Power Circuit Breakers Insulated-Case Circuit Breakers

Contents

Specifications

See Eaton's *Product Specification Guide*, available on CD or on the Web.

CSI Format:	1995	2010
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Insulated Case Circuit Breakers— Magnum SB and Series NRX Insulated-Case Circuit Breakers	**Section 16475**	**Section 26 28 11**
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Low-Voltage Circuit Breakers

Summary of Differences Between Low-Voltage Power Circuit Breakers, Insulated-Case Circuit Breakers, and Molded-Case Circuit Breakers

There are main classifications of low-voltage circuit breakers—molded-case circuit breakers and low-voltage power circuit breakers. All UL®, NEMA® and ANSI standards are for molded-case circuit breakers and low-voltage power circuit breakers.

However, the industry recognizes three types of circuit breakers—molded-case circuit breakers (MCCB), insulated-case circuit breakers (ICCB) and low-voltage power circuit breakers LVPCB).

Low-voltage power circuit breakers comply with the following standards:

- ANSI Std. C37.16—Preferred Ratings
- ANSI Std. C37.17—Trip Devices for LVPCB
- ANSI Std. C37.50—Test Procedures
- IEEE® Std. C37.13—LVPCB Used in Enclosures
- UL 1066—LVPCB

Both molded-case circuit breakers and insulated-case circuit breakers typically comply with the following standards:

- UL 489—MCCB
- UL 489—Molded-Case Switches (MCS)
- NEMA AB1—MCCB and MCS
- NEMA AB3—MCCB Application

Table 26.0-1. Breaker Type Comparison Chart

Description	LVPCB—Magnum DS® (and Series NRX® with Digitrip)	ICCB—Series NRX® with Power Xpert® Release Trip Unit (and Magnum SB®)	MCCB—QUICKLAG®/Series C®/Series G®
Applicable standards	ANSI/IEEE C37 UL® 1066	NEMA® AB1/AB3 UL 489	NEMA AB1/AB3 UL 489
Available frame sizes	Small number of frame sizes available. Typical 800–6000 A	Small number of frame sizes available. Typical 800–5000 A	Large number of frame sizes available. Typical 100–2500 A
Interrupting rating	Interrupting duty at 635 Vac: 42–130 kA and current limiting with/without fuses up to 200 kA	Interrupting duty at 600 Vac: 42–130 kA and current limiting without fuses up to 150 kA	Interrupting duty at 480 Vac: 22–100 kA without fuses and up to 200 kA for current-limiting type with/without integral fuses
Current limiting	Special current limiting types available with/without fuses up to 200 kA	Special current limiting types available without fuses up to 150 kA	Current limiting available with/without fuses up to 200 kA
Series ratings	Not available in series ratings	Not available in series ratings	Available in series ratings
Short-time withstand rating	Selective trip over full range of fault currents up to interrupting rating (high short-time ratings). Instantaneous tripping can be set to OFF.	Selective trip over partial range of fault currents within the interrupting rating (medium short-time ratings—typically up to 42 kA). Non-defeatable instantaneous override for high magnitude faults.	Selective trip over a smaller range of fault currents within the interrupting rating (low short-time ratings—typically up to 10 times the frame size).
Enclosure types	Used in switchgear (UL 1558) and custom enclosures	Used in switchboards (UL 891), MCCs (UL 845) and custom enclosures	Used in switchboards (UL 891), panelboards (UL 67), MCCs (UL 845), control panels (UL 508) and NEMA rated enclosures
Closing speed	3-cycle closing for electrically operated devices	3-cycle closing for electrically operated devices	Greater than 5-cycle closing for electrically operated devices
Mounting	Available in drawout construction permitting racking to a distinct “test position” and removal for maintenance	Available in fixed or drawout construction permitting racking to a distinct “test position” and removal for maintenance	Typically fixed-mounted but large frame sizes may be available in drawout construction
Operator type	Types of operators: mechanically operated and electrically operated two-step stored energy	Types of operators: mechanically operated and electrically operated two-step stored energy	Types of operators: mechanically operated over-center toggle or motor operator
Maintenance	Extensive maintenance possible on all frame sizes	Limited maintenance possible on all frame sizes	Very limited maintenance possible (only on larger frame sizes)
Enclosed rating	100% continuous current rated in its enclosure	100% continuous current rated in its enclosure	80% continuous-current rated, unless specifically stated to be rated 100% in an enclosure
Relative cost	Higher	Medium	Low

Magnum Low-Voltage Power Circuit Breakers for Global Application

Magnum low-voltage power circuit breakers enable comprehensive solutions to meet and exceed the unique and wide-ranging requirements of today's global power distribution systems. This powerful circuit breaker offering is designed for ultimate custom configuration and application flexibility, with the needs of the power distribution equipment user and the electrical equipment manufacturer in mind.

Standards

Magnum DS circuit breakers meet or exceed all applicable requirements of ANSI Standards C37.13, C37.17, C37.50 and CSA.

See **Tab 20** for ANSI/UL 1558 low-voltage drawout switchgear application considerations, including system voltage and frequency, continuous current ratings, ambient temperature, altitude, and other unusual environmental and operating conditions.

See **Tab 21** for UL 891 switchboard application considerations, ratings and layouts.

Three Product Families

Magnum consists of three product families; each provides specific rating features and approvals to optimize performance when applied in power distribution equipment and custom enclosures:

Magnum DS Low-Voltage Power Circuit Breakers for ANSI/UL 1558 Rated Switchgear Applications

- Up to 635 Vac
- 200–6000 A continuous
- 42–200 kA interrupting

Magnum DS Low-Voltage Power Circuit Breaker Family ANSI Rated for Switchgear Applications

Magnum SB Low-Voltage Insulated-Case Circuit Breakers for UL 891 Switchboard Applications

- Up to 635 Vac
- 200–6000 A continuous
- 50–150 kA interrupting

Magnum SB Low-Voltage Insulated-Case Circuit Breaker Family UL Rated for Switchboard Applications

All Magnum Breaker Types—Features, Benefits and Functions

- **Interruption ratings up to 200 kA** with current limiting performance and low current let-through to reduce damaging energy to down-stream equipment at high fault levels or with high short-time ratings for increased selectivity
- **Short-time ratings up to 130 kA** to maximize system coordination and selectivity
- **Four physical frame sizes** (narrow, standard, double narrow and double) to promote breaker application in compact modular enclosures
- **Continuous current ratings from 800–6000 A** with 100% rating at 40 °C and no derating on most ratings up to 50 °C in a properly sized and ventilated enclosure
- **Fixed breaker mounting configurations** with horizontal and optional vertical and front connected terminal connections
- **Drawout breaker mounting configurations** with cassette and optional safety shutters
- **Three- and four-pole breaker configurations**
- **Through-the-door design** for human interface with the breaker compartment door closed
- **Two-step stored energy mechanism** for manually and electrically operated breakers
- **Digitrip™ RMS Trip Unit family protection** with four models each providing increasing levels of protection and feature options for coordination, information and diagnostics:
  - ❑ Microprocessor-based rms sensing
  - ❑ Basic to programmable over-current protection and alarms
  - ❑ Local display for information, status and diagnostics
  - ❑ Ampere, voltage and power metering
  - ❑ Power quality, harmonics and waveform capture
  - ❑ Communications with translators to common protocols
  - ❑ Zone selective interlocking for improved coordination
  - ❑ Integral Arcflash Reduction Maintenance System™
  - ❑ Breaker health monitoring
- **Field-installable accessories** (UL listed) common across the breaker frames and designed to be easily installed in the field to service or modify the breaker at the point of use
- **Secondary terminal contacts** mounted at the top front of the breaker and away from the primary voltage areas for improved safety and access. Finger-safe terminal blocks accommodate ring-tongue or spade type terminals as standard

Through-the-Door Design for Human Interface with the Breaker Compartment Door Closed

High Technology Microprocessor-Based Digitrip RMS 1150+ Trip Units are Available with Advanced Features Like Programmable Overcurrent Settings, Power Metering, Power Quality and Communications

Breaker Features on Front Cover

The controls and indicators are functionally grouped on the breaker faceplate to optimize the human interface, visibility and ease of use. For maximum safety, a modern, through-the-door design permits access to the breaker levering system, trip unit, controls and indicators with the door closed.

① Mechanical trip flag pop-out indicator (optional)—red
Interlocked indicator requiring manual reset is also available

② Accessory viewing windows for:

- ❑ Shunt Trip Attachment (STA)
- ❑ Spring Release device (SR)
- ❑ Undervoltage Release (UVR) device or second STA

③ Digitrip RMS trip unit (Model 520M shown) protected by clear cover

④ Contact status indicators:

- ❑ OPEN—green
- ❑ CLOSED—red

⑤ Spring status indicators:

- ❑ Charged—yellow
- ❑ Discharged—white

⑥ Push OFF (open) pushbutton—red

⑦ Push ON (close) pushbutton—green

⑧ Manual spring charging handle for manually charging the stored energy springs

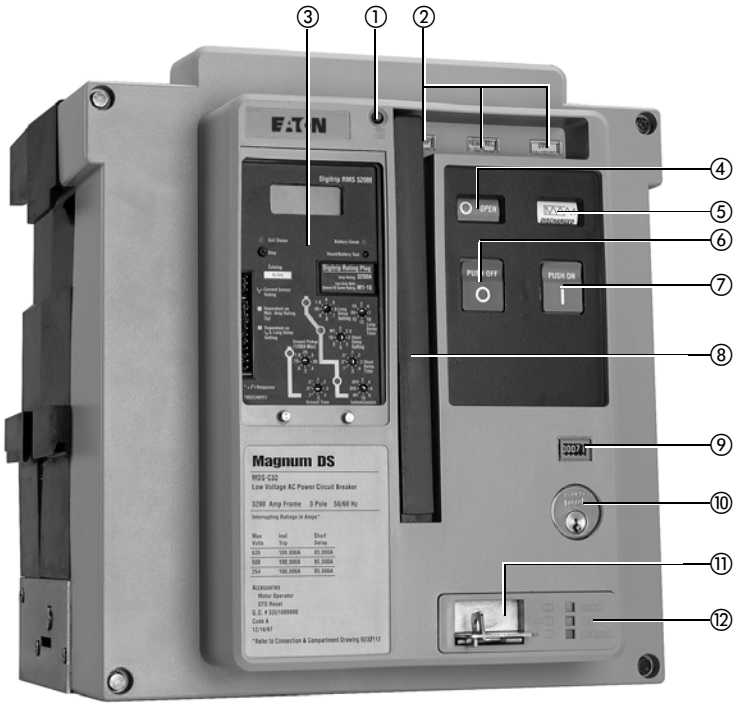
⑨ Mechanical operations counter (optional)

⑩ Key off lock (optional)

⑪ Padlockable levering device shutter for drawout breakers

⑫ Color-coded position indicator for drawout breakers:

- ❑ CONNECT—red
- ❑ TEST—yellow
- ❑ DISCONNECT—green



Magnum DS Drawout Breaker

Accessory Viewing Windows Visibly Confirm the Breaker Shunt Trip, Spring Release, UVR Installation and Their Control Voltage Rating

Drawout Breaker Levering Can be Accomplished with the Compartment Door Closed without the Need for a Special Levering Tool

Through-the-Door Design for Human Interface with the Breaker Compartment Door Closed, for Example, Manually Charging the Stored Energy Springs

Breaker Internal Features

Magnum circuit breakers are designed for ease of access for inspection, modification and maintenance at the point of use. The breaker front cover is easily removed with four captive bolts, revealing the modular internal breaker features.

① Secondary terminal points for internal standardized breaker wiring connections

② Breaker accessory mounting deck with three positions for mounting:

- ❑ Shunt Trip Attachment (STA)
- ❑ Spring Release device (SR)
- ❑ Undervoltage Release (UVR) device or second STA

③ Digitrip RMS Trip Unit (Model 1150+ shown)

④ Spring charging motor (optional) for electrically charging the stored energy springs

⑤ Manual spring charging handle for manually charging the stored energy springs

⑥ Padlockable levering device shutter for drawout breakers

⑦ Color-coded position indicator for drawout breakers:

- ❑ CONNECT—red
- ❑ TEST—yellow
- ❑ DISCONNECT—green

⑧ Secondary contact blocks for connection to external cell control wiring

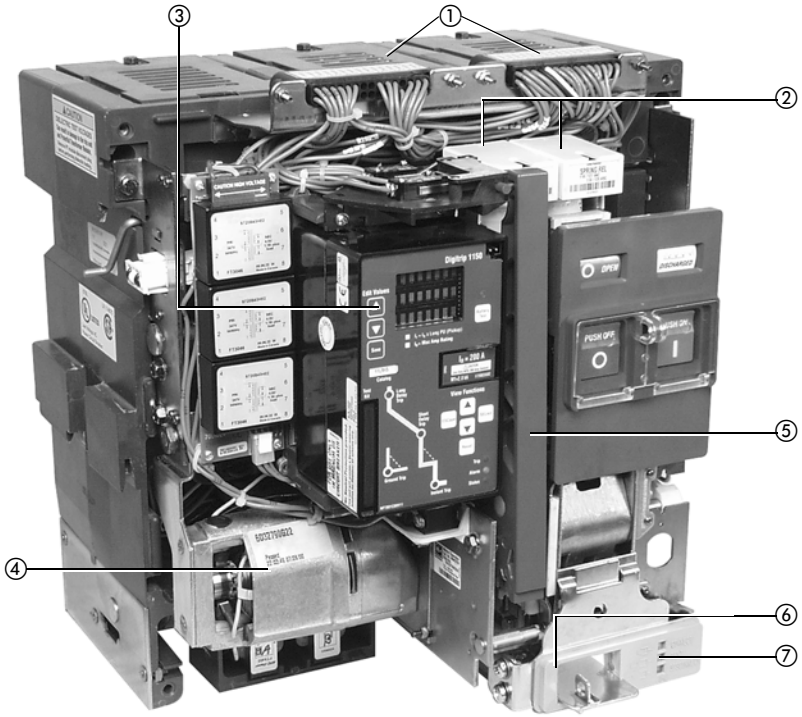
⑨ Removable arc chute covers for easy access to breaker main contacts

⑩ Primary finger cluster disconnecting contacts for drawout breaker are mounted on the breaker element for ease of access for inspection and maintenance

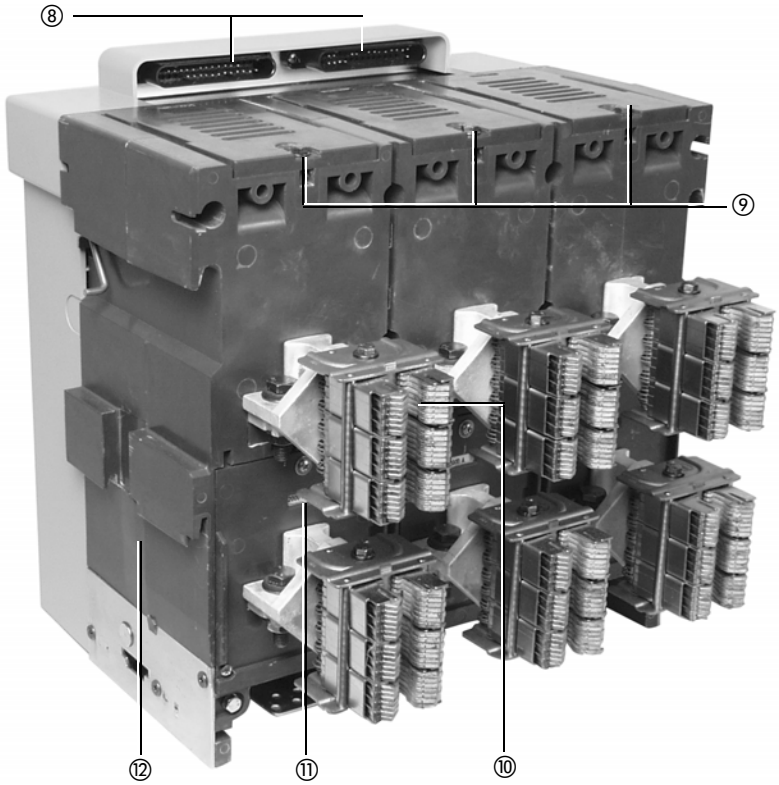
Note: Some competitors mount the primary finger clusters inside the cell, requiring shutdown of the switchgear for inspection and maintenance.

⑪ Current sensor viewing windows to view and confirm breaker sensor rating

⑫ Rigid frame housing (thermoset composite resin) providing increased strength and durability



Magnum Drawout Breaker Front View with Front Cover Removed Showing Easy Access to the Breaker Internal Devices



Magnum Drawout Breaker Rear View Showing Primary Disconnecting Finger Clusters Mounted on the Breaker for Ease of Inspection

Magnum DS Low-Voltage Power Circuit Breakers

Magnum DS is a true UL 1066 listed low-voltage power circuit breaker family, designed for the highest performance requirements of switchgear and specialty enclosure applications.

- Magnum DS low-voltage power circuit breakers have interruption ratings up to 130 kA at 635 Vac and short-time withstand through 100 kA, with continuous current ratings up to 6000 A to maximize system coordination and selectivity
- Magnum MDDX non-current limiting PCBs have 200 kA interrupting ratings and up to 100 kA short-time rating at 508 Vac with continuous current ratings up to 6000 A
- Magnum MDSX current limiting power circuit breakers (fuseless) have 200 kA interrupting ratings and 30–50 kA short-time ratings at 480 Vac with continuous current ratings up to 5000 A
- Magnum MDSL current limiting power circuit breakers with integral current limiters (fuses) have 200 kA interrupting ratings at 600 Vac with continuous current ratings up to 2000 A

UL and ANSI Test Certifications

Magnum DS meets or exceeds the applicable ANSI, NEMA, UL and CSA® standards, including:

- ANSI C37.13 (low-voltage AC power circuit breakers used in enclosures)
- ANSI C37.16 (preferred ratings, related requirements, and application recommendations for low-voltage power circuit breakers and AC power circuit breakers)
- ANSI C37.17 (trip devices for AC and general purpose DC low-voltage power circuit breakers)
- ANSI C37.50 (test procedures for low-voltage AC power circuit breakers used in enclosures)
- UL 1066 (standard for low-voltage AC and DC power circuit breakers used in enclosures)
- NEMA SG3 (this standard adopts ANSI C37.16 in its entirety)

Comprehensive Enclosure Solutions

Magnum DS has proven performance in Eaton manufactured switchgear and switchboards with the following test certifications:

- UL 1558 (Magnum DS low-voltage metal-enclosed switchgear)
- UL 891 (Pow-R-Line® C low-voltage switchboards)
- UL 1008 standard for transfer switch equipment
- UL, CSA 22.2.31 low-voltage assemblies

Approvals

- UL listed: Magnum DS breaker UL File No. E52096 and cassette UL File No. E204565
- ABS (American Bureau of Shipping) Type Listed Certificate Number 04-HS422844A-DUB

Magnum DS, MDSX and MDSL Circuit Breakers

Magnum DS low-voltage power circuit breakers have high withstand ratings from 42 to 100 kA to provide for maximum system coordination and selectivity.

Magnum MDSX current limiting power circuit breakers have fast opening contacts to provide interrupting ratings up to 200 kA at 508 Vac without fuses.

Magnum MDSL current limiting power circuit breakers have integral current limiters to provide interrupting ratings of 200 kA at 600 Vac.

Selecting the Optimal Magnum Solution for System Coordination, Interruption Performance and Arc Flash Reduction

Table 26.1-1. System Application Considerations

Magnum Breaker Type	Short-Time Current (See Table 26.1-2)	System Coordination	Interruption	Arc Flash Energy	Operating System Convenience and Life Time Cost
 **MDS and MDDX** High short-time current—LS trip functions with trip unit instantaneous off	Up to 65 kA (narrow frame) Up to 85 kA (standard frame) Up to 100 kA (double narrow and double frame)	Up to 100 kA	Up to 100 kA at 635 Vac—MDS/MDN Up to 200 kA at 508 Vac MDDX	Highest energy	Inspect, reset and close after interruption
 **MDSX** Current limiting—fast opening reverse loop contacts with trip unit instantaneous off	30 kA (standard frame) 50 kA (double frame)	Up to the rated short-time current Based on trip unit settings	200 kA at 508 Vac	Lower energy at fault levels in current limiting range above short-time current rating	Inspect, reset and close after interruption
 **MDSL** Current limiting — integral current limiters with trip unit instantaneous off	Based on current limiter selected	Based on current limiter selected and trip unit settings	Up to 200 kA at 600 Vac	Lower energy at fault levels in the current limiting range of current limiter	Blown limiters require replacement and inventory Operating watts loss is higher than fuse-less breakers
All Magnum breakers with trip unit instantaneous on	Per Magnum breaker type applied	Trip unit instantaneous settings affect system coordination and continuity	Per Magnum breaker type applied	May be reduced by employing trip unit: Ground fault settings, zone selective interlocking, Arcflash Reduction Maintenance System	Per Magnum breaker type applied

Magnum MDS, MDN and MDDX High Short-Time Current Rating Breakers for Maximum Coordination

Magnum MDS and MDDX breakers are designed to hold in and carry their rated short-time current up to 0.5 seconds, the maximum trip unit short-time delay setting. System coordination is maximized when the instantaneous trip unit settings are either turned off or set high enough to facilitate coordination with other load side protective devices in the circuit.

Energy let-through and arc flash energy to the downstream circuit can be significantly reduced by employing instantaneous trip unit settings, as well as ground fault and zone interlocking. However, the desire to reduce arc flash may have to be balanced with the necessity to maintain system coordination and continuity. This is especially true at the low fault levels characteristic of arcing faults, because the trip unit instantaneous trip setting may have to be set as low as the minimum setting, which could cause lack of coordination.

The integral Arcflash Reduction Maintenance System trip unit option can be employed to optimize arc flash reduction during system startup and maintenance operations.

Magnum MDSX Fuseless Current Limiting Performance Up to 200 kAIC

Magnum MDSX breakers provide new fuseless technology with interruption ratings up to 200 kA at 508 Vac. The interruption performance is current limiting when the fault currents exceeds the short-time current rating. The self-protecting fast-opening reverse-loop contacts quickly open, clearing the fault in approximately 1/4 cycle, reducing energy let-through and arc flash energy.

Below their short-time current rating, MDSX breakers coordinate like standard MDS breakers. Arc flash levels to the downstream circuit can be reduced by employing the trip unit instantaneous settings as well as ground fault, zone interlocking and Arcflash Reduction Maintenance System features.

MDSX breakers have the same compact footprint as standard MDS breakers.

MDSX improves overall operating system continuity, convenience and life cycle costs by eliminating fuse trucks, blown limiter change outs, replacement limiter inventories and the higher operating watts loss associated with fuses.

Magnum MDSL Current Limiting Performance with Integral Current Limiters Up to 200 kAIC

Magnum MDSL breakers with integral current limiters provide interruption ratings up to 200 kA at 600 Vac. MDSL is especially effective in reducing energy let-through and arc flash at the highest fault currents and those that fall within the current limiting range of the current limiter. Interruption is clean and efficient with most of the arc display contained within the current limiter. A wide array of current limiter ratings are available for selection and application with the breaker current sensor ratings and trip unit settings to provide for system coordination.

When fault currents fall below the current limiting range of the limiter, energy let-through and arc flash energy will increase. In this range, a lower rated current limiter may be applied, but considerations must be given to nuisance blowing of the limiter and system coordination.

MDSL breakers can also employ trip unit instantaneous settings as well as ground fault, zone interlocking and Arcflash Reduction Maintenance System features to reduce arc flash levels. Physically, they are 6.00 inches (152.4 mm) deeper than standard construction Magnum breakers.

Magnum DS Switchgear Class UL 1066

Magnum DS Low-Voltage Power Circuit Breaker Family ANSI Rated for Switchgear Applications

Table 26.1-2. Magnum DS Switchgear Class UL 1066 Low-Voltage Power Circuit Breakers

Frame Amperes	Breaker Type Catalog Number	Frame Type	rms Symmetrical Current Ratings kA 50/60 Hz ①						Poles Available	Available Current Sensor and Rating Plugs for Digitrip RMS Trip Unit (Establishes Breaker I_n Rating)
			Interrupting at 254 Vac	Interrupting at 508 Vac	Interrupting at 635 Vac	Short-Time Withstand Rating at 254/508 Vac	Short-Time Withstand Rating at 635 Vac	Fixed Internal Instantaneous Trip		
800	MDN-408	Narrow	42	42	42	42	42	—	3, 4	200, 250, 300, 400, 600, 800
	MDN-508	Narrow	50	50	50	50	50	—	3, 4	
	MDN-608	Narrow	65	65	65	65	65	—	3, 4	
	MDN-C08	Narrow	100	100	65	20	20	18 x I_n	3, 4	
	MDS-408	Standard	42	42	42	42	42	—	3, 4	
	MDS-508	Standard	50	50	50	50	50	—	3, 4	
	MDS-608	Standard	65	65	65	65	65	—	3, 4	
	MDS-808	Standard	85	85	85	85	85	—	3, 4	
	MDS-C08	Standard	100	100	100	85	85	85	3, 4	
	MDS-H08	Standard	130	130	130	85	85	85	3	
	MDS-L08 ②	Standard	200	200	200	②	②	—	3	
1200	MDN-412	Narrow	42	42	42	42	42	—	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200
	MDN-512	Narrow	50	50	50	50	50	—	3, 4	
	MDN-612	Narrow	65	65	65	65	65	—	3, 4	
	MDN-C12	Narrow	100	100	65	25	25	18 x I_n	3, 4	
	MDS-512	Standard	50	50	50	50	50	—	3, 4	
	MDS-612	Standard	65	65	65	65	65	—	3, 4	
	MDS-812	Standard	85	85	85	85	85	—	3, 4	
	MDS-C12	Standard	100	100	100	85	85	85	3, 4	
	MDS-H12	Standard	130	130	130	85	85	85	3	
	MDS-X12	Standard	200	200	65	30	30	30	3, 4	
1600	MDN-416	Narrow	42	42	42	42	42	—	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600
	MDN-516	Narrow	50	50	50	50	50	—	3, 4	
	MDN-616	Narrow	65	65	65	65	65	—	3, 4	
	MDN-C16	Narrow	100	100	65	30	30	18 x I_n	3, 4	
	MDS-516	Standard	50	50	50	50	50	—	3, 4	
	MDS-616	Standard	65	65	65	65	65	—	3, 4	
	MDS-816	Standard	85	85	85	85	85	—	3, 4	
	MDS-C16	Standard	100	100	100	85	85	85	3, 4	
	MDS-H16	Standard	130	130	130	85	85	85	3	
	MDS-L16 ②	Standard	200	200	200	②	②	—	3	
	MDS-X16 ③	Standard	200	200	200	65	30	30	3	
2000	MDN-620	Narrow	65	65	65	65	65	—	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600, 2000
	MDN-C20	Narrow	100	100	65	35	35	18 x I_n	3, 4	
	MDS-620	Standard	65	65	65	65	65	—	3, 4	
	MDS-820	Standard	85	85	85	85	85	—	3, 4	
	MDS-C20	Standard	100	100	100	85	85	85	3, 4	
	MDS-H20	Standard	130	130	130	85	85	85	3	
	MDS-L20 ②	Standard	200	200	200	②	②	—	3	
	MDS-X20 ③	Standard	200	200	65	30	30	30	3	

① Interrupting ratings shown based on breaker equipped with integral Digitrip rms trip unit. Interruption ratings for non-automatic breakers are equal to the published short-time withstand rating. These interruption ratings are based on the standard duty cycle consisting of an open operation, a 15-second interval and a close-open operation, in succession, with delayed tripping in case of short-delay devices. The standard duty cycle for short-time ratings consists of maintaining the rated current for two periods of 1/2 seconds each, with a 15-second interval of zero current between the two periods.

