

Protection and Communication Setup

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Qualified Persons **WARNING**

Only qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet**NOTICE**

Thoroughly and carefully read this instruction sheet and all materials included in the product's instruction handbook before installing or operating the IntelliRupter PulseCloser Fault Interrupter. Become familiar with the Safety Information and Safety Precautions on pages 5 and 6. The latest version of this publication is available online in PDF format at sandc.com/en/support/product-literature/.

Retain this Instruction Sheet

This instruction sheet is a permanent part of the IntelliRupter® fault interrupter. Designate a location where users can easily retrieve and refer to this publication.

Proper Application **WARNING**

The equipment in this publication is only intended for a specific application. The application must be within the ratings furnished for the equipment. Ratings for the IntelliRupter fault interrupter are listed in the ratings table in Specification Bulletin 766-31.

Special Warranty Provisions

The standard warranty contained in seller's standard conditions of sale, as set forth in Price Sheets 150 and 181, applies to the IntelliRupter fault interrupter and its associated options except for the control group as applicable. For these devices, the first and second paragraphs of said warranty are replaced by the following:

General: The seller warrants to the immediate purchaser or end user for a period of 10 years from the date of shipment that the equipment delivered, with the exception of a radio, will be of the kind and quality specified in the contract description and will be free of defects of workmanship and material. Should any failure to conform to this warranty appear under proper and normal use within 10 years after the date of shipment, the seller agrees, upon prompt notification thereof and confirmation

that the equipment has been stored, installed, operated, and maintained in accordance with recommendations of the seller and standard industry practice, to correct the nonconformity either by repairing any damaged or defective parts of the equipment or (at seller's option) by shipment of necessary replacement parts.

The seller's warranty does not apply to any equipment that has been disassembled, repaired, or altered by anyone other than the seller. This limited warranty is granted only to the immediate purchaser or, if the equipment is purchased by a third party for installation in third-party equipment, the end user of the equipment. The seller's duty to perform under any warranty may be delayed, at the seller's sole option, until the seller has been paid in full for all goods purchased by the immediate purchaser. No such delay shall extend the warranty period.

The seller further warrants to the immediate purchaser or end user that for a period of two years from the date of shipment the software will perform substantially in accordance with the then-current release of specifications if properly used in accordance with the procedures described in seller's instructions. The seller's liability regarding any of the software is expressly limited to exercising its reasonable efforts in supplying or replacing any media found to be physically defective or in correcting defects in the software during the warranty period. Seller does not warrant the use of the software will be uninterrupted or error-free.

For equipment/services packages, the seller warrants, for a period of one year after commissioning, that the IntelliRupter fault interrupters will provide automatic fault isolation and system reconfiguration per agreed-upon service levels. The remedy shall be additional system analysis and reconfiguration of the IntelliTeam SG Automatic Restoration System until the desired result is achieved.

Warranty Qualifications

The standard warranty contained in seller's standard conditions of sale, as set forth in Price Sheets 150 and 181, does not apply to major components not of S&C manufacture, such as batteries, customer-specified remote terminal units and communication devices, as well as hardware, software, resolution of protocol-related matters, and notification of upgrades or fixes for those devices. The seller will assign to the immediate purchaser or end user all manufacturers' warranties that apply to such major components.

The seller's standard warranty does not apply to any components not of S&C manufacture that are supplied and installed by the purchaser or to the ability of seller's equipment to work with such components.


Warranty of equipment/services packages is contingent upon receipt of adequate information on the user's distribution system, sufficiently detailed to prepare a technical analysis. The seller is not liable if an act of nature or parties beyond S&C's control negatively impact performance of equipment/services packages; for example, new construction that impedes radio communication, or changes to the distribution system that affect protection systems, available fault currents, or system loading characteristics.

End User License Agreement

The end user is granted a nontransferable, non-sublicensable, nonexclusive license to use the LinkStart Connection Management Software, IntelliLink Setup Software, IntelliTeam Automatic Restoration Software, Loop Restoration Software, and/or other software furnished with an IntelliRupter PulseCloser Fault Interrupter only upon acceptance of all the terms and conditions of the seller's end user license agreement set forth in Price Sheet 155 and Price Sheet 156.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels attached to the IntelliRupter PulseCloser Fault Interrupter. Become familiar with these types of messages and the importance of these various signal words:

 DANGER
“DANGER” identifies the most serious and immediate hazards that will result in serious personal injury or death if instructions, including recommended precautions, are not followed.


 WARNING
“WARNING” identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

 CAUTION
“CAUTION” identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE
“NOTICE” identifies important procedures or requirements that can result in product or property damage if instructions are not followed.

Following Safety Instructions

If any portion of this instruction sheet is not understood and assistance is required, contact the nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website sandc.com, or call the S&C Global Support and Monitoring Center at 1-888-762-1100.

NOTICE	
Read this instruction sheet thoroughly and carefully before installing or operating the IntelliRupter PulseCloser Fault Interrupter.	

Replacement Instructions and Labels

If additional copies of this instruction sheet are required, contact the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

DANGER



IntelliRupter PulseCloser Fault Interrupters operate at high voltage. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

- 1. QUALIFIED PERSONS.** Access to an IntelliRupter fault interrupter must be restricted only to qualified persons. See the "Qualified Persons" section on page 3.
- 2. SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
- 3. PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules.
- 4. SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
- 5. OPERATING MECHANISM AND BASE.** IntelliRupter fault interrupters contain fast-moving parts that can severely injure fingers. Do not remove or disassemble operating mechanisms or remove access panels on the IntelliRupter fault interrupter base unless directed by S&C Electric Company.
- 6. ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, tested, and grounded. The integrated power module (IPM) contains components that can retain a voltage charge for many days after the IntelliRupter fault interrupter has been de-energized and can derive a static charge when in close proximity to a high-voltage source. Voltage levels can be as high as the peak line-to-ground voltage last applied to the IntelliRupter fault interrupter. IntelliRupter fault interrupters that have been energized or installed near energized lines should be considered live until tested and grounded.
- 7. GROUNDING.** The IntelliRupter fault interrupter base must be connected to a suitable earth ground at the base of the utility pole, or to a suitable building ground for testing, before energizing an IntelliRupter fault interrupter, and at all times when energized.

The ground wire(s) must be bonded to the system neutral, if present. If the system neutral is not present, proper precautions must be taken to ensure the local earth ground, or building ground, cannot be severed or removed.
- 8. VACUUM INTERRUPTER POSITION.** Always confirm the **Open/Close** position of each interrupter by visually observing its indicator.

Interrupters, terminal pads, and disconnect blades on disconnect style models may be energized with the interrupters in any position.

Interrupters, terminal pads, and disconnect blades on disconnect style models may be energized from either side of the IntelliRupter fault interrupter.
- 9. MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.

This instruction sheet is used with software version IntelliRupterECInstaller-7.6.x.exe. The “x” can indicate any number from 0 to 255. Other related software component version information is found on the *Setup>General>Revisions* screen. IntelliRupterECInstaller-7.6.x.exe is the name of the installer file available at the S&C Automation Customer Support Portal.

These instructions cover protection and communication setup of an IntelliRupter PulseCloser Fault Interrupter. IntelliRupter fault interrupters may be used in standalone radial-protection applications, for source-transfer operations, for loop restoration, or as part of an IntelliTeam SG Automatic Restoration System.

The Standard Control Group can operate stand-alone (non-communicating) applications, SCADA communications, and automatic loop restoration. It also includes IntelliTeam SG Bronze-Level Software for applications with two sources, including automatic source transfer. Optional IntelliTeam SG Silver-Level Software is used for basic closed-loop applications, and IntelliTeam SG Gold-Level Software is for applications with three or more sources.

