n % x Max IL 5 - 25 (in increments of 1 %)	%
403013	0x0BC4			Current unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
403014	0x0BC5	1 – 0		Reverse power type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
403015	0x0BC6			Reverse power pickup	R/W	Unsigned	1 - 65,500 (in increments of 1 kW)	kW
403016	0x0BC7			Reverse power time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
403017	0x0BC8	0		Phase rotation sensing type	R/W	Encoded	0 = ABC (-NA breakers) / 0 = 123 (IEC breakers) 1 = CBA (-NA breakers) / 0 = 321 (IEC breakers)	–
403018	0x0BC9	1 – 0		Phase rotation type settting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
403019	0x0BCA	1 – 0		Phase loss type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
403020	0x0BCB			Phase loss time	R/W	Unsigned	1 - 240 (in increments of 1 s)	s

1) PXR25 only!

9.3.4 Event logs

A trip event provides historical values for the data objects at time the event occurred. The trip unit classifies the event information in order to be able to provide a different quantity for each type. The Modbus communication can only access the historical summary, as well as the trip and event data.

Table 30: Event classification

Event type	Quantity of numbers stored	Description of the event log
Summary	200	→ table 31
Tripping	10	→ table 32
Alarms	10	→ table 32 and → table 33

A single trip may be registered under multiple event types. For example, a protective trip may be recorded in the summary log (→ table 31) as well as in the trip log (→ table 32).

Event information is accessed by selecting the event type and the event ID. Register 408193 is a R/W register for selecting the event type and must be written with function codes 06 or 16. The event information can be read with function codes 03 or 04.

If the event type selection is written to register 408193, the first and last event ID can be retrieved from registers 408194 and 408196, respectively, in order to determine the range of events that have been stored for the selected event type. Register 408198 is a R/W register for selecting the ID of the event in question and must be written with function code 16. If the requested event has been recorded by the device, registers 408200 and 408202 will supply both the ID of the previous event and that of the next event. After writing to register 408198, register 408212 should be read in order to determine which type of event should be requested. If the device has not recorded the event in question, it will return the exception code 135.

The date and time at which the requested event occurred are read in logs 408204 to 408211, with the same date and time description as in → table 35, page 77. This value corresponds to the time at which the historical event occurred.

Log 408212 indicates the data content of the selected event type. This is a constant value for the three event types supported by the Modbus port.

The event data also provide a validity bit for each data object, starting with register 408213. If bit 0 is set to 1, the initial data will be valid for the current trip type, bit 1 for the second data object, bit 2 for the third data object, and so forth.

The number of valid bit registers is calculated as:
(number of data objects - 1)/16

The following registers are assigned to the data objects. Any request outside the range of the register address will return the exception code 02.

Table 31: Event summary

Register number	Modbus Address [Hex]	Format	R/W	Description (historical event overview)
408193	0x2000	Encoded	R/W	Event type: summary = 0x8EFF
408194	0x2001	Unsigned 32	R	Earliest event ID
408196	0x2003	Unsigned 32	R	Latest event ID
408198	0x2005	Unsigned 32	R/W	Requested event ID
408200	0x2007	Unsigned 32	R	Previous event ID
408202	0x2009	Unsigned 32	R	Next event ID
408204	0x200B	Date/time	R	Date/time
408212	0x2013	Encoded	R	Data format: 0x0000: Basic event 0x0001: Time adjustment 0x0004: Trip 0x0005: Alarm 0x0006: Minor alarm
408213	0x2014	B0	R	Validity bit of the object
408214	0x2015	Encoded	R	Cause of event: 00: boot process - time OK 01: download of the setpoint values 02: time has been adjusted 03: trip 04: alarm 05: test mode has been selected 06: exiting the test mode 08: boot process - no time 09: test completed 10: maintenance mode activated 11: maintenance mode deactivated 12: opened via the communication interface 13: closed via the communication interface

Table 32: Historical trip / major alarm event

Register number	Modbus Address [Hex]	Format	R/W	Description	Unit
408193	0x2000	Encoded	R/W	Event type: Trip: 0x80FF Alarm: 0x81FF	–
408194	0x2001	Unsigned 32	R	Earliest event ID	–
408196	0x2003	Unsigned 32	R	Latest event ID	–
408198	0x2005	Unsigned 32	R/W	Requested event ID	–
408200	0x2007	Unsigned 32	R	Previous event ID	–
408202	0x2009	Unsigned 32	R	Next event ID	–
408204	0x200B	Date/time	R	Date/time	–
408212	0x2013	Encoded	R	Data format: Trip: 0x0004 Main alarm: 0x0005	–
408213	0x2014	Bit 15 - Bit 0	R	Validity bits of the object	–
408214	0x2015	Bit 31 - Bit 16	R	Validity bits of the object	–
408215	0x2016	Encoded	R	Status reason (primary, secondary, reason)	–
408217	0x2018	Unsigned 32	R	I_{L1} / IA	A
408219	0x201A	Unsigned 32	R	I_{L2} / IB	A
408221	0x201C	Unsigned 32	R	I_{L3} / IC	A
408223	0x201E	Unsigned 32	R	I_N / IN	A
408227	0x2022	Unsigned 32	R	I_G / IG residual	A
408229	0x2024	Unsigned 16	R	U_{L1-L2} (VAB)	V
408230	0x2025	Unsigned 16	R	U_{L2-L3} (VBC)	V
408231	0x2026	Unsigned 16	R	U_{L3-L1} (VCA)	V
408232	0x2027	Unsigned 16	R	U_{L1-N} (VAN)	V
408233	0x2028	Unsigned 16	R	U_{L2-N} (VBN)	V
408234	0x2029	Unsigned 16	R	U_{L3-N} (VCN)	V
408235	0x202A	Signed 32	R	Active 3-phase power	W
408237	0x202C	Signed 32	R	Reactive 3-phase power	VAR
408239	0x202E	Unsigned 32	R	Apparent 3-phase power	VA
408241	0x2030	Signed 32	R	Active power demand	W
408243	0x2032	Signed 32	R	Reactive power demand	VAR
408245	0x2034	Unsigned 32	R	Apparent power demand	VA
408247	0x2036	Signed 16	R	N/A	–
408248	0x2037	Unsigned 32	R	Frequency	1/10 Hz
408248	0x2038	Signed 16	R	Apparent power factor	1/100 pf
408250	0x2039	Unsigned 32	R	Number of operations	–
408251	0x203A	Bit 31 - Bit 0	R	Binary status with valid bits	–

Table 33: Minor alarm event

Register number	Modbus Address [Hex]	Format	R/W	Description
408193	0x2000	Encoded	R/W	Event type – summary = 0x81FF
408194	0x2001	Signed 32	R	Earliest event ID
408196	0x2003	Signed 32	R	Latest event ID
408198	0x2005	Signed 32	R/W	Requested event ID
408200	0x2007	Signed 32	R	Previous event ID
408202	0x2009	Signed 32	R	Next event ID
408204	0x200B	Date/time	R	Date/time
408212	0x2013	Encoded	R	Data format – Small alarm: 0x0006
408213	0x2014	Bit 0	R	Valid bits of the object
408214	0x2015	Encoded	R	Status reason (primary, secondary, reason code)

9.3.5 Block of registers

The data object registers of an Eaton product can be rearranged by setting up a block of registers based on the register column in → table 25, page 57. The block of registers is stored in the non-volatile memory and is only available for real time data.

Function code 16 will load the object assignments for the block of registers. The block assignments are stored starting with registers 401001/420481 (0x03E8/0x5000). Only the first register address of the data object is assigned within the block. For example, although the data object "I_{L1} (I_A)" occupies registers 0x1202 and 0x1203, only register 0x1202 will be loaded into the assigned block of registers. The verification of this block of assigned registers can be read by the release from the registers 401001/420481 (0x03E8/0x5000) using the function codes 03 or 04.

The data of the objects configured in the assigned block of registers are mapped to the registers starting with 401201/420737 (0x04B0/0x5100) and continue successively for each assigned object. The number of objects and their order in this data block depends on the configuration of the assigned block of registers. The total number of data blocks in the registers is limited to 100.

The data can be obtained from the data block of the registers by reading function codes 03 or 04. The address of the start object must match the start address of an object in the data block of the registers. The number of registers to be obtained must match the end address of an object within the data block of the registers.

Table 34: Configuration register

Definition of the register	R/W	Modbus register number		Modbus register address		Number
		Low	High	Low	High	
Assigned block of the register configuration	R/W	401001	420481	0x03E8	0x5000	100
Assigned block of register data	R	401201	420737	0x04B0	0x5100	100 x 2
Invalid object access configuration	R/W	402001	425345	0x07D0	0x6300	1
Configuration of the word order of floating-point data	R/W	402002	425346	0x07D1	0x6301	1
Configuration of the word order of fixed-point data	R/W	402003	425347	0x07D2	0x6302	1
Remote control	R/W	402901	425089	0x0B54	0x6200	3
Time and date register	R/W	402921		0x0B68		8

9.3.6 Configuration register

The non-volatile register 402001/425345 (0x07D0/0x6300) is used to configure the release to respond to a group of data objects, some of which are invalid for this particular group, for example because they are not supported by the release type, etc.

If a value is not equal to zero (default setting), any attempt to access a group of data objects containing an invalid object will return the error code 02.

If the register 402001/425345 (0x07D0/0x6300) is set to 0, the release will respond to a group of objects featuring data that are contained in the valid objects of the group. Since no data are available for the invalid objects, the information in the register is not defined. These registers may contain 0x00000000, and a value of 0xFFFFFF may be used to represent an invalid unsigned fixed-point object. The value 0x80000000 may be used to represent an invalid signed fixed-point object.

NAN = 0x7FF20000 may be used to represent an invalid floating-point value (NAN = not a number = invalid floating-point value). This makes it possible to access a register block with a single read command, even if some of the relevant registers are not implemented in this particular block, in order to avoid having to use multiple read commands that contain only the implemented registers. The application thus ensures the selection of the implemented registers. The start register number must be a valid object. If the start register number accesses an invalid object, exception code 02 will be returned for the invalid data object regardless of this configuration setting.

The non-volatile register 402002/425346 (0x07D1/0x6301) is used to configure the data transfer sequence of 32-bit floating-point data. If not equal to 0 (default setting), the low-order word for the floating-point value will be displayed first in the Modbus register range. If the register is set to 0, the high-order word for the floating-point number will be displayed first in the Modbus register range.

The non-volatile register 402003/425347 (0x07D2/0x6302) is used to configure the data transfer sequence of 32-bit fixed-point data. If the value is not equal to 0 (default setting), the low-order fixed-point word will be displayed first in the Modbus register range. If the register is set to 0, the high-order fixed-point word will be displayed first in the Modbus register range.

The registers 402001/425345 to 402003/425347 (0x07D0/0x6300 to 0x07D2/0x6300) are configured via the write function codes 06 or 16.

In order to support Modbus masters that can only access register 9999, some Eaton registers that were originally assigned to registers above 9999 have been granted double access, both to the original register (to ensure compatibility) and to a new assigned register below 9999. The format is given as a low/high register number followed by (low 16/high 16 Modbus) register addresses.

For example: 4xxxx/4yyyy ($XXXX+1_{16}$/$YYYY+1_{16}$).

9.3.7 Remote control

A range of registers is reserved for the remote control of the release, starting with 402901/425089 to 402903/425091. These three registers should be written using function code 16, together with a "slave action code" and the corresponding ones' complement. The data format registers are shown below.

Data format for remote control

Register 402901 (0x6200)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 1 (slave action)								Byte 0 (slave action)							

Register 402902 (0x6201)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 0 (slave action)								Byte 2 (slave action)							

Register 402903 (0x6202)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 2 (slave action)								Ones' complement of byte 1 (slave action)							

The "slave action code" and its functioning are listed in → table 35, and whether it is supported depends on the specific product.

If the "slave action code" and the associated ones' complement command are valid, the release will perform the action in question. Check breaker status to verify if the requested action has been executed successfully. If so, it will return a normal function code 16 response to the Modbus master.
Since it may take some time for the release to become active, the Modbus master can also query the release (e.g. by reading its status) to determine whether the slave action function has been successfully completed following the normal response. If the "slave action code" and the associated ones' complement command are invalid, the release will return the exception code 03.

Table 35: Remote control

Command group	Definition	Pass-word	Decimal byte						Decimal word		
			402903		402902		402901		402903	402902	402901
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Reset	Reset the trip	No	255	255	253	0	0	2	65535	64768	2
	Reset the min./max. values of currents	Yes	255	254	242	0	1	13	65534	61952	269
	Reset the min./max. values of the L-N voltages[1)]	Yes	255	254	240	0	1	15	65534	61440	271
	Reset the min./max. values of the L-L voltages[1)]	Yes	255	254	241	0	1	14	65534	61696	270
	Reset the peak power requirement[1)]	Yes	255	255	251	0	0	4	65535	64256	4
	Reset all min./max. values	Yes	255	254	251	0	1	4	65534	64256	260
	Reset the energy[1)]	Yes	255	255	247	0	0	8	65535	63232	8
	Reset trip count	Yes	255	250	254	0	5	1	65530	65024	1281
	Reset the operations count	Yes	255	254	253	0	1	2	65534	64768	258
	Reset max. temperature	Yes	255	250	253	0	5	2	65530	64768	1282
	Reset runtime	Yes	255	254	252	0	1	3	65534	64512	259
	Reset all diagnostics information	Yes	255	250	252	0	5	3	65530	64512	1283
	Reset the power-up display	No	255	255	252	0	0	3	65535	64512	3
	Open breaker	Yes	254	255	255	1	0	0	65279	65281	0
Main-tenance mode	Activate the maintenance mode	No	254	255	247	1	0	8	65279	63233	8
	Deactivate the maintenance mode	No	254	255	246	1	0	9	65279	62977	9

Command group	Definition	Password	Decimal byte						Decimal word		
			402903		402902		402901		402903	402902	402901
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Relay output	Activate relay output 1	No	251	254	254	4	1	1	64510	65028	257
	Deactivate relay output 1	No	251	253	254	4	2	1	64509	65028	513
	Activate relay output 2	No	251	254	253	4	1	2	64510	64772	258
	Deactivate relay output 2	No	251	253	253	4	2	2	64509	64772	514

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x6202		0x6201		0x6200		0x6202	0x6201	0x6200
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Reset	Reset the trip	No	0x00FF	0x00FF	0x00FD	0x0000	0x0000	0x0002	0xFFFF	0xFD00	0x0002
	Reset the min./max. values of currents	Yes	0x00FF	0x00FE	0x00F2	0x0000	0x0001	0x000D	0xFFFE	0xF200	0x010D
	Reset the min./max. values of the L-N voltages[1)]	Yes	0x00FF	0x00FE	0x00F0	0x0000	0x0001	0x000F	0xFFFE	0xF000	0x010f
	Reset the min./max. values of the L-L voltages[1)]	Yes	0x00FF	0x00FE	0x00F1	0x0000	0x0001	0x000E	0xFFFE	0xF100	0x010E
	Reset the peak power requirement[1)]	Yes	0x00FF	0x00FF	0x00FB	0x0000	0x0000	0x0004	0xFFFF	0xFB00	0x0004
	Reset all min./max. values	Yes	0x00FF	0x00FE	0x00FB	0x0000	0x0001	0x0004	0xFFFE	0xFB00	0x0104
	Reset the energy[1)]	Yes	0x00FF	0x00FF	0x00F7	0x0000	0x0000	0x0008	0xFFFF	0xF700	0x0008
	Reset trip count	Yes	0x00FF	0x00FA	0x00FE	0x0000	0x0005	0x0001	0xFFFA	0xFE00	0x0501
	Reset the operations count	Yes	0x00FF	0x00FE	0x00FD	0x0000	0x0001	0x0002	0xFFFE	0xFD00	0x0102
	Reset max. temperature	Yes	0x00FF	0x00FA	0x00FD	0x0000	0x0005	0x0002	0xFFFA	0xFD00	0x0502
	Reset runtime	Yes	0x00FF	0x00FE	0x00FC	0x0000	0x0001	0x0003	0xFFFE	0xFC00	0x0103
	Reset all diagnostics information	Yes	0x00FF	0x00FA	0x00FC	0x0000	0x0005	0x0003	0xFFFA	0xFC00	0x0503
	Reset the power-up display	No	0x00FF	0x00FF	0x00FC	0x0000	0x0000	0x0003	0xFFFF	0xFC00	0x0003
	Open breaker	Yes	0x00FE	0x00FF	0x00FF	0x0001	0x0000	0x0000	0xFEFF	0xFF01	0x0000
Maintenance mode	Activate the maintenance mode	No	0x00FE	0x00FF	0x00F7	0x0001	0x0000	0x0008	0xFEFF	0xF701	0x0008
	Deactivate the maintenance mode	No	0x00FE	0x00FF	0x00F6	0x0001	0x0000	0x0009	0xFEFF	0xF601	0x0009

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x6202		0x6201		0x6200		0x6202	0x6201	0x6200
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Relay output	Activate relay output 1	No	0x00FB	0x00FE	0x00FE	0x0004	0x0001	0x0001	0xFBFE	0xFE04	0x0101
	Deactivate relay output 1	No	0x00FB	0x00FD	0x00FE	0x0004	0x0002	0x0001	0xFBFD	0xFE04	0x0201
	Activate relay output 2	No	0x00FB	0x00FE	0x00FD	0x0004	0x0001	0x0002	0xFBFE	0xFD04	0x0102
	Deactivate relay output 2	No	0x00FB	0x00FD	0x00FD	0x0004	0x0002	0x0002	0xFBFD	0xFD04	0x0202

9.3.8 Date and time

The release supports the reading and writing of real-time clock information by the Modbus master. Eight registers, starting with register number 402921, are reserved for this purpose (→ table 36).
The system clock can be set using function code 16.

Note: The day of the week (register number 402924) is set automatically once year, month and date registers are set. Therefore this is a read only register.

Table 36: Real-time clock

Modbus register number	Modbus register address	Definition	Data range	Format
402921	0x0B68	Month	1 - 12	Unsigned 16
402922	0x0B69	Day	1 - 31	Unsigned 16
402923	0x0B6A	Year	2000 - 2099	Unsigned 16
402924	0x0B6B	Day of the week	1: Sunday … 7: Saturday	Unsigned 16
402925	0x0B6C	Hour	0 - 23	Unsigned 16
402926	0x0B6D	Minute	0 - 59	Unsigned 16
402927	0x0B6E	Seconds	0 - 59	Unsigned 16
402928	0x0B6F	1/100 of a second	0 - 99	Unsigned 16

9.3.9 Internal diagnostics

The release supports the Modbus diagnostics for monitoring the internal Modbus communication using function code 08.

Table 37: Diagnostics

Sub-function code	Data	Action
0	–	Echo query
1	0000: The counters are retained 00FF: Clear all counters	Restart the communication interface
4	0000	Force listen
10	0000	Clear counters
11	0000	Number of Modbus UART bus messages
12	0000	Number of Modbus UART CRC errors
13	0000	Number of exceptions
14	0000	Number of slave messages
15	0000	Number of slave non-responses
16	0000	Number of slave NAKs[1)]
17	0000	Number of "slave busy" messages
18	0000	Number of Modbus UART run errors
20	0000	Clear Modbus UART counters
23	0000	Number of "incorrect Modbus UART character length" errors [2)]
24	0000	Number of "Modbus UART performance failure" errors [3)]
25	0000	Number of Modbus UART parity errors
26	0000	MCU1 firmware version
27	0000	MCU1 firmware revision
28	0000	MCU1 firmware build
29	0000	MCU2 firmware version
30	0000	MCU2 firmware revision
31	0000	MCU2 firmware build
32	0000	USB firmware version
33	0000	USB firmware revision
34	0000	Reset the block of registers
35	0000	COM-MCU firmware version
36	0000	COM-MCU firmware revision
37	0000	COM-MCU firmware version

1) NAK = not acknowledged
2) Framing error
3) Noise error

9.3.10 Primary status codes

Table 38: Primary status codes

Code	Meaning
0x01	open
0x02	closed
0x03	tripped
0x04	Alarm active
0x0D	Threshold value active

9.3.11 Secondary status codes

Table 39: Secondary status codes

Code	Meaning
0x01	not applicable
0x03	Test mode
0x07	has been switched on since last trip / triggered alarm
0x08	alarm

9.3.11.1 Reason codes

Table 40: Reason codes

Code	Meaning
0x0000	unknown
0x0001	normal
0x0003	Instantaneous short circuit
0x000E	Auxiliary power supply too low
0x0011	Current imbalance
0x001F	Operation count
0x0021	Control via the communication interface
0x0025	Coil monitoring
0x002B	Diagnostic warning #2 (configuration read error)
0x003D	Overload
0x003E	Short-time delay
0x0049	Phase currents are close to the threshold value, load alarm
0x004C	Override
0x004D	Setpoint error
0x004E	Overtemperature
0x0050	Overload (neutral conductor)
0x0054	Ground fault
0x0071	Calibration
0x0088	Real-time clock
0x0099	Maintenance mode
0x009A	Fault in the breaker mechanism
0x07FC	Digital bypass
0x07FD	Non-volatile memory failure
0x07FE	Watchdog fault
0x07FF	Motor alarm or motor tripping

9.3.12 Device information

The device information (fixed data range) includes, for example, the device name, model name, catalogue number, version number, serial number, date code, firmware version 1 and 2, USB version, and product ID.

Table 41: Reason code definitions

Register number	Modbus address [Hex]	Description	Format	Range	Register	Comment
404497	0x1190	Device name	ASCII	16 characters	8	EATON PXR20 EATON PXR25
404505	0x1198	Model name	ASCII	16 characters	8	PXR 20/25 MCCB
404513	0x11A0	Catalogue number	ASCII	32 characters	16	internal catalogue number (max. 20 characters)
404529	0x11B0	Style number	ASCII	32 characters	16	internal version number (max. 20 characters)
404545	0x11C0	Serial number	ASCII	32 characters	16	if supported
404561	0x11D0	Date code	ASCII	12 characters	6	yy.mm.dd
404567	0x11D6	Firmware version 1	ASCII	16 characters	8	Sample version 01.02.0033
404575	0x11DE	Firmware version 2	ASCII	16 characters	8	Sample version 01.02.0033
404583	0x11E6	USB version	ASCII	16 characters	8	Sample version 01.02.0033
404591	0x11EE	Release family	Unsigned 16	16-bit	1	PXR20: 0x01 PXR25: 0x01
404592	0x11EF	Standard	Unsigned 16	16-bit	1	IEC only: 0x01 UL only: 0x02 UL/IEC: 0x03
404593	0x11F0	Poles	Unsigned 16	16-bit	1	3-pole / 4-pole
404607	0x11FE	Product ID	Bitmap	32-bit	2	ppppppvvvvdddddd Division code (dddddd) 6 (0x06) Product code (pppppp): 2: NZM2 PXR 3: NZM3 PXR 4: NZM4 PXR Comm version (vvvv) 0

9.3.13 Exception codes

If there is an error in the request or the response, the release will return an exception code.

Table 42: Exception codes

Exception code	Reason
01	The function code in the query is not supported by the trip unit. **Note:** This exception code is also used for unsupported sub-function codes in Modbus diagnostics.
02	The requested data register or bit address is not supported.
03	The data in the query are not supported.
04	The trip unit does not support this query or only part of a register is used in the query.
05	ACK = acknowledged
06	The trip unit is unable to execute the current request at this time.
07	NAK = not acknowledged The trip unit is unable to execute the request.
135	No event entry for requested event ID ortype of event.

10 Industrial Ethernet Communication Adapter Modules (ECAM)

The Ethernet communication adapter modules (ECAM) are optional accessories for digital NZM circuit breakers with PXR20 or PXR25 technology.

These modules are designed to connect with the circuit breaker's internal communication module and expand the communication capabilities into EtherNet/IP™, EtherCAT® or PROFINET interfaces.

For operation, an interface module (included in the PXR25, available as an accessory for PXR20) and an internal Modbus RTU module are also required.

A supply of 24 V DC must be connected to the interface module (→ figure 10, page 41), as well as to the Ethernet communication adapter modules (→ figure 16) below.