② Magnum MDSL current limiting power circuit breaker with integral current limiters. Current limiter selected determines short time and fixed instantaneous trip rating.

③ Magnum MDSX current limiting power circuit breaker with fast opening contacts.

Table 26.1-2. Magnum DS Switchgear Class UL 1066 Low-Voltage Power Circuit Breakers (Continued)

Frame Amperes	Breaker Type Catalog Number	Frame Type	rms Symmetrical Current Ratings kA 50/60 Hz ①						Poles Available	Available Current Sensor and Rating Plugs for Digitrip RMS Trip Unit (Establishes Breaker I_n Rating)
			Interrupting at 254 Vac	Interrupting at 508 Vac	Interrupting at 635 Vac	Short-Time Withstand Rating at 254/508 Vac	Short-Time Withstand Rating at 635 Vac	Fixed Internal Instantaneous Trip		
2500	MDS-625	Standard	65	65	65	65	65	—	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600, 2000, 2500
	MDS-825	Standard	85	85	85	85	85	—	3, 4	
	MDS-C25	Standard	100	100	100	100	85	85	3, 4	
	MDS-H25	Standard	130	130	130	85	85	85	3	
3200	MDS-632	Standard	65	65	65	65	65	—	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600, 2000, 2500, 3200
	MDS-832	Standard	85	85	85	85	85	—	3, 4	
	MDS-C32	Standard	100	100	100	85	85	85	3, 4	
	MDS-H32	Standard	130	130	130	85	85	85	3	
	MDS-X32 ②	Double	200	200	④	50	50	50	3	
4000	MDS-840	Double	85	85	85	85	85	—	3, 4	2000, 2500, 3200, 4000
	MDS-C40	Double	100	100	100	100	100	—	3, 4	
	MDS-H40	Double	130	130	130	130	130	—	3	
	MDS-X40 ②	Double	200	200	④	50	50	50	3	
	MDN-640	Double Narrow	65	65	65	65	65	—	3, 4	
	MDN-840	Double Narrow	85	85	65	85	65	—	3, 4	
	MDN-C40	Double Narrow	100	100	65	100	65	—	3, 4	
	MDD-X40	Double	200	200	100	100	100	—	3	
5000	MDS-850	Double	85	85	85	85	85	—	3, 4	2500, 3200, 4000, 5000
	MDD-X50	Double	200	200	100	100	100	—	3	
	MDS-C50	Double	100	100	100	100	100	—	3, 4	
	MDS-H50	Double	130	130	130	130	130	—	3	
	MDS-X50 ②③	Double	200	200	④	50	50	50	3	
6000	MDS-C60 ③	Double	100	100	100	100	100	—	3, 4	3200, 4000, 5000, 6000
	MDS-H60 ③	Double	130	130	130	130	130	—	3	
	MDD-X60 ③	Double	200	200	100	100	100	—	3	2500, 3200, 4000, 5000

① Interrupting ratings shown based on breaker equipped with integral Digitrip rms trip unit. Interruption ratings for non-automatic breakers are equal to the published short-time withstand rating. These interruption ratings are based on the standard duty cycle consisting of an open operation, a 15-second interval and a close-open operation, in succession, with delayed tripping in case of short-delay devices. The standard duty cycle for short-time ratings consists of maintaining the rated current for two periods of 1/2 seconds each, with a 15-second interval of zero current between the two periods.

② Magnum MDSX current limiting power circuit breaker with fast opening contacts.

③ Breaker applied in a tested fan cooled enclosure.

④ Product to be tested. Contact Eaton for product rating.

Magnum MDSX Fuseless Current Limiting Power Circuit Breakers

Magnum MDSX

Magnum MDSX Current Limiting Power Circuit Breakers have fast opening contacts to provide interrupting ratings up to 200 kA at 508 Vac without fuses. The interruption performance is current limiting when the fault currents exceed the short-time current rating. The self-protecting fast opening reverse loop contacts quickly open, clearing the fault in approximately 1/4 cycle, reducing energy let-through and arc flash energy. Below their short-time current rating, MDSX breakers coordinate like standard MDS breakers.

Arc flash levels to the downstream circuit can be reduced by employing the trip unit instantaneous settings as well as ground fault, zone interlocking, and Arcflash Reduction Maintenance System™ features. MDSX breakers have the same compact footprint as standard MDS breakers. MDSX improves overall operating system continuity, convenience and life cycle costs by eliminating fuse trucks, blown limiter change outs, replacement limiter inventories and the higher operating watts loss associated with fuses.

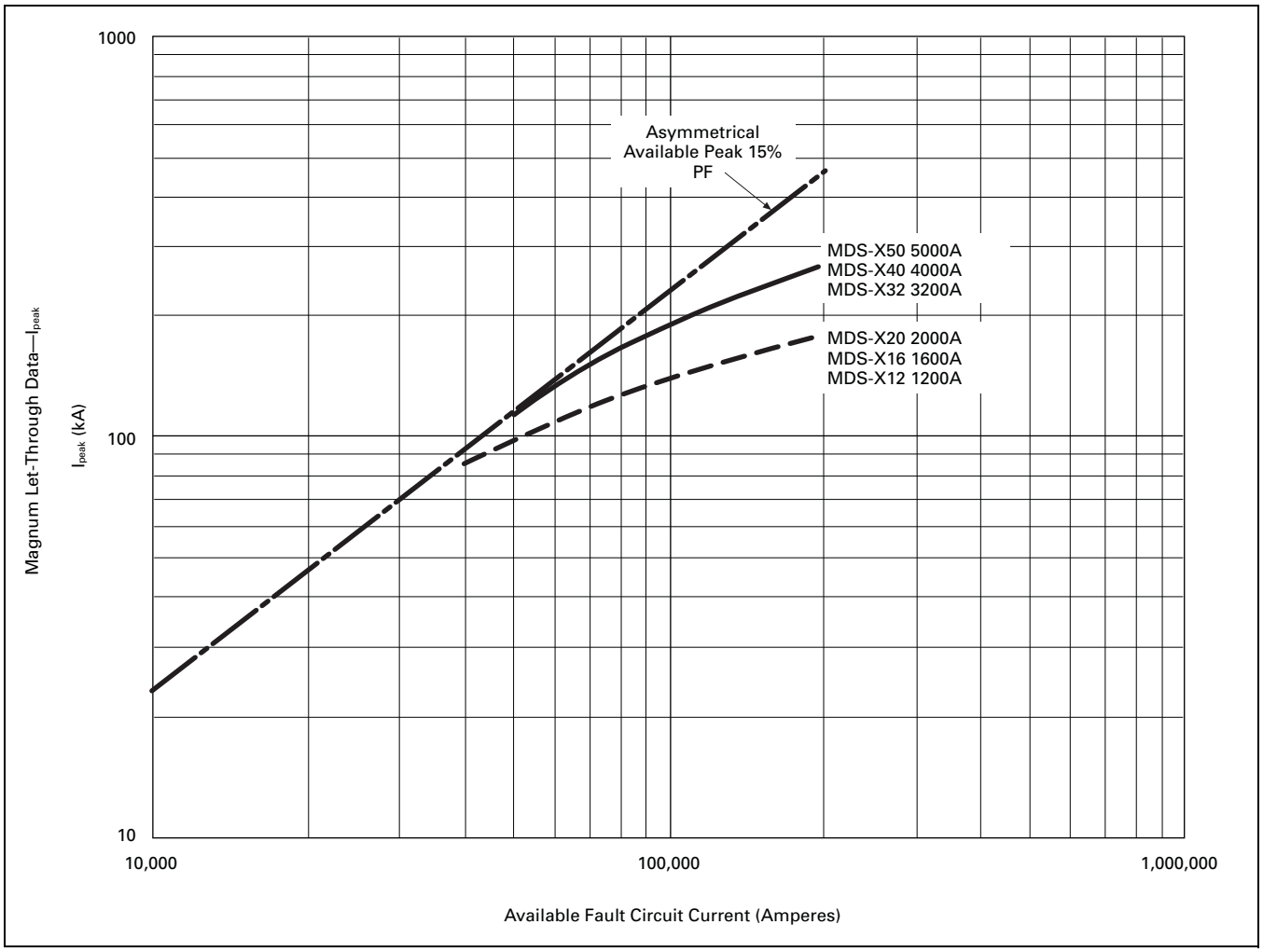


Figure 26.1-1. Magnum Let-Through Data

Magnum MDSL Fused Current Limiting Power Circuit Breakers

The following curves illustrate the ratings, melting time-current characteristics and current limiting, or let-through characteristics, of limiters for Magnum low-voltage power circuit breakers.

The let-through current for a given limiter application is readily determined by extending a vertical line from the applicable maximum available symmetrical fault amperes at the bottom margin to the characteristic line for the particular limiter, and from this intersection extending a horizontal line to the left margin and reading the peak current. The withstand rating of any circuit elements protected by the limiters should be at least equal to this peak current.

It will be noted that the let-through current increases with the limiter size or ampere rating; in other words, the maximum current limiting effect is obtained with the smallest size. This effect is to be expected, because the resistance decreases as the rating increases. If the vertical line from the bottom margin as described in the previous paragraph does not intersect the limiter characteristic line, the available system fault current is below the "threshold" current of that limiter, and it will offer no current limiting effect.

The current limiting principle is illustrated below:

I_a = The Available Peak Fault Current

t_m = The Melting Time

I_p = The Peak Let-Through Current

t_a = The Arcing Time

t_c = The Total Interrupting (Clearing) Time

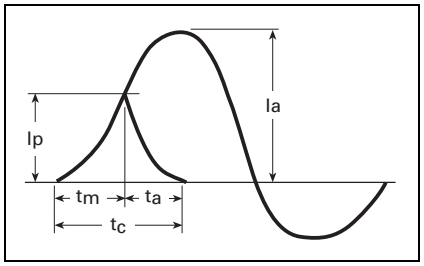


Figure 26.1-2. Current Limiting

Limiter Selection

The selection of a suitable limiter rating for a given application is generally governed by a choice of the following types of protection:

A. Maximum protection of "downstream" components. Type MDSL breakers are often used for this purpose even when the maximum available fault currents are within the interrupting rating of the corresponding unfused Magnum breakers.

B. Protection of the circuit breaker only.

Case A would tend to use the smallest available limiter; Case B the largest. When downstream protection is required, the selection is usually a compromise, because certain small limiters cannot be coordinated with the breaker to avoid nuisance blowing on overloads or small and moderate short circuits.

Minimum, recommended and maximum limiter sizes for Magnum MDSL breakers are given in the table below.

Table 26.1-3. Magnum MDSL Ratings

Frame	Available Sensor/ Rating Plug (Amperes)	Catalog Number
800	200, 250, 300, 400, 600, 800	**MDSL08**
1600	200, 250, 300, 400, 600, 800, 1000, 1200, 1600	**MDSL16**
2000	1600, 2000	**MDSL20**

Table 26.1-4. Magnum MDSL Sensor/Rating Plug vs.Current Limiter Selection ①

Sensor and Rating Plug I_n	MDSL Current Limiter Selection Chart ②									
200	MA250	MA300	MA400	MA600 ③	MA800	MB1200	MB1600	MB2000	MD2500	MD3000
250			MA400	MA600	MA800 ③	MB1200	MB1600	MB2000	MD2500	MD3000
300			MA400	MA600	MA800 ③	MB1200	MB1600	MB2000	MD2500	MD3000
400				MA600	MA800	MB1200 ③	MB1600	MB2000	MD2500	MD3000
600					MA800	MB1200	MB1600	MB2000 ③	MD2500	MD3000
800						MB1200	MB1600	MB2000	MD2500 ③	MD3000
1000							MB1600	MB2000	MD2500 ③	MD3000
1200								MB2000	MD2500 ③	MD3000
1600										MD3000 ③
2000										MD3000 ③

① Select the current limiter based on the Magnum breaker frame and current sensor and rating plug as shown.

② Refer to MDSL current limiter curves for let-through and time characteristics.

③ The recommended ratings shown as shaded provide for reduced current let-through and breaker coordination within the trip unit settings. Selection of current limiters below the recommended ratings shown provides lower current let-through; however, trip unit settings must be considered to avoid nuisance operation.

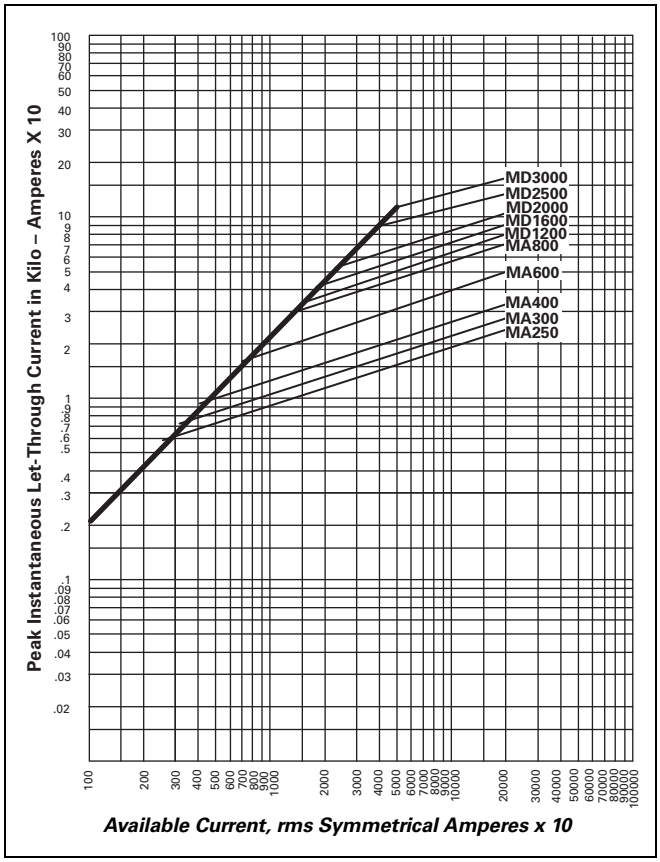


Figure 26.1-3. Type Magnum DSL Limiters, Peak Let-Through Current Characteristics

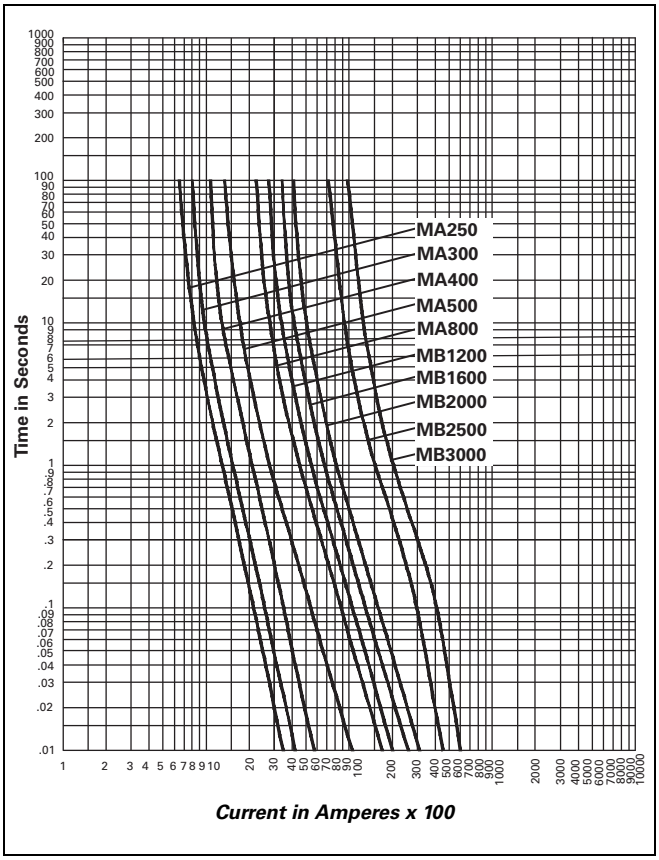
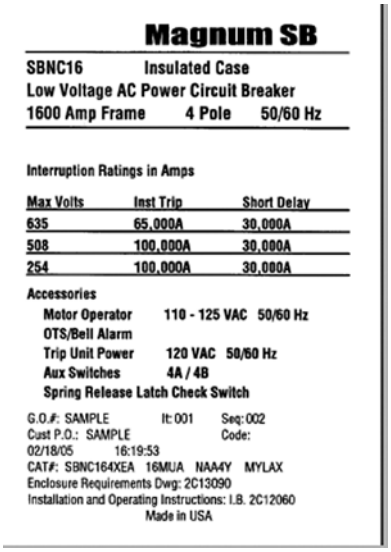


Figure 26.1-4. Type Magnum DSL Limiters Average Melting Time-Current Characteristics

Magnum SB Low-Voltage Insulated-Case Circuit Breakers

Magnum SB Low-Voltage Insulated-Case Circuit Breakers are Designed for the Performance and Economic Requirements of UL 891 Switchboards



Magnum SB

SBNC16 Insulated Case
Low Voltage AC Power Circuit Breaker
1600 Amp Frame 4 Pole 50/60 Hz

Interruption Ratings in Amps

Max Volts	Inst Trip	Short Delay
635	65,000A	30,000A
508	100,000A	30,000A
254	100,000A	30,000A

Accessories
Motor Operator 110 - 125 VAC 50/60 Hz
OTS/Bell Alarm
Trip Unit Power 120 VAC 50/60 Hz
Aux Switches 4A / 4B
Spring Release Latch Check Switch

G.O.#: SAMPLE It: 001 Seq: 002
Cust P.O.: SAMPLE Code:
02/18/05 16:19:53
CAT#: SBNC164XEA 16MUA NAA4Y MYLAX
Enclosure Requirements Dwg: 2C13090
Installation and Operating Instructions: I.B. 2C12060
Made in USA

Typical Magnum SB Low-Voltage Insulated-Case Circuit Breaker Nameplate

Magnum SB is a low-voltage insulated-case circuit breaker family designed for the performance and economic requirements of UL 891 switchboards.

- Magnum SB insulated-case circuit breakers have Interruption ratings up to 100 kA at 635 Vac with continuous current ratings up to 6000 A
- Magnum SB insulated-case circuit breakers have lighter-duty short-time current ratings and fixed internal instantaneous trips on most ratings, which is characteristic of UL 489 molded-case breakers commonly used in UL 891 switchboards. This provides for greater economy and excellent coordination and selectivity for most commercial applications
- Fixed internal instantaneous trips are included on all SB insulated-case circuit breakers rated 3200 A and below to provide an extra safety factor by reducing the energy let-through to downstream circuits at the maximum instantaneous trip point and to facilitate feeder circuit breaker protection in UL 891 switchboards with 3-cycle bus bracing
- Magnum SBSE current limiting power circuit breakers have 150 kA interrupting ratings at 480 Vac with continuous current ratings up to 5000 A. The short-time current rating is 30 kA for standard frame and 50 kA for double frame breakers

UL and ANSI Test Certifications

Magnum SB meets or exceeds the applicable ANSI, NEMA, UL and CSA standards, including:

- ANSI C37.13 (low-voltage AC power circuit breakers used in enclosures)
- ANSI C37.16 (preferred ratings, related requirements, and application recommendations for low-voltage power circuit breakers and AC power circuit breakers)
- ANSI C37.17 (trip devices for AC and general purpose DC low-voltage power circuit breakers)
- ANSI C37.50 (test procedures for low-voltage AC power circuit breakers used in enclosures)
- UL 1066 (standard for low-voltage AC and DC power circuit breakers used in enclosures)
- NEMA SG3 (this standard adopts ANSI C37.16 in its entirety)

Comprehensive Enclosure Solutions

Magnum SB has proven performance in Eaton manufactured switchboards with the following test certifications:

- UL 891 (Drawout Magnum SB and Pow-R-Line C low-voltage switchboards)
- UL, CSA 22.2.31 low-voltage assemblies

Approvals

- UL listed: Magnum SB breaker UL File E52096 and cassette UL File E204565

Magnum SB Switchboard Class Insulated-Case

Magnum SB Low-Voltage Insulated-Case Circuit Breaker Family UL Rated for Switchboard Applications

Table 26.1-5. Magnum SB Switchboard Class Insulated-Case Low-Voltage Air Circuit Breakers

Frame Amperes	Breaker Type Catalog Number	Frame Type	rms Symmetrical Current Ratings kA 50/60 Hz ①					Poles Available	Available Current Sensor and Rating Plugs for Digitrip RMS Trip Unit (Establishes Breaker I_n Rating)
			Interrupting at 254 Vac	Interrupting at 508 Vac	Interrupting at 635 Vac	Short-Time Withstand Rating	Fixed Internal Instantaneous Trip		
800	SBN-508	Narrow	50	50	35	20	18 x I_n	3, 4	200, 250, 300, 400, 600, 800
	SBN-608	Narrow	65	65	42	20	18 x I_n	3, 4	
	SBN-C08	Narrow	100	100	65	20	18 x I_n	3, 4	
	SBS-608	Standard	65	65	65	20	18 x I_n	3, 4	
	SBS-808	Standard	85	85	85	20	18 x I_n	3, 4	
	SBS-C08	Standard	100	100	85	20	18 x I_n	3, 4	
	SBS-H08	Standard	130	130	130	20	18 x I_n	3	
1200	SBN-512	Narrow	50	50	35	25	18 x I_n	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200
	SBN-612	Narrow	65	65	42	25	18 x I_n	3, 4	
	SBN-C12	Narrow	100	100	65	25	18 x I_n	3, 4	
	SBS-612	Standard	65	65	65	25	18 x I_n	3, 4	
	SBS-812	Standard	85	85	85	25	18 x I_n	3, 4	
	SBS-C12	Standard	100	100	85	25	18 x I_n	3, 4	
	SBS-H12	Standard	130	130	130	25	18 x I_n	3	
	SBS-E12 ②	Standard	200	150	65	30	30	3	
1600	SBN-516	Narrow	50	50	35	30	18 x I_n	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600
	SBN-616	Narrow	65	65	42	30	18 x I_n	3, 4	
	SBN-C16	Narrow	100	100	65	30	18 x I_n	3, 4	
	SBS-616	Standard	65	65	65	30	18 x I_n	3, 4	
	SBS-816	Standard	85	85	85	30	18 x I_n	3, 4	
	SBS-C16	Standard	100	100	85	30	18 x I_n	3, 4	
	SBS-H16	Standard	130	130	130	30	18 x I_n	3	
	SBS-E16 ②	Standard	200	150	65	30	30	3	
2000	SBN-620	Narrow	65	65	65	35	18 x I_n	3, 4	200, 250, 300, 400, 600, 800,
	SBN-C20	Narrow	100	100	65	35	18 x I_n	3, 4	
	SBS-620	Standard	65	65	65	35	18 x I_n	3, 4	1000, 1200, 1600, 2000
	SBS-820	Standard	85	85	85	35	18 x I_n	3, 4	
	SBS-C20	Standard	100	100	85	35	18 x I_n	3, 4	
	SBS-H20	Standard	130	130	130	35	18 x I_n	3	
	SBS-E20 ②	Standard	200	150	65	30	30	3	
2500	SBS-625	Standard	65	65	65	45	18 x I_n	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600, 2000, 2500
	SBS-825	Standard	85	85	85	45	18 x I_n	3, 4	
	SBS-C25	Standard	100	100	85	45	18 x I_n	3, 4	
	SBS-H25	Standard	130	130	130	45	18 x I_n	3	
	SBS-E25 ②	Double	200	150	100	50	50	3	

① Interrupting ratings shown based on breaker equipped with integral Digitrip RMS trip unit. These interruption ratings are based on the standard duty cycle consisting of an open operation, a 15 second interval and a close-open operation, in succession, with delayed tripping in case of short-delay devices. The standard duty cycle for short time ratings consists of maintaining the rated current for two periods of 1/2 seconds each, with a 15 second interval of zero current between the two periods.

② Magnum SBSE current limiting power circuit breaker with fast opening contacts.

Table 26.1-5. Magnum SB Switchboard Class Insulated-Case Low-Voltage Air Circuit Breakers (Continued)

Frame Amperes	Breaker Type Catalog Number	Frame Type	rms Symmetrical Current Ratings kA 50/60 Hz ①					Poles Available	Available Current Sensor and Rating Plugs for Digitrip RMS Trip Unit (Establishes Breaker I_n Rating)
			Interrupting at 254 Vac	Interrupting at 508 Vac	Interrupting at 635 Vac	Short-Time Withstand Rating	Fixed Internal Instantaneous Trip		
3000	SBS-630	Standard	65	65	65	50	18 x I_n	3, 4	200, 250, 300, 400, 600, 800, 1000, 1200, 1600, 2000, 2500, 3000
	SBS-830	Standard	85	85	85	50	18 x I_n	3, 4	
	SBS-C30	Standard	100	100	85	50	18 x I_n	3, 4	
	SBS-H30	Standard	130	130	130	50	18 x I_n	3	
	SBS-E30 ②	Double	200	150	④	50	50	3	
4000	SBS640	Double	65	65	65	65	18 x I_n	3, 4	2000, 2500, 3000, 4000
	SBN640	Double Narrow	65	65	65	65	18 x I_n	3, 4	
	SBS-840	Double	85	85	85	72	18 x I_n	3, 4	
	SBS-C40	Double	100	100	100	72	18 x I_n	3, 4	
	SBS-H40	Double	130	130	130	72	18 x I_n	3	
	SBN-840	Double Narrow	85	85	65	72/65	18 x I_n	3, 4	
	SBN-C40	Double Narrow	100	100	65	72/65	18 x I_n	3, 4	
	SBS-E40 ②	Double	200	150	100	50	50	3, 4	
5000	SBS-850	Double	85	85	85	85	18 x I_n	3	2500, 3000, 4000, 5000
	SBS-C50	Double	100	100	100	90	18 x I_n	3, 4	
	SBS-H50	Double	130	130	130	90	18 x I_n	3	
	SBS-E50 ②③	Double	200	150	100	50	50	3	
6000	SBS-C60 ③	Double	100	100	100	100	18 x I_n	3, 4	3000, 4000, 5000, 6000
	SBS-H60	Double	130	130	130	100	18 x I_n	3	

① Interrupting ratings shown based on breaker equipped with integral Digitrip RMS trip unit. These interruption ratings are based on the standard duty cycle consisting of an open operation, a 15 second interval and a close-open operation, in succession, with delayed tripping in case of short-delay devices. The standard duty cycle for short time ratings consists of maintaining the rated current for two periods of 1/2 seconds each, with a 15 second interval of zero current between the two periods.