The automatic loop-restoration system is non-communicating and uses normally closed IntelliRupter fault interrupters or conventional reclosers with a normally open IntelliRupter fault interrupter switching point. The feeders on either side of the switching point are fed from different sources. When a fault occurs on either feeder, the normally closed IntelliRupter fault interrupters (or reclosers) in that feeder open and then use PulseClosing® Technology (or reclose) sequentially to sectionalize and isolate the fault. Service is automatically restored to unfaulted line segments by closing the IntelliRupter fault interrupter at the normally open switching point.

The automatic source-transfer system uses two IntelliRupter fault interrupters with peer-to-peer communication to ensure a high degree of critical-load continuity by minimizing interruptions resulting from the loss of one source.

The IntelliTeam SG system monitors real-time load, and it uses peer-to-peer communication to determine fault location and alternate source-restoration capability. After protection operations isolate the fault, the IntelliTeam SG system automatically restores service to as many unfaulted line segments as the alternate source has reserve capacity to supply. An IntelliTeam SG system with a Gold license can be easily expanded to automate large distribution regions by using multiple alternate sources.

The Standard Control Group with Battery Backup is the same software in the Standard Control Group and includes a battery that can operate for a minimum of four hours after loss of ac-line voltage on both sides of the IntelliRupter fault interrupter to provide extended dead-line switching.

The Universal Control Group includes IntelliTeam SG Automatic Restoration Software with a Gold license and IntelliTeam® Designer software. This group will operate all features of the IntelliTeam SG system with three or more sources, and it can be configured to operate in an IntelliTeam® II Automatic Restoration System.

IntelliRupter fault interrupters may be configured before installation or on site with a secure Wi-Fi communication link to a laptop computer running IntelliLink® Setup Software. User-selectable setup parameters include device name and location, phase identifications, terminal designations, current-flow directions, voltage-reporting units, and a time-synchronization source.

Up to four **General** profiles can be configured; one is selected for normal use. IntelliTeam SG software allows selection of an **Alternate** profile for use when the IntelliRupter fault interrupter is powered from an alternate source. See S&C Instruction Sheets 766-532, “IntelliRupter® PulseCloser® Fault Interrupter: *IntelliTeam® Automatic Restoration System Setup*,” and 1044-570, “IntelliTeam® Designer: *User’s Guide*,” for more information regarding the setup and confirmation of the IntelliTeam SG system.

A wide variety of features and functions can be selected and configured in the **General** profiles, including the following:

Overcurrent Elements—Simultaneous Independent Directional Phase, Ground, Negative-Sequence, and Sensitive Earth Time-Overcurrent, Instantaneous-Overcurrent, and Definite-Time elements are provided.

PulseClosing Technology Operations—The IntelliRupter fault interrupter can be configured to test for faults using PulseClosing Technology—a unique, patented means for verifying the line is clear of faults before initiating a closing operation. It uses precisely timed, quick close and open operation of the interrupters and analysis of the current pulse to determine whether a fault is present. A **PulseClosing Technology** operation subjects the system to a small fraction of the fault energy experienced during conventional reclosing. If no fault is detected, the device will close. A **PulseClosing Technology** operation can also be initiated before a regular closing operation from the fully open and locked out condition to determine whether a fault is present.

Conventional Closing—The IntelliRupter fault interrupter can be configured to use a conventional close for any test after the initial fault trip. The “hard” close may be required to allow a fuse operation after the initial fuse-saving operation. Up to four test operations can be configured, and each can be a **PulseClosing Technology** operation or a conventional close. A different inverse curve can be used for each close. Conventional closing subjects the system to high-impact fault current at each closing operation.

PulseFinding™ Fault Location Technique Operations—When a fault occurs downstream of series-connected IntelliRupter fault interrupters that cannot be selectively coordinated, the devices can be configured so they all trip open. The fault is quickly located by sequential **PulseClosing Technology** operations, starting at the open device closest to the source. Each successive downstream device will perform a **PulseClosing Technology** operation, find no fault and, quickly close. But the device nearest the fault will perform a **PulseClosing Technology** operation, sense the fault, and stay open.

Intelligent Fuse Saving—In conventional fuse-saving schemes, the upstream protective device operates to save the lateral fuse. Intelligent fuse saving configures the IntelliRupter fault interrupter so when fault current is above the point where the fuse would be faster than the device, the IntelliRupter fault interrupter operates on a delayed curve so only the fuse operates to isolate the fault. Customers downstream of the device do not experience a momentary outage.

Sequence Coordination—The **Sequence Coordination** element maintains proper coordination between the IntelliRupter fault interrupter and downstream reclosers. If a fault is cleared by a downstream recloser, the IntelliRupter fault interrupter will shift to a slower time-current coordination curve before fault testing by the downstream recloser.

Hot Line Tag Profile—The **Hot Line Tag** mode can be set locally with the HOT LINE TAG lever and with an IntelliLink or SCADA command. The **Hot Line Tag** profile allows the user to select alternate overcurrent, voltage, and frequency protection with one trip-to-lockout, and it blocks all closing commands. For more information, see the “Manual Hot Line Tag” section in Instruction Sheet 766-510, “S&C IntelliRupter® PulseCloser® Fault Interrupter: *Installation*.”

Closing Profiles—A **Closing Profile** operation is used when the IntelliRupter fault interrupter is closed from the **Open and Locked Out** position. The **Synch Check** mode may be used before closing, or a PulseClosing Technology operation, to test for faults. Overcurrent, voltage, and frequency protection may all be set for one trip to lockout. **Closing Profile** operations are time-limited and will switch to the assigned general profile when closing is successful. A second **Closing Profile** operation with different parameters than the first **Closing Profile** operation may be selected.

Single-Phase Trip—IntelliRupter fault interrupters can be configured to open only the faulted phases for an overcurrent trip signal.

Cold Load Pickup—The **Cold Load Pickup** modifier can be set to modify overcurrent protection after an extended outage.

Ground Trip Block—The **Ground Trip Block** mode prevents an inadvertent trip caused by the imbalance created by diverting current on one or two phases through single-phase bypass switches.

DNP Point Mapping—DNP points for the IntelliRupter fault interrupter can be mapped to different point numbers on a SCADA system. See S&C Instruction Sheet 766-560, “IntelliRupter® PulseCloser® Fault Interrupter: *DNP Points List and Implementation*.”

Requirements and Installation

Review the “Computer Requirements” and “Software Installation” sections in Instruction Sheet 766-571, “IntelliRupter® PulseCloser® Fault Interrupter: *Software Installation*.”

Coordinaide™— The S&C Protection & Coordination Assistant

Coordinaide software can plot various TCC curves for a protection overcurrent element direction. The curves appropriate for both the upstream and downstream protective devices can then be selected, and their parameters downloaded to a Setpoints Group File for uploading to the IntelliRupter fault interrupter control. A Setpoints Group File can also be downloaded from a control and opened using Coordinaide software for evaluation.

The link to Coordinaide software is located on the S&C website at: **sandc.com/en/support/coordinaide/**. When selected, the link the opening page has a brief description of the protection applications Coordinaide software can handle. When launching the program, the next page contains the Conditions of Use disclaimer, the minimum Web browser requirements, and a link to the Coordinaide software users guide. After agreeing to the Conditions of Use, one final click launches the program.

Operation Screen

After the computer has been configured and set up for Wi-Fi communication, connection is automatically accomplished through IntelliLink Setup Software.

To connect to an IntelliRupter fault interrupter with IntelliLink Setup Software, see the “Wi-Fi Connection to an IntelliRupter Fault Interrupter with IntelliLink® Setup Software” section in Instruction Sheet 766-571, “IntelliRupter® PulseCloser® Fault Interrupter: *Software Installation.*”

After verification of the password, the *Operation* screen opens. See Figure 1. It shows the present status of IntelliRupter fault interrupter, including voltage and current readings and any existing fault or error conditions. The IntelliRupter fault interrupter is also operated from this screen.

