MN012007EN

Power Xpert® Release trip units for Power Defense molded case circuit breakers

Powering Business Worldwide

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

The information, recommendations, descriptions and safety notations in this document are based on Eaton Corporation's ("Eaton") experience and judgment and may not cover all contingencies. If further information is required, an Eaton sales office should be consulted. Sale of the product shown in this literature is subject to the terms and conditions outlined in appropriate Eaton selling policies or other contractual agreement between Eaton and the purchaser.

THERE ARE NO UNDERSTANDINGS, AGREEMENTS, WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OTHER THAN THOSE SPECIFICALLY SET OUT IN ANY EXISTING CONTRACT BETWEEN THE PARTIES. ANY SUCH CONTRACT STATES THE ENTIRE OBLIGATION OF EATON. THE CONTENTS OF THIS DOCUMENT SHALL NOT BECOME PART OF OR MODIFY ANY CONTRACT BETWEEN THE PARTIES.

In no event will Eaton be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein. The information contained in this manual is subject to change without notice.

Contents

1. Introduction to the Power Xpert® Release trip unit

The Power Xpert Release (PXR) trip unit has features and flexibility that allow configuration for a wide variety of protection applications. Communication options support integration into supervisory systems to monitor performance and, if desired, control the circuit breaker. Advanced metering of current, voltage, energy and power allow monitoring of real-time energy use.

The PXR trip unit is available in multiple models for frames ranging from 60 A through 2500 A in MCCBs and up through 4000 A in ACB products. All PXR trip units share common features including configuration of their protective functions, cause-of-trip information, built in secondary injection for testing and a USB port for connection to configuration and monitoring software. Certain models include energy metering with 1% accuracy, network connectivity, multi-language display and advanced protection features.

The PXR trip unit, along with current sensors and a trip actuator, is the subsystem of a circuit breaker that provides the protective functions. The PXR analyzes signals from the current sensors; if current level and time delay settings are exceeded then the PXR will trip the circuit breaker. The overload and short circuit tripping characteristics for a specific circuit breaker are determined by the current rating and user selected protection settings.

Metering uses those same current sensors to monitor and record current. In models that include voltage metering, a full set of power and energy data is available with 1% accuracy. Additionally the PXR supports a waveform capture mechanism by which you can monitor your systems currents and voltages.

The communication systems provide real-time status and data from the PXR for integration with business information systems, control schemes or other systems used by service personnel. The PXR trip units support several field-busses including ModbusRTU, ethernet and ProfibusDP. Ethernet communications also includes an advanced web-interface for use with phone, tablet or PC browsers.

Certain models have a LCD display to make set-up and system monitoring possible from the face of the MCCB. Other models have rotary switches to set the available protection settings. Regardless of the interface on the PXR trip units, all aspects of the configuration and performance are available using PXPM software.

This manual covers the Power Xpert Release family in the Power Defense line of circuit breakers. Instruction leaflets (IL) are provided with each circuit breaker that covers the installation. Both this manual and circuit breaker instruction leaflets should be consulted when applying the PXR trip unit. Please access www.eaton.com/powerdefense for full details.

1.1 Protection settings overview

The following table shows an overview of protection functionality available in the PXR family trip units in Power Defense circuit breakers. Detailed information for each trip unit and circuit breaker are in Section 9: Available protection settings. Note that external control voltage is not required for protection functionality.

Protection settings		PXR 10	PXR 20	PXR 20D and 25	Units
	Available protection styles	LI LSI	LSI LSIG, LSI with ARMS LSIG with ARMS	LSI LSIG, LSI with ARMS LSIG with ARMS	
Overload protection (L)					
I_r	Pickup	10 settings	10 settings	Variable	Amps
t_r	Time delay @ 6 x I_r	Fixed at 10	10 settings	Variable from 0.50	Seconds
	Time delay slope	I^2t	I^2t	I^2t, I^4t	
	Thermal memory	Enable/disable	Enable/disable	Enable/disable	
Short circuit protection (S)					
	Enable/disable (OFF position)	Yes	Yes	Yes	
I_{sd}	Pickup	6 settings 2.0 to 10	9 settings from 1.5	Variable from 1.5	x I_r
t_{sd}	Time delay flat	2 settings 0.15 or 0.30	7 settings from 0.05 to 0.50	Variable from 0.05 to 0.50	Seconds
	Time delay I^2t @ 8 x I_r	0.30	3 settings 0.07, 0.15, 0.30	Variable from 0.07 to 0.30	
	Zone selective interlock with visual indication	Not available	Enable/disable	Enable/disable	
Instantaneous protection (I)					
I_i	Pickup	10 settings	10 settings	Variable from 2.0	x I_n
Ground (Earth) fault protection (G)					
	Enable/disable (OFF position)	Not available	Enable/disable	Enable/disable	
I_g	Pickup - trip		6 settings from 0.2	Variable from 0.20	x I_n
	Pickup - alarm only		3 settings 0.20, 0.50, 1.0	Variable from 0.20	
t_g	Time delay flat		7 settings from 0.10, to 1.0	Variable from 0.10 to 1.0	Seconds
	Time delay I^2t @1.0 x I_n		3 settings 0.07, 0.15, 0.30	Variable from 0.07 to 0.30	
	Alarm contact		Optional	Configurable	
	Thermal memory		Enable/disable	Enable/disable	
Neutral protection					
	4th pole or external neutral trip	3 settings 60% 100% off	3 settings 60% 100% off	3 settings 60% 100% off	x I_r
Maintenance mode protection (ARMS)					
	Maintenance mode with visual indication	Not available	Local OFF w/ remote enable -or- local ON	Local OFF w/ remote enable -or- local ON	
	Pickup		5 settings 2.5, 4.0, 6.0, 8.0, 10	5 settings 2.5, 4.0, 6.0, 8.0, 10	x I_n
	Status contact		Optional	Optional	
General					
	Cause-of-trip	Stored in memory	Stored in memory	Stored in memory	
		Available through PXPM	LED indication	LED indication	
	High load alarm 1 Pickup	Not available	85%	Variable 50% to 120%	x I_r
	High load alarm 2 Pickup		105%		
	High load alarm Contact		Optional	Configurable	
	Temperature trip	105 °C / 220 °F	105 °C / 220 °F	105 °C / 220 °F	

Notes:

Section 9 contains a detailed list of all available settings for each trip unit and breaker frame combination.
Light gray shaded settings are programmable through the USB with PXPM software.

1.1.1 Time current curves

Time current curves (TCC) for every Power Defense circuit breaker within the PXR family of trip units are available at www.eaton.com/tcc.

1.2 Metering features

The following table shows the electrical system information which is metered by the trip unit. It is available for viewing in PXPM, on the display (if equipped) or for reading via communication channels.

Metering data	PXR 10	PXR 20	PXR 20D	PXR 25
Current	*	*	*	*
Current maximum and minimum		*	*	*
Voltage line to line and line to neutral				*
Voltage maximum and minimum (L-L and L-N)				*
Power kW (real, demand, peak)				*
Power kVAR (reactive, demand, peak)				*
Power kVA (apparent, demand, peak)				*
Energy kWh (total, fwd, rev) VARh (net), VAh (net)				*
Frequency				*
Power factor				*

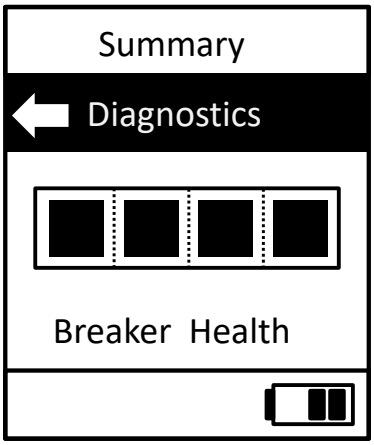
1.2.1 Metered data specifications

Metered data accuracy is as follows:

Metered value	Range of conditions (units)	PXR 10	PXR 20	PXR 20D	PXR 25
Current (I)	5 to 10 % of In (A)	5.0 %	5.0 %	1.0 %	1.0 %
	10 to 120 % of In (A)	5.0 %	2.0 %	0.5 %	0.5 %
Voltage (V)	60 to 102 (V)	not applicable			1.0 %
	102 to 690 (V)				0.5 %
	690 to 750 (V)				1.0 %
Power (kW) Energy (kWh)	5% to 10% of In (A) 102 to 690 (V) Power factor = 1				1.5 %
	10 to 120 % of In (A) 102 to 690 V Power factor = 1				1.0 %
Power (kW) Energy (kWh)	10 to 20 % of In (A) 102 to 690 (V) PF = 0.5 inductive or 0.8 capacitive				1.5 %
	20 to 120 % of In (A) 102 to 690 (V) PF = 0.5 inductive or 0.8 capacitive				1.0 %
Note:	Accuracy is expressed as % of reading, currents are RMS, voltages are line-to-line.				

1.3 Health monitor

The PXR 20D and 25 trip units utilize an innovative algorithm to determine a health status. The health status is continuously updated as overloads and interruption events occur. To view the factors that affect the health monitor, select the "Diagnostics" menu. The summary screen shown below is 100% of life with all four bars shaded. Each bar is approximately 25% of breaker health according to the algorithm. As the life is decreased, the shading in the leading bars will disappear. An alarm will be generated at 25% of health remaining.



Since circuit breaker health includes more than just contact wear, other screens in the diagnostics menu will indicate the factors that go into the health calculation.

- Number of recorded operations
- Last time the breaker was exercised
- Run time
- Internal temperature
- Overloads
- Short circuit events

When the summary of life is indicating 0%, the breaker should be inspected for possible replacement.

2 PXR user interface

The PXR trip unit interface is common across all frame sizes of the Power Defense family of circuit breaker frames. This common user interface ensures rapid configuration and makes it easier to train service personnel. In each frame size, the elements of the interface are easily recognized even when compressed into smaller fames or mounted horizontally.

The PXR 10 has the simplest user interface (UI), including the essential protection settings and status. The PXR 20D and PXR 25 have the richest UI, providing setting and operational information at a glance. Refer to the front panel illustrations of the PXR 10, PXR 20, PXR 20D and PXR 25 to determine which user interface elements are provided.

There is a setting for the PXR 20D and PXR 25 to rotate the text in the display for breakers that are mounted horizontally in a panelboard.

2.1 Key interface elements

2.1.1 Status indicator

All PXR trip units have an indicator in the top left labeled "STATUS". During normal operation, this indicator blinks green (on and off approximately once each second), indicating that the trip unit is operating normally.

The status indicator blinks red if the trip unit detects an internal problem. This indicates a problem with the trip actuator coil, a firmware error, or a mechanism error. Take immediate action to replace the trip unit or breaker.

When the status indicator remains off, there is no auxiliary power applied or insufficient primary current to power the trip unit. PXR trip units in MCCB will self-power at 20% of the circuit breaker frame In.

2.1.2 USB – test and configuration port

The lower right corner of all PXR trip units has a standard micro-B USB connector. PXPM software uses the USB port to configure, test and monitor the trip unit. Download the installation package for PXPM software from www.eaton.com/pxpm.

A USB cable connection from a host PC will power the trip unit when the trip unit is not harvesting sufficient energy from the mains or there is no auxiliary power applied. Commercially available battery packs can also power the trip unit. This connection is intended for temporary use while a user is configuring, monitoring or testing the trip unit.

2.1.3 Pickup/cause-of-trip indicators

All PXR family trip units record the cause-of-trip (CoT) in memory. The CoT is available by using PXPM software and via the communication networks.

There are four pickup/cause-of-trip indicators labeled "LONG", "SHORT", "INST", and "GROUND" on all except the PXR 10. The appropriate indicator blinks when a current level pickup setting is exceeded. After a trip event, the appropriate indicator flashes (0.25 second on, three seconds off) and is annunciated on the display.

- "LONG" – Long delay or over temperature
- "SHORT" – Short delay
- "INST" – Instantaneous, override or maintenance mode
- "GROUND" – Ground fault

2.1.4 Reset

The button labeled "RESET" can be pressed using a small tool. When pressed, it clears the cause-of-trip indicators, clears any latched alarms on the configurable relays and clears the ZSI "check mark" on the display (illuminates after a ZSI input signal is detected).

2.1.5 Battery

For PXR units, which have cause-of-trip indicators, within the trip unit is a small tray that holds the battery. The battery supports the cause-of-trip indicators for 20 days when the trip unit is not powered. The battery plays no part in the protection functions of the trip system. On the initial installation of the circuit breaker, remove and discard the insulating tab to enable the battery. This battery is a standard CR type "coin-cell", for replacement use: CR1216. The battery also holds the power for the real time clock chip for time and date information. After replacing the battery, the time and date should be reprogrammed.

The "RESET" button can be pressed and held for two seconds to test the battery. If OK, the "LONG" LED will illuminate green, if the battery should be replaced it will illuminate yellow. For PXR 20D and PXR 25 the battery status is also indicated in the lower right corner of the display.

2.1.6 High load indicator

On the PXR 25, the indicator labeled "Alarm1/Alarm2" (high-load indicator) is illuminated yellow based on the configured load setting. It will be on solid (noted as: _____) when above the alarm1 pickup and blink (noted as: _ _ _ _) when above the alarm2 pickup. Note that high load alarm2 (blink) takes precedence over high load alarm1 (on).

On the PXR 20, the indicator labeled "85%Ir/105%Ir" (high-load indicator) is illuminated yellow based on fixed load setting. It will be on solid (noted as: _____) when above 85% of I_r and blink (noted as: _ _ _ _) when above 105% of Ir.

2.1.7 Maintenance mode switch

When supplied, the PXR trip unit incorporates the Arc Flash Reduction Maintenance System™ (ARMS). The switch is labeled "Maintenance Mode" and has two positions labeled "OFF/Remote" and "ON". A blue light next to the maintenance mode switch illuminates when the ARMS protection is enabled.

- "ON" – ARMS is enabled locally and cannot be disabled remotely
- "OFF/Remote" – ARMS can be enabled or disabled remotely by a dry contact, communications or PXPM. See Section 3.6: Maintenance mode protection for complete details

2.1.8 Push to trip

A red button on the front of the trip unit or circuit breaker provides a mechanical means of tripping the circuit breaker. Use a small tool to depress it and trip the breaker mechanism.

2.1.9 Tamper proof cover

A clear plastic cover allows the settings to be viewed but not changed. Controlling physical access is a key element in your comprehensive security policy. Unauthorized access to change settings is prevented by insertion of a standard sealing wire through the security holes in order to meet applicable tamper-proof requirements.

2.1.10 Password security

Protecting your system from cyber security threats is very important. In addition to the tamper-proof cover, PXR trip units have a four-digit password used to secure certain settings and to enable secondary injection testing. To change a setting, which is not set by a physical switch, will require you to enter the four-digit password. Authorization to make changes will timeout after 10 seconds of inactivity. Password security is also enforced when using the display, PXPM software and when another device attempts a change via a communication network.

Changing the factory default password is a key element of a comprehensive cyber security policy. From the factory the default is '0000'. Upon installation of the PXR, the password should be changed (under the settings menu) and only made available to those individuals who require it.

For additional information and cyber security best practices, please go to www.eaton.com/cybersecurity. Detailed guidance is under the "Documentation" tab on this cybersecurity home page.

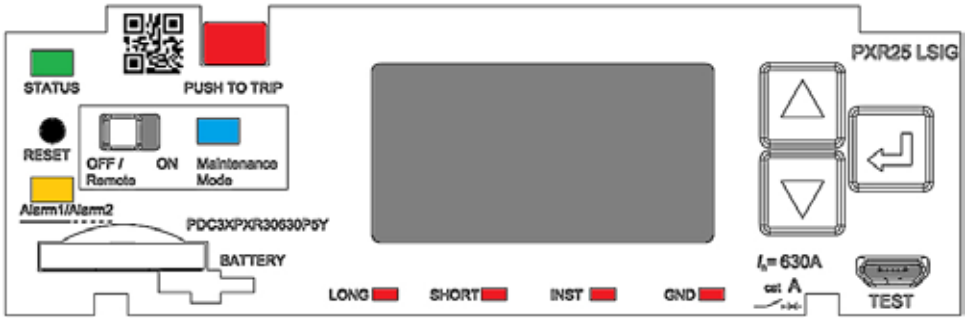
2.1.11 Catalog number and I_n rating

Trip unit family and protection functionality are printed in the upper right of the front panel. The rated I_n values are printed near the test port. The catalog number is also printed on the front, it starts with "PD" and the last three digits define the factory configuration options. See Section 9.1: Identifying the trip unit for a full list of options.

2.1.12 2-D bar code

The 2D barcode on the front of each trip unit encodes the trip unit catalog and serial number. This can be used to look-up product information that is available on-line from Eaton.

