Operating Manual for Series NRX
Trip Units - Digitrip™ 520/520M

Instructions apply to:

Series NRX, Type NF Frame
ANSI, UL1066, UL489 / IEC, IZMX16, IZM91

Series NRX, Type RF Frame
IEC, IZMX40
Before commencing the installation

- Disconnect the power supply of the device
- Ensure that devices cannot be accidentally restarted
- Verify isolation from the supply. Earth and short circuit
- Cover or enclose neighboring units that are live
- Danger if breaker mechanism spring is charged! Discharge spring
- Follow the engineering instructions of the device concerned
- Only suitably qualified personnel in accordance with applicable national work safety regulations may work on this device/system
- Before installation and before touching the device ensure that you are free of electrostatic charge
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices

Note: The recommendations and information contained herein are based on experience and judgement, but should not be considered to be all inclusive or to cover every application or circumstance that may arise.

If you have any questions or need further information or instructions, please contact your local Eaton representative or visit www.eaton.com.
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Section 1: General description of Digitrip trip units in Eaton Series NRX circuit breakers

Note: The range of Eaton circuit breakers described in this document is known as Series NRX. In some markets this range may also be referred to as IZMX circuit breakers and/or IZM91/95 circuit breakers.

General

Eaton circuit breakers are tripped automatically on overload fault current conditions by the combined action of three components:

1. The sensors, which provide lower-level current signals to the Digitrip unit.
2. The Digitrip trip unit, which measures the current from the sensors, and will provide a tripping signal to the trip actuator when the levels and time delay settings are exceeded.
3. The low-energy trip actuator, which converts electrical energy to mechanical energy to trip the circuit breaker.

Sensors

The current sensors consist of two coils: one coil on an iron core and one air core (Rogowski) coil (Figure 18). As current begins to flow through the circuit breaker, the iron core coil generates a secondary current which powers the trip unit. At the same time, the air core coil provides signal values which are processed by the electronic circuitry.

Digitrip Trip Unit

This instruction book specifically covers the application of Digitrip 520/520M units installed in Series NRX circuit breakers. The Digitrip trip units are circuit breaker subsystems that provide the protective functions of a circuit breaker. The primary function of the trip unit is circuit protection but some models offer additional features such as Metering and Maintenance Mode protection. The trip units are enclosed in removable housings, installed in the breaker, and can be replaced or upgraded in the field by the customer.

The line of trip units consists of the Digitrip 520 and 520M for UL/ANSI and IEC standards. The Digitrip 520 and 520M trip units may be applied on both 50 and 60 Hz systems. Refer to Figure 1 to become familiar with the trip unit general layout.

All trip unit models are microprocessor-based AC protection devices that provide true rms current sensing for the proper coordination with the thermal characteristics of conductors and equipment. The Digitrip unit analyzes the secondary current signals from the circuit breaker current sensors and, when preset current levels and time delay settings are exceeded, will send an initiating trip signal to the trip actuator of the circuit breaker. As a result, all tripping operations initiated by the protection functions are performed by its internal circuitry. There is no mechanical or direct magnetic action between the primary current and the mechanical tripping parts of the circuit breaker and external control voltage is not required for basic protection functionality.

The automatic overload and short circuit tripping characteristics for a specific circuit breaker are determined by the rating plug and the selected functional protection settings. Specific setting instructions are provided in Section 3: Protection Settings.

There are five phase and two ground (time-current) curve shaping adjustments. To satisfy the protection needs of any specific installation, the exact selection of the available protection function adjustments is set by the user. The short delay and ground fault pickup adjustments can be set for either FLAT or I^2t response.

Low-energy trip actuator

The mechanical force required to initiate the tripping action of the circuit breaker is provided by a special low-energy trip actuator. The circuit breaker mechanism assembly contains a mechanism-actuated reset lever and a trip lever to actuate the tripping action of the circuit breaker.

⚠️ WARNING

IMPROPER POLARITY CONNECTIONS ON THE TRIP ACTUATOR COIL TO THE DIGITRIP TRIP UNIT WILL DEFLECT THE OVERLOAD AND SHORT CIRCUIT PROTECTION, WHICH COULD RESULT IN PERSONAL INJURY. OBSERVE POLARITY MARKINGS ON THE TRIP ACTUATOR LEADS IF LEADS OR CONTACTS ARE EVER REMOVED.

Catalog Number Referencing

Table 1 below offers a quick reference to the basic function and protection features as designated by the trip unit catalog number.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Function/Protection</th>
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<td>Metering function</td>
</tr>
<tr>
<td>R</td>
<td>ARMS Maintenance Mode function</td>
</tr>
<tr>
<td>L</td>
<td>Long time trip (overload)</td>
</tr>
<tr>
<td>S</td>
<td>Short time trip</td>
</tr>
<tr>
<td>I</td>
<td>Instantaneous trip</td>
</tr>
<tr>
<td>G</td>
<td>Ground (Earth) fault trip</td>
</tr>
<tr>
<td>A</td>
<td>Ground (Earth) Alarm only</td>
</tr>
</tbody>
</table>

Example of CAT number

![Diagram](image)

Protection

Each trip unit is completely self-contained and requires no external control power to operate its protection systems. It operates from power and current signal levels derived through current sensors mounted in the circuit breaker. The types of protection available for each model are shown in Table 3.

Note: All models (LI, LSI, LSIG, and LSIA) will provide neutral protection.
Mode of trip and status information

On all models there are tri-colored light-emitting diodes (LED), that could be lit green, red, or orange. The status LED will blink green approximately once each second to indicate that the trip unit is operating normally. This Status LED will blink at a faster rate if the Digitrip is in a pick-up or overload condition.

The Digitrip has the ability to detect a problem with nonvolatile memory or if the trip actuator coil is open circuit, or if there is a circuit breaker mechanism problem. Depending upon the state and the status of power to the trip unit when a problem is detected the Status LED will light red or flash red or orange.

LEDs on the face of the trip units (for INST, LONG, SHORT, and GROUND) flash red to indicate the cause or trip mode for an automatic trip operation (for example, ground fault, overload, or short circuit trip). A battery located in the frame module maintains the trip indication until the Reset/Battery Test button is pushed. The battery is good if its LED lights green when the Battery Check button is pushed (see Section 8).

Note: The trip unit provides all protection functions regardless of the status of the battery. The battery is only needed to maintain the cause of trip indication.

Table 2. Legend for Figure 1

<table>
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<tr>
<th>Number</th>
<th>Item</th>
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<td>3</td>
<td>Status LED</td>
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<td>4</td>
<td>Rating Plug</td>
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<td>Cause of Trip LED</td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
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<td>11</td>
<td>Battery</td>
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<tr>
<td>12</td>
<td>Battery Check LED</td>
</tr>
<tr>
<td>13</td>
<td>Reset/Battery Test</td>
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</tbody>
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Figure 1. Example Digitrip 520M LSIG with legend
List of Digitrip 520/M trip units with type codings and catalogue numbers

| Digitrip 520 LI | Catalogue Number: N5LI |
| Protection Features: | |
| System Protection | Long delay protection (L) |
| IZMX and IZM91/95 frame: | Instantaneous protection (I) |
| IZMX16/40...A... | |
| IZM91/95...A... | |

| Digitrip 520 LSI(G) | Catalogue Number: N5LSI |
| Protection Features: | |
| Selective Protection | Long delay protection (L) |
| IZMX and IZM91/95 frame: | Short delay protection (S) |
| IZMX16/40...V... | Instantaneous protection (I) |
| IZM91/95...V... | Earth fault protection (G) |

| Digitrip 520 M LSI/LSIG/LSIA with or without Maintenance Mode | Catalogue Number: N5M(R)LSI |
| Protection Features: | |
| Universal Protection | Maintenance Mode (R) optional |
| IZMX and IZM91/95 frame: | Long delay protection (L) |
| IZMX16/40...U... | Short delay protection (S) |
| IZM91/95...U... | Instantaneous protection (I) |
| Catalogue Number: N5M(R)LSIG | Earth fault protection (G) |

| Digitrip 520 M LSI/LSIG/LSIA with or without Maintenance Mode | Catalogue Number: N5M(R)LSIA |
| Protection Features: | |
| Universal Protection | Maintenance Mode (R) optional |
| IZMX and IZM91/95 frame: | Long delay protection (L) |
| IZMX16/40...U... | Short delay protection (S) |
| IZM91/95...U... | Earth fault alarm (A) |