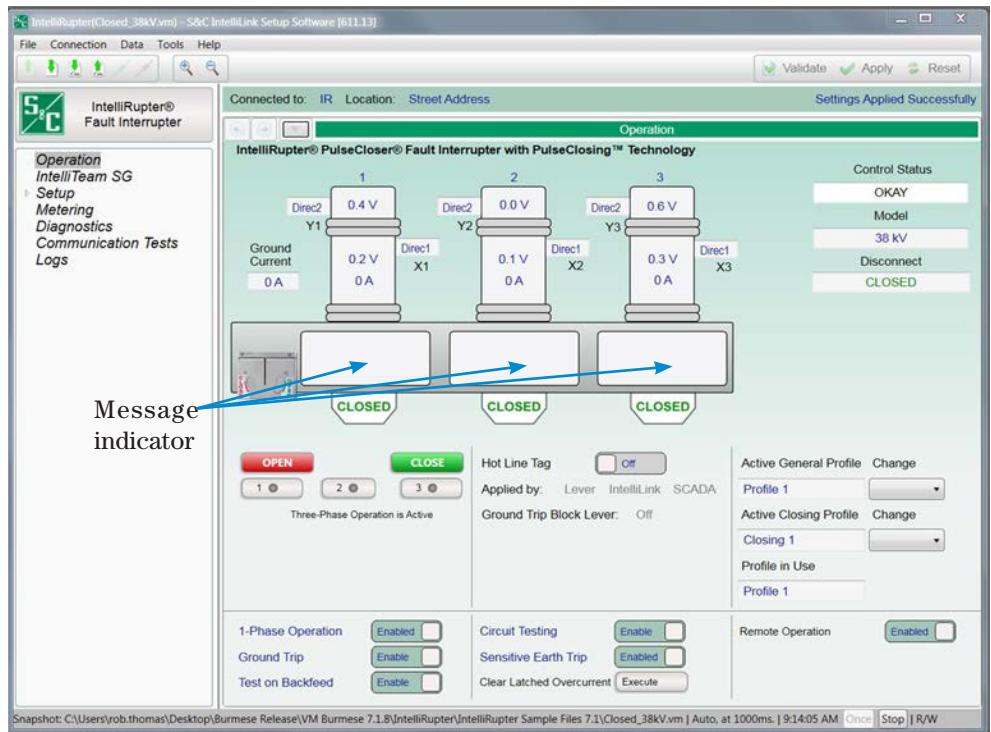


Figure 1. The IntelliRupter fault interrupter *Operation* screen.

The left menu on every IntelliRupter screen shows topics that can be expanded and clicked to navigate to another screen. On the *Operation* screen, “Operation” is highlighted on the left menu. Screens having multiple topics are tabbed, as shown in Figure 2 on page 13. When a particular topic is selected, the tab is highlighted.

Clicking on the change buttons next to the user commands found on the lower portion of the *Operation* screen will toggle the command state. The active state is shown by the word displayed on the change button.

When the **Single-Phase Operation** mode is enabled the **1**, **2**, and **3** buttons found under the **Open** and **Close** buttons can be selected to enable single-phase operation. Select a pole by clicking on one of the buttons. The indication will change to orange to show the next **Open** or **Close** request will be applied to the selected pole. One, two, or three poles can be operated depending on the selections. Click the **Open** or **Close** button after making the selection.

The active **General** profile or the active **Closing** profile can be changed by selecting an **Alternative** profile from the **Change** pull down menu item next to the text box displaying the active profile.

Return to the *Operation* screen from other IntelliLink software screens by clicking on the **Operation** menu item on the navigation tree at the left of the screen.

The *Operation* screen contains three message indicators. See Figure 1 on page 11. The list of possible messages in the order of precedence is:

Settings Mismatch	LOCKOUT-OC
LOCKED OPEN	LOCKOUT-SEF
Close Blkd No Energy	PICKUP-FREQ
Fault-Pulseclosing	PICKUP-SECT
Lockout-Pulseclosing	PICKUP-VOLTS
Close Blkd-Sync Check	PICKUP-OC
Close Blkd Pulse Inop	PICKUP-SEF
LOCKOUT-FREQ	TESTING
LOCKOUT-SECT	TESTING-SEF

Note: Blkd = Blocked; Inop = Inoperable; FREQ = Frequency; SECT = Sectionalizing; OC = Overcurrent; SEF = Sensitive Earth Fault.

**IntelliLink Software
Workspace**

The IntelliLink software user interface includes many standard features found in Windows-based products as well as some custom features designed to make navigating through the IntelliRupter fault interrupter settings easier. See Figure 2.

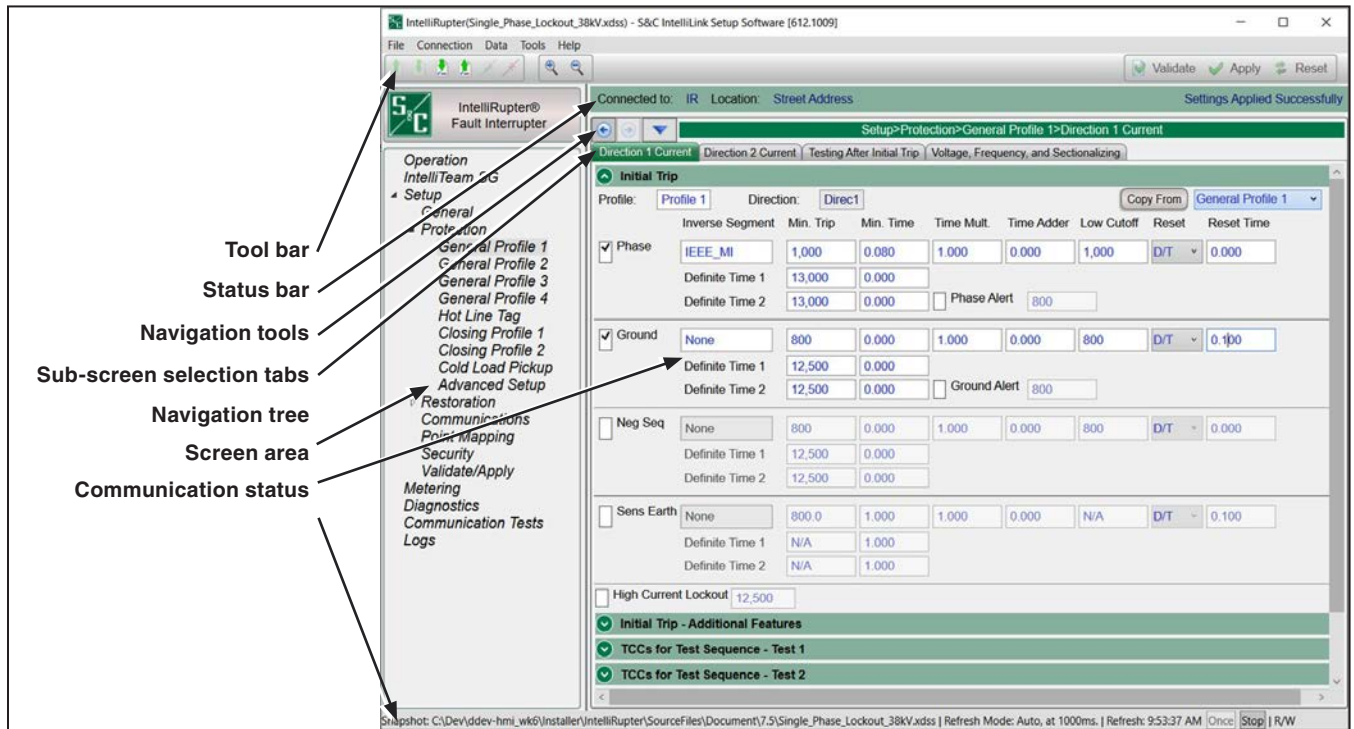


Figure 2. IntelliLink software features.