2.2 PXR 25 and 20D display with keypad



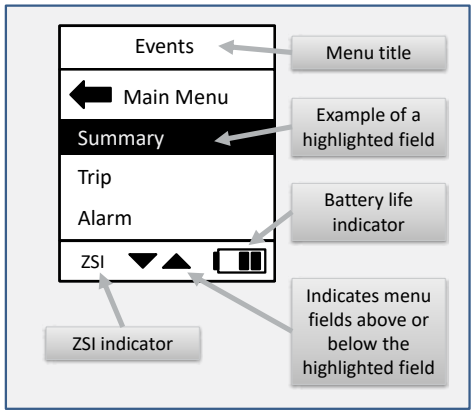
The PXR 20D and PXR 25 user interface (UI) has a display and keypad on the front of the trip unit. This display provides information regarding the operation of the trip unit and the method to select configuration options. The keypad provides for navigation through the menu structures. Information is presented on the display in English, Chinese, German, Spanish, or up to two additional languages (loaded by PXPM). To provide for easier reading of the display with the circuit breaker mounted on its side, the display is configurable to rotate 90 degrees left or right.

There are three navigation buttons near the display used to control the information shown on the display and to select configuration options:

Up arrow button - Used to move up in the menu display screen or increase an adjustment value.

Down arrow button - Used to move down in the menu screens or decrease an adjustment value.

Enter button - Used to enter a menu or configuration setting or to go back to the previsions menu.

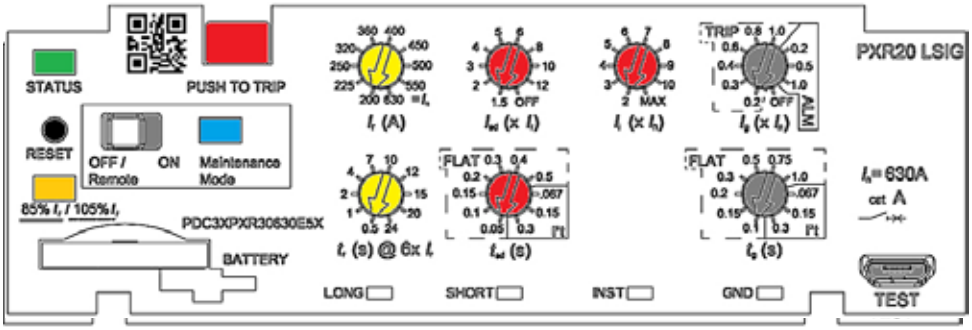


Each trip unit style has configurable settings for protection and other features. All can be configured using either the front panel or by using PXPM software. Details regarding the available protection settings for each frame are found in Section 9: Available protection settings.

When the PXR trip unit is initially powered-up, the display will briefly show a loading screen and then change to the main menu. During this time, the trip unit is already functioning and performing protection operations. Depending on the trip unit style, there are up to 12 submenu selections from the main menu. Each is accessed by pressing the down arrow or up arrow buttons to highlight the appropriate submenu, then pressing the enter button

Back lighting is included on the display with a power saver feature that after two minutes of inactivity will extinguish the backlight. In addition, after 20 minutes of inactivity, the display will enter an idle-screen mode that scrolls through the most important status information and settings. Pressing any button will light the backlight and, if active, stop automatic scrolling, allowing you to navigate the menu structure. With the tamper-proof cover secured, only the up arrow and down arrow buttons are accessible, pressing either will light the backlight, stop the automatic scrolling and allow you to navigate and view status and setting information.

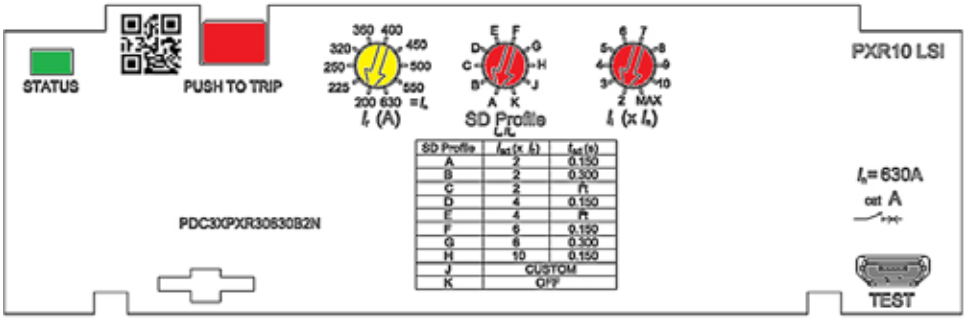
2.3 PXR 20 with rotary switches



Depending on the trip unit style, up to seven rotary switches can be found on the trip unit's front panel. The switches are color-coded and set protection settings using a surrounding legend indicating the value of that setting. These are the core protection settings, other configurable settings can be set using PXPM. Details regarding the available protection settings for each frame are found in Section 9: Available protection settings.

Each switch has ten positions and is set to achieve the appropriate trip-curve response. The yellow color switches set the overload configuration, red switches set the short circuit behavior and grey switches set the ground fault behavior. The "PICKUP" switches set the levels as a function of the breaker ratings. The "TIME" switches set the response in seconds. Each switch can be set using a small screwdriver, the arrow pointing to the selected value.

2.4 PXR 10 simplified rotary switches



The PXR 10 trip curve configuration is simple, using the switches on the front panel. LSI trip units have three rotary switches, while the LI version has only two, eliminating the center "SD Profile" switch. For all, the yellow color rotary switch sets the I_r and the red switches define short circuit behavior. Details regarding the available protection settings for each frame are found in Section 9: Available protection settings.

The cause of any breaker tripping event cause-of-trip (CoT) is recorded by the PXR 10 and can be accessed along with captured current values by using the PXPM software.

2.5 Thermal-magnetic trip units

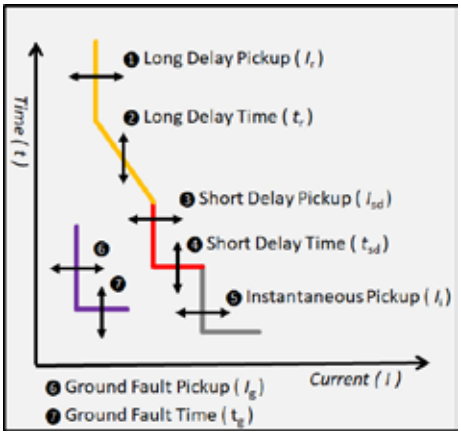
The Power Defense line of circuit breakers also includes thermal-magnetic trip units in several combinations of fixed and adjustable protection. Details can be found at www.eaton.com/powerdefense.

3 Protection setting description

The PXR trip unit protection settings are easily customized to any application. Settings for long delay pickup, long delay time, short delay pickup, short delay time, instantaneous pickup, ground fault pickup, and ground fault time are all configurable. These functions are set using PXPM software, or rotary switches or the UI on the front of the trip unit.

Maximum and minimum settings will vary by trip unit style and breaker frame. A summary of the available settings by PXR model and breaker frame is shown in Section 1.1, please consult the detailed tables within Section 9: Available protection settings.

Before placing any circuit breaker in operation, set each trip unit protection setting to the values specified by the engineer responsible for the installation.



3.1 Long delay pickup and time setting

The PXR trip unit offers a wide range of settings for long delay pickup (LDPU or I_r). The actual pickup value for long delay will be 110% of the set point value with a +/- 5% tolerance to ensure that the circuit breaker can carry the full rating of (I_r), without tripping.

The long delay time setting value represents the clearing times when the current value equals six times (I_r). All times are referenced from the top of the tolerance band, ensuring that the time never exceeds that maximum setting.

I_r is also the base for the short delay current setting.

3.1.1 Long delay slope selection

The I^2t setting is the factory default curve for long delay. Certain styles of trip unit offer other slope selections. The curve can be changed using PXPM software or the UI to better match application requirements for protection and coordination.

- I^2t - Inverse time current curve, used in standard distribution protection (factory default).
- I^4t - Extremely inverse time current curve, for coordination with fuses or special types of loads.

3.1.2 Long delay thermal memory

In addition to the standard long delay protection, a long time memory (LTM) function is supported. This protects load circuits from the effects of repeated overload conditions. LTM is enabled from the factory but can be reconfigured using the UI or by using PXPM software.

As an example, if a circuit breaker is closed soon after a long delay trip, and the current again exceeds the long delay setting (I_r), the LTM automatically reduces the time to trip to allow for the fact that the load conductor temperature is already higher than normal because of the prior overload condition. When the load current returns to normal, below pickup, the LTM will begin to reset (after about ten minutes it will have reset fully) so the next long delay trip time will again correspond to cold start on the curve. In certain applications and when doing repetitive field testing, it may be desirable to disable the LTM function.

3.2 Short delay pickup and time settings

Settings for short delay pickup (SDPU or I_{sd}) are expressed as multiples of the long delay pickup current setting (I_r).

The short delay time (t_{sd}) is selected in conjunction with one of two short delay slopes, flat, or I^2t. The I^2t response curve will provide a longer time delay for currents below eight times I_r as compared with a flat response curve. For currents greater than eight times I_r, the I^2t response reverts to a flat response.

The optional zone selective interlocking (ZSI) feature may affect the tripping times for the short delay protective function. Please refer to the section on ZSI.

3.3 Instantaneous pickup setting

The instantaneous (I_i) setting is expressed as multiples of the circuit breaker frame rating (I_n). The instantaneous protection trips the breaker with no intentional time delay.

3.4 Ground fault settings

When the PXR 20, 20D or 25 trip unit includes ground fault protection features, the distribution system characteristics (such as system grounding, number of sources, and number and location of ground points) must be considered along with the manner and location in which the circuit breaker is applied to the system. To ensure correct ground fault equipment performance and compliance, you must conduct the field testing required to comply with country or regional requirements.

3.4.1 Ground fault pickup

The PXR trip unit provides flexibility in detecting and acting on ground currents. A ground fault alarm can provide an early warning of a ground fault condition and a ground fault trip can provide protection under these conditions. Three modes of operation are selectable from the front of the trip unit.

- The ground detection may be turned off by selecting "OFF".
- The ground fault detection pickup level with an alarm only action can be used by selecting "Alarm". Multiple levels of pickup are available depending on the trip unit style.
- The ground fault detection pickup level with an action of trip may also be used by selected "Trip". If a ground fault causes the circuit breaker to trip.

3.4.2 Ground fault time

The PXR trip unit provides selection for two different ground fault slopes: a fixed time (flat) or I^2t response. The slope should be chosen to match coordination needs. The I^2t slope response provides a longer time delay for coordination of currents below 1.0 x I_n frame. After 1.0x the response reverts to a fixed time (flat) response. The time delay and slope are selected using PXPM or the user interface (UI).

3.4.3 Ground fault thermal memory

In addition to standard ground fault protection, the PXR trip unit also has a ground fault memory. This protects load circuits from the effects of intermittent ground faults over a short period of time. Ground fault memory is enabled from the factory but can be reconfigured using the UI or by using PXPM software.

Consider an example where there is "sputtering" ground fault. With ground fault memory, the trip unit "remembers" the sputtering ground current. When the ground current returns to normal, below pickup, the memory will begin to reset (after about ten minutes it will have reset fully). The next ground trip time will again correspond to the curve. Without this function enabled, ground fault protection memory resets each time the arc goes out, so that a sputtering fault may not trip the circuit breaker.

3.4.4 Ground fault relay

If the ground fault alarm option is selected, a red ground alarm indicator will illuminate to show the presence of ground current in excess of the ground alarm setting. The optional relays in the trip unit can be configured to energize an alarm relay upon this condition. The indicator and relay will reset automatically when the ground current reduces to a value less than the ground fault pickup setting.

If the ground fault trip option is selected, the trip unit can indicate when the circuit breaker has tripped on a ground fault. You must then push the "RESET" button in order to reset the relay contact.

3.4.5 Ground fault sensing

The PXR 20/25 trip unit provides for three modes of sensing to detect ground fault currents: residual, source ground, and zero sequence. The mode is selected using the UI or by using the configuration software.

See Section 3.5: Special consideration for ground fault test for guidance when testing ground fault functionality.

Residual current sensing

Residual sensing is the standard mode of ground fault sensing in PXR based circuit breakers. This mode uses one current sensor on each phase conductor and one on the neutral for a four-wire system. If the system neutral is grounded, but phase to neutral loads are not used, the PXR trip unit includes all of the components necessary for ground fault protection. This mode of sensing sums the outputs of the three or four individual current sensors. If the sum is zero, then no ground fault exists. Residual ground fault sensing features are adaptable to main and feeder circuit breaker applications. If an external neutral sensor is used with reverse feed breaker applications, the proper polarity of the neutral needs to be considered.

Source ground / zero sequence sensing

These two methods are only available on Power Defense frames five and six. The source ground return method is usually applied when ground fault protection is desired only on the main circuit breaker in a simple radial system. This method is also applicable to double-ended systems where a mid-point grounding electrode is employed.

For this mode of sensing, a single current sensor mounted on the equipment-bonding jumper will directly measure the total ground current flowing in the grounding electrode conductor. Setting the ground fault type will enable this protection.

Zero sequence sensing also referred to as vectoral summation, available in certain styles, is applicable to mains, feeders, and special schemes involving zone protection.

Ground (Earth) sensing method	Frame	Sensor catalog #
Residual	PD2 – up to 100 A w/o bus-bar	PDG2XNCTD0100
	PD2 – 100 to 225 A w/o bus-bar	PDG2XNCTD0225
	PD2 – up to 100 A	PDG2XNCTB0100
	PD2 – 100 to 225 A	PDG2XNCTB0225
	PD3	PDG3XNCTB0600
	PD4	PDG4XNCTB0800
	PD5	PDG5XNCTB1200
	PD6	PDG6XNCTB2500
Source ground / zero sequence	All	Tbd

3.5 Special consideration for ground fault test

3.5.1 NEC requirements and UL standards

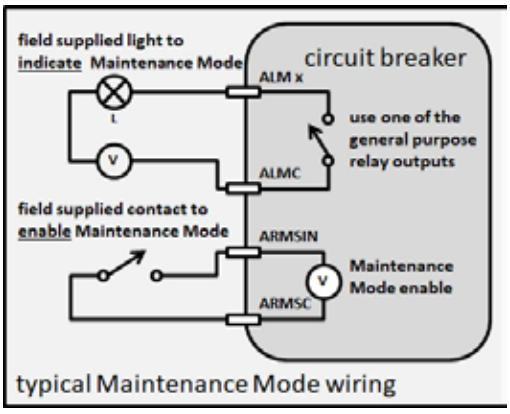
The National Electric Code (NEC) under Article 230-95-C requires that any ground-fault protection system be performance tested when first installed. UL Standard 489 amd 1053 specify that instructions for ground fault testing accompany each ground fault protection system. Please consult Instruction leaflet number IL012125EN available at www.eaton.com/powerdefense to aid you in ground fault testing the Power Defense circuit breaker.

3.6 Maintenance mode protection

The PXR trip units support Eaton's Arc Flash Reduction Maintenance System (ARMS), also known as maintenance mode. When maintenance is being performed and the ARMS is enabled, the trip unit will trip the breaker with no intentional delay whenever the configured pickup level is exceeded. The maintenance mode protection overlays the LSI protection functions and operates in parallel. If maintenance mode causes the circuit breaker to trip, the "INST" indicator will be illuminated and the "Maintenance Mode Trip" message will be displayed if the style of trip unit has a display.

The maintenance mode pickup level setting is configured using the UI or PXPM software. They range from 2.5 (most protective) to 10, expressed as a multiplier of In. The adjustable current settings allow for different levels of protection. A higher level may be needed when, for example, another load fed from the ARMS protected breaker may contain motors that are being started and create large inrush currents over the lowest trip current level. The selection of one of the reduction settings should be determined and selected by a person who is experienced in power system analysis.

3.6.1 Actuating and indicating maintenance mode protection



There are three ways to actuate the maintenance mode function, locally, remotely using a contact, or remotely using communications. A blue LED on the trip unit always illuminates to confirm when the function is enabled.

- For locally actuating the maintenance mode function, use the slide switch on the front of the trip unit. When in the "ON" position, maintenance mode is enabled locally and cannot be turned-off remotely or by communications. This method does not require auxiliary power to the trip unit, and the blue LED on the face of trip unit will light when the trip unit is self-powered.
- Maintenance mode can be remotely actuated by an external contact wired to the breaker when the local switch is in the "OFF/Remote" position. See Section 5.1: Wiring table for details regarding the contact and wiring length. Auxiliary power (24 V DC) is required for this functionality.
- A third method to actuate maintenance mode is via communications. This can be done through a modbus register, a communications adapter module (CAM) or by the configuration software using the USB port. When maintenance mode is enabled by communications, it must also be disabled via communications. Moving the local switch from "OFF/Remote" to "ON" and back to "OFF/Remote" will not disable maintenance mode. Auxiliary power (24 V DC) is required for communications functionality, including maintenance mode remote activation.

Use one of the general-purpose, configurable, relay contacts to remotely indicate when maintenance mode is active. Auxiliary power (24 V DC) is required for the remote indication via a relay contact.

3.7 Override

The PXR trip unit provides an override trip function that will trip the circuit breaker at the withstand rating of the circuit breaker frame. This function is factory set and reacts to the peak current level. It is always active regardless of the user's instantaneous adjustment selection. The instantaneous ("INST") indicator shows this cause-of-trip.

3.8 Zone selective interlocking (ZSI)

The zone selective interlocking (ZSI) function is an option when ordering the circuit breaker. ZSI functions in conjunction with the short delay and ground fault protection functions. ZSI provides the fastest possible tripping for faults within the zone of protection of the circuit breaker and also provides positive coordination among all circuit breakers in the system (mains, ties, feeders, and downstream circuit breakers). Application note (AP02602002E) is available and has additional detail.