Table 3. Available Digitrip 520 and 520M Trip Units
### Table 4. Technical Data

<table>
<thead>
<tr>
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<th>Digitrip 520 LSI(G)</th>
<th>Digitrip 520M</th>
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<td>Ampere range</td>
<td>NF frame 200-1600A RF frame 800-4000A</td>
<td>NF frame 200-1600A RF frame 800-4000A</td>
<td>NF frame 200-1600A RF frame 800-4000A</td>
</tr>
<tr>
<td>RMS sensing</td>
<td>●</td>
<td>●</td>
<td>●</td>
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</tbody>
</table>

#### General

- **Ordering style options**: LI, LSI, LSIG, MLSI, MLSIG, MLSIA, MRLSI, MRLSIG, MRLSIA
- **Rating plug (I_n)**
- **Overtemperature trip**: ●
- **Long delay protection (L)**
  - **Long delay pickup**: (0.5 – 1.0) x I_n, (0.5 – 1.0) x I_n, (0.5 – 1.0) x I_n
  - **Long delay time t_L at 6 x I_n**: 2 – 24 s, 2 – 24 s, 2 – 24 s
  - **Long delay thermal memory**: ●
- **Short delay protection (S)**
  - **Short delay pickup**: –, (2 - 10) x I_n, (2 - 10) x I_n
  - **Short delay time t_S**: –, 100 – 500 ms, 100 – 500 ms
  - **Zone Selective Interlocking ZSI**: optional
- **Instantaneous protection (I)**
  - **Instantaneous pickup**: (2 - 12) x I_n, (2 - 12) x I_n, (2 - 12) x I_n
  - **Trip position**: ●
  - **Making current release**: ●
- **Option earth fault protection (G)**
  - **Earth fault option**: –
  - **Earth fault alarm**: –
  - **Earth fault pickup**: –, (0.25 - 1.0) x I_n, (0.25 - 1.0) x I_n
  - **Earth fault delay t_F, Pt 0.625 x I_n**: –, 100 – 500 ms, 100 – 500 ms
  - **Ground (earth) fault delay t_G, flat characteristic curve**: –, 100 – 500 ms, 100 – 500 ms
  - **Zone Selective Interlocking ZSI**: optional
  - **Ground fault memory**: ●

#### Neutral protection

- ●

#### System diagnostics

- **Status/long pickup LED**: ●
- **High load alarm/alarm contacts**: –
- **Cause of trip LEDs**: ●●
- **Magnitude of trip information**: ●●
- **Remote ground trip/alarm contacts**: ●●

#### System metering

- **Digital display**: 4 character LCD
- **Maintenance Mode (ARMS)**: optional

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I_n = rating plug = rating of current sensors
I_L = Long delay pickup setting

- © Requires 24 Vdc auxiliary voltage input (LSIG-ground trip alarm, LSIA ground alarm only).
- ® Limited to 1200 A for UL® rating
- â Four Cause of Trip LEDs: L, S, I, G. Current Release trip is indicated by the red instantaneous LED:
  - • Orange Instantaneous LED indicates rating plug trip
  - • Orange Long Delay LED indicates temperature trip
  - • Red or orange LED status indicates internal trip unit or circuit breaker diagnostic problem detected.
- © Requires 24 Vdc auxiliary voltage input and LSI style.
Digitrip identified by catalogue numbers and nameplates

520 LI

520 LSIG

520 LSI

520M LSI

520M LSIG

520M LSIA

Figure 2. Digitrip Nameplates
Installation and removal

Installation of the trip unit

Align the Digitrip trip unit with the two guide grooves of the Series NRX circuit breaker. Keep it parallel with the receiving, molded deck plate. Press the unit into the circuit breaker until the trip unit seats firmly into the receiving housing and the two latching tabs click into place.

Rating plug installation

**CAUTION**

*IF A RATING PLUG IS NOT INSTALLED IN THE TRIP UNIT, THE UNIT WILL INITIATE A TRIP WHEN IT IS ENERGIZED. AN ORANGE LED LIGHT WILL LIGHT ABOVE THE INST TEXT*

Insert the rating plug into the cavity on the right side of the trip unit. Wiggle the plug slightly to help align the pins on the plug with the sockets in the cavity. The plug should engage with a slight insertion force. At this point, it will be roughly 3/16” above the Digitrip and it will take four turns to tighten it to its stop position.

Trip unit/rating plug removal

To remove the rating plug from the trip unit, use a 1/8-inch / 3 mm wide screwdriver to loosen the screw. It will take about four turns to release it.

To remove the trip unit from the circuit breaker’s Frame Rating Module, break the factory seal, deflect the two locking tabs, and pull to release the unit from the mounting plate. Pull the unit to disengage the molded, 24-pin connector from the circuit breaker. (Figure 3)

Wiring

The internal components of the circuit breaker and how they are wired internally and externally to the circuit breaker secondary contacts are shown in the breaker master connection diagrams provided as Appendix E and F.

Plexiglass cover

A clear, tamper-proof, plexiglass cover fits on the Digitrip. This cover allows the settings to be viewed but not changed, except by authorized personnel. The plexiglass cover meets applicable tamper-proof requirements. Security is ensured by the insertion of a standard meter seal through the thumb screw holes. The plexiglass cover has access holes for the Scroll pushbutton and Maintenance Mode setting (if applicable).

Voltage supply input/alarm

Auxiliary voltage requirements

When the circuit breaker is wired for external 24 Vdc input, it will provide an auxiliary voltage supply so that the Digitrip 520M liquid crystal display (LCD) will be functional even when the circuit breaker has no load. The burden of the Digitrip is 6 VA. A Digitrip 520M trip unit without auxiliary voltage will not display data until load current reaches approximately 100A (single-phase) or 35A (three-phase) on the Series NRX circuit breaker.

Ground alarm

Auxiliary voltage of 24 Vdc is required to provide either a ground trip or ground alarm only output contact via the relay supplied for the Digitrip 520M trip unit.

Ground fault trip

The 520M (metering) styles will provide ground fault trip contacts when the circuit breaker trips on a ground fault. You must then push the Reset button in order to reset the internal contacts.
Ground fault alarm

A ground fault alarm alerts a user to a ground fault condition without tripping the circuit breaker. A red ground alarm LED on the front of the trip unit will indicate the presence of a ground fault condition that exceeds the programmed setting.

The ground fault alarm relay is energized when the ground current continuously exceeds the ground fault pickup setting for a time in excess of a 0.1-second delay. The alarm relay will reset automatically if the ground current is less than the ground fault pickup.

High load alarm (Digitrip 520M model only)

The Digitrip 520M model of the LSI style only will provide a high load alarm contact instead of the ground alarm function when wired to the circuit breaker secondary contacts 11 and 13. The function activates after a 1-second time delay when any phase current exceeds 85 percent of the \( I_n \) setting.

Display feature (Digitrip 520M only)

The Digitrip 520M models have a user interface in addition to the green and red/orange LED trip indicators. This seven-element display performs a metering function and can be used to monitor load currents.

When the Scroll button on the face of the trip unit is pressed and released, the display will show PH 1 for Phase 1 or A, and then the current value. If the Scroll button is not pressed again, the display will continue to show the current value for Phase 1. Each time the Scroll button is pressed the next monitored function will be displayed. The other real-time readings can be displayed in the sequence below:

- PH 2 Phase 2 (B)
- PH 3 Phase 3 (C)
- PH 4 Neutral
- PH 5 Ground (if Ground function is supplied)
- HI Highest phase current will be displayed
- OL Overload (Digitrip in overload mode)
- HL High load alarm
- HELP This message indicates that the trip unit is out of calibration or programmed incorrectly and should be replaced at the earliest opportunity.

In addition, the Digitrip 520M will display and freeze the magnitude of the trip value after a trip event if auxiliary voltage is available. Use the Step pushbutton to view each phase value. The highest value that can be locally presented is 9999. Any fault currents greater than this value will be shown as “HI.” Pushing the Reset pushbutton will clear this data.

Also related to the phase value after a trip event are four dashes “- - - -”. This message means that the microprocessor could not complete its writing of the trip event’s magnitude into its nonvolatile memory. A possible cause of this would be the lack or loss of auxiliary voltage during or after the trip event.

Another reason can be a tripping event during Maintenance Mode.

Standards

The Digitrip 520/520M trip units are listed by Underwriters Laboratories™ under UL File E7819 and UL File E52096 for use in Series NRX-NF circuit breakers. These same units are also listed by the Canadian Standards Association (CSA®) under File LR 43556.

Section 2: Principles of operation

General

All models of trip units are designed for industrial circuit breaker environments where the ambient temperatures can range from \(-20^\circ C \) to \(+85^\circ C \) but rarely exceed \(70^\circ C \) to \(75^\circ C \). If, however, temperatures near the trip unit exceed this range, the trip unit performance may be degraded. In order to ensure that the tripping function is not compromised due to an over-temperature condition, the microcomputer chip has a built-in over-temperature protection feature, factory set to trip the circuit breaker if the chip temperature is excessive. If over-temperature is the reason for the trip, the orange LONG LED will flash.