Tool Bar



Open Snapshot

Same as *Main Menu>File>Open Snapshot*—Clicking on this icon opens a file browser to allow the selection of a snapshot file.



Save Data Snapshot

Same as *Main Menu>File>Save Data Snapshot*—Clicking on this icon allows saving a snapshot of the control data. It provides a picture of the controls memory content in a programming format.



Save Setpoints

Same as *Main Menu>File>Save Setpoints*—Clicking on this icon opens the Save Setpoints dialog box.



Load Setpoints•

Same as *Main Menu>File>Load Setpoints*—Clicking on this icon opens the Load Setpoints dialog box.



Zoom In

Clicking on this icon increases the size of objects and text in the screen area. See Figure 2 on page 13.



Zoom Out

Clicking on this icon decreases the size of objects and text in the screen area. See Figure 2 on page 13.



Validate

Same as **Validate** button on the *Setup>Validate/Apply* screen. See Figure 122 on page 230. Checks the pending changes; does not apply them.



Apply

Same as **Apply** button on the *Setup>Validate/Apply* screen. See Figure 122 on page 230. Checks the pending changes, and applies them if no errors are found.



Reset

Same as **Reset Buffer** button on the *Setup>Validate/Apply* screen. See Figure 122 on page 230. Removes pending changes and returns to settings in the memory.

- When setpoints from an older or a newer compatible version of IntelliLink software is loaded and the setpoints do not exist in this version, an error will occur because the software does not understand any setpoints not presently supported by the software. The unknown objects also will not be converted.

Status Bar

	Connected to:	This field shows the user defined device name. The device name is entered on the <i>Setup>General>Site-Related</i> screen.
	Location:	This field shows the user defined device location. The device location is entered on the <i>Setup>General>Site-Related</i> screen.
	Validate Status	This field shows the status of the Validate and Apply functions.

Navigation Tools

	Navigation History	Clicking on this icon opens a list of the last 10 screens visited. Selecting a screen from the list will automatically transition from the present screen to the selected screen.
	Navigate Back	Clicking on this icon selects the next screen down in the history list.
	Navigate Forward	Clicking on this icon selects the next screen up in the history list.
	Bread crumb Field	This field contains the path of the current screen.

Navigation Tree

	Expand Arrow	This indicates the item to the right is collapsed with additional items underneath. Clicking on this icon expands the list to show the hidden sub-items.
	Collapse Arrow	This indicates the item to the right is expanded showing additional items underneath. Clicking on this icon collapses the list to hide the displayed sub-items.

Sub-screen Selection Tabs



Green indicates the active screen tab.



Grey indicates an inactive tab. Clicking on an inactive tab changes from the active screen to the screen associated with the clicked tab.

Screen Area and Data Entry

The screen area contains various data objects used for configuring the control as well as some features for displaying and accessing the data objects. The basic data objects contain text boxes for direct text entry and list boxes for data selection.



Text boxes with white background and light blue text indicate editable content. The cursor will change when hovering over and editable field.



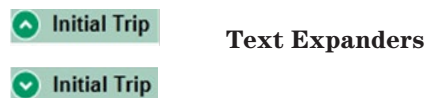
Text boxes with a grey background and dark blue text indicate dynamic text populated by the control. This text cannot be changed.



List boxes as indicated by the down arrow supply a list of choices when selected. The current selection will either be shown on the list box or in an adjacent text box.



Check boxes will be provided for enable/disable decisions. Data fields for disabled items will be automatically hidden or grey shaded. Data fields for disabled items cannot be changed.



Expanders are provided to help manage the view. When the data below the expander is visible the expander icon arrow points up. Clicking on the icon collapses or hides the data from view. When the data is hidden the expander arrow points down. Clicking on the icon displays the hidden data.

Communication Status

The communication status bar at the bottom of every IntelliLink software screen displays the connection addresses, the refresh mode, and the last refresh. The time changing after “Refresh:” indicates the control is communicating. The refresh defaults to **Auto** mode but can be stopped by clicking on the **Stop** button and manually refreshed by clicking on the **Once** button that comes into context when the refresh is stopped.

Site-Related

Device

Device Name

Enter a name for the IntelliRupter fault interrupter, up to 12 characters. See Figure 3. This name is displayed at the top of every screen in the **Connected to:** field.

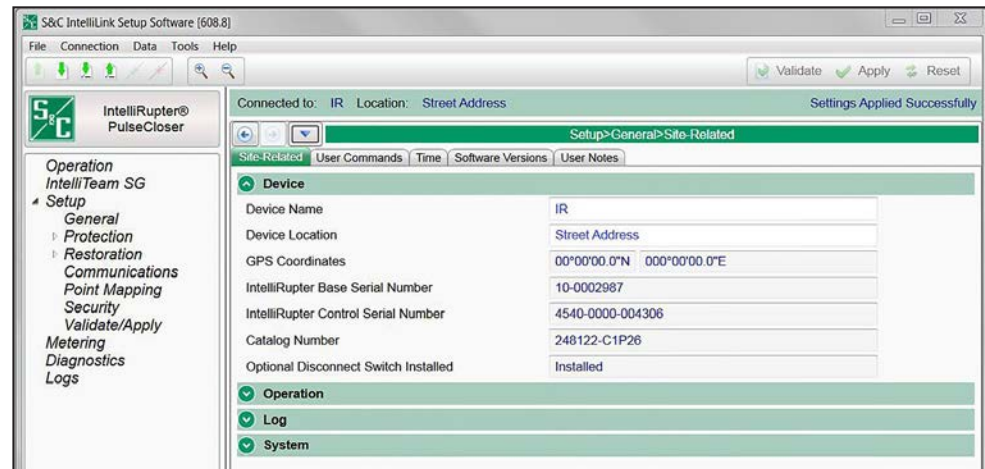


Figure 3. The Setup>General>Site-Related>Device screen.

Device Location

Enter a location for the IntelliRupter fault interrupter, up to 64 characters. This location is displayed at the top of every screen in the **Location:** field.

GPS Coordinates

The location data provided by the integrated global positioning system is automatically displayed.

IntelliRupter Base Serial Number

The serial number is automatically read from the base memory module.

IntelliRupter Control Serial Number

This serial number is automatically read from the protection and control module.

Catalog Number

The catalog number is automatically read from the base memory module.

Base Memory Module Version Number

This field displays the version number for the base memory module.

Optional Disconnect Switch Installed

Presence of the integral disconnect is automatically determined from the base memory module.

Operation

Mode of Operation

Select the **Operation** mode with the drop-down button. See Figure 4. The **Radial** mode is the default and provides basic protection with no automatic load restoration. The **IntelliTeam SG** mode starts IntelliTeam SG system operation after fault interruption and isolation have completed. Refer to S&C Instruction Sheets 766-532, “IntelliTeam® Automatic Restoration System Setup” and 1044-570, “S&C IntelliTeam® Designer: *User’s Guide*” for information about IntelliTeam Automatic Restoration System configuration. To use an IntelliRupter fault interrupter with the IntelliTeam® II Automatic Restoration System, the IntelliTeam SG software must be set to operate in the **IntelliTeam II Compatibility** mode. The **Loop** mode uses a standard loop restoration system configuration.