When ZSI is enabled, a fault within the zone of protection will immediately trip the breaker and send a signal to upstream trip units to restrain them from tripping immediately. The restraining signal causes the upstream circuit breakers to follow their set coordination time delays so that the service is interrupted to the isolated fault area only while the fault is cleared in the shortest time possible.

The ZSI is wired using a set of three wires labeled zone in (Zin), zone out (Zout), and zone common (Zcom). These signals are compatible will all Eaton circuit breakers which have the ZSI function. The zone out signal is sent whenever a ground fault pickup or short delay pickup is exceeded. This provides maximum selectivity for coordination with larger upstream circuit breakers.

ZSI in the PXR trip unit is fully compatible with ZSI in the Digitrip for Magnum, Digitrip for NRX, OPTIM and 310+ Series C and Series G trip units. If a PXR trip unit has the ZSI option but it is not needed in an application, it may be disabled using the Power Xpert Protection Manager software or the menus on the UI, or the Zout and Zin may be connected to "self-interlock" the unit.

PXR trip units with a display have a visual indication of the ZSI system being active and connected to the other breakers in the ZSI system. A small check-mark will appear next to the ZSI when the trip unit receives a ZSI-IN signal. The general-purpose, configurable, relay contacts may also be programmed to indicate ZSI signals and status.

3.9 Operating temperature

All models of trip units are designed for commercial/industrial circuit breaker environments. The frames are rated for load and temperature per individual circuit breaker. As an additional protection, if temperatures in the PXR trip-unit exceed 105 °C (220 °F), a factory-set over-temperature protection feature will trip the circuit breaker to protect the internal electronic components.

4 Communication functionality

The PXR family of trip units offers wide support for communications. A USB port is present on all PXR family trip units. All PXR 20, 20D and 25 support external communication adapter modules (CAM) while certain models have built-in Modbus-RTU.

4.1 Integrated Modbus - remote terminal unit (RTU)

A Modbus communication port is integrated into the PXR trip unit for certain styles. Breaker status (closed/tripped/open), set points and operating information are all available via Modbus. The trip unit responds to messages from the master using the remote terminal unit (RTU) protocol. Modbus port configuration can be viewed and set using the user interface (UI) or using Power Xpert Protection Manager software. 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.

The detailed Modbus register map is shown in Section 10: Modbus communication port register map.

4.2 USB port

The PXR includes a micro-B form USB port on the front of the trip unit. This USB connection is used in conjunction with your PC running the PXPM software to configure, control, and test the trip unit. The USB host-side also supplies power to the electronics for configuration when the circuit breaker is not carrying current or when no auxiliary power is applied and for trip unit testing (both trip and no-trip). A commercial USB battery supply may also be used.

The USB port is covered by the clear, lockable cover to prevent unauthorized modification to settings. Controlling physical access to the USB port is a key element in your comprehensive cyber security plan.

4.3 External communications adapter modules (CAMs)

The PXR 20, 20D and 25 trip units are equipped to handle a flexible and modular system of communication adapter modules (CAMs). These modules provide communication from the trip unit to a field bus network. These modules mount on a DIN rail and wired into the trip unit.

The following networks are supported:

Network	Module name	Instruction leaflet	Wiring harness
ETHERNET (Modbus TCP)	PXR-ECAM – MTCP	IL0131132EN	Field wired
PROFIBUS	PXR-PCAM	IL120009EN	Field wired
Legacy CAM modules			
Modbus-RTU	MCAM	IL0131091EN	IL019001EN
INCOM	ICAM	IL01301033E	IL019001EN

Please consult the respective instruction leaflet for details.

5 External wiring of the trip unit

The PXR family has a rich set of options for integrating the trip unit into a larger system. Wires exit the breaker at the rear through a trough on both the left and right side. The wiring functionality and color coding is identical throughout the family and frames.

5.1 Wiring table

Wire colors and function are consistent across all PXRs in the Power Defense family. The styles and options ordered determine which of the following wires are provided.

Feature	Short name	Color	Notes
Aux power	AUX +24V	Orange	24 VDC 0.5 A 20 VA is required. Eaton PSG family recommended.
	AUX 0V	Orange / black	
ZSI	ZIN	Yellow / black	These connect to other ZSI enabled breakers in the system. Maximum length of 75 meters (250 feet) using AWG # 22 wire.
	ZOUT	Yellow / red	
	ZCOM	Yellow	
Neutral sensor	N1	Grey	Connect to the external neutral current sensor.
	N2	White	
Voltage sensor	NV	White / grey	Connect to the neutral sensor module and then the neutral bus.
Alarm relay(s)	ALM1	Black / white	Normally open contacts, close when the associated alarm is active. Contacts rated to 240 VAC, 1 Amp. See Section 5.3: General purpose relay mapping
	ALM2	Black / red	
	ALM3	Black / violet	
	ALMC	Black	
Modbus	MODBA	Green / black	Modbus RTU, max of 99 nodes, length 1,200 meters (4,000 ft.). Recommended cable: twisted-pair foil shield w/ drain wire, 120 ohms impedance. Rated for the use (typical 75C and 300 V NEC CM, or Belden Data Tray series 3074F for 600 V NEC TC).
	MODBB	Green / red	
	MODBG	Green	
Maintenance mode	ARMSIN	Brown	External dry contact. This is a low-voltage signal, use a high quality gold contact and keep wire length under 3 meters (15 feet).
	ARMSC	Brown / white	
Communication adapter (CAM) link	CMM1 (TX+)	Violet / white	Connection to the selected CAM module. Refer to CAM ILs for wiring details.
	CMM2 (TX-)	Violet / red	
	CMM3 (GND)	Violet / green	
	CMM4 (RX+)	Violet / yellow	
	CMMG (RX-)	Violet	

5.2 Auxiliary power

Providing auxiliary power to the PXR trip unit will provide full functionality even when the circuit breaker is open or when the circuit breaker is under very light load such that the self-powering current transformer cannot provide sufficient energy to fully power the trip unit.

The power requirements are: 24 VDC +/- 10%, 1.0 A. The Eaton PSG family of power supplies with 24 V output are recommended. One supply can feed multiple PXR trip units if desired.

REMEMBER: Auxiliary power is not required to provide current protection features. Protection is active well before any overload. The trip unit begins to power-up at very low levels of current (approximately 20% of the frame rating). For single-phase applications, self-power occurs at a higher current threshold (approximately 30% of the frame rating).

5.3 General purpose relay mapping

The PXR family supports optional general purpose relay contacts (1 to 3 relays depending on the PXR model and the breaker frame). Any relay in the PXR can be configured to any one of the functions. The mapping is conveniently done using the Power Xpert Protection Manager software. Relays require auxiliary power to operate.

	Description of relay operation:	
Function name	**"The relay will close when ... "**	**"The relay will open when ... "**
Aux contact	breaker is closed.	breaker is open.
Bell contact	breaker is tripped.	breaker is not tripped (open or closed).
Trip alarm - overload	there is a long or over-temperature trip.	RESET button is pressed or communications reset command received.
Trip alarm - neutral current	there is a neutral current trip.	RESET button is pressed or communications reset command received.
Trip alarm - short delay	there is a short delay trip.	RESET button is pressed or communications reset command received.
Trip alarm - instantaneous	there is an instantaneous trip.	RESET button is pressed or communications reset command received.
Trip alarm - short circuit	there is a short, inst or override trip.	RESET button is pressed or communications reset command received.
Trip alarm - ground fault	there is a ground fault trip.	RESET button is pressed or communications reset command received.
Trip alarm - (ARMS) maintenance mode	there is a maintenance mode trip.	RESET button is pressed or communications reset command received.
Trip alarm - all trips	there is any type of protective current (all the above) trip.	RESET button is pressed or communications reset command received.
Alarm - high load alarm 2	current flow is greater than set point (adjustable from 50% to 120% of Ir). Note: alarm1/alarm2 LED will BLINK.	current flow falls 5% below the set point.
Alarm - high load alarm 1	current flow is greater than set point (adjustable from 50% to 120% of Ir). Note: the alarm1/alarm2 LED will ON.	current flow falls 5% below the set point.
Alarm - high temperature	temperature exceeds 5C below the level of the temperature trip setting.	temperature falls 5C below the trip setting.
Alarm -ground fault pre alarm	ground current is greater than the set point (adjustable from 50% to 100%).	ground current falls 5% below the set point.
Alarm - thermal memory	the thermal memory value is >75%.	the thermal memory value is <70%.
Alarm - watchdog and aux power	auxiliary power is active and the trip unit is healthy and operating.	there is an error in the trip unit from any of the self-diagnostics.
Alarm - low battery	the battery is below 1 bar (25%).	the battery value is 1 bar (25%) or higher.
Fault - internal	there is an internal fault detected.	RESET button is pressed or communications reset command received.
Fault - health	the health value is below 25%.	the health value is at or above 25%.
Fault -communication	any external communications error occurs.	RESET button is pressed or communications reset command received.
Alarm - all fault alarms	any of the above 4 faults are active.	all of the above four faults are inactive.
Maintenance mode active	the trip unit is in the maintenance mode.	when the trip unit exits maintenance mode.
ZSI active	the ZSI function active.	ZSI is not active.
ZSI input received	a ZSI INPUT signal is received.	RESET button is pressed or communications reset command received.
ZSI output sent	a ZSI OUTPUT signal is sent.	RESET button is pressed or communications reset command received.
Open breaker pulsed	an OPEN breaker command from any of the communications channels is received.	two seconds after the OPEN breaker command is received.
Close breaker pulsed	a CLOSE breaker command from any of the communications channels is received.	two seconds after the CLOSE breaker command is received.
Output 1	an output 1 ON command is received on any of the communications channels.	an output 1 OFF command is received on any of the communications channels.
Output 2	an output 2 ON command is received on any of the communications channels.	an output 2 OFF command is received on any of the communications channels.

5.4 Neutral voltage sensor

For applications with a neutral conductor external to the circuit breaker, a small module is provided. This module has wire leads and must be used between the neutral conductor and the voltage sensor input to the trip unit. The neutral voltage provides a reference to accurately measure voltages in "Y" connected power system.

IMPORTANT: This module contains circuitry to reduce the line voltage to levels accepted by the trip unit. Failure to use this module for neutral sensing may cause permanent damage to the trip unit.

6 Power Xpert® Protection Manager - configuration software

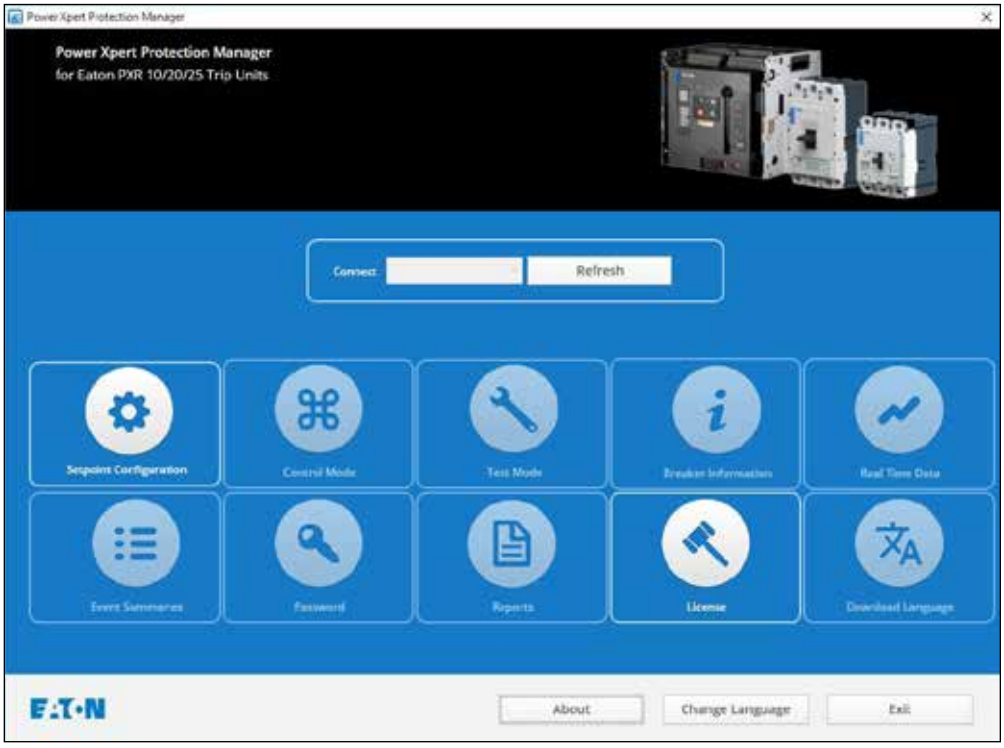
Eaton's PXPM is a Microsoft® Windows-based software that configures, controls, monitors and tests Eaton PXR trip units. The user can create, modify, and save configurations for a PXR trip unit. The software further allows user to reset trip units, adjust trip unit's date and time, capture current or voltage waveforms, and perform trip or no-trip tests.

The software is available as a download from the following link: www.eaton.com/PXPM.

The Power Xpert Protection Manager provides two key features. You may choose set point configuration to create, modify and save configurations for PXR trip units. The remote control and test offers users the ability to reset trip units, adjust trip unit time, capture current or voltage waveforms, perform trip or no-trip tests and generate test reports.

6.1 Set point configuration through PXPM

Key to configuring your trip unit is the configuration screen, which allows users to view and edit set points.



Typical actions available from the configuration screens include:

- View and edit set points - For each set point, its range, step size and description are shown in the tooltip when a user hovers the mouse cursor over that set point. A blank space for a set point indicates that user may work in offline mode, and cannot edit the read-only set point.

- Change trip unit - Takes user back to "Create New Offline Setting Screen" to modify trip unit's settings.
- Save (visible in open settings) - Saves changes in set points. Note that if set points have already been saved to a file, click save button will overwrite the file with new set points.
- Save as - Saves set points to a configuration file. Users will be prompted to select a location and a name for the configuration file.
- Export - Sends the set points to a trip unit. The trip unit must be connected to the computer through a USB to Micro-USB cable for successful operation.

- Curves - Shows a dynamic representation of the trip-curve as you are configuring the set points. It displays long and short delay protection curves, as well as ground (earth) and instantaneous protection curves.

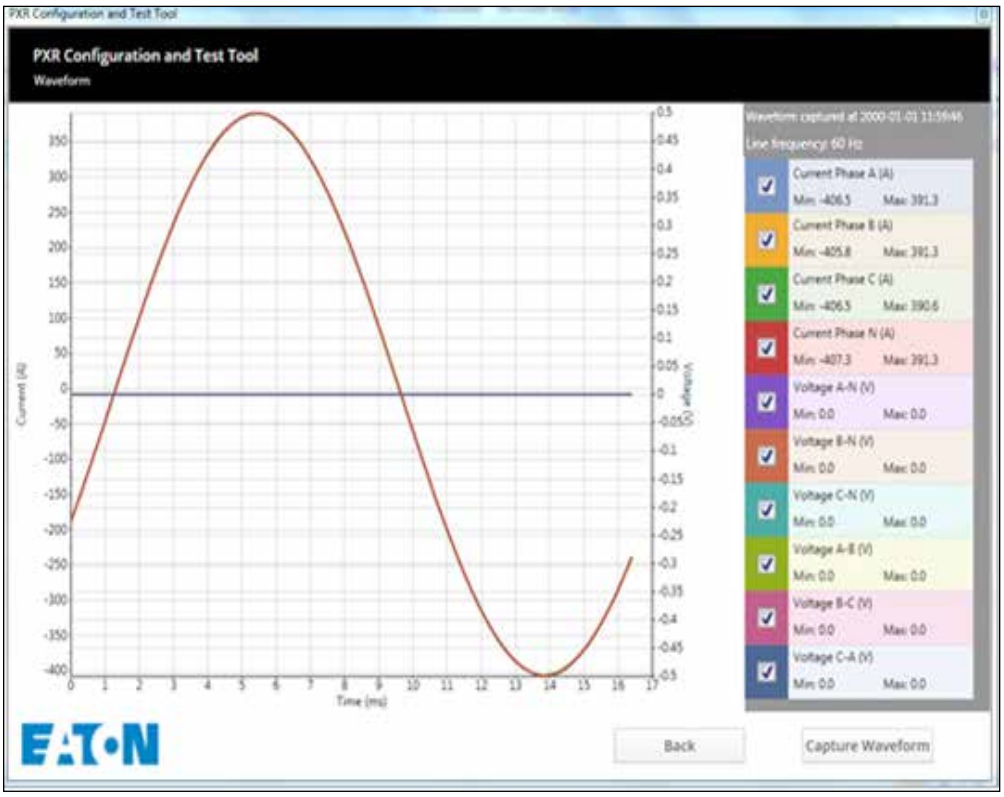
- Change summary - Displays a summary of set points that have been changed in the present session. Both original and changed values are displayed.
- Extract to PDF - Exports all set points to a portable document format (PDF) file. Modified set point parameters are highlighted in the exported PDF file.
- Undo all changes - Resets all set points to their original values.