② Magnum SBSE current limiting power circuit breaker with fast opening contacts.

③ Breaker applied in a tested fan cooled enclosure.

④ Product to be tested. Contact Eaton for product rating.

Breaker-Mounted Options

Magnum breakers are available with a comprehensive array of factory-installed breaker options to enable configured-to-order solutions for specified customer requirements. Field option kits are available to provide easy service, modification and customization of the breaker at the point of use.

- **Shunt trip device** (**ST**). Provides for remote electrically controlled breaker opening when energized by a rated voltage input
- **Spring charge motor (MOT)**. Charges the breaker closing springs automatically, facilitating remote or local closing. The motor assembly includes its own cut-off switch that changes state at the end of the charging cycle. This contact can be wired out for external indication
- **Spring release device** (**SR**). Provides for remote electrically controlled breaker closing when its coils are energized by a rated voltage input
- **Undervoltage release** (**UVR**). Trips the breaker when an existing voltage signal is lost or falls below an established threshold
- **Auxiliary switch**. Up to 6a/6b auxiliary individual dedicated contacts are available for customer use to indicate if the breaker is in the OPEN or CLOSE position
- **Mechanical trip indicator flag** ①. The red trip indicator flag pops out to provide local visual indication when the Digitrip RMS trip unit acts to trip the breaker on an overcurrent condition. Available in two options: an interlocked version that mechanically locks out the breaker until the indicator is manually reset and a non-interlocked version for indication only
- **Bell alarm/overcurrent trip switch** ① **(OTS)**. Provides two Form C contacts that change state when the Digitrip RMS trip unit acts to trip the breaker. The contacts are available for external indication or customer use and are manually reset by the mechanical trip indicator
- **Padlockable pushbutton cover**. Permits padlocking hinged cover plates to block access to the PUSH ON and PUSH OFF buttons on the breaker faceplate
- **Mechanical operations counter**. Records mechanical operations of the breaker over its installed life
- **Key off lock provisions**. Enables mounting of a single cylinder Kirk®, Castell or Ronis Key Lock to lock the breaker in the OPEN position
- **Latch check switch**. Provides one Form C contact that changes state when the breaker is ready to close. Can be wired to the spring release device for fast transfer applications or wired for external ready-to-close indication

Shunt Trip, Spring Release and Undervoltage Release Device Installed on Accessory Deck

Auxiliary Switches Come in Modular 2a/2b Contact Stages Providing up to 6a/6b Dedicated Contacts

Mechanical Trip Indicator with Bell Alarm (OTS) Switches Mounted ①

① For the Digitrip RMS 1150+ trip unit, other protective functions, if programmed, will cause the OTS and mechanical trip indicator flag to operate.

26

Digitrip RMS Trip Unit Family for Magnum Circuit Breakers

The Magnum family of Digitrip RMS trip units consists of four trip unit models, each providing increasing levels of features and options to enable the ultimate selection to match application requirements for protection, coordination, information, diagnostics and communication:

- Digitrip RMS 520
- Digitrip RMS 520M
- Digitrip RMS 520MC
- Digitrip RMS 1150+

Common Trip Unit Features

A summary of the important features common to all Magnum trip units is as follows:

- Microprocessor-based true rms sensing
- Discrete rotary or programmable settings
- Unit status LED (green)
- Cause of trip LEDs (red)
- Battery check LED (green)
- Reset/battery test pushbutton
- Making current release
- Thermal memory
- Over-temperature protective trip
- Zone selective interlocking (ZSI) provisions
- Rating plug receptacle
- Backup battery for cause of trip LEDs
- Test kit receptacle with cover
- Plug-in mounting for easy replacement
- Clear plastic cover (sealable)

Digitrip RMS trip units are highly accurate microprocessor-based protective devices that use a sampling algorithm to compute true rms values for precise system coordination and metering. The trip unit is completely self-contained and requires no external control power to perform its overcurrent protective functions because the power to operate the trip unit is derived from the primary current passing through the current sensors. When the trip unit is operating, the green unit status LED begins to blink like a heartbeat to visibly confirm the microprocessor is powered up.

The trip unit overcurrent protective pickup settings are a function of the breaker In rating, which is established by the rating plug and current sensors. When preset conditions are exceeded, the trip unit initiates a trip signal to the trip actuator, tripping the circuit breaker. Red cause-of-trip LEDs light up to indicate the cause of trip, powered by a easily replaceable backup battery located behind the rating plug. The LED will flash to save power, until the trip unit reset button is depressed.

All trip units include three important self-protecting safety features that are provided as standard:

Making Current Release (MCR): employs a fast-acting analog instantaneous trip that prevents the breaker from closing and latching on a fault when the peak current exceeds 25 x the breaker I_n rating. This reduces arc flash energy during breaker closing for faults within the self-protecting range. The MCR is enabled for the first two cycles following the circuit breaker closing operation and thereafter, depending on the type of Magnum breaker applied, becomes inactive.

Over-Temperature Protective Trip: automatically trips the breaker when the temperature inside the trip unit exceeds 85°C, which indicates that there are significantly higher temperatures within enclosure.

Thermal Memory: provides over-temperature protection on load circuits against effects of repeated overload conditions. This feature is defeatable for special applications such as welding and primary injection testing.

Trip Units

Eaton's electrical sector introduced the first microprocessor-based trip unit and has advanced the technology into a new family of UL and CSA listed Digitrip RMS electronic and programmable trip units designed and engineered exclusively for Magnum DS breakers.

Electronic Trip Units

- Digitrip RMS 520 enables the user as many as nine phase and ground current protection settings for maximum flexibility in trip-curve shaping and multi-unit coordination, and adds ground current protection settings
- Digitrip RMS 520M adds phase, neutral and ground current metering with a four-character LCD display window
- Digitrip RMS 520MC adds communication of current values and breaker status (open, closed, tripped), and Arcflash Reduction Maintenance System™ for arc flash reduction

Programmable Trip Units

- Digitrip RMS 1150+ provides programmability for more sophisticated distribution systems
  - Increased protection and coordination capabilities
  - Systems monitoring information including power factor, voltage, current, harmonic distortion values and waveform capture with a bright three-line, (eight characters per line) LED display
  - Two programmable contacts for customer use
  - Time and date stamping of trip events for improved trouble-shooting and diagnostics
  - Accuracy of 1% on current and voltage values and 2% on energy and power
  - Systems diagnostic information and breaker health menu
  - Communications
  - Arcflash Reduction Maintenance System for arc flash reduction

Magnum 520MC Trip Unit with Arcflash Reduction Maintenance System, Four-Digit LCD Display and Ampere-Based Communications

Magnum 1150+ Trip Unit with Arcflash Reduction Maintenance System, 24-Digit LED Display, Programmable Protection, Alarms and Relaying, Power Metering, Power Quality and Alarms, Waveform Capture, Communications and Breaker Health Monitoring

Arcflash Reduction Maintenance System

The Arcflash Reduction Maintenance System Maintenance Mode function of the Digitrip 520MC and 1150+ can reduce arc flash incident energy that is generated on a fault condition. This is accomplished by an analog trip circuit that, when armed, provides a fast-acting response to the fault. This is separate from the normal system protection setting of instantaneous.

Eaton's Arcflash Reduction Maintenance System employs a separate, dedicated analog trip circuit that eliminates microprocessor latencies, resulting in clearing times that are **faster than standard instantaneous tripping**. This provides superior arc flash reduction to competitors' systems that simply lower the standard instantaneous pickup set point.

There are three ways to arm the Maintenance Mode Arcflash Reduction Maintenance System setting. One method is locally at the trip unit front panel. For the 520MC, the two-position switch in the Maintenance Mode section of the trip unit is used. Turning the switch to the ON position will arm the setting. For the 1150+, the local front keypad is used to enable the Maintenance Mode setting. The setting is located in the SYSTEM submenu of programmable settings (PGM SET).

For the second method of arming the Maintenance Mode function, a remote switch wired through the breaker secondary contacts can remotely arm the Maintenace Mode setting. A high-quality gold-plated or palladium contact is required in this application.

A third method to arm the Maintenance Mode setting is via a communication device. There is a confirmation screen that verifies the arming. A BIM (Breaker Interface Module) or Power Xpert® system are communication methods to arm the setting.

The Arcflash Reduction Maintenance System setting has five unique settings (2.5, 4.0, 6.0, 8.0, 10.0 x I_n). To adjust this setting, a rotary switch on the trip unit face is provided for the 520MC while the 1150+ trip unit uses its local keypad.

For all three arming methods, the 520MC provides a blue LED to confirm the Maintenance Mode function is on. In addition, there is also a normally open breaker contact that allows the user to wire in an external stacklight or annunciator for remote indication. For the 1150+, the message "Maintenance Mode Enabled" will be shown on its LED display. The 1150+ also has an alarm relay that can be programmed to track the Maintenance Mode state.

The maintenance mode function will provide fast tripping even when the regular Instantaneous is set to OFF. The instantaneous LED position is also used to indicate a trip initiated by the Maintenance Mode setting. The 520MC LCD display, if powered, will indicate with four dashes while the 1150+ will display the message "Maintenance Mode Trip."

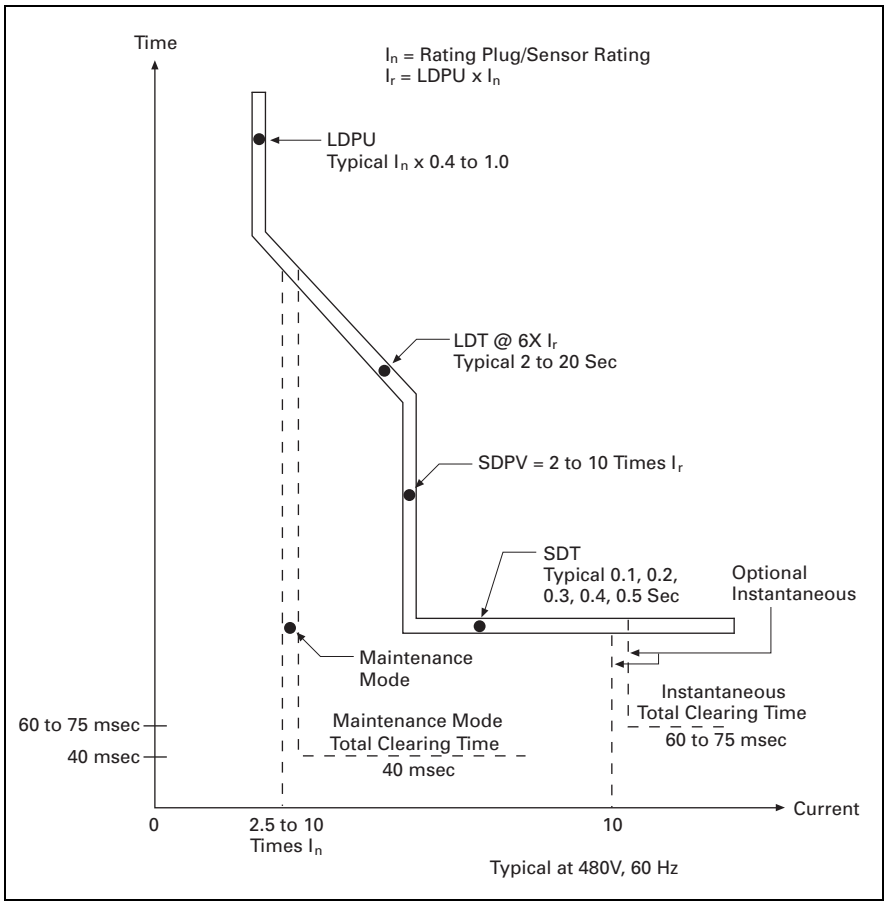
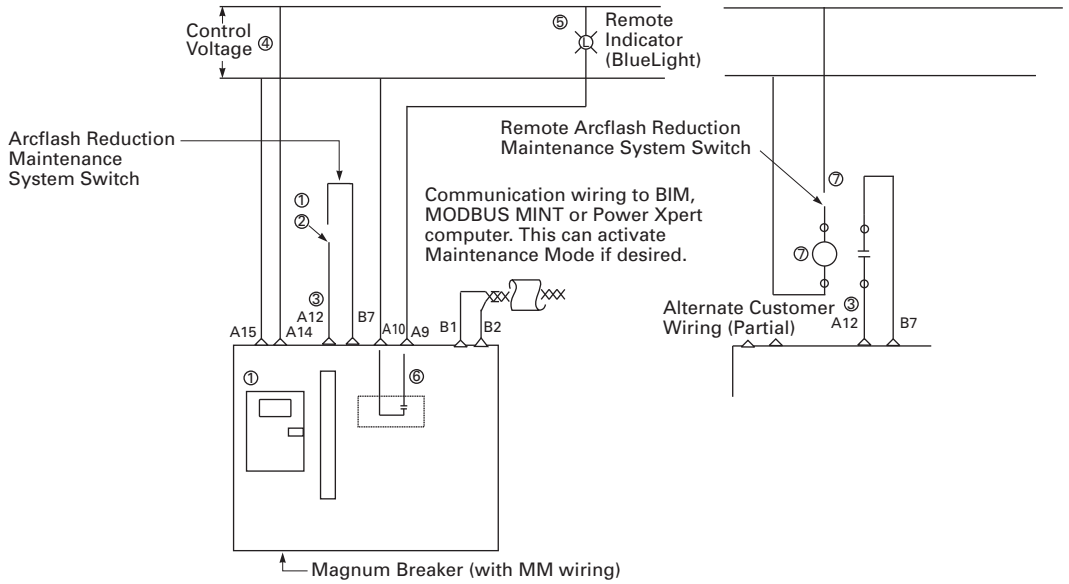


Figure 26.1-5. Arcflash Reduction Maintenance System—Typical Time Current Curve with Maintenance Mode



① The Digitrip 520MC (Cat 5ARMxxx) can locally be placed in Maintenance Mode via a two-position switch located on the trip unit. The function can also be armed via a remote switch as shown. In addition, the function can be activated via communications. A blue LED on the Digitrip verifies the Digitrip is in Maintenance Mode.

② The recommended selector switch for this low-voltage application is Eaton part number 10250T1333-2E, which includes a contact block rated for logic level and corrosive use.

③ The maximum length of this wiring to remote Arcflash Reduction Maintenance System switch (or alternate relay contact) is 9.78 ft (3m). Use #20 AWG wire or larger.

④ Control voltage is 120 Vac or 230 Vac or 24–48 Vdc or 125 Vdc. Check Magnum circuit breaker front cover for trip unit power requirements.

⑤ A remote stack light, annunciator panel or other remote indication device can be connected to verify that the Digitrip is in Maintenance Mode.

⑥ Relay in (GF alarm/PS module) makes when in Maintenance Mode. Contact is rated 1A at 120 Vac or 0.5 A at 230 Vac or 1 A at 24–48 Vdc and 0.35 A at 125 Vdc.

⑦ The Digitrip 520MC can also be placed remotely in its Maintenance Mode via a general purpose relay–ice cube type with logic level contacts–activated by remote control switch. A recommended type is IDEC Relay RY22. Choose voltage as desired.

Figure 26.1-6. Maintenance Mode Wiring Digitrip 520MC

Digitrip 520 Trip Unit

Digitrip 520 Trip Unit with Basic Overcurrent Protection

The Digitrip 520 is a simple basic trip unit with three available types of protection (LI, LSI and LSIG). Up to nine rotary-type current and time settings provide for maximum flexibility in curve-shaping and multi-unit coordination.

- The Instantaneous function (I) includes an off position setting when Short Time (S) protection is provided to increase application flexibility in the field
- I^2t time delay settings for better curve shaping when Short Time (S) and Ground Fault (G) protective functions are selected
- Zone Selective Interlocking (ZSI) provided when Short Time (S) and/or Ground Fault (G) protective functions are selected. ZSI provides hard-wired positive system coordination, allowing the breaker closest to the fault to trip first, thus avoiding unnecessary and costly system downtime. ZSI is a useful method to reduce arc flash

Digitrip 520M Trip Unit

Digitrip 520M Trip Unit with Four-Digit LCD Display and Ampere-based Metering, Alarms and System Diagnostics

The Digitrip 520M is available with three types of protection (LSI, LSIG and LSIA) and includes the following added features:

- Four-digit LCD display with a step pushbutton to scroll through the display data, including ampere-based metering of phase, neutral and ground currents, plus operational and cause-of-trip diagnostic information
- When specified, the Power Relay Module (PRM) is supplied to perform the following features:
  - Power up the trip unit display from an external customer supplied source through the breaker secondary contacts to retain the cause-of-trip and magnitude of trip information
  - Provide relay contact for remote indication of overload (LSI) or ground trip (LSIG) or ground alarm (LSIA)
- Type LSIA units alarm only when ground fault settings are exceeded, which is quite useful in critical power applications
- Plug receptacle for auxiliary power module to power up the trip unit display during bench testing remote from the switchgear

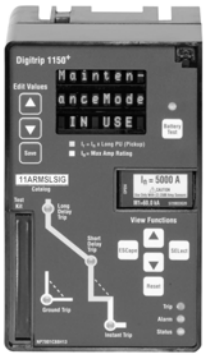
Digitrip 520MC Trip Unit

Digitrip 520MC Trip Unit With Arcflash Reduction Maintenance System, Four-Digit LCD Display and Ampere-based Communications

The Digitrip 520MC is available in three types of protection (LSI, LSIG and LSIA) and includes the following enhancements:

- Communications of ampere-based data, breaker status and cause-of-trip information using the INCOM™ communications system. Each trip unit has a unique hexadecimal address (001 to 999) set by rotary switches. A red transmit LED is provided to confirm communications activity. Peripheral translator devices are available to convert INCOM to other protocols like Modbus, Ethernet and so on
- Arcflash Reduction Maintenance System allows the operator to enable a special trip unit maintenance mode with a preset accelerated instantaneous override trip that can reduce arc flash energy up to 30%. This accelerated tripping results in total clearing times that are faster than standard instantaneous tripping. The arc flash reduction level is preset at the trip unit using a five-position switch that facilitates the maximum arc flash reduction setting possible while avoiding nuisance tripping. The Arcflash Reduction Maintenance System can be turned on locally at the trip unit, remotely using peripheral devices, or via communications. A blue LED provides local indication the trip unit is in the Maintenance Mode. Remote indication can be accomplished by a dedicated trip unit contact for use with a stack light or annunciator panel, or via communications

Digitrip 1150+ Trip Unit



Digitrip 1150+ Trip Unit

The Digitrip 1150+ trip unit is a highly advanced programmable protective device available in three types of protection (LSI, LSIG and LSIA). The following is a first level summary of the special features and options:

- 24-character LED digital display easily visible from 50 feet and ideal for dark equipment environments
- Membrane type dust-resistant keypad pushbuttons to facilitate local unit programming, including view functions (Up, Down, ESCape, SELect and Reset), edit values (Up, Down and Save) and battery test
- Programmable trip unit settings and curves including I^2t and I^4t curves, as well as IEEE moderately inverse, very inverse and extremely inverse curves
- Voltage and power metering
- Power quality monitoring and alarm with THD and waveform capture
- Health menu—The health menu on the Digitrip 1150+ front panel will provide information on the Magnum circuit breaker's health, as well as a history of the circuit breaker and circuit it is protecting. This data is useful for planning maintenance and inspection schedules. The type of data includes the total number of all instantaneous and short delay trips seen by the circuit breaker. A second counter shows the number of overloads (LDT) and ground faults (GFT) encountered while in service. The OP count provides data on the number of close operations experienced by the circuit breaker. The last time the circuit breaker was operated (open or closed or tripped) is viewable with time and date displayed. Also included is the maximum temperature in degrees Centigrade as seen by the Digitrip microprocessor CHip. The capture of the data requires external trip unit power. This data, once captured, is stored in non-volatile memory. These features are available for remote communications
- Programmable alarm contacts or trip contacts
- Programmable relay functions including undervoltage, overvoltage, underfrequency, overfrequency, reverse power, voltage unbalance and phase rotation
- Communications of comprehensive access to trip unit capabilities including programmable settings, breaker control, metering, alarm, status, relaying and diagnostic information. Peripheral translator devices are available to convert INCOM to other protocols like Modbus, Ethernet and so on
- Accessory bus for use with peripheral digital relay modules that can be programmed through the trip unit keypad for additional auxiliary and various alarm contacts
- Arcflash Reduction Maintenance System allows the operator to enable a special trip unit Maintenance Mode with a preset accelerated instantaneous override trip that can reduce arc flash energy up to 30%. This accelerated tripping results in total clearing times that are faster than standard instantaneous tripping. The arc flash reduction level is preset at the trip unit for the maximum arc flash reduction setting possible, while avoiding nuisance tripping. The Arcflash Reduction Maintenance System can be turned on locally at the trip unit, remotely using peripheral devices, or via communications. The display provides local indication the trip unit is in the Maintenance Mode. Remote indication can be accomplished by a dedicated trip unit contact for use with a stack light or annunciator panel, or via communications

Table 26.1-6. Digitrip Trip Units for Magnum DS and SB ANSI/UL Rated Power Circuit Breakers

					
Trip Unit Type		**Digitrip 520**	**Digitrip 520M**	**Digitrip 520MC**	**Digitrip 1150+** ①
Ampere range Interrupting rating at 480 V rms sensing		200–6000 A 42–200 kA Yes	200–6000 A 42–200 kA Yes	200–6000 A 42–200 kA Yes	200–6000 A 42–200 kA Yes
Protection and Coordination					
Protection	Ordering options Fixed rating plug (I_n) Overtemperature trip	LI, LSI, LSIG Yes Yes	LSI, LSIG, LSIA Yes Yes	LSI, LSIG, LSIA Yes Yes	LSI, LSIG, LSIA Yes Yes
Long delay protection (L)	Long delay pickup Long delay time I^2t at 6 x I_r Long delay time I^4t IEEE curves	0.4–1.0 x (I_n) 2–24 seconds No No	0.4–1.0 x (I_n) 2–24 seconds No No	0.4–1.0 x (I_n) 2–24 seconds No No	0.4–1.0 x (I_n) 2–24 seconds 1–5 seconds Yes
	Long delay thermal memory High load alarm	Yes No	Yes No	Yes No	Yes 0.5–1.0 x (I_r)
Short delay protection (S)	Short delay pickup Short delay time I^2t at 8 x I_r Short delay time flat Short delay time ZSI	200–1000% x (I_r) and M1 100–500 ms 100–500 ms Yes	200–1000% x (I_r) and M1 100–500 ms 100–500 ms Yes	200–1000% x (I_r) and M1 100–500 ms 100–500 ms Yes	200–1000% x (I_r) and M1 100–500 ms 100–500 ms Yes
Instantaneous protection (I)	Instantaneous pickup Making current release Off position	200–1000% x (I_n) and M1 Yes LSI and LSIG	200–1000% x (I_n) and M1 Yes Yes	200–1000% x (I_n) and M1 Yes Yes	200–1000% x (I_n) and M1 Yes Yes
Ground fault protection (G) ②	Ground fault alarm Ground fault pickup Ground fault delay I^2t at 0.625 x I_n	No 25–100% x (I_n) 100–500 ms	Yes 25–100% x (I_n) 100–500 ms	Yes 25–100% x (I_n) 100–500 ms	Yes 24–100% x (I_n) 100–500 ms
	Ground fault delay flat Ground fault ZSI Ground fault thermal memory	100–500 ms Yes Yes	100–500 ms Yes Yes	100–500 ms Yes Yes	100–500 ms Yes Yes
Disable ground fault protection		No	No	No	No
Neutral protection (N)		Model LSI	Model LSI	Model LSI	Model LSI
System Diagnostics					
Cause-of-trip LEDs Magnitude of trip information		Yes No	Yes Yes	Yes Yes	Yes Yes
Remote signal contacts Programmable contacts		No No	Yes No	Yes No	Yes Yes
System Monitoring					
Digital display Current (%) full scale sensor		No No	4-character LCD Yes ±2%	4-character LCD Yes ±2%	24-character LED Yes ±1%
Voltage (%) L to L Power and energy (%) Apparent power kVA and demand		No No No	No No No	No No No	Yes ±1% Yes ± 2% Yes
Reactive power Power factor Crest factor		No No No	No No No	No No No	Yes Yes Yes
Power quality—harmonics % THD, waveform capture		No No	No No	No No	Yes Yes
System Communications					
Type Power supply in breaker		No N/A	No Optional	INCOM Standard	INCOM/TripLink Standard
Additional Features					
Trip log (three events) Electronic operations counter		No No	No No	No No	Yes Yes
Testing method ③ Waveform capture		Test set No	Test set No	Test set No	Integral and test set Yes
Arcflash Reduction Maintenance System Breaker health monitor Protective relay functions		No No No	No No No	Yes No No	Yes Yes Yes ①

① Over and undervoltage alarm or trip, over and underfrequency alarm or trip, voltage unbalance alarm or trip, reverse power trip, and phase rotation alarm are included.

② 1200 A maximum ground fault setting per UL/NEC®.

③ Test set for secondary injection.

Legend: I_n = Rating Plug and Sensor Rating.
I_r = Long Delay Pickup setting.

Time-Current Curve Shaping

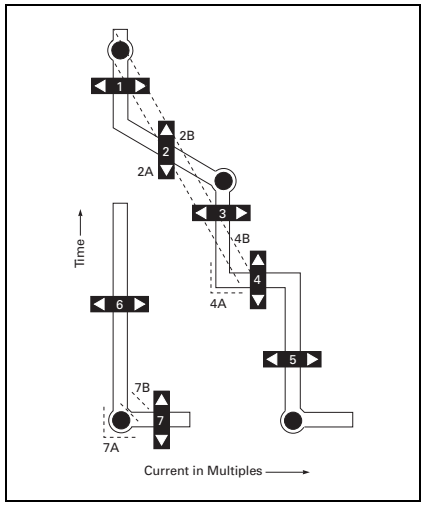


Figure 26.1-7. Time-Current Curve Shaping

Note: See selection guide charts for availability of adjustments.

Long Delay (L)

1. Long Delay Pickup
   Determines the continuous ampere rating of the breaker.
2. Long Delay Time
   Determines the amount of time the breaker will carry a low level overload before tripping.
   a. I^2t Response
      I^2t in: For coordination with other circuit breakers with electronic trip devices and for coordination with thermal-magnetic circuit breakers.
   b. I^4t Response
      I^4t in: For coordination with fuses and upstream transformer damage curves.