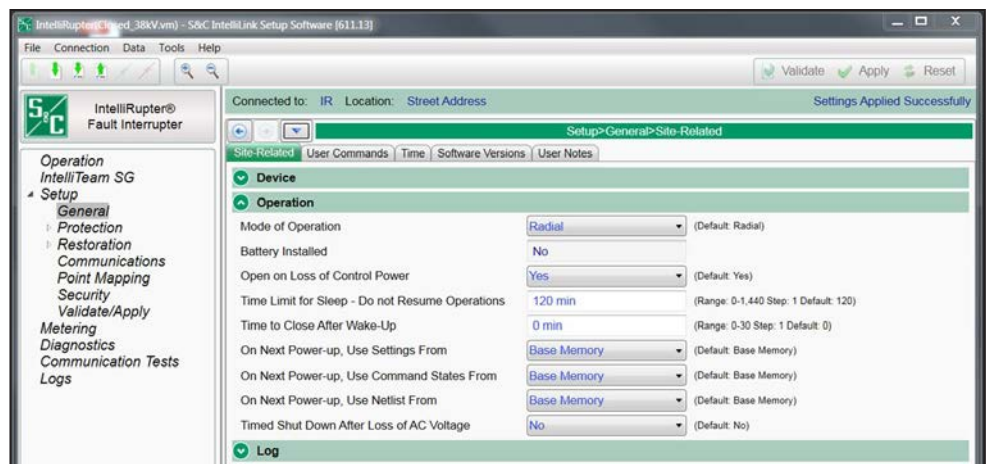


Figure 4. The *Setup>General>Site-Related>Operation* screen.

To enable CEC status information on the *Operation* screen, both the **Coordination Mode** setpoint in one or more of the **General** profiles must be set to the **Communication Enhanced Coordination** feature on the *Setup>Protection>General Profile 1-4>Direction 1 Current>TCCs for Coordination* screen, and the **Mode of Operation** setpoint must be set to the **IntelliTeam SG** feature on the *Setup>General>Site-Related* screen.

Battery Installed

The control automatically determines whether a battery is installed.

Open on Loss of Control Power

Select the **Yes** option to configure the IntelliRupter fault interrupter to open when capacitor energy storage reaches a critical level because of loss of line power and a low battery charge. Opening on loss of control power limits in-rush current when the circuit is re-energized and feeder segments are sequentially picked up. Select the **No** option to configure the IntelliRupter fault interrupter to remain closed when stored energy is depleted.

Time Limit for Sleep—Do Not Resume Operations

This is the maximum number of minutes the IntelliRupter fault interrupter can remain de-energized after opening on loss of control power and still be able to close automatically when control power is restored. The IntelliRupter fault interrupter must have been in the **Closed** position before loss of control power. Setting this value to 0 minutes will prohibit an automatic close. (Range: 0-1440; Step: 1 minute; Default: 120)

Time to Close After Wake-Up

When control power is restored and the **Time Limit for Sleep—Do Not Resume Operations** timer has not expired, automatic closing of the IntelliRupter fault interrupter will be delayed by this timer. It may take up to 30 seconds after line power is restored for the IntelliRupter fault interrupter to automatically close, even when the **Time to Close After Wake-Up** timer is set to 0 minutes. (Range: 0-30; Step: 1 minute; Default: 0)

On Next Power-up, Use Settings From:

Select from the drop-down list. Select the **Control Once** or **Control Always** options when the IntelliRupter fault interrupter was previously configured and those control settings will be used. When the protection-and-control module is a replacement, select the **Base Memory** option. The replacement module will be configured with the settings stored in the base memory module. Settings are stored for: **Block Ground Trip, Use 2nd Closing Profile, HLT Set by SCADA, HLT Set by Wi-Fi, HLT Set by IntelliLink screen, Block Circuit Testing, Block Test on Backfeed, Block SEF Trip, Block Single Phase Trip, Remote Operation**, and the active **General** functions.

On Next Power-up, Use Command States From:

Select from the drop-down list. Select the **Control Once** or **Control Always** options when the IntelliRupter fault interrupter was previously configured and those command states will be used. When the protection-and-control module is a replacement, select the **Base Memory** option. The replacement module will be configured by the command states stored in the base memory module. States are stored for these functions:

- **Ground/Neg-Seq Trip Enable/Block**
- **Loop Restoration Enable/Disable**
- **Circuit Testing Enable/Block**
- **Test on Backfeed Enable/Block**
- **Sensitive Earth Trip Enable/Block**
- **Single-Phase Trip Enable/Block**
- **Remote Operation Enable/Disable**
- **HLT Set by SCADA, HLT Set by IntelliLink.**
- **Latched Overcurrent Execute**

When the GROUND TRIP manual lever is in the **Blocked** state, it takes precedence over the saved user command state.

When the HOT LINE TAG manual lever is in the **On** state, it takes precedence over the saved user command state.

On Next Power-up, Use Netlist From:

Select from the drop-down list. Select the **Control Once** or **Control Always** options when the IntelliRupter fault interrupter was previously configured and that Netlist will be used. When the protection-and-control module is a replacement, select the **Base Memory** option. The replacement module will be configured with the Netlist stored in the base memory module.

Timed Shut Down after Loss of AC Voltage

Select the **Yes** option to require timer expiration before shutdown. The **No** option is the default.

Time to Disconnect Battery After Loss of Ac Voltage

This setting configures the timer. (Range: 1-240; Step: 1 minute; Default: 120)

Log

Logging Level

The selected logging level determines the type of data-log messages captured in the base memory module and is displayed on the *Logs>Historic Log* screen. See Figure 5. The **Normal** setting is the default. Every data-log message is assigned one of these specific log levels:

Normal—User information

Extended—User information and internal status

All—User information, internal status, and internal trace/debugging information

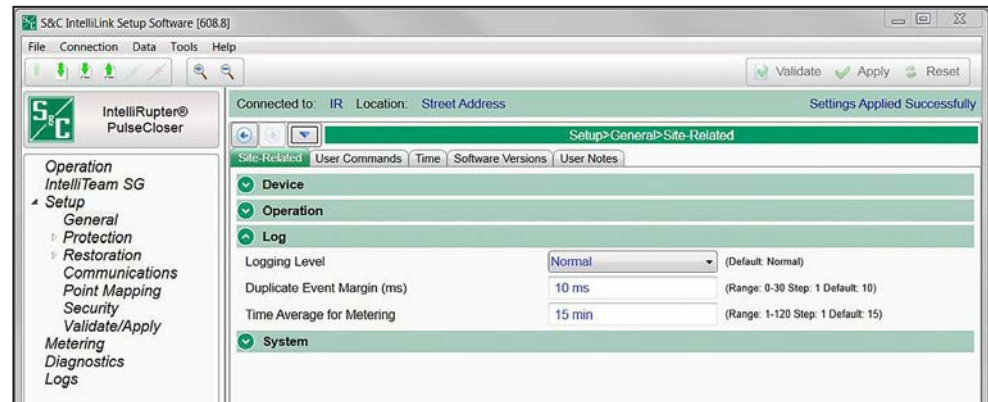


Figure 5. The Setup>General>Site-Related>Log screen.

Duplicate Event Margin (milliseconds)

Storing rapidly occurring duplicate events can flood the internal memory and does not yield useful diagnostic information. Every element of their event records must match for events to be considered duplicates. This setpoint selects data to be stored in the internal memory and be displayed on the *Logs>Historic Log* screen. It determines the time between logging a duplicate event. It has no effect on an alternating sequence of events.

For example, the setpoint can be set to 10 ms. For a sequence of events ABABAB (where A and B are different), assume the next event occurs 1 ms after the previous one. Though identical events occur within 2 ms, well within the value of the setpoint, all events will be logged. (Range: 0-30; Step: 1 millisecond; Default: 10)

Time Average for Metering

This is the sampling period in minutes used in generating data for the compact flash metering pro files. A smaller interval results in more log entries. (Minimum: 1; Maximum: 120; Increment: 1; Default:15)

- Until terminal-X phase rotation is measured, the IntelliRupter fault interrupter measures positive and negative sequence voltage based on the **123** or **132** setting in *Setup>General>System>Phase Rotation* screen.
- In the event the phase rotation setting on the *Setup>General>System>Phase Rotation* screen results in the IntelliRupter fault interrupter detecting both terminals X & Y have higher negative sequence voltages than positive sequence voltages, the *Metering* screen will initially display negative sequence voltages for both terminals. After about 1 minute these terminal X & Y negative sequence voltages will change to positive sequence voltages.