6.2 Remote control and test

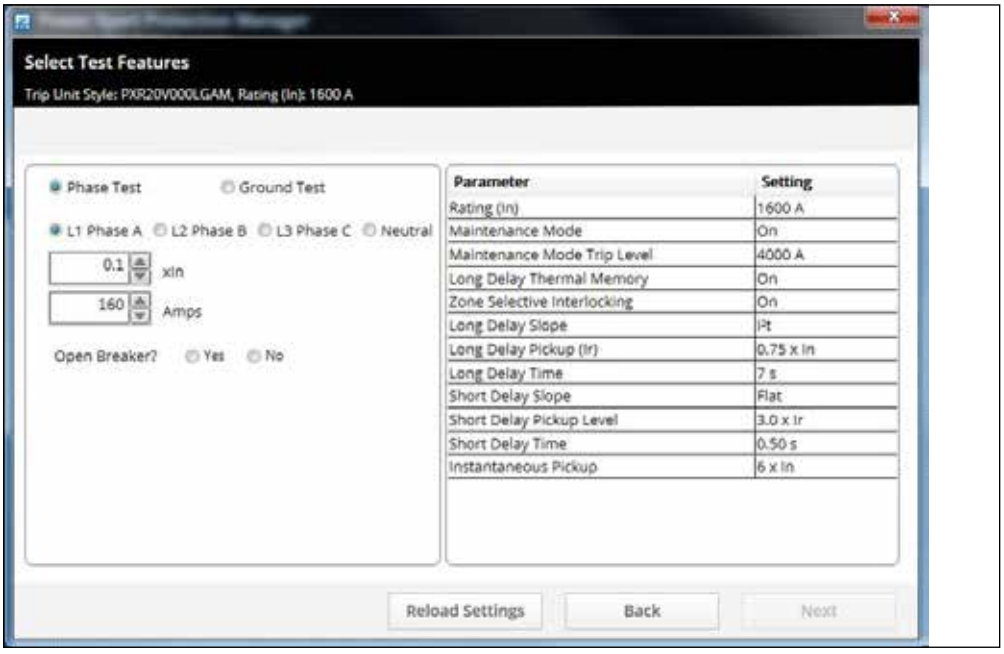
When service is required, the remote control and test section allows users to reset trip unit, change trip unit date and time, capture waveforms, and performs trip or no-trip tests. The test functions require no extra equipment and provide a battery of testing possibilities. All PXR trip units can perform secondary injection testing using an on-board but totally independent circuit to provide the secondary injection.

- Reset trip unit - The internal record of causes of trip, diagnostics and metering data can be reset in this set of screens.
- Change trip unit date and time - The internal clock that keeps track of time can be set to the desired date and time.

- Capture waveform – The PXR trip units allow user to manually capture both current and voltage waveforms by simply clicking the mouse. A full-cycle of waveform is captured, and displayed in the PXPM software.



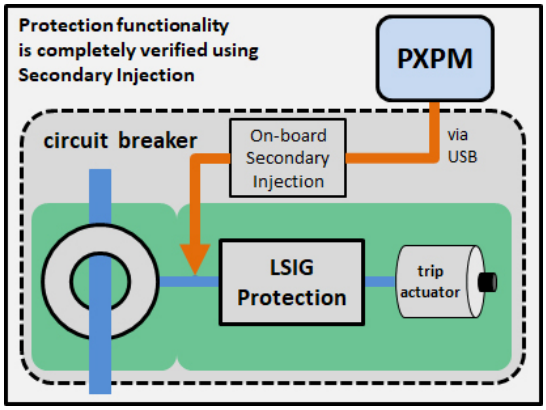
- Test trip unit - The PXR trip units allow the user to perform LSIG, maintenance mode and current sensor tests. Click test mode button to perform test operations.



6.2.1 Testing the breaker and trip unit

The PXPM software controls 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 is used to observe the current being injected and the elapsed time until trip. To perform testing will require you to enter the four-digit password

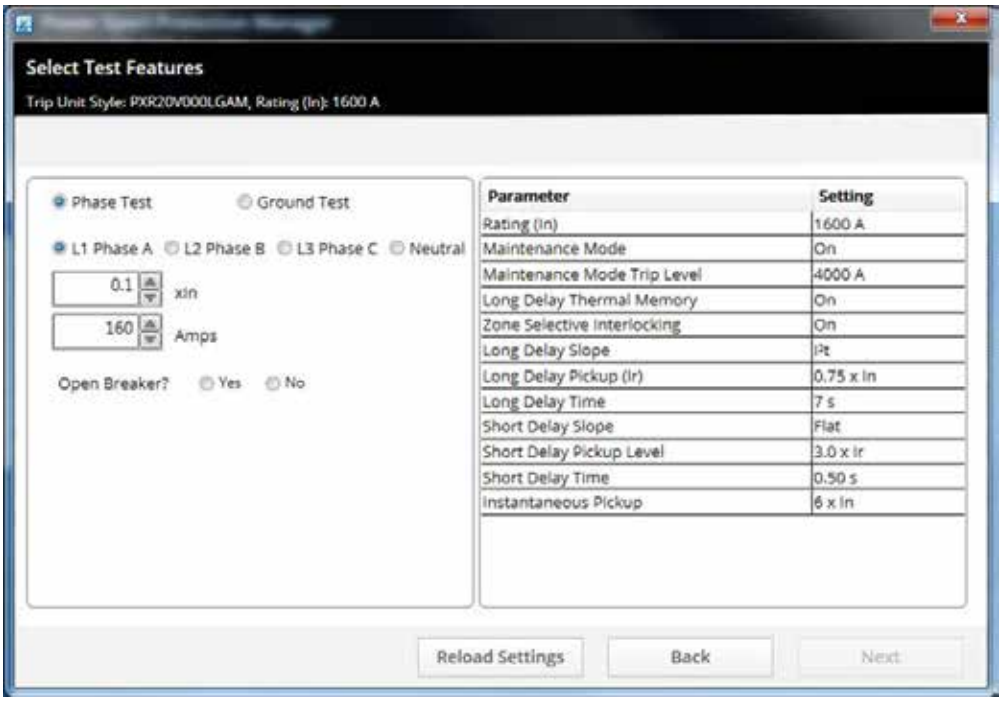
The PXR trip unit has two built-in functional test modes available for use. One is a simulated current test and the other is an internal secondary injection current test. Either mode can be configured for opening or not opening the breaker.



The simulated test is an easy test to verify multiple points on the time-current curve. The test current values are simulated in the software algorithms to precisely verify the accuracy of the trip unit.

For internal secondary injection testing, the trip unit uses an independent built-in circuit to generate a test signal, which is injected into the sensor input circuit. This test feature replaces the need for an external secondary injection test kit.

Typical test set-up dialog box:



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 in that session.

6.3 Record keeping

The Power Xpert Protection Manager software provides printable copies of configuration and test results. If desired, make a copy and attach it to the interior of the circuit breaker cell door or another visible location. This information should be used and maintained by those personnel in your organization that have the responsibility for protection equipment.

7 Event, alarm, and trip recording with waveform capture

The PXR trip unit will record information surrounding events, alarms, and trips into a set of logs. The information is easily viewed using PXPM software. For simple events, only the reason and a time-stamp (based on the trip unit's real-time clock) are stored. Important events additionally store a snap-shot of real-time values (currents and voltages). The most important events store additional information, storing waveforms of current and voltage experienced during the event as long as auxiliary power is applied. For a trip waveform, ten cycles (six pre-event, four post-event) are saved for review using PXPM software.

Each log can store a set number of events and is managed as a first-in first-out buffer (FIFO). As the information is stored for the most recent event, the information from the oldest event is eliminated.

7.1 Trigger and data log matrix

What data is captured: / What triggers a capture:	Event cause Time-stamp	Current: IA, IB, IC, IN, IG Voltages: VAB, VBC, VCA, VAN, VBN, VCN (PXR 25 only) Power and demand: watts, Vars, VA (PXR 25 only) Power factor (PXR 25 only) Line frequency Breaker operations count Trip unit internal temperature	Waveform of: IA, IB, IC, IN, IG Waveform of: VAB, VBC, VCA, VAN, VBN, VCN (PXR25)	
Event - power up - clock ok	•			
Event - power up - clock bad	•			
Event - set points download	•			
Event - Enter test mode	•			
Event - exit test mode	•			
Event - test complete	•			
Event - enter maintenance mode	•			Indicator also illuminates
Event - exit maintenance mode	•			
Event - time change (if > 60 seconds)	•			Previous time is recorded
Alarm - calibration	•			
Alarm - set points fault	•			
Alarm - battery low voltage	•			
Alarm - low control voltage	•			
Alarm - RTC error	•			
Alarm - NV memory error	•			
Alarm - watchdog timer	•			
Alarm - long delay pickup (test mode)	•	•		
Alarm - ground fault (test mode)	•	•		
Alarm - trip actuator fault	•			
Alarm - operations count	•			
Alarm - long delay pickup	•	•	•	
Alarm - ground fault	•	•	•	
Alarm - high load	•	•	•	
Alarm - neutral current	•	•	•	
Trip - over temperature	•	•		
Trip - test	•	•		
Trip - long delay	•	•	•	All trips include four cycles before trip and six cycles after cycles of waveform capture
Trip - short delay	•	•	•	
Trip - instantaneous	•	•	•	
Trip - ground	•	•	•	
Trip - maintenance mode	•	•	•	
Trip - neutral	•	•	•	

8 Maintenance of the trip unit

Minimal maintenance is required. Keep the clear plastic cover in place regardless of if you lock it or not to help keep the front of the unit clear of dirt. Do not insert any foreign objects into the USB port; this may damage the connector's contacts. Do not subject the trip unit to any harsh chemicals or gasses to preserve the original look and feel of the unit.

8.1 Replacing the battery

The battery is provided in certain PXR styles to maintain the LED indication of the cause-of-trip. A battery icon at the bottom of the display indicates remaining battery life. The battery plays no part in the protection function of the trip system. The battery can be replaced at any time, even while the circuit breaker is in-service, without affecting the operation of the circuit breaker or its protection functions.

The 3 V lithium battery, type CR1216 ("coin-cell"), is easily removed and replaced; pull to remove the battery tray, remove the old battery from the holder, replace with new one (observe proper polarity as marked on the tray), and then re-insert the battery tray into the slot on the trip unit. In the PD2, remove the cover above the handle and pockets using a small screw-driver to access the battery. Accidentally installing the battery in the reverse direction will not harm the battery or the trip unit, but will defeat the function of the battery.

8.2 Replacing the ETU

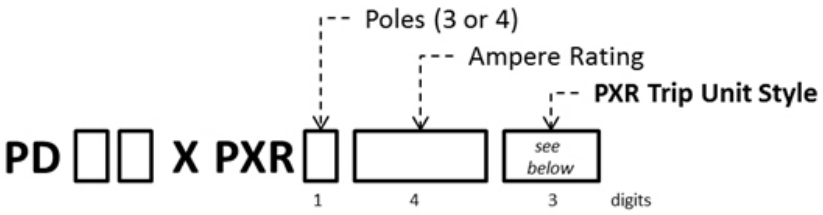
Although not typically needed, certain styles of the PXR trip unit can be changed in the field to add features. The Instruction Leaflet for each trip unit includes instructions for possible replacement and/or addition of features.

9 Available protection settings

Available settings for any circuit breaker are a function of the frame and trip unit. Please consult the following information to help identify the frame, trip unit and available settings.

9.1 Identifying the trip unit

The catalog numbers for circuit breakers that include the PXR trip units use the following schema:



The PXR trip unit style codes are shown in the table:

Trip unit style	Trip unit model and protection function	Communication, relay, maintenance mode, zone interlock (options)
B1N	PXR10 LI	
B2N	PXR10 LSI	
E2N	PXR20 LSI	
E2R	PXR20 LSI	Relays
E2Z	PXR20 LSI	ZSI and relays
E2M	PXR20 LSI	Modbus and relays
E2C	PXR20 LSI	CAM and relays
E2W	PXR20 LSI	ZSI and Modbus (and relays)
E2X	PXR20 LSI	ZSI and CAM (and relays)
E3R	PXR20 LSIG	Relays
E3Z	PXR20 LSIG	ZSI and relays
E3M	PXR20 LSIG	Modbus and relays
E3C	PXR20 LSIG	CAM and relays
E3W	PXR20 LSIG	ZSI and Modbus (and relays)
E3X	PXR20 LSIG	ZSI and CAM (and relays)
E4R	PXR20 LSI ARMS	Relays
E4Z	PXR20 LSI ARMS	ZSI and relays
E4M	PXR20 LSI ARMS	Modbus and relays
E4C	PXR20 LSI ARMS	CAM and relays
E4W	PXR20 LSI ARMS	ZSI and Modbus (and relays)
E4X	PXR20 LSI ARMS	ZSI and CAM (and relays)
E5R	PXR20 LSIG ARMS	Relays
E5Z	PXR20 LSIG ARMS	ZSI and relays
E5M	PXR20 LSIG ARMS	Modbus and relays
E5C	PXR20 LSIG ARMS	CAM and relays
E5W	PXR20 LSIG ARMS	ZSI and Modbus (and relays)
E5X	PXR20 LSIG ARMS	ZSI and CAM (and relays)
D2M	PXR20D LSI	Modbus and relays
D2D	PXR20D LSI	Modbus and CAM (and relays)
D2W	PXR20D LSI	ZSI and Modbus (and relays)
D2Y	PXR20D LSI	ZSI, Modbus, and CAM (and relays)
D3M	PXR20D LSIG	Modbus and relays
D3D	PXR20D LSIG	Modbus and CAM (and relays)
D3W	PXR20D LSIG	ZSI and Modbus (and relays)
D3Y	PXR20D LSIG	ZSI, Modbus, and CAM (and relays)
D4M	PXR20D LSI ARMS	Modbus and relays
D4D	PXR20D LSI ARMS	Modbus and CAM (and relays)
D4W	PXR20D LSI ARMS	ZSI and Modbus (and Relays)
D4Y	PXR20D LSI ARMS	ZSI, Modbus, and CAM (and relays)
D5M	PXR20D LSIG ARMS	Modbus and relays
D5D	PXR20D LSIG ARMS	Modbus and CAM (and relays)
D5W	PXR20D LSIG ARMS	ZSI and Modbus (and relays)
D5Y	PXR20D LSIG ARMS	ZSI, Modbus, and CAM (and relays)
P2M	PXR25 LSI	Modbus and relays
P2D	PXR25 LSI	Modbus and CAM (and relays)
P2W	PXR25 LSI	ZSI and Modbus (and relays)
P2Y	PXR25 LSI	ZSI, Modbus, and CAM (and relays)
P3M	PXR25 LSIG	Modbus and relays
P3D	PXR25 LSIG	Modbus and CAM (and relays)
P3W	PXR25 LSIG	ZSI and Modbus (and relays)

Trip unit style	Trip unit model and protection function	Communication, relay, maintenance mode, zone interlock (options)
P3Y	PXR25 LSIG	ZSI, Modbus, and CAM (and relays)
P4M	PXR25 LSI ARMS	Modbus and relays
P4D	PXR25 LSI ARMS	Modbus and CAM (and relays)
P4W	PXR25 LSI ARMS	ZSI and Modbus (and relays)
P4Y	PXR25 LSI ARMS	ZSI, Modbus, and CAM (and relays)
P5M	PXR25 LSIG ARMS	Modbus and relays
P5D	PXR25 LSIG ARMS	Modbus and CAM (and relays)
P5W	PXR25 LSIG ARMS	ZSI and Modbus (and relays)
P5Y	PXR25 LSIG ARMS	ZSI, Modbus, and CAM (and relays)
B8N	PXR10 LSI motor	
P8M	PXR25 LSI motor	Relay ready and Modbus ready
P8D	PXR25 LSI motor	Relay ready, Modbus ready, CAM onboard
P8W	PXR25 LSI motor	Relay ready, Modbus ready, ZSI onboard
P8Y	PXR25 LSI motor	Relay ready, Modbus ready, CAM onboard, ZSI onboard
P9M	PXR25 LSIG motor	Relay ready and Modbus Ready
P9D	PXR25 LSIG motor	Relay ready, Modbus ready, CAM onboard
P9W	PXR25 LSIG motor	Relay ready, Modbus ready, ZSI onboard
P9Y	PXR25 LSIG motor	Relay ready, Modbus ready, CAM onboard, ZSI onboard

9.2 Detailed settings tables

The following set of tables details the settings available in each PXR and circuit breaker frame style.