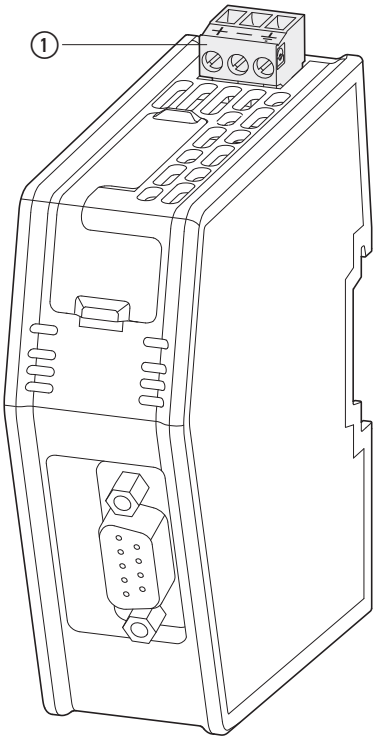


Figure 16: Ethernet communication adapter modules power supply wiring

① 24 V DC terminal (±10 %)

The Modbus cable, which is connected to the ECAM, must comply with the specifications on → page 53 of this manual.

The fieldbus wiring is done as follows:

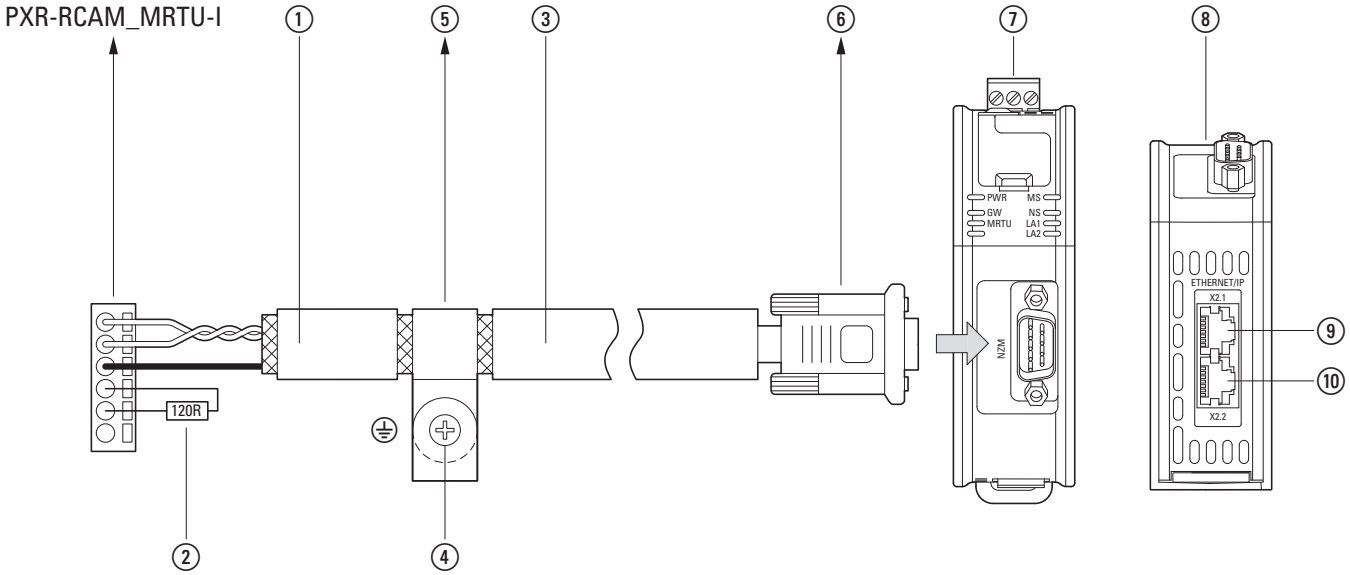


Figure 17: Ethernet communication adapter modules wiring

① Modbus RTU input
② Bus termination resistor (for the final node)
③ Modbus RTU-compatible cable:triple wire: two twisted signal wires; one shielded COM wire
④ HF-compatible functional grounding
⑤ Modbus cable
⑥ RS-485 Sub DB9 male connector
⑦ Front view
⑧ Bottom view
⑨ RJ45 input
⑩ RJ45 output

The Sub DB9 male connector wiring must be done as follows:

Sub DB9 male connector	Pin	Signal	Description
	1	Not available	Not used
	2	Not available	Not used
	3	Not available	Not used
	4	Not available	Not used
	5	GND	Ground
	6	Not available	Output for external bus termination
	7	Not available	Not used
	8	B	NZM Line B
	9	A	NZM Line A
	Connector	Shield	Functional earth (braided shield)

Figure 18: Sub DB9 Male connector wiring

The ECAM has 8 red/green LEDs.

The following → tables 43 and 44 describe their behaviour.

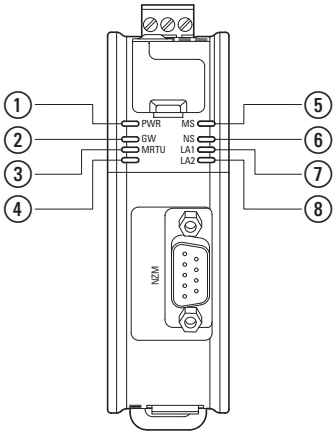


Figure 19: Front panel LEDs

Table 43: LEDs behaviour description – EtherCAT®

Number	Name	Function
①	PWR	Indicates power presence
②	GW	Gateway Application
③	MRTU	Modbus RTU Activity
④	–	Not used
⑤	RUN	RUN
⑥	ERR	ERROR
⑦	LA IN	Link Activity Port in
⑧	LA OUT	Link Activity Port out

Table 44: LEDs behaviour description – EtherNet/IP™ and PROFINET

Number	Name	Function
①	PWR	Indicates power presence
②	GW	Gateway Application
③	MRTU	Modbus RTU Activity
④	–	Not used
⑤	NS	Network Status
⑥	MS	Module Status
⑦	LA1	Link Activity Port 1
⑧	LA2	Link Activity Port 2

10.1 EtherNet/IP™

The PXR-ECAM-IP is designed to connect with an electronic trip unit's internal communication module (PXR-RCAM-MRTU-I) Modbus-RTU link and expand the communication capabilities into EtherNet/IP™. The PXR-ECAM-IP is intended for use with PXR20 or PXR25 moulded case circuit breakers (MCCB).

This section details the data and functions available for the Digital NZM with PXR20 or PXR25 trip units via the PXR-ECAM-IP register map. Depending upon trip unit capabilities, a large number of features are accessible through the registers as following described.

10.1.1 Configuration of the Modbus parameters

In order to synchronize the communication between the breaker Modbus RTU (slave device) and the ECAM (which acts as the Modbus RTU master device), the slave ID (Modbus RTU slave), baud rate and parity bit settings of both devices must be configured with the same values.

The ECAM's Modbus RTU slave ID (which the master device addresses to), baud rate and parity bit settings can be configured via ADIs 500-502.

Both, Modbus Slave (PXR-RCAM-MRTU-I) and Modbus Master (PXR-ECAM-IP) have the same default parameters. In case the Modbus RTU slave parameters are not changed from the default values, the values of this communication module do not need to be changed as well.
The ADIs 500, 501 and 502 only provide the possibility to do so, if desired by the user.
The stop bit is automatically set up and the value is 1.

The default settings of the Modbus Slave and Modbus Master are as follows:

Table 45: EtherNet/IP™ Modbus settings

Setting value	ADI Number	Data range	Default value
Slave ID	500	1 - 247	2
Baud rate	501	00: 9,600 bit/s 01: 19,200 bit/s 02: 38,400 bit/s 03: 57,600 bit/s	01
Parity	502	00: none 01: odd 02: even	02

The valid parameter values will be applied instantly. Writing parameter values outside valid ranges have no effect.

After a power-cycle, meaning the switch off and then on of the module, the PXR-ECAM-IP does not save configured values but returns them to default values.

The Modbus communication parameters of the NZM breaker (Modbus RTU slave) cannot be configured via Ethernet communication adapter module (ECAM).

10.1.2 IP configuration/DIP Switch Settings

The DIP switches are used to configure the device's fieldbus addresses. Flipping a single switch adds the switch specific value to the total address value. As a result, values in a range from 0 to 255 can be configured that way.

Table 46: Fieldbus address configuration via DIP switch

Switch	1	2	3	4	5	6	7	8
Value	1	2	4	8	16	32	64	128

For example, flipping switches 4 and 6 results in the address 40.

Figure 20: DIP switches flipping example

The valid settings for EtherNet/IP™ are shown on → table 47.

Table 47: Fieldbus address configuration via DIP switch

Switches Setting Value	**Remarks**
000	If the DIP switches are set to 0, the IP address settings stored in the NV-memory of the device are used. The factory default behaviour is DHCP. The IP address settings can be configured by the IPconfig tool. The tool can be downloaded here: https://www.eaton.com/digitalnzm
001	If the DIP switches are set to 1, the address settings of the device are as follows: IP address: 192.168.1.1 Subnet mask: 255.255.255.0 Default Gateway: 192.168.1.2
001 - 254	If the DIP switches are set in the range from 1 to 254, the IP address settings of the device are determined by the switches: IP address: 192.168.1.<DIP Switch Setting> Subnet mask: 255.255.255.0 Default Gateway: 192.168.1.1
255	Invalid Setting. Device will not start-up properly. PWR and GW are flashing red.

10.1.3 EtherNet/IP™ Electronic Data Sheet (EDS file)

Each device in an EtherNet/IP™ network is associated with an Electronic Data Sheet (EDS file), which describes the implementation of the product. This file is used by the network configuration tool during network configuration.

→ If necessary, the latest version of the EDS file for the PXR-ECAM-IP can be downloaded here:
https://www.eaton.com/digitalnzm

10.1.4 EtherNet/IP™ register map

There are seven different release types in the NZM digital circuit breaker family. As a result, the devices access the registers differently, since not all versions support all functions.

The release type -AX does not support a communication connection; register access is therefore not possible.

→ The available functions overview, for each trip unit type, can be found on → chapter 3, “Protection and measurement functions”, page 19.

10.1.4.1 Input status (discrete inputs)

The input status bits can be requested via object: 0xA2, with attribute: 5 and Instance: 1.

The input status answer is a 4 bytes data type. The first 16 bits (1001 to 1016) indicate the current status, while the last 16 bits (1017 to 1032) indicate whether the corresponding status is valid or supported by the release unit.

Table 48: Input status - EtherNet/IP™

Input	Description or value	Input	Description or value
1001	The breaker is in the closed position	1017	The breaker is in the closed position and is valid
1002	Unacknowledged trip condition	1018	Unacknowledged trip condition is valid
1003	Active or unacknowledged alarm	1019	Active or unacknowledged alarm is valid
1004	0	1020	0
1005	Maintenance mode is active	1021	Maintenance mode is active and valid
1006	Test mode is active	1022	Test mode is active and valid
1007	0	1023	0
1008	0	1024	0
1009	Clockwise phase sequence (ABC)	1025	Clockwise phase sequence (ABC) is valid
1010	Overload mode is active (an overload is present)	1026	Overload mode is active and valid (an overload is present)
1011	Zone selectivity (ZSI) is active	1027	Zone selectivity (ZSI) is active and valid
1012	0	1028	0
1013	Ground-fault protection type is “source ground”	1029	Ground-fault protection type is “source ground” and valid
1014	0	1030	0
1015	0	1031	0
1016	0	1032	0

10.1.4.2 Real-time data object register

Data that is subject to real-time changes, such as current, voltage and energy, can be requested via object: 0xA2, with attribute: 5 and instances according to → table 49.

Real-time data can be obtained either in IEEE floating-point or fixed-point format. For data displayed in fixed-point format, each result is presented as a multiplication of the real-time data with a scaling factor. Energy objects can only be obtained in fixed-point format.

Instances for which the IEEE floating-point value is not specified are only supported in fixed-point format (FP).

Table 49: Real-time data register – EtherNet/IP™

Instance		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
56	182	Cause of status (→ table 60, → table 61): High byte = primary status Low byte = secondary status	–	Encoded	–	Yes	Yes
57	183	I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
58	184	I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
59	185	I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
60	186	I_G (IG)	A	Unsigned 32	10	Yes	Yes
61	187	I_N (IN)	A	Unsigned 32	10	Yes	Yes
62	188	U_{L1-L2} (VAB)	V	Unsigned 32	10	–	Yes
63	189	U_{L2-L3} (VBC)	V	Unsigned 32	10	–	Yes
64	190	U_{L3-L1} (VCA)	V	Unsigned 32	10	–	Yes
65	191	U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
66	192	U_{L2-N} (VBN)	V	Unsigned 32	10	–	Yes
67	193	U_{L3-N} (VCN)	V	Unsigned 32	10	–	Yes
72	198	Active 3-phase power	W	Signed 32	1	–	Yes
73	199	Reactive 3-phase power	Var	Signed 32	1	–	Yes
74	200	Apparent 3-phase power	VA	Unsigned 32	1	–	Yes
75	201	Power factor	–	Signed 32	100	–	Yes
76	202	Frequency	Hz	Unsigned 16	10	–	Yes
81	207	Peak active power demand	W	Signed 32	1	–	Yes
82	208	Product ID	–	Unsigned 32	–	Yes	Yes
83	209	Frequency	Hz	Unsigned 16	100	–	Yes
–	210	Active energy (forward)	kWh	Unsigned 32	1	–	Yes
–	211	Active energy (reverse)	kWh	Unsigned 32	1	–	Yes
–	212	Active energy combined (= forward + reverse)	kWh	Unsigned 32	1	–	Yes

Instance		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
–	213	Apparent energy	kVAh	Unsigned 32	1	–	Yes
–	214	Active energy (forward)	Wh	Unsigned 64	1	–	Yes
–	215	Active energy (reverse)	Wh	Unsigned 64	1	–	Yes
–	216	Active energy combined (= forward + reverse)	Wh	Signed 64	1	–	Yes
–	217	Apparent energy	VAh	Unsigned 64	1	–	Yes
84	218	Peak reactive power demand	Var	Signed 32	1	–	Yes
85	219	Peak apparent power demand	VA	Unsigned 32	1	–	Yes
90	224	Active power demand	W	Signed 32	1	–	Yes
91	225	Reactive power demand	Var	Signed 32	1	–	Yes
92	226	Apparent power demand	VA	Unsigned 32	1	–	Yes
93	227	Minimum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
94	228	Maximum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
95	229	Minimum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
96	230	Maximum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
97	231	Minimum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
98	232	Maximum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
99	233	Minimum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
100	234	Maximum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
101	235	Minimum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
102	236	Maximum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
103	237	Minimum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
104	238	Maximum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
105	239	Minimum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
106	240	Maximum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
107	241	Minimum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
108	242	Maximum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
109	243	Minimum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
110	244	Maximum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
111	245	Minimum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
112	246	Maximum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
113	247	Minimum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
114	248	Maximum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
115	249	Overload pre-warning	%	Unsigned 32	1	–	Yes
116	250	Current phase unbalance	%	Unsigned 32	100	–	Yes
117	251	Voltage phase unbalance	%	Unsigned 32	100	–	Yes
118	252	THD % value - I_{L1} (IA)	%	Unsigned 32	100	–	Yes

Instance		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
119	253	THD % value - I_{L2} (IB)	%	Unsigned 32	100	–	Yes
120	254	THD % value - I_{L3} (IC)	%	Unsigned 32	100	–	Yes
121	255	THD % value - I_N (IN)	%	Unsigned 32	100	–	Yes
122	256	THD % value - U_{L1} (VA)	%	Unsigned 32	100	–	Yes
123	257	THD % value - U_{L2} (VB)	%	Unsigned 32	100	–	Yes
124	258	THD % value - U_{L3} (VC)	%	Unsigned 32	100	–	Yes
125	259	THD % value - U_{L1-N} (VAN)	%	Unsigned 32	100	–	Yes
126	260	THD % value - U_{L2-N} (VBN)	%	Unsigned 32	100	–	Yes
127	261	THD % value - U_{L3-N} (VCN)	%	Unsigned 32	100	–	Yes
128	262	PXR state flag1 Bit 0: USB cable connected Bit 1: Breaker is ON (HIN) Bit 2: Breaker is Tripped (HIA) Bit 3: Maintenance mode activated via ARMS wiring on interface module Bit 4: Maintenance mode activated via any communication link Bit 5: N/A Bit 6: Maintenance mode activated Bit 7: Auxiliar supply connected to BSM	–	Unsigned 16	1	–	Yes
129	263	Counter - I_{sd}, I_i tripping	–	Unsigned 16	1	Yes	Yes
130	264	Counter - I_r, I_g tripping	–	Unsigned 16	1	Yes	Yes
131	265	Operations counter	–	Unsigned 16	1	Yes	Yes
132	266	Counter - I_{sd} tripping	–	Unsigned 16	1	Yes	Yes
133	267	Counter - I_i tripping	–	Unsigned 16	1	Yes	Yes
134	268	Counter - bypass tripping	–	Unsigned 16	1	Yes	Yes
135	269	Counter - I_r tripping	–	Unsigned 16	1	Yes	Yes
136	270	Counter - I_g tripping	–	Unsigned 16	1	Yes	Yes
137	271	Counter - trips total	–	Unsigned 16	1	Yes	Yes
138	272	Counter - test mode tripping	–	Unsigned 16	1	Yes	Yes
139	273	Counter - number of openings via the communication interface	–	Unsigned 16	1	Yes	Yes
140	274	Counter - external actuation[1)]	–	Unsigned 16	1	Yes	Yes
141	275	Time of last actuation (year, month, day, hour, minute, second)	–	Unsigned 16	–	Yes	Yes
142	276	Operating time[2)] in minutes	min	Unsigned 16	1	Yes	Yes
143	277	Operating time[2)] in hours	h	Unsigned 16	1	Yes	Yes

Instance		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
144	278	Operating time[2] in days	d	Unsigned 16	1	Yes	Yes
145	279	Residual life[3]	points	Unsigned 16	–	Yes	Yes
146	280	Harmonics are for: 0 - I_{L1} (IA) 1 - I_{L2} (IB) 2 - I_{L3} (IC) 4 - I_N (IN) 5 - U_{L1} (VA) 6 - U_{L2} (VB) 7 - U_{L3} (VC) 8 - U_{L1-N} (VAN) 9 - U_{L2-N} (VBN) 10 - U_{L3-N} (VCN)	–	Unsigned 16	1	–	Yes
147	281	Item harmonics [0]	%	Unsigned 16	100	–	Yes
148	282	Item harmonics [1]	%	Unsigned 16	100	–	Yes
149	283	Item harmonics [2]	%	Unsigned 16	100	–	Yes
150	284	Item harmonics [3]	%	Unsigned 16	100	–	Yes
151	285	Item harmonics [4]	%	Unsigned 16	100	–	Yes
152	286	Item harmonics [5]	%	Unsigned 16	100	–	Yes
153	287	Item harmonics [6]	%	Unsigned 16	100	–	Yes
154	288	Item harmonics [7]	%	Unsigned 16	100	–	Yes
155	289	Item harmonics [8]	%	Unsigned 16	100	–	Yes
156	290	Item harmonics [9]	%	Unsigned 16	100	–	Yes
157	291	Item harmonics [10]	%	Unsigned 16	100	–	Yes
158	292	Item harmonics [11]	%	Unsigned 16	100	–	Yes
159	293	Item harmonics [12]	%	Unsigned 16	100	–	Yes
160	294	Item harmonics [13]	%	Unsigned 16	100	–	Yes
161	295	Item harmonics [14]	%	Unsigned 16	100	–	Yes
162	296	Item harmonics [15]	%	Unsigned 16	100	–	Yes
163	297	Item harmonics [16]	%	Unsigned 16	100	–	Yes
164	298	Item harmonics [17]	%	Unsigned 16	100	–	Yes
165	299	Item harmonics [18]	%	Unsigned 16	100	–	Yes
166	300	Item harmonics [19]	%	Unsigned 16	100	–	Yes
167	301	Item harmonics [20]	%	Unsigned 16	100	–	Yes
168	302	Item harmonics [21]	%	Unsigned 16	100	–	Yes
169	303	Item harmonics [22]	%	Unsigned 16	100	–	Yes
170	304	Item harmonics [23]	%	Unsigned 16	100	–	Yes
171	305	Item harmonics [24]	%	Unsigned 16	100	–	Yes
172	306	Item harmonics [25]	%	Unsigned 16	100	–	Yes
173	307	Item harmonics [26]	%	Unsigned 16	100	–	Yes

Instance		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
174	308	Item harmonics [27]	%	Unsigned 16	100	–	Yes
175	309	Item harmonics [28]	%	Unsigned 16	100	–	Yes
176	310	Item harmonics [29]	%	Unsigned 16	100	–	Yes
177	311	Item harmonics [30]	%	Unsigned 16	100	–	Yes
178	312	Item harmonics [31]	%	Unsigned 16	100	–	Yes
179	313	Item harmonics [32]	%	Unsigned 16	100	–	Yes
180	314	Item harmonics [33]	%	Unsigned 16	100	–	Yes
181	315	Item harmonics [34]	%	Unsigned 16	100	–	Yes

10.1.4.3 Set points instances

The set points instances are arranged in four groups (groups 0, 1, 2 and 5).

Each group can be conceived as a binary array of information.

Before reading or writing the settings, the appropriate group should be selected. Access to the groups are obtained via object 0xA2, with attribute 5 and instance 3, which is a R/W register used to select the respective group (default: group 0). The high byte contains the desired group number, while the low byte must contain the value 255 (0x0FF).

Prior to writing the settings, the correct password must be entered via object 0xA2, with attribute 5 and instance 2, and the settings have to be written within 10 seconds of the password check.

For trip units that support settings, the settings of groups 0, 1, 2 and 5 should be written one after the other.