Note: Exceptions to this may occur if there is a fault condition, the IntelliRupter fault interrupter detects less than three-phase voltage present, or unequal phase-voltage magnitudes are occurring.

- After phase rotation is measured, the measured-phase sequence is displayed on the *Metering* screen.

Note: The measured System Phase Rotation displayed on the *Metering* screen may be different than the **Phase Rotation** setpoint on the *Setup>General>Site-Related>System>Phase Rotation* screen.

- After phase rotation is determined, it is not re-verified unless one of the following events occur:
 - Voltage is lost on both terminals.
 - The 5-minute **Phase Rotation Reverification** timer expires.
 - Any new settings are applied.

For example, the *Metering* screen display of system-phase rotation may be delayed five minutes if the terminal-phase associations have changed without a preceding loss-of-voltage event on both terminals X & Y.

- At power up with all three poles open, and when terminals X & Y have unequal phase-sequence voltages, the IntelliRupter fault interrupter presumes terminal-X voltage to be positive sequence.

Phase Rotation

Phase rotation is automatically determined by the Protection and Control module. Select the **123**, **132**, or **Undefined** option. The control will update this after making the measurement.

Direction 1 / Direction 2

This setting determines the normal current direction. Select the **X->Y** or **Y->X** option. X is the lower terminal and Y is the upper terminal. Directional-overcurrent protection is set with respect to the circuits named Direction1 and Direction2. When the Direction 1/ Direction 2 configuration is X->Y, Direction 1 protection settings are applied to a fault that flows into the Y terminal and out of the X terminal. See Figure 7 on page 25, Figure 8 on page 25, and Figure 9 on page 25.

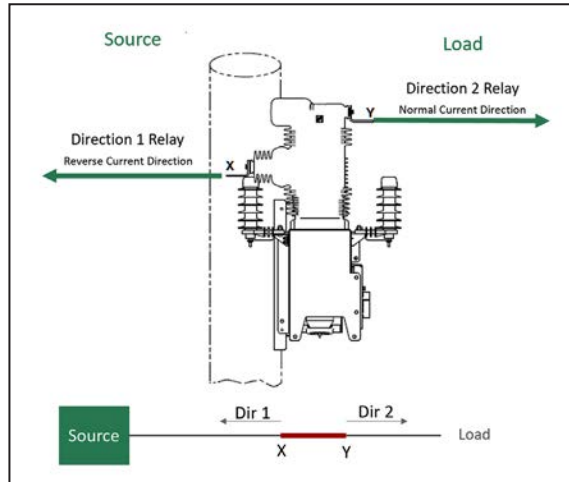


Figure 7. Direction 1/Direction 2 XY, default.

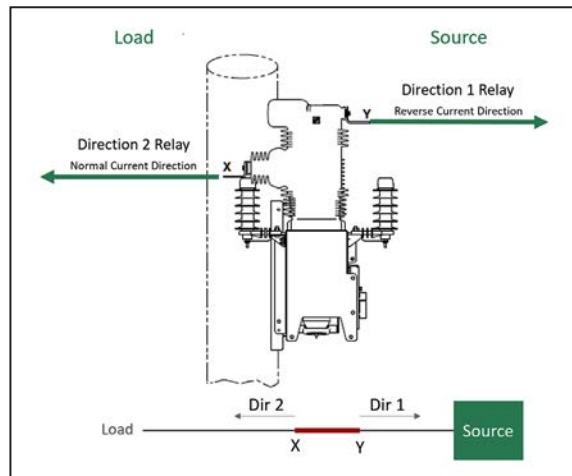


Figure 8. Direction 1/Direction 2 YX.

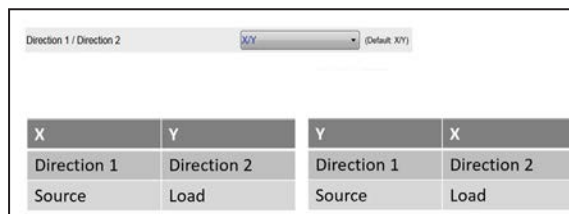


Figure 9. Set the first letter as the source. Direction 2 will always be the load.

The IntelliTeam Automatic Restoration System uses the voltage measured on the terminal configured as Direction 1 to determine the good-source voltage measurement. The Direction 1 terminal must be configured as the terminal that is the normal-source side of a normally closed IntelliRupter fault interrupter. For a normally open IntelliRupter fault interrupter with the normal switch function defined as a Tie/Sub, the Direction 1 terminal must be configured as the terminal on the alternate-source side of the IntelliRupter fault interrupter. A normally open IntelliRupter fault interrupter with a normal switch function defined as a Tie may have the Direction 1 terminal configured as either terminal X or terminal Y.

Label for Direction 1 (6 char limit)

This label associates Direction 1 of the directional-overcurrent protection with the name of a substation, source, or load. The designation selected should take into consideration the source may change when the circuit is automatically reconfigured. Directional-overcurrent protection should be set to protect against faults on circuits connected to this terminal.

Label for Direction 2 (6 char limit)

This label associates Direction 2 of the directional overcurrent protection with the name of a substation, source, or load. The designation selected should take into consideration the source may change when the circuit is automatically reconfigured. Directional-overcurrent protection should be set to protect against faults on circuits connected to this terminal.

Normal Power Flow

When set to the **X->Y** mode, kW and metering values will show as positive for normal power flow when power is flowing from terminal X to terminal Y and show as negative for reverse power flow when power is flowing from terminal Y to terminal X. Selecting the **Y->X** mode reverses the application of the sign, resulting in positive for power flowing from terminal Y to terminal X and negative for power flowing from terminal X to terminal Y.

Calculations with the default **X->Y** setting:

- **Total kVA** value as reported on DNP is computed and is the sum of the **kVA** value from each pole. The **kVA** value for each pole is computed as the square root of ($kW * kW + kvar * kvar$). So, the **Total kVA** value is always a positive number.
- **Total kW** value is computed and is the algebraic sum of the **kW** value from each pole. This can be negative or positive.
- **Total kvar** value is computed and is the algebraic sum of **kvar** value from each pole. This can be negative or positive.
- For voltage and current flowing in the same direction (**X->Y**), the **kW** value is positive. The **kvar** value is dependent on leading or lagging current.
- For current flowing in the opposite direction of voltage (**Y->X**), the **kW** value is negative. The **kvar** value is dependent on leading or lagging current.
- The **MWH** value is accumulated separately for the **positive kW** and **negative kW** values. With the **X->Y** setting, positive power consumption is accumulated into the **X->Y** column data, and negative power consumption is accumulated into the **Y->X** column data.

System Type

Select from the drop-down list: **Multi-Grounded** (default), **Ungrounded**, **Uni-Grounded Solid**, **Uni-Grounded Resistive**, **Uni-Grounded Reactive**, or **Uni-Grounded Resonant**. The selection affects how the **Overcurrent** element and **SEF** element directionality are determined.

Directional Protection

Directional fault determination is made based on the signals available within the specified protection element response times. This means directional determination never retards IntelliRupter fault interrupter tripping times. However, directional measurements of fully asymmetric faults improve with longer signal processing times. Consequently, minimum response times of 2 cycles or greater result in very secure directional determination.

The directional characteristic maximum torque angles used by the IntelliRupter fault interrupter are only specified for Terminal-Y faults and are shown in Table 1 on page 28. Therefore, Terminal-X fault maximum torque angles are 180° from those shown for Terminal-Y. Refer to the *Setup>General>System>System Type* screen for all system grounding options.