9.2.1 PDG2 PXR10 settings (LI)

Frame	60 A	100 A	150 A	225 A	All	60 A	100 A	150 A	225 A
Setting	Ir				tr @ 6xIr	Ii (nxIn)			
Switch	1				-	2			
1	15	32	50	80	10	2	2	2	2
2	16	35	60	90	10	3	3	3	3
3	20	40	63	100	10	4	4	4	4
4	25	50	70	110	10	5	5	5	5
5	30	60	80	125	10	6	6	6	6
6	35	63	90	150	10	8	7	8	7
7	40	70	100	160	10	10	8	10	8
8	45	80	110	175	10	12	9	12	9
9	50	90	125	200	10	15	10	15	10
10	60	100	150	225	10	18.3	11.0	14.0	9.3

9.2.2 PDG2 PXR10 settings (LSI)

Frame	60 A	100 A	150 A	225 A	All	SD profile		60 A	100 A	150 A	225 A
Setting	Ir				tr @ 6xIr	Isd (nxIr)	tsd (s)	Ii (nxIn)			
Switch	1				-	2		3			
1	15	32	50	80	10	2.0	0.150	2	2	2	2
2	16	35	60	90	10	2.0	0.300	3	3	3	3
3	20	40	63	100	10	2.0	I^2t	4	4	4	4
4	25	50	70	110	10	4.0	0.150	5	5	5	5
5	30	60	80	125	10	4.0	I^2t	6	6	6	6
6	35	63	90	150	10	6.0	0.150	8	7	8	7
7	40	70	100	160	10	6.0	0.300	10	8	10	8
8	45	80	110	175	10	10.0	0.150	12	9	12	9
9	50	90	125	200	0.5 to 24	2.0 to 10.0	0.05 to 0.30	15	10	15	10
10	60	100	150	225	10	OFF	-	18.3	11.0	14.0	9.3

Configurable using PXPM software

9.2.3 PDC2 PXR10 settings (LI)

Frame	63 A	100 A	160 A	200 A	250 A	All	63 A	100 A	160 A	200 A	250 A
Setting	Ir					tr @ 6xIr	Ii (nxIn)				
Switch	1					-	2				
1	16	25	40	50	63	10	2	2	2	2	2
2	18	32	50	63	80	10	3	3	3	3	3
3	20	40	63	80	100	10	4	4	4	4	4
4	25	50	70	90	125	10	5	5	5	5	5
5	32	55	80	100	150	10	6	6	6	6	6
6	40	63	90	125	160	10	8	7	8	7	6.5
7	45	70	100	150	175	10	10	8	10	8	7
8	50	80	125	160	200	10	12	9	12	9	7.5
9	55	90	150	175	225	10	15	10	14	10	8
10	63	100	160	200	250	10	17.4	11.0	13.1	10.5	8.4

9.2.4 PDC2 PXR10 settings (LSI)

Frame	63 A	100 A	160 A	200 A	250 A	All	SD profile		63 A	100 A	160 A	200 A	250 A
Setting	Ir					tr @ 6xIr	Isd (nxIr)	tsd (s)	Ii (nxIn)				
Switch	1					-	2		3				
1	16	25	40	50	63	10	2.0	0.150	2	2	2	2	2
2	18	32	50	63	80	10	2.0	0.300	3	3	3	3	3
3	20	40	63	80	100	10	2.0	I^2t	4	4	4	4	4
4	25	50	70	90	125	10	4.0	0.150	5	5	5	5	5
5	32	55	80	100	150	10	4.0	I^2t	6	6	6	6	6
6	40	63	90	125	160	10	6.0	0.150	8	7	8	7	6.5
7	45	70	100	150	175	10	6.0	0.300	10	8	10	8	7
8	50	80	125	160	200	10	10.0	0.150	12	9	12	9	7.5
9	55	90	150	175	225	0.5 to 24	2.0 to 10.0	0.05 to 0.30	15	10	14	10	8
10	63	100	160	200	250	10	OFF	-	17.4	11.0	13.1	10.5	8.4

Configurable using PXPM software

9.2.5 PDG2 PXR20 settings

Frame	60 A	100 A	150 A	225 A	All	All		60 A	100 A	150 A	225 A	G styles	
Setting	Ir				tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)				Ig (nxIn)	tg (s)
Switch	1				2	3	4	5				6	7
1	15	32	50	80	0.5	1.5	0.050	2	2	2	2		0.100
2	16	35	60	90	1.0	2.0	0.100	3	3	3	3	0.30	0.150
3	20	40	63	100	2.0	3.0	0.150	4	4	4	4	0.40	0.200
4	25	50	70	110	4.0	4.0	0.200	5	5	5	5	0.60	0.300
5	30	60	80	125	7.0	5.0	0.300	6	6	6	6	0.80	0.500
6	35	63	90	150	10.0	6.0	0.400	8	7	8	7	1.00	0.750
7	40	70	100	160	12.0	8.0	0.500	10	8	10	8	0.20	1.000
8	45	80	110	175	15.0	10.0	0.067	12	9	12	9	0.50	0.067
9	50	90	125	200	20.0	12.0	0.150	15	10	13	9	1.00	0.150
10	60	100	150	225	24.0	OFF	0.300	18.3	11.0	14.0	9.3	OFF	0.300
							Flat					Trip	Flat
							I^2t					Alarm	I^2t

9.2.6 PDC2 PXR20 settings

Frame	63 A	100 A	160 A	200 A	250 A	All	All		63 A	100 A	160 A	200 A	250 A	G styles	
Setting	Ir					tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)					Ig (nxIn)	tg (s)
Switch	1					2	3	4	5					6	7)
1	16	25	40	50	63	0.5	1.5	0.050	2	2	2	2	2	0.20	0.100
2	18	32	50	63	80	1.0	2.0	0.100	3	3	3	3	3	0.30	0.150
3	20	40	63	80	100	2.0	3.0	0.150	4	4	4	4	4	0.40	0.200
4	25	50	70	90	125	4.0	4.0	0.200	5	5	5	5	5	0.60	0.300
5	32	55	80	100	150	7.0	5.0	0.300	6	6	6	6	6	0.80	0.500
6	40	63	90	125	160	10.0	6.0	0.400	8	7	8	7	6.5	1.00	0.750
7	45	70	100	150	175	12.0	8.0	0.500	10	8	10	8	7	0.20	1.000
8	50	80	125	160	200	15.0	10.0	0.067	12	9	12	9	7.5	0.50	0.067
9	55	90	150	175	225	20.0	12.0	0.150	15	10	14	10	8	1.00	0.150
10	63	100	160	200	250	24.0	OFF	0.300	17.4	11.0	13.1	10.5	8.4	OFF	0.300
								Flat						Trip	Flat
								I^2t						Alarm	I^2t

9.2.7 PDG2 PXR25 and 20D settings

Frame	60 A	100 A	150 A	225 A	All	All		60 A	100 A	150 A	225 A	G styles	
Setting	Ir				tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)				Ig (nxIn)	tg (s)
Min	15	25	50	80	0.5	1.5	0.050	2	2	2	2	0.20	0.100
Max	60	100	150	225	24.0	12.0	0.500	18.3	11.0	14.0	9.3	1.00	1.000
Min							0.067					0.20	0.067
Max							0.300					1.00	0.300
Step	1	1	1	1	0.10	0.10	0.010	0.10	0.10	0.10	0.10	0.010	0.010
Add'l opt												OFF	
							Flat					Trip	Flat
							I^2t					Alarm	I^2t

9.2.8 PDC2 PXR25 and 20D settings

Frame	63 A	100 A	160 A	200 A	250 A	All	All		63 A	100 A	160 A	200 A	250 A	G styles	
Setting	Ir					tr @ 6xIr	Isd (nxIr)	tsd(s)					Ii (nxIn)	Ig (nxIn)	tg (s)
Min	16	25	40	50	63	0.5	1.5	0.050	2	2	2	2	2	0.20	0.100
Max	63	100	160	200	250	24.0	12.0	0.500	17.4	11.0	13.1	10.5	8.4	1.00	1.000
Min								0.067						0.20	0.067
Max								0.300						1.00	0.300
Step	1	1	1	1	1	0.10	0.10	0.010	0.10	0.10	0.10	0.10	0.10	0.010	0.010
Add'l opt														OFF	
								Flat						Trip	Flat
								I^2t						Alarm	I^2t

9.2.9 PDG3 PXR10 settings (LI)

Frame	3A			3B			All	3A			3B		
	125 A	250 A	400 A	250 A	400 A	600 A		125 A	250 A	400 A	250 A	400 A	600 A
Setting	Ir						tr @ 6xIr	Ii (nxIn)					
Switch	1						-	2					
1	45	90	160	90	160	250	10	2	2	2	2	2	2
2	50	100	175	100	175	275	10	3	3	3	3	3	3
3	60	110	200	110	200	300	10	4	4	4	4	4	4
4	63	125	225	125	225	320	10	5	5	5	5	5	5
5	70	150	250	150	250	350	10	6	6	6	6	6	6
6	80	160	275	160	275	400	10	8	8	7	10	8	7
7	90	175	300	175	300	450	10	10	10	8	15	10	8
8	100	200	320	200	320	500	10	15	12	9	20	12	9
9	110	225	350	225	350	550	10	20	15	10	25	15	10
10	125	250	400	250	400	600	10	24.0	17.6	11.0	28.8	18.0	12.0

9.2.10 PDG3 PXR10 settings (LSI)

Frame	3A			3B			3A or 3B			3A			3B		
	125 A	250 A	400 A	250 A	400 A	600 A	All	SD profile		125 A	250 A	400 A	250 A	400 A	600 A
Setting	Ir						tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)					
Switch	1						-	2		3					
1	45	90	160	90	160	250	10	2.0	0.150	2	2	2	2	2	2
2	50	100	175	100	175	275	10	2.0	0.300	3	3	3	3	3	3
3	60	110	200	110	200	300	10	2.0	I^2t	4	4	4	4	4	4
4	63	125	225	125	225	320	10	4.0	0.150	5	5	5	5	5	5
5	70	150	250	150	250	350	10	4.0	I^2t	6	6	6	6	6	6
6	80	160	275	160	275	400	10	6.0	0.150	8	8	7	10	8	7
7	90	175	300	175	300	450	10	6.0	0.300	10	10	8	15	10	8
8	100	200	320	200	320	500	10	10.0	0.150	15	12	9	20	12	9
9	110	225	350	225	350	550	0.5 to 24	2.0 to 10	0.05 to 0.30	20	15	10	25	15	10
10	125	250	400	250	400	600	10	OFF		24.0	17.6	11.0	28.8	18.0	12.0
							Configurable using PXPM software								

9.2.11 PDC3 PXR10 settings (LI)

Frame	3A		3B			All	3A		3B		
	250 A	400 A	250 A	400 A	630 A		250 A	400 A	250 A	400 A	630 A
Setting	Ir					tr @ 6xIr	Ii (nxIn)				
Switch	1					-	2				
1	63	100	63	100	200	10	2	2	2	2	2
2	80	125	80	125	225	10	3	3	3	3	3
3	100	140	100	140	250	10	4	4	4	4	4
4	125	160	125	160	320	10	5	5	5	5	5
5	150	200	150	200	360	10	6	6	6	6	6
6	160	225	160	225	400	10	8	7	10	8	7
7	175	250	175	250	450	10	10	8	15	10	8
8	200	320	200	320	500	10	12	9	20	12	9
9	225	360	225	360	550	10	15	10	25	15	10
10	250	400	250	400	630	10	17.6	11.0	28.8	18.0	11.4

9.2.12 PDC3 PXR10 settings (LSI)

Frame	3A		3B			3A or 3B			3A		3B		
	250 A	400 A	250 A	400 A	630 A	All	SD profile		250 A	400 A	250 A	400 A	630 A
Setting	Ir					tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)				
Switch	1					-	2		3				
1	63	100	63	100	200	10	2.0	0.150	2	2	2	2	2
2	80	125	80	125	225	10	2.0	0.300	3	3	3	3	3
3	100	140	100	140	250	10	2.0	I^2t	4	4	4	4	4
4	125	160	125	160	320	10	4.0	0.150	5	5	5	5	5
5	150	200	150	200	360	10	4.0	I^2t	6	6	6	6	6
6	160	225	160	225	400	10	6.0	0.150	8	7	10	8	7
7	175	250	175	250	450	10	6.0	0.300	10	8	15	10	8
8	200	320	200	320	500	10	10.0	0.150	12	9	20	12	9
9	225	360	225	360	550	0.5 to 24	10.0	0.300	15	10	25	15	10
10	250	400	250	400	630	10	OFF		17.6	11.0	28.8	18.0	11.4
						Configurable using PXPM software							

9.2.13 PDG3 PXR20 settings

Frame	3A			3B			All			3A			3B			G styles	
	125	250	400	250	400	600				125	250	400	250	400	600		
Setting	Ir						tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)						Ig (nxIn)	tg (s)
Switch	1						2	3	4	5						6	7
1	45	90	160	90	160	250	0.5	1.5	0.050	2	2	2	2	2	2	0.20	0.100
2	50	100	175	100	175	275	1.0	2.0	0.100	3	3	3	3	3	3	0.30	0.150
3	60	110	200	110	200	300	2.0	3.0	0.150	4	4	4	4	4	4	0.40	0.200
4	63	125	225	125	225	320	4.0	4.0	0.200	5	5	5	5	5	5	0.60	0.300
5	70	150	250	150	250	350	7.0	5.0	0.300	6	6	6	6	6	6	0.80	0.500
6	80	160	275	160	275	400	10.0	6.0	0.400	8	8	7	10	8	7	1.00	0.750
7	90	175	300	175	300	450	12.0	8.0	0.500	10	10	8	15	10	8	0.20	1.000
8	100	200	320	200	320	500	15.0	10.0	0.067	15	12	9	20	12	9	0.50	0.067
9	110	225	350	225	350	550	20.0	12.0	0.150	20	15	10	25	15	10	1.00	0.150
10	125	250	400	250	400	600	24.0	OFF	0.300	24.0	17.6	11.0	28.8	18.0	12.0	OFF	0.300
									Flat							Trip	Flat
									I^2t							Alarm	I^2t

9.2.14 PDC3 PXR20 settings

Frame	3A		3B			All			3A		3B			G styles	
	250 A	400 A	250 A	400 A	630 A				250 A	400 A	250 A	400 A	630 A		
Setting	Ir					tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)					Ig (nxIn)	tg (s)
Switch	1					2	3	4	5					6	7
1	63	100	63	100	200	0.5	1.5	0.050	2	2	2	2	2	0.20	0.100
2	80	125	80	125	225	1.0	2.0	0.100	3	3	3	3	3	0.30	0.150
3	100	140	100	140	250	2.0	3.0	0.150	4	4	4	4	4	0.40	0.200
4	125	160	125	160	320	4.0	4.0	0.200	5	5	5	5	5	0.60	0.300
5	150	200	150	200	360	7.0	5.0	0.300	6	6	6	6	6	0.80	0.500
6	160	225	160	225	400	10.0	6.0	0.400	8	7	10	8	7	1.00	0.750
7	175	250	175	250	450	12.0	8.0	0.500	10	8	15	10	8	0.20	1.000
8	200	320	200	320	500	15.0	10.0	0.067	12	9	20	12	9	0.50	0.067
9	225	360	225	360	550	20.0	12.0	0.150	15	10	25	15	10	1.00	0.150
10	250	400	250	400	630	24.0	OFF	0.300	17.6	11.0	28.8	18.0	11.4	OFF	0.300
								Flat						Trip	Flat
								I^2t						Alarm	I^2t

9.2.15 PDG3 PXR25 and 20D settings

Frame	3A			3B			All			3A			3B			G styles	
	125 A	250 A	400 A	250 A	400 A	630 A				125 A	250 A	400 A	250 A	400 A	600 A		
Setting	Ir						Ir (nxIr)	Isd	tsd(s)	Ii (nxIn)						Ig	tg (s)
Min	45	90	160	90	160	250	0.5	1.5	0.050	2	2	2	2	2	2	0.20	0.100
Max	125	250	400	250	400	600	24.0	12.0	0.500	24.0	17.6	11.0	28.8	18.0	12.0	1.00	1.000
Min									0.067							0.20	0.067
Max									0.300							1.00	0.300
Step	1	1	1	1	1	1	0.10	0.10	0.010	0.10	0.10	0.10	0.10	0.10	0.10	0.010	0.01
Add'l Opt																OFF	
									Flat							Trip	Flat
									I^2t							Alarm	I^2t

9.2.16 PDC3 PXR25 and 20D settings

Frame	3A		3B			All			3A		3B			G styles	
	250 A	400 A	250 A	400 A	630 A				250 A	400 A	250 A	400 A	630 A		
Setting	Ir					Ir (nxIr)	Isd	tsd(s)	Ii (nxIn)					Ig (nxIn)	tg (s)
Min	63	100	63	100	200	0.5	1.5	0.050	2	2	2	2	2	0.20	0.100
Max	250	400	250	400	630	24.0	12.0	0.500	17.6	11.0	28.8	18.0	11.4	1.00	1.000
Min								0.067						0.20	0.067
Max								0.300						1.00	0.300
Step	1	1	1	1	1	1	0.10	0.010	0.10	0.10	0.10	0.10	0.10	0.010	0.010
Add'l opt														OFF	
								Flat						Trip	Flat
								I^2t						Alarm	I^2t

9.2.17 PDG4 PXR10 settings (LI)

Frame	800 A	All	800
Setting	Ir	tr @ 6xIr	Ii (nxIn)
Switch	1	-	2
1	320	10	2
2	350	10	3
3	400	10	4
4	450	10	5
5	500	10	6
6	550	10	6.5
7	600	10	6
8	630	10	7.5
9	700	10	8
10	800	10	8.5

9.2.18 PDG4 PXR10 settings (LSI)

Frame	800 A	All	SD profile		800
Setting	Ir	tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)
Switch	1	-	2		3
1	320	10	2.0	0.150	2
2	350	10	2.0	0.300	3
3	400	10	2.0	I^2t	4
4	450	10	4.0	0.150	5
5	500	10	4.0	I^2t	6
6	550	10	6.0	0.150	6.5
7	600	10	6.0	0.300	6
8	630	10	8.0	0.150	7.5
9	700	0.5 to 24	8.0	0.300	8
10	800	10	OFF		8.5
		Configurable using PXPM software			