Short Delay (S)

3. Short Delay Pickup
   Determine or set the level of fault current at which the short-time trip delay countdown is actuated.
4. Short Delay
   Sets the amount of time the breaker will carry both a low level and high fault currents before tripping.
   a. Flat Response
      I^2t out: For coordination with other circuit breakers with electronic trip devices.
   b. I^2t Response
      I^2t in: For coordination with fuses and thermal-magnetic breakers.

Instantaneous (I)

5. Instantaneous Pickup
   Determines the level of fault current that will actuate a trip with no time delay.

Ground Fault (G)

6. Ground Fault Pickup
   Determines the level of fault current at which the ground fault trip delay countdown is actuated.
7. Ground Fault Delay
   Determines the amount of time the breaker will carry a ground fault before tripping.
   a. Flat Response
      I^2t out: For coordination with other circuit breakers with electronic ground fault settings.
   b. I^2t Response
      I^2t in: For coordination with zero sequence ground fault relays, fuses and thermal-magnetic breakers.

Feeder Breakers—General

Circuit breakers for feeder circuit protection may be manually or electrically operated, with long and short delay or long delay and instantaneous type trip devices, and trip settings, as required for the specific circuit and load requirements.

General purpose feeder breakers, such as for lighting circuits, are usually equipped with long delay and short delay trip devices, with the long delay pickup set for the maximum load demand in the circuit. Where arcing fault protection is required, add instantaneous trip with setting as low as practicable consistent with inrush requirements. As an option, the Arcflash Reduction Maintenance System can be selected for increased arc flash protection during maintenance.

Motor Starting Feeder Breakers

These breakers are usually electrically operated, with long delay, short delay and instantaneous tripping characteristics for motor running, locked rotor and fault protection. The breaker sensor rating should be chosen so that the long delay pickup can be set at 125% of motor full load current for motors with a 1.15 service factor, or at 115% for all other motors. Contactors are recommended for this application when circuit breaker duty cycle is exceeded.

Repetitive Duty

Repetitive breaker opening and closing, such as in frequent motor starting and stopping, are covered by ANSI standards C37.13 and C37.16. These standards list the number of operations between servicing (adjusting, cleaning, lubrication, tightening and so on) and the total numbers of operations under various conditions without requiring replacement of parts, for the various breaker frame sizes.

For motor starting duty, with closing starting currents up to 600% and opening running currents up to 100% of the breaker frame size, at 80% power factor or higher, the endurance or total operations (not requiring parts replacement) will be as follows:

800 A Frame: 1400 operations
1600 A Frame: 400 operations

The frequency of operation should not exceed 20 starts in 10 minutes or 30 in one hour.

Group Motor Feeder Breakers

Typical loads for such circuits are motor control centers. The feeder breakers may be either manually or electrically operated as preferred, and are usually equipped with long and short delay trip protection only for coordination with the individual motor circuit devices. The minimum long delay pickup setting should be 115% of the running current of the largest motor in the group, plus the sum of the running circuits of all other motors.

Zone Selective Interlocking

Zone selective interlocking provides positive system coordination by allowing the breaker closest to the fault to trip without any preset time delays. This is achieved by setting up the distribution system as shown in **Figure 26.1-8**. The hardwired connection between the trip units sends a restraining signal upstream, allowing the breaker closest to the fault to act instantaneously. Zone selective interlocking also reduces stress on the distribution system by isolating faults without time delays.

By definition, a selectively coordinated system is one where by adjusting trip unit pickup and time delay settings, the circuit breaker closest to the fault trips first. The upstream breaker serves two functions: (1) backup protection to the downstream breaker and (2) protection of the conductors between the upstream and downstream breakers. These elements are provided for on Digitrip trip units.

For faults that occur on the conductors between the upstream and downstream breakers, it is ideally desirable for the upstream breaker to trip with no time delay. This is the feature provided by zone selective interlocking. Digitrip trip units include this option.

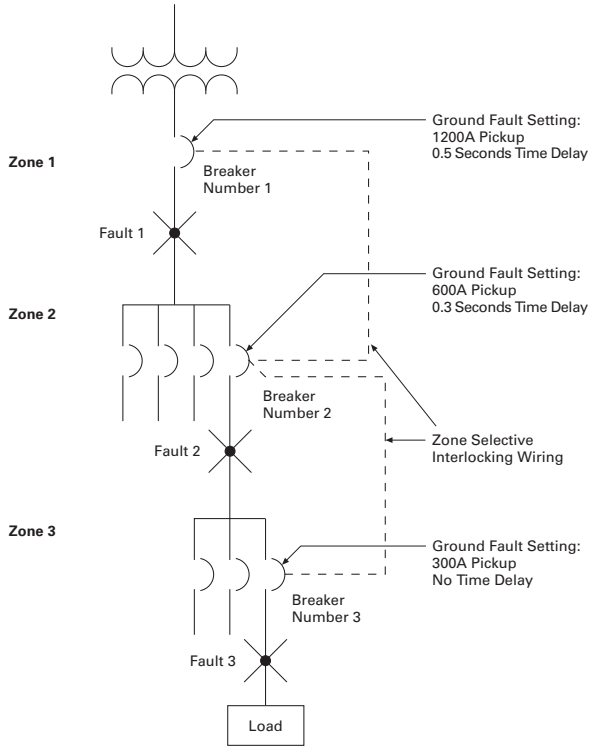
Zone selective interlocking is a communication signal between trip units applied on upstream and downstream breakers. Each trip unit must be applied as if zone selective interlocking were not employed, and set for selective coordination.

During fault conditions, each trip unit that senses the fault sends a restraining signal to all upstream trip units. This restraining signal results in causing the upstream trip to continue timing as it is set. In the absence of a restraining signal, the trip unit trips the associated breaker with no intentional time delay, minimizing damage to the fault point. This restraining signal is a very low level. To minimize the potential for induced noise, and provide a low impedance interface between trip units, twisted pair conductors are used for interconnection.

Ground fault and short delay pickup on Digitrip trip units have zone selective interlocking.

Zone selective interlocking may be applied as a type of bus differential protection. It must be recognized; however, that one must accept the minimum pickup of the trip unit for sensitivity.

It must also be recognized that not all systems may be equipped with zone selective interlocking. Systems containing multiple sources, or where the direction of power flow varies, require special considerations, or may not be suitable for this feature. Digitrip zone interlocking has been tested with up to three levels with up to 20 trip units per level.



Fault 1

There are no interlocking signals. The main breaker trip unit will initiate the trip instantaneously.

Fault 2

The feeder breaker trip unit will initiate the trip instantaneously to clear the fault; and Zone 2 will send an interlocking signal to the Zone 1 trip unit. The Zone 1 trip unit will begin to time out, and in the event that the feeder breaker in Zone 2 would not clear the fault, the main breaker in Zone 1 will clear the fault in 0.5 seconds.

Fault 3

The branch breaker trip unit will initiate the trip instantaneously to clear the fault; and Zone 3 will send an interlocking signal to the Zone 2 trip unit; and Zone 2 will send an interlocking signal to Zone 1.

Zone 1 and Zone 2 trip units will begin to time out, and in the event that the branch breaker in Zone 3 would not clear the fault, the feeder breaker in Zone 2 will clear the fault in 0.3 seconds. Similarly, in the event that the feeder breaker in Zone 2 would not clear the fault, the main breaker in Zone 1 will clear the fault in 0.5 seconds.

Figure 26.1-8. Zone Selective Interlocking

Table 26.1-7. Magnum DS and SB Breaker Control Device Application Guide—Vdc

Breaker Control Device Nominal Voltage		24 Vdc	32 Vdc	48 Vdc	125 Vdc	250 Vdc
Shunt Trip (ST)	Trip circuit		—			
Operational voltage range	70–110%	17–26 Vdc		34–53 Vdc	77–138 Vdc	154–275 Vdc
Power consumption (inrush)	(required for 35 ms)	250 watts		250 watts	450 watts	450 watts
Opening time	Seconds	35 ms		35 ms	35 ms	35 ms
Spring Release (SR)	Close circuit		—			
Operational voltage range	70–110%	17–26 Vdc		34–53 Vdc	77–138 Vdc	154–275 Vdc
Power consumption (inrush)	(required for 200 ms)	250 watts		250 watts	450 watts	450 watts
Closing time	Seconds	35 ms		35 ms	35 ms	35 ms
Spring Charge Motor (MOT)			—			
Operational voltage range	85–110% voltage	20–26 Vdc		41–53 Vdc	94–138 Vdc	187–275 Vdc
Amps (running)	Running	16.0 A		7.5 A	3.0 A	1.3 A
Amps (inrush)	% of running	200%		600%	600%	600%
Power consumption		400 watts		400 watts	400 watts	350 watts
Charging time	Seconds	2.5 sec		2.5 sec	2.5 sec	2.5 sec
Undervoltage Release (UVR)						
Operational voltage range	85–110% voltage	20–26 Vdc	27–35 Vdc	41–53 Vdc	94–138 Vdc	187–275 Vdc
Drop-out voltage range	30–60% voltage	7–14 Vdc	10–19 Vdc	14–29 Vdc	33–75 Vdc	66–150 Vdc
Power consumption (inrush)	Required for 200 ms	250 watts	275 watts	275 watts	450 watts	450 watts
Power consumption (continuous)	Required for 400 ms	18 watts	15 watts	18 watts	10 watts	10 watts
Opening time	Seconds	70 ms	70 ms	70 ms	70 ms	70 ms
Auxiliary Switches			—			
Minimum load						
Contact rating	Inductive load	0.5 A		0.5 A	0.5 A	0.25 A

Table 26.1-8. Compact Spring Charge Motor

Breaker Control Device Nominal Voltage		24 Vdc	48 Vdc	110–125 Vdc	220–250 Vdc	110–127 Vac	208–240 Vac	208–277 Vac
Spring Charge Motor (MOT)								
Operational voltage range	85–110% voltage	20–26 Vac	41–53 Vac	94–138 Vac	187–275 Vac	94–140 Vac	177–264 Vac	177–305 Vac
Amps (running)	Running	6.0 A	3.0 A	1.0 A	0.6 A	1.0 A	0.75 A	1.10 A
Amps (inrush)	% of running	600%	600%	1200%	800%	600%	667%	500%
Power consumption	Watts or VA	150 VA	150 VA	150 VA	150 VA	150 VA	180 VA	300 VA
Charging time	Seconds	5.5 sec	5.5 sec	5.5 sec	5.5 sec	5.5 sec	5.5 sec	3.5 sec

Table 26.1-9. Magnum DS and SB Breaker Control Device Application Guide—Vac

Breaker Control Device Nominal Voltage		120 Vac	240 Vac	415 Vac	480 Vac	600 Vac
Shunt Trip (ST)	Trip circuit			—	—	—
Operational voltage range	70–110%	77–140 Vac	146–264 Vac			
Power consumption (inrush)	(Required for 35 ms)	450 VA	450 VA			
Opening time	Seconds	35 ms	35 ms			
Spring Release (SR)	Close circuit			—	—	—
Operational voltage range	70–110%	77–140 Vac	146–264 Vac			
Power consumption (inrush)	(Required for 200 ms)	450 VA	450 VA			
Closing time	Seconds	35 ms	35 ms			
Spring Charge Motor (MOT)				—	—	—
Operational voltage range	85–110% voltage	93–140 Vac	177–264 Vac			
Amps (running)	Running	2.0 A	1.0 A			
Amps (inrush)	% of running	600%	600%			
Power consumption	Watts or VA	250 VA	250 VA			
Charging time	Seconds	5 sec	5 sec			
Undervoltage Release (UVR)						
Operational voltage range	85–110% voltage	94–140 Vac	177–264 Vac	323–457 Vac	408–528 Vac	510–660 Vac
Drop-out voltage range	30–60% voltage	33–76 Vac	62–144 Vac	114–249 Vac	144–288 Vac	180–360 Vac
Power consumption (inrush)	Required for 200 ms	450 VA	400 VA	480 VA	400 VA	400 VA
Power consumption (continuous)	Required for 400 ms	10 VA	10 VA	10 VA	10 VA	10 VA
Opening time	Seconds	70 ms	70 ms	70 ms	70 ms	70 ms
Auxiliary Switches				—	—	—
Minimum load						
Contact rating	Inductive load	10 A	10 A			

Legend:

LS	Limit Switch for Closing Spring
MOT	Motor for Spring Charging
ST	Shunt Trip ①
SR	Spring Release
UVR	Undervoltage Release
OTS	Overcurrent Trip Switch

Description of Operation:

1 — Motor is energized through LS contact.
2 — Motor runs and charges closing spring.
3 — When closing spring is fully charged, LS contacts change state.
4 — Close contacts energize SR coil.
5 — When breaker closes, "b" opens.
6 — LS contacts change state and motor recharges closing springs.

* Contacts shown for breaker open (not fully charged), not tripped.

- - - - Dotted line denotes Magnum Breaker.

① Continuous Duty Shunt Trip also available that eliminates the requirement for the "a" contact cutout switch.

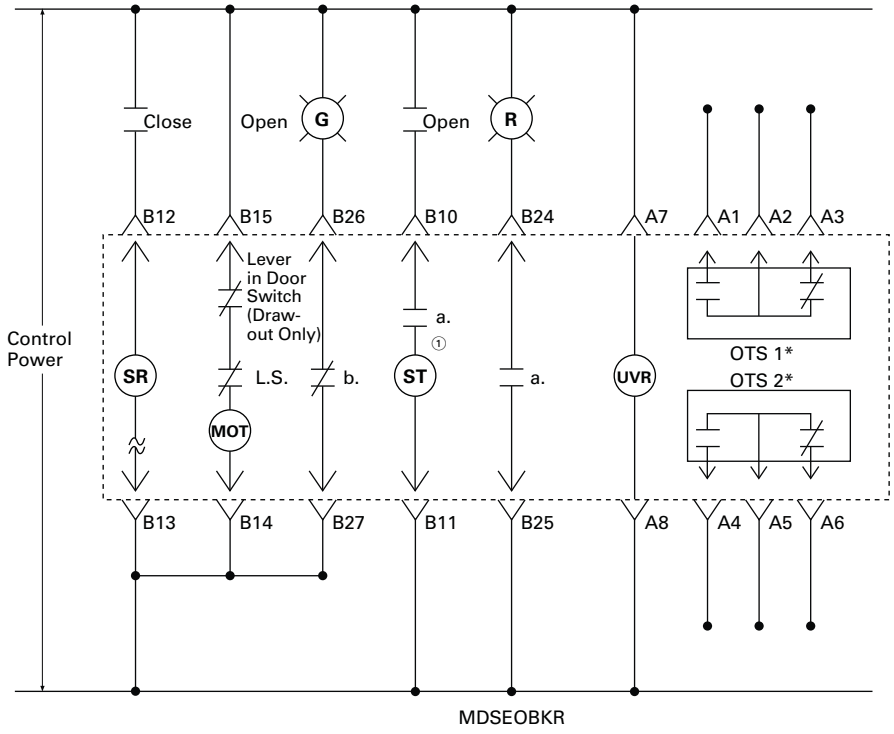


Figure 26.1-9. Typical Magnum Breaker Control Circuit Diagram

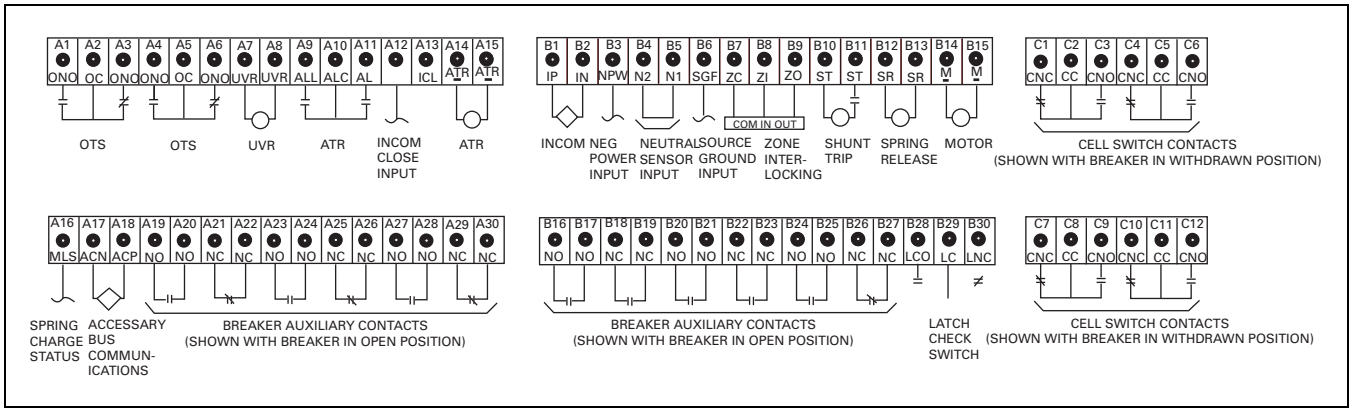


Figure 26.1-10. Typical Magnum Secondary Terminal Block Connection Diagram

Applications

Transformer Main Secondary Breakers

Transformer secondary breakers are required or recommended for one or more of the following purposes:

1. To provide a one-step means of removing all load from the transformer.
2. To provide transformer overload protection in the absence of an individual primary breaker, and/or when primary fuses are used.
3. To provide the fastest clearing of a short circuit in the secondary main bus.
4. To provide a local disconnecting means, in the absence of a local primary switch or breaker, for maintenance purposes.
5. For automatic or manual transfer of loads to alternate sources, as in double-ended secondary selective unit substations.
6. For simplifying key interlocking with primary interrupter switches.
7. To satisfy NEC service entrance requirements when more than six feeder breakers are required.

Main secondary breakers must have adequate interrupting and continuous current ratings. They should be able to carry continuously not only the anticipated maximum continuous output of the transformer, but also any temporary overloads.

For a fully selective system, instantaneous protection on main breakers should be defeated, as they typically cannot be coordinated with downstream devices.

Maximum capabilities of transformers of various types, can be found in **Tab 14** It will be noted that the maximum ratings will often require the substitution of larger frame main breakers than those listed in the tables. Even if a self-cooled transformer only is considered, it should be remembered that with ratings of 750 kVA and higher, provision for the future addition of cooling fans is automatically included. It is recommended that the main breaker have sufficient capacity for the future fan-cooled rating, plus an allowance for overloads, if possible, particularly because load growth cannot always be predicted.

The same considerations should be given to the main bus capacities and main current transformer ratios.

Bus Sectionalizing (Tie) Breakers

The minimum recommended continuous current rating of bus sectionalizing or tie breakers, as used in double-ended secondary selective unit sub-stations, or for connecting two single-ended substations, is one-half that of the associated main breakers. It is common practice to select the tie breaker of the next frame size below that of the main breakers. However, many users and engineers prefer that the tie breaker be identical to and interchangeable with the main breakers, so that under normal conditions it will be available as a spare main breaker.

In general, the tie breaker, like the main breaker, trip unit should have its instantaneous tripping defeated.

Generator Breakers

In most applications where generators are connected through breakers to the secondary bus, they are used as emergency standby sources only, and are not synchronized or paralleled with the unit substation transformers. Under these conditions, the interrupting rating of the generator breaker will be based solely on the generator kVA and sub-transient reactance. This reactance varies with the generator type and rpm, from a minimum of approximately 9% for a two-pole 3600 rpm turbine driven generator to 15% or 20% or more for a medium or slow speed engine type generator. Thus the feeder breakers selected for the unit substation will usually be adequate for a standby generator of the same kVA as the transformer.

Most generators have a 2-hour 25% overload rating, and the generator breaker must be adequate for this overload current. Selective type long and short delay trip protection only is usually recommended for coordination with the feeder breakers, with the long delay elements set at 125% to 150% of the maximum generator current rating for generator protection.

In the case of two or more paralleled generators, anti-motoring reverse power relays (device 32) are recommended for protection of the prime movers, particularly piston type engines. For larger generators requiring a Magnum MDS-632 or larger, voltage-restraint type overcurrent relays (device 51V) are recommended.

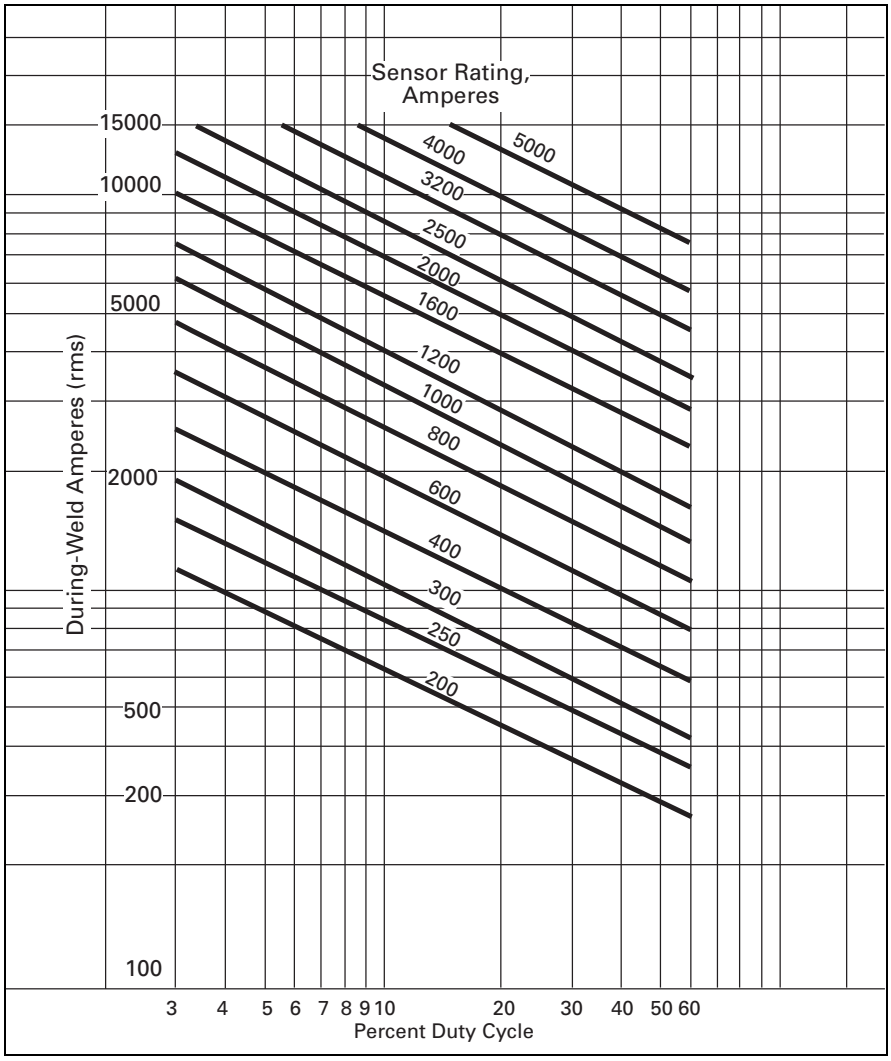


Figure 26.1-11. Magnum DS Breaker Sensor Selection Guide for Resistance Welding Applications

Resistance Welding

The application of Eaton's Magnum DS circuit breakers to resistance welding circuits is shown in **Figure 26.1-11** of the Sensor Selection Guide. Sensor ratings only are given; the breaker frame must be selected as required for interrupting ratings.

The Magnum DS microprocessor-based true rms sensing devices have a thermal memory and are well suited for this service. The thermal memory functions prevent exceeding the breaker and cable maximum permissible thermal energy level. The circuit also replicates time dissipation of thermal energy.

The size of the thermal memory is 30 T $(I_n / I_n)^2$ unit amperes^2 seconds. It fills at a rate of $(i_w / I_n)^2$ unit amperes^2 seconds/second, trips at 30T seconds, and empties at the rate of $(I_n / I_n)^2$ unit amperes^2 seconds/second, where:

T = Long time delay setting in seconds (range is 2–24 seconds)

i_w = rms value of the welding current in amperes

I_n = Rating plug current value in amperes

The memory is filled during the weld and empties during the non-welding period of the duty cycle.

These welding applications are based on long delay and instantaneous trip devices with the following settings. The long time delay setting is based on the weld amperes and duty cycle. Instantaneous trip setting is two times the average weld amperes (weld amperes times percent duty cycle) or higher.

Note: Making Current Release (MCR) may prevent closing the breaker during a welding cycle.

Magnum Peripheral Devices

Modbus Translator Module (mMINT)

Modbus Translator Module

The mMINT (Modbus Master INCOM Network Translator) is a DIN mounted accessory that facilitates communication with a Modbus RTU Network and as many as 32 Digitrip 520MC and 1150+ trip units or other INCOM communications devices by passing Modbus registers transparently between the two networks.

Time Delay Undervoltage (TDUVR)

Time Delay Undervoltage

The Magnum time delay undervoltage is a DIN mounted accessory device applied in concert with a Magnum, Series C® or Series G® breaker mounted instantaneous UVR to provide an adjustable time delay ride-through on a temporary loss of voltage. Selectable time delay settings are 0.1, 0.5, 1 and 2 seconds. Models are available for 120 Vac and 230 Vac applications.

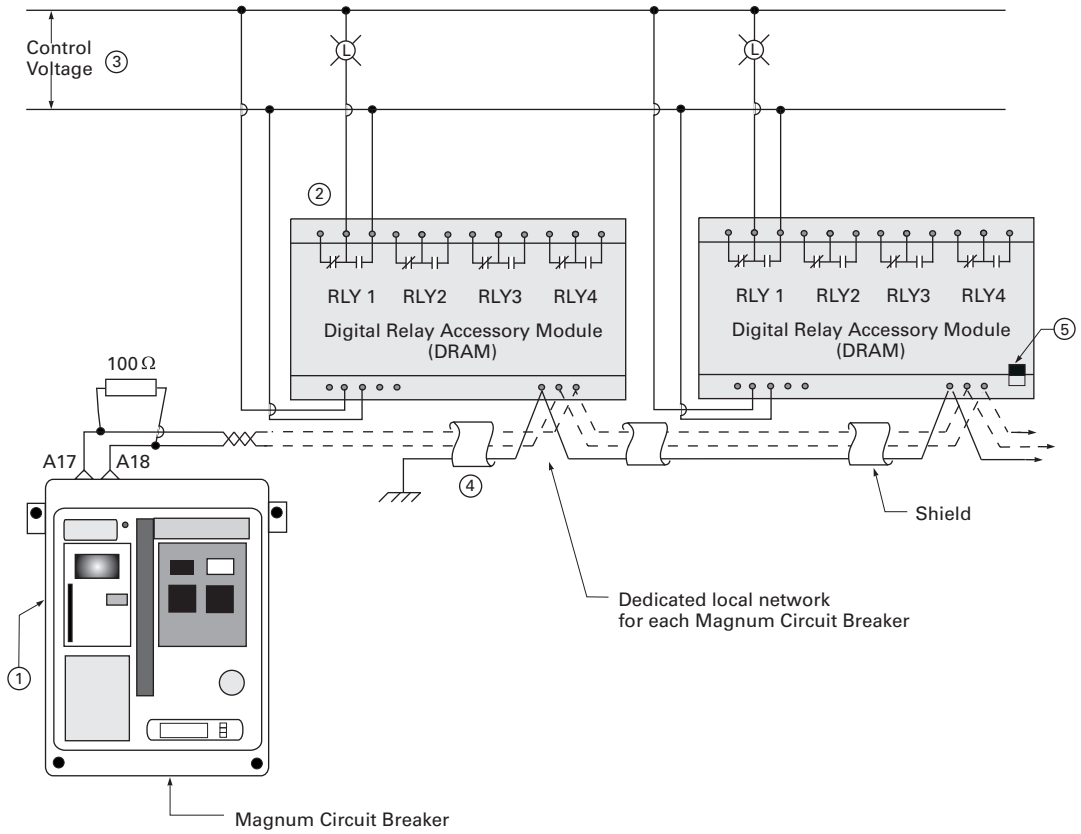
Other Protocol Translators

To facilitate diverse communications from INCOM to other protocols, Eaton offers a host of translator devices including MINTII (RS-232), EtherNet (Power Xpert Gateway), Modbus (mMINT), PROFIBUS DP (PMINT) and others. Contact Eaton for the status of other communication technologies.