The setting groups are assigned as follows:

- Group 0: System group
- Group 1: Protective group
- Group 2: Modbus group
- Group 5: Advanced protection functions

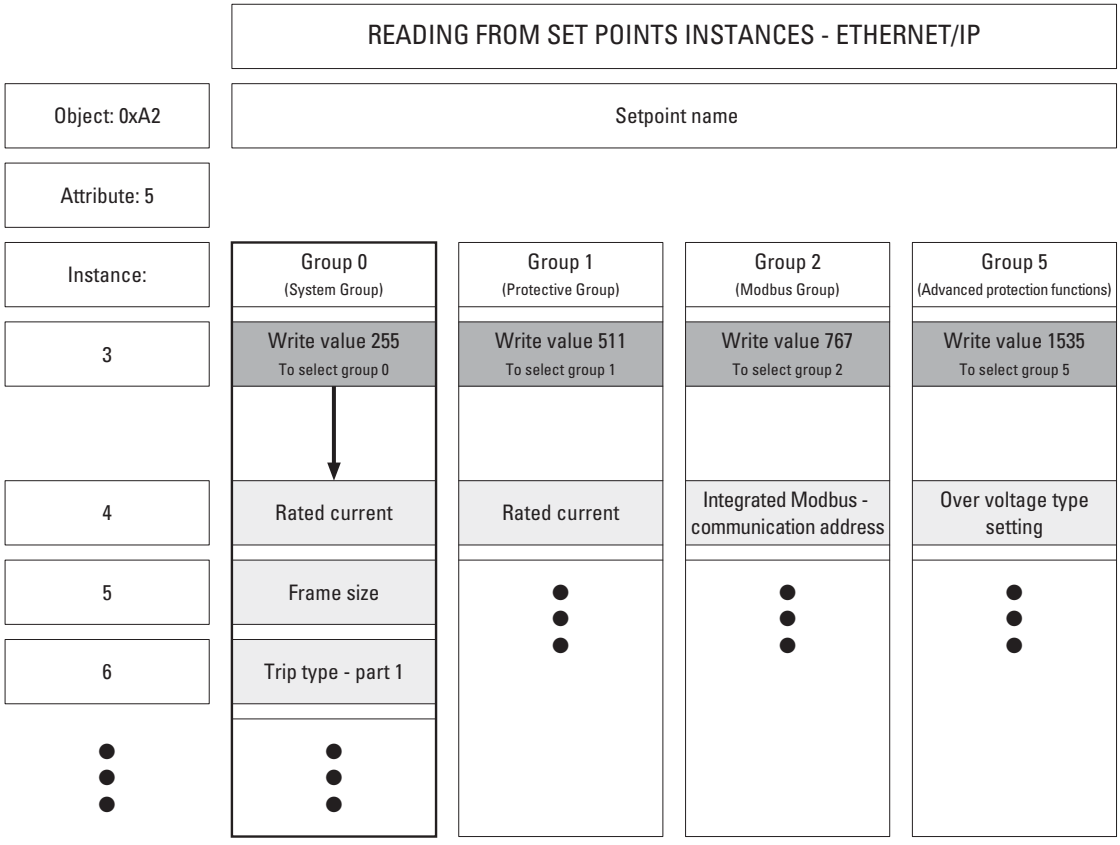


Figure 21: Reading from set points instances – EtherNet/IP™

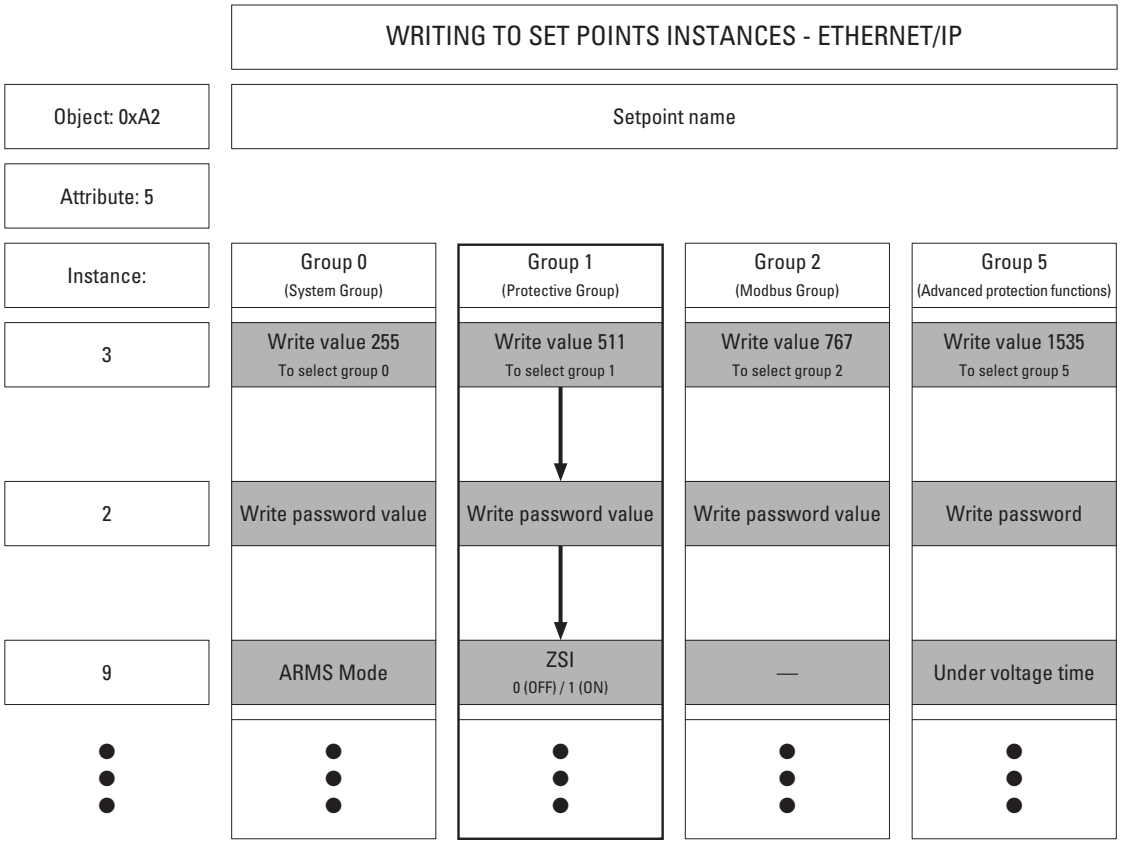


Figure 22: Writing to set points instances – EtherNet/IP™

Table 50: Setting group 0: "System group" – EtherNet/IP™

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
2	15 - 0		Password	W	–	0000 (default setting	–
3	15 - 0	0xFFFFFF	Group 0 = system	R/W	–	0x00FF	–
4	12 - 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
5	2 - 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type 11: NZM2 12: NZM3 13: NZM4	–
6	3 - 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short-circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
7			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	–
8	8	0x0100	Maintenance mode: state	R	Encoded	0: off 1: on	–
	BBE	0x0001	Maintenance mode: remote control	R/W	Encoded	0: off 1: on	–
9[1)]	2 - 0	0x0007	Maintenance mode: Trip setting	R/W	Encoded	1: 2.5 x I_n 2: 4 x I_n 3: 6 x I_n 4: 8 x I_n 5: 10 x I_n[2)]	A
11[1)]	0	0x0001	Direction of incoming supply	R/W	Encoded	0: forward 1: reverse **Note:** only available on the PXR25	–

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
12[1)]	0	0x0001	Sign convention	R/W	Encoded	Sign convention: 0: IEC 1: IEEE 2: IEEE old	–
13[1)]			Power demand window	R/W	Encoded	Power demand: 0: fixed 1: sliding	–
14[1)]			Power demand interval	R/W	Encoded	Power demand: 5 - 60 min (1 min increments)	–
17			Configuration of relay 1	R/W	Encoded	Configuration of relay 1 and relay 2: → table 22, page 44	–
18			Configuration of relay 2	R/W	Encoded		–
20[1)]			Phase sequence – phase L1 (A)	R/W	Encoded	Phase L1 (A) 0: counterclockwise 1: clockwise	–
23[1)]		0xBCC	Alarm - Residual Life	R/W	Encoded	Range: 50 - 100, step size 1, default value: 75 Alarm level value 100 ≙ 0 % residual life Alarm level value 75 ≙ 25 % residual life Formula for conversion: Alarm level expressed as a percentage = 100 - point value	–

1) PXR25 only!
2) For 600 A and 630 A frame size 3 breakers maximum trip setting is 8 x I_n.

In setting group 0, the maintenance mode setting (instance 8) can be divided into two parts. The high byte is read only and is used for the status indication of the maintenance mode, the comprehensive results of the maintenance mode rotary switch, the secondary terminal and the communication settings. The low byte can be configured and is used to indicate the maintenance mode settings via the communication port.

The respective protection settings may vary according to the size, type and rated operational current of the release.

Table 51: Setting group 1: "Protection group" – EtherNet/IP™

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
2	15 - 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
3	15 - 0	0xFFFFFF	Group 1 = protection	R/W			–
4	12 - 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160,200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875,1000, 1200, 1250, 1400, 1600	A
5	2 - 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
6	3 - 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
7			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	
8	0	0x0001	Thermal memory (overload protection)	R/W	Encoded	Activates/deactivates the thermal memory of the overload protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. Reactivate the thermal memory after testing: 0: switched off 1: switched on	

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
9	0	0x0001	ZSI	R/W	Encoded	ZSI, zone-selectivity: If enabled for releases with ground-fault protection, ZSI is implemented for both the short-time delayed short-circuit release and for ground-fault protection. If enabled for releases without groundfault protection, ZSI is only implemented for the short-time delayed short-circuit release. 0: switched off 1: switched on	–
10	0 - 1	0x0003	Overload release - waveform	R/W	Encoded	Waveform of the overload release 2 = I^2t (default setting)	–
11			Settings -release (I_r)	R/W	Unsigned 16	Settings – overload (I_r = x * I_n): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 40: 0.4 45: 0.4 50: 0.5 55: 0.5 00: 0.6 05: 0.6 10: 0.7 15: 0.8 20: 0.8 25: 0.8 30: 0.9 35: 1.0 40: 1.0 The following applies to the NZM PXR25: General value range: 20 - 1600 (in increments of 1 (1 A)) **Caution:** The value range depends on the type: (e.g. a 250-A switch can be set in the range from 40 % to 100 % of In (value range: 100 - 250)	–
12			Settings -overload delay time (t_r)	R/W	Unsigned 16	Settings - overload delay time (t_r = x [s]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 40: 4 50: 5 60: 6 70: 7 80: 8 100: 10 120: 12 140: 14 160: 16 180: 18 200: 20 32767: ∞ (overload protection deactivated)	s

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
13[1)]			Load alarm 1	R/W	Unsigned 16	Load alarm 1 level (AL1 = n % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 1 must be set equal or lower than load alarm 2. 85 % fixed value for PXR20 trip units	%
14	0	0x0001	Short-time delayed short circuit release - waveform	R/W	Encoded	Waveform of the short-time delayed short-circuit release 0: flat (default setting) 1: I^2t	–
15			Settings - short-time delayed short-circuit release (I_{sd})	R/W	Unsigned 16	Settings - short-time delayed short circuit release (I_{sd} = n x I_r): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2.0 30: 3.0 40: 4.0 50: 5.0 60: 6.0 65: 6.5 70: 7.0 75: 7.5 80: 8.0 85: 8.5 90: 9.0 95: 9.5 100: 10.0 The following applies to the NZM PXR25: The value range [20 - 100] corresponds to 2 to 10, in increments of 0.1 (1 for values)	A
16			Settings - delay time of the short-time delayed short-circuit release (t_{sd})	R/W	Unsigned 16	Settings - delay time of the short-time delayed short-circuit release (t_{sd} = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 100] corresponds to 0 to 1,000 ms, respectively.	ms

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
17			Settings - instantaneous short-circuit release (I_i)	R/W	Unsigned 16	Settings - instantaneous short-circuit release ($I_i = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 30: 3 40: 4 50: 5 60: 6 70: 7 80: 8 90: 9 100: 10 110: 11 120: 12 140: 14 160: 16 180: 18 The following applies to the NZM PXR25: The value range [20 - 180] corresponds to 2 to 18, in increments of 0.1 (1 for values)	A
18	0	0x0001	Type of ground-fault detection	R	Unsigned 16	Type of ground-fault detection: 0: differential current detection	–
19	0 - 1	0x0003	Settings - functioning of the ground-fault protection	R/W	Encoded	Type of ground-fault protection 0: trip 1: alarm 2: OFF	–
20	0	0x0001	ground-fault release - waveform	R/W	Encoded	ground-fault release - waveform: 0: flat 1: I^2t	–
21			Settings - ground-fault release (I_g)	R/W	Unsigned 16	Settings - ground-fault release ($I_g = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 0.2 30: 0.3 40: 0.4 60: 0.6 80: 0.8 100: 1.0 The following applies to the NZM PXR25: The value range [20 - 100] corresponds to 0.2 to 1.0, in increments of 0.1 (10 for values)	A

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
22			Settings - delay time of the ground-fault release (t_g)	R/W	Unsigned 16	Settings - delay time of the ground-fault release (t_g = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 1000] corresponds to 0 to 1,000 ms, respectively.	ms
23			Thermal memory (ground fault protection)	R/W	Encoded	Activates/deactivates the thermal memory of the ground-fault protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. **Note:** Must be reactivated after testing! 0: switched off 1: switched on	–
24			Settings - neutral protection	R/W	Unsigned 16	Adjusts the neutral protection of an NZM PXR25 breaker with a "/VAR" variably adjustable neutral conductor 0 ≙ 0 % 60 ≙ 60 % 100 ≙ 100 % (default setting) The lower setting affects the LSI protection functions of the switch, but not the ground-fault protection function ("G"). **Note:** L = long delay (= overload protection I_r) S = short delay (= short-time delayed short-circuit protection I_{sd}) I = instantaneous (= instantaneous shortcircuit protection I_i) G = ground fault (= ground fault protection I_g)	%
25[1)]			Load alarm 2	R/W	Unsigned 16	Load alarm 2 level (AL2 = x % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 2 must be set higher than load alarm 1. 105 % fixed value for PXR20 trip units	%
26			Pre-alarm of the groundfault release	R/W	Encoded	If the ground-fault protection function is set to "trip" (see instance 19), a pre-alarm can also be set. ($GF_{pre\text{-}alarm}$ = x % x I_g) 50 - 100 (in increments of 5 %)	%

1) 1) Function is not supported by PXR20!

Table 52: Setting group 2: "Modbus" group – EtherNet/IP™

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
2	15 - 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
3	15 - 0	0xFFFFFF	Group 2 = onboard Modbus	R/W	Encoded	0x02FF	–
4	15 - 0		Integrated Modbus - communication address	R/W	Encoded	001 - 247 002: default setting	–
5	15 - 0		Integrated Modbus - baud rate	R/W	Encoded	00: 9,600 bit/s 01: 19,200 bit/s (default setting) 02: 38,400 bit/s 02: 57,600 bit/s	–
6	15 - 0		Integrated Modbus - parity	R/W	Encoded	00: none 01: odd 02: even (default setting)	–
7	15 - 0		Integrated Modbus - stop bit	R/W	Encoded	00: 1 bit (default setting) 01: 2 bits	–

Table 53: Setting goup 5: Advanced protection functions[1)] – EtherNet/IP™

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
2	15 – 0		Password	W	Encoded	0000 (default setting)	–
3		0xFFFFFF	Group 5: Advanced protection functions[1)]	R/W	Encoded	0x05FF	–
4	1 – 0		Over voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
5			Over voltage pickup	R/W	Unsigned	180 - 850 (in increments of 1 V)	V
6			Over voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
7	1 – 0		Under voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
8			Under voltage pickup	R/W	Unsigned	60 - 690 (in increments of 1 V)	V
9			Under voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
10	1 – 0		Voltage unbalance type setting	R/W		0 = Trip 1 = Alarm 2 = OFF	–
11			Voltage unbalance pickup	R/W	Unsigned	Voltage unbalance level = n % x Max line- to-line voltage 5 - 25 (in increments of 1 %)	%
12			Voltage unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
13	1 – 0		Current unbalance type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
14			Current unbalance pickup	R/W	Unsigned	Current unbalance level = n % x Max IL 5 - 25 (in increments of 1 %)	%
15			Current unbalance time	R/W	Unsigned	1 - 300 (in increments of 1s)	s
16	1 – 0		Reverse power type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
17			Reverse power pickup	R/W	Unsigned	1 - 65,500 (in increments of 1kW)	kW
18			Reverse power time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
19	0		Phase rotation sensing type	R/W	Encoded	0 = ABC (-NA breakers) / 0 = 123 (IEC breakers) 1 = CBA (-NA breakers) / 0 = 321 (IEC breakers)	–
20	1 – 0		Phase rotation type settting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
21	1 – 0		Phase loss type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
22			Phase loss time	R/W	Unsigned	1 - 240 (in increments of 1 s)	s

1) PXR25 only!

10.1.4.4 Event logs

A trip event provides historical values for the data objects at the time the event has occurred. The trip unit classifies the event information in order to be able to provide a different quantity for each type.
The EtherNet/IP™ communication can only access the historical summary, as well as the trip and event data.

Table 54: Event classification – EtherNet/IP™

Event type	Quantity of numbers stored	Description of the event log
Summary	200	→ table 55
Tripping	10	→ table 56
Alarms	10	→ table 56 and → table 57

A single trip may be registered under multiple event types. For example, a protective trip may be recorded in the summary log (→ table 55) as well as in the trip log (→ table 56).

Event logs information is accessed via object: 0xA2, with attribute: 5 and instances according to tables 55, 56 and 57.

If the event type selection is written to instance 316, the first and last event ID can be retrieved from instances 317 and 318, respectively, in order to determine the range of events that have been stored for the selected event type. Instance 319 is a R/W register for selecting the ID of the event in question. If the requested event has been recorded by the device, instances 320 and 321 will supply both the ID of the previous event and that of the next event.

If the device has not recorded the event in question, the exception code can be queried by requesting the Modbus communication status of the ECAM from the controller via a dedicated industrial protocol object (via object: 0xA2, with attribute: 5 and instance: 410).

For more information on the exception codes, see
→ section 10.1.4.11, “Exception codes”, page 130.

The date and time at which the requested event occurred are read in log 322, with the same date and time description as in → table 59, page 127.
This value corresponds to the time at which the historical event occurred.

Log 323 indicates the data content of the selected event type. This is a constant value for the three event types supported by the module.

The event data also provide a valid bit for each data object, starting with instance 324. If bit 0 is set to 1, the initial data will be valid for the current trip type, bit 1 for the second data object, bit 2 for the third data object, and so forth.

The number of valid bit registers is calculated as:
(number of data objects - 1)/16

The following instances are assigned to the data objects.

Table 55: Event summary – EtherNet/IP™

Instance	Format	R/W	Description (historical event overview)
316	Encoded	R/W	Event type: summary = 0x8EFF
317	Unsigned 32	R	Earliest event ID
318	Unsigned 32	R	Latest event ID
319	Unsigned 32	R/W	Requested event ID
320	Unsigned 32	R	Previous event ID
321	Unsigned 32	R	Next event ID
322	Date/time	R	Date/time
323	Encoded	R	Data format: 0x0000: Basic event 0x0001: Time adjustment 0x0004: Trip 0x0005: Alarm 0x0006: Minor alarm
324	B0	R	Validity bit of the object
325	Encoded	R	Cause of event: 00: boot process - time OK 01: download of the setpoint values 02: time has been adjusted 03: trip 04: alarm 05: test mode has been selected 06: exiting the test mode 08: boot process - no time 09: test completed 10: maintenance mode activated 11: maintenance mode deactivated 12: opened via the communication interface 13: closed via the communication interface

Table 56: Historical trip / major alarm event – EtherNet/IP™

Instance	Format	R/W	Description (historical event overview)	Unit
316	Encoded	R/W	Event type: Trip: 0x80FF Alarm: 0x81FF	–
317	Unsigned 32	R	Earliest event ID	–
318	Unsigned 32	R	Latest event ID	–
319	Unsigned 32	R/W	Requested event ID	–
320	Unsigned 32	R	Previous event ID	–
321	Unsigned 32	R	Next event ID	–
322	Date/time	R	Date/time	–
323	Encoded	R	Data format: Trip: 0x0004 Main alarm: 0x0005	–
324	Bit 15 - Bit 0	R	Valid bits of the object	–
325	Bit 31 - Bit 16	R	Valid bits of the object	–

Instance	Format	R/W	Description (historical event overview)	Unit
326	Encoded	R	Status reason (primary, secondary, reason)	–
327	Unsigned 32	R	I_{L1} (IA)	A
328	Unsigned 32	R	I_{L2} (IB)	A
329	Unsigned 32	R	I_{L3} (IC)	A
330	Unsigned 32	R	I_N (IN)	A
332	Unsigned 32	R	I_G (IG residual)	A
333	Unsigned 16	R	U_{L1-L2} (VAB)	V
334	Unsigned 16	R	U_{L2-L3} (VBC)	V
335	Unsigned 16	R	U_{L3-L1} (VCA)	V
336	Unsigned 16	R	U_{L1-N} (VAN)	V
337	Unsigned 16	R	U_{L2-N} (VBN)	V
338	Unsigned 16	R	U_{L3-N} (VCN)	V
339	Signed 32	R	Active 3-phase power	W
340	Signed 32	R	Reactive 3-phase power	VAR
341	Unsigned 32	R	Apparent 3-phase power	VA
342	Signed 32	R	Active power demand	W
343	Signed 32	R	Reactive power demand	VAR
344	Unsigned 32	R	Apparent power demand	VA
345	Signed 16	R	N/A	–
346	Unsigned 16	R	Frequency	1/10 Hz
347	Signed 16	R	Apparent power factor	1/100 pf
348	Unsigned 32	R	Number of operations	–
349	Bit 31 - Bit 0	R	Binary status with valid bits	–

Table 57: Minor alarm event – EtherNet/IP™

Instance	Format	R/W	Description (historical event overview)
316	Encoded	R/W	Event type: Summary = 0x81FF
317	Signed 32	R	Earliest event ID
318	Signed 32	R	Latest event ID
319	Signed 32	R/W	Requested event ID
320	Signed 32	R	Previous event ID
321	Signed 32	R	Next event ID
322	Date/time	R	Date/time
323	Encoded	R	Data format: Small alarm: 0x0006
324	Bit 0	R	Valid bits of the object
325	Encoded	R	Status reason (primary, secondary, reason code)

10.1.4.5 Remote control

One instance with 3 elements of 16 bits is reserved for remote control of the release, accessed via object: 0xA2, with attribute: 5 and Instance: 358. These three elements should be written together with a "slave action code" and the corresponding ones' complement.

The data format registers, which is an array of 16 bits, are shown below.

Data format for remote control

Instance 358 - Element 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 1 (slave action)								Byte 0 (slave action)							

Instance 358 - Element 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 0 (slave action)								Byte 2 (slave action)							

Instance 358 - Element 3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 2 (slave action)								Ones' complement of byte 1 (slave action)							

The "slave action code" and its functioning are listed in → table 58, and whether it is supported depends on the specific product.

If the "slave action code" and the associated ones' complement command are valid, the release will perform the action in question. If the "slave action code" and the associated ones' complement command are invalid, the exception code can be queried by requesting the Modbus communication status of the ECAM from the controller via a dedicated industrial protocol object (via object: 0xA2, with attribute: 5 and instance: 410).

→ For more information on the exception codes, see → section 10.1.4.11, "Exception codes", page 130.

Table 58: Remote control – EtherNet/IP™

Command group	Definition	Pass-word	Decimal byte						Decimal word		
			358 Byte 5	358 Byte 4	358 Byte 3	358 Byte 2	358 Byte 1	358 Byte 0	358 Word 3	358 Word 2	358 Word 1
Reset	Reset the trip	No	255	255	253	0	0	2	65535	64768	2
	Reset the min./max. values of currents	Yes	255	254	242	0	1	13	65534	61952	269
	Reset the min./max. values of the L-N voltages[1)]	Yes	255	254	240	0	1	15	65534	61440	271
	Reset the min./max. values of the L-L voltages[1)]	Yes	255	254	241	0	1	14	65534	61696	270
	Reset the peak power requirement[1)]	Yes	255	255	251	0	0	4	65535	64256	4
	Reset all min./max. values	Yes	255	254	251	0	1	4	65534	64256	260
	Reset the energy[1)]	Yes	255	255	247	0	0	8	65535	63232	8
	Reset trip count	Yes	255	250	254	0	5	1	65530	65024	1281
	Reset the operations count	Yes	255	254	253	0	1	2	65534	64768	258
	Reset max. temperature	Yes	255	250	253	0	5	2	65530	64768	1282
	Reset runtime	Yes	255	254	252	0	1	3	65534	64512	259
	Reset all diagnostics information	Yes	255	250	252	0	5	3	65530	64512	1283
	Reset the power-up display	No	255	255	252	0	0	3	65535	64512	3
	Open breaker	Yes	254	255	255	1	0	0	65279	65281	0
Maintenance mode	Activate the maintenance mode	No	254	255	247	1	0	8	65279	63233	8
	Deactivate the maintenance mode	No	254	255	246	1	0	9	65279	62977	9

Command group	Definition	Pass-word	Decimal byte						Decimal word		
			358 Byte 5	358 Byte 4	358 Byte 3	358 Byte 2	358 Byte 1	358 Byte 0	358 Word 3	358 Word 2	358 Word 1
Relay output	Activate relay output 1	No	251	254	254	4	1	1	64510	65028	257
	Deactivate relay output 1	No	251	253	254	4	2	1	64509	65028	513
	Activate relay output 2	No	251	254	253	4	1	2	64510	64772	258
	Deactivate relay output 2	No	251	253	253	4	2	2	64509	64772	514

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x0166 Byte 5	Byte 4	0x0166 Byte 3	Byte 2	0x0166 Byte 1	Byte 0	0x0166 Word 3	0x0166 Word 2	0x0166 Word 1
Reset	Reset the trip	No	0x00FF	0x00FF	0x00FD	0x0000	0x0000	0x0002	0xFFFF	0xFD00	0x0002
	Reset the min./max. values of currents	Yes	0x00FF	0x00FE	0x00F2	0x0000	0x0001	0x000D	0xFFFE	0xF200	0x010D
	Reset the min./max. values of the L-N voltages[1)]	Yes	0x00FF	0x00FE	0x00F0	0x0000	0x0001	0x000F	0xFFFE	0xF000	0x010f
	Reset the min./max. values of the L-L voltages[1)]	Yes	0x00FF	0x00FE	0x00F1	0x0000	0x0001	0x000E	0xFFFE	0xF100	0x010E
	Reset the peak power requirement[1)]	Yes	0x00FF	0x00FF	0x00FB	0x0000	0x0000	0x0004	0xFFFF	0xFB00	0x0004
	Reset all min./max. values	Yes	0x00FF	0x00FE	0x00FB	0x0000	0x0001	0x0004	0xFFFE	0xFB00	0x0104
	Reset the energy[1)]	Yes	0x00FF	0x00FF	0x00F7	0x0000	0x0000	0x0008	0xFFFF	0xF700	0x0008
	Reset trip count	Yes	0x00FF	0x00FA	0x00FE	0x0000	0x0005	0x0001	0xFFFA	0xFE00	0x0501
	Reset the operations count	Yes	0x00FF	0x00FE	0x00FD	0x0000	0x0001	0x0002	0xFFFE	0xFD00	0x0102
	Reset max. temperature	Yes	0x00FF	0x00FA	0x00FD	0x0000	0x0005	0x0002	0xFFFA	0xFD00	0x0502
	Reset runtime	Yes	0x00FF	0x00FE	0x00FC	0x0000	0x0001	0x0003	0xFFFE	0xFC00	0x0103

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x0166		0x0166		0x0166		0x0166	0x0166	0x0166
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
	Reset all diagnostics information	Yes	0x00FF	0x00FA	0x00FC	0x0000	0x0005	0x0003	0xFFFA	0xFC00	0x0503
	Reset the power-up display	No	0x00FF	0x00FF	0x00FC	0x0000	0x0000	0x0003	0xFFFF	0xFC00	0x0003
	Open breaker	Yes	0x00FE	0x00FF	0x00FF	0x0001	0x0000	0x0000	0xFEFF	0xFF01	0x0000
Maintenance mode	Activate the maintenance mode	No	0x00FE	0x00FF	0x00F7	0x0001	0x0000	0x0008	0xFEFF	0xF701	0x0008
	Deactivate the maintenance mode	No	0x00FE	0x00FF	0x00F6	0x0001	0x0000	0x0009	0xFEFF	0xF601	0x0009
Relay output	Activate relay output 1	No	0x00FB	0x00FE	0x00FE	0x0004	0x0001	0x0001	0xFBFE	0xFE04	0x0101
	Deactivate relay output 1	No	0x00FB	0x00FD	0x00FE	0x0004	0x0002	0x0001	0xFBFD	0xFE04	0x0201
	Activate relay output 2	No	0x00FB	0x00FE	0x00FD	0x0004	0x0001	0x0002	0xFBFE	0xFD04	0x0102
	Deactivate relay output 2	No	0x00FB	0x00FD	0x00FD	0x0004	0x0002	0x0002	0xFBFD	0xFD04	0x0202

10.1.4.6 Date and time

The release supports the reading and writing of real-time clock information by the Ethernet communication adapter module EtherNet/IP™.
Eight registers, starting with instance number 350, are reserved for this purpose.