9.2.19 PDC4 PXR10 settings (LI)

Frame	800 A	1000 A	All	800	1000
Setting	Ir		tr @ 6xIr	Ii (nxIn)	
Switch	1		-	2	
1	320	400	10	2	2
2	400	550	10	3	3
3	450	630	10	4	4
4	500	700	10	5	5
5	550	750	10	6	6
6	600	800	10	6.5	6.5
7	630	850	10	6	6
8	700	900	10	7.5	7.5
9	750	950	10	8	8
10	800	1000	10	8.5	6.8

9.2.20 PDC4 PXR10 settings (LSI)

Frame	800 A	1000 A	All	SD profile		800	1000
Setting	Ir		tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)	
Switch	1		-	2		3	
1	320	400	10	2.0	0.150	2	2
2	400	550	10	2.0	0.300	3	3
3	450	630	10	2.0	I^2t	4	4
4	500	700	10	4.0	0.150	5	5
5	550	750	10	4.0	I^2t	6	6
6	600	800	10	6.0	0.150	6.5	6.5
7	630	850	10	6.0	0.300	6	6
8	700	900	10	8.0	0.150	7.5	7.5
9	750	950	0.5 to 24	8.0	0.300	8	8
10	800	1000	10	OFF		8.5	6.8
			Configurable using PXPM software				

9.2.21 PDG4 PXR20 settings

Frame	800 A	All	All	All	800	G styles	
Setting	Ir	tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)	Ig (nxIn)	tg (s)
Switch	1	2	3	4	5	6	7
1	320	0.5	1.5	0.050	2	0.20	0.100
2	350	1.0	2.0	0.100	3	0.30	0.150
3	400	2.0	2.5	0.150	4	0.40	0.200
4	450	4.0	3.0	0.200	5	0.60	0.300
5	500	7.0	4.0	0.300	6	0.80	0.500
6	550	10.0	5.0	0.400	6.5	1.00	0.750
7	600	12.0	6.0	0.500	7	0.20	1.000
8	630	15.0	7.0	0.067	7.5	0.50	0.067
9	700	20.0	8.0	0.150	8	1.00	0.150
10	800	24.0	OFF	0.300	8.5	OFF	0.300
				Flat		Trip	Flat
				I^2t		Alarm	I2t

9.2.22 PDC4 PXR20 settings

Frame	800 A	1000 A	All	All	All	800	1000	G styles	
Setting	Ir		tr @ 6xIr	Isd (nxIr)	tsd(s)	Ii (nxIn)		Ig (nxIn)	tg (s)
Switch	1		2	3	4	5		6	7
1	320	400	0.5	1.5	0.050	2	2	0.20	0.100
2	400	550	1.0	2.0	0.100	3	3	0.30	0.150
3	450	630	2.0	2.5	0.150	4	4	0.40	0.200
4	500	700	4.0	3.0	0.200	5	5	0.60	0.300
5	550	750	7.0	4.0	0.300	6	6	0.80	0.500
6	600	800	10.0	5.0	0.400	6.5	6.5	1.00	0.750
7	630	850	12.0	6.0	0.500	6	6	0.20	1.000
8	700	900	15.0	7.0	0.067	7.5	7.5	0.50	0.067
9	750	950	20.0	8.0	0.150	8	8	1.00	0.150
10	800	1000	24.0	OFF	0.300	8.5	8.0	OFF	0.300
					Flat			Trip	Flat
					I^2t			Alarm	I2t

9.2.23 PDG4 PXR25 and 20D settings

Frame	800A					G styles	
Setting	**Ir**	**tr @ 6xIr**	**Isd (nxIr)**	**tsd(s)**	**Ii (nxIn)**	**Ig (nxIn)**	**tg (s)**
Min	320	0.5	1.5	0.050	2	0.20	0.100
Max	800	24.0	8.0	0.500	8.50	1.00	1.000
Min				0.067		0.20	0.067
Max				0.300		1.00	0.300
Step	1.0	0.10	0.10	0.010	0.10	0.01	0.010
Add'l opt						OFF	
				Flat		Trip	Flat
				I^2t		Alarm	I2t

9.2.24 PDC4 PXR25 and 20D settings

Frame	800 A	1000 A	All	All	All	800	1000	G styles	
Setting	**Ir**		**tr @ 6xIr**	**Isd (nxIr)**	**tsd(s)**	**Ii (nxIn)**		**Ig (nxIn)**	**tg (s)**
Min	320	400	0.5	1.5	0.050	2	2	0.20	0.100
Max	800	1000	24.0	8.0	0.500	8.50	8.00	1.00	1.000
Min2					0.067			0.20	0.067
Max2					0.300			1.00	0.300
Step	1.00	1.00	0.100	0.100	0.010	0.10	0.10	0.01	0.010
Add'l opt								OFF	
					Flat			Trip	Flat
					I^2t			Alarm	I2t

9.2.25 PDG5 PXR20 settings

Frame	800 A	1200 A	1600 A IEC	800 A	1200/1600A	All	All	800	1200	1600	G styles	
Setting	**Ir**			**tr @ 6xIr**		**Isd (nxIr)**	**tsd(s)**	**Ii (nxIn)**			**Ig (nxIn)**	**tg (s)**
Switch	**1**			**2**		**3**	**4**	**5**			**6**	**7**
1	320	500	800	0.5	0.5	1.5	0.050	2	2	2	0.20	0.100
2	350	550	900	1	1.0	2.0	0.100	3	3	2.5	0.30	0.150
3	400	600	1000	2	2.0	3.0	0.150	4	4	3	0.40	0.200
4	450	630	1100	4	4.0	4.0	0.200	5	5	3.5	0.60	0.300
5	500	700	1200	7	7.0	5.0	0.300	6	6	4	0.80	0.500
6	550	800	1250	8	10.0	6.0	0.400	8	7	5	1.00	0.750
7	600	900	1300	10	12.0	8.0	0.500	10	8	6	0.20	1.000
8	630	1000	1400	12	15.0	10.0	0.067	12	9	7	0.50	0.067
9	700	1100	1500	13	20.0	12.0	0.150	15	10	8	1.00	0.150
10	800	1200	1600	14	24.0	OFF	0.300	18.0	12.0	9.0	OFF	0.300
							Flat				Trip	Flat
							I^2t				Alarm	I^2t

Note that ground fault pickup will not exceed 1200 A

9.2.26 PDG5 PXR25 and 20D settings

Frame	800 A	1200 A	1600A IEC	800 A	1200/1600A	All	All	800	1200	1600	G styles	
Setting	Ir			tr @ 6xIr		Isd (nxIr)	tsd(s)	Ii (nxIn)			Ig (nxIn)	tg (s)
Min	320	500	800	0.5	0.5	1.5	0.050	2	2	2	0.20	0.100
Max	800	1200	1600	14	24.0	12.0	0.500	18.0	12.0	9.0	1.00	1.000
Min							0.067				0.20	0.067
Max							0.300				1.00	0.300
Step	1.000	1.000	1.000		0.100	0.100	0.010	0.10	0.10	0.10	0.01	0.010
Add'l Opt											OFF	
							Flat				Trip	Flat
							I^2t				Alarm	I2t

9.2.27 PDG6 PXR20 settings

	1600 A	2000 A	2500 A	All	1600 A	2000 A	2500 A	All	1600	2000	2500	G styles	
Setting	Ir			tr @ 6xIr	Isd (nxIr)			tsd(s)	Ii (nxIn)			Ig (nxIn)	tg (s)
Switch	1			2	3			4	5			6	7
1	700	1000	1600	0.5	1.5	1.5	1.5	0.050	2	2	2	0.20	0.100
2	800	1100	1700	1.0	2.0	2.0	2.0	0.100	3	3	2.5	0.30	0.150
3	900	1200	1800	2.0	3.0	3.0	2.5	0.150	4	4	3	0.40	0.200
4	1000	1250	1900	4.0	4.0	4.0	3.0	0.200	5	5	3.5	0.60	0.300
5	1100	1400	2000	7.0	5.0	5.0	3.5	0.300	6	6	4	0.80	0.500
6	1200	1600	2100	Frame	6.0	6.0	4.0	0.400	7	7	4.5	1.00	0.750
7	1250	1700	2200	12.0	7.0	7.0	4.5	0.500	8	8	5	0.20	1.000
8	1400	1800	2300	15.0	8.0	8.0	5.0	0.067	9	8.5	6	0.50	0.067
9	1500	1900	2400	20.0	9.0	9.0	6.0	0.150	10	9	7	1.00	0.150
10	1600	2000	2500	24.0	OFF			0.300	10.9	8.7	7.0	OFF	0.300
								Flat				Trip	Flat
								I^2t				Alarm	I2t

Note that ground fault pickup will not exceed 1200 A

9.2.28 PDG6 PXR25 and 20D settings

Frame	1600 A	2000 A	2500 A	All	1600 A	2000 A	2500 A	All	1600	2000	2500	G styles	
Setting	Ir			tr @ 6xIr	Isd (nxIr)			tsd(s)	Ii (nxIn)			Ig (nxIn)	tg (s)
Min	700	1000	1600	0.5	1.5	1.5	1.5	0.050	2	2	2	0.20	0.100
Max	1600	2000	2500	24.0	9.0	9.0	6.0	0.500	10.9	8.7	7.0	1.00	1.000
Min								0.067				0.20	0.067
Max								0.300				1.00	0.300
Step	5	5	5	0.100	0.100	0.100	0.100	0.010	0.100	0.100	0.100	0.010	0.010
Add'l opt												OFF	
								Flat				Trip	Flat
								I^2t				Alarm	I2t

10 Modbus communication port register map

A ModbusRTU communication module is integrated to the trip unit for certain styles.

10.1 Viewing/setting Modbus parameters

Modbus connection parameters can be viewed and set from LCD display, via PXPM and Modbus communication. To view from Modbus communication, the settings are stored beginning at register number 404000 and extending through 404003 and may be read by using function code 03 or 04, listed in the following table. These four registers can be written one by one with function code 06 to change Modbus setting. If the data written into these registers is out of range, it will result in an exception code 03.

Definition	Modbus register number	Data range
Slave ID	404000	001 – 246 (factory default = 2)
Baud rate	404001	00 = 9600 bit/s 01 = 19200 bit/s (factory default) 02 = 38400 bit/s 03 = 57600 bit/s
Parity	404002	00 = None 01 = Odd 02 = Even (factory default)
Stop bit	404003	00 = 1 bit (factory default) 01 = 2 bits

10.2 Communication protocol

Only the Modbus RTU communication mode is recognized by the trip unit. The trip unit can support a maximum of 122 registers (244 data bytes) in a single Modbus transaction. The trip unit responds to Modbus function codes 02, 03, 04, 06, 08 and 16.

10.3 Modbus register map

10.3.1 Input status (discrete inputs)

Input status bits 101001 through 101032 may be available using function code 02. The status definitions are defined the following table. The first 16 bits are the actual status state while the late 16 bits indicate whether the corresponding status state is valid, or supported by the trip unit.

Input	Definition	Input	Definition
1001	Breaker is in the closed position	1017	Breaker is in the closed position is valid
1002	Un-acknowledged trip condition	1018	Un-acknowledged trip condition is valid
1003	Active or un-acknowledged alarm	1019	Active or un-acknowledged alarm is valid
1005	Maintenance mode is active	1021	Maintenance mode is active is valid
1006	Test mode is active	1022	Test mode is active is valid
1010	Long delay pickup is active	1026	Long delay pickup is active is valid
1011	Zone interlock is active	1027	Zone interlock is active is valid
1013	“Ground” is source ground	1029	“Ground” is source ground is valid

10.3.2 Real-time data object registers

The data changing in real time, such as current, voltage, power, etc. are shown in the table below. Real time data can be obtained either in IEEE floating point or in fixed point format. For data shown in fixed point format, each result would be the real time data multiplied by a scale factor. The scale factors are shown as the last column in the table. Energy objects can be only obtained in fixed point format.

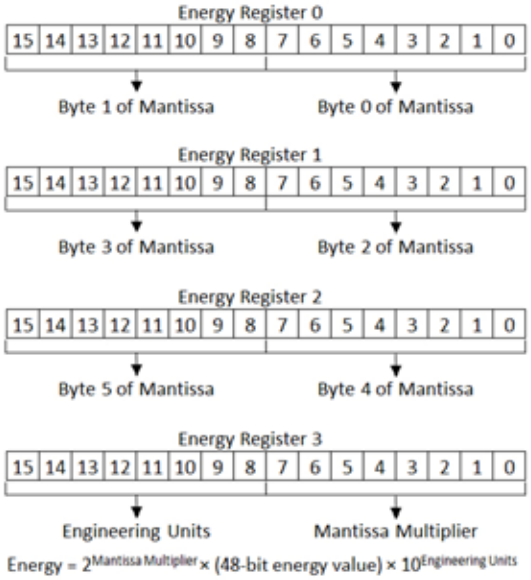
Each data object occupies two registers (four bytes) in length except for certain energy objects. These energy objects occupy four registers. Since these objects have the capability to change in real time, a complete data object must be obtained in a single transaction to avoid data tearing. Attempting to access a partial data object will result in an exception code 84. Refer to a later section entitled “Exception codes”.

Register number		Register address (HEX)		Objects		Fp scale factor
IEEE float	Fixed point (FP)	IEEE float	Fixed point (FP)	Descriptions	Units	
404609	406145	1200	1800	High byte is primary status, low byte is secondary status (see Section 0)		
404610	406146	1201	1801	Cause of status (see Section 0)		
404611	406147	1202	1802	IA	A	10
404613	406149	1204	1804	IB	A	10
404615	406151	1206	1806	IC	A	10
404617	406153	1208	1808	IG	A	10
404619	406155	120A	180A	IN	A	10
404623	406159	120E	180E	VAB	V	10
404625	406161	1210	1810	VBC	V	10
404627	406163	1212	1812	VCA	V	10
404631	406167	1216	1816	VAN	V	10
404633	406169	1218	1818	VBN	V	10
404635	406171	121A	181A	VCN	V	10
404651	406187	122A	182A	Real 3 phase power	W	1
404653	406189	122C	182C	Reactive 3 phase power	Vars	1
404655	406191	122E	182E	Apparent 3 phase power	VA	1
404659	406195	1232	1832	Power factor		100
404661	406197	1234	1834	Frequency	Hz	10
404697	406233	1258	1858	Real power peak demand	W	1
404719	406255	126E	186E	Product ID		
404721	406257	1270	1870	Frequency	Hz	100
	406259		1872	Forward energy	KWh	1
	406261		1874	Reverse energy	KWh	1
	406263		1876	Total energy	KWh	1
	406271		187E	Apparent energy	KVAh	1
404765	406301	129C	189C	Temperature	C	1
	406305		18A0	Forward energy	Wh	1
	406309		18A4	Reverse energy	Wh	1
	406313		18A8	Total energy	Wh	1
	406329		18B8	Apparent energy	VAh	1
404797	406333	12BC	18BC	Reactive power peak demand	Vars	1
404799	406335	12BE	18BE	Apparent power peak demand	VA	1
404845	406381	12EC	18EC	Real power demand	W	1
404847	406383	12EE	18EE	Reactive power demand	Vars	1
404849	406385	12F0	18F0	Apparent power demand	VA	1
404851	406387	12F2	18F2	Minimum IA	A	10
404853	406389	12F4	18F4	Maximum IA	A	10
404855	406391	12F6	18F6	Minimum IB	A	10
404857	406393	12F8	18F8	Maximum IB	A	10
404859	406395	12FA	18FA	Minimum IC	A	10
404861	406397	12FC	18FC	Maximum IC	A	10
404863	406399	12FE	18FE	Minimum IG	A	10
404865	406401	1300	1900	Maximum IG	A	10
404867	406403	1302	1902	Minimum IN	A	10
404869	406405	1304	1904	Maximum IN	A	10
404871	406407	1306	1906	Minimum VAB	V	10
404873	406409	1308	1908	Maximum VAB	V	10
404875	406411	130A	190A	Minimum VBC	V	10

Register number		Register address (HEX)		Objects		Fp scale factor
IEEE float	Fixed point (FP)	IEEE float	Fixed point (FP)	Descriptions	Units	
404877	406413	130C	190C	Maximum VBC	V	10
404879	406415	130E	190E	Minimum VCA	V	10
404881	406417	1310	1910	Maximum VCA	V	10
404883	406419	1312	1912	Minimum VAN	V	10
404885	406421	1314	1914	Maximum VAN	V	10
404887	406423	1316	1916	Minimum VBN	V	10
404889	406425	1318	1918	Maximum VBN	V	10
404891	406427	131A	191A	Minimum VCN	V	10
404893	406429	131C	191C	Maximum VCN	V	10
404959	406495	135E	195E	INST/SDT/HIGH_INST count		1
404961	406497	1360	1960	LDT/GFT count		1
404963	406499	1362	1962	Operations count		1
404965	406501	1364	1964	Short delay trip count		1
404967	406503	1366	1966	Inst delay trip count		1
404969	406505	1368	1968	High current delay trip count		1
404971	406507	136A	196A	Long delay trip count		1
404973	406509	136C	196C	Ground fault trip count		1
404975	406511	136E	196E	Total trip count		1
404977	406513	1370	1970	Test trip count		1
404979	406515	1372	1972	Open by comm count		1
404981	406517	1374	1974	Manual open count		1
404983	406519	1376	1976	Time of last operation (Y,M,D,H,M,S)		1
404995	406531	1382	1982	Max device temperature	C	1
404997	406533	1384	1984	Time of max device temperature		1
405009	406545	1390	1990	Running time: minute		1
405011	406547	1392	1992	Running time: hour		1
405013	406549	1394	1994	Running time: day		1
405015	406551	1396	1996	Life point		1

Energy objects can be obtained in two-register fixed point data format and four-register encoded format, not supporting in floating point data format.