Digital Relay Accessory Module (DRAM)

Digital Relay Accessory Module

The DRAM is a DIN mounted accessory device with four Form C contacts that can be programmed by the Digitrip 1150+ for indication of any combination of the following conditions: auxiliary switch, INST, SDT, LDT, GndT, GFAlm, HLAlm, DEADman and others using the trip unit communications bus function.



① The Digitrip 1150 front panel is used to program the external module for any combination of the following: Aux Switch, Bell Alarm, INST, SDT, LDT, GndT or GFAlm, HLAlm, DEADman, WATCHDOG, ALARM (the Alarm relay tracks the function of the Aux Relay A programming).
② Each module has four relays. Each relay has a Form C contact with each having a rating of 10A max at 250 Vac. (Maximum of four DRAM Modules per circuit breaker–two shown in illustration.)
③ Control voltage is 120 Vac ±20% or 48–125 Vdc.
④ Communication cable is C-H style 2A957805G01 or Belden 9463 cable.
⑤ Set switch up to insert 100 ohm terminating resistor on last relay of network.

Figure 26.1-12. Digitrip Relay Accessory Module Diagram

Accessories and Peripheral Devices

Levering Tool

Levering Tool

Magnum drawout breakers are designed for closed door manual levering by use of a standard 3/8-inch (10 mm) drive set, which is a commonly available tool. This eliminates the need for a unique levering device, which tends to get lost if not properly stored.

Magnum Remote Racking Device

Magnum Breaker Remote Racking Device

Eaton's MRR1000 remote racking device provides a means of remotely inserting or removing any drawout circuit breaker in the Magnum DS and SB family of air circuit breakers (ACBs), to help mitigate arc flash exposure. The MRR1000 permits the operator to remotely open and close a breaker from up to 25 feet away during the rack-in or rack-out process, a distance well beyond the arc flash boundary for traditional LV switchgear.

- 120 Vac power supply (with plug)
- Works with all breakers in the Magnum family (MDS, MDN, SBS, SBN and CM52 network protectors)
- Locking fixture mounts directly to Magnum breaker escutcheon
- 25-foot umbilical cord between the operator and the device
- Hand-held pendant with OPEN/CLOSE and IN/OUT pushbuttons, with ENABLE button
- Ready lights indicating power to the unit and pendant
- Safety interlock prevents operation of unit until it is safely locked in place
- Complete racking in 25 seconds or less
- Handles for ease of installation
- Works on new and existing Magnum breakers without the need for any modifications to doors, breakers or structures

MRR1000 Connected to Magnum Breaker

Universal Remote Power Racking System (Type RPR-2)

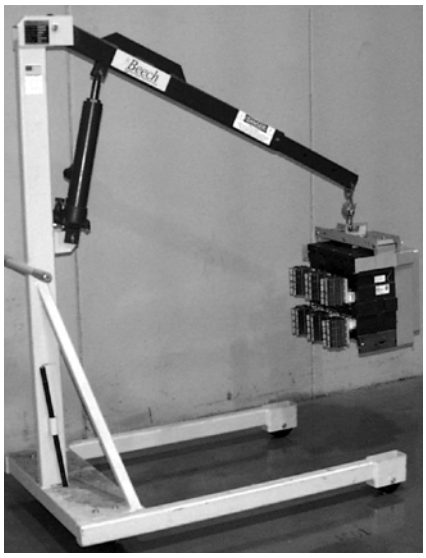
Remote Power Racking System

For maximum safety during drawout breaker levering operations, the universal remote power racking system (RPR-2) can be employed on Magnum, as well as other drawout low- and medium-voltage power circuit breakers that use rotation of a shaft for insertion or removal. Remote control is accomplished by an operator pendant with an INSERT and REMOVE pushbutton station and a 25-foot connecting cable. The RPR-2 requires 120 Vac, 15 A power from a common plug receptacle. Status indication and selectable torque limitation matched to the breaker racking mechanism are also provided.

Lifting Yoke and Floor Lifting Device

Magnum breakers include lifting ears on each side to accept a lifting yoke (or suitable sling) to facilitate lifting using a skyhook from a top of gear lifter, floor lifter or crane. Various lifting yoke style numbers are available for all Magnum frame types in both three-pole and four-pole configurations.

A roll-on-the-floor lifting device style number 6727D63H20 is equipped with a skyhook for use in conjunction with a breaker lifting yoke or suitable sling to lift the breaker from above. Shelf-type roll-on-the-floor lifters can also be used to lift the breaker from underneath without a lifting yoke.



Floor Lifting Device

Test Cabinet

The test cabinet is a separately mounted device with open and close pushbuttons that facilitates bench testing of electrically operated Magnum breakers. An input power cord is provided for connection to a 120 Vac, 15 A plug receptacle. The test cabinet output power is matched to the breaker control voltage(s) and is connected to the breaker via a cord that plugs into the breaker secondary contacts.

Hand-Held Functional Test Kit

Hand-Held Test Kit

A secondary injection hand-held test kit catalog number MTST120V or MTST240V is available to functionally test Magnum and Series G breakers equipped with Digitrip trip units. The kit includes test cords and faceplate templates to match the breaker being tested, and an auxiliary power module. This test kit functionally confirms proper operations at the minimum trip unit settings.

Auxiliary Power Module

The auxiliary power module catalog number PRTAAPM120V or PRTAAPM240V plugs into the receptacle located in the front of the trip unit to power the display and/or communications functions during bench testing. An input power cord is provided for connection to a 120 Vac or 230 Vac source.

Secondary Injection Test Kit

A test kit style number MTK2000 is available for secondary injection testing of Magnum breakers with Digitrip trip units. This test kit functionally confirms proper operation at all trip unit settings. Test reports can be downloaded to a PC via a removable SD card.

TripLink

TripLink style number 5720B59G01 enables the downloading of the trip unit protection settings and circuit data from one Digitrip 1150+ trip unit to another, which saves time during startup and maintenance.

TripLink is a means of transferring settings from one circuit breaker to another. TripLink transfers all protection settings and time and date, and the circuit breaker's circuit data. The transfer of these settings may be useful for cloning a lineup of circuit breakers, cloning a circuit breaker's settings for replacing the circuit breaker with its clone for maintenance purposes, or for making common settings for a test program.

TripLink Transfer

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Series NRX Breaker with Power Xpert Release (PXR) Trip Units

Series NRX with PXR—NF Frame

Series NRX with PXR—RF Frame

Power Xpert Release Trip Unit

General Description

Series NRX circuit breakers—a major breakthrough of minor proportions.

The Series NRX NF frame provides the performance of a power circuit breaker—up to 1200 A and 65 kA interruption capacity at 480 Vac—in the compact size of a molded-case breaker. It offers all the protection, features and flexibility you would expect in an air circuit breaker, in a compact footprint. The RF frame expands protection capabilities up to 3000 A with an interruption capacity of 100 kA at 480 Vac.

In today's commercial, facilities, data centers or manufacturing environment, space for new and retrofit equipment is a precious commodity. When building space is at a premium, or when system upgrading requires additional functionality, the compact size and broad capabilities of the Series NRX make it the right choice for the applications.

The Series NRX is available with a variety of connection options (see **Table 26.2-2**), which give you the ability to efficiently lay out distribution equipment. It is important in switchboards that breakers are easily accessible for maintenance, inspection and operation. The cassette design allows you to inspect parts without removing the cassette from the switchboard cell. The design of the breaker and cassette enables full use of the breaker handle and cassette rails with a gloved hand, allowing electricians to remain in the appropriate PPE protective gear.

PXR Series NRX UL 489 breakers feature the innovative Power Xpert Release (PXR) trip units. PXR trip units are available with a wide variety of protection, metering and monitoring options including the Arcflash Reduction Maintenance System™, 1% accurate current and voltage metering, and a variety of serial communication options.

Series NRX breakers with Power Xpert Release (PXR) trip units are UL 489 listed insulated-case circuit breakers. They are tested to 20,000 and 10,000 mechanical operations for the NF and RF, respectively. This is significantly higher than industry standards①, required for equivalent products on the market. All Series NRX breakers are UL Listed to carry 100% of the nameplate amperage rating continuously in an enclosure. All this ensures long, reliable operation and reduces maintenance requirements.

Series NRX accessories can be quickly installed at the job site without any special tools. Each breaker comes standard with an accessory tray with the necessary accessories to simply plug and lock an accessory into the tray.

The breaker handle's ergonomic design also maximizes functionality and leverage. For a manually charged breaker, seven strokes completely charges the breaker quickly and easily, making it easier to cycle when needed during commissioning or scheduled maintenance.

① UL 489: For $I_n \leq 2500$ A, mechanical ops =2500, For $I_n > 2500$, mechanical ops = 1500. IEC60947-2: For $I_n \leq 2500$ A, mechanical ops =3000, For $I_n > 2500$, mechanical ops = 2000.

Technical Data

Table 26.2-1. UL 489 Ratings

Frame Amperes	Breaker Type Catalog Number	Frame Type	rms Symmetrical Current Ratings kA 50/60 Hz					Poles Available	Available Trip Rating (Establishes Breaker I_n Rating) ③
			Interrupting at 240 Vac	Interrupting at 480 Vac	Interrupting at 600 Vac	30 Cycle Short-Time Withstand Rating ①	Instantaneous Override (Equivalent Symmetrical rms, kA) ②		
NF Frame—UL 489									
800	**NYR4-08**	NF-R	50	42	42	16 x I_n	16 x I_n	3, 4	200, 250, 300,
	NYR5-08	NF-R	65	50	42	16 x I_n	16 x I_n	3, 4	400, 500, 600,
	NYR6-08	NF-R	85	65	42	16 x I_n	16 x I_n	3, 4	800
1200	**NYR4-12**	NF-R	50	42	42	16 x I_n	16 x I_n	3, 4	200, 250, 300,
	NYR5-12	NF-R	65	50	42	16 x I_n	16 x I_n	3, 4	400, 500, 600,
	NYR6-12	NF-R	85	65	42	16 x I_n	16 x I_n	3, 4	800, 1200
NF Frame—UL 489 with High Short-Time (30 Cycle) Withstand Capabilities									
800	**NYS4-08**	NF-S	50	42	42	42	42	3, 4	200, 250, 300,
	NYS5-08	NF-S	65	50	42	42	42	3, 4	400, 500, 600,
	NYS6-08	NF-S	85	65	42	42	42	3, 4	800
1200	**NYS4-12**	NF-S	50	42	42	42	42	3, 4	200, 250, 300,
	NYS5-12	NF-S	65	50	42	42	42	3, 4	400, 500, 600,
	NYS6-12	NF-S	85	65	42	42	42	3, 4	800, 1200
RF Frame—UL 489									
800	**RYR5-08**	RF- R	65	65	—	16 x I_n	16 x I_n	3, 4	800
	RYR8-08	RF- R	85	85	—	16 x I_n	16 x I_n	3, 4	
	RYRC-08	RF- R	100	100	—	16 x I_n	16 x I_n	3, 4	
1200	**RYR5-12**	RF- R	65	65	—	16 x I_n	16 x I_n	3, 4	800, 1200
	RYR8-12	RF- R	85	85	—	16 x I_n	16 x I_n	3, 4	
	RYRC-12	RF- R	100	100	—	16 x I_n	16 x I_n	3, 4	
1600	**RYR5-16**	RF- R	65	65	—	16 x I_n	16 x I_n	3, 4	800, 1200,
	RYR8-16	RF- R	85	85	—	16 x I_n	16 x I_n	3, 4	1600
	RYRC-16	RF- R	100	100	—	16 x I_n	16 x I_n	3, 4	
2000	**RYR5-20**	RF- R	65	65	—	16 x I_n	16 x I_n	3, 4	800, 1200,
	RYR8-20	RF- R	85	85	—	16 x I_n	16 x I_n	3, 4	1600, 2000
	RYRC-20	RF- R	100	100	—	16 x I_n	16 x I_n	3, 4	
2500	**RYR5-25**	RF- R	65	65	—	16 x I_n	16 x I_n	3, 4	800, 1200,
	RYR8-25	RF- R	85	85	—	16 x I_n	16 x I_n	3, 4	1600, 2000,
	RYRC-25	RF- R	100	100	—	16 x I_n	16 x I_n	3, 4	2500
3000	**RYR5-30**	RF- R	65	65	—	16 x I_n	16 x I_n	3, 4	800, 1200,
	RYR8-30	RF- R	85	85	—	16 x I_n	16 x I_n	3, 4	1600, 2000,
	RYRC-30	RF- R	100	100	—	16 x I_n	16 x I_n	3, 4	2500, 3000
RF Frame—UL 489 with High Short-Time (30 Cycle) Withstand Capabilities									
800	**RYS6-08**	RF-S	65	65	—	65	—	3, 4	800
	RYS8-08	RF-S	85	85	—	65	65	3, 4	
	RYSC-08	RF-S	100	100	—	65	65	3, 4	
1200	**RYS6-12**	RF-S	65	65	—	65	—	3, 4	800, 1200
	RYS8-12	RF-S	85	85	—	65	65	3, 4	
	RYSC-12	RF-S	100	100	—	65	65	3, 4	
1600	**RYS6-16**	RF-S	65	65	—	65	—	3, 4	800, 1200,
	RYS8-16	RF-S	85	85	—	65	65	3, 4	1600
	RYSC-16	RF-S	100	100	—	65	65	3, 4	
2000	**RYS6-20**	RF-S	65	65	—	65	—	3, 4	800, 1200,
	RYS8-20	RF-S	85	85	—	65	65	3, 4	1600, 2000
	RYSC-20	RF-S	100	100	—	65	65	3, 4	
2500	**RYS6-25**	RF-S	65	65	—	65	—	3, 4	800, 1200,
	RYS8-25	RF-S	85	85	—	65	65	3, 4	1600, 2000,
	RYSC-25	RF-S	100	100	—	65	65	3, 4	2500
3000	**RYS6-30**	RF-S	65	65	—	65	—	3, 4	800, 1200,
	RYS8-30	RF-S	85	85	—	65	65	3, 4	1600, 2000,
	RYSC-30	RF-S	100	100	—	65	65	3, 4	2500, 3000

① UL 489 does not require a short-time withstand rating for breakers. The UL 489 Series NRX breakers have instantaneous override fixed at 22.5 x I_n (asymmetrical peak value). An equivalent symmetrical RMS value would roughly equate to 16 x I_n.

② A 30-cycle withstand option is available for Series NRX breakers to provide better selectivity.

③ No change of hardware is required, trip rating can be programmed using I_n Programming Tool Kit.

Table 26.2-2. Circuit Breaker Dimensions in Inches (mm) and Weights in lb (kg)

Description	Height		Width		Depth		Weight	
Frame	**NF**	**RF**	**NF**	**RF**	**NF**	**RF**	**NF**	**RF**
Fixed—Rear Connect								
Three-pole	13.31 (338.0)	15.65 (397.6)	8.25 (209.6)	13.22 (334.0)	7.16 (181.8)	11.51 (292.4)	45 (20)	120 (55)
Four-pole	13.31 (338.0)	15.65 (397.6)	11.00 (279.4)	19.41 (492.9)	7.15 (181.6)	11.51 (292.4)	62 (28)	155 (71)
Fixed—Front Connect								
Three-pole	15.99 (406.3)	—	8.25 (209.6)	—	7.16 (181.8)	—	45 (20)	120 (55)
Four-pole	15.99 (406.3)	—	11.00 (279.4)	—	7.15 (181.6)	—	62 (28)	155 (71)
Drawout								
Three-pole	14.17 (359.9)	17.96 (456.1)	10.00 (254.0)	15.67 (397.9)	10.50 (266.7)	14.48 (367.8)	87 (40)	211 (96)
Four-pole	14.17 (359.9)	17.96 (456.1)	12.75 (323.9)	18.06 (458.7)	10.50 (266.7)	14.48 (367.8)	109 (50)	258 (117)

Table 26.2-3. PXR Adjustable Trip Settings

Time/Current Characteristic	Pickup Setting	Pickup Point ①	Time Band, Seconds
Long delay	0.4, 0.5, 0.6, 0.7, 0.75, 0.8, 0.9, 0.95, 0.98, 1.0	I_n times long delay setting	6 x (I_r): 0.5, 1, 2, 4, 7, 10, 12, 15, 20, 24
Instantaneous	Off, 2, 4, 5, 6, 7, 8, 10, 12, 15	I_n times instantaneous setting	—
Short delay	1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 10	I_r times short delay setting	8 x (I_r) I^2t: 0.1, 0.3, 0.4, 0.5 Flat response: 0.0, 0.1, 0.2, 0.3, 0.4, 0.5
Ground fault	Off, 0.2, 0.4, 0.6, 0.8, 1.0	I_n times ground fault setting	0.625 x (I_n) I^2t: 0.1, 0.2, 0.3, 0.4, 0.5 Flat response: 0.1, 0.2, 0.3, 0.4, 0.5

① I_n = Maximum continuous current rating
I_r = Long delay pickup setting x I_n

Accessories

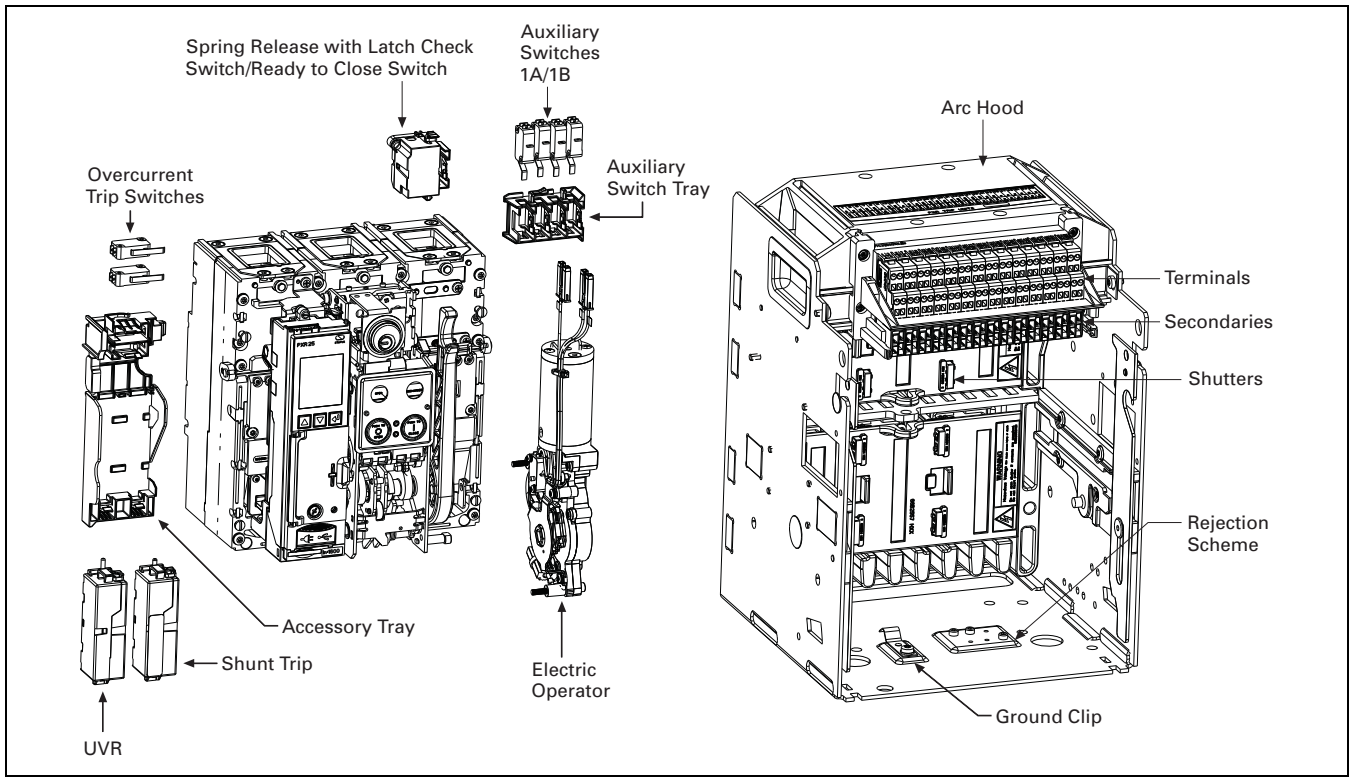

Figure 26.2-1. Breaker, Cassette and Accessories

Table 26.2-4. Undervoltage Release Ratings

Control Voltages	Frequency	Operational Voltage Range 85%–110%	Dropout Voltage Range 35%–60%	Inrush/Continuous Power Consumption (VA)	Opening Time (ms)—NF	Opening Time (ms)—RF
24	DC	20–26	8–14	425/2	25	37
48	DC	41–53	17–29	750/3	25	37
60	DC	51–66	21–36	825/4	25	37
110–127	50–60 Hz	94–140	44–66	1150/8	25	37
110–125	DC	94–138	44–66	1150/8	25	37
208–240	50–60 Hz	177–264	84–125	1200/8	25	37
220–250	DC	187–275	88–132	1200/8	25	37

Table 26.2-5. Spring Release Ratings

Control Voltages	Frequency	Operational Voltage Range 85%–110%	Inrush Power Consumption (VA)	Closing Time (ms)—NF	Closing Time (ms)—RF
24	DC	20–26	400	20	35
48	DC	41–53	500	20	35
60	DC	51–66	500	20	35
110–127	50–60 Hz	94–140	750	20	35
110–125	DC	94–138	750	20	35
208–240	50–60 Hz	177–264	800	20	35

Table 26.2-6. Motor Operator Ratings

Control Voltages	Frequency	Operational Voltage Range 85%–110%	Running Current (A)	Typical Inrush Current	Power Consumption (VA)	Maximum Charging Time (sec)
NF						
24	DC	20–26	6	325%	160	4
48	DC	41–53	3	500%	150	3
60	DC	51–66	2	350%	150	4
110–127	50–60 Hz	94–140	2	300%	280	3
110–125	DC	94–138	1	500%	150	3
208–240	50–60 Hz	177–264	1	1000%	280	4
220–250	DC	187–275	1	1000%	280	4
RF						
24	DC	20–26	7	350%	200	6
48	DC	41–53	3	450%	175	6
60	DC	51–66	2	450%	225	6
110–127	50–60 Hz	94–140	3	300%	425	6
110–125	DC	94–138	2	375%	275	6
208–240	50–60 Hz	177–264	1.5	300%	400	6
220–250	DC	187–275	1	400%	250	6

Table 26.2-7. Control Voltages and Currents

Control Voltages	24 Vdc	48 Vdc	60 Vdc	110–125 Vdc	110–127 Vac	220–250 Vdc	208–240 Vac
Current							
Close current (inrush)	14	10	8	7	7	4	4
Shunt trip current (ST)—(inrush/continuous)	16/0.08	10/0.06	8/0.07	7/0.07	7/0.07	4/0.04	4/0.04
NF—Charge motor current (inrush/continuous)	20/6	15/3	7/2	5/1	6/2	10/1	10/1
RF—Charge motor current (inrush/continuous)	23/7	14/3	14/3	8/2	9/3	4/1	5/1.5
Operating Voltage Rating							
Close	20–26	41–53	51–66	94–138	94–140	187–275	177–264
Open	17–26	34–53	42–66	77–138	77–140	154–275	146–264
Charge—NF	20–26	41–53	51–66	94–138	94–140	187–275	177–264
Charge—RF	26–26	41–53	51–66	94–138	94–140	187–275	177–264

Table 26.2-8. Overcurrent Trip Switch Ratings

Control Voltages	Frequency	Contact Rating (Amperes)
250	50–60 Hz	10
125	DC	0.5
250	DC	0.25

Table 26.2-9. Auxiliary Switch

Control Voltages	Frequency	Contact Rating (Amperes)
250	50–60 Hz	10
125	DC	0.5
250	DC	0.25

Table 26.2-10. Shunt Trip Ratings

Control Voltages	Frequency	Operational Voltage Range 70%–110%	Inrush/Continuous Power Consumption (VA)	Opening Time (ms)—NF	Closing Time (ms)—RF
24	DC	17–26	400/2	15	22
48	DC	34–53	500/3	15	22
60	DC	42–66	500/4	15	22
110–127	50–60 Hz	77–140	800/8	15	22
110–125	DC	77–138	800/8	15	22
208–240	50–60 Hz	146–264	850/8	15	22

NF Control Circuit Terminal Assignment

1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55
+ ST1	+ UV1	OT1C	OT1B	ACCY2	N1	ALMC	ALM2	G1	+24V	ZIN	ZCOM	CMM1	CMM3	PTVA	PTVC	MODBA	MODBG	ACCY5	ACCY7	EO1	SR1	C1	B1	C2	C3	B3	C4
- ST2	- UV2	OT1M	ACCY1	ACCY3	N2	ALM1	ALM3	G2	AGND	ARMSIN	ZOUT	CMM2	CMM4	PTVB	PTVN	MODBB	ACCY4	ACCY6	SC	EO2	SR2	A1	B2	A2	A3	B4	A4
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56

1, 2 - Shunt trip
3, 4 - UVR/2nd shunt trip
5~7 - Overload trip switch 1 (OTS) (5-COM, 6-NO, 7-NC)
8~10 - Overload trip switch 2 (OTS)/Remote reset (8-NC, 9-COM, 10-NO/9-RR1, 10-RR2)
11, 12 - External neutral sensor
13~16 - Alarm/Status indicating relays (13-COM)
17, 18 - Source Ground / Zero Sequence Sensing Input
19, 20 - Control voltage supply 24 Vdc
21, 23, 24 - Zone Selective Interlocking (ZSI)
20, 22 - Arcflash Reduction Maintenance System (ARMS) Remote Activation
25~28 - Communication Adapter Module (CAM) (optional)
29~32 - PT module
33~35 - Modbus RTU RS-485 Communications (standard)
36 - ACCY4 (Reserved)
37~39 - Latch check switch (37-COM, 38-NO, 39-NC
40 - Closing spring charged status contact
41, 42 - Spring Charging Motor
43, 44 - Spring Release (SR) (closing coil)
45~56 - Auxiliary contact On/off, C-COM, A-NO, B-NC

RF Control Circuit Terminal Assignment

1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47
+ ST1	+ UV1	OT1C	OT1B	OT2C	N1	ALMC	ALM2	G1	+24V	ZIN	ZCOM	CMM1	CMM3	PTVA	PTVC	MODBA	MODBG	2CMM3	2CMM1		RR1		
- ST2	- UV2	OT1M	OT2B	OT2M	N2	ALM1	ALM3	G2	AGND	ARMSIN	ZOUT	CMM2	CMM4	PTVB	PTVN	MODBB	2CMM2	2CMM4			RR2		
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48

1, 2 - Shunt trip
3, 4 - UVR/2nd shunt trip
5~7 - Overload trip switch 1 (OTS) (5-COM, 6-NO, 7-NC)
8~10 - Overload trip switch 2 (OTS) (8-NC, 9-COM, 10-NO)
11, 12 - External neutral sensor
13~16 - Alarm/Status indicating relays (13-COM)
17, 18 - Source Ground / Zero Sequence Sensing Input
19, 20 - Control voltage supply 24 Vdc
21, 23, 24 - Zone Selective Interlocking (ZSI)
20, 22 - Arcflash Reduction Maintenance System (ARMS) Remote Activation
25~28 - Communication Adapter Module (CAM) (optional)
29~32 - PT module
33~35 - Modbus RTU RS-485 Communications (standard)
36~39 - Communication Accessory Module (CAM) (optional)
40~42 - Reserved
43, 44 - Remote reset
45~48 - Reserved

49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	95
LCC	LCB	+ E01	SR1	C1	B1	C2	C3	B3	C4	C5	B5	C6	C7	B7	C8	C9	B9	C10	C11	B11	C12		
LCM	SC	- E02	SR2	A1	B2	A2	A3	B4	A4	A5	B6	A6	A7	B8	A8	A9	B10	A10	A11	B12	A12		
50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96

49~51 Latch check switch (49-COM, 50-NO, 51-NC)
52 - Closing spring charged status contact
53, 54 - Spring Charging Motor
55~56 - Spring Release (SR) (closing coil)
57~92 - Auxiliary contact On/off, C-COM, A-NO, B-NC

Power Xpert Release (PXR)

Power Xpert Release

The Power Xpert Release (PXR) trip unit, along with current sensors and a trip actuator, is the subsystem of a circuit breaker that provides the protective, monitoring and optional metering functions. The PXR analyzes signals from the current sensors and voltage connections. If current level and time delay settings are exceeded, then the PXR trip unit will trip the circuit breaker. The automatic overload and short circuit tripping characteristics for a specific circuit breaker are determined by the current rating and user selected protection settings. A wide range of adjustments of the protection allow the breaker to be coordinated and adapted to any application. External control voltage is not required for current protection functionality.