Note: The day of the week (instance 353) is set automatically once year, month and date registers are set. Therefore this is a read only register.

Table 59: Real-time clock – EtherNet/IP™

Instance	Definition	Data range	Format
350	Month	01. Dez	Unsigned 16
351	Day	Jan 31	Unsigned 16
352	Year	2000 - 2099	Unsigned 16
353	Day of the week	1 = Sunday ... 7 = Saturday	Unsigned 16
354	Hour	0 - 23	Unsigned 16
355	Minute	0 - 59	Unsigned 16
356	Seconds	0 - 59	Unsigned 16
357	1/100 of a second	0 - 99	Unsigned 16

10.1.4.7 Primary status codes

Table 60: Primary status codes (High Byte) – EtherNet/IP™

Code	Meaning
0x01	open
0x02	closed
0x03	tripped
0x04	Alarm active
0x0D	Threshold value active

10.1.4.8 Secondary status codes

Table 61: Secondary status codes (Low Byte) – EtherNet/IP™

Code	Meaning
0x01	not applicable
0x03	Test mode
0x07	Has been switched on since last trip / triggered alarm
0x08	Alarm

10.1.4.9 Reason codes

Table 62: Reason codes – EtherNet/IP™

Code	Meaning
0x0000	unknown
0x0001	normal
0x0003	Instantaneous short circuit
0x000E	Auxiliary power supply too low
0x0011	Current imbalance
0x001F	Operation count
0x0021	Control via the communication interface
0x0025	Coil monitoring
0x002B	Diagnostic warning #2 (configuration read error)
0x003D	Overload
0x003E	Short-time delay
0x0049	Phase currents are close to the threshold value, load alarm
0x004C	Override
0x004D	Setpoint error
0x004E	Overtemperature
0x0050	Overload (neutral conductor)
0x0054	Ground fault

Code	Meaning
0x0071	Calibration
0x0088	Real-time clock
0x0099	Maintenance mode
0x009A	Fault in the breaker mechanism
0x07FC	Digital bypass
0x07FD	Non-volatile memory failure
0x07FE	Watchdog fault
0x07FF	Motor alarm or motor tripping

10.1.4.10 Device information

The device information (fixed data range) includes, for example, the device name, model name, catalogue number, version number, serial number, date code, firmware version 1 and 2, USB version, and product ID.

Table 63: Reason code definitions – EtherNet/IP™

Instance	Description	Format	Range	Register	Comment
42	Device name	ASCII	16 characters	8	EATON PXR20 EATON PXR25
43	Model name	ASCII	16 characters	8	PXR 20/PX25 MCCB
44	Catalogue number	ASCII	32 characters	16	internal catalogue number (max. 20 characters)
45	Style number	ASCII	32 characters	16	internal version number (max. 20 characters)
46	Serial number	ASCII	32 characters	16	if supported
47	Date code	ASCII	12 characters	6	yy.mm.dd
48	Firmware version 1	ASCII	16 characters	8	Sample version 01.02.0033
49	Firmware version 2	ASCII	16 characters	8	Sample version 01.02.0033
50	USB version	ASCII	16 characters	8	Sample version 01.02.0033
51	Release family	Unsigned 16	16-bit	1	PXR20: 0x01 PXR25: 0x01
52	Standard	Unsigned 16	16-bit	1	IEC only: 0x01 UL only: 0x02 UL / IEC: 0x03
53	Poles	Unsigned 16	16-bit	1	3-pole / 4-pole
55	Product ID	Bitmap	32-bit	2	ppppppvvvvdddddd Division code (dddddd) 06 (0x06) Product code (pppppp): 2: NZM2 PXR 3: NZM3 PXR 4: NZM4 PXR Comm version (vvvv) 0

10.1.4.11 Exception codes

If there is an error in the request or the response, the release will return an exception code via instance 410.

Table 64: Exception codes – EtherNet/IP™

Modbus returned exception code values	Meaning
0	No error
8	Timeout error occurred
10	Illegal function exception
11	Illegal data address
12	Illegal data value
13	Slave device failure
14	Slave acknowledge
15	Slave device busy
16	Memory parity error
17	ECAM path unavailable
18	ECAM target device failed to respond

10.2 EtherCAT®

The PXR-ECAM-ECT is designed to connect with an electronic trip unit's internal communication module (PXR-RCAM-MRTU-I) Modbus-RTU link and expand the communication capabilities into EtherCAT®.
The PXR-ECAM-ECT is intended for use with PXR20 or PXR25 moulded case circuit breakers (MCCB).

This section details the data and functions available for the Digital NZM with PXR20 or PXR25 trip units via the PXR-ECAM-ECT register map.

Depending upon trip unit capabilities, a large number of features are accessible through the registers as following described.

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

10.2.1 Configuration of the Modbus parameters

In order to synchronize the communication between the breaker Modbus RTU (slave device) and the ECAM (which acts as the Modbus RTU master device), the slave ID (Modbus RTU slave), baud rate and parity bit settings of both devices must be configured with the same values.

The ECAM's Modbus RTU slave ID (which the master device addresses to), baud rate and parity bit settings can be configured via SDOs 0x21F4 - 0x21F6.

Both, Modbus Slave (PXR-RCAM-MRTU-I) and Modbus Master (PXR-ECAM-ECT) have the same default parameters. In case the Modbus RTU slave parameters are not changed from the default values, the values of this communication module do not need to be changed as well. The SDOs 0x21F4 - 0x21F6 only provide the possibility to do so, if desired by the user.

The stop bit is automatically set up and the value is 1.

The default settings of the Modbus Slave and Modbus Master are as follows:

Table 65: EtherCAT® settings

Setting value	SDO Number [Hex]	Data range	Default value
Slave ID	0x21F4	1 - 247	2
Baud rate	0x21F5	9,600 bit/s 19,200 bit/s 38,400 bit/s 57,600 bit/s	19,200 bit/s
Parity	0x21F6	00: none 01: odd 02: even	02

The valid parameter values will be applied instantly. Writing parameter values outside valid ranges has no effect.

After a power-cycle, meaning the switch off the trip unit, the PXR-ECAM-ECT does not save configured values but returns them to default values.

The Modbus communication parameters of the NZM breaker (Modbus RTU slave) cannot be configured via Ethernet communication adapter module (ECAM).

10.2.2 EtherCAT® Slave Information file (ESI file)

Each device in an EtherCAT® network is associated with an EtherCAT® Slave Information file (an ESI file), which describes the implementation of the product. This file is used by the network configuration tool during network configuration.

If necessary, the latest version of the ESI file for the PXR-ECAM-ECT can be downloaded here:
https://www.eaton.com/digitalnzm

10.2.3 EtherCAT® register map

There are seven different release types in the NZM digital circuit breaker family. As a result, the devices access the registers differently, since not all versions support all functions.

The release type -AX does not support a communication connection; register access is therefore not possible.

The available functions overview, for each trip unit type, can be found on → chapter 3, "Protection and measurement functions", page 19.

10.2.3.1 Input status (discrete inputs)

The input status bits can be requested via sub index: 0 and index 2001 (Hex). The input status answer is a 4 bytes data type. The first 16 bits (1001 - 1016) indicate the current status, while the last 16 bits (1017 - 1032) indicate whether the corresponding status is valid or supported by the release unit.

Table 66: Input status – EtherCAT®

Input	Description or value	Input	Description or value
1001	The breaker is in the closed position	1017	The breaker is in the closed position and is valid
1002	Unacknowledged trip condition	1018	Unacknowledged trip condition is valid
1003	Active or unacknowledged alarm	1019	Active or unacknowledged alarm is valid
1004	0	1020	0
1005	Maintenance mode is active	1021	Maintenance mode is active and valid
1006	Test mode is active	1022	Test mode is active and valid
1007	0	1023	0
1008	0	1024	0
1009	Clockwise phase sequence (ABC)	1025	Clockwise phase sequence (ABC) valid
1010	Overload mode is active (an overload is present)	1026	Overload mode is active and valid (an overload is present)
1011	Zone selectivity (ZSI) is active	1027	Zone selectivity (ZSI) is active and valid
1012	0	1028	0
1013	Ground-fault protection type is "source ground"	1029	Ground-fault protection type is "source ground" and valid
1014	0	1030	0
1015	0	1031	0
1016	0	1032	0

10.2.3.2 Real-time data object register

Data that is subject to real-time changes, such as current, voltage and energy, can be requested via sub index: 0 and indexes according to → table 67.

Real-time data can be obtained either in IEEE floating-point or fixed-point format. For data displayed in fixed-point format, each result is presented as a multiplication of the real-time data with a scaling factor. Energy objects can only be obtained in fixed-point format.

Indexes for which the IEEE floating-point value is not specified are only supported in fixed-point format (FP).

Table 67: Real-time data register – EtherCAT®

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x2038	0x20B6	Cause of status (→ table 72, → table 73): High byte = primary status Low byte = secondary status	–	Encoded	–	Yes	Yes
0x2039	0x20B7	I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
0x203A	0x20B8	I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
0x203B	0x20B9	I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
0x203C	0x20BA	I_G (IG)	A	Unsigned 32	10	Yes	Yes
0x203D	0x20BB	I_N (IN)	A	Unsigned 32	10	Yes	Yes
0x203E	0x20BC	U_{L1-L2} (VAB)	V	Unsigned 32	10	–	Yes
0x203F	0x20BD	U_{L2-L3} (VBC)	V	Unsigned 32	10	–	Yes
0x2040	0x20BE	U_{L3-L1} (VCA)	V	Unsigned 32	10	–	Yes
0x2041	0x20BF	U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
0x2042	0x20C0	U_{L2-N} (VBN)	V	Unsigned 32	10	–	Yes
0x2043	0x20C1	U_{L3-N} (VCN)	V	Unsigned 32	10	–	Yes
0x2048	0x20C6	Active 3-phase power	W	Signed 32	1	–	Yes
0x2049	0x20C7	Reactive 3-phase power	Var	Signed 32	1	–	Yes
0x204A	0x20C8	Apparent 3-phase power	VA	Unsigned 32	1	–	Yes
0x204B	0x20C9	Power factor	–	Signed 32	100	–	Yes
0x204C	0x20CA	Frequency	Hz	Unsigned 16	10	–	Yes
0x2051	0x20CF	Peak active power demand	W	Signed 32	1	–	Yes
0x2052	0x20D0	Product ID	–	Unsigned 32	–	Yes	Yes
0x2053	0x20D1	Frequency	Hz	Unsigned 16	100	–	Yes
–	0x20D2	Active energy (forward)	kWh	Unsigned 32	1	–	Yes
–	0x20D3	Active energy (reverse)	kWh	Unsigned 32	1	–	Yes
–	0x20D4	Active energy combined (= forward + reverse)	kWh	Unsigned 32	1	–	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
–	0x20D5	Apparent energy	kVAh	Unsigned 32	1	–	Yes
–	0x20D6	Active energy (forward)	Wh	Unsigned 64	1	–	Yes
–	0x20D7	Active energy (reverse)	Wh	Unsigned 64	1	–	Yes
–	0x20D8	Active energy combined (= forward + reverse)	Wh	Signed 64	1	–	Yes
–	0x20D9	Apparent energy	VAh	Unsigned 64	1	–	Yes
0x2054	0x20DA	Peak reactive power demand	Var	Signed 32	1	–	Yes
0x2055	0x20DB	Peak apparent power demand	VA	Unsigned 32	1	–	Yes
0x205A	0x20E0	Active power demand	W	Signed 32	1	–	Yes
0x205B	0x20E1	Reactive power demand	Var	Signed 32	1	–	Yes
0x205C	0x20E2	Apparent power demand	VA	Unsigned 32	1	–	Yes
0x205D	0x20E3	Minimum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
0x205E	0x20E4	Maximum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
0x205F	0x20E5	Minimum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
0x2060	0x20E6	Maximum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
0x2061	0x20E7	Minimum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
0x2062	0x20E8	Maximum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
0x2063	0x20E9	Minimum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
0x2064	0x20EA	Maximum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
0x2065	0x20EB	Minimum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
0x2066	0x20EC	Maximum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
0x2067	0x20ED	Minimum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
0x2068	0x20EE	Maximum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
0x2069	0x20EF	Minimum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
0x206A	0x20F0	Maximum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
0x206B	0x20F1	Minimum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
0x206C	0x20F2	Maximum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
0x206D	0x20F3	Minimum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
0x206E	0x20F4	Maximum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
0x206F	0x20F5	Minimum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
0x2070	0x20F6	Maximum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
0x2071	0x20F7	Minimum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
0x2072	0x20F8	Maximum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
0x2073	0x20F9	Overload pre-warning	%	Unsigned 32	1	–	Yes
0x2074	0x20FA	Current phase unbalance	%	Unsigned 32	100	–	Yes
0x2075	0x20FB	Voltage phase unbalance	%	Unsigned 32	100	–	Yes
0x2076	0x20FC	THD % value - I_{L1} (IA)	%	Unsigned 32	100	–	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x2077	0x20FD	THD % value - I_{L2} (IB)	%	Unsigned 32	100	–	Yes
0x2078	0x20FE	THD % value - I_{L3} (IC)	%	Unsigned 32	100	–	Yes
0x2079	0x20FF	THD % value - I_N (IN)	%	Unsigned 32	100	–	Yes
0x207A	0x2100	THD % value - U_{L1} (VA)	%	Unsigned 32	100	–	Yes
0x207B	0x2101	THD % value - U_{L2} (VB)	%	Unsigned 32	100	–	Yes
0x207C	0x2102	THD % value - U_{L3} (VC)	%	Unsigned 32	100	–	Yes
0x207D	0x2103	THD % value - U_{L1-N} (VAN)	%	Unsigned 32	100	–	Yes
0x207E	0x2104	THD % value - U_{L2-N} (VBN)	%	Unsigned 32	100	–	Yes
0x207F	0x2105	THD % value - U_{L3-N} (VCN)	%	Unsigned 32	100	–	Yes
0x2080	0x2106	PXR state flag1 Bit 0: USB cable connected Bit 1: Breaker is ON (HIN) Bit 2: Breaker is Tripped (HIA) Bit 3: Maintenance mode activated via ARMS wiring on interface module Bit 4: Maintenance mode activated via any communication link Bit 5: N/A Bit 6: Maintenance mode activated Bit 7: Auxiliar supply connected to BSM	–	Unsigned 16	1	–	Yes
0x2081	0x2107	Counter - I_{sd}, I_i tripping	–	Unsigned 16	1	Yes	Yes
0x2082	0x2108	Counter - I_r, I_g tripping	–	Unsigned 16	1	Yes	Yes
0x2083	0x2109	Operations counter	–	Unsigned 16	1	Yes	Yes
0x2084	0x210A	Counter - I_{sd} tripping	–	Unsigned 16	1	Yes	Yes
0x2085	0x210B	Counter - I_i tripping	–	Unsigned 16	1	Yes	Yes
0x2086	0x210C	Counter - bypass tripping	–	Unsigned 16	1	Yes	Yes
0x2087	0x210D	Counter - I_r tripping	–	Unsigned 16	1	Yes	Yes
0x2088	0x210E	Counter - I_g tripping	–	Unsigned 16	1	Yes	Yes
0x2089	0x210F	Counter - trips total	–	Unsigned 16	1	Yes	Yes
0x208A	0x2110	Counter - test mode tripping	–	Unsigned 16	1	Yes	Yes
0x208B	0x2111	Counter - number of openings via the communication interface	–	Unsigned 16	1	Yes	Yes
0x208C	0x2112	Counter - external actuation[1)]	–	Unsigned 16	1	Yes	Yes
0x208D	0x2113	Time of last actuation (year, month, day, hour, minute, second)	–	Unsigned 16	–	Yes	Yes
0x208E	0x2114	Operating time[2)] in minutes	min	Unsigned 16	1	Yes	Yes
0x208F	0x2115	Operating time[2)] in hours	h	Unsigned 16	1	Yes	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x2090	0x2116	Operating time[2] in days	d	Unsigned 16	1	Yes	Yes
0x2091	0x2117	Residual life[3]	points	Unsigned 16	–	Yes	Yes
0x2092	0x2118	Harmonics are for: 0 - I_{L1} (IA) 1 - I_{L2} (IB) 2 - I_{L3} (IC) 4 - I_N (IN) 5 - U_{L1} (VA) 6 - U_{L2} (VB) 7 - U_{L3} (VC) 8 - U_{L1-N} (VAN) 9 - U_{L2-N} (VBN) 10 - U_{L3-N} (VCN)	–	Unsigned 16	1	–	Yes
0x2093	0x2119	Item harmonics [0]	%	Unsigned 16	100	–	Yes
0x2094	0x211A	Item harmonics [1]	%	Unsigned 16	100	–	Yes
0x2095	0x211B	Item harmonics [2]	%	Unsigned 16	100	–	Yes
0x2096	0x211C	Item harmonics [3]	%	Unsigned 16	100	–	Yes
0x2097	0x211D	Item harmonics [4]	%	Unsigned 16	100	–	Yes
0x2098	0x211E	Item harmonics [5]	%	Unsigned 16	100	–	Yes
0x2099	0x211F	Item harmonics [6]	%	Unsigned 16	100	–	Yes
0x209A	0x2120	Item harmonics [7]	%	Unsigned 16	100	–	Yes
0x209B	0x2121	Item harmonics [8]	%	Unsigned 16	100	–	Yes
0x209C	0x2122	Item harmonics [9]	%	Unsigned 16	100	–	Yes
0x209D	0x2123	Item harmonics [10]	%	Unsigned 16	100	–	Yes
0x209E	0x2124	Item harmonics [11]	%	Unsigned 16	100	–	Yes
0x209F	0x2125	Item harmonics [12]	%	Unsigned 16	100	–	Yes
0x20A0	0x2126	Item harmonics [13]	%	Unsigned 16	100	–	Yes
0x20A1	0x2127	Item harmonics [14]	%	Unsigned 16	100	–	Yes
0x20A2	0x2128	Item harmonics [15]	%	Unsigned 16	100	–	Yes
0x20A3	0x2129	Item harmonics [16]	%	Unsigned 16	100	–	Yes
0x20A4	0x212A	Item harmonics [17]	%	Unsigned 16	100	–	Yes
0x20A5	0x212B	Item harmonics [18]	%	Unsigned 16	100	–	Yes
0x20A6	0x212C	Item harmonics [19]	%	Unsigned 16	100	–	Yes
0x20A7	0x212D	Item harmonics [20]	%	Unsigned 16	100	–	Yes
0x20A8	0x212E	Item harmonics [21]	%	Unsigned 16	100	–	Yes
0x20A9	0x212F	Item harmonics [22]	%	Unsigned 16	100	–	Yes
0x20AA	0x2130	Item harmonics [23]	%	Unsigned 16	100	–	Yes
0x20AB	0x2131	Item harmonics [24]	%	Unsigned 16	100	–	Yes
0x20AC	0x2132	Item harmonics [25]	%	Unsigned 16	100	–	Yes
0x20AD	0x2133	Item harmonics [26]	%	Unsigned 16	100	–	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x20AE	0x2134	Item harmonics [27]	%	Unsigned 16	100	–	Yes
0x20AF	0x2135	Item harmonics [28]	%	Unsigned 16	100	–	Yes
0x20B0	0x2136	Item harmonics [29]	%	Unsigned 16	100	–	Yes
0x20B1	0x2137	Item harmonics [30]	%	Unsigned 16	100	–	Yes
0x20B2	0x2138	Item harmonics [31]	%	Unsigned 16	100	–	Yes
0x20B3	0x2139	Item harmonics [32]	%	Unsigned 16	100	–	Yes
0x20B4	0x213A	Item harmonics [33]	%	Unsigned 16	100	–	Yes
0x20B5	0x213B	Item harmonics [34]	%	Unsigned 16	100	–	Yes

10.2.3.3 Set points indexes

The set points indexes are arranged in four groups (groups 0, 1, 2 and 5).

Each group can be conceived as a binary array of information.

Before reading or writing the settings, the appropriate group should be selected. Access to the groups are obtained via sub index 0 and index 2003 (hex), which is a R/W register used to select the respective group (default: group 0). The high byte contains the desired group number, while the low byte must contain the value 255 (0x0FF).

Prior to writing the settings, the correct password must be entered via sub index 0 and index 2002 (hex), and the settings have to be written within 10 seconds of the password check.

For trip units that support settings, the settings of groups 0, 1, 2 and 5 should be written one after the other.