Table 1 lists the operating current and reference voltages used for torque angle measurements, along with the maximum torque angles (MTA) for Terminal-Y. Torque angles are combined to determine direction of phase-to-ground, phase-to-phase, phase-to-phase-to-ground, and three-phase faults. SEF fault direction is determined separately and uses zero-sequence torque after it has been filtered. SEF filtered zero-sequence torque is used when the **SEF** element is the only protection element timing.

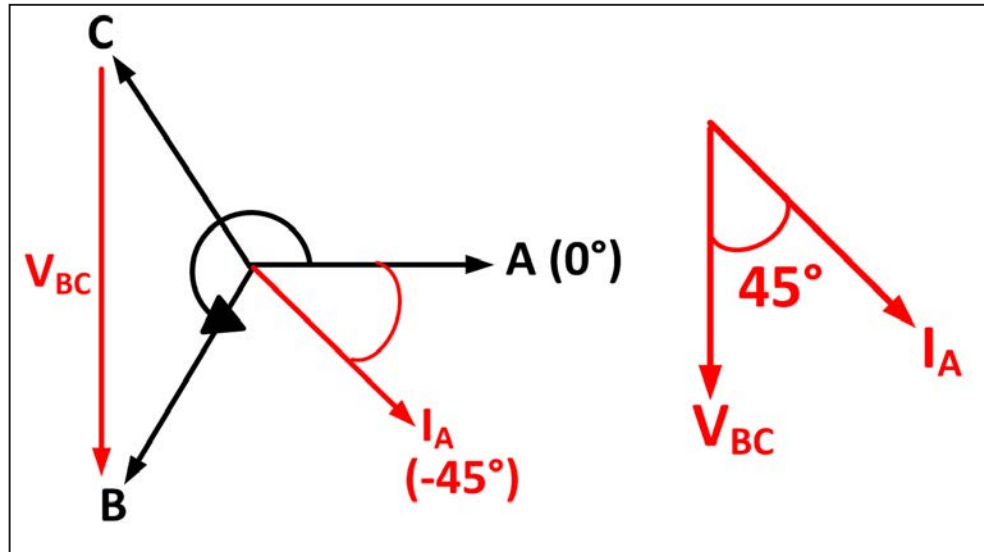


Figure 10. Phase-A direction example for a 1-2-3 rotation.

Table 1. System Grounding Method for Terminal-Y Fault

Directional Measurement	Operating Current	Reference Voltage	Terminal Y Max Torque Angle	
Phase-A	I _A	V _B - V _C	-45° (1-2-3 rotation) +135° (1-3-2 rotation)	
Phase-B	I _B	V _C - V _A		
Phase-C	I _C	V _A - V _B		
Ground	3I ₀	3V ₀	-135°	Ungrounded
			+135°	Uni-Grounded Resonant
			+135°	All others
Zero Sequence (SEF filtered 3V ₀ >10%)	3I ₀	3V ₀	+90°	Ungrounded
			0°	Uni-Grounded Resonant
			-135°	All others

Referring to Table 1 and Figure 10 and using the Terminal-Y Phase-A directional measurement as an example, V_{BC} is the reference voltage and I_A is the operating current. The Terminal-Y Phase-A MTA is -45° for a 1-2-3 (A-B-C) rotation.

Therefore,

$$\angle MTA = \angle V_{BC} - \angle I_A, \text{ and}$$

$$\angle I_A = \angle V_{BC} - \angle MTA$$

Substituting -45° from Table 1 for $\angle MTA$, maximum torque is achieved when

$$\angle I_A = \angle(V_{BC} + 45^\circ),$$

or the Terminal-Y Phase-A directional MTA occurs when I_A leads V_{BC} by 45° for a 1-2-3 rotation.

Referring to Table 1 on page 28 and Figure 11, if the corresponding operating current leads or lags its reference voltage by $\pm 90^\circ$ from the respective maximum torque angle (MTA), the fault is determined to be on Terminal-Y. Otherwise, the fault is determined to be on Terminal-X or is unknown.

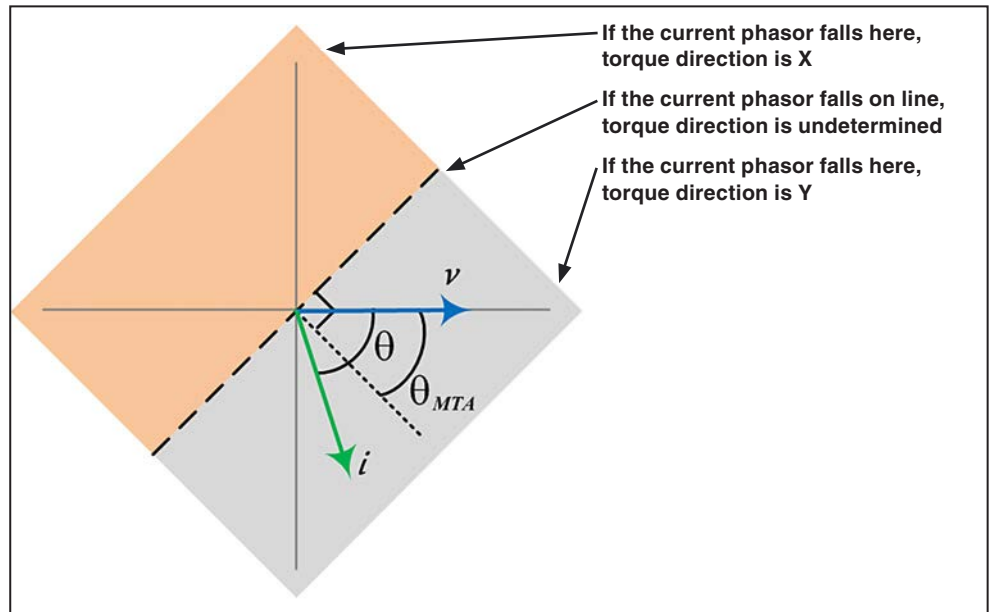


Figure 11. Directional boundary diagram based on maximum torque angles.

When a fault initiates and the phase-to-ground voltage is <16% of the nominal system phase-to-ground voltage, pre-fault phase-to-ground memory voltage is used to measure torque angles when required. In the event the pre-fault phase-to-ground memory voltage is <16% of the nominal system phase-to-ground voltage, protection elements may operate nondirectionally. When protection elements operate nondirectionally, the fault direction indeterminate flag is set and logged.

System Frequency

Select the system frequency, either the **60 Hz** or **50 Hz** option.

System Phase-to-Phase Voltage

Enter the value of the system phase-to-phase voltage in kV. (Range: 4.00-40.00; Step: 0.01 kV; Default: 12.47)

Voltage Reporting

Select from the drop-down list: the **Phase to Ground** or **Phase to Phase** option. This setting applies to values reported on the *Operation* screen, the *Metering* screen, and the DNP voltage analog points.

Voltage Reporting Base

Select from the drop-down list: the **120 Vac** (default), **240 Vac**, **%**, or **kV** option. This setting only applies to the values reported on the *Operation* and *Metering* screens.

Backfeed Voltage Level

If the **Test on Backfeed** setting is set to the **Block** option on the *Operation* screen, enter the percentage of system phase-to-phase voltage on the load side above which a **PulseClosing Technology** or **Close-Testing** operation is prevented. (Range: 5-100; Step: 1%; Default: 10)

Note: This check will not be performed if the IntelliRupter fault interrupter is in a **Pole-Mismatch** state as the result of a single-phase trip.

Power Factor Sign Convention

This setting determines the sign convention applied to both the power factor DNP analog input points and the power factor values displayed on the *Metering* screen. (Range: IEC or IEEE; Default: IEC) See Figure 12.