The PXR trip unit consists of two modules: the frame module and the control module. The control module contains a microcontroller that performs true rms current sensing measurements and calculations for protection. It may be replaced in the field. The frame module is matched to the ratings of the circuit breaker and permanently attached to the circuit breaker frame. It should not be removed or exchanged.

The current sensors are internal to the circuit breaker frame and consist of two coils: one coil on an iron core and one coil on an air core (Rogowski coil). As current begins to flow through the circuit breaker, the iron core coil generates a secondary current that powers the trip unit.

At the same time, the air core coil provides signals that are processed to determine the current through the circuit breaker. The mechanical action required to initiate tripping of the circuit breaker is provided by a special low-energy trip actuator. This trip actuator is an integral part of the circuit breaker mechanism that enables fast tripping of the circuit breaker. The trip actuator is automatically reset by the mechanism.

Standards and Certifications

The PXR trip units are listed by Underwriters Laboratories Inc. (UL) and Canadian Standards Association (CSA) for use in Series NRX NF and Series NRX RF circuit breakers. All PXR units have also passed the IEC 60947-2 test program that includes EMC testing. All trip units meet the low-voltage and EMC directives and carry the CE mark.

PXR Protection Settings/Features

In traditional to the list, **Table 26.2-11** and **Table 26.2-12** highlight a summary of the PXR 20 and PXR 25 features.

- Long Delay Pickup and Time Setting
- Long Delay Slope Selection
- Long Delay Thermal Memory
- Short Delay Pickup and Time Settings
- Instantaneous Pickup Setting
- Ground Fault Setting/Sensing: Ground Fault Pickup, Ground Fault Time, Ground Fault Thermal Memory, Ground Fault Relay, Residual Current Sensing, Source Ground Sensing, Zero Sequence Sensing
- High Instantaneous
- Making Current Release (MCR)
- Zone Selective Interlocking (ZSI)
- Alpha Numeric Dot Matrix digital display (all models)
- Health menu
- Native Modbus RTU communications (optional on PXR20 / standard on PXR25). Optional Communication Access Modules (CAM) are available for other serial communication protocols or when open/close control of the breaker is required across serial communications
- Maintenance Mode: The PXR trip units support Eaton's Arcflash Reduction Maintenance System, also referred to as Maintenance Mode. When enabled, the trip unit will trip the breaker with an accelerated trip time whenever the configured pickup level is exceeded. The Maintenance Mode function operates regardless of the Instantaneous settings. If Maintenance Mode causes the circuit breaker to trip, the "INST" indicator will be illuminated and the "ARMS Trip" message will be displayed (if auxiliary power is present)

Table 26.2-11. Trip Unit Summary Features

Feature	PXR 20	PXR 25
Programmable rating plugs	■	■
Ground Fault with On/Alarm/Off settings (optional)	■	■
High resolution LCD display with Current Bar Graph Display	■	■
Comprehensive diagnostics (breaker health, trip info) with health bar graph	■	■
Zone Selective Interlocking (ZSI) with indication of input signal for testing	■	■
Waveform Capture	Current only	Current and voltage
Current metering (IA, IB, IC, IN, IG, min./max.)	■	■
Modbus RTU native to the breaker	Optional	■
Dual port communication option with CAM module	■	■
Internal secondary injection testing capabilities	■	■
(3) Standard auxiliary alarm relays	■	■
Arcflash Reduction Maintenance System (local and remote) optional	■	■
Voltage metering (Line-to-Line, Line-to-Neutral, min./max.)		■
Power metering—Real (kW), Apparent (kVA) and Reactive (kvar)		■
Power Demand metering—Real (kW), Apparent (kVA) and Reactive (kvar)		■
Peak Demand metering—Real (kW), Apparent (kVA) and Reactive (kvar)		■
Energy metering—Real (kWh), Apparent (kVAh), Reactive (kvarh), forward/reverse/net		■
Power Factor		■

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Table 26.2-12. PXR Trip Units for Series NRX ANSI/UL Rated Circuit Breakers

				
Trip Unit Type			**PXR 20**	**PXR 25**
Protection and Coordination				
Protection	Styles		LSI, LSIG, LSIG, LSI	LSI, LSIG, LSIA, LSI, LSIG, LSIA
	Fixed rating plug (I_n)		Yes	Yes
	Overtemperature trip		Yes	Yes
Long delay protection (L)	Slope		I^2t, I^4t, $I^{0.5}t$, It	I^2t, I^4t, $I^{0.5}t$, It
	Long Delay Pickup (I_r)	x (I_n)	0.4, 0.5, 0.6, 0.7, 0.75, 0.8, 0.9, 0.95, 0.98, 1.0	0.4, 0.5, 0.6, 0.7, 0.75, 0.8, 0.9, 0.95, 0.98, 1.0
	Long Delay Time at 6 x (I_r)	Seconds	0.5, 1, 2, 4, 7, 10, 12, 15, 20, 24 ①	0.5, 1, 2, 4, 7, 10, 12, 15, 20, 24 ①
	Thermal Memory		Included	Included
	High Load Alarm	% x (I_r)	Fixed Level 85%	Fixed Level 85%
Short delay protection (S)	Short Delay Slope		Flat, I^2t	Flat, I^2t
	Short Delay Pickup	x (I_r)	1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 10	1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 10
	Short Delay Time at 8 x (I_r) I2t	Seconds	0.1, 0.3, 0.4, 0.5	0.1, 0.3, 0.4, 0.5
	Short Delay Time Flat	Seconds	0.0, 0.1, 0.2, 0.3, 0.4, 0.5	0.0, 0.1, 0.2, 0.3, 0.4, 0.5
	Zone Interlock		Enable/Disable	Enable/Disable
Instantaneous protection (I)	Instantaneous	x (I_n)	Off, 2, 4, 5, 6, 7, 8, 10, 12, 15	Off, 2, 4, 5, 6, 7, 8, 10, 12, 15
Ground (earth) fault protection (Option G)	Ground Fault Pickup	x (I_n) ②	Off, 0.2, 0.4, 0.6, 0.8, 1.0	Off, 0.2, 0.4, 0.6, 0.8, 1.0
	Ground Fault Alarm	x (I_n)	0.2, 0.4, 0.6, 1.0	0.2, 0.4, 0.6, 1.0
	Ground Fault Delay at 0.625 x (I_n) I^2t	Seconds	0.1, 0.2, 0.3, 0.4, 0.5	0.1, 0.2, 0.3, 0.4, 0.5
	Ground Fault Delay Flat	Seconds	0.1, 0.2, 0.3, 0.4, 0.5	0.1, 0.2, 0.3, 0.4, 0.5
	Zone Interlock		Enable/Disable	Enable/Disable
	Thermal Memory		Included	Included
Disable ground fault protection			Yes	Yes
Neutral protection (N)			Yes (Off, 100, 200%)	Yes (Off, 100, 200%)
System Diagnostics				
Cause-of-trip LEDs			Yes (control power or battery)	Yes (control power or battery)
Magnitude of trip information			Yes	Yes
Remote signal contacts			Yes	Yes
System Monitoring				
Digital display			Yes, alpha numeric dot matrix	Yes, alpha numeric dot matrix
Current (%)			Yes, ±1% of reading	Yes, ±1% of reading
Voltage (%) L to L			No	Yes, ±1% of reading
Apparent power kVA and kvar demand			No	Yes
Reactive power			No	Yes
Power factor			No	Yes
System Communications				
Type			Optional ③	Yes ③
USB configuration and test port			Yes	Yes
Power supply			+24 Vdc	+24 Vdc
Additional Features				
Trip log			Yes	Yes
Electronic operations counter			Yes	Yes
Testing method ③			PC/laptop and aux. power	PC/laptop and aux. power
ZSI testing capability			Yes	Yes
Waveform capture			Yes (only current)	Yes (current and voltage)
Arcflash Reduction Maintenance System			Yes	Yes
Breaker health monitor			Yes	Yes
Programmable alarm/status relays (quantity 3)			Yes	Yes

① If I^4T slope is selected, not all times are available. Consult time-current curves.

② Ground fault pick-up is limited to 1200 A maximum in ANSI/UL frames to comply with standards.

③ Native Modbus RTU communications is optional for PXR20 and standard for PXR25. Optional Communication Adapter Modules available for both PXR20 and PXR25: (PROFIBUS, Modbus RTU, INCOM, Ethernet (Web Server, TCP IP, http(s), Modbus TCP, SMTP Mail).

Legend: I_n = I_n Programming Tool Kit.
I_r = Long Delay Pickup setting.

Power Xpert Protection Manager

Eaton's Power Xpert Protection Manager (PXPM) is a Microsoft® Windows®-based software that configures, controls and tests Eaton PXR 20/25 trip units. The PXPM software and PXR trip unit, in conjunction, are designed to make it easier for OEMs and end customers to access breaker load and usage information, conduct diagnosis and troubleshooting activities, configure settings, as well as validate and perform testing.

Installation

System Requirements

Hardware requirements:

- Eaton PXR 20/25 trip unit
- USB to Micro-USB cable
- Auxiliary power module (Catalog Number: PRTBAPMDV)

Software requirements:

- Microsoft Windows 7 (32-bit or 64-bit)
- Adobe® Acrobat® Reader (version 5 or higher)

Screen resolution:

- 1280x1024 pixels or higher resolutions

To download the software, go to the link http://www.eaton.com/SeriesNRX. Please click on product "Series NRX NF and RF frame Low-Voltage Power Circuit Breakers with PXR electronic trip units". The PXPM download link will be found on the Features tab.

Using the PXPM Software

Upon starting PXPM, the user will be presented with the main dashboard shown in **Figure 26.2-2**. This dashboard allows users to navigate a range of capabilities varying from configuring trip unit settings to performing remote control and test functions. **Figure 26.2-3** shows a summary of which capabilities are contained in each path of PXPM's main dashboard.

Figure 26.2-2. PXPM Main Dashboard

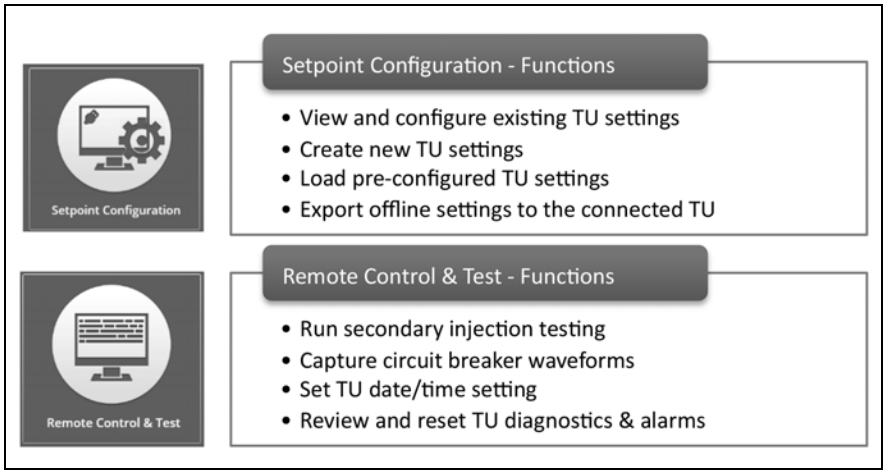


Figure 26.2-3. Summary of PXPM Capabilities

A summary of PXPM capabilities and features include:

- Perform Secondary Injection Testing, no test kit required
- Zone Selective Interlocking testing
- Printable field reports
- Factory acceptance testing
- Waveform capture for troubleshooting and diagnostics
- Time Current Curve (TCC) by setting
- Set point storage
- Easy to navigate through graphical interfaces
- Program Settings Wizard

Overview—Secondary Injection Testing

With PXPM, secondary injection testing becomes as simple as plugging a USB cord from a laptop to the PXR and performing the test. **Figure 26.2-4** shows how to set up a secondary injection test through PXPM.

- Choose desired x I_n, test amperage and breaker function
- Hovering over the x I_n value will display its range and step value
- Auxiliary power needs to be connected to the TU in order to open the breaker during testing; otherwise, select "No"

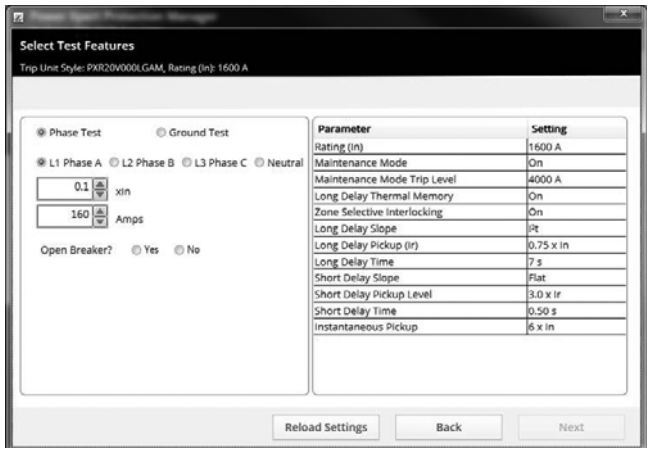


Figure 26.2-4. PXPM Secondary Injection Setup

Once all settings have been selected, the user will run the test. **Figure 26.2-5** is an example of a completed test.

- If you would like to run another test, select "Continue Testing"
- If testing is complete, select "Stop Testing"

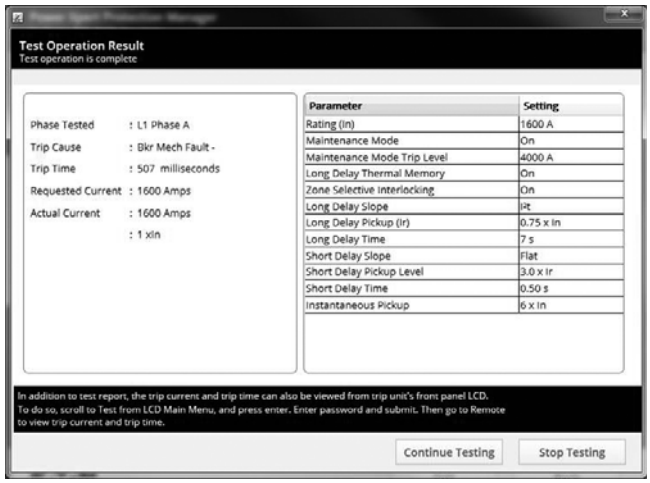


Figure 26.2-5. Example of a Completed Secondary Injection Test

After a completed test, there will be the option to continue testing or to stop testing. If the user chooses to "Stop Testing," then a prompt will occur about printing a test report (.PDF). An example of this printable test report is shown in **Figure 26.2-6**.

Power Xpert Protection Manager for PXR 20/25
Trip Units - Test Report

Created: 3/7/2016 10:05:07 AM

System		
Parameter	As Found	As Left
Timestamp	09:43:26 AM	10:04:47 AM
Rating (In)	1600 A	1600 A
Maintenance Mode	On	On
Maintenance Mode Remote Control	Disable	Disable
Maintenance Mode Trip Level	4000 A	4000 A
Line Frequency	50 Hz	50 Hz
Reverse Feed Breaker	Forward	Forward

Current Protection Configuration		
Parameter	As Found	As Left
Long Delay Thermal Memory	On	On
Zone Selective Interlocking	On	On
Long Delay Slope	I²t	I²t
Long Delay Pickup (Ir)	0.75 x In	0.75 x In
Long Delay Time	4 s	4 s
Short Delay Slope	I²t	I²t
Short Delay Pickup Level	5.0 x Ir	5.0 x Ir
Short Delay Time	0.10 s	0.10 s
Instantaneous Pickup	15 x In	15 x In
Ground Sensing Type	Residual	Residual
Local Ground Fault Protection Type Setting	Trip	Trip
Ground Fault Slope	Flat	Flat
Ground Fault Pickup	0.2	0.2
Ground Fault Trip Time	0.2 s	0.2 s
Neutral Protection Ratio	100%	100%

Figure 26.2-6. Example of Printable Test Report

Internal Secondary Injection Test

The trip unit uses an independent built-in circuit to generate a test signal that is injected into the sensor input circuit (see **Figure 26.2-7**). This test feature replaces the need for an external secondary injection test kit.

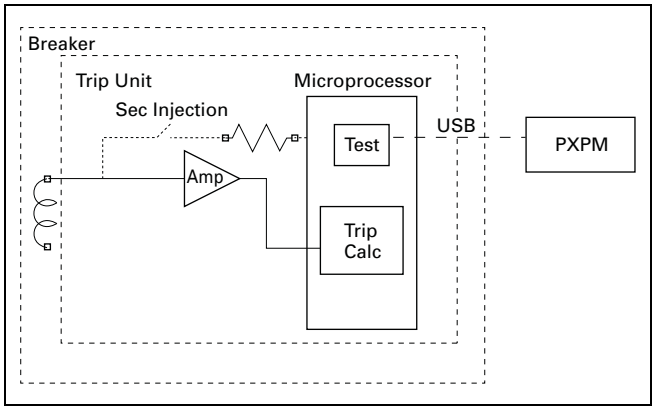


Figure 26.2-7. Sensor Input Circuit

Series NRX Breaker Communications

Native Modbus-Remote Terminal Unit (RTU) RS-485 Communication Port

A Modbus communication port is standard in the PXR 25 trip units and is available as an option on PXR 20 trip units. This native Modbus RTU capability gives access to breaker status and metering information.

Note: Breaker open/close control capability across communications requires a separate Communication Adapter Module (CAM).

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 display and navigation buttons or using PXPM software.

Table 26.2-13. Factory Defaults

Description	Factory Default	Options
Slave address	001	001 to 247
Baud rate	9600	9600 or 19,200
Parity	Even	Even, odd, none
Stop bits	1	1 or 2

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

Series NRX Breaker Communication Adapter Modules (CAMs)

The NRX circuit breakers with PXR 20/25 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. Various networks are supported by the following modules, listed with their instruction leaflet:

- ICAM—INCOM: IL0131124EN
- MCAM—Modbus RTU: IL0131091EN
- PCAM—PROFIBUS: IL0131092EN
- ECAM—ETHERNET: IL0131125EN

These modules are remotely mounted on a DIN rail and wired into the trip unit using the circuit breaker's secondary terminal block. The wiring harness as described in the module's instruction leaflet must be used. The field bus is then wired to a connection on the CAM Supported module.

An added feature of the CAMs is the option to open (using a shunt-trip) or close (using a spring release) the circuit breaker if so equipped and wired. There is also a jumper on the front of each CAM Supported module that will enable or disable the remote communication control capability. It may be desirable to put this jumper in the disable position when maintenance work or testing is being done on the circuit breaker.

Ethernet Communications Adapter Module

The Series NRX Ethernet communications Adapter Module is an accessory that operates as a communicating device in conjunction with a compatible PXR trip unit/breaker via an Ethernet network.

The Ethernet Communications Adapter Module (ECAM) provides monitoring and control of the PXR trip unit using a standard web browser. Supposed Ethernet protocols include: TCP IP, http(s), Modbus TCP and SMTP Mail. Supported functions include: Metering; Control; Alarms; Command, event and data logging; Setpoint monitoring; Alarm and logging configuration; and Breaker control.

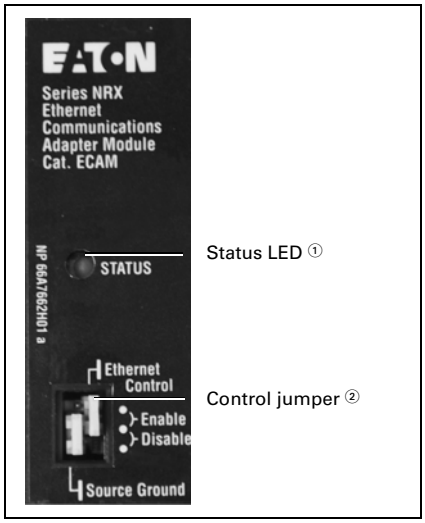


Figure 26.2-8. ECAM Communications Adapter Module (Front View—Close-Up)

Jumpers and Indicator LEDs

Refer to **Figure 26.2-8** to become familiar with specific jumper and LED locations on the ECAM.

Microcontroller LED (Status) ①

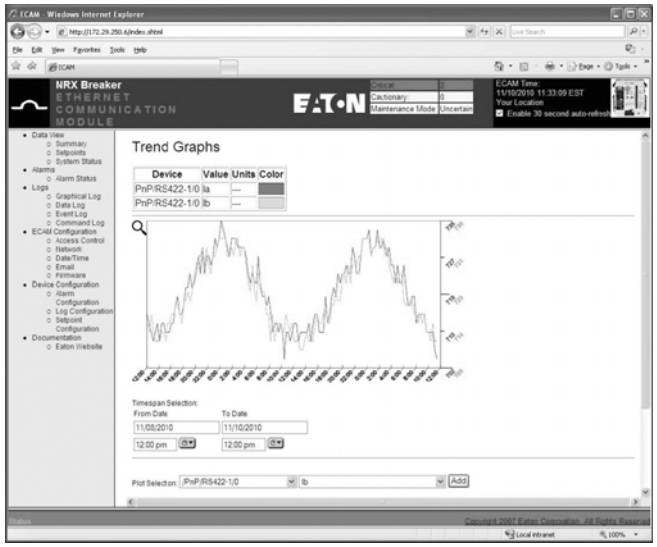
The status indicator will be flashing green when the module is powered up and the microprocessor is executing instructions. On power-up, the status LED will be red for approximately 45 seconds while the module boots. When the Series NRX Ethernet Communications Adapter Module is connected to a PXR trip unit for the first time, this LED will alternately flash red and green to signal a learning process between both units. This automatic process will take approximately 20 seconds and occurs only once during the initial startup. The LED will also flash red if the module is not connected or unable to communicate with a PXR trip unit.

Ethernet Control Jumper ②

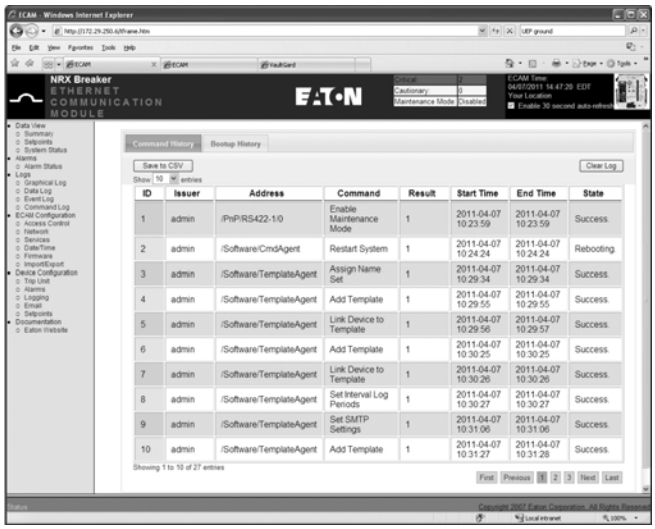
The Ethernet control jumper provides the user with a means of enabling or disabling remote communication control commands to the PXR trip unit. With the jumper placed in the "Enable" position, remote control commands, such as open, close and reset, can be executed. With the jumper in the "Disable" position, commands will not be accepted.