The setting groups are assigned as follows:

- Group 0: System group
- Group 1: Protective group
- Group 2: Modbus group
- Group 5: Advanced protection functions

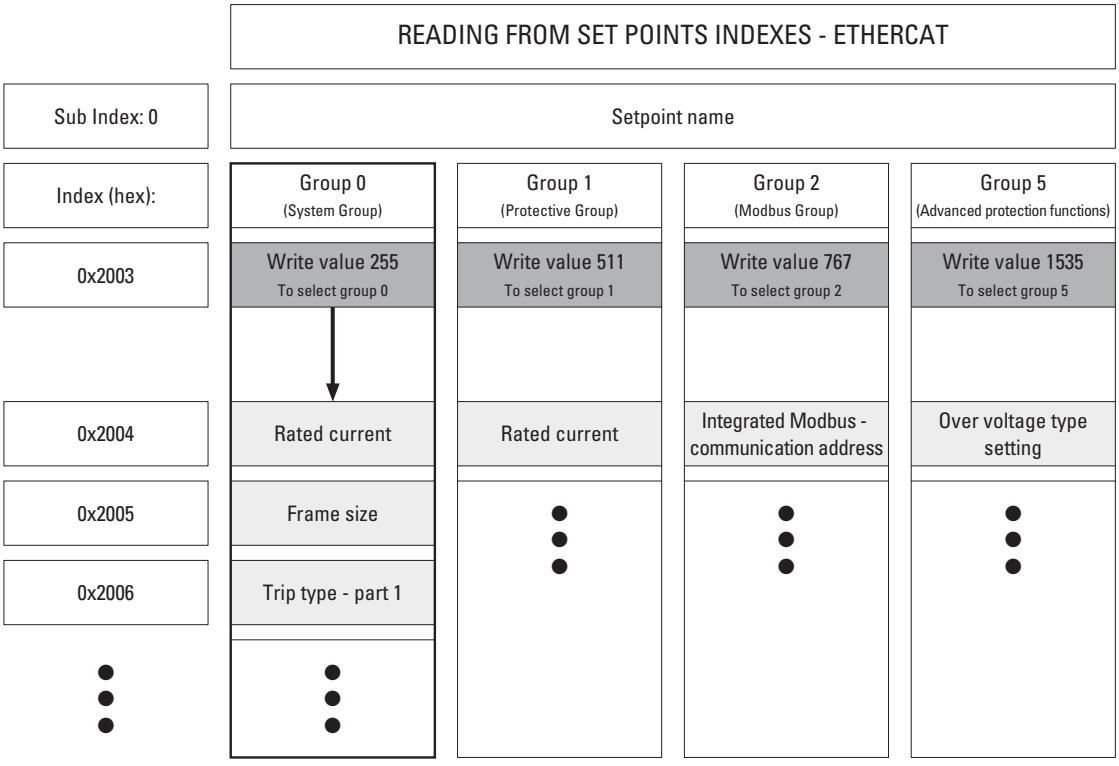


Figure 23: Reading from set points indexes – EtherCAT®

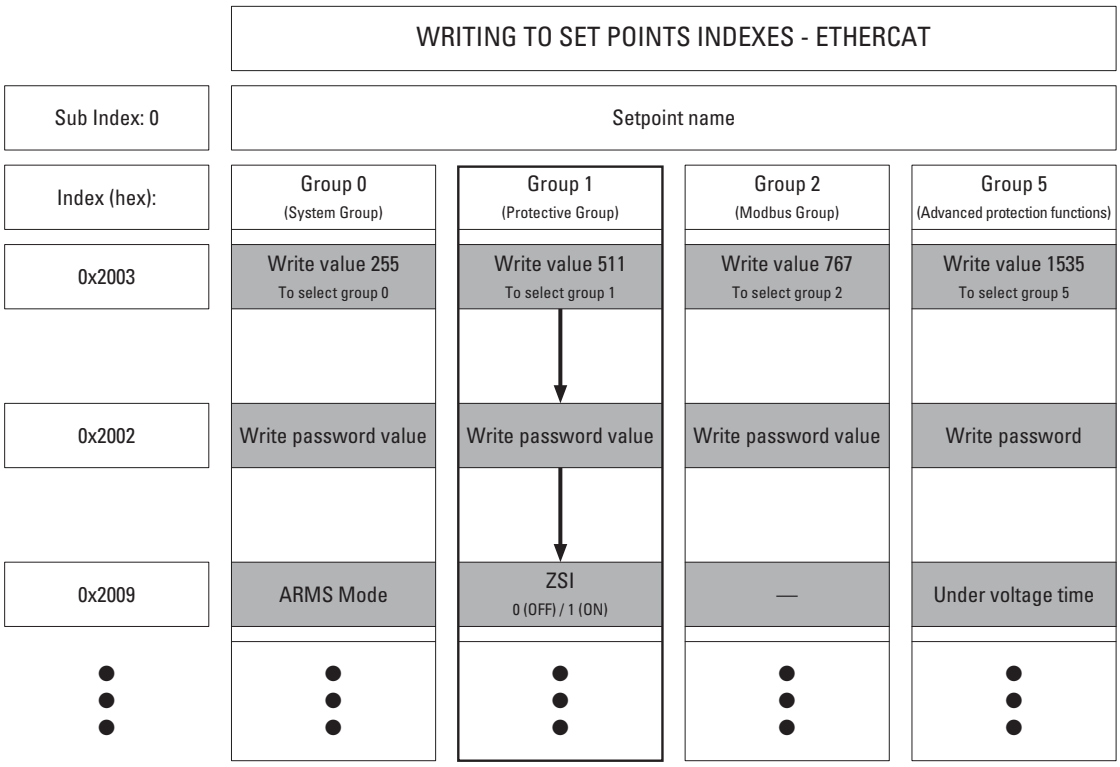


Figure 24: Writing to set points indexes – EtherCAT®

Table 68: Setting group 0: "System group" – EtherCAT®

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2002	15 - 0		Password	W	–	0000 (default setting	–
0x2003	15 - 0	0xFFFFFF	Group 0 = system	R/W		0x00FF	–
0x2004	12 - 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
0x0x2005	2 - 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
0x2006	3 - 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short-circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
0x2007			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	–
0x2008	8	0x0100	Maintenance mode: state	R	Encoded	0: off 1: on	–
	BBE	0x0001	Maintenance mode: remote control	R/W	Encoded	0: off 1: on	–
0x2009[1)]	2 - 0	0x0007	Maintenance mode: Trip setting	R/W	Encoded	1: 2.5 x I_n 2: 4 x I_n 3: 6 x I_n 4: 8 x I_n 5: 10 x I_n[2)]	A
0x200B[1)]	0	0x0001	Direction of incoming supply	R/W	Encoded	0: forward 1: reverse **Note:** only available on the PXR25	–

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x200C[1)]	0	0x0001	Sign convention	R/W	Encoded	Sign convention: 0: IEC 1: IEEE 2: IEEE old	–
0x200D[1)]			Power demand window	R/W	Encoded	Power demand: 0: fixed 1: sliding	–
0x200E[1)]			Power demand interval	R/W	Encoded	Power demand: 5 - 60 min (1 min increments)	–
0x0x2011			Configuration of relay 1	R/W	Encoded	Configuration of relay 1 and relay 2: → table 22, page 44	–
0x2012			Configuration of relay 2	R/W	Encoded		–
0x2014[1)]			Phase sequence - phase L1 (A)	R/W	Encoded	Phase L1 (A) 0: counterclockwise 1: clockwise	–
0x2017[1)]		0xBCC	Alarm - Residual Life	R/W	Encoded	Range: 50 - 100, step size 1, default value: 75 Alarm level value 100 ≙ 0 % residual life Alarm level value 75 ≙ 25 % residual life Formula for conversion: Alarm level expressed as a percentage = 100 - point value	–

1) PXR25 only!
2) For 600 A and 630 A frame size 3 breakers maximum trip setting is 8 x I_n

In setting group 0, the maintenance mode setting (index 2008) can be divided into two parts. The high byte is read only and is used for the status indication of the maintenance mode, the comprehensive results of the maintenance mode rotary switch, the secondary terminal and the communication settings. The low byte can be configured and is used to indicate the maintenance mode settings via the communication port.

The respective protection settings may vary according to the size, type and rated operational current of the release.

Table 69: Setting group 1: "Protection group" – EtherCAT®

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2002	15 - 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
0x2003	15 - 0	0xFFFFFF	Group 1 = protection	R/W			–
0x2004	12 - 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
0x2005	2 - 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
0x2006	3 - 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
0x2007			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	–
0x2008	0	0x0001	Thermal memory (overload protection)	R/W	Encoded	Activates/deactivates the thermal memory of the overload protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. Reactivate the thermal memory after testing: 0: switched off 1: switched on	–

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2009	0	0x0001	ZSI	R/W	Encoded	ZSI, zone-selectivity: If enabled for releases with ground-fault protection, ZSI is implemented for both the short-time delayed short-circuit release and for ground-fault protection. If enabled for releases without groundfault protection, ZSI is only implemented for the short-time delayed short-circuit release. 0: switched off 1: switched on	–
0x200A	0 - 1	0x0003	Overload release - waveform	R/W	Encoded	Waveform of the overload release 2: I^2t (default setting)	–
0x200B			Settings - release (I_r)	R/W	Unsigned 16	Settings – overload (I_r = x * I_n): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 40: 0.4 45: 0.45 50: 0.5 55: 0.55 60: 0.6 65: 0.65 70: 0.7 75: 0.75 80: 0.8 85: 0.85 90: 0.9 95: 0.95 100: 1.0 The following applies to the NZM PXR25: General value range: 20 - 1600 (in increments of 1 (1 A)) **Caution:** The value range depends on the type: (e.g. a 250-A switch can be set in the range from 40 % to 100 % of I_n (value range: 100 - 250)	–
0x200C			Settings - overload delay time (t_r)	R/W	Unsigned 16	Settings - overload delay time (t_r = x [s]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 40: 4 50: 5 60: 6 70: 7 80: 8 100: 10 120: 12 140: 14 160: 16 180: 18 200: 20 32767: ∞ (overload protection deactivated)	s

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x200D[1)]			Load alarm 1	R/W	Unsigned 16	Load alarm 1 level (AL1 = n % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 1 must be set equal or lower than load alarm 2. 85 % fixed value for PXR20 trip units	%
0x200E	0	0x0001	Short-time delayed short circuit release - waveform	R/W	Encoded	Waveform of the short-time delayed short-circuit release 0: flat (default setting) 1: I^2t	–
0x200F			Settings - short-time delayed short-circuit release (I_{sd})	R/W	Unsigned 16	Settings - short-time delayed short circuit release (I_{sd} = n x I_r): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2.0 30: 3.0 40: 4.0 50: 5.0 60: 6.0 65: 6.5 70: 7.0 75: 7.5 80: 8.0 85: 8.5 90: 9.0 95: 9.5 100: 10.0 The following applies to the NZM PXR25: The value range [20 - 100] corresponds to 2 to 10, in increments of 0.1 (1 for values)	A
0x2010			Settings - delay time of the short-time delayed short-circuit release (t_{sd})	R/W	Unsigned 16	Settings - delay time of the short-time delayed short-circuit release (t_{sd} = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 100] corresponds to 0 to 1,000 ms, respectively.	ms

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2011			Settings - instantaneous short-circuit release (I_i)	R/W	Unsigned 16	Settings - instantaneous short-circuit release ($I_i = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 30: 3 40: 4 50: 5 60: 6 70: 7 80: 8 90: 9 100: 10 110: 11 120: 12 140: 14 160: 16 180: 18 The following applies to the NZM PXR25: The value range [20 - 180] corresponds to 2 to 18, in increments of 0.1 (1 for values)	A
0x2012	0	0x0001	Type of ground-fault detection	R	Unsigned 16	Type of ground-fault detection: 0 = differential current detection	–
0x2013	0 - 1	0x0003	Settings - functioning of the ground-fault protection	R/W	Encoded	Type of ground-fault protection 0: trip 1: alarm 2: OFF	–
0x2014	0	0x0001	ground-fault release - waveform	R/W	Encoded	ground-fault release - waveform: 0: flat 1: I^2t	–
0x2015			Settings - ground-fault release (I_g)	R/W	Unsigned 16	Settings - ground-fault release ($I_g = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 0.2 30: 0.3 40: 0.4 60: 0.6 80: 0.8 100: 1.0 100: 1000 The value range [20 - 100] corresponds to 0.2 to 1.0, in increments of 0.1 (10 for values)	A

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2016			Settings - delay time of the ground-fault release (t_g)	R/W	Unsigned 16	Settings - delay time of the ground-fault release (t_g = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 100] corresponds to 0 to 1,000 ms, respectively.	ms
0x2017			Thermal memory (ground fault protection)	R/W	Encoded	Activates/deactivates the thermal memory of the ground-fault protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. **Note:** Must be reactivated after testing! 0: switched off 1: switched on	–
0x2018			Settings - neutral protection	R/W	Unsigned 16	Adjusts the neutral protection of an NZM PXR25 breaker with a "/VAR" variably adjustable neutral conductor 0 = 0 % 60 = 60 % 100 = 100 % (default setting) The lower setting affects the LSI protection functions of the switch, but not the ground-fault protection function ("G"). **Note:** L = long delay (= overload protection I_r) S = short delay (= short-time delayed short-circuit protection I_{sd}) I = instantaneous (= instantaneous shortcircuit protection I_i) G = ground fault (= ground fault protection I_g)	%
0x2019[1)]			Load alarm 2	R/W	Unsigned 16	Load alarm 2 level (AL2 = x % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 2 must be set higher than load alarm 1. 105 % fixed value for PXR20 trip units	%
0x201A			Pre-alarm of the groundfault release	R/W	Encoded	If the ground-fault protection function is set to "trip" (see index 2013), a pre-alarm can also be set. ($GF_{pre\text{-}alarm}$ = x % x I_g) 50 - 100 (in increments of 5 %)	%

1) Function is not supported by PXR20!

Table 70: Setting group 2: "Modbus" group – EtherCAT®

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2002	15 - 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
0x2003	15 - 0	0xFFFFFF	Group 2 = onboard Modbus	R/W	Encoded	0x02FF	–
0x2004	15 - 0		Integrated Modbus - communication address	R/W	Encoded	001 - 247 (default setting 002)	–
0x2005	15 - 0		Integrated Modbus - baud rate	R/W	Encoded	00: 9,600 bit/s 01: 19,200 bit/s (default setting) 02: 38,400 bit/s 02: 57,600 bit/s	–
0x2006	15 - 0		Integrated Modbus - parity	R/W	Encoded	00: none 01: odd 02: even (default setting)	–
0x2007	15 - 0		Integrated Modbus - stop bit	R/W	Encoded	00: 1 bit (default setting) 01: 2 bits	–

Table 71: Setting goup 5: Advanced protection functions[1] – EtherCAT®

Instance	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x2002	15 – 0		Password	W	Encoded	0000 (default setting)	–
0x2003		0xFFFFFF	Group 5: Advanced protection functions[1]	R/W	Encoded	0x05FF	–
0x2004	1 – 0		Over voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x2005			Over voltage pickup	R/W	Unsigned	180 - 850 (in increments of 1 V)	V
0x2006			Over voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x2007	1 – 0		Under voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x2008			Under voltage pickup	R/W	Unsigned	60 - 690 (in increments of 1V)	V
0x2009			Under voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x200A	1 – 0		Voltage unbalance type setting	R/W		0 = Trip 1 = Alarm 2 = OFF	–
0x200B			Voltage unbalance pickup	R/W	Unsigned	Voltage unbalance level = n % x Max line-to-line voltage 5 - 25 (in increments of 1%)	%
0x200C			Voltage unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x200D	1 – 0		Current unbalance type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x200E			Current unbalance pickup	R/W	Unsigned	Current unbalance level = n % x Max I_L 5 - 25 (in increments of 1 %)	%
0x200F			Current unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x2010	1 – 0		Reverse power type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x2011			Reverse power pickup	R/W	Unsigned	1 - 65,500 (in increments of 1 kW)	kW
0x2012			Reverse power time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x2013	0		Phase rotation sensing type	R/W	Encoded	0 = ABC (-NA breakers) / 0 = 123 (IEC breakers) 1 = CBA (-NA breakers) / 0 = 321 (IEC breakers)	–
0x2014	1 – 0		Phase rotation type settting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x2015	1 – 0		Phase loss type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x2016			Phase loss time	R/W	Unsigned	1 - 240 (in increments of 1 s)	s

1) PXR25 only!

10.2.3.4 Event logs

A trip event provides historical values for the data objects at the time the event has occurred. The trip unit classifies the event information in order to be able to provide a different quantity for each type. The EtherCAT® communication can only access the historical summary, as well as the trip and event data.

Table 72: Event classification – EtherCAT®

Event type	Quantity of numbers stored	Description of the event log
Summary	200	→ table 73
Tripping	10	→ table 74
Alarms	10	→ table 74 and → table 75

A single trip may be registered under multiple event types. For example, a protective trip may be recorded in the summary log (→ table 73) as well as in the trip log (→ table 74).

Event logs information is accessed via sub index: 0 and indexes according to → tables 73, 74 and 75.

If the event type selection is written to index 213C, the first and last event ID can be retrieved from instances 213D and 213E, respectively, in order to determine the range of events that have been stored for the selected event type. Index 213F is a R/W register for selecting the ID of the event in question. If the requested event has been recorded by the device, instances 2140 and 2141 will supply both the ID of the previous event and that of the next event.

If the device has not recorded the event in question, the exception code can be queried by requesting the Modbus communication status of the ECAM from the controller via a dedicated industrial protocol object (sub index: 0 and index 2167).

→ For more information on the exception codes, see → section 10.2.3.11, “Exception codes”, page 160.

The date and time at which the requested event occurred are read in log 2142, with the same date and time description as in → table 77, page 157. This value corresponds to the time at which the historical event occurred.

Log 2143 indicates the data content of the selected event type. This is a constant value for the three event types supported by the module.

The event data also provide a valid bit for each data object, starting with index 2144. If bit 0 is set to 1, the initial data will be valid for the current trip type, bit 1 for the second data object, bit 2 for the third data object, and so forth.

The number of valid bit registers is calculated as:
(number of data objects - 1)/16.

The following indexes are assigned to the data objects.

Table 73: Event summary – EtherCAT®

Index [Hex]	Format	R/W	Description (historical event overview)
0x213C	Encoded	R/W	Event type: summary = 0x8EFF
0x213D	Unsigned 32	R	Earliest event ID
0x213E	Unsigned 32	R	Latest event ID
0x213F	Unsigned 32	R/W	Requested event ID
0x2140	Unsigned 32	R	Previous event ID
0x2141	Unsigned 32	R	Next event ID
0x2142	Date/time	R	Date/time
0x2143	Encoded	R	Data format: 0x0000: Basic event 0x0001: Time adjustment 0x0004: Trip 0x0005: Alarm 0x0006: Minor alarm
0x2144	B0	R	Validity bit of the object
0x2145	Encoded	R	Cause of event: 00: boot process - time OK 01: download of the setpoint values 02: time has been adjusted 03: trip 04: alarm 05: test mode has been selected 06: exiting the test mode 08: boot process - no time 09: test completed 10: maintenance mode activated 11: maintenance mode deactivated 12: opened via the communication interface 13: closed via the communication interface

Table 74: Historical trip / major alarm event – EtherCAT®

Index [Hex]	Format	R/W	Description (historical event overview)	Unit
0x213C	Encoded	R/W	Event type: trip: 0x80FF alarm: 0x81FF	–
0x213D	Unsigned 32	R	Earliest event ID	–
0x213E	Unsigned 32	R	Latest event ID	–
0x213F	Unsigned 32	R/W	Requested event ID	–
0x2140	Unsigned 32	R	Previous event ID	–
0x2141	Unsigned 32	R	Next event ID	–
0x2142	Date/time	R	Date/time	–
0x2143	Encoded	R	Data format: trip: 0x0004 main alarm: 0x0005	–
0x2144	Bit 15 – Bit 0	R	Valid bits of the object	–

Index [Hex]	Format	R/W	Description (historical event overview)	Unit
0x2145	Bit 31 – Bit 16	R	Valid bits of the object	–
0x2146	Encoded	R	Status reason (primary, secondary, reason)	–
0x2147	Unsigned 32	R	I_{L1} (IA)	A
0x2148	Unsigned 32	R	I_{L2} (IB)	A
0x2149	Unsigned 32	R	I_{L3} (IC)	A
0x214A	Unsigned 32	R	I_N (IN)	A
0x214C	Unsigned 32	R	I_G (IG residual)	A
0x214D	Unsigned 16	R	U_{L1-L2} (VAB)	V
0x214E	Unsigned 16	R	U_{L2-L3} (VBC)	V
0x214F	Unsigned 16	R	U_{L3-L1} (VCA)	V
0x2150	Unsigned 16	R	U_{L1-N} (VAN)	V
0x2151	Unsigned 16	R	U_{L2-N} (VBN)	V
0x2152	Unsigned 16	R	U_{L3-N} (VCN)	V
0x2153	Signed 32	R	Active 3-phase power	W
0x2154	Signed 32	R	Reactive 3-phase power	VAR
0x2155	Unsigned 32	R	Apparent 3-phase power	VA
0x2156	Signed 32	R	Active power demand	W
0x2157	Signed 32	R	Reactive power demand	VAR
0x2158	Unsigned 32	R	Apparent power demand	VA
0x2159	Signed 16	R	N/A	–
0x215A	Unsigned 16	R	Frequency	1/10 Hz
0x215B	Signed 16		Apparent power factor	1/100 pf
0x215C	Unsigned 16	R	Number of operations	–
0x215D	Bit 31 – Bit 0	R	Binary status with valid bits	–

Table 75: Minor alarm event – EtherCAT®

Index [Hex]	Format	R/W	Description (historical event overview)
0x213C	Encoded	R/W	Event type: summary = 0x81FF
0x213D	Signed 32	R	Earliest event ID
0x213E	Signed 32	R	Latest event ID
0x213F	Signed 32	R/W	Requested event ID
0x2140	Signed 32	R	Previous event ID
0x2141	Signed 32	R	Next event ID
0x2142	Date/time	R	Date/time
0x2143	Encoded	R	Data format: Small alarm: 0x0006
0x2144	Bit 0	R	Valid bits of the object
0x2145	Encoded	R	Status reason (primary, secondary, reason code)

10.2.3.5 Remote control

One index with 3 elements of 16 bits is reserved for remote control of the release, accessed via sub index: 0 and index 2166. These three elements should be written together with a "slave action code" and the corresponding ones' complement.

The data format registers, which is an array of 16 bits, are shown below.

Data format for remote control

Index 2166 - Element 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 1 (slave action)								Byte 0 (slave action)							

Index 2166 - Element 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 0 (slave action)								Byte 2 (slave action)							

Index 2166 - Element 3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 2 (slave action)								Ones' complement of byte 1 (slave action)							

The "slave action code" and its functioning are listed in → table 76, and whether it is supported depends on the specific product.

If the "slave action code" and the associated ones' complement command are valid, the release will perform the action in question. If the "slave action code" and the associated ones' complement command are invalid, the exception code can be queried by requesting the Modbus communication status of the ECAM from the controller via a dedicated industrial protocol object (via sub index: 0 and index 2167).

→ For more information on the exception codes, see → section 10.2.3.11, "Exception codes", page 160.