The Digitrip uses the Eaton custom-designed ASIC (Application Specific Integrated Processor) chip, an integrated circuit that includes a microcomputer to perform its numeric and logic functions. The principles of operation of the trip unit are shown in Figure 5.

All sensing and tripping power required to operate the protection function is derived from the current sensors in the circuit breaker. The signals from these sensors provide the correct input information for the protection functions, as well as tripping power, whenever the circuit breaker is carrying current. These signals are digitized by the circuitry.

The microcomputer continually digitizes these signals. This data is used to calculate true rms current values, which are then continually compared with the protection function settings and other operating data stored in the memory. The software then determines whether to initiate protection functions, including tripping the circuit breaker through the trip actuator.

Trip and operation indicators

The LEDs on the face of the trip unit flash red or orange to indicate the reason for any automatic trip operation. Following an automatic trip operation, the backup battery continues to supply power to the LEDs. The LED pulse circuit is provided to reduce battery burden and will supply a quick flash of the trip LED approximately every four seconds. It is therefore important to view the unit for at least five seconds to detect a flashing cause of trip indicator.

Following a trip operation, push the Reset/Battery Test button to turn off the LEDs.

A green Status LED indicates the operational status of the trip unit. Once the load current through the circuit breaker exceeds approximately 35A (three-phase power), the green LED will flash on and off once each second to indicate that the trip unit is energized and operating properly.

Making current release (MCR)

All models of trip units have a making current release function. This safety feature prevents the circuit breaker from being closed and latched-on on a faulted circuit. The NRX NF Frame is equipped with a nonadjustable release that is preset to pick up at a peak current of 45,000A. The release level of the RF Frame is preset to 36,000 A for 1600A frame ratings, 56,000A for 2000A and 2500A frame ratings, and 90,000A for 4000A frame ratings.

The MCR is enabled only for the first two cycles following an initial circuit breaker closing operation. The MCR will trip the circuit breaker instantaneously and flash the instantaneous (INST) red LED.
High instantaneous

For Series NRX NF-Frames, all models of the trip unit have a high instantaneous trip feature. This element is always active even when the customer instantaneous adjustment is set to the OFF position. The high instantaneous is a separate analog peak detecting circuit that is set in the frame rating module of the circuit breaker. It will initiate a trip at a high current peak value which depends on the circuit breaker types and ratings. It will indicate by flashing the red instantaneous (INST) LED.

For the Series NRX RF-Frame, some models of the trip unit have a high instantaneous trip feature. For specifics on instantaneous trip, please reference RF-Frame time current curves, AD01301004E.
Zone selective interlocking (optional)

Note: The zone selective interlocking function is a circuit breaker option when ordering the Series NRX. Circuit breakers from the factory that are ordered with the zone interlocking function included will have three wires (Zout, Zcom, Zin) connected to secondary contacts (27, 28, 29). These contacts can then be wired for zone interlock to other circuit breakers in the various zones. Zone selective interlocking requires no additional modules or auxiliary power supplies to function.

Zone selective interlocking is available on the SHORT delay and GROUND fault protection functions. The zone interlocking, if supplied, is wired via a single set of three wires labeled Zone In (Zin) and Zone Out (Zout) along with a zone common wire. The zone selective interlocking function has combined the logic interlocking of SHORT delay and GROUND fault. A zone out signal is sent whenever the ground fault pickup is exceeded or when the short delay value of 2 x Iₜₐ₉ is exceeded. Zone selective interlocking provides the fastest possible tripping for faults within the zone of protection by coordinating among all applicable circuit breakers in the system (mains, ties, feeders, and downstream circuit breakers) to limit a power outage to only the affected parts of the system. When zone interlocking is employed, a fault within the zone of protection of the breaker will:

• Trip the affected circuit breaker immediately, and at the same time
• Send a signal to upstream Digitrip units to restrain from tripping immediately. The restraining signal causes the upstream circuit breakers to follow their set coordination times, so that the service is only minimally disrupted while the fault is cleared in the shortest time possible.

For an example of how zone selective interlocking may be used, see Appendix A of this instructional leaflet.

Diagnostics indicator—circuit breaker/trip unit

The Digitrip unit has LEDs for diagnostic reasons. The Status LED is bicolor. A normal powered unit will flash the green status at a 1-second repetition rate.

If a problem is encountered in any of the following scenarios:

• NVRAM memory problem
• MCR auxiliary switch or circuit breaker mechanism is in an improper state
• Trip actuator (TA) coil circuit is open

The Status LED will light or flash red. This is an indication to troubleshoot the trip actuator, circuit breaker mechanism/MCR switch or trip unit’s NVRAM memory as soon as possible (see Troubleshooting Guide).

In addition, the Digitrip 520M style units (not Maintenance Mode style), provide a relay contact alarm (12 to 11) and can provide these alarm diagnostics externally.

Ground Fault Protection

General

When the Digitrip includes ground fault protection features, the distribution system characteristics (such as system grounding, number of sources, and number and location of ground points) must be considered along with the manner and location in which the circuit breaker is applied to the system.

The Digitrip 520 uses three modes of sensing to detect ground fault currents: residual, source ground, and zero sequence (Table 5). Series NRX circuit breakers can accommodate all three types, including four-pole circuit breakers. The circuit breaker secondary contact inputs are used to configure the three schemes. No jumper from 19 to 20 programs the unit for a residual ground fault scheme, while a jumper from 19 to 20 programs the trip unit for either a source ground or zero sequence configuration. If present, this jumper resides on the stationary side of the switchgear assembly for drawout circuit breakers. In all three schemes, the proper current sensor is required per Table 5.

Residual sensing

Residual sensing is the standard mode of ground fault sensing in Series NRX circuit breakers. This mode uses one current sensor on each phase conductor (Figure 18) and one on the neutral for a four-wire system (Figure 18). If the system neutral is grounded, but no phase to neutral loads are used, the Digitrip 520 includes all of the components necessary for ground fault protection. This mode of sensing vectorially sums the outputs of the three or four individual current sensors. For separately mounted neutrals, as long as the vectorial sum is zero, then no ground fault exists. Residual ground fault sensing features are adaptable to main and feeder circuit breaker applications. Available ground fault pickup settings employing residual sensing are given in Tables 7 and 8.

 ALWAYS OBSERVE THE POLARITY MARKINGS ON THE INSTALLATION DRAWINGS. IF THE NEUTRAL SENSOR CONNECTIONS ARE INCORRECT, A NUISANCE TRIP MAY OCCUR.

To ensure correct ground fault equipment performance, conduct field tests to comply with requirements (North America: NEC Article 230-95 C).

Source ground sensing

Depending upon the installation requirements, alternate ground fault sensing schemes may be dictated. The ground return method is usually applied when ground fault protection is desired only on the main circuit breaker in a simple radial system. This method is also applicable to double-ended systems where a mid-point grounding electrode is employed. For this mode of sensing, a single current sensor mounted on the equipment-bonding jumper directly measures the total ground current flowing in the grounding electrode conductor. The settings shown in Table 6 will apply when using the source ground sensor displayed in Figure 18 and asserting the source ground jumper.

Note: When using a Communication Module (see “Communication Module” section), the enabling of source ground mode is done via the position of the jumper located on this module.

Zero sequence sensing

Zero sequence sensing, also referred to as vectorial summation, is applicable to mains, feeders, and special schemes involving zone protection. The maximum outside diameter is 8.20 in (208.3 mm). The inside minimum diameter is 5.80 in (147.3 mm). The maximum thickness is 1.70 in (43.2 mm). The settings displayed in Table 5 will apply.
Section 3: Protection settings

General

Before placing any circuit breaker in operation, set each trip unit protection setting to the values specified by the engineer responsible for the installation. The number of settings that must be made is determined by the type of protection supplied by each unit. Each setting is made by turning a rotary switch. The selected setting for each adjustment appears on the trip unit label. The installed rating plug will establish the maximum continuous current rating of the circuit breaker ($I_n$). Instantaneous and ground current settings are defined in multiples of ($I_n$).

Should an automatic trip occur as a result of the current exceeding the pre-selected value, the labeled LED will flash red.

Note: Use the following to access Time Current Curves. Go to Eaton’s Web site: http://www.eaton.com and search “NRX Digitrip 520 Curves”.

Long delay settings

The long delay current setting $I_R$ determines the maximum continuous current the circuit breaker can carry without tripping. Each setting is expressed as a multiple of the maximum rated current $I_n$ set by the rating plug. The nominal current pickup value is 110% of the setting. The available current settings for the long time pickup $I_R$ are:

$$I_R = (0.5/0.6/0.7/0.75/0.8/0.9/0.95/1.0) \times I_n$$

Note: $I_R$ is also the basis for the short delay current setting.