Data View Summary

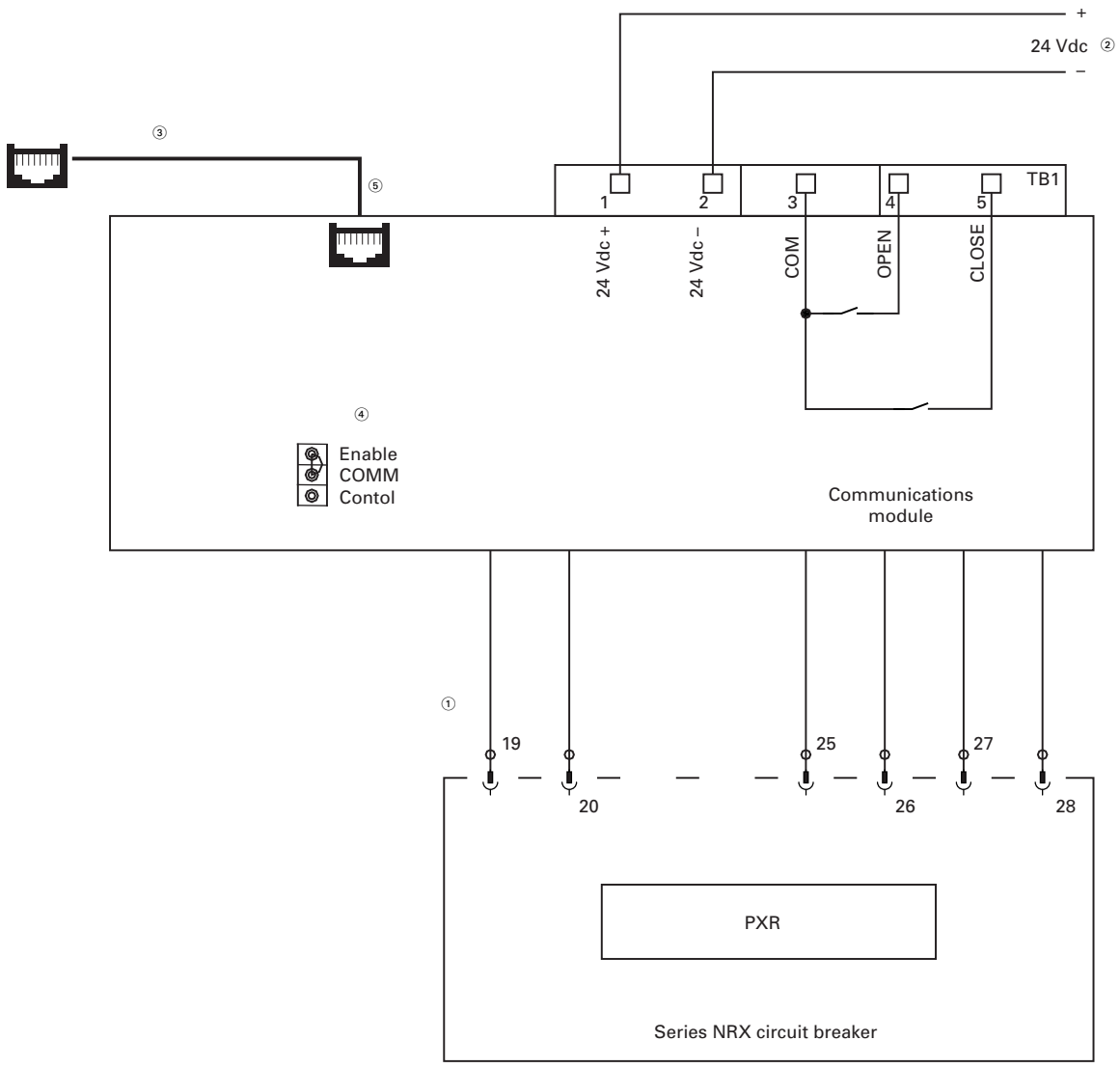
Alarm Status



Trend Graph View



Commands



① The Series NRX communication module is a separate device that snaps onto a remote mounted DIN rail.
② The communications module voltage requirement is 240 Vdc ± 10% and should be sourced from a high quality supply (6 watts is the burden of the CAM).
③ A shielded CAT5, CAT5e or CAT6 cable for 10/100 Mb/s Ethernet is recommended. The shielded cable is recommended for the best communication reliability in industrial environments. The metal jacket provides a ground to the housing on the ECAM, which is grounded to the breaker housing via the CAM ground pin. Be sure to ground the breaker housing per the instructions in the breaker IL.
④ Set the jumper on the module to enable or disable the communications control as desired.
⑤ Use shielded Ethernet cable.

Figure 26.2-9. Series NRX Ethernet Communication with PXR 20/25

Modbus Communication Adapter Module (MCAM)

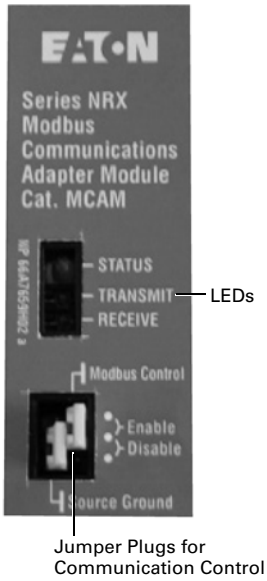
The Series NRX Modbus Communications Adapter Module (MCAM) is an accessory that will operate as a communication device in conjunction with a compatible Series NRX trip unit/breaker in a master communications network. PXR trip units are available with native Modbus RTU communications. However, an MCAM is needed if breaker open/close control is required across communications as shown in **Figure 26.2-12**.

The Modbus adapter communicates to a master on a Modbus network using the Modbus RTU (remote terminal unit) protocol. Information is exchanged through the MCAM between the Modbus master and the PXR trip unit using assigned registers.

The MCAM is a slave device and, as such, requires a master device for control command initiation. Each Modbus communications adapter module provides:

- Circuit breaker open/close/reset control
- Flashing status LED indicating module has power
- Modbus communication enable/disable selection jumper for remote open/close control
- DIN rail mounting (11 mm high, 28 mm wide, DIN rail minimum requirement)
- Input power for module from 24 Vdc

The MCAM is designed to be installed, operated and maintained by adequately trained people. These instructions do not cover all details or variations of the equipment for its storage, delivery, installation, checkout, safe operation or maintenance.



Communications Adapter Module (Front View)

MicroController LED (Status)

This indicator will be flashing green whenever the module is powered up and when the microprocessor is executing instructions. When the Series NRX MCAM is connected to a PXR trip unit for the first time, this LED will alternately flash red and green to signal a learning process between both units. This automatic process will take approximately 15 seconds and occurs only once during the initial startup. The LED will also flash red if the module is not connected to or unable to communicate with a PXR trip unit.

Modbus RS-485 Network Tx LED (Transmit)

This LED will be lit whenever the module is transmitting on the Modbus RTU network.

Modbus RS-485 Network Rx LED (Receive)

This LED will be lit whenever the module is receiving communication from the Modbus RTU network.

Modbus Control Jumper

This jumper provides the user with a means of enabling or disabling remote communication control commands to the PXR trip unit. With the jumper placed in the ENABLE position, remote Open and Close Breaker commands and Write Setpoint Registers can be acted upon. With the jumper in the DISABLE position, these commands will not be accepted.

Source/Residual Ground Selection Jumper

Consult PXR trip unit instructions (MN013003EN—Operating Manual for Series NRX PXR 20/25 Trip Unit) for further information on ground sensing. This jumper is not applicable and does not function for PXR style trip units.

Wiring Diagrams

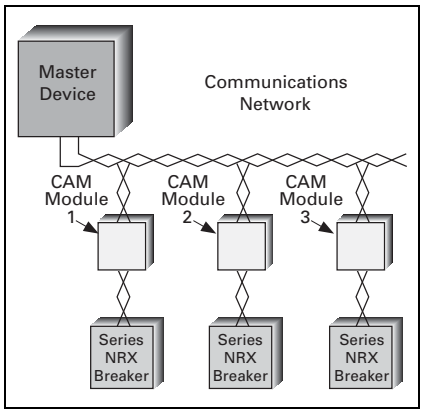
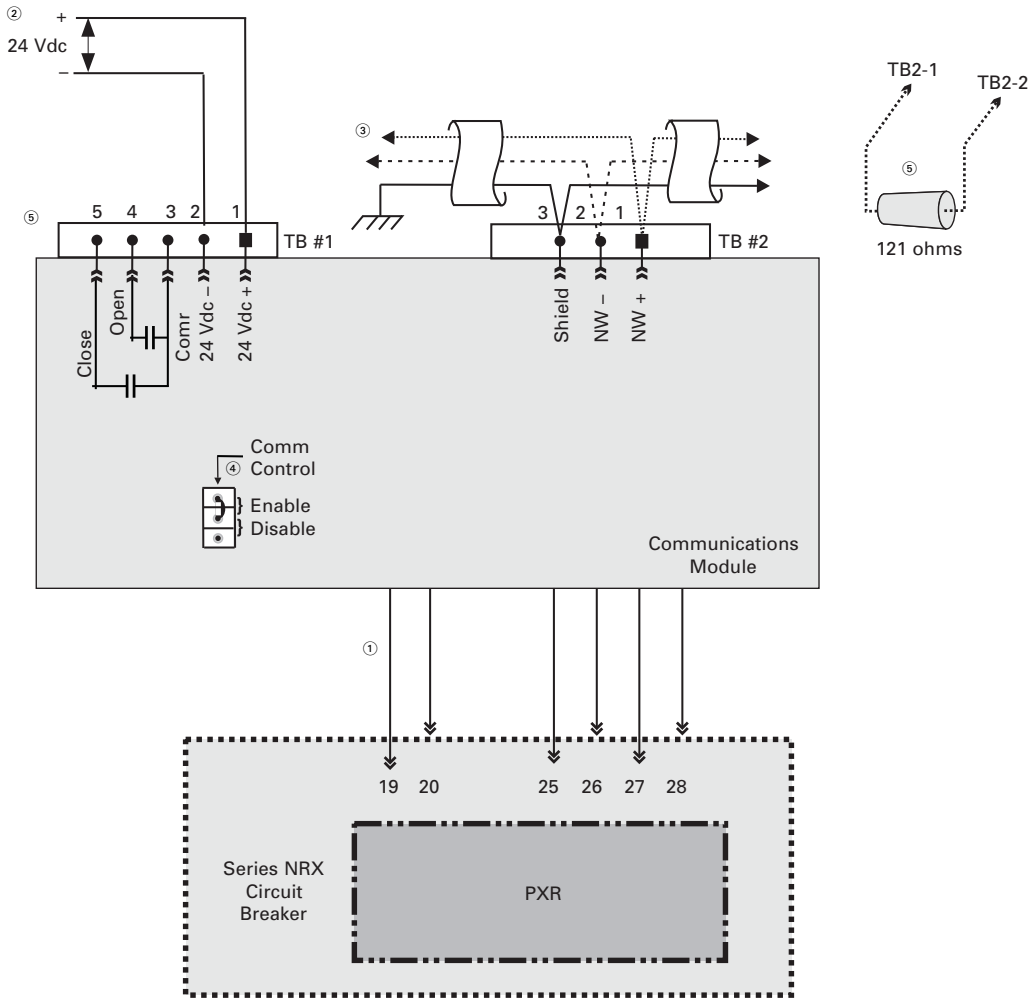
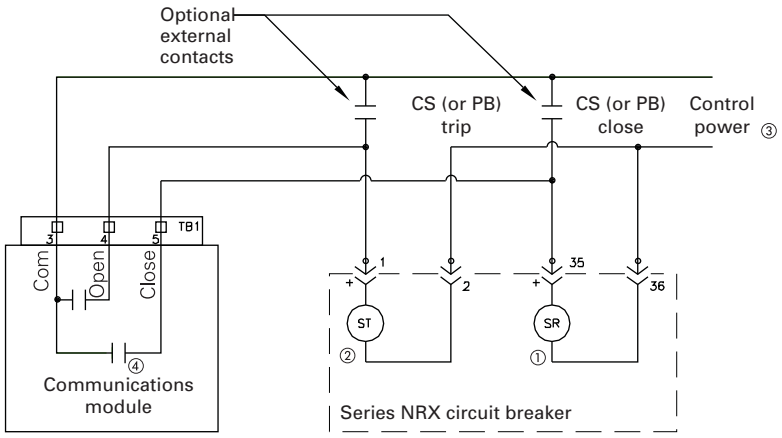


Figure 26.2-10. Modbus Communication Adapter Modules in a Modbus Network



① The Series NRX communications module is a separate device that snaps onto a remote mounted DIN rail.
② The trip unit AUX voltage is 24 Vdc ±10% and should be sourced from a reliable service.
③ Ground the shield at the master device.
④ Set the jumper on the module to enable or disable the remote open and close communication control commands, as desired.
⑤ Connectors are UL/CSA rated 300 V, VDE rated 250 V. Recommended: BL 3.5/90/5BK, Orientation: 90° lead exit, but other lead orientations are possible. Wire gauge: #18 AWG/0.82 mm.
⑥ The final device in the daisy-chain configuration must have a 121 ohms termination resistor installed across terminals #1 and #2 on TB #2.

Figure 26.2-11. Series NRX Modbus Communication with PXR



① Spring release and shunt trip wiring as shown for optional communication close or open capability.
② Choose spring release coil voltage rating as desired if communications is required.
③ Choose shunt trip voltage rating to be the same as spring release voltage rating if communication is required.
④ Control power voltage rating must match ST and SR coil voltage rating.
⑤ Close duration is two seconds on communication activation when communication control is enabled.

Figure 26.2-12. Communications Control (SR and ST Wiring)

Series NRX NF and RF Wiring Diagrams

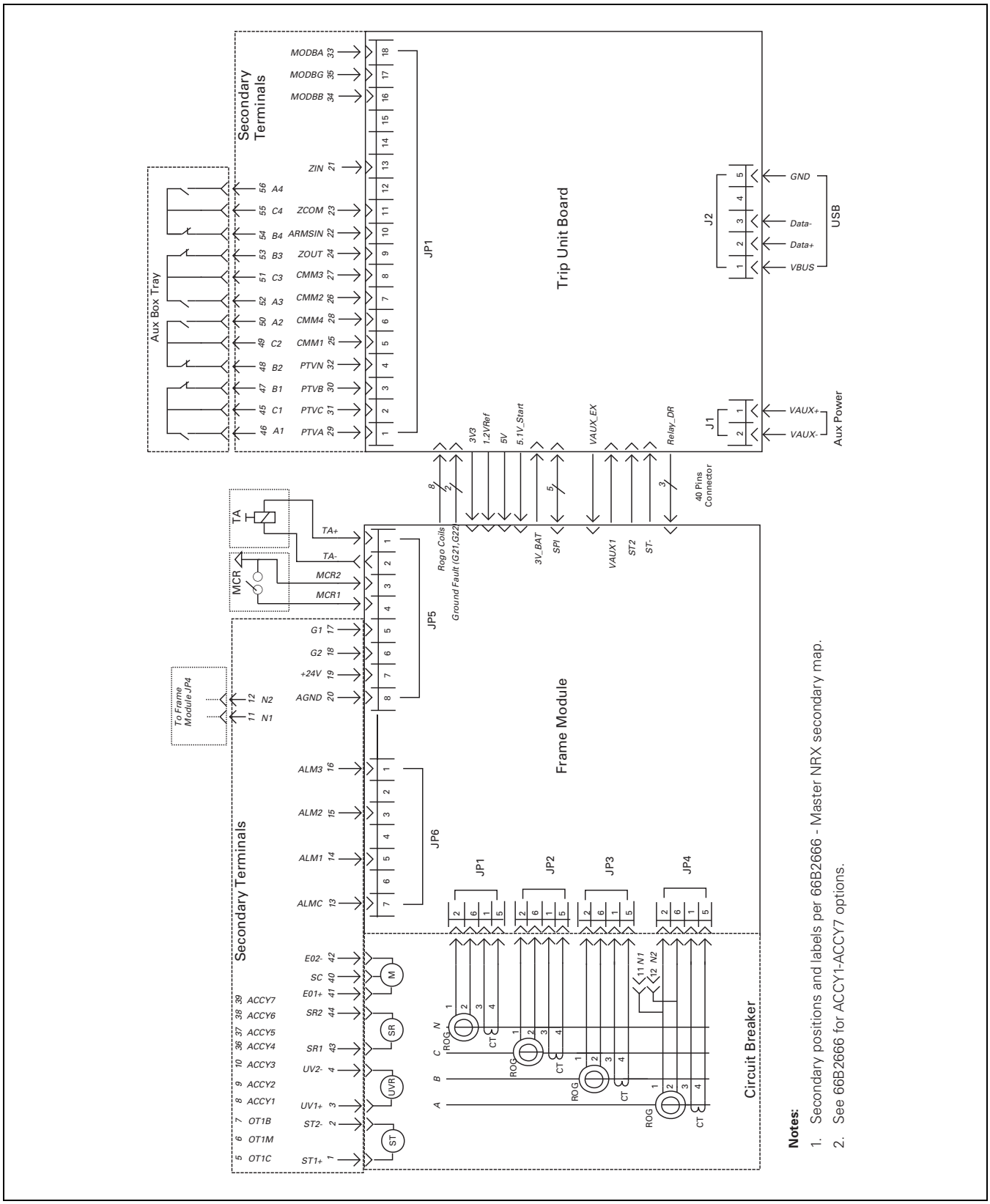


Figure 26.2-13. Typical Breaker Master Connection Diagram—Type NF Frame/IZMX16

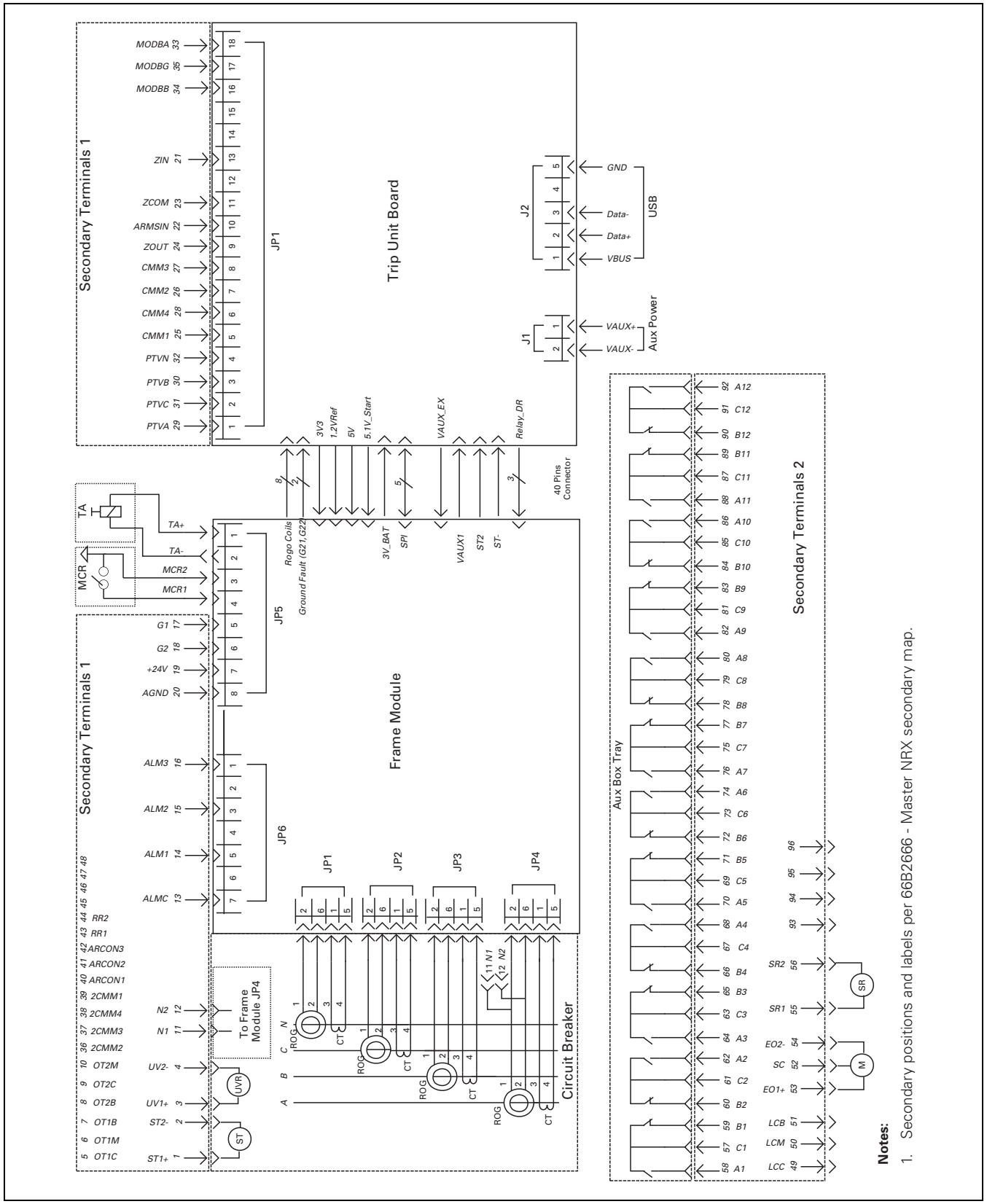


Figure 26.2-14. Typical Breaker Master Connection Diagram—Type RF Frame/IZMX40

Series NRX with Digitrip

Series NRX

General Description

Series NRX Type NF-frame with Digitrip is a low-voltage power circuit breaker suitable for UL 1558, UL 891 and IEC switchgear and switchboards. Ratings include: 800 A (UL 1066), 800 A and 1200 A (UL 489), and 630–1600 A (IEC 60947-2). The dimensions and design of the Series NRX NF-frame allows up to eight UL 1066 or UL 489 breakers in a 24-inch (600 mm) wide structure. The one frame size, regardless of ampere rating, reduces drawing conversion, structure integration time and parts inventory for several board, gear and machinery applications. The Series NRX with Digitrip utilizes an "arc chute" design, Arcflash Reduction Maintenance System, breaker-mounted communication modules, "direct drive" mechanism, Plug-n-Play accessories, and Rogowski coil to offer a life of 20,000 mechanical operations and 10,000 electrical operations with a high degree of reliability.

Technical Data

Table 26.2-14. UL 1066 Ratings

Description	Rating
Continuous current rating (amps)	800
Short-Circuit Rating (kA)	
254 Vac	85
508 Vac	65
635 Vac	42
Short-time withstand (kA)	42

Table 26.2-15. UL 489 Ratings ①

Description	Rating	
Continuous current rating (amps)	800	1200
Short-Circuit Rating (kA)		
240 Vac	85	85
480 Vac	65	65
600 Vac	42	42
Short-time withstand (kA)	42	42

① Series NRX will carry a 100% continuous rating in an enclosure in January 2016.

Table 26.2-16. IEC 60947-2 Ratings

Description	Rating					
Continuous current rating (amps)	630 and 800		1000 and 1250		1600	
Short-Circuit Rating (kA)	**Icu**	**Ics**	**Icu**	**Ics**	**Icu**	**Ics**
240/254 Vac	85	50	85	50	85	50
415/435 Vac	65	50	65	50	65	50
690/725 Vac	42	42	42	42	42	42
Short-time withstand = Icw (kA)	42	42	42	42	42	42

Table 26.2-17. Circuit Breaker Dimensions in Inches (mm) and Weights in lb (kg)

Description	Height	Width	Depth	Weight
Fixed				
Three-pole	13.18 (334.8)	8.25 (209.6)	7.15 (181.6)	33.58 (15.23)
Four-pole	13.18 (334.8)	11.00 (279.4)	7.15 (181.6)	44.40 (20.14)
Drawout with Cassette				
Three-pole	14.18 (360.2)	10.02 (254.5)	10.69 (271.5)	85.20 (38.65)
Four-pole	14.18 (360.2)	12.69 (322.3)	10.69 (271.5)	104.00 (47.17)

Table 26.2-18. Digitrip Adjustable Trip Settings

Time/Current Characteristic	Pickup Setting	Pickup Point ②	Time Band, Seconds
Long delay	0.5, 0.6, 0.7, 0.75, 0.8, 0.9, 0.95, 1.0	I_n times long delay setting	2, 4, 7, 10, 12, 15, 20, 24 (at 6 times pickup value)
Instantaneous	2, 3, 4, 6, 8, 10, 12	I_n times instantaneous setting	—
Short delay	2, 2.5, 3, 4, 5, 6, 8, 10	I_r times short delay setting	0.1, 0.2, 0.3, 0.4, 0.5 (flat response) 0.1, 0.3, 0.5 ③
Ground fault	0.25, 0.3, 0.35, 0.4, 0.5, 0.6, 0.75, 1.0 (1200 A maximum)	I_n times ground fault setting	0.1, 0.2, 0.3, 0.4, 0.5 (flat response) 0.1, 0.3, 0.5 ③

② I_n = Rating plug value
I_r = Long delay pickup setting x I_n
③ I^2t response.

Table 26.2-19. Replacement Rating Plugs Field installation rating plug on fixed or drawout breakers.

I_n of Rating Plug	Frame Size I_n (maximum)		
	630–800 A ④	1000–1250 A ④	1600 A ④
	Group A	Group B	Group C
	Catalog Number	Catalog Number	Catalog Number
200	**NA200T**	—	—
250	**NA250T**	—	—
300	**NA300T**	—	—
400	**NA400T**	**NB400T**	—
500	**NA500T**	**NB500T**	—
600	**NA600T**	**NB600T**	—
630	**NA630T** ④	**NB630T** ④	—
800	**NA800T**	**NB800T**	**NC800T**
1000	—	**NB1000T**	**NC1000T**
1200	—	**NB1200T**	**NC1200T**
1250	—	**NB1250T** ④	**NC1250T** ④
1600	—	—	**NC1600T** ④

④ IEC only (not UL listed).

Note: Rating plug must be selected based on breaker frame rating.

For time/current curves, please visit **www.eaton.com/seriesnrx**.