Table 76: Remote control – EtherCAT®

Command group	Definition	Pass-word	Decimal byte						Decimal word		
			8550 Byte 5	8550 Byte 4	8550 Byte 3	8550 Byte 2	8550 Byte 1	8550 Byte 0	8550 Word 3	8550 Word 2	8550 Word 1
Reset	Reset the trip	No	255	255	253	0	0	2	65535	64768	2
	Reset the min./max. values of currents	Yes	255	254	242	0	1	13	65534	61952	269
	Reset the min./max. values of the L-N voltages[1)]	Yes	255	254	240	0	1	15	65534	61440	271
	Reset the min./max. values of the L-L voltages[1)]	Yes	255	254	241	0	1	14	65534	61696	270
	Reset the peak power requirement[1)]	Yes	255	255	251	0	0	4	65535	64256	4
	Reset all min./max. values	Yes	255	254	251	0	1	4	65534	64256	260
	Reset the energy[1)]	Yes	255	255	247	0	0	8	65535	63232	8
	Reset trip count	Yes	255	250	254	0	5	1	65530	65024	1281
	Reset the operations count	Yes	255	254	253	0	1	2	65534	64768	258
	Reset max. temperature	Yes	255	250	253	0	5	2	65530	64768	1282
	Reset runtime	Yes	255	254	252	0	1	3	65534	64512	259
	Reset all diagnostics information	Yes	255	250	252	0	5	3	65530	64512	1283
	Reset the power-up display	No	255	255	252	0	0	3	65535	64512	3
	Open breaker	Yes	254	255	255	1	0	0	65279	65281	0

Command group	Definition	Password	Decimal byte						Decimal word		
			8550 Byte 5	8550 Byte 4	8550 Byte 3	8550 Byte 2	8550 Byte 1	8550 Byte 0	8550 Word 3	8550 Word 2	8550 Word 1
Maintenance mode	Activate the maintenance mode	No	254	255	247	1	0	8	65279	63233	8
	Deactivate the maintenance mode	No	254	255	246	1	0	9	65279	62977	9
Relay output	Activate relay output 1	No	251	254	254	4	1	1	64510	65028	257
	Deactivate relay output 1	No	251	253	254	4	2	1	64509	65028	513
	Activate relay output 2	No	251	254	253	4	1	2	64510	64772	258
	Deactivate relay output 2	No	251	253	253	4	2	2	64509	64772	514

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x2166		0x2166		0x2166		0x2166	0x2166	0x2166
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Reset	Reset the trip	No	0x00FF	0x00FF	0x00FD	0x0000	0x0000	0x0002	0xFFFF	0xFD00	0x0002
	Reset the min./max. values of currents	Yes	0x00FF	0x00FE	0x00F2	0x0000	0x0001	0x000D	0xFFFE	0xF200	0x010D
	Reset the min./max. values of the L-N voltages[1)]	Yes	0x00FF	0x00FE	0x00F0	0x0000	0x0001	0x000F	0xFFFE	0xF000	0x010f
	Reset the min./max. values of the L-L voltages[1)]	Yes	0x00FF	0x00FE	0x00F1	0x0000	0x0001	0x000E	0xFFFE	0xF100	0x010E
	Reset the peak power requirement[1)]	Yes	0x00FF	0x00FF	0x00FB	0x0000	0x0000	0x0004	0xFFFF	0xFB00	0x0004
	Reset all min./max. values	Yes	0x00FF	0x00FE	0x00FB	0x0000	0x0001	0x0004	0xFFFE	0xFB00	0x0104
	Reset the energy[1)]	Yes	0x00FF	0x00FF	0x00F7	0x0000	0x0000	0x0008	0xFFFF	0xF700	0x0008
	Reset trip count	Yes	0x00FF	0x00FA	0x00FE	0x0000	0x0005	0x0001	0xFFFA	0xFE00	0x0501
	Reset the operations count	Yes	0x00FF	0x00FE	0x00FD	0x0000	0x0001	0x0002	0xFFFE	0xFD00	0x0102
	Reset max. temperature	Yes	0x00FF	0x00FA	0x00FD	0x0000	0x0005	0x0002	0xFFFA	0xFD00	0x0502
	Reset runtime	Yes	0x00FF	0x00FE	0x00FC	0x0000	0x0001	0x0003	0xFFFE	0xFC00	0x0103
	Reset all diagnostics information	Yes	0x00FF	0x00FA	0x00FC	0x0000	0x0005	0x0003	0xFFFA	0xFC00	0x0503
	Reset the power-up display	No	0x00FF	0x00FF	0x00FC	0x0000	0x0000	0x0003	0xFFFF	0xFC00	0x0003
	Open breaker	Yes	0x00FE	0x00FF	0x00FF	0x0001	0x0000	0x0000	0xFEFF	0xFF01	0x0000
Maintenance mode	Activate the maintenance mode	No	0x00FE	0x00FF	0x00F7	0x0001	0x0000	0x0008	0xFEFF	0xF701	0x0008
	Deactivate the maintenance mode	No	0x00FE	0x00FF	0x00F6	0x0001	0x0000	0x0009	0xFEFF	0xF601	0x0009

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x2166		0x2166		0x2166		0x2166	0x2166	0x2166
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Relay output	Activate relay output 1	No	0x00FB	0x00FE	0x00FE	0x0004	0x0001	0x0001	0xFBFE	0xFE04	0x0101
	Deactivate relay output 1	No	0x00FB	0x00FD	0x00FE	0x0004	0x0002	0x0001	0xFBFD	0xFE04	0x0201
	Activate relay output 2	No	0x00FB	0x00FE	0x00FD	0x0004	0x0001	0x0002	0xFBFE	0xFD04	0x0102
	Deactivate relay output 2	No	0x00FB	0x00FD	0x00FD	0x0004	0x0002	0x0002	0xFBFD	0xFD04	0x0202

10.2.3.6 Date and time

The release supports the reading and writing of real-time clock information by the external communication module EtherCAT®.

Eight registers, starting with index number 215E, are reserved for this purpose.

Note: The day of the week (index 2161) is set automatically once year, month and date registers are set. Therefore this is a read only register.

Table 77: Real-time clock – EtherCAT®

Index [Hex]	Definition	Data range	Format
0x215E	Month	1 - 12	Unsigned 16
0x215F	Day	1 - 31	Unsigned 16
0x2160	Year	2000 - 2099	Unsigned 16
0x2161	Day of the week	1 = Sunday … 7 = Saturday	Unsigned 16
0x2162	Hour	0 - 23	Unsigned 16
0x2163	Minute	0 - 59	Unsigned 16
0x2164	Seconds	0 - 59	Unsigned 16
0x2165	1/100 of a second	0 - 99	Unsigned 16

10.2.3.7 Primary status codes

Table 78: Primary status codes – EtherCAT®

Code	Meaning
0x01	open
0x02	closed
0x03	tripped
0x04	Alarm active
0x0D	Threshold value active

10.2.3.8 Secondary status codes

Table 79: Secondary status codes – EtherCAT®

Code	Meaning
0x01	not applicable
0x03	Test mode
0x07	has been switched on since last trip / triggered alarm
0x08	Alarm

10.2.3.9 Reason codes

Table 80: Reason codes – EtherCAT®

Code [Hex]	Meaning
0x0000	unknown
0x0001	normal
0x0003	Instantaneous short circuit
0x000E	Auxiliary power supply too low
0x0011	Current imbalance
0x001F	Operation count
0x0021	Control via the communication interface
0x0025	Coil monitoring
0x002B	Diagnostic warning #2 (configuration read error)
0x003D	Overload
0x003E	Short-time delay
0x0049	Phase currents are close to the threshold value, load alarm
0x004C	Override
0x004D	Setpoint error
0x004E	Overtemperature
0x0050	Overload (neutral conductor)
0x0054	Ground fault

Code [Hex]	Meaning
0x0071	Calibration
0x0088	Real-time clock
0x0099	Maintenance mode
0x009A	Fault in the breaker mechanism
0x07FC	Digital bypass
0x07FD	Non-volatile memory failure
0x07FE	Watchdog fault
0x07FF	Motor alarm or motor tripping

10.2.3.10 Device information

The device information (fixed data range) includes, for example, the device name, model name, catalogue number, version number, serial number, date code, firmware version 1 and 2, USB version, and product ID.

Table 81: Reason code definitions – EtherCAT®

Index [Hex]	Description	Format	Range	Register	Comment
0x202A	Device name	ASCII	16 characters	8	EATON PXR20 EATON PXR25
0x202B	Model name	ASCII	16 characters	8	PXR 20/25 MCCB
0x202C	Catalogue number	ASCII	32 characters	16	internal catalogue number (max. 20 characters)
0x202D	Style number	ASCII	32 characters	16	internal version number (max. 20 characters)
0x202E	Serial number	ASCII	32 characters	16	if supported
0x202F	Date code	ASCII	12 characters	6	yy.mm.dd
0x2030	Firmware version 1	ASCII	16 characters	8	Sample version 01.02.0033
0x2031	Firmware version 2	ASCII	16 characters	8	Sample version 01.02.0033
0x2032	USB version	ASCII	16 characters	8	Sample version 01.02.0033
0x2033	Release family	Unsigned 16	16-bit	1	PXR20: 0x01 PXR25: 0x01

Index [Hex]	Description	Format	Range	Register	Comment
0x2034	Standard	Unsigned 16	16-bit	1	IEC only: 0x01 UL only: 0x02 UL / IEC: 0x03
0x2035	Poles	Unsigned 16	16-bit	1	3-pole / 4-pole
0x2037	Product ID	Bitmap	32-bit	2	ppppppvvvvdddddd Division code (dddddd) 06 (0x06) Product code (pppppp): 2: NZM2 PXR 3: NZM3 PXR 4: NZM4 PXR Comm version (vvvv) 0

10.2.3.11 Exception codes

If there is an error in the request or the response, the release will return an exception code, via index 2167.

Table 82: Exception codes – EtherCAT®

Modbus returned exception code values	Meaning
0	No error
8	Timeout error occurred
10	Illegal function exception
11	Illegal data address
12	Illegal data value
13	Slave device failure
14	Slave acknowledge
15	Slave device busy
16	Memory parity error
17	ECAM path unavailable
18	ECAM target device failed to respond

10.3 PROFINET

The PXR-ECAM-PNET is designed to connect with an electronic trip unit's internal communication module (PXR-RCAM-MRTU-I) Modbus-RTU link and expand the communication capabilities into PROFINET.

The PXR-ECAM-PNET is intended for use with PXR20 or PXR25 moulded case circuit breakers (MCCB).

This section details the data and functions available for the Digital NZM with PXR20 or PXR25 trip units via the PXR-ECAM-PNET register map.

Depending upon trip unit capabilities, a large number of features are accessible through the registers as following described.

10.3.1 Configuration of the Modbus parameters

In order to synchronize the communication between the breaker Modbus RTU (slave device) and the ECAM (which acts as the Modbus RTU master device), the slave ID (Modbus RTU slave), baud rate and parity bit settings of both devices must be configured with the same values.

The ECAM's Modbus RTU slave ID (which the master device addresses to), baud rate and parity bit settings can be configured via API 0, indexes 0x1F4m 0x1F5 and 0x1F6.

Both, Modbus Slave (PXR-RCAM-MRTU-I) and Modbus Master (PXR-ECAM-PNET) have the same default parameters. In case the Modbus RTU slave parameters are not changed from the default values, the values of this communication module do not need to be changed as well. The API 0, indexes 0x1F4, 0x1F5 and 0x1F6, only provide the possibility to do so, if desired by the user.

The stop bit is automatically set up and the value is 1.

The default settings of the Modbus Slave and Modbus Master are as follows:

Table 83: PROFINET settings - PROFINET

Setting value	Index Number [Hex]	Data range	Default value
Slave ID	0x1F4	1 - 247	2
Baud rate	0x1F5	00: 9,600 bit/s 01: 19,200 bit/s 02: 38,400 bit/s 03: 57,600 bit/s	01
Parity	0x1F6	00: none 01: odd 02: even	02

The valid parameter values will be applied instantly. Writing parameter values outside valid ranges has no effect.

After a power-cycle, meaning the switch off the trip unit, the PXR-ECAM-PNET does not save configured values but returns them to default values.

The Modbus communication parameters of the NZM breaker (Modbus RTU slave) cannot be configured via Ethernet communication adapter module (ECAM).

10.3.2 IP configuration/DIP Switch Settings

The DIP switches are used to configure the device's fieldbus addresses. Flipping a single switch adds the switch specific value to the total address value. As a result, values in a range from 0 to 255 can be configured that way.

Table 84: Fieldbus address configuration via DIP switch

Switch	1	2	3	4	5	6	7	8
Value	1	2	4	8	16	32	64	128

For example, flipping switches 4 and 6 results in the address 40.

Figure 25: DIP switches flipping example

Table 85: Fieldbus address configuration via DIP switch

Switches Setting Value	**Remarks**
000	If the DIP switches are set to 0, the IP address settings stored in the NV-memory of the device are used. The factory default behaviour is DHCP. The IP address settings can be configured by the IPconfig tool. The tool can be downloaded here: https://www.eaton.com/digitalnzm
001	If the DIP switches are set to 1, the address settings of the device are as follows: IP address: 192.168.1.1 Subnet mask: 255.255.255.0 Default Gateway: 192.168.1.2
001 - 254	If the DIP switches are set in the range from 1 to 254, the IP address settings of the device are determined by the switches: IP address: 192.168.1.<DIP Switch Setting> Subnet mask: 255.255.255.0 Default Gateway: 192.168.1.1
255	Invalid Setting. Device will not start-up properly. PWR and GW are flashing red.

10.3.3 PROFINET (GSDML file)

Each device in a PROFINET network is associated with a PROFINET GSDML file, which describes the implementation of the product. This file is used by the network configuration tool during network configuration.

→ If necessary, the latest version of the GSDML file for the PXR-ECAM-PNET can be downloaded here:
https://www.eaton.com/digitalnzm

10.3.4 PROFINET register map

There are seven different release types in the NZM digital circuit breaker family. As a result, the devices access the registers differently, since not all versions support all functions.

The release type -AX does not support a communication connection; register access is therefore not possible.

→ The available functions overview, for each trip unit type, can be found in → chapter 3, "Protection and measurement functions".

10.3.4.1 Input status (discrete inputs)

The input status bits can be requested via API: 0, index 1.
The input status answer is a 4 bytes data type. The first 16 bits (1001 - 1016) indicate the current status, while the last 16 bits (1017 - 1032) indicate whether the corresponding status is valid or supported by the release unit.

Table 86: Input status - PROFINET

Input	Description or value	Input	Description or value
1001	The breaker is in the closed position	1017	The breaker is in the closed position and is valid
1002	Unacknowledged trip condition	1018	Unacknowledged trip condition is valid
1003	Active or unacknowledged alarm	1019	Active or unacknowledged alarm is valid
1004	0	1020	0
1005	Maintenance mode is active	1021	Maintenance mode is active and valid
1006	Test mode is active	1022	Test mode is active and valid
1007	0	1023	0
1008	0	1024	0
1009	Clockwise phase sequence (ABC)	1025	Clockwise phase sequence (ABC) valid
1010	Overload mode is active (an overload is present)	1026	Overload mode is active and valid (an overload is present)
1011	Zone selectivity (ZSI) is active	1027	Zone selectivity (ZSI) is active and valid
1012	0	1028	0
1013	Ground-fault protection type is "source ground"	1029	Ground-fault protection type is "source ground" and valid
1014	0	1030	0
1015	0	1031	0
1016	0	1032	0

10.3.4.2 Real-time data object register

Data that is subject to real-time changes, such as current, voltage and energy, can be requested via API: 0 and indexes according to → table 87.

Real-time data can be obtained either in IEEE floating-point or fixed-point format. For data displayed in fixed-point format, each result is presented as a multiplication of the real-time data with a scaling factor.
Energy objects can only be obtained in fixed-point format.

Indexes for which the IEEE floating-point value is not specified are only supported in fixed-point format (FP).

Table 87: Real-time data register - PROFINET

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x0038	0x00B6	Cause of status (→ table 98, → table 99): High byte = primary status Low byte = secondary status	–	Encoded	–	Yes	Yes
0x0039	0x00B7	I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
0x003A	0x00B8	I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
0x003B	0x00B9	I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
0x003C	0x00BA	I_G (IG)	A	Unsigned 32	10	Yes	Yes
0x003D	0x00BB	I_N (IN)	A	Unsigned 32	10	Yes	Yes
0x003E	0x00BC	U_{L1-L2} (VAB)	V	Unsigned 32	10	–	Yes
0x003F	0x00BD	U_{L2-L3} (VBC)	V	Unsigned 32	10	–	Yes
0x0040	0x00BE	U_{L3-L1} (VCA)	V	Unsigned 32	10	–	Yes
0x0041	0x00BF	U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
0x0042	0x00C0	U_{L2-N} (VBN)	V	Unsigned 32	10	–	Yes
0x0043	0x00C1	U_{L3-N} (VCN)	V	Unsigned 32	10	–	Yes
0x0048	0x00C6	Active 3-phase power	W	Signed 32	1	–	Yes
0x0049	0x00C7	Reactive 3-phase power	Var	Signed 32	1	–	Yes
0x004A	0x00C8	Apparent 3-phase power	VA	Unsigned 32	1	–	Yes
0x004B	0x00C9	Power factor	–	Signed 32	100	–	Yes
0x004C	0x00CA	Frequency	Hz	Unsigned 16	10	–	Yes
0x0051	0x00CF	Peak active power demand	W	Signed 32	1	–	Yes
0x0052	0x00D0	Product ID	–	Unsigned 32	–	Yes	Yes
0x0053	0x00D1	Frequency	Hz	Unsigned 16	100	–	Yes
–	0x00D2	Active energy (forward)	kWh	Unsigned 32	1	–	Yes
–	0x00D3	Active energy (reverse)	kWh	Unsigned 32	1	–	Yes
–	0x00D4	Active energy combined (= forward + reverse)	kWh	Unsigned 32	1	–	Yes
–	0x00D5	Apparent energy	kVAh	Unsigned 32	1	–	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
–	0x00D6	Active energy (forward)	Wh	Unsigned 64	1	–	Yes
–	0x00D7	Active energy (reverse)	Wh	Unsigned 64	1	–	Yes
–	0x00D8	Active energy combined (= forward + reverse)	Wh	Signed 64	1	–	Yes
–	0x00D9	Apparent energy	VAh	Unsigned 64	1	–	Yes
0x0054	0x00DA	Peak reactive power demand	Var	Signed 32	1	–	Yes
0x0055	0x00DB	Peak apparent power demand	VA	Unsigned 32	1	–	Yes
0x005A	0x00E0	Active power demand	W	Signed 32	1	–	Yes
0x005B	0x00E1	Reactive power demand	Var	Signed 32	1	–	Yes
0x005C	0x00E2	Apparent power demand	VA	Unsigned 32	1	–	Yes
0x005D	0x00E3	Minimum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
0x005E	0x00E4	Maximum value - I_{L1} (IA)	A	Unsigned 32	10	Yes	Yes
0x005F	0x00E5	Minimum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
0x0060	0x00E6	Maximum value - I_{L2} (IB)	A	Unsigned 32	10	Yes	Yes
0x0061	0x00E7	Minimum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
0x0062	0x00E8	Maximum value - I_{L3} (IC)	A	Unsigned 32	10	Yes	Yes
0x0063	0x00E9	Minimum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
0x0064	0x00EA	Maximum value - I_G (IG)	A	Unsigned 32	10	Yes	Yes
0x0065	0x00EB	Minimum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
0x0066	0x00EC	Maximum value - I_N (IN)	A	Unsigned 32	10	Yes	Yes
0x0067	0x00ED	Minimum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
0x0068	0x00EE	Maximum value - U_{L1} (VA)	V	Unsigned 32	10	–	Yes
0x0069	0x00EF	Minimum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
0x006A	0x00F0	Maximum value - U_{L2} (VB)	V	Unsigned 32	10	–	Yes
0x006B	0x00F1	Minimum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
0x006C	0x00F2	Maximum value - U_{L3} (VC)	V	Unsigned 32	10	–	Yes
0x006D	0x00F3	Minimum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
0x006E	0x00F4	Maximum value - U_{L1-N} (VAN)	V	Unsigned 32	10	–	Yes
0x006F	0x00F5	Minimum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
0x0070	0x00F6	Maximum value - U_{L2-N} (VAN)	V	Unsigned 32	10	–	Yes
0x0071	0x00F7	Minimum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
0x0072	0x00F8	Maximum value - U_{L3-N} (VAN)	V	Unsigned 32	10	–	Yes
0x0073	0x00F9	Overload pre-warning	%	Unsigned 32	1	–	Yes
0x0074	0x00FA	Current phase unbalance	%	Unsigned 32	100	–	Yes
0x0075	0x00FB	Voltage phase unbalance	%	Unsigned 32	100	–	Yes
0x0076	0x00FC	THD % value - I_{L1} (IA)	%	Unsigned 32	100	–	Yes
0x0077	0x00FD	THD % value - I_{L2} (IB)	%	Unsigned 32	100	–	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x0078	0x00FE	THD % value - I_{L3} (IC)	%	Unsigned 32	100	–	Yes
0x0079	0x00FF	THD % value - I_N (IN)	%	Unsigned 32	100	–	Yes
0x007A	0x0100	THD % value - U_{L1} (VA)	%	Unsigned 32	100	–	Yes
0x007B	0x0101	THD % value - U_{L2} (VB)	%	Unsigned 32	100	–	Yes
0x007C	0x0102	THD % value - U_{L3} (VC)	%	Unsigned 32	100	–	Yes
0x007D	0x0103	THD % value - U_{L1-N} (VAN)	%	Unsigned 32	100	–	Yes
0x007E	0x0104	THD % value - U_{L2-N} (VBN)	%	Unsigned 32	100	–	Yes
0x007F	0x0105	THD % value - U_{L3-N} (VCN)	%	Unsigned 32	100	–	Yes
0x0080	0x0106	PXR state flag1 Bit 0: USB cable connected Bit 1: Breaker is ON (HIN) Bit 2: Breaker is Tripped (HIA) Bit 3: Maintenance mode activated via ARMS wiring on interface module Bit 4: Maintenance mode activated via any communication link Bit 5: N/A Bit 6: Maintenance mode activated Bit 7: Auxiliar supply connected to BSM	–	Unsigned 16	1	–	Yes
0x0081	0x0107	Counter - I_{sd}, I_i tripping	–	Unsigned 16	1	Yes	Yes
0x0082	0x0108	Counter - I_r, I_g tripping	–	Unsigned 16	1	Yes	Yes
0x0083	0x0109	Operations counter	–	Unsigned 16	1	Yes	Yes
0x0084	0x010A	Counter - I_{sd} tripping	–	Unsigned 16	1	Yes	Yes
0x0085	0x010B	Counter - I_i tripping	–	Unsigned 16	1	Yes	Yes
0x0086	0x010C	Counter - bypass tripping	–	Unsigned 16	1	Yes	Yes
0x0087	0x010D	Counter - I_r tripping	–	Unsigned 16	1	Yes	Yes
0x0088	0x010E	Counter - I_g tripping	–	Unsigned 16	1	Yes	Yes
0x0089	0x010F	Counter - trips total	–	Unsigned 16	1	Yes	Yes
0x008A	0x0110	Counter - test mode tripping	–	Unsigned 16	1	Yes	Yes
0x008B	0x0111	Counter - number of openings via the communication interface	–	Unsigned 16	1	Yes	Yes
0x008C	0x0112	Counter - external actuation[1)]	–	Unsigned 16	1	Yes	Yes
0x008D	0x0113	Time of last actuation (year, month, day, hour, minute, second)	–	Unsigned 16	–	Yes	Yes
0x008E	0x0114	Operating time[2)] in minutes	min	Unsigned 16	1	Yes	Yes
0x008F	0x0115	Operating time[2)] in hours	h	Unsigned 16	1	Yes	Yes
0x0090	0x0116	Operating time[2)] in days	d	Unsigned 16	1	Yes	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x0091	0x0117	Residual life[3)]	points	Unsigned 16	–	Yes	Yes
0x0092	0x1118	Harmonics are for: 0 - I_{L1} (IA) 1 - I_{L2} (IB) 2 - I_{L3} (IC) 4 - I_N (IN) 5 - U_{L1} (VA) 6 - U_{L2} (VB) 7 - U_{L3} (VC) 8 - U_{L1-N} (VAN) 9 - U_{L2-N} (VBN) 10 - U_{L3-N} (VCN)	–	Unsigned 16	1	–	Yes
0x0093	0x0119	Item harmonics [0]	%	Unsigned 16	100	–	Yes
0x0094	0x011A	Item harmonics [1]	%	Unsigned 16	100	–	Yes
0x0095	0x011B	Item harmonics [2]	%	Unsigned 16	100	–	Yes
0x0096	0x011C	Item harmonics [3]	%	Unsigned 16	100	–	Yes
0x0097	0x011D	Item harmonics [4]	%	Unsigned 16	100	–	Yes
0x0098	0x011E	Item harmonics [5]	%	Unsigned 16	100	–	Yes
0x0099	0x011F	Item harmonics [6]	%	Unsigned 16	100	–	Yes
0x009A	0x0120	Item harmonics [7]	%	Unsigned 16	100	–	Yes
0x009B	0x0121	Item harmonics [8]	%	Unsigned 16	100	–	Yes
0x009C	0x0122	Item harmonics [9]	%	Unsigned 16	100	–	Yes
0x009D	0x0123	Item harmonics [10]	%	Unsigned 16	100	–	Yes
0x009E	0x0124	Item harmonics [11]	%	Unsigned 16	100	–	Yes
0x009F	0x0125	Item harmonics [12]	%	Unsigned 16	100	–	Yes
0x00A0	0x0126	Item harmonics [13]	%	Unsigned 16	100	–	Yes
0x00A1	0x0127	Item harmonics [14]	%	Unsigned 16	100	–	Yes
0x00A2	0x0128	Item harmonics [15]	%	Unsigned 16	100	–	Yes
0x00A3	0x0129	Item harmonics [16]	%	Unsigned 16	100	–	Yes
0x00A4	0x012A	Item harmonics [17]	%	Unsigned 16	100	–	Yes
0x00A5	0x012B	Item harmonics [18]	%	Unsigned 16	100	–	Yes
0x00A6	0x012C	Item harmonics [19]	%	Unsigned 16	100	–	Yes
0x00A7	0x012D	Item harmonics [20]	%	Unsigned 16	100	–	Yes
0x00A8	0x012E	Item harmonics [21]	%	Unsigned 16	100	–	Yes
0x00A9	0x012F	Item harmonics [22]	%	Unsigned 16	100	–	Yes
0x00AA	0x0130	Item harmonics [23]	%	Unsigned 16	100	–	Yes
0x00AB	0x0131	Item harmonics [24]	%	Unsigned 16	100	–	Yes
0x00AC	0x0132	Item harmonics [25]	%	Unsigned 16	100	–	Yes
0x00AD	0x0133	Item harmonics [26]	%	Unsigned 16	100	–	Yes
0x00AE	0x0134	Item harmonics [27]	%	Unsigned 16	100	–	Yes

Index [Hex]		Object	Unit	Format	Scale factor (FP)	Trip Unit	
IEEE floating point	Fixed point (FP)	Description (Values in brackets reflect the American notation.)				PXR20	PXR25
0x00AF	0x0135	Item harmonics [28]	%	Unsigned 16	100	–	Yes
0x00B0	0x0136	Item harmonics [29]	%	Unsigned 16	100	–	Yes
0x00B1	0x0137	Item harmonics [30]	%	Unsigned 16	100	–	Yes
0x00B2	0x0138	Item harmonics [31]	%	Unsigned 16	100	–	Yes
0x00B3	0x0139	Item harmonics [32]	%	Unsigned 16	100	–	Yes
0x00B4	0x013A	Item harmonics [33]	%	Unsigned 16	100	–	Yes
0x00B5	0x013B	Item harmonics [34]	%	Unsigned 16	100	–	Yes

10.3.4.3 Set points indexes

The set points indexes are arranged in four groups (groups 0, 1, 2 and 5).