The two-register format is presented in units of kilowatt hours. The four registers encoded energy object occupies register 3 through register 0. Register 3 is the high order register and register 0 is the low order register. Register 3 high byte contains value corresponding to engineering units(power of 10 signed exponent). Register 3 low byte contains a mantissa multiplier value(power of 2 exponent). Register 3 through register 0 contains a 48-bit energy mantissa in units of watthours. The data format of four registers is shown.



10.3.3 Set points registers

The trip unit's set points are organized into groups. Each group can be considered as a binary array of information which can be obtained through Modbus register access. Register 403001 is an R/W register used to select the particular group (Default selected group 0). The high byte contains the requested group number, while the low byte must contain 255(0FF16). The set points register can be read using function code 03 or 04. Register 403001 can be written using function code 06 or 16. For trip units which support write set points capabilities, the set points group 0/1/2 should be written one by one using function code 06, the set points group four should be written the whole group using function code 16. Before reading or writing the set points, register 403001 should be written to choose corresponding group. Before writing any set points, you must input correct password, and write the set points within ten seconds after password checks ok.

Set points group 0: system group

Register number	Bit field	Mask field	Set point name	R/W	Format	Value definition	Unit
403000	15-0		Password	W		"0000" (factory default)	
403001	15-0	0xFFFF	Group 0 = system	R/W		0x00FF	
403002	12-0	0x1FFF	Rating information	R	Encoded	PD2 PD3A: 125, 250, 400. PD3B: 400, 600, 630. PD4: 800, 1000. PD5: PD6:	A
403003	2-0	0x0007	Breaker frame	R	Encoded	00 --> NRX NF 01 --> NRX RF 11 --> NZM2 12 --> NZM3 13 --> NZM4 21 --> PD2 22 --> PD3-A 23 --> PD3-B 24 --> PD4 25 --> PD5 26 --> PD6	

Register number	Bit field	Mask field	Set point name	R/W	Format	Value definition	Unit
403004			Style1	R	Encoded 0 = false 1 = true	b0 --> LdSel : with long delay protection b1 --> SdSel : with short delay protection b2 --> InstSel : with Inst protection b3 --> GfSel : with ground fault protection b4 --> ARMSel : with maintenance mode b5 --> OvrideSel : with override protection b6 --> RCDSel : with ground fault RCD b7 --> MotorSel : with motor protection b8 --> NeuSenorSel : with neutral sensor b9 --> ThermalSel : with thermal memory b12 --> VoltSel : with voltage sampling feature b13 --> ExtADCSel : with external AD7779	
403005	3-0	0x000F	Style2	R	Encoded 0 = false 1 = true	b0 --> ModbusSel : with integrated Modbus b1 --> CAMSel : with CAM RS422 port b2 --> IOModuleSel : with IO module port b3 --> RelaySel : with relay b4 --> ZSISel : with ZSI b12 --> NZM_ACB_Sel b13 --> IECSel : IEC = 1, UL = 0	
403006	8	0x0100	Maintenance mode: state	R	Encoded	0 = Off 1 = On	
	0	0x0001	Maintenance mode: remote control	R/W	Encoded	0 = Off 1 = On	
403007	2-0	0x0007	Arms level	R/W	Encoded	1 = 2.5 * In 2 = 4 * In 3 = 6 * In 4 = 8 * In 5 = 10 * In	A
403008			Frequency	R	Unsigned	Range: 50, 60 , 400	Hz
403009	0	0x0001	Rev feed	R/W	Encoded	0 = Forward 1 = Reverse	
403010	0	0x0001	Sign convention	R/W	Encoded	sign convention : 0 = IEC, 1 = IEEE, 2 = IEEEalt	
403011			Power window	R/W	Encoded	Power demand window : 0 = fixed, 1 = sliding	
403012			Power interval	R/W	Encoded	Power demand interval: [5…60] min	min
403013			Language	R/W	Encoded	set language on local LCD display 0x01 --> English 0x02 --> German 0x03 --> French 0x04 --> Spanish 0x05 --> Italian 0x06 --> Chinese 0x07 --> Russian 0x08 --> Dutch 0x09 --> Danish 0x10 --> Greek 0x11 --> Portuguese 0x12 --> Swedish 0x13 --> Finnish 0x14 --> Czech 0x15 --> Estonian 0x16 --> Hungarian 0x17 --> Lithuanian 0x18 --> Latvian 0x19 --> Polish 0x20 --> Slovenian 0x21 --> Slovak 0x22 --> Bulgarian 0x23 --> Romanian 0x24 --> Croatian	
403014			LCD_rotation	R/W	Encoded	Setting LCD display direction 0 <--> horizontal 1 <--> vertical - left 2 <--> vertical - right	
403015			Relay_config1	R/W	Encoded	Relay 1/2/3 function configuration	
403016			Relay_config2	R/W	Encoded	OFF_RELAY = 0x0000	

Register number	Bit field	Mask field	Set point name	R/W	Format	Value definition	Unit
403017			Relay_config3	R/W	Encoded	TRIP_OVERLOAD_RELAY = 0x0001 TRIP_NEUTRAL_RELAY = 0x0002 TRIP_SHORTCIRCUIT_RELAY = 0x0003 TRIP_SHORTDELAY_RELAY = 0x0004 TRIP_INST_RELAY = 0x0005 TRIP_GROUND_RELAY = 0x0006 TRIP_MM_RELAY = 0x0007 TRIP_ALL_RELAY = 0x0008 ALARM_HL_ALARM_RELAY = 0x0010 ALARM_HL_LOAD_RELAY = 0x0011 ALARM_HIGHTEMP_RELAY = 0x0012 ALARM_GROUND_RELAY = 0x0013 ALARM_THERMAL_RELAY = 0x0014 ALARM_WATCHDOG_RELAY = 0x0015 ALARM_LOW_BAT_RELAY = 0x0016 ALARM_INTERNAL_FAULT_RELAY = 0x0017 ALARM_STP_ERROR_RELAY = 0x0018 ALARM_BRK_HEALTH_RELAY = 0x0019 ALARM_COMM_FAULT_RELAY = 0x001A ALARM_ALL_RELAY = 0x001B AUX_RELAY = 0x0020 BELL_RELAY = 0x0021 MM_ACTIVE_RELAY = 0x0022 ZSI_ACTIVE_RELAY = 0x0023 ZSI_INPUT_RELAY = 0x0024 ZSI_OUTPUT_RELAT = 0x0025 COMM_OPEN_RBK_RELAY = 0x0026 COMM_CLOSE_BRK_RELAY = 0x0027 OUTPUT_1_ RELAY = 0x0028 OUTPUT_2_RELAY = 0x0029	
403018			Pole location - phase a(1)	R/W	Encoded	Pole location - phase A(1) 0 - left 1 - right	
403019			Reserved				
403020			Reserved				
403021			Reserved				

Set points group 1: protection group

Register	Bit field	Mask field	Set point name	R/W	Format	Value definition	Unit
403000	15-0		Password	W		"0000"	
403001	15-0	0xFFFF	Group 0 = system	R/W		0x00FF	
403002	12-0	0x1FFF	Rating information	R	Encoded	PD2: PD3A: 125, 250, 400. PD3B: 400, 600, 630. PD4: 800, 1000. PD5: PD6:	A
403003	2-0	0x0007	Break frame	R	Encoded	00 --> NRX NF 01 --> NRX RF 11 --> NZM2 12 --> NZM3 13 --> NZM4 21 --> PD2 22 --> PD3-A 23 --> PD3-B 24 --> PD4 25 --> PD5 26 --> PD6	

Register	Bit field	Mask field	Set point name	R/W	Format	Value definition	Unit
403004			Style1	R	Encoded 0 = false 1 = true	b0 --> LdSel : with long delay protection b1 --> SdSel : with short delay protection b2 --> InstSel : with Inst protection b3 --> GfSel : with ground fault protection b4 --> ARMSel : with maintenance mode b5 --> OvrideSel : with override protection b6 --> RCDSel : with ground fault RCD b7 --> MotorSel : with motor protection b8 --> NeuSenorSel : with neutral sensor b9 --> ThermalSel : with thermal memory b12 --> VoltSel : with voltage sampling feature b13 --> ExtADCSel : with external AD7779	
403005	3-0	0x000F	Style2	R	Encoded 0 = false 1 = true	b0 --> ModbusSel : with integrated Modbus b1 --> CAMSel : with CAM RS422 port b2 --> IOModuleSel : with IO module port b3 --> RelaySel : with relay b4 --> ZSISel : with ZSI b12 --> NZM_ACB_Sel b13 --> ECSel : IEC = 1, UL = 0	
403006	0	0x0001	LD thermal memory	R/W	Encoded	thermal memory enable/disable LD Thermal Memory (powered and unpowered operation. Used only in I^2t and I^4t) trip unit : 0 <--> off 1 <--> cooling	
403007	0	0x0001	ZSI	R/W	Encoded	ZSI, zone interlock *when enable, for trip unit with G, ZSI is implemented for short delay and ground fault. *when enable, for trip unit without G, ZSI is implemented for short delay. trip unit side : 0 <--> disable 1 <--> enable	
403008	0-1	0x0003	LD_slp	R/W	Encoded	long delay slope: 0 = $I^{0.5}T$ 1 = IT 2 = I^2T 3 = I^4T	
403009			LD pick up (Ir)	R/W	Unsigned	long delay pick up: detail see the "PXR MCCB amp rating labels" Ir = xxx (A)	A
403010			LD time (tr)	R/W	Unsigned	long delay time: detail see the "PXR MCCB amp rating labels" Tr = xxx /10 (s)	Sec
403011			High load alarm	R/W	Unsigned	high load alarm level [100… 110] step 1 100%Ir…110%Ir	%
403012	0	0x0001	SD slp	R/W	Encoded	Short delay slope: 0 = flat 1 = I^2T	
403013			SD pick up (Isd)	R/W	Unsigned	Short delay pick up: detail see the "PXR MCCB amp rating labels" Isd = xxx /10 (xIr)	*Ir
403014			SD time (tsd)	R/W	Unsigned	long delay time: detail see the "PXR MCCB amp rating labels" Tsd = xxx / 1000 (s)	ms
403015			Instantaneous pick up(Ii)	R/W	Unsigned	Instantaneous pick up: detail see the "PXR MCCB amp rating labels" Ii = xxx /10 (xIn)	*In
403016	0	0x0001	Ground sensing type	R	Encoded	Ground sensing type setting: MCCB only support residual mode 0 = residual 1 = source/zero sequence	
403017	0-1	0x0003	Local ground fault type	R/W	Encoded	Ground fault style - trip/alarm/OFF 0 = Trip 1 = Alarm 2 = OFF	
403018	0	0x0001	Ground fault slope	R/W	Encoded	Ground fault slope: 0 = Flat 1 = I^2T	
403019			Ground pick up(Ig)	R/W	Unsigned	Ground fault pick up: detail see the "PXR MCCB Amp Rating Labels" Ig = xxx / 100 (x In)	*In

Register	Bit field	Mask field	Set point name	R/W	Format	Value definition	Unit
403020			Ground time(tg)	R/W	Unsigned	Ground fault time: detail see the "PXR MCCB amp rating labels" Tg = xxx / 1000 (s)	Sec
403021			Ground fault thermal memory	R/W		Thermal memory enable/disable LD thermal memory (powered and unpowered operation. Used only in I^2t and I^4t) 0 = off 1 = cooling	
403022			Neutral protection ratio	R/W	Unsigned	Neutral protection ratio: 0 <--> 0% 60 <--> 60% 100 <--> 100%	%
403023			High load warning	R/W		High load alarm level [50… 100] step 5 50%Ir...100%Ir	
403024			GF_pre_alarm	R/W		Ground Fault trip pre alarm pick up: *100 [50…100] step 5	
403025			reserved (TBD)				

Set points group 2: ModbusRTU group

Register	Bit field	Mask field	Set points name	R/W	Format	Value definition	Units
403000	15-0	0xFFFF	Password	W	Encoded	default "0000"	
403001	15-0	0xFFFF	Group 2 = on-board Modbus	R/W	Encoded	0x02FF	
403002	15-0		Integrated Modbus -- communication address	R/W	Encoded	001 - 246	
403003	15-0		Integrated Modbus -- baudrate	R/W	Encoded	00 = 9600 bit/s 01 = 19200 bit/s 02 = 38400 bit/s 03 = 57600 bit/s	
403003	15-0		Integrated Modbus -- parity	R/W	Encoded	00 = none 01 = odd 02 = even	
403003	15-0		Integrated Modbus -- stop bit	R/W	Encoded	00 = 1 bit 01 = 2 bits	

Set points group 3: CAM settings group

Register	Bit field	Mask field	Set points name	R/W	Format	Value definition
403000	15-0	0xFFFF		W	Encoded	Default "0000"
403001	15-0	0xFFFF		R	Encoded	0x03FF
403002	15-0		CAM connection status	R	Encoded	0 = No external CAM 1 = External Modbus 2 = INCOM CAM 3 = Ethernet CAM 4 = Profibus CAM
403003	15-0		CAM communication address	R	Encoded	001~246 <--> 001~246
403004	15-0		CAM baud rate	R	Encoded	0 = 1200bps 1 = 4800bps 2 = 9600bps 3 = 19200bos
403005	15-0		CAM parity	R	Encoded	0 = None 1 = Odd 2 = Even
403006			CAM stopbit	R		0 = 1bit 1 = 2bits
403007			INCOM CAM address	R		0001~4094 <--> 0001~4094

Register	Bit field	Mask field	Set points name	R/W	Format	Value definition
403008			INCOM CAM baud rate	R		1 <--> 9600bps see IL01301033e P8 "for series NRX INCOM communication adapter module, baud rate is fixed at 9600 baud and represented by a value of 01"
403009			Ethernet CAM DHCP enable	R		0 <--> false 1 <--> true
403010			Ethernet CAM IP addr. MSB	R		0~255 <--> 0~255
403011			Ethernet CAM IP addr. LSB	R		0~255 <--> 0~255
403012			Ethernet CAM IP addr. MSB	R		0~255 <--> 0~255
403013			Ethernet CAM IP addr. LSB	R		0~255 <--> 0~255
403014			Ethernet CAM subnet mask	R		16~32 <--> 16~32
403015			Ethernet CAM default gateway	R		0~255 <--> 0~255
403016			Ethernet CAM default gateway	R		0~255 <--> 0~255
403017			Ethernet CAM reset pin	R		0~255 <--> 0~255
403018			Profibus CAM address	R		1~125 <--> 1~125

Set points group 4: I/O module group

Register	Bit field	Mask field	Set points name	R/W	Format	Value definition
403000	15-0	0xFFFF	Password	W	Encoded	Default "0000"
403001	15-0	0xFFFF	I/O module cfg	R/W	Encoded	0x04FF
403002	15-0		Validity flags 0….15	R/W	Encoded	For each bit: 0 : corresponding parameter inactive 1 : corresponding parameter active e.g. Bit 8 = 1 ==> parameter 8 = active
403003	15-0		Validity flags 16….31	R/W	Encoded	For each bit: 0 : corresponding parameter inactive 1 : corresponding parameter active e.g. Bit 8 = 1 ==> parameter 8 = active
403004	15-0		0: digital output 0	R/W	Encoded	
403005	15-0		1: digital output 1	R/W	Encoded	
403006			2: digital output 2	R/W	Encoded	
403007			3: digital output 3	R/W	Encoded	
403008			4: S0 channel 0 type	R/W		0: output disabled 1: sends pulses based on active energy 2: sends pulses based on reactive energy 3: sends pulses based on apparent energy
403009			5: S0 channel 0 scale	R/W		0: sends a pulse every 1: W 1: sends a pulse every 10 W 2: sends a pulse every 100 W 3: sends a pulse every 1000 W
403010			6: S0 channel 0 pulse	R/W		pulse duration x *10 ms range: 1…50 ==> 10…500 ms
403011			7: S0 channel 1 type	R/W		0: output disabled 1: sends pulses based on active energy 2: sends pulses based on reactive energy 3: sends pulses based on apparent energy
403012			8: S0 channel 1 scale	R/W		0: sends a pulse every 1 W 1: sends a pulse every 10 W 2: sends a pulse every 100 W 3: sends a pulse every 1000 W
403013			9: S0 channel 1 pulse	R/W		Pulse duration x *10 ms Range: 1…50 ==> 10…500 ms
403014			10: Modbus address	R/W		Modbus ID (= device address) permitted range: 1…255

Register	Bit field	Mask field	Set points name	R/W	Format	Value definition
403015			11: Modbus baud-rate	R/W		0: 9600 bit/s 1: 19200 bit/s 2: 38400 bit/s 3: 57600 bit/s 4: 115200 bit/s (TBD, not used in code)
403016			12: Modbus parity	R/W		Modbus parity / stop bits: 0: no parity / 2 stop bits 1: even parity, 1 stop bit 2: odd parity, 1 stop bit
403017			Reserved 1			
403018			Reserved 2			
403019			Reserved 3			
403020			Reserved 4			
403021			Reserved 5			
403022			Reserved 6			
403023			Reserved 7			
403024			Reserved 8			
403025			Reserved 9			
403026			Reserved 10			

10.3.4 Event registers

The triggering of an event in trip unit can provide historical data object values at the instance in time the event occurs occurring around the time of the event. Trip unit categorizes the event information into classifications to provide various numbers of each type. Modbus communication can only have the access to obtain historical summary, trip and alarm event data, as shown:

Event type	Number stored
Historical summary	200
Historical trip	10
Historical alarm	10

Event classification

A single triggering can place information into multiple event types. For example, the occurrence of an event triggered by a circuit breaker trip may provide both historical summary and historical trip information.