The long time delay $t_R$ determines the duration of an overload without tripping. The available settings for the long time delay $t_R$ are:

$$t_R = 2/4/7/10/12/15/20/24 \text{ s (at 6 x } I_n)$$

Figure 6. Applying Long Delay Settings

Figure 7. Long Delay Current Settings

Figure 8. Long Delay Time Settings

Note: In addition to the standard long delay protection element, trip units also have a long time memory (LTM) function, which protects load circuits from the effects of repeated overload conditions. If a circuit breaker is reclosed soon after a long delay trip, and the current again exceeds the long delay setting ($I_R$), the LTM automatically reduces the time to trip to allow for the fact that the load circuit temperature is already higher than normal because of the prior overload condition. Each time the overload condition is repeated, the LTM causes the circuit breaker to trip in a progressively shorter time. When the load current returns to normal, the LTM begins to reset; after about 5 minutes it will have reset fully, so the next long delay trip time will again correspond to the Setting value.

Note: In certain applications, it may be desirable to disable the LTM function. Open the test port cover with a small screwdriver blade by prying up the edge near the test port marking. Use small, long-nose pliers to move the LTM jumper inside the test port (see Figure 9) to its (pin bridging) inactive position. (The LTM function can be enabled again at any time by moving the LTM jumper back to its original Active position.)

The action of the LTM must be considered when performing multiple long delay time tests (see Section 4).

Figure 9. Long Time Memory (LTM) Jumper

Test Kit Port

Test Port

Connector (storage) LTM

Active

Position for Field Testing

Connector (bridging) LTM

Inactive
Short delay settings

On Digitrip 520 LSI and 520M (RILSI/G/A) trip units (IZMX...V and ...U) tripping due to the short-circuit current \( I_c \) can be delayed by the time \( t_{sd} \). This provides selectivity for the short-circuit protection in switchgear with several grading levels. Available setting values for the short delay pickup \( I_{sd} \) are:

\[
I_{sd} = (2/3/4/5/6/7/8/10) \times I_n
\]

Important: The short delay setting \( I_{sd} \) is based on the long delay \( I_n \).

There are two different short delay response curve shapes: fixed time (FLAT) and \( I^2t \). The shape selected depends on the type of selective coordination chosen. The \( I^2t \) response curve will provide a longer time delay for current below 8 \( I_n \) than will the FLAT response curve.

Flat response: \( t_{sd} = 0.1/0.2/0.3/0.4/0.5 \) s

\( I^2t = 0.1/0.3/0.5 \) s

The \( I^2t \) response is applicable to currents less than eight times the ampere rating of the continuous current rating \( I_n \). For currents greater than 8 \( I_n \) the \( I^2t \) response reverts to the FLAT response.

Note: See section 2, zone interlocking.

---

**Figure 10. Applying Short Delay Settings**

**Figure 11. Short Delay Current Settings**

---

Instantaneous settings

If the current setting \( I_i \) is exceeded, the circuit breaker is tripped instantaneously.

Available settings values for \( I_i \) are:

\[
I_i = (2/3/4/5/6/8/10) \times I_n; \text{ OFF}
\]

---

**Figure 12. Short Delay Time Settings**

**Figure 13. Applying Instantaneous Settings**

---

**Figure 14. Instantaneous Settings**
Ground fault settings

If the trip unit is equipped with earth fault protection, loads can be protected against impermissibly high ground-fault currents. There is a maximum of 1200A for UL type trip units (Table 7). The specific ground current settings for each model are listed in Table 6, Table 7 and Table 8 and on the applicable time-current curve for the circuit breaker.

The response value \( I_g \) together with the setting for the time delay \( t_g \) determines the shut off of the ground fault. Available settings for the ground fault pickup \( I_g \) are:

\[ I_g = (0.25/0.3/0.35/0.4/0.5/0.6/0.75/1.0) \times I_n \]

There are two different ground fault curve shapes: fixed time (FLAT) or \( I^2t \) response. The shape selected depends on the type of selective coordination chosen. The \( I^2t \) response will provide a longer time delay for current below 0.625 \( I_n \) than will the FLAT response.

Available settings for the earth fault delay \( t_g \) are:

**FLAT response:** \( t_g = 0.1/0.2/0.3/0.4/0.5 \) s

**\( I^2t \) response:** \( t_g = 0.1*/0.3*/0.5* \) s

The \( I^2t \) response is applicable to currents less than 0.625 times the ampere rating of the installed rating plug \( I_n \). For currents greater than 0.625 \( I_n \), the \( I^2t \) response reverts to the FLAT response.

**Available Settings**

- 0.25
- 0.3
- 0.35
- 0.4
- 0.5
- 0.6
- 0.75
- 1.0

Specific Values Given on Circuit Breaker Time-Current Curve and in Table 4 or 5

---

**Figure 15. Applying Ground Fault Settings**

**Figure 16. Ground Fault Current Settings**

**Figure 17. Ground Fault Time Settings**
### Table 5. Series NRX/Digitrip Ground Fault Sensing Modes

<table>
<thead>
<tr>
<th>Series NRX Frame</th>
<th>Ground (Earth) Sensing Method</th>
<th>Sensor Style</th>
<th>IZMX Type Coding</th>
<th>Breaker Secondary Contacts Required</th>
<th>Neutral Input Contacts</th>
<th>Ground Sensor Input Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF, RF</td>
<td>Residual</td>
<td>521B76G12</td>
<td>IZMX-CT16-N</td>
<td>No jumper</td>
<td>15 , 16</td>
<td>15 , 16</td>
</tr>
<tr>
<td>NF, RF</td>
<td>Source ground</td>
<td>70C1527G14</td>
<td>IZMX-CT-NGS</td>
<td>Jumper 19 to 20</td>
<td>17 , 18</td>
<td></td>
</tr>
<tr>
<td>NF</td>
<td>Zero sequence</td>
<td>70C1527G14</td>
<td>IZMX-CT-NGS</td>
<td>Jumper 19 to 20</td>
<td>17 , 18</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** This information applies to trip units with Ground protection.

### Table 6. Ground (Earth) Fault Current Settings—Source Ground/Zero Ground Fault Settings

<table>
<thead>
<tr>
<th>Ground Fault Current Settings (Amperes)</th>
<th>Available ground fault setting (I_f)</th>
<th>0.25</th>
<th>0.30</th>
<th>0.35</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.75</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any rating plug</td>
<td></td>
<td>100A</td>
<td>120A</td>
<td>140A</td>
<td>160A</td>
<td>200A</td>
<td>240A</td>
<td>300A</td>
<td>400A</td>
</tr>
</tbody>
</table>

### Table 7. Ground (Earth) Fault Current Setting - Residual - ANSI Ratings

**Available Rating Plug Amperes (I_f)**

<table>
<thead>
<tr>
<th>Available Rating Plug Amperes (I_f)</th>
<th>0.25</th>
<th>0.30</th>
<th>0.35</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.75</th>
<th>1.00</th>
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<tr>
<td>200</td>
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<td>300</td>
<td>75</td>
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<td>120</td>
<td>150</td>
<td>180</td>
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<td>221</td>
<td>252</td>
<td>315</td>
<td>378</td>
<td>473</td>
<td>630</td>
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</table>

For NF Frame Only (IZMX16/IZM91):

<table>
<thead>
<tr>
<th>Available Rating Plug Amperes (I_f)</th>
<th>0.25</th>
<th>0.30</th>
<th>0.35</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.75</th>
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For NF or RF Frames (IZMX40/IZM95):

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<th>Available Rating Plug Amperes (I_f)</th>
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<th>0.30</th>
<th>0.35</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
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</tbody>
</table>

1. Tolerance on settings are ±10% of values shown.
2. ANSI rating units provide a hard limit of 1200A ground fault current regardless of setting.
<table>
<thead>
<tr>
<th>Available Rating Plug (Ampères)</th>
<th>0.25</th>
<th>0.30</th>
<th>0.35</th>
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</table>

Available for NF Frame Only
IZMX16/IZM91

<table>
<thead>
<tr>
<th>Available Rating Plug (Ampères)</th>
<th>0.25</th>
<th>0.30</th>
<th>0.35</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.75</th>
<th>1.00</th>
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<tr>
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<td>1600</td>
</tr>
</tbody>
</table>