Before reading or writing the settings, the appropriate group should be selected. Access to the groups are obtained via API 0 and index 3, which is a R/W register used to select the respective group (default: group 0).
The high byte contains the desired group number, while the low byte must contain the value 255 (0x0FF).

Prior to writing the settings, the correct password must be entered via API 0 and index 2, and the settings have to be written within 10 seconds of the password check.

For trip units that support settings, the settings of groups 0, 1, 2 and 5 should be written one after the other.

The setting groups are assigned as follows:

- Group 0: System group
- Group 1: Protective group
- Group 2: Modbus group
- Group 5: Advanced protection functions

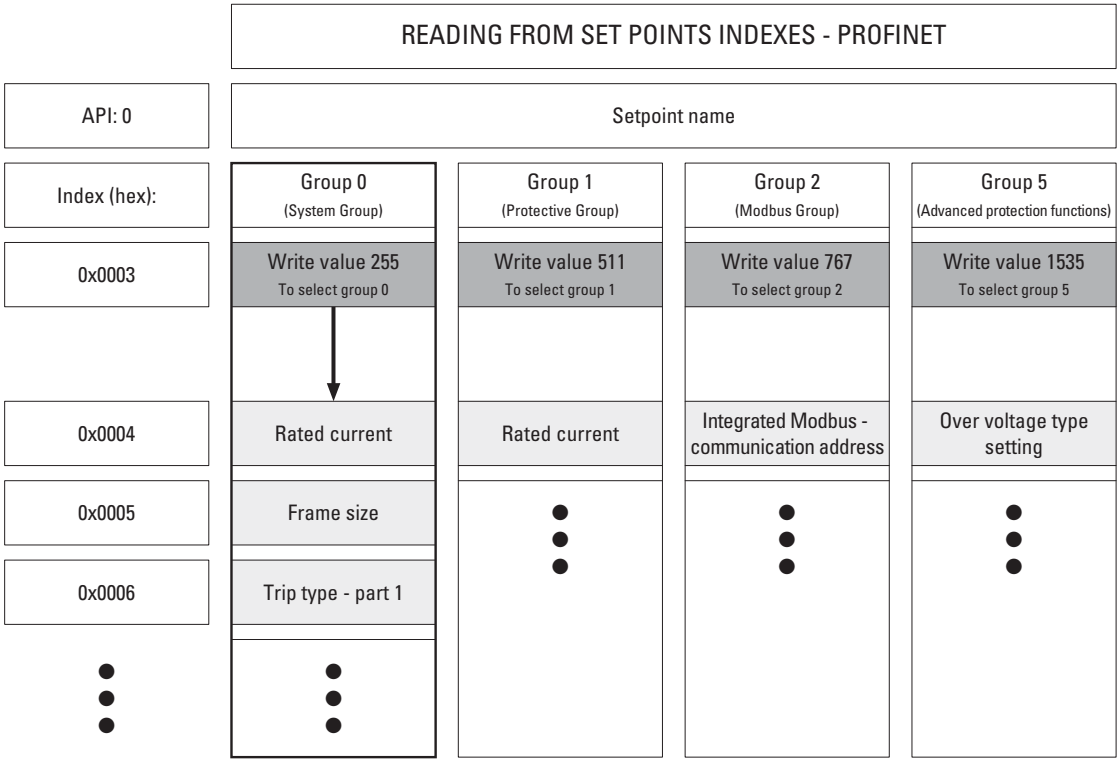


Figure 26: Reading from set points indexes – PROFINET

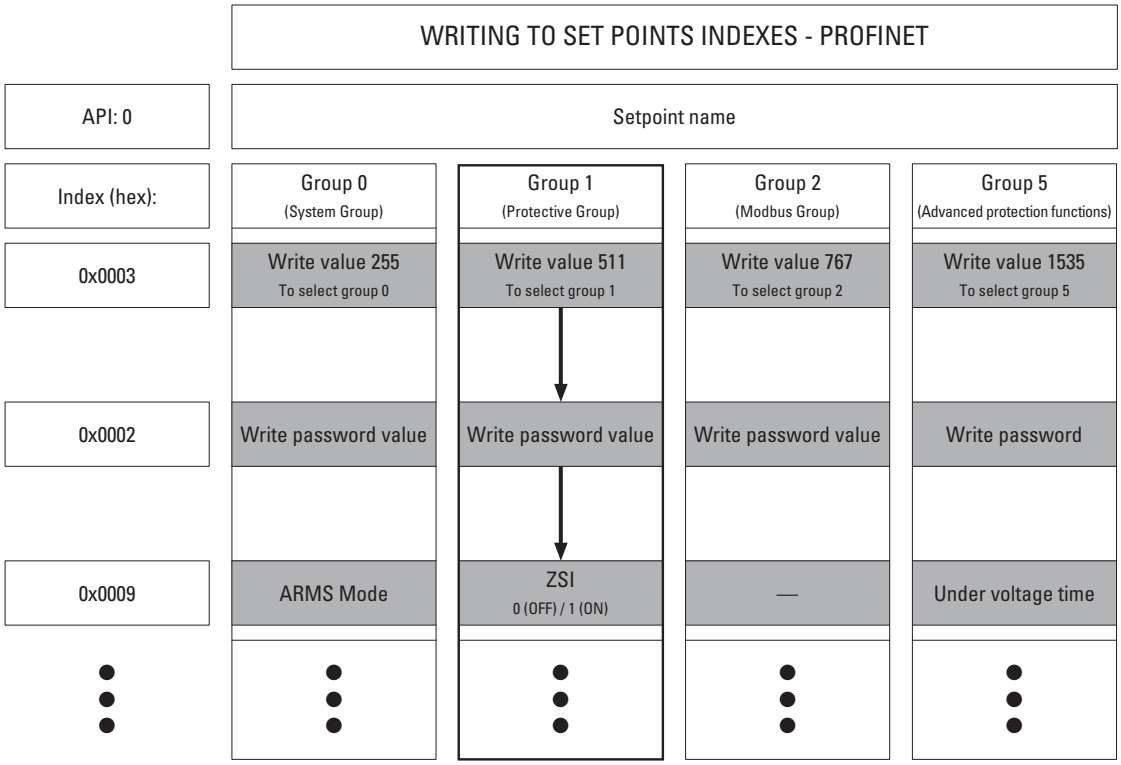


Figure 27: Writing to set points indexes – PROFINET

Table 88: Setting group 0: "System group" – PROFINET

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0002	15 - 0		Password	W	–	0000 (default setting	–
0x0003	15 - 0	0xFFFFFF	Group 0 = system	R/W		0x00FF	–
0x0004	12 - 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
0x0005	2 - 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
0x0007	3 - 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short-circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
0x0007			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	–
0x0008	8	0x0100	Maintenance mode: state	R	Encoded	0: off 1: on	–
	BBE	0x0001	Maintenance mode: remote control	R/W	Encoded	0: off 1: on	–
0x0009[1)]	2 - 0	0x0007	Maintenance mode: Trip setting	R/W	Encoded	1: 2.5 x I_n 2: 4 x I_n 3: 6 xI_n 4: 8 x I_n 5: 10 x I_n[2)]	A
0x000B[1)]	0	0x0001	Direction of incoming supply	R/W	Encoded	0: forward 1: reverse **Note:** only available on the PXR25	–

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x000C[1)]	0	0x0001	Sign convention	R/W	Encoded	Sign convention: 0: IEC 1: IEEE 2: IEEE old	–
0x000D[1)]			Power demand window	R/W	Encoded	Power demand: 0: fixed 1: sliding	–
0x000E[1)]			Power demand interval	R/W	Encoded	Power demand: 5 - 60 min (1 min increments)	–
0x0011			Configuration of relay 1	R/W	Encoded	Configuration of relay 1 and relay 2: → table 22, page 44	–
0x0012			Configuration of relay 2	R/W	Encoded		–
0x0014[1)]			Phase sequence - phase L1 (A)	R/W	Encoded	Phase L1 (A) 0: counterclockwise 1: clockwise	–
0x0017[1)]		0xBCC	Alarm - Residual Life	R/W	Encoded	Range: 50 - 100, step size 1, default value: 75 Alarm level value 100 ≙ 0 % residual life Alarm level value 75 ≙ 25 % residual life Formula for conversion: Alarm level expressed as a percentage = 100 - point value	–

1) PXR25 only!
2) For 600 A and 630 A frame size 3 breakers maximum trip setting is 8 x I_n

In setting group 0, the maintenance mode setting (index 8) can be divided into two parts. The high byte is read only and is used for the status indication of the maintenance mode, the comprehensive results of the maintenance mode rotary switch, the secondary terminal and the communication settings. The low byte can be configured and is used to indicate the maintenance mode settings via the communication port.

The respective protection settings may vary according to the size, type and rated operational current of the release.

Table 89: Setting group 1: "Protection group" – PROFINET

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0002	15 – 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
0x0003	15 – 0	0xFFFFFF	Group 1 = protection	R/W			–
0x0004	12 – 0	0x1FFFF	Rated current	R	Encoded	NZM2: 25, 40, 63, 90, 100, 140, 160, 200, 220, 250, 300 NZM3: 250, 350, 400, 450, 600, 630 NZM4: 550, 600, 630, 800, 875, 1000, 1200, 1250, 1400, 1600	A
0x0005	2 – 0	0x0007	Frame size	R	Encoded	The frame size indicates the breaker type. 11: NZM2 12: NZM3 13: NZM4	–
0x0006	3 - 0	0x000F	Trip type version - part 1	R	Encoded	Bit 0: LdSel: with overload protection I_r = 1 Bit 1: SdSel: with short-time delayed short-circuit protection I_{sd} = 1 Bit 2: InstSel: with instantaneous short circuit release I_i = 1 Bit 3: GfSel: with ground-fault protection I_g = 1 Bit 4: ARMSel: with maintenance mode = 1 Bit 5: OvrideSel: with instantaneous release function = 1 Bit 6: not used Bit 7: MotorSel: with motor-protection function = 1 Bit 8: NeuSenorSel: 0: 3-pole device 1: 4-pole device Bit 9: ThermalSel: with thermal memory = 1 Bit 12: VoltSel: with voltage meter = 1 Bit 13: 0: PXR20 1: PXR25	–
0x0007			Trip type version - part 2	R	Encoded	Bit 0: ModbusSel: with integrated Modbus RTU = 1 Bit 1: CAMSel: with CAM RS422 = 1 Bit 2: IOModuleSel: with IO module = 1 Bit 3: RelaySel: with relay module = 1 Bit 4: ZSISel: with zone selectivity = 1 Bit 5: LCDSel: with LCD display = 1	–
0x0008	0	0x0001	Thermal memory (overload protection)	R/W	Encoded	Activates/deactivates the thermal memory of the overload protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. Reactivate the thermal memory after testing: 0: switched off 1: switched on	–

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0009	0	0x0001	ZSI	R/W	Encoded	ZSI, zone-selectivity: If enabled for releases with ground-fault protection, ZSI is implemented for both the short-time delayed short-circuit release and for ground-fault protection. If enabled for releases without groundfault protection, ZSI is only implemented for the short-time delayed short-circuit release. 0: switched off 1: switched on	–
0x000A	0 - 1	0x0003	Overload release - waveform	R/W	Encoded	Waveform of the overload release 2: I^2t (default setting)	–
0x000B			Settings - release (I_r)	R/W	Unsigned 16	Settings - overload ($I_r = x * I_n$): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 40: 0.4 45: 0.4 50: 0.5 55: 0.5 00: 0.6 05: 0.6 10: 0.7 15: 0.8 20: 0.8 25: 0.8 30: 0.9 35: 1.0 40: 1.0 The following applies to the NZM PXR25: General value range: 20 - 1600 (in increments of 1 (1 A)) **Caution:** The value range depends on the type: (e.g. a 250-A switch can be set in the range from 40 % to 100 % of I_n (value range: 100 - 250)	–
0x000C			Settings - overload delay time (t_r)	R/W	Unsigned 16	Settings - overload delay time ($t_r = x$ [s]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 40: 4 50: 5 60: 6 70: 7 80: 8 100: 10 120: 12 140: 14 160: 16 180: 18 200: 20 32767: ∞ (overload protection deactivated)	s

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x000D[1)]			Load alarm 1	R/W	Unsigned 16	Load alarm 1 level (AL1 = n % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 1 must be set equal or lower than load alarm 2. 85 % fixed value for PXR20 trip units	%
0x000E	0	0x0001	Short-time delayed short circuit release - waveform	R/W	Encoded	Waveform of the short-time delayed short-circuit release 0: flat (default setting) 1: I^2t	–
0x000F			Settings - short-time delayed short-circuit release (I_{sd})	R/W	Unsigned 16	Settings - short-time delayed short circuit release (I_{sd} = n x I_r): NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2.0 30: 3.0 40: 4.0 50: 5.0 60: 6.0 65: 6.5 70: 7.0 75: 7.5 80: 8.0 85: 8.5 90: 9.0 95: 9.5 100: 10.0 The following applies to the NZM PXR25: The value range [20 - 100] corresponds to 2 to 10, in increments of 0.1 (1 for values)	A
0x0010			Settings - delay time of the short-time delayed short-circuit release (t_{sd})	R/W	Unsigned 16	Settings – delay time of the short-time delayed short-circuit release (t_{sd} = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 100] corresponds to 0 to 1,000 ms, respectively.	ms

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0011			Settings - instantaneous short-circuit release (I_i)	R/W	Unsigned 16	Settings - instantaneous short-circuit release ($I_i = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 2 30: 3 40: 4 50: 5 60: 6 70: 7 80: 8 90: 9 100: 10 110: 11 120: 12 140: 14 160: 16 180: 18 The following applies to the NZM PXR25: The value range [20 - 180] corresponds to 2 to 18, in increments of 0.1 (1 for values)	A
0x0012	0	0x0001	Type of ground-fault detection	R	Unsigned 16	Type of ground-fault detection: 0 = differential current detection	–
0x0013	0 - 1	0x0003	Settings - functioning of the ground-fault protection	R/W	Encoded	Type of ground-fault protection 0: trip 1: alarm 2: OFF	–
0x0014	0	0x0001	ground-fault release - waveform	R/W	Encoded	Ground-fault release - waveform: 0: flat 1: I^2t	–
0x0015			Settings - ground-fault release (I_g)	R/W	Unsigned 16	Settings - ground-fault release ($I_g = n \times I_n$) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 20: 0.2 30: 0.3 40: 0.4 60: 0.6 80: 0.8 100: 1.0 The value range [20 - 100] corresponds to 0.2 to 1.0, in increments of 0.1 (10 for values)	A
0x0016			Settings - delay time of the ground-fault release (t_g)	R/W	Unsigned 16	Settings - delay time of the ground-fault release (t_g = x [ms]) NZM PXR20: R NZM PXR25: R/W NZM PXR20: 0 (no delay) 20 100 300 500 750 1000 The following applies to the NZM PXR25: The value range [0 - 100] corresponds to 0 to 1,000 ms, respectively.	ms

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0017			Thermal memory (ground fault protection)	R/W	Encoded	Activates/deactivates the thermal memory of the ground-fault protection. Recommended for repetitive testing only. Among other things, the thermal memory protects the switch against overheating during repeated overloads. **Note:** Must be reactivated after testing! 0: switched off 1: switched on	–
0x0018			Settings - neutral protection	R/W	Unsigned 16	Adjusts the neutral protection of an NZM PXR25 breaker with a "/VAR" variably adjustable neutral conductor 0 ≙ 0 % 60 ≙ 60 % 100 ≙ 100 % (default setting) The lower setting affects the LSI protection functions of the switch, but not the ground-fault protection function ("G"). **Note:** L = long delay (= overload protection I_r) S = short delay (= short-time delayed short-circuit protection I_{sd}) I = instantaneous (= instantaneous shortcircuit protection I_i) G = ground fault (= ground fault protection I_g)	%
0x0019[1)]			Load alarm 2	R/W	Unsigned 16	Load alarm 2 level (AL2 = x % x I_r): 50 - 120 (in increments of 1) for motor protection PXR25 trip unit PMX 50 - 130 (in increments of 1) for PXR25 trip unit PX Load alarm 2 must be set higher than load alarm 1. 105 % fixed value for PXR20 trip units	%
0x001A			Pre-alarm of the groundfault release	R/W	Encoded	If the ground-fault protection function is set to "trip" (see index 13), a pre-alarm can also be set. ($GF_{pre\text{-}alarm}$ = x % x I_g) 50 - 100 (in increments of 5 %)	%

1) Function is not supported by PXR20!

Table 90: Setting group 2: "Modbus" group – PROFINET

Index [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0002	15 - 0	0xFFFFFF	Password	W	Encoded	0000 (default setting)	–
0x0003	15 - 0	0xFFFFFF	Group 2 = on-board Modbus	R/W	Encoded	0x02FF	–
0x0004	15 - 0		Integrated Modbus - communica-tion address	R/W	Encoded	001 - 247 (default setting 002)	–
0x0005	15 - 0		Integrated Modbus - baud rate	R/W	Encoded	00: 9,600 bit/s 01: 19,200 bit/s (default setting) 02: 38,400 bit/s 02: 57,600 bit/s	–
0x0006	15 - 0		Integrated Modbus - parity	R/W	Encoded	00: none 01: odd 02: even (default setting)	–
0x0007	15 - 0		Integrated Modbus - stop bit	R/W	Encoded	00: 1 bit (default setting) 01: 2 bits	–

Table 91: Setting group 5: Advanced protection functions[1)] – PROFINET

Instance [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x0002	15 – 0		Password	W	Encoded	0000 (default setting)	–
0x0003		0xFFFFFF	Group 5: Advanced protection functions[1)]	R/W	Encoded	0x05FF	–
0x0004	1 – 0		Over voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x0005			Over voltage pickup	R/W	Unsigned	180 - 850 (in increments of 1 V)	V
0x0006			Over voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x0007	1 – 0		Under voltage type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x0008			Under voltage pickup	R/W	Unsigned	60 - 690 (in increments of 1 V)	V
0x0009			Under voltage time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x000A	1 – 0		Voltage unbalance type setting	R/W		0 = Trip 1 = Alarm 2 = OFF	-
0x000B			Voltage unbalance pickup	R/W	Unsigned	Voltage unbalance level = n % x Max line-to-line voltage 5 - 25 (in increments of 1 %)	%

Instance [Hex]	Bit field	Mask field	Setpoint name	R/W	Format	Description or value	Unit
0x000C			Voltage unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x000D	1 – 0		Current unbalance type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	-
0x000E			Current unbalance pickup	R/W	Unsigned	Current unbalance level = n % x Max IL 5 - 25 (in increments of 1 %)	%
0x000F			Current unbalance time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x0010	1 – 0		Reverse power type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x0011			Reverse power pickup	R/W	Unsigned	1 - 65,500 (in increments of 1 kW)	kW
0x0012			Reverse power time	R/W	Unsigned	1 - 300 (in increments of 1 s)	s
0x0013	0		Phase rotation sensing type	R/W	Encoded	0 = ABC (-NA breakers) / 0 = 123 (IEC breakers) 1 = CBA (-NA breakers) / 0 = 321 (IEC breakers)	–
0x0014	1 – 0		Phase rotation type settting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x0015	1 – 0		Phase loss type setting	R/W	Encoded	0 = Trip 1 = Alarm 2 = OFF	–
0x0016			Phase loss time	R/W	Unsigned	1 - 240 (in increments of 1 s)	s

1) PXR25 only!

10.3.4.4 Event logs

A trip event provides historical values for the data objects at the time the event has occurred. The trip unit classifies the event information in order to be able to provide a different quantity for each type. The PROFINET communication can only access the historical summary, as well as the trip and event data.

Table 92: Event classification – PROFINET

Event type	Quantity of numbers stored	Description of the event log
Summary	200	→ table 93
Tripping	10	→ table 94
Alarms	10	→ table 94 and → table 95

A single trip may be registered under multiple event types. For example, a protective trip may be recorded in the summary log (→ table 93) as well as in the trip log (→ table 94).

Event logs information is accessed via API: 0 and indexes according to → tables 93, 94 and 95.

If the event type selection is written to index 13C, the first and last event ID can be retrieved from indexes 13D and 13E, respectively, in order to determine the range of events that have been stored for the selected event type. Index 13F is a R/W register for selecting the ID of the event in question. If the requested event has been recorded by the device, indexes 140 and 141 will supply both the ID of the previous event and that of the next event.

If the device has not recorded the event in question, the exception code can be queried by requesting the Modbus communication status of the ECAM from the controller via a dedicated industrial protocol object (via API: 0 and index 167).

→ For more information on the exception codes, see → section 10.3.4.11, “Exception codes”, page 191.

The date and time at which the requested event occurred are read in log 2142, with the same date and time description as in → table 97, page 188. This value corresponds to the time at which the historical event occurred.

Log 143 indicates the data content of the selected event type. This is a constant value for the three event types supported by the module.

The event data also provide a valid bit for each data object, starting with index 144. If bit 0 is set to 1, the initial data will be valid for the current trip type, bit 1 for the second data object, bit 2 for the third data object, and so forth.

The number of valid bit registers is calculated as.
(number of data objects - 1)/16

The following indexes are assigned to the data objects.