Access to event information is based on the selection of event type and event ID. Register 408193 is a R/W register used to select the event type, using function code 06 or 16 to write. The event information may be read by using function code 03 or 04.

When written event type selection in register 408193, the earliest and latest event ID can be obtained respectively in register 408194 and 408196 to determine the range of events saved for the selected event type. Register 408198 is a R/W register used to select the request event ID and is written with function code 16. If request event exists in trip unit, register 408200 and 408202 provide the Previous event ID and Next event ID. If the requested event doesn't exist in trip unit, exception code 0 x 87 is returned.

The date and time when request event happened is read in registers 408204 through 408211 using the same date and time description as shown in 0. This value corresponds to the time of occurrence of the historical event.

Register 408212 provides an indication of the selected event type's data content. This is a constant value for the three event types Modbus port supports.

Event data also provide a validity bit for each data object, starting from register 408213. Bit 0 setting to be 1 indicates that the first data is valid for current trip unit style, bit 1 for the second data object, bit 2 for the third data object and so on. The number of validity bit registers is calculated as (number of data objects - 1)/16.

The following registers are the data objects. Request out of the range of the registers address would result in exception code 02.

Historical summary

Register	Format	R/W	Historical summary event
408193	Encoded	R/W	Event type: summary = 8EFF16
408194	Unsigned32	R	Earliest event ID
408196	Unsigned32	R	Latest event ID
408198	Unsigned32	R/W	Requested event ID
408200	Unsigned32	R	Previous event ID
408202	Unsigned32	R	Next event ID
408204	Date/time	R	Date/time
408212	Encoded	R	Format of data= 0000_{16}, 0001_{16}, 0004_{16}, 0005_{16}, 0006_{16}
408213	B0	R	Object validity bit
408214	Encoded	R	Event Cause: 00 = Power up – time OK 01 = Set points download 02 = Time adjusted 03 = Trip 04 = Alarm 05 = Enter test mode 06 = Exit test mode 08 = Power up – no time 09 = Test completed 10 = Maintenance mode active 11 = Maintenance mode inactive 12 = Opened by Communications 13 = Closed by communications

Historical trip event

Register	Format	R/W	Descriptions	Units
408193	Encoded	R/W	Event type: trip = 80FF16/alarm = 81FF16	
408194	Unsigned32	R	Earliest event ID	
408196	Unsigned32	R	Latest event ID	
408198	Unsigned32	R/W	Requested event ID	
408200	Unsigned32	R	Previous event ID	
408202	Unsigned32	R	Next event ID	
408204	Date/time	R	Date/time	
408212	Encoded	R	Format of data: trip = 0004_{16}, major alarm = 0005_{16}	
408213	B15-b00	R	Object validity bits	
408214	B31-b16	R	Object validity bits	
408215	Encoded	R	Status cause (primary, secondary, cause)	
408217	Unsigned32	R	IA	A
408219	Unsigned32	R	IB	A
408221	Unsigned32	R	IC	A
408223	Unsigned32	R	IN	A
408225	Unsigned32	R	IG source	A
408227	Unsigned32	R	IG residual	A
408229	Unsigned16	R	VAB	V
408230	Unsigned16	R	VBC	V
408231	Unsigned16	R	VCA	V

Register	Format	R/W	Descriptions	Units
408232	Unsigned16	R	VAN	V
408233	Unsigned16	R	VBN	V
408234	Unsigned16	R	VCN	V
408235	Signed32	R	Real 3 phase power	W
408237	Signed32	R	Reactive 3 phase power	VAR
408239	Unsigned32	R	Apparent 3 phase power	VA
408241	Signed32	R	Real 3 phase power demand	W
408243	Signed32	R	Reactive 3 phase power demand	VAR
408245	Unsigned32	R	Apparent 3 phase power demand	VA
408247	Singed16	R	Device temperature	1/10 °C
408248	Unsigned16	R	Frequency	1/10 Hz
408249	Singed16	R	Apparent power factor	1/100 pf
408250	Unsigned16	R	Operations count	
408251	B31-b00	R	Binary status with validity bits	

Historical alarm

Register	Format	R/W	Historical summary event
408193	Encoded	R/W	Event type: summary = $81FF_{16}$
408194	Unsigned32	R	Earliest event ID
408196	Unsigned32	R	Latest event ID
408198	Unsigned32	R/W	Requested event ID
408200	Unsigned32	R	Previous event ID
408202	Unsigned32	R	Next event ID
408204	Date/time	R	Date/time
408212	Encoded	R	Format of data: minor alarm = 0006_{16}
408213	B0	R	Object validity bit
408214	Encoded	R	Status cause(primary, secondary, cause)

Note: address 408225 and 408227 are both ground current. According to the set point 'Ground Sensing' setting in set points group 1: protection group, the actual ground current would be displayed in related register and value in the other register would be zero. For example, if the 'Ground Sensing' setting is 0, representing the ground current sensing type is residual ground current. IG residual in address 408227 would be the actual value and IG source in address 408225 would be zero.

10.3.5 Block of registers

A block of registers can be established in trip unit to remap the data object registers of an Eaton product. The block of registers is stored in non-volatile memory.

Function code 16 is used to load the object assignments for the block of registers. The block assignments are stored beginning at 401001/420481 (0x03E8/0x5000). Only the first data object register address is assigned within the block of registers. For example, although data object IA occupies register 0x1202 and 0x1203, only register 0x1202 is loaded into the block of assignment registers. Verification of this block of assignment registers can be read from trip unit with a function code 03 or 04 from these 401001/420481 (0x03E8/0x5000) registers.

Data pertaining to the objects configured in the block of assignment registers is mapped into registers starting at 401201/420737 (0x 04B0/0x5100) and continuing in successive order for each object assigned. The number of objects and their placement order in this data block of registers is dependent on the configuration of the block of assignment registers. The total number of data block of registers is limited to 100.

The data can be obtained from the data block of registers by a read function code 03 or 04. The address of the starting object must be aligned with a starting address of an object within the data block of registers. The number of registers to obtain must align with an ending address of an object within the data block of registers.

Configuration registers

Register definition	R/W	Modbus register number		Modbus register address		Number
		Low	High	Low	High	
Mapped block of registers configuration	R/W	401001	420481	0x03E8	0x5000	100
Mapped block of registers data	R	401201	420737	0x04B0	0x5100	100* 2
Invalid object access configuration	R/W	402001	425345	0x07D0	0x6300	1
Floating point data word order configuration	R/W	402002	425346	0x07D1	0x6301	1
Fixed point data word order configuration	R/W	402003	425347	0x07D2	0x6302	1
Remote control	R/W	402901	425089	0x0B54	0x6200	3
Date and time register	R/W	402921		0x0B68		8

Non-volatile Register 402001/425345(0x07D0/0x6300) is used to configure trip unit to respond to a group of data objects, of which some objects are invalid within that group. When none-zero (factory default value), any attempt to access a group of data objects that contain an invalid object will result in an illegal data object code 02.

When register 402001/425345(0x07D0/0x6300) is set to zero, trip unit will respond to a group of objects with data contained in the valid objects of the group. Since data is not available for the invalid objects, the information in the register is undefined. These registers may contain 000016 or a value of (0xFFFFFFFF16) may be used to represent an invalid unsigned fixed point object, (0x8000000016) may be used to represent an invalid signed fixed point object and (NAN = 0x7FF2000016) may be used to represent an invalid floating point value. This allows access to a block of registers using a single read command, of which some are not implemented in that block, rather than multiple read commands which contain only implemented registers. The application is thus responsible for selecting the implemented registers. The starting register number must be valid object. If the starting register number accesses an invalid object, the illegal data object exception code 02 will be issued, regardless of this configuration setting.

Non-volatile register 402002/425346(0x07D1/0x6301) is used to configure the data transmission order of 32-bit floating point data. If none-zero (factory default value), the floating point low order word is first in the Modbus register space. When the register is set to be 0, the floating point high order word is first in the Modbus register space.

Non-volatile register 402003/425347(0x07D2/0x6302) is used to configure the data transmission order of 32-bit fixed point data. If none-zero (factory default value), the fixed point low order word is first in the Modbus register space. When the register is set to be 0, the fixed point high order word is first in the Modbus register space.

Configuring any or all registers 402001/425345 through 402003/425347(0x07D0/0x6300 through 0x07D2/0x6300) is accomplished using a write function code "06" or "16".

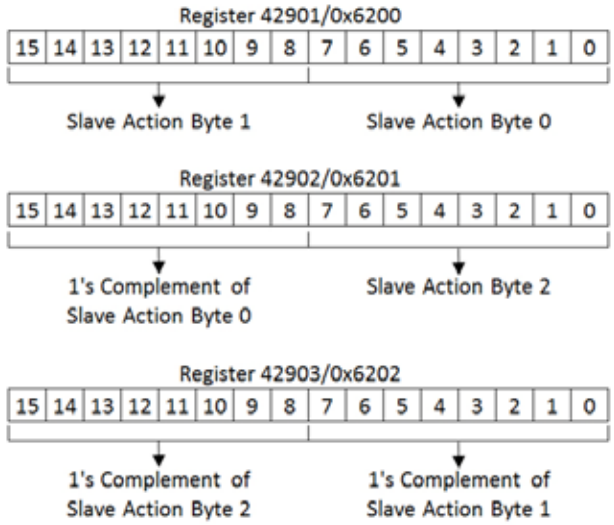
To accommodate Modbus master that can only access to register 9999, some Eaton registers initially assigned above 9999 have been assigned dual access, both at the original register(to provide compatibility) and at a new register assignment below 9999. The format is given as low/high register numbers followed by (low16/high16 Modbus register addresses). An example is: 4xxxx/4yyyyy (XXXX+116/YYYY+116).

10.3.6 Remote control

A set of registers is reserved for trip unit remote control, starting from 42901/425089 through 42903/425091. These three registers should be written together with a "slave action number" and its first complement using function code 16. The "slave action number" and its function are listed in remote control data formats, their support being product dependent.

If the "slave action number" and its first complement command is valid, trip unit will execute the action. Once the command is successfully acknowledged by trip unit, it returns a normal function code 16 response to Modbus master. Since it may take some time for trip unit to take action, Modbus master may further determine if the product completed the

slave action function successfully after the normal response by interrogating the trip unit, for example, by reading its status. If the "slave action number" and its first complement command is invalid, trip unit returns exception code 03.



Remote Control Date Format

Control group	Definition	Byte 2	Byte 1	Byte 0
Reset	Reset trip	0	0	2
	Reset min/max currents	0	1	13
	Reset min/max line-to-neutral voltages	0	1	15
	Reset min/max line-to-line voltages	0	1	14
	Reset peak demand watts	0	0	4
	Reset all min/max values	0	1	4
	Reset energy	0	0	8
	Reset trip count	0	5	1
	Reset operations count	0	1	2
	Reset temperature	0	5	2
	Reset runtime	0	1	3
	Reset all diagnostics information	0	5	3
	Reset powered up indication	0	0	3
	Open breaker	0	0	1
Maintenance mode	Enable maintenance mode	1	0	8
	Disable maintenance mode	1	0	9
Relay output	Activate relay output # YY	4	1	YY
	De-activate relay output # YY	4	2	YY

10.3.7 Date and time

Trip unit supports Modbus master read real-time clock information. Eight registers, starting from register number 402921 are reserved for this information, as defined in 0. Detailed information is listed in 0. User could set system time through function code 16.

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

10.3.8 Internal diagnostics

Trip unit support internal Modbus diagnostics to monitor internal Modbus port communication with function code 08. For different sub-function codes, diagnostics information is listed below.

Sub-function code	Data	Action
0		Echo query
1	0000 remain the counters 00FF reset all counters	Restart communication
4	0000	Force listen
10	0000	Clear counters
11	0000	Modbus UART bus message count
12	0000	Modbus UART CRC error count
13	0000	Exception count
14	0000	Slave message count
15	0000	Slave no response count
16	0000	Slave NAK count
17	0000	Slave busy count
18	0000	Modbus UART over run error count
20	0000	Clear Modbus UART counters
23	0000	Modbus UART framing error count
24	0000	Modbus UART noise error count
25	0000	Modbus UART parity error count
26	0000	MCU1 firmware version
27	0000	MCU1 firmware reversion
28	0000	MCU1 firmware build
29	0000	MCU2 firmware version
30	0000	MCU2 firmware reversion
31	0000	MCU2 firmware build
32	0000	USB version
33	0000	USB reversion
34	0000	Reset block of registers

Primary status /secondary status/cause code definitions

Definition	Code
Open	0x01
Closed	0x02
Tripped	0x03
Alarmed	0x04
Picked-up	0x0D

Definition	Code
Not applicable	0x01
Test mode	0x03
Powered-up since last trip/alarm reset	0x07
Alarm	0x08

Definition	Code	Definition	Code
Unknown	0x0000	Fixed hardware instantaneous	0x004C
Normal	0x0001	Set points error	0x004D
Instantaneous	0x0003	Over temperature	0x004E
Aux-power under power	0x000E	Long delay neutral over current	0x0050
Current un-balance	0x0011	Ground fault	0x0054
Operations count	0x001F	Earth fault	0x0055
Control via communication	0x0021	Calibration	0x0071
Coil supervision	0x0025	Real time clock	0x0088
Battery low voltage alarm	0x0029	MM mode	0x0099
Diagnostics warning #2 (configuration reading failure)	0x002B	Breaker mechanism fault	0x009A
Long delay	0x003D	Digital bypass	0x07FC
Short delay	0x003E	NV memory failure	0x07FD
Phase currents near pickup, high load alarm	0x0049	Watchdog fault	0x07FE
Making current release	0x004B	Motor alarm or trip	0x07FF

10.3.9 Board information data (fixed data section)

Trip unit information, include device name, model name, catalog #, style # , serial # date code, firmware version1/ 2, USB version and product ID, the following registers are the data objects.

Fixed data section

Register number	Modbus address	Description	Format	Range	Registers	Comments
404497	0x1190	Device name	ASCII	16 char	8	EATON PXR25 (for pxr25) EATON PXR20D (for pxr20d EATON PXR20 (for pxr20))
404505	0x1198	Model name	ASCII	16 char	8	PXR 20/25 MCCB
404513	0x11A0	Catalog #	ASCII	32 char	16	Vista catalog # (max 20 characters)
404529	0x11B0	Style #	ASCII	32 char	16	Vista style # (max 20 characters)
404545	0x11C0	Serial #	ASCII	32 char	16	
404561	0x11D0	Date code	ASCII	12 char	6	yyyy.mm.dd
404567	0x11D6	Firmware version 1	ASCII	16 char	8	Example version of 01.02.0033
404575	0x11DE	Firmware version 2	ASCII	16 char	8	Example version of 01.02.0033
404583	0x11E6	USB version	ASCII	16 char	8	Example version of 01.02.0033
404591	0x11EE	Reserved			16	
	…	Reserved				Refer to
404606	0x11FD	Reserved				
404607	0x11FE	Product ID	Bit map	32-bit	2	ppppppvvvvdddddd Use division code (dddddd) of 32 (0x20) Use product code (pppppp) of 2 for PXR MCCB Start with comm version (vvvv) of 0
					112	Block size

10.3.10 Exception codes

When there's error in request or response, trip unit would respond an exception code.

- If the function code in the query is not supported by trip unit, exception code 01 is returned in the response, also used for the unsupported sub-function code in Modbus diagnostics.
- If the requested data register/ bit address is illegal, exception code 02 is returned.
- If the data in the query is illegal, exception code 03 is returned.
- If trip unit doesn't support the query function, exception code 04 is returned.
- In certain circumstances, exception code 05(ACK) is returned.
- If trip unit can't perform the current request at this time, a BUSY exception code 06 is returned.
- If trip unit can't perform the requested action, a NAK exception code 07 is returned.
- If only a partial register is used in the query, exception code 132 is returned.
- If the requested event entry doesn't exist, exception code 135 is returned.

Notes:

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
Publication No. MN012007EN /
TBG001403
June 2018

Powering Business Worldwide