Available for NF or RF Frames
IZMX40/IZM95

<table>
<thead>
<tr>
<th>Available Rating Plug (Ampères)</th>
<th>0.25</th>
<th>0.30</th>
<th>0.35</th>
<th>0.40</th>
<th>0.50</th>
<th>0.60</th>
<th>0.75</th>
<th>1.00</th>
</tr>
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<tbody>
<tr>
<td>2000</td>
<td>500</td>
<td>600</td>
<td>700</td>
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<td>1200</td>
<td>1500</td>
<td>2000</td>
</tr>
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<td>2500</td>
<td>625</td>
<td>750</td>
<td>875</td>
<td>1000</td>
<td>1250</td>
<td>1500</td>
<td>1875</td>
<td>2500</td>
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<td>3000</td>
<td>750</td>
<td>900</td>
<td>1050</td>
<td>1200</td>
<td>1500</td>
<td>1800</td>
<td>2250</td>
<td>3000</td>
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<td>3200</td>
<td>800</td>
<td>960</td>
<td>1120</td>
<td>1280</td>
<td>1600</td>
<td>1920</td>
<td>2400</td>
<td>3200</td>
</tr>
<tr>
<td>4000</td>
<td>1000</td>
<td>1200</td>
<td>1400</td>
<td>1600</td>
<td>2000</td>
<td>2400</td>
<td>3000</td>
<td>4000</td>
</tr>
</tbody>
</table>

Tolerance on settings are ±10% of values shown.
Sensor Types with graphics

Phase Sensor Type - NF frame (IZMX16/IZM91)

Phase Sensor Type - RF frame (IZMX40/IZM95)

Neutral Sensor Type - NF frame (IZMX16/IZM91)

Neutral Sensor Type - RF frame (IZMX40/IZM95)

Source Ground/Zero Sequence Sensor - NF frame (IZMX16/IZM91) Source Ground RF frame (IZMX40/IZM95) only

Figure 18. Sensor Types
Section 4: Test procedures

General

⚠️ WARNING

DO NOT ATTEMPT TO INSTALL, TEST, OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH OR SEVERE PERSONAL INJURY CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. DE-ENERGIZE THE CIRCUIT AND DISCONNECT THE CIRCUIT BREAKER BEFORE PERFORMING MAINTENANCE OR TESTS. ANY TRIPPING OPERATION WILL CAUSE DISRUPTION OF SERVICE AND POSSIBLE PERSONAL INJURY, RESULTING IN THE UNNECESSARY SWITCHING OF CONNECTED EQUIPMENT. TESTING A CIRCUIT BREAKER WHILE IT IS IN-SERVICE AND CARRYING LOAD CURRENT IS NOT RECOMMENDED. TESTING OF A CIRCUIT BREAKER THAT RESULTS IN THE TRIPPING OF THE CIRCUIT BREAKER SHOULD BE DONE ONLY WITH THE CIRCUIT BREAKER IN THE TEST OR DISCONNECTED CELL POSITIONS OR WHILE THE CIRCUIT BREAKER IS ON A TEST BENCH.

When to test

Testing prior to startup can best be accomplished with the circuit breaker out of its cell or in the TEST, DISCONNECTED, or WITHDRAWN (or removed) cell positions.

Note: Since time-current settings are based on desired system coordination and protection schemes, the protection settings selected and preset in accordance with Section 3 should be reset to their as-found conditions if altered during any routine test sequence.

Functional field testing

⚠️ CAUTION

PERFORMING TESTS WITHOUT THE EATON-APPROVED TEST KIT MAY DAMAGE THE DIGITRIP UNIT.

Functional test kit (handheld)

Description of handheld test kit

A battery-powered test kit is available and capable of testing the functional trip elements for trip units 520/520M and for Series NRX circuit breakers, including power up, instantaneous trip, short delay trip, and ground (earth) fault trip. These test selections are chosen with the switch labeled “Select Test” located in the upper right-hand corner of the test kit. The test currents are not adjustable for this test kit.

The catalog number for this functional test kit is MTST230V or IZMX-TEST.

Figure 19. Functional Test Kit

Test procedure

⚠️ CAUTION

BEFORE PLUGGING A TEST KIT INTO THE TEST PORT, PLACE THE LTM JUMPER IN THE INACTIVE POSITION (SEE FIGURE 16). AFTER TESTING, RETURN THE LTM JUMPER TO ITS ORIGINAL POSITION.

Complete procedural instructions for Eaton’s functional test kit can be found in IL01301067E, which is packaged with each test kit.

Note: You can access the test kit I.L. by going to Eaton’s Website: http://www.eaton.com and search “IL01301067”.

Once the testing procedure is completed, disconnect the test cable from the test kit to prevent accidental operation and battery drainage. Reset the trip unit settings to its original condition. Reposition the LTM jumper to the as-found condition. Install the small cover on the Digitrip and reposition the plexiglass cover.

Currents

Each test selected by the Select Test switch on the test kit supplies a fixed milliampere/millivolt value. The rating plug, such as the long delay setting, will affect the per unit (I_p) current value and the response of the Digitrip unit.

Batteries

The functional test kit contains a total of seven 9V batteries. A lithium ion cell is the preferred battery type for BAT A and is attached to the main pc board of the test kit. If either LED does not light or lights only dimly, replace the appropriate battery or batteries.

Note: The functional test kit also includes a 120/230 Vac auxiliary power cord that plugs into the trip unit. This can be used to conserve test kit battery life.

Ground (Earth) Fault Performance Testing

For additional information and record keeping on performance testing for ground fault trip units see Appendix D.
Section 5: Trip unit battery

General

The battery plays no part in the protection function of the trip system. The battery is provided to maintain the LED indication of the cause of trip. A Battery Check pushbutton and a green Battery Check LED is also provided. On the initial installation of the circuit breaker, pull to remove battery and then discard the insulating tab and then replace battery (see Figure 20). This will activate the battery. Check the battery status by depressing the Battery Test pushbutton.

![Battery Pull-Off Tab](image)

Use Type 1/3 N Lithium Battery Only.

Battery check

The battery is a long-life, lithium, camera-type unit. Check the status of the battery at any time by pressing the Battery Check pushbutton and observing the green LED.

<table>
<thead>
<tr>
<th>Battery Check</th>
<th>Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighted = GOOD</td>
<td>Push and Hold Button to TEST</td>
</tr>
<tr>
<td>Push Button to RESET Trip Unit</td>
<td></td>
</tr>
</tbody>
</table>

If the Battery Check LED does not light green, replace the battery. The condition of the battery has no effect on the protection function of the trip unit. Even with the battery removed, the unit will still trip the circuit breaker in accordance with its settings. However, without the battery, the cause of trip LED will not light. If the battery is replaced, one or more of the cause of trip LEDs may be illuminated. Push the Reset/Battery test button to turn off the indicators. The trip unit will be ready to indicate the next cause of trip.

**Note:** A healthy battery is required to fully reset the four-bit latch chips and associated cause of trip LEDs.

Battery installation and removal

The 3V lithium cell battery (Figure 20) is easily removed and replaced. The battery is located in the frame module below the Digitrip trip unit. Insert a small screwdriver at the bottom side to open the access door. Remove the old battery by pulling up on the removal tab that wraps under the battery cell. When inserting the new cell, pay special attention to ensure that the proper polarity is observed. The main body of the battery is the positive (+) side.

**Note:** While in service, the battery can be replaced without affecting the operation of the circuit breaker or its protective functions. However, it is recommended that the circuit breaker be opened and removed from service.
Section 6: Rating plugs

The rating plug defines the rated current ($I_n$) for the trip unit and is the basis for the trip unit current settings:

1. The instantaneous and ground current setting (if provided) are multiples of ($I_n$)
2. The long delay current setting, ($I_r$), is a fractional multiple of ($I_n$):
   \[ L\text{ong\ Delay\ current\ setting} = (I_r) = LD \times (I_n) \]
3. The short delay current setting is a multiple of ($I_r$):
   \[ S\text{hort\ Delay\ current\ setting} = SD \times (I_r) = SD \times [LD \times (I_n)] \]

A rating plug value, ($I_n$), that is less than the breaker's maximum continuous current rating (as listed on the nameplate of the breaker $I_u$) may be chosen to be the basis for the coordination of the protection function of the circuit breaker without affecting its short-circuit current capability.

Generally, ratings plugs are defined per customer breaker selection upon ordering and are installed in the factory. Field-installable kits are also available as defined in Tables 9 and 10.