Table 93: Event summary – PROFINET

Index [Hex]	Format	R/W	Description (historical event overview)
0x013C	Encoded	R/W	Event type: summary = 0x8EFF
0x013D	Unsigned 32	R	Earliest event ID
0x013E	Unsigned 32	R	Latest event ID
0x013F	Unsigned 32	R/W	Requested event ID
0x0140	Unsigned 32	R	Previous event ID
0x0141	Unsigned 32	R	Next event ID
0x0142	Date/time	R	Date/time
0x0143	Encoded	R	Data format 0x0000: Basic event 0x0001: Time adjustment 0x0004: Trip 0x0005: Alarm 0x0006: Minor alarm
0x0144	B0	R	Validity bit of the object
0x0145	Encoded	R	Cause of event: 00: boot process - time OK 01: download of the setpoint values 02: time has been adjusted 03: trip 04: alarm 05: test mode has been selected 06: exiting the test mode 08: boot process - no time 09: test completed 10: maintenance mode activated 11: maintenance mode deactivated 12: opened via the communication interface 13: closed via the communication interface

Table 94: Historical trip / major alarm event – PROFINET

Index [Hex]	Format	R/W	Description (historical event overview)	Unit
0x013C	Encoded	R/W	Event type: Trip: 0x80FF Alarm: 0x81FF	–
0x013D	Unsigned 32	R	Earliest event ID	–
0x013E	Unsigned 32	R	Latest event ID	–
0x013F	Unsigned 32	R/W	Requested event ID	–
0x0140	Unsigned 32	R	Previous event ID	–
0x0141	Unsigned 32	R	Next event ID	–
0x0142	Date/time	R	Date/time	–
0x0143	Encoded	R	Data format: Trip: 0x0004 Main alarm: 0x0005	–
0x0144	Bit 15 - Bit 0	R	Valid bits of the object	–

Index [Hex]	Format	R/W	Description (historical event overview)	Unit
0x0145	Bit 31 - Bit 16	R	Valid bits of the object	–
0x0146	Encoded	R	Status reason (primary, secondary, reason)	–
0x0147	Unsigned 32	R	I_{L1} (IA)	A
0x0148	Unsigned 32	R	I_{L2} (IB)	A
0x0149	Unsigned 32	R	I_{L3} (IC)	A
0x014A	Unsigned 32	R	I_N (IN)	A
0x014C	Unsigned 32	R	I_G (IG residual)	A
0x014D	Unsigned 16	R	U_{L1-L2} (VAB)	V
0x014E	Unsigned 16	R	U_{L2-L3} (VBC)	V
0x014F	Unsigned 16	R	U_{L3-L1} (VCA)	V
0x0150	Unsigned 16	R	U_{L1-N} (VAN)	V
0x0151	Unsigned 16	R	U_{L2-N} (VBN)	V
0x0152	Unsigned 16	R	U_{L3-N} (VCN)	V
0x0153	Signed 32	R	Active 3-phase power	W
0x0154	Signed 32	R	Reactive 3-phase power	VAR
0x0155	Unsigned 32	R	Apparent 3-phase power	VA
0x0156	Signed 32	R	Active power demand	W
0x0157	Signed 32	R	Reactive power demand	VAR
0x0158	Unsigned 32	R	Apparent power demand	VA
0x0159	Signed 16	R	N/A	–
0x015A	Unsigned 16	R	Frequency	1/10 Hz
0x015B	Signed 16	R	Apparent power factor	1/100 pf
0x015C	Unsigned 32	R	Number of operations	–
0x015D	Bit 31 - Bit 0	R	Binary status with valid bits	–

Table 95: Minor alarm event – PROFINET

Index [Hex]	Format	R/W	Description (historical event overview)
0x013C	Encoded	R/W	Event type: Summary = 0x81FF
0x013D	Signed 32	R	Earliest event ID
0x013E	Signed 32	R	Latest event ID
0x013F	Signed 32	R/W	Requested event ID
0x0140	Signed 32	R	Previous event ID
0x0141	Signed 32	R	Next event ID
0x0142	Date/time	R	Date/time
0x0143	Encoded	R	Data format: Small alarm: 0x0006
0x0144	Bit 0	R	Valid bits of the object
0x0145	Encoded	R	Status reason (primary, secondary, reason code)

10.3.4.5 Remote control

One index with 3 elements of 16 bits is reserved for remote control of the release, accessed via API: 0 and index 166. These three elements should be written together with a "slave action code" and the corresponding ones' complement. The data format registers, which is an array of 16 bits, are shown below.

Data format for remote control

Index 166 - Element 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Byte 1 (slave action)								Byte 0 (slave action)							

Index 166 - Element 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 0 (slave action)								Byte 2 (slave action)							

Index 166 - Element 3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Ones' complement of byte 2 (slave action)								Ones' complement of byte 1 (slave action)							

The "slave action code" and its functioning are listed in → table 96, and whether it is supported depends on the specific product.

If the "slave action code" and the associated ones' complement command are valid, the release will perform the action in question. If the "slave action code" and the associated ones' complement command are valid, the release will perform the action in question. If the "slave action code" and the associated ones' complement command are invalid, the exception code can be queried by requesting the Modbus communication status of the ECAM from the controller via a dedicated industrial protocol object (via API 0 and index 167).

→ For more information on the exception codes, see → section 10.3.4.11, "Exception codes", page 191.

Table 96: Remote control – PROFINET

Command group	Definition	Pass-word	Decimal byte						Decimal word		
			358 Byte 5	358 Byte 4	358 Byte 3	358 Byte 2	358 Byte 1	358 Byte 0	358 Word 3	358 Word 2	358 Word 1
Reset	Reset the trip	No	255	255	253	0	0	2	65535	64768	2
	Reset the min./max. values of currents	Yes	255	254	242	0	1	13	65534	61952	269
	Reset the min./max. values of the L-N voltages[1)]	Yes	255	254	240	0	1	15	65534	61440	271
	Reset the min./max. values of the L-L voltages[1)]	Yes	255	254	241	0	1	14	65534	61696	270
	Reset the peak power requirement[1)]	Yes	255	255	251	0	0	4	65535	64256	4
	Reset all min./max. values	Yes	255	254	251	0	1	4	65534	64256	260
	Reset the energy[1)]	Yes	255	255	247	0	0	8	65535	63232	8
	Reset trip count	Yes	255	250	254	0	5	1	65530	65024	1281
	Reset the operations count	Yes	255	254	253	0	1	2	65534	64768	258
	Reset max. temperature	Yes	255	250	253	0	5	2	65530	64768	1282
	Reset runtime	Yes	255	254	252	0	1	3	65534	64512	259
	Reset all diagnostics information	Yes	255	250	252	0	5	3	65530	64512	1283
	Reset the power-up display	No	255	255	252	0	0	3	65535	64512	3
	Open breaker	Yes	254	255	255	1	0	0	65279	65281	0
Mainte-nance mode	Activate the maintenance mode	No	254	255	247	1	0	8	65279	63233	8
	Deactivate the maintenance mode	No	254	255	246	1	0	9	65279	62977	9

Command group	Definition	Pass-word	Decimal byte						Decimal word		
			358 Byte 5	358 Byte 4	358 Byte 3	358 Byte 2	358 Byte 1	358 Byte 0	358 Word 3	358 Word 2	358 Word 1
Relay output	Activate relay output 1	No	251	254	254	4	1	1	64510	65028	257
	Deactivate relay output 1	No	251	253	254	4	2	1	64509	65028	513
	Activate relay output 2	No	251	254	253	4	1	2	64510	64772	258
	Deactivate relay output 2	No	251	253	253	4	2	2	64509	64772	514

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x0166		0x0166		0x0166		0x0166	0x0166	0x0166
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Reset	Reset the trip	No	0x00FF	0x00FF	0x00FD	0x0000	0x0000	0x0002	0xFFFF	0xFD00	0x0002
	Reset the min./max. values of currents	Yes	0x00FF	0x00FE	0x00F2	0x0000	0x0001	0x000D	0xFFFE	0xF200	0x010D
	Reset the min./max. values of the L-N voltages[1)]	Yes	0x00FF	0x00FE	0x00F0	0x0000	0x0001	0x000F	0xFFFE	0xF000	0x010f
	Reset the min./max. values of the L-L voltages[1)]	Yes	0x00FF	0x00FE	0x00F1	0x0000	0x0001	0x000E	0xFFFE	0xF100	0x010E
	Reset the peak power requirement[1)]	Yes	0x00FF	0x00FF	0x00FB	0x0000	0x0000	0x0004	0xFFFF	0xFB00	0x0004
	Reset all min./max. values	Yes	0x00FF	0x00FE	0x00FB	0x0000	0x0001	0x0004	0xFFFE	0xFB00	0x0104
	Reset the energy[1)]	Yes	0x00FF	0x00FF	0x00F7	0x0000	0x0000	0x0008	0xFFFF	0xF700	0x0008
	Reset trip count	Yes	0x00FF	0x00FA	0x00FE	0x0000	0x0005	0x0001	0xFFFA	0xFE00	0x0501
	Reset the operations count	Yes	0x00FF	0x00FE	0x00FD	0x0000	0x0001	0x0002	0xFFFE	0xFD00	0x0102
	Reset max. temperature	Yes	0x00FF	0x00FA	0x00FD	0x0000	0x0005	0x0002	0xFFFA	0xFD00	0x0502
	Reset runtime	Yes	0x00FF	0x00FE	0x00FC	0x0000	0x0001	0x0003	0xFFFE	0xFC00	0x0103
	Reset all diagnostics information	Yes	0x00FF	0x00FA	0x00FC	0x0000	0x0005	0x0003	0xFFFA	0xFC00	0x0503
	Reset the power-up display	No	0x00FF	0x00FF	0x00FC	0x0000	0x0000	0x0003	0xFFFF	0xFC00	0x0003
	Open breaker	Yes	0x00FE	0x00FF	0x00FF	0x0001	0x0000	0x0000	0xFEFF	0xFF01	0x0000
Mainte-nance mode	Activate the maintenance mode	No	0x00FE	0x00FF	0x00F7	0x0001	0x0000	0x0008	0xFEFF	0xF701	0x0008
	Deactivate the maintenance mode	No	0x00FE	0x00FF	0x00F6	0x0001	0x0000	0x0009	0xFEFF	0xF601	0x0009

Command group	Definition	Pass-word	Hex byte						Hex word		
			0x0166		0x0166		0x0166		0x0166	0x0166	0x0166
			Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0	Word 3	Word 2	Word 1
Relay output	Activate relay output 1	No	0x00FB	0x00FE	0x00FE	0x0004	0x0001	0x0001	0xFBFE	0xFE04	0x0101
	Deactivate relay output 1	No	0x00FB	0x00FD	0x00FE	0x0004	0x0002	0x0001	0xFBFD	0xFE04	0x0201
	Activate relay output 2	No	0x00FB	0x00FE	0x00FD	0x0004	0x0001	0x0002	0xFBFE	0xFD04	0x0102
	Deactivate relay output 2	No	0x00FB	0x00FD	0x00FD	0x0004	0x0002	0x0002	0xFBFD	0xFD04	0x0202

10.3.4.6 Date and time

The release supports the reading and writing of real-time clock information by the external communication module PROFINET.
Eight registers, starting with index number 15E, are reserved for this purpose.

Note: The day of the week (index 161) is set automatically once year, month and date registers are set. Therefore this is a read only register.

Table 97: Real-time clock – PROFINET

Index [Hex]	Definition	Data range	Format
0x015E	Month	1 - 12	Unsigned 16
0x015F	Day	1 - 31	Unsigned 16
0x0160	Year	2000 - 2099	Unsigned 16
0x0161	Day of the week	1 = Sunday ... 7 = Saturday	Unsigned 16
0x0162	Hour	0 - 23	Unsigned 16
0x0163	Minute	0 - 59	Unsigned 16
0x0164	Seconds	0 - 59	Unsigned 16
0x0165	1/100 of a second	0 - 99	Unsigned 16

10.3.4.7 Primary status codes

Table 98: Primary status codes – PROFINET

Code	Meaning
0x01	open
0x02	closed
0x03	tripped
0x04	Alarm active
0x0D	Threshold value active

10.3.4.8 Secondary status codes

Table 99: Secondary status codes – PROFINET

Code	Meaning
0x01	not applicable
0x03	Test mode
0x07	has been switched on since last trip / triggered alarm
0x08	alarm

10.3.4.9 Reason codes

Table 100:Reason codes – PROFINET

Code [Hex]	Meaning
0x0000	unknown
0x0001	normal
0x0003	Instantaneous short circuit
0x000E	Auxiliary power supply too low
0x0011	Current imbalance
0x001F	Operation count
0x0021	Control via the communication interface
0x0025	Coil monitoring
0x002B	Diagnostic warning #2 (configuration read error)
0x003D	Overload
0x003E	Short-time delay
0x0049	Phase currents are close to the threshold value, load alarm
0x004C	Override
0x004D	Setpoint error
0x004E	Overtemperature
0x0050	Overload (neutral conductor)
0x0054	Ground fault

Code [Hex]	Meaning
0x0071	Calibration
0x0088	Real-time clock
0x0099	Maintenance mode
0x009A	Fault in the breaker mechanism
0x07FC	Digital bypass
0x07FD	Non-volatile memory failure
0x07FE	Watchdog fault
0x07FF	Motor alarm or motor tripping

10.3.4.10 Device information

The device information (fixed data range) includes, for example, the device name, model name, catalogue number, version number, serial number, date code, firmware version 1 and 2, USB version, and product ID.

Table 101:Reason code definitions – PROFINET

Index [Hex]	Description	Format	Range	Register	Comment
0x002A	Device name	ASCII	16 characters	8	EATON PXR20 EATON PXR25
0x002B	Model name	ASCII	16 characters	8	PXR 20/25 MCCB
0x002C	Catalogue number	ASCII	32 characters	16	internal catalogue number (max. 20 characters)
0x002D	Style number	ASCII	32 characters	16	internal version number (max. 20 characters)
0x002E	Serial number	ASCII	32 characters	16	if supported
0x002F	Date code	ASCII	12 characters	6	yy.mm.dd
0x0030	Firmware version 1	ASCII	16 characters	8	Sample version 01.02.0033
0x0031	Firmware version 2	ASCII	16 characters	8	Sample version 01.02.0033
0x0032	USB version	ASCII	16 characters	8	Sample version 01.02.0033
0x0033	Release family	Unsigned 16	16-bit	1	PXR20: 0x01 PXR25: 0x01
0x0034	Standard	Unsigned 16	16-bit	1	IEC only: 0x01 UL only: 0x02 UL / IEC: 0x03
0x0035	Poles	Unsigned 16	16-bit	1	3-pole / 4-pole
0x0037	Product ID	Bitmap	32-bit	2	ppppppvvvvdddddd Division code (dddddd) 06 (0x06) Product code (pppppp): 2: NZM2 PXR 3: NZM3 PXR 4: NZM4 PXR Comm version (vvvv) 0

10.3.4.11 Exception codes

If there is an error in the request or the response, the release will return an exception code, via index 167.

Table 102:Exception codes - PROFINET

Modbus returned exception code values	Meaning
0	No error
8	Timeout error occurred
10	Illegal function exception
11	Illegal data address
12	Illegal data value
13	Slave device failure
14	Slave acknowledge
15	Slave device busy
16	Memory parity error
17	ECAM path unavailable
18	ECAM target device failed to respond

11 Troubleshooting

The following table provides helpful information in the event of a fault.

Table 103:Possible faults, causes and solutions

Fault	Probable cause	Possible solution
The status LED of the trip unit is not flashing.	No current is flowing through the current transformers of the circuit breaker to the trip unit.	Connect the +24 V DC supply for auxiliary power and monitor the status LED.
The circuit breaker will trip in the event of a ground fault.	A ground fault is actually present.	Determine the location of the fault.
	When using a 3-pole circuit breaker with ground-fault protection in a four-wire system, the neutral current will not be detected.	A 4-pole circuit breaker should therefore be used.
	High inrush phase currents may cause the device to temporarily detect a ground fault.	If zone selective interlocking is used, Z_{out} to Z_{in} should be connected by means of a jumper to obtain a short delay. → section 4.11, "Zone selective interlocking (ZSI)", page 32
	The trip unit is malfunctioning.	Contact your Eaton representative for manufacturer support.
The breaker trips too quickly in the event of a ground fault or a short-time delay (zone selective interlocking is not used).	The ZSI function is active.	Make sure that the ZSI function in the settings menu is turned off. → section 4.11, "Zone selective interlocking (ZSI)", page 32
	The trip unit settings are incorrect. Is the I^2t slope or the "flat" option selected?	Change the ground fault or short-time delay settings.
	The trip unit is malfunctioning.	Contact your Eaton representative for manufacturer support.
The breaker trips too rapidly on long delay.	The thermal memory is active.	In the event of repeated tripping, the thermal memory protects the switch and any downstream system components against overheating.
	The trip unit settings are incorrect.	Change the long-delay settings.
The primary source of injection current is not supplying the correct current.	The testing of the primary injection and the trip times yields incorrect results.	Use an oscilloscope with a current probe to determine the exact current value and times, and to ensure that no inrush current peaks will occur.
	Single-phase testing.	When testing a single phase, the current may "bleed" into other de-energized phases and thereby reduce the testing phase current itself.
	During testing with high current pulses, an overload trip may occur due to the cumulative effect of the short-current pulses.	Deactivate the thermal memory for the duration of the test. Reactivate the memory again once the test has been completed!
	The precise input levels are difficult to control and reproduce when testing the primary injection at high current levels.	Use functional current testing (remote) via USB/PXPM.
The LCD display is not connected to the power supply.	No auxiliary power (24 V DC) will be available if the current flowing through the circuit breaker is less than the minimum current required for the operation of the LCD display.	Connect the auxiliary power supply.
The status LED is permanently red or flashes red.	The circuit breaker locking mechanism is not closing properly.	Contact your Eaton representative for manufacturer support.
	Internal memory issue.	Contact your Eaton representative for manufacturer support.
The maintenance mode fails to deactivate.	Faulty remote or local switch.	Make sure that the local or remote switch is not turned on.
	The maintenance mode was originally activated via the communication interface, which is currently not available.	If possible, restore the communication link and check for possible wiring errors.

11 Troubleshooting

12 PXR25 Navigation menu

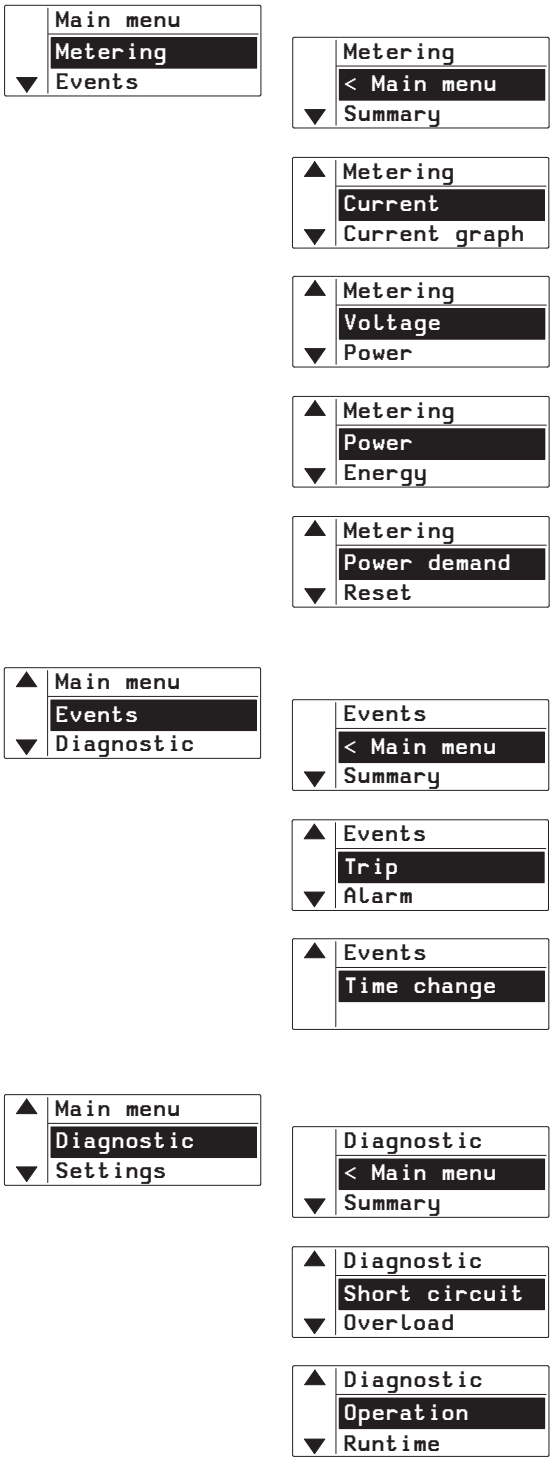


Figure 28: Menu items “measurement data”, “events” and “diagnostics”.

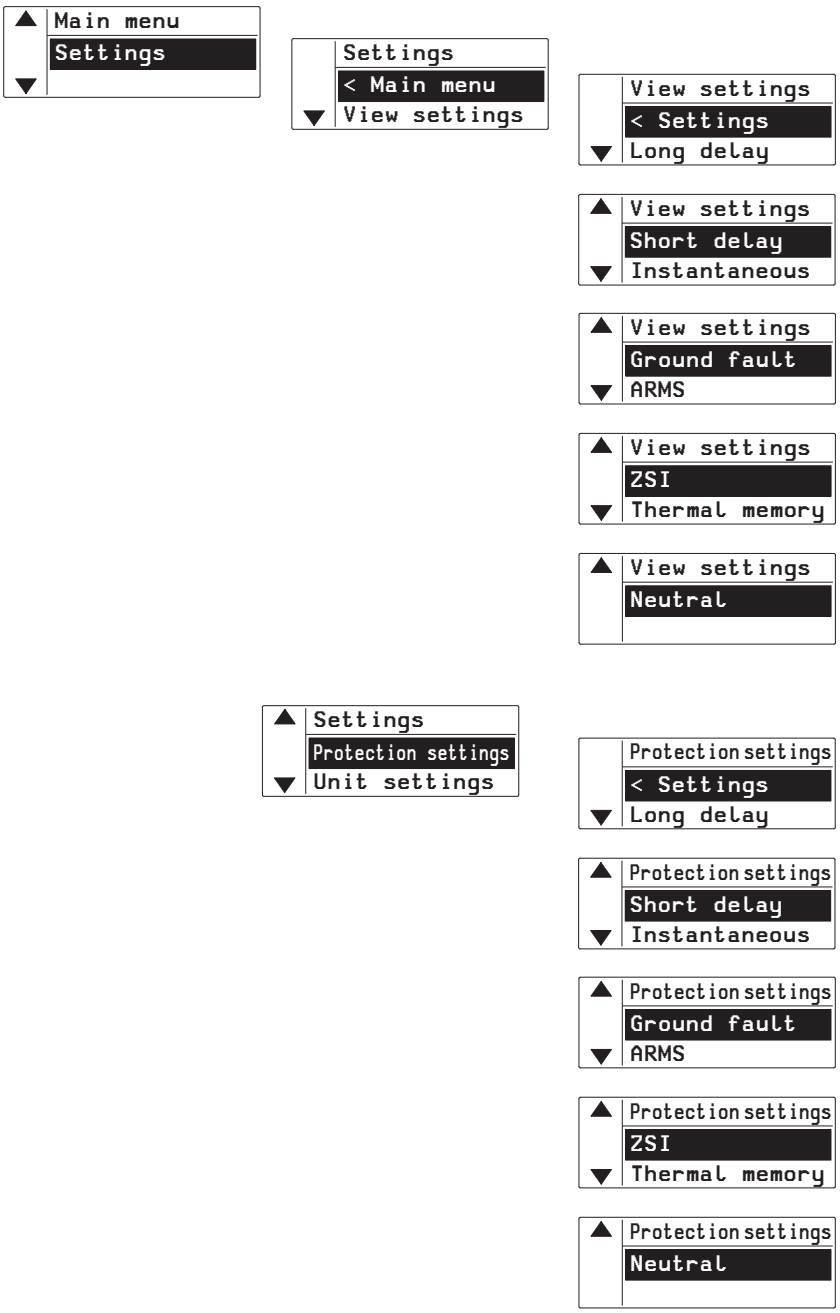


Figure 29: Menu item "settings"

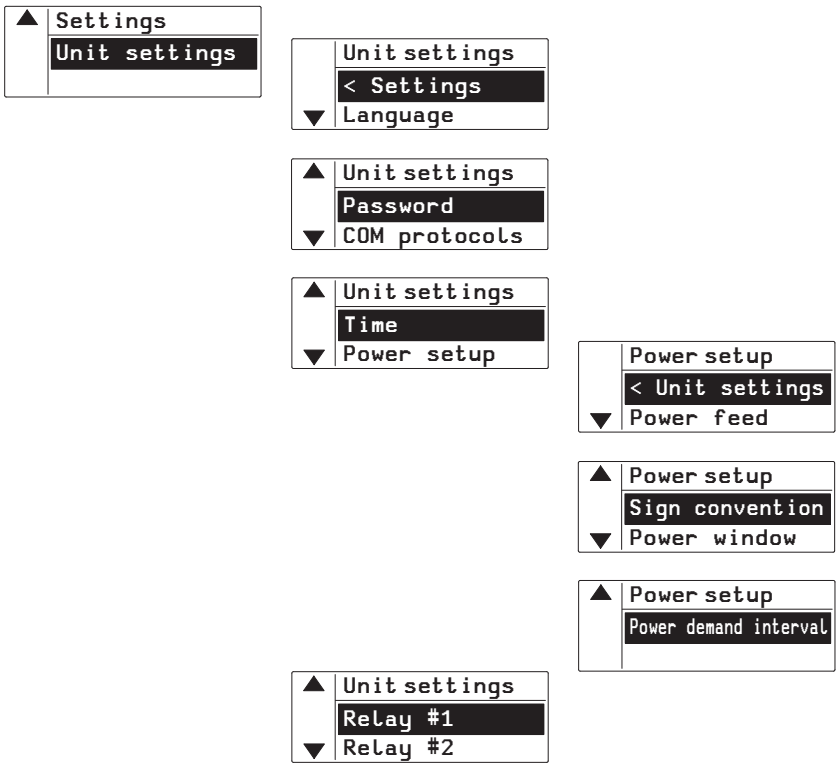


Figure 30: Menu item “device settings”

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