Accessories

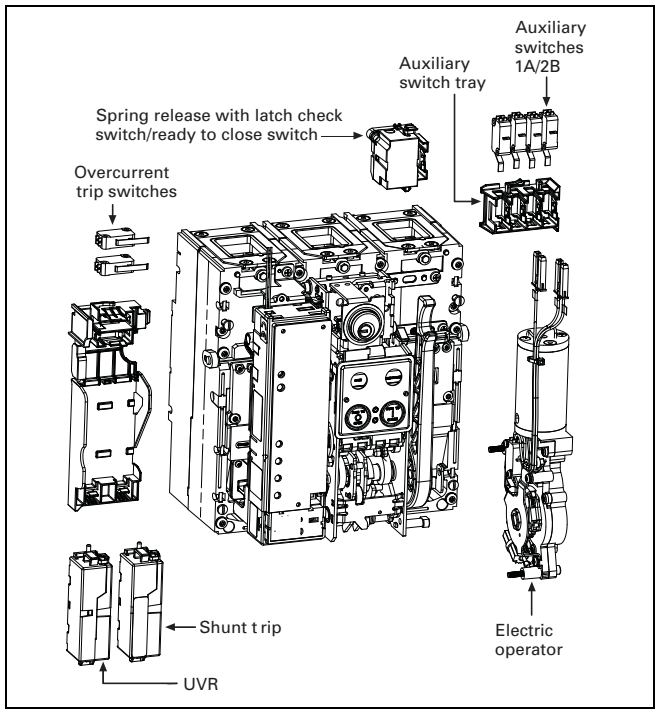


Figure 26.2-15. Breaker and Accessories

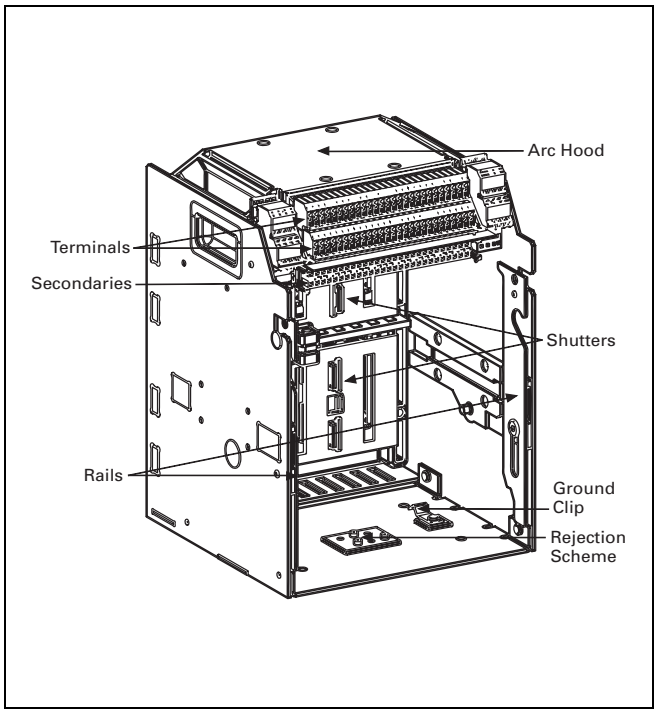


Figure 26.2-16. Cassette/Cradle Components

Table 26.2-20. Shunt Trip

Control Voltages	Frequency	Operational Voltage Range 70%–110%	Inrush/Continuous Power Consumption (VA)	Opening Time (ms)
24	DC	17–26	500/5	25
48	DC	34–53	530/5	25
110–127	5–60 Hz	77–140	540/5	25
110–125	DC	77–138	540/5	25
208–240	50–60 Hz	146–264	500/5	25
220–250	DC	154–275	515/5	25

Table 26.2-21. UVR

Control Voltages	Frequency	Operational Voltage Range 85%–110%	Dropout Volts 35%–60%	Inrush/Continuous Power Consumption (VA)	Opening Time (ms)
24	DC	20–26	8–14	500/5	50
32	DC	27–35	11–19	620/5	50
48	DC	41–53	17–29	850/5	50
110–127	50–60 Hz	94–140	44–94	890/5	50
110–125	DC	94–138	44–94	890/5	50
208–240	50–60 Hz	177–264	84–125	910/5	50
220–250	DC	187–275	88–132	910/5	50
380–415	AC	323–457	145–228	960/5	50
480	AC	408–528	168–288	800/8	50
600	AC	510–660	210–360	800/12	50

Table 26.2-22. Spring Release

Control Voltages	Frequency	Operational Voltage Range 70%–110%	Inrush Power Consumption (VA)	Closing Time (ms)
24	DC	17–26	500	25
48	DC	34–53	530	25
110–127	50–60 Hz	77–140	540	25
110–125	DC	77–138	540	25
208–240	50–60 Hz	146–264	500	25
220–250	DC	154–275	515	25

Table 26.2-23. Motor Operator

Control Voltages	Frequency	Operational Voltage Range 85%–110%	Running Current (A)	Typical Inrush Current	Power Consumption (VA)	Maximum Charging Time (sec)
24	DC	20–26	5	500%	150	3
48	DC	41–53	3	500%	150	3
110–127	50–60 Hz	94–140	2	300%	280	3
110–125	DC	94–138	1	500%	150	3
208–240	50–60 Hz	177–264	1	1000%	280	4
220–250	DC	187–275	1	1000%	280	4

Table 26.2-24. Control Voltages and Currents

Control Voltages	24 Vdc	48 Vdc	110–125 Vdc	110–127 Vac	220–250 Vdc	208–240 Vac
Current						
Close current (inrush)	21	11	5	5	2	2
Shunt trip current (ST)—(inrush/continuous)	21/0.2	11/0.1	5/0.04	5/0.04	2/0.02	2/0.02
Charge motor current—(inrush/continuous)	TBD	TBD	5/1	6/2	10/1	10/1
Operating Voltage Rating						
Close	17–26	34–53	77–138	77–140	154–275	146–264
Trip	17–26	34–53	77–138	77–140	154–275	146–264
Charge	20–26	41–53	94–138	94–140	187–275	177–264

Table 26.2-25. OCT/OTS

Control Voltages	Frequency	Contact Rating (Amperes)
250	50–60 Hz	10
125	DC	0.5
250	DC	0.25

Table 26.2-26. Auxiliary Switch

Control Voltages	Frequency	Contact Rating (Amperes)
250	50–60 Hz	10
125	DC	0.5
250	DC	0.25

Table 26.2-27. Breaker Position/Continuity

Breaker Position	Continuity Between Red and Black Lead Pairs	Continuity Between Blue and Black Lead Pairs
Open	NO	45 and 43 46 and 47 51 and 49 52 and 53
Closed	44 and 43 48 and 47 50 and 49 54 and 53	NO

Table 26.2-28. Digitrip Trip Units for NRX ANSI/UL Rated Circuit Breakers

				
Trip Unit Type		**Digitrip 520**	**Digitrip 520M**	**Digitrip 1150**
Ampere range Interrupting rating at 480 V rms sensing		200–1600 A 42 kA Yes	200–1600 A 42 kA Yes	200–1600 A 42 kA Yes
Protection and Coordination				
Protection	Styles Fixed rating plug (I_n) Overtemperature trip	LI, LSI, LSIG Yes Yes	LSI, LSIG, LSIA, RLSI, RLSIG, RLSIA Yes Yes	LSI, LSIG, LSIA, RLSI, RLSIG, RLSIA Yes Yes
Long delay protection (L)	Long delay pickup Long delay time I^2t at 6 x I_r Long delay time I^4t IEEE curves	0.5–1.0 x (I_n) 2–24 seconds No No	0.5–1.0 x (I_n) 2–24 seconds No No	0.5–1.0 x (I_n) 2–24 seconds 1–5 seconds Yes
	Long delay thermal memory High load alarm	Yes No	Yes Yes (LSI only)	Yes 0.5–1.0 x (I_r)
Short delay protection (S)	Short delay pickup Short delay time I^2t at 8 x I_r Short delay time flat Short Delay Time ZSI	200–1000% x (I_r) 100–500 ms 100–500 ms Yes (optional)	200–1000% x (I_r) 100–500 ms 100–500 ms Yes (optional)	200–1000% x (I_r) 100–500 ms 100–500 ms Yes (optional)
Instantaneous protection (I)	Instantaneous pickup Making current release Off position	200–1200% x (I_n) Yes LSI and LSIG	200–1200% x (I_n) Yes Yes	200–1200% x (I_n) and M1 Yes Yes
Ground fault protection (G) ①	Ground fault alarm Ground fault pickup Ground fault delay I^2t at 0.625 x I_n	No 25–100% x (I_n) 100–500 ms	Yes 25–100% x (I_n) 100–500 ms	Yes 24–100% x (I_n) 100–500 ms
	Ground fault delay flat Ground fault ZSI Ground fault thermal memory	100–500 ms Yes (optional) Yes	100–500 ms Yes (optional) Yes	100–500 ms Yes (optional) Yes
Disable ground fault protection		No	No	No
Neutral protection (N)		Yes	Yes	Yes
System Diagnostics				
Cause-of-trip LEDs Magnitude of trip information		Yes No	Yes Yes	Yes Yes
Remote signal contacts Programmable contacts		No No	Yes No	Yes Yes
System Monitoring				
Digital display Current (%)		No No	4-character LCD Yes ±2% full scale	Color graphic LCD Yes ±1% of reading
Voltage (%) L to L Power and energy (%) Apparent power kVA and demand		No No No	No No No	Yes ±1% of reading Yes ±2% of reading Yes
Reactive power kvar Power factor Crest factor		No No No	No No No	Yes Yes Yes
Power quality—harmonics % THD, waveform capture		No No	No No	Yes Yes
System Communications				
Type Power supply		No N/A	Yes ③ +24 Vdc	Yes ③ +24 Vdc
Additional Features				
Trip log Electronic operations counter		No No	No No	Yes Yes
Testing method ② Waveform capture		Test set No	Test set No	Integral and test set Yes (current and voltage)
Arcflash Reduction Maintenance System Breaker health monitor Programmable relay functions		No No No	Yes (RLSI, RLSIG, RLSIA) No No	Yes (RLSI, RLSIG, RLSIA) Yes Yes

① 1200 A maximum ground fault setting per UL/NEC®.

② Test set for secondary injection.

③ Optional communications modules available: Ethernet (Web-browsing, Modbus TCP/IP and SNMP), Modbus RTU, INCOM, PROFIBUS DP.

Legend: I_n = Rating Plug and Sensor Rating.
I_r = Long Delay Pickup setting.

Series NRX Breaker Communications Adapter Modules

Series NRX Communications Adapter Module

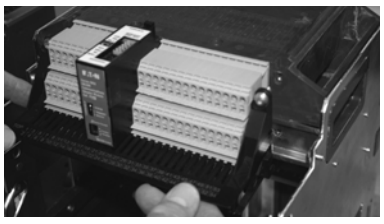
General Description

The Series NRX Communication Adapter Modules (CAMs) are DIN mounted accessories that facilitate communication with a variety of different communications protocols:

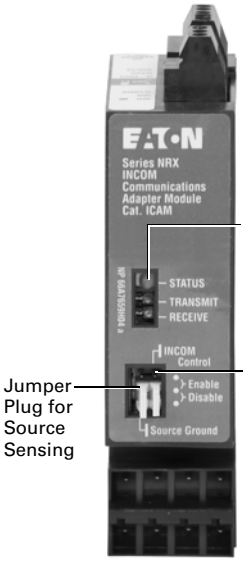
- Modbus Communication Adapter Module (MCAM)—Modbus RTU
- INCOM Communication Adapter Module (ICAM)—INCOM
- PROFIBUS Communication Adapter Module (PCAM)—PROFIBUS DP
- Ethernet Communication Adapter Module (ECAM)—Web-enabled, Modbus TCP/IP, SNMP and Power Xpert Toolkit

The communication device may be mounted in the Series NRX cassette secondary terminal blocks or remote mounted on a DIN rail.

- Module/address is assigned to the cassette/cell location. This eliminates the need to do any reprogramming when a replacement breaker is installed in the existing location
- Communication of "Open," "Close" and "Trip" status is via the CAM module, not through the trip unit
- 24 Vdc control power
- Use with Digitrip 520M or Digitrip 1150 NRX trip units



Communication Adapter Module Cassette Mounted in Secondary Terminal Blocks



Communications Adapter Module (Front View)

Microcontroller LED (Status)

This indicator will be flashing green whenever the module is powered up and when the microprocessor is executing instructions. When the Series NRX communications adapter module is connected to a Series NRX trip unit for the first time, this LED will alternately flash red and green to signal a learning process between both units. This automatic process will take approximately 15 seconds and occurs only once during the initial startup. The LED will also flash red if the module is not connected to, or unable to communicate.

Control Jumper

This jumper provides the user with a means of enabling or disabling remote communication control commands to the Series NRX trip unit. With jumper placed in the ENABLE position, remote slave action commands, such as open and close, can be acted upon. With the jumper in the DISABLE position, commands will not be accepted.

Source/Residual Ground Selection Jumper

This jumper selects the protection configuration for Series NRX trip units with ground fault protection or ground fault alarm functionality. Consult Series NRX trip unit instructions for further information on ground sensing. This jumper is not applicable and does not function for non-ground fault style trip units.

Wiring Diagrams

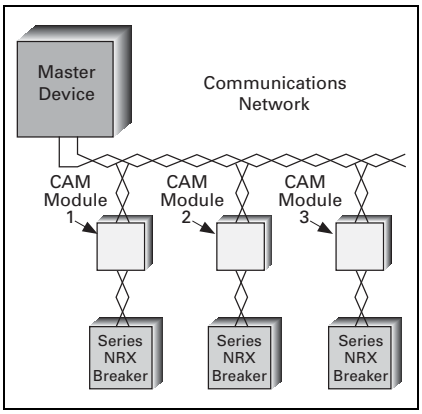


Figure 26.2-17. Communications Adapter Modules in a Modbus RTU, INCOM or PROFIBUS DP Network

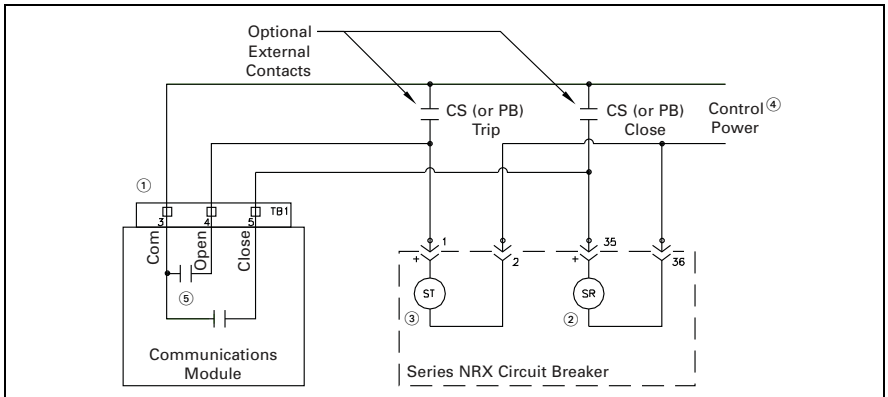
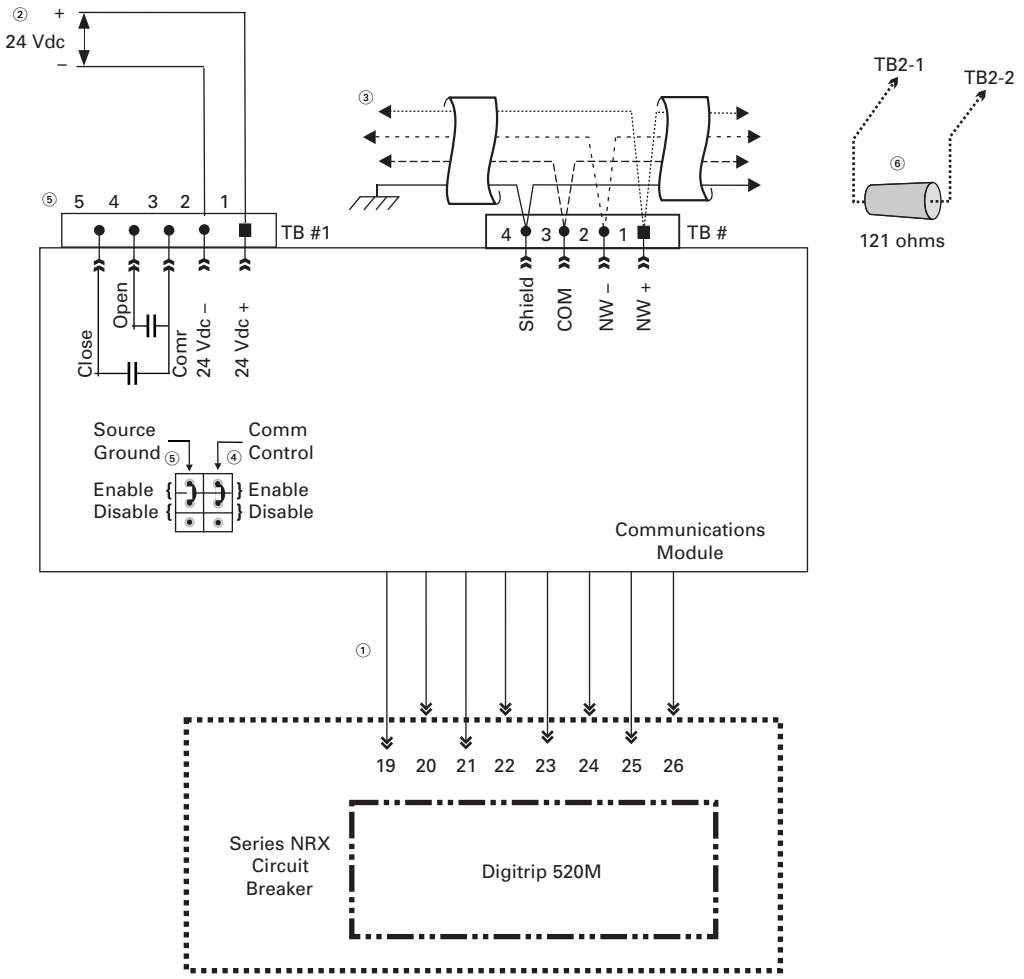
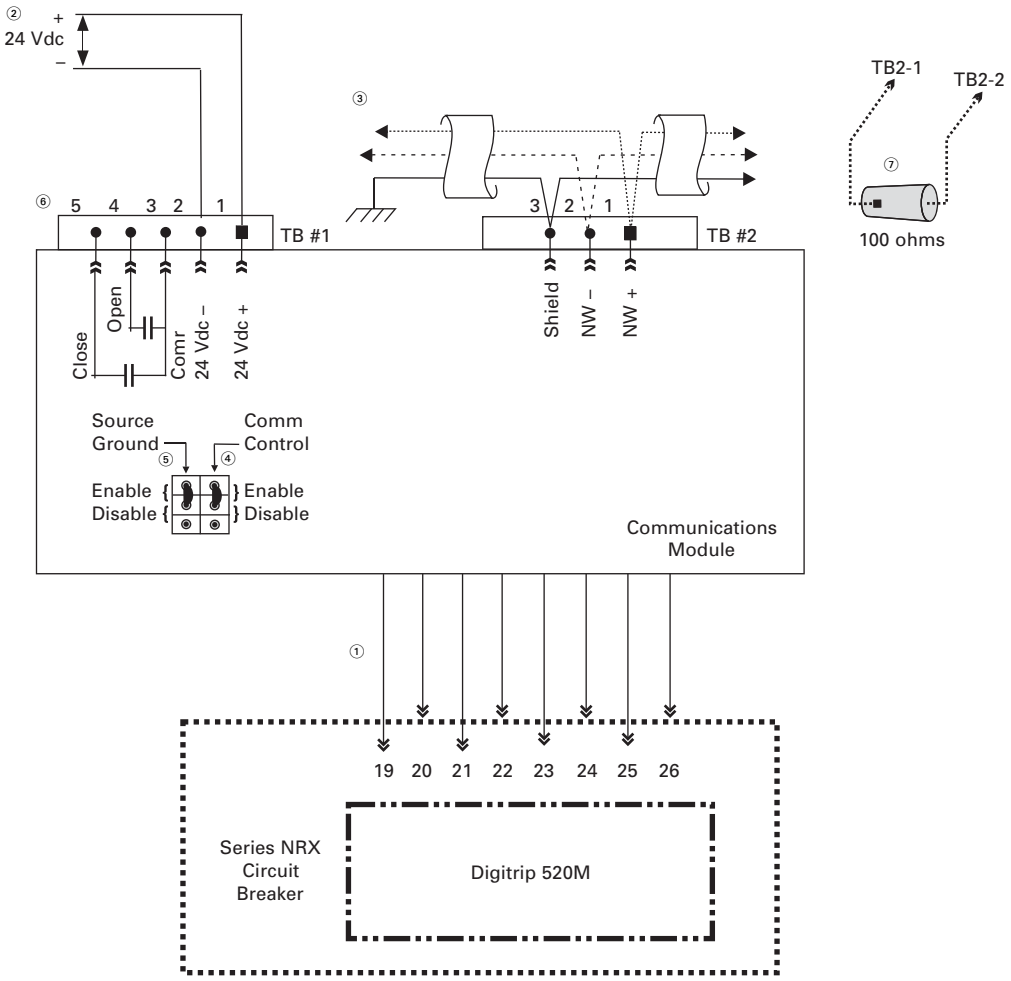


Figure 26.2-18. Communications Control (SR and ST Wiring)



① The Series NRX communication module is a separate device that snaps into the DIN rail starting at location 19 through 26. (Removal of the four contact blocks is required.)
② The trip unit AUX voltage is 24 Vdc ±10% and should be sourced from a reliable service.
③ Ground the shield at the master device.
④ Set the jumper on the module to enable or disable the communications control as desired.
⑤ When the communications module is employed and source ground or zero sequence ground sensing method is required, the ground fault function is enabled by this jumper.
⑥ Connectors are UL/CSA rated 300 V, VDE rated 250 V. Recommended: Weidmuller (BL 3.5/90/5BK) Orientation: 90° lead exit, but other lead orientations are possible. Wire guage: # 18 AWG/0.82 mm.
⑦ The final device in the daisy-chain configuration must have a 121 ohms termination resistor installed across terminals #1 and #2 on TB #2.

Figure 26.2-19. Series NRX Modbus Communication with Digitrip 520M



① The Series NRX communication module is a separate device that snaps into the DIN rail starting at location 19 through 26. (Removal of the four contact blocks is required.)

② The trip unit AUX voltage is 24 Vdc ±10% and should be sourced from a reliable service.

③ INCOM communication cable is a two conductor with shield type wire in "daisy chain" configuration. The recommended cable (Belden "Blue Hose" # 9643 or equivalent) has a twisted-pair of wires (# 20 AWG stranded 7 x 28 conductors with PVC insulation) having an aluminum/mylar foil shield with drain wire. The maximum system capacity is 10,000 feet of communications cable and 1000 devices on the INCOM network. Make sure that the twisted-pair wire is recommended for INCOM network use. Use shielded twisted-pair wire to connect each slave to the INCOM network, daisy-chain style. The polarity of the twisted-pair is not important. Ground the shield at the host computer (device).

④ Set the jumper on the module to enable or disable the communications control as desired.

⑤ When the communications module is employed and source ground or zero sequence ground sensing method is required, the ground fault function is enabled by this jumper.

⑥ Connectors are UL/CSA rated 300 V, VDE rated 250 V. Recommended: Weidmuller (BL 3.5/90/5BK) Orientation: 90° lead exit, but other lead orientations are possible. Wire gauge: # 18 AWG/0.82 mm.

⑦ The final device in the daisy-chain configuration must have a 100 ohms termination resistor installed across terminals #1 and #2 on TB #2.

Figure 26.2-20. Series NRX INCOM Communication with Digitrip 520M

26

Ethernet Communications Adapter Module

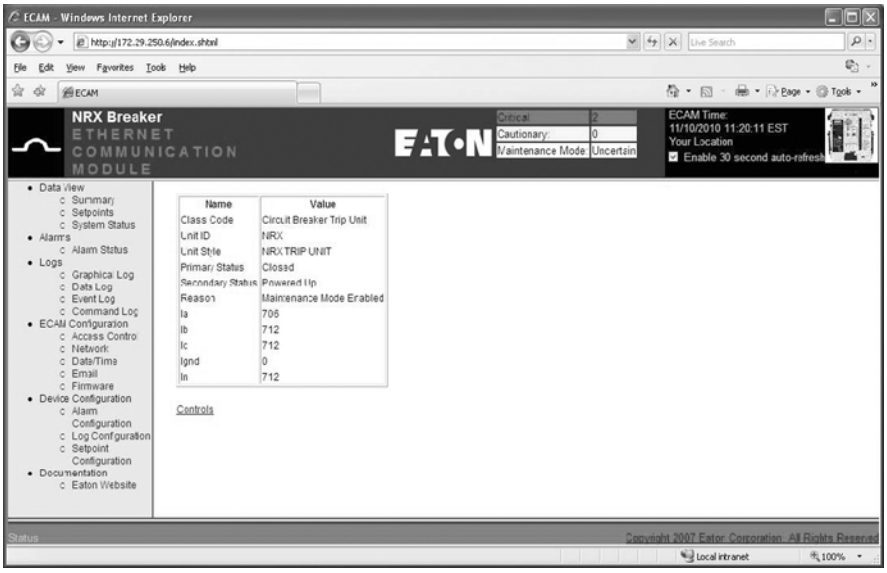
Series NRX Ethernet Communications Adapter Module

General Description

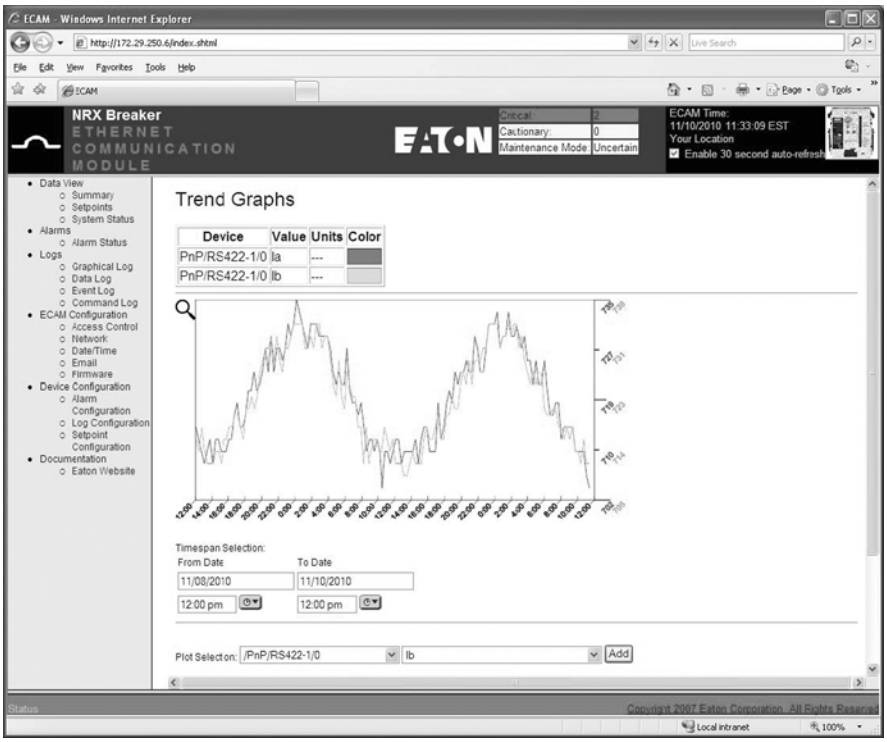
The Series NRX Ethernet communications adapter module is an accessory that operates as a communicating device in conjunction with a compatible Series NRX trip unit/breaker via an Ethernet network. The catalog number of this product is ECAM.

The Ethernet communications adapter module provides Web-enabled monitoring and control of the Series NRX trip unit metering, logging, and control functions using a standard web browser. Features include display of measured current, voltage, power, energy and alarms; command, event and data logging; configuration of set point, alarm and logging parameters; and control functions such as open/close breaker.

In addition to Web server capability, data communication is provided in Modbus TCP/IP and SNMP protocols. Additionally, the Series NRX Ethernet Communications Adapter Module provides data communications to the Eaton Power Xpert Software as an easy means of centralizing and gathering data for long-term data archival, analysis and trending.



Data View Summary



Trend Graph View