### Table 9. Series NRX NF Frame Rating Plugs

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>630A</td>
<td>800A</td>
<td>1000A</td>
</tr>
<tr>
<td>400</td>
<td>N400T</td>
<td>N400T</td>
<td>N400T</td>
</tr>
<tr>
<td>500</td>
<td>N500T</td>
<td>N500T</td>
<td>N500T</td>
</tr>
<tr>
<td>600</td>
<td>N600T</td>
<td>N600T</td>
<td>N600T</td>
</tr>
<tr>
<td>630</td>
<td>N630T</td>
<td>N630T</td>
<td>N800T</td>
</tr>
<tr>
<td>800</td>
<td>N800T</td>
<td>N800T</td>
<td>N800T</td>
</tr>
<tr>
<td>1000</td>
<td>N1000T</td>
<td>N1000T</td>
<td>N1000T</td>
</tr>
<tr>
<td>1200</td>
<td>N1200T</td>
<td>N1200T</td>
<td>N1200T</td>
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<td>1250</td>
<td>N1250T</td>
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</tr>
<tr>
<td>1600</td>
<td>N1600T</td>
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<td>N1600T</td>
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</table>

© IEC Only - (not UL Listed)
### Table 10. NRX Type RF Frame Rating Plugs

<table>
<thead>
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<th>Frame Size</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>x</td>
<td>RD800T IZMX-RP40D-800</td>
<td>x</td>
<td>RE800T IZMX-RP40E-800</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1000</td>
<td>x</td>
<td>RD1000T IZMX-RP40D-1000</td>
<td>x</td>
<td>RE1000T IZMX-RP40E-1000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1200</td>
<td>x</td>
<td>RD1200T IZMX-RP40D-1200</td>
<td>x</td>
<td>RE1200T IZMX-RP40E-1200</td>
<td>x</td>
<td>RF1200T IZMX-RP40F-1200</td>
<td>x</td>
<td>RG1200T IZMX-RP40G-1200</td>
</tr>
<tr>
<td>1250</td>
<td>x</td>
<td>RD1250T IZMX-RP40D-1250</td>
<td>x</td>
<td>RE1250T IZMX-RP40E-1250</td>
<td>x</td>
<td>RF1250T IZMX-RP40F-1250</td>
<td>x</td>
<td>RG1250T IZMX-RP40G-1250</td>
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<tr>
<td>1600</td>
<td>x</td>
<td>RD1600T IZMX-RP40D-1600</td>
<td>x</td>
<td>RE1600T IZMX-RP40E-1600</td>
<td>x</td>
<td>RF1600T IZMX-RP40F-1600</td>
<td>x</td>
<td>RG1600T IZMX-RP40G-1600</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>RG4000T IZMX-RP40G-4000</td>
</tr>
</tbody>
</table>

All Frames are IEC Only
Section 7: Maintenance Mode feature

Arcflash Reduction Maintenance System™ mode (ARMS)

⚠️ WARNING

ONLY CERTIFIED AND COMPETENT PERSONNEL SHOULD ATTEMPT TO INSTALL OR MAINTAIN POTENTIALLY HAZARDOUS EQUIPMENT. DEATH OR SEVERE PERSONAL INJURY CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING. ALWAYS FOLLOW SAFETY PROCEDURES. EATON IS NOT LIABLE FOR MISAPPLICATION OR IMPROPER INSTALLATION OF ITS PRODUCTS.

⚠️ CAUTION

OBSERVE ALL RECOMMENDATIONS, NOTES, CAUTIONS, AND WARNINGS RELATING TO THE SAFETY OF PERSONNEL AND EQUIPMENT. OBSERVE AND COMPLY WITH ALL GENERAL AND LOCAL HEALTH AND SAFETY LAWS, CODES, AND PROCEDURES. CONDUCT A FLASH HAZARD ANALYSIS TO DETERMINE PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS.

Maintenance Mode

Per the above WARNING, it is highly recommended that maintenance be conducted on the electrical equipment, including circuit breakers with the system de-energized.

For situations that arise when it is not possible, the Maintenance Mode function of the Digitrip 520M family (catalog numbers N5MRLSI, N5MRLSIG, N5MRLSIA) 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. The reduced arc condition will occur only in devices downstream of the trip unit in Maintenance Mode. This function is separate from the normal system protection setting of instantaneous. The Maintenance Mode section is located in the upper, white portion of the unit.

Maintenance Mode current setting

The Maintenance Mode setting, when armed, uses a fixed pick up current value for tripping the breaker depending on the frame type. For the NF Frame this value is 2000A, for the RF Frame this value is 8000A. For additional information on clearing times please reference the Maintenance Mode Trip Curve found in the Application Data document, AD01301004E.

Actuating Maintenance Mode

There are three ways to actuate the Maintenance Mode setting. One method is locally via the selector switch in the Maintenance Mode section of the trip unit. Turning the switch to the ON position will arm the setting selected. A blue LED confirms that the function is on.

For the second method of actuating the Maintenance Mode function, this switch must be in the position labeled 0/1. With this setting, a remote switch wired through the circuit breaker secondary contacts 33 and 34 can remotely arm the Maintenance Mode setting. A high quality gold plated or palladium contact is required in this application. The blue LED will verify that the function is armed.

A third method to arm the Maintenance Mode is via a communication device. When Maintenance Mode is enabled via device communications, this setting must be disabled by a communications device.

Remote indication of Maintenance Mode

A contact is available for customer use to indicate remotely that the Maintenance Mode setting is actuated. This normally open contact is available on secondary contacts 11 and 12 to light a remote blue indicating light. This contact will not operate if status LED is red indicating the unit has detected a problem with the Trip Actuator coil.

Tripping and testing

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 LCD display, if powered, will indicate this with four dashes. The Maintenance Mode setting, external wiring (if any), and tripping functionality should be periodically verified by primary injection current testing.

Section 8: Communication Adapter Modules (CAM)

This module provides communication from the Digitrip 520M to a field bus network (Figure 22). Various networks are supported and available:

- ICAM—INCOM™
- MCAM—Modbus® RTU
- ECAM—ETHERNET
- PCAM—PROFIBUS DP

Power requirements: 6 watts at 24 Vdc (INCOM and Modbus).

These modules, for the drawout type circuit breaker, will snap onto the DIN rail of the cassette. They are designed to install or replace the four contact blocks (eight contacts in total) at secondary contacts 19 through 26. (See Appendix E and F for circuit breaker master connection diagrams.)
When the module is installed and powered with 24 Vdc, the Digitrip 520M will be able to communicate with this module via contacts CMM1, CMM2, CMM3, and CMM4. For communication to the Modbus or INCOM network, a plug-in connector on the top of this module provides the required network connections. For additional information on each of the communication modules please reference the following instruction leaflets:

- IL01301033E (ICAM)
- IL01301034E (MCAM)
- IL01301035E (PCAM)
- IL01301052E (ECAM)

**Note:** When using a Communication Module, the enabling of source ground mode is done via the position of the jumper located on this module.

![Communication Module](image)

**Figure 22. Communication Module**

### Section 9: References

**Series NRX circuit breakers**

- MN01301001E NRX Circuit Breaker Manual - NF
- MN01301003E NRX Circuit Breaker Manual - RF
- IL70C1592 Rating Plug
- IL01301031E Source Ground/ Zero Sequence Sensor
- IL01301032E Neutral Current Sensor - NF
- IL01301046E Neutral Current Sensor - RF
- IL01301067E Functional Test Kit
- TD01301014E Series NRX Circuit Breaker Wiring Diagrams

### Time-current curves

The time-current curves are listed below for particular frame models. All protection function time-current settings should be made by following the recommendations of the specifying engineer in charge of the installation.

**Type NF Frame (IZMX16/IZM91)**

- AD01301004E Application Data
  - Long Delay
  - Long Delay and Short Delay
  - Instantaneous
  - Ground Fault
  - Maintenance Mode

**Type RF Frame (IZMX40/IZM95)**

- AD01301004E Application Data
  - Long Delay
  - Long Delay and Short Delay
  - Instantaneous
  - Ground Fault
  - Maintenance Mode

Use the following to access Time Current Curves. Go to Eaton’s Web site: http://www.eaton.com and search “NRX Digitrip 520 Curves.”

All Series NRX publications can be found on-line at http://www.eaton.com by searching for the respective publication number.

### Curve Select

The “CurveSelect” software tool enables the representation of tripping characteristics which correspond to the individual switch and relay settings using Microsoft Excel®. In many electrical power networks the protective devices are connected in series. The program makes it possible to represent and evaluate all curves at the same time with a minimum of effort.

You can download the tool for free at www.eaton.com.
Appendix A: Zone interlocking examples

Case 1: There is no zone selective interlocking. (Standard time delay coordination is used.)
Assume that a ground fault of 2000A occurs and refer to Figure 24.
Fault at location 3
The branch circuit breaker will trip, clearing the fault in 0.1 seconds.
Fault at location 2
The feeder circuit breaker will trip, clearing the fault in 0.3 seconds.
Fault at location 1
The main circuit breaker will trip, clearing the fault in 0.5 seconds.

Case 2: There is zone selective interlocking.
Assume a ground fault of 2000A occurs and refer to Figure 24.
Fault at location 3
The branch circuit breaker trip unit will initiate the trip in 0.045 seconds to clear the fault and the branch will send a restraint signal to the feeder trip unit; the feeder will send a restraint interlocking signal to Z1.
Main and feeder trip units will begin to time out and, in the event that the branch circuit breaker does not clear the fault, the feeder circuit breaker will clear the fault in 0.3 seconds (as above). Similarly, in the event that the feeder breaker does not clear the fault, the main breaker will clear the fault in 0.5 seconds (as above).

Fault at location 2
The feeder circuit breaker trip unit will initiate the trip in 0.045 seconds to clear the fault and will send an interlocking signal to the main trip unit. The main trip unit will begin to time out and, in the event that the feeder circuit breaker Z2 does not clear the fault, the main breaker will clear the fault in 0.5 seconds (as above).

Fault at location 1
There are no interlocking signals. The main circuit breaker trip unit will initiate the trip in 0.045 seconds.

Figure 25 presents a zone selective interlocking connection diagram for a system with two main circuit breakers from incoming sources and a bus tie circuit breaker.

Notes:
1. Wiring to be twisted wire pair AWG #14 to #20 (0.5 bis 2.5mm²). Route zone interlocking wiring separate from power conductors. DO NOT GROUND any zone interlocking wiring.
2. The maximum distance between two farthest breakers on different zones (from the ZO downstream to ZI upstream terminals is 250 feet (76m).
3. A maximum of 20 breakers may be contained in parallel in one zone.
4. Provide a self-interlocking jumper (on Zone 3) if coordination is desired with other downstream circuit breakers not providing the zone interlock feature.

Figure 24. Typical Zone Interlocking
Figure 25. Typical Zone Interlocking Connections with two Main Circuit Breakers (M1, M2) and a Tie Circuit Breaker (T)

Legend:
- C = Common (ungrounded) - Contact 28
- ZO = Zone Out Output Signal - Contact 27
- ZI = Zone In Input Signal from Lower Level Zone - Contact 29
## Appendix B: Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Possible Solution(s)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Status LED is not blinking</td>
<td>Current through breaker is &lt;100A (single-phase) or 35A (three-phase)</td>
<td>No problem. Status LED will not operate with breaker currents &lt;&lt;100A (single-phase) or 35A (three-phase)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trip unit is malfunctioning</td>
<td>Replace trip unit</td>
<td></td>
</tr>
<tr>
<td>Unit Status LED is steadily on</td>
<td>Light loading</td>
<td>No problem. Status LED will not flash until above 35A</td>
<td>See Section 2 note for trip and operational indicators</td>
</tr>
<tr>
<td></td>
<td>Trip unit is malfunctioning</td>
<td>Replace trip unit</td>
<td></td>
</tr>
<tr>
<td>When current starts flowing through the breaker, it trips.</td>
<td>Rating plug is not installed or is loose</td>
<td>Install rating plug and/or check for loose connections</td>
<td></td>
</tr>
<tr>
<td>the breaker, it trips. The orange (not red) instantaneous</td>
<td>Rating plug is open internally</td>
<td>Replace rating plug</td>
<td></td>
</tr>
<tr>
<td>trip LED lights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED does not light when Battery Check button is pressed</td>
<td>Battery installed backwards</td>
<td>Install correctly</td>
<td>See Section 5</td>
</tr>
<tr>
<td></td>
<td>Dead battery</td>
<td>Replace battery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fram module is malfunctioning</td>
<td>Contact Eaton</td>
<td></td>
</tr>
<tr>
<td>Breaker trips on ground fault</td>
<td>There actually is a ground fault</td>
<td>Find location of the fault</td>
<td></td>
</tr>
<tr>
<td>Breaker trips too rapidly on ground fault or short delay</td>
<td>Zone interlock signal is not present</td>
<td>Check wiring connections</td>
<td>Refer to Appendix A and Section 2 zone selective interlocking</td>
</tr>
<tr>
<td></td>
<td>Trip unit settings are not correct</td>
<td>Change settings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trip unit is malfunctioning</td>
<td>Replace trip unit</td>
<td></td>
</tr>
<tr>
<td>Breaker trips too rapidly on long delay</td>
<td>Long Time Memory selected</td>
<td>Turn off Long Time Memory</td>
<td>Refer to Section 3 for Long Delay Time setting</td>
</tr>
<tr>
<td></td>
<td>Trip unit settings are not correct</td>
<td>Change settings. Long Time Delay setting is based on 6 * Ic</td>
<td></td>
</tr>
<tr>
<td>Breaker trips with orange (not red) LED above long verbiage</td>
<td>High temperature Trip encountered</td>
<td>Check application connections, venting, etc.</td>
<td></td>
</tr>
<tr>
<td>Cause of Trip LEDs flashing and breaker is closed</td>
<td>Trip unit was not reset from previous event or test</td>
<td>Depress Reset pushbutton to clear LED flashing</td>
<td>See below</td>
</tr>
<tr>
<td></td>
<td>Battery voltage too low to reset latch chip and LEDs</td>
<td>Replace battery</td>
<td>See Section 5 for battery check</td>
</tr>
<tr>
<td>A Cause of Trip LED keeps rettriggering in the application</td>
<td>Digitrip memory buffer not completely reset</td>
<td>Need to reset Digitrip unit when Status LED is operational. Possibly do this by temporarily (or permanently) adding auxiliary power and then depress Reset pushbutton to fully clear trip buffer</td>
<td>See Section 2 mode of trip and status information</td>
</tr>
<tr>
<td>Status LED is red continuously or flashing red</td>
<td>Circuit breaker MCR (b) auxiliary switch not indicating proper state</td>
<td>Check auxiliary switch for continuity</td>
<td>Refer to Appendix E or F master connection diagram</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker mechanism not properly closing</td>
<td>Check with factory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trip actuator coil not connected (coil supervisor alarm)</td>
<td>Check coil connector R5 and check coil resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal memory problem</td>
<td>Replace Digitrip unit</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix C: Specifications

<table>
<thead>
<tr>
<th>Protection</th>
<th>Trip Pickup</th>
<th>Trip Time</th>
<th>Trip Pickup Tolerance</th>
<th>Trip Time Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LONG IPt</td>
<td>( I_p = 0.5, 0.6, 0.7, 0.75, 0.8, 0.9, 0.95, 1.0 \times I_n )</td>
<td>2, 4, 7, 10, 12, 15, 20, 24 at 6 ( I_p )</td>
<td>( 110% \pm 10% \times I_p )</td>
<td>( +0, -30% )</td>
</tr>
<tr>
<td>SHORT FLAT</td>
<td>2, 3, 4, 5, 6, 7, 8, 10 ( I_p )</td>
<td>0.1, 0.2, 0.3, 0.4, 0.5</td>
<td>( \pm 10% )</td>
<td>Per curve</td>
</tr>
<tr>
<td>SHORT IPt</td>
<td>2, 3, 4, 5, 6, 7, 8, 10 ( I_p )</td>
<td>0.1*, 0.3*, 0.5* at 8 ( I_p )</td>
<td>( \pm 10% )</td>
<td>Per curve</td>
</tr>
<tr>
<td>INST</td>
<td>2, 3, 4, 6, 8, 10, 12, OFF ( I_p )</td>
<td>OFF N/A on LI style</td>
<td>( \leq 50\text{ ms} )</td>
<td>( \pm 10% )</td>
</tr>
<tr>
<td>GROUND FLAT</td>
<td>0.25, 0.3, 0.35, 0.4, 0.6, 0.75, 1 ( I_p )</td>
<td>0.1, 0.2, 0.3, 0.4, 0.5</td>
<td>( \pm 10% )</td>
<td>Per curve</td>
</tr>
<tr>
<td>GROUND IPt</td>
<td>0.25, 0.3, 0.35, 0.4, 0.6, 0.75, 1 ( I_p )</td>
<td>0.1*, 0.3*, 0.5* at 0.625 ( I_p )</td>
<td>( \pm 10% )</td>
<td>Per curve</td>
</tr>
<tr>
<td>MCR</td>
<td>Automatically defined by the breaker type</td>
<td>( \leq 30\text{ ms} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH INST</td>
<td>Automatically defined by breaker type</td>
<td>( \leq 30\text{ ms} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Operating Specifications
- **Frequency**: 50, 60 Hz
- **Temperature range of circuit breaker**: -20°C to 55°C
- **Temperature trip of PC board**: 85°C
- **Relative humidity (noncondensing)**: 0 to 85%
- **Metering accuracy**: \( \pm 3\% \times NF \text{ Max Frame Rating (1600A), }\pm 4\% \text{ RF Max Frame Rating (4000A)} \)
- **Control voltage consumption**: 6 watts
- **Control voltage (if desired for Digitrip 520M alarm relays)**: 24 Vdc \( \pm 10\% \)

#### Alarm Relays (Resistive Load)

<table>
<thead>
<tr>
<th>Type</th>
<th>Current</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>0.5A</td>
<td>230 Vac</td>
</tr>
<tr>
<td>AC</td>
<td>1A</td>
<td>120 Vac</td>
</tr>
<tr>
<td>DC</td>
<td>1A</td>
<td>48 Vdc</td>
</tr>
<tr>
<td>DC</td>
<td>0.35A</td>
<td>125 Vdc</td>
</tr>
</tbody>
</table>
Appendix D: Performance testing for ground fault trip units—primary injection

North American Testing Requirements

In North America and certain other countries it is required that any ground fault protection system be performance tested when first installed. Conduct tests in accordance with the approved instructions provided with the equipment. Make a written record of this test and make the results available to the authority having inspection jurisdiction.

Standards requirements

As a follow-up to the basic performance requirements stipulated by the NEC, UL Standard No. 1053 requires that certain minimum instructions must accompany each ground fault protection system. These statements (in General Test Instructions), plus a copy of the record forms (Figure 28, Figure 29, and Figure 30), are included as part of this instructional leaflet.

General test instructions

The interconnected system must be evaluated only by qualified personnel and in accordance with the equipment assembler’s detailed instructions.

To avoid improper operations following apparently correct simulated test operations, the polarity of the neutral sensor connections (if used) must agree with the equipment assembler’s detailed instructions. Where a question exists, consult the specifying engineer and/or equipment assembler.

⚠️ WARNING

ELECTRICAL SHOCK OR BURN INJURY CAN OCCUR WHEN WORKING ON POWER SYSTEMS. ALWAYS TURN OFF POWER SUPPLYING CIRCUIT BREAKER BEFORE CONDUCTING TESTS. TEST OUT OF THE CELL, IF POSSIBLE.

Verify the grounding points of the system using high voltage testers and resistance bridges to ensure that ground paths do not exist that could bypass the sensors.

Use a low voltage (0- to 24-volt), high-current, AC source to apply a test current of 125 percent of the ground pickup setting through one phase of the circuit breaker. This should cause the circuit breaker to trip in less than 1 second and operate the alarm indicator, if one is supplied. Reset the circuit breaker and the alarm indicator. Repeat the test on the other two phases (Figure 26).

Apply the same current as described above through one phase of the circuit breaker, returning through the neutral sensor. The breaker should not trip, and the alarm indicator, if one is supplied, should not operate. Repeat the test on the other two phases.

Apply the same current as described above through any two phases of the circuit breaker. The breaker should not trip, and the alarm indicator, if one is supplied, should not operate. Repeat the test using the other two combinations of circuit breaker phases (Figure 27) or through a breaker pole and the neutral that employs a neutral sensor. Record the test results on the test form provided with the equipment (Figure 30).

Figure 26. Connection Details for Conducting Single-Pole, Single-Phase Current Tests With the Circuit Breaker Removed From the Cell
Figure 27. Connection Details for Conducting Single-Phase Current Tests With the Circuit Breaker Removed From the Cell

**CAUTION**

IF TEMPORARY CONNECTIONS WERE MADE FOR THE PURPOSE OF CONDUCTING TESTS, RESTORE PROPER OPERATING CONDITIONS BEFORE RETURNING THE CIRCUIT BREAKER TO SERVICE.

Record keeping

Use the forms in this section for record keeping. Record the indicated reference information and initial time-current trip function settings. If desired, make a copy of the form and attach it to the interior of the circuit breaker cell door or another visible location. **Figure 29** provides a place for recording test data and actual trip values.

Ideally, sheets of this type should be used and maintained by those personnel in the user’s organization that have the responsibility for protection equipment.
### Series NRX
#### TRIP FUNCTION SETTINGS

<table>
<thead>
<tr>
<th>Circuit No./Address</th>
<th>Breaker Shop Order Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trip Function</th>
<th>Per Unit Setting</th>
<th>Multi</th>
<th>Ampere Equivalent Setting</th>
<th>Time Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instantaneous</td>
<td>$I_p$</td>
<td></td>
<td>$LDS \times I_p$</td>
<td></td>
</tr>
<tr>
<td>Long Delay</td>
<td>$I_p$</td>
<td>Sec.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Delay</td>
<td>$I_p$</td>
<td>Sec.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Fault</td>
<td>$I_p$</td>
<td>Sec.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Date _____________________________ | By _____________________________ |

Figure 28. Typical Trip Function Record Nameplate

### Series NRX
#### AUTOMATIC TRIP OPERATION RECORD

<table>
<thead>
<tr>
<th>Circuit No./Address</th>
<th>Breaker Shop Order Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trip Function</th>
<th>Settings Reference</th>
<th>Orig. 0</th>
<th>Rev. 1</th>
<th>Rev. 2</th>
<th>Rev. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instantaneous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Delay Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Delay Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Fault Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Fault Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date of Trip</th>
<th>Trip Mode Indicator</th>
<th>Setting Ref.</th>
<th>Setting Change Made</th>
<th>Investigated By</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 29. Automatic Trip Operation Record
### GROUND FAULT TEST RECORD FORM

Ground Fault Test Record should be retained by those in charge of the building's electrical installation in order to be available to the authority having jurisdiction.

<table>
<thead>
<tr>
<th>Test Date</th>
<th>Circuit Breaker Number</th>
<th>Results</th>
<th>Tested By</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 31. Typical Performance Test Record Form
Appendix E: Typical breaker master connection diagram - NF

Figure 32. Series NRX-NF frame (IZMX16/IZM91) breaker master connection diagram drawing number 6D32389 (continued next page)
Figure 33. Series NRX-NF frame (IZMX16/IZM91) breaker master connection diagram drawing number 6D32389 (continued from previous page)

Notes for Figures 31 and 32 (Diagram drawing number 6D32389 - NF Frame)

1. All contacts shown with circuit breaker open and discharged and control power de-energized. The OTS are shown in reset position.
2. All trip unit wires are #22 AWG—0.34 mm²—300V.
3. All accessory wires are #18 AWG—0.82 mm²—600V.
4. 54 contacts maximum.
5. PT module inputs for Digitrip 1150 only.
6. Connectors K15 and K16 are not always present.
7. On three-pole circuit breakers only, connector K4—1.2 wires only are wired out to secondary contacts.
8. Odd number contacts have guide rib on black housing.
9. Zone interlock wiring shown dotted—optional jumper is standard.
10. Latch check switch can be wired either externally (option) or internally (option) to a spring release accessory. Wiring LCS internally ensures the one-shot pulse provided by the SR circuitry is made active only after the mechanism spring is charged and the latch is in its proper state.
11. For accessories having a DC rating, the odd numbers will be treated as positive voltage.
12. Reserved for spring charge SC input contact.
13. For Digitrip 520M ALM2 is an alarm used for GF (Ground fault style trip unit). ALM1 is used for diagnostic alarm or maintenance mode active. For Digitrip 1150, these contacts can be programmed as desired.
Appendix F: Typical breaker master connection diagram - RF

Figure 34. Series NRX-RF frame (IZMX40/IZM95) breaker master connection diagram drawing number 6D32424 (continued on next page)
Figure 35. Series NRX-RF frame (IZMX40/IZM95) master connection diagram drawing number 6D32424 (continued from previous page and notes on next page)
Notes for pages 36 and 37 (Diagram drawing number 6D32424 - RF Frame)

1. All contacts shown with circuit breaker open and discharged and control power de-energized. The OTS are shown in reset position.
2. All trip unit wires are #22 AWG—0.34 mm²—300V.
3. All accessory wires are #18 AWG—0.82 mm²—600V.
4. 92 contacts maximum.
5. Contacts 14, 30, 31 and 32, 47, 48 not used.
6. Connectors K15 and K16 are not always present.
7. On three-pole circuit breakers only, connector K4—1.2 wires only are wired out to secondary contacts.
8. Odd number contacts have guide rib on black housing.
9. Zone interlock wiring shown dotted—optional jumper is standard.
10. Latch check switch can be wired either externally (option) or internally (option) to a spring release accessory. Wiring LCS internally ensures the one-shot pulse provided by the SR circuitry is made active only after the mechanism spring is charged and the latch is in its proper state.
11. For accessories having a DC rating, the odd numbers will be treated as positive voltage.
12. Reserved for spring charge SC input contact.
13. For Digitrip 520M ALM2 is used for GF (ground fault style trip unit) or high load alarm (non-ground fault style trip unit). ALM1 is used for diagnostic alarm or maintenance mode active. For Digitrip 1150, these contacts can be programmed as desired.
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