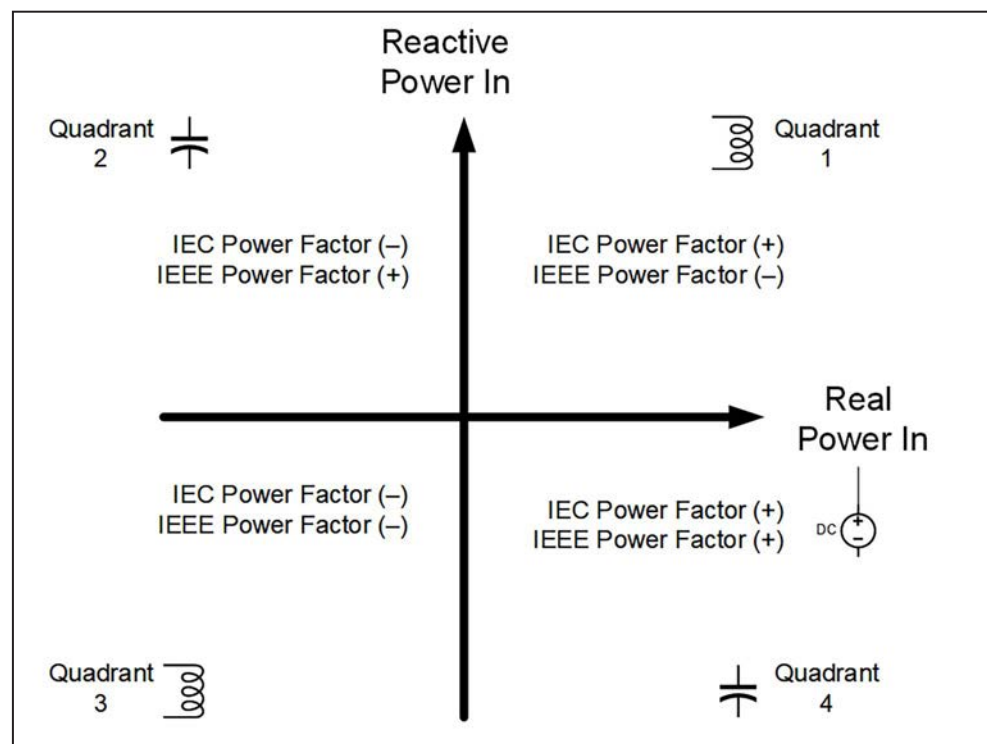


Figure 12. The sign convention diagram.

For **IEC** mode, the power factor sign is solely dependent on the direction of real power flow and is independent of the load being inductive or capacitive.

- The power factor is positive for normal (positive) Real Power flow; that is, when real power flows into the load.
- The power factor is negative for reverse (negative) Real Power flow; that is, when real power flows out of the load.

For **IEEE** mode, the power factor sign is solely dependent on the nature of the load being capacitive or inductive.

- For an inductive load, the power factor is negative.
- For a capacitive load, the power factor is positive.

Maximum Interrupting Current

The IntelliRupter fault interrupter supports a maximum interrupting current rating of 12.5 kA or 16 kA. The 12.5 kA rating is available for all supported system voltage levels. The 16 kA setting can only be used for system voltage up to 27 kV. There is a validation rule that prevents a 16 kA selection for higher voltages. Tripping is blocked when the current is above the **Maximum Interrupting Current** setting.

Use Least-Used Poles First in Closing Profiles

When set to the **Yes** option, the pole with the highest **Remaining Contact Wear** value will close first when using either **Closing Profile** setting. Otherwise, the closing sequence will be Pole 1, followed by Pole 2, and then Pole 3. Default is the **No** option.

Frequency Difference Threshold

This setting is used by the *Metering>Sync Check* screen. When the absolute value of the difference in frequency between Terminal X and Terminal Y exceeds this threshold, the frequency values are displayed in red. (Range: 0.1-5.0; Step: 0.1; Default: Disabled)

User Commands

The *Operation* screen has five commonly used functions that accommodate customized labeling. See Figure 13. The text for those custom labels is configured in the **Command Label**, **Active Label**, and **Inactive Label** fields found on the *Setup>General>User Commands* screen.

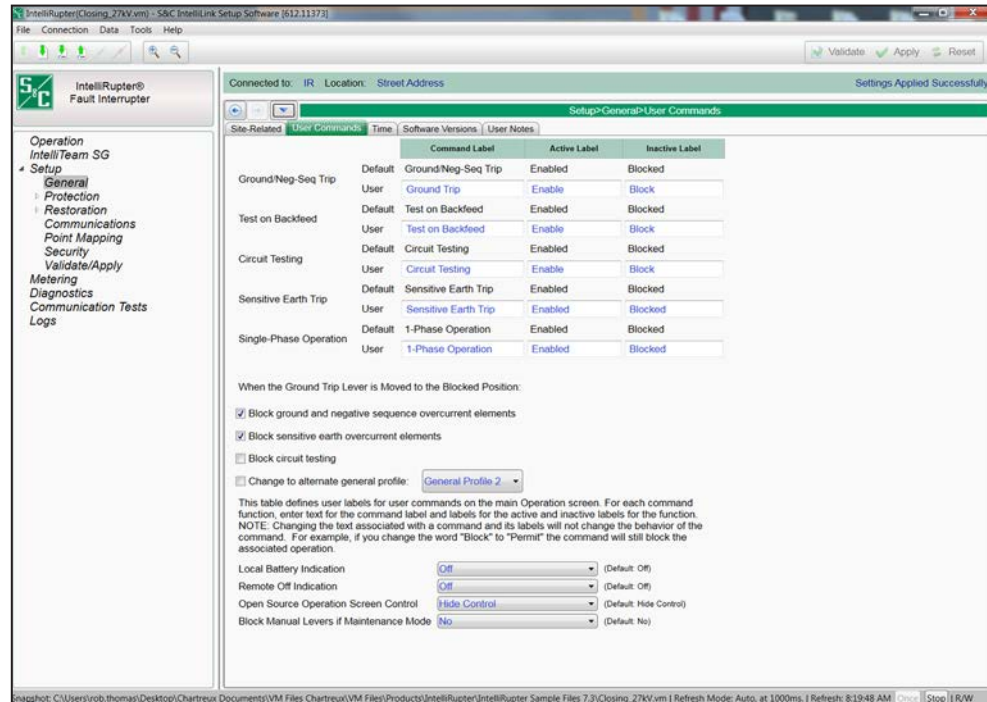


Figure 13. The Setup>General>User Commands screen.

Note: Changing the text associated with a command and its labels will not change the behavior of the command. For example, if the word “Block” is changed to “Permit,” the command will still block the associated operation.

Ground/Neg-Seq Trip

When enabled, this function allows tripping caused by a **Ground Overcurrent** element or a **Negative Sequence Overcurrent** element. A **Trip** operation is commonly blocked when work will be performed on a line, resulting in a larger-than-normal load imbalance. This function is a convenient way to block the configured **Ground Overcurrent** and **Negative Sequence Overcurrent** elements. This function does not activate a **Ground Overcurrent** element or **Negative Sequence Overcurrent** element if it has not been set in the active profile.

Test on Backfeed

This function establishes whether certain voltage conditions must be satisfied prior to executing a specified test sequence after an initial trip. Test sequences are configured on the *Setup>Protection>General Profile>Testing After Initial Trip* screen.

When enabled, the **PulseClosing Technology** or **Close Test** operation occurs regardless of whether there is system voltage present on both X and Y terminals, or only the X or Y terminal of the IntelliRupter fault interrupter.

The **Test on Backfeed** mode is commonly disabled (blocked) for applications involving distributed generation. In this instance, disabling the **Test on Backfeed** mode prevents a **PulseClosing Technology** or **Close Test** operation after the initial trip until the distributed generation has tripped offline.

When the **Test on Backfeed** mode is disabled, the IntelliRupter fault interrupter waits for terminal X or Y voltage to fall below the **Backfeed Voltage Level** setting on the *Setup>General>Site-Related>System* screen before proceeding with the specified **Testing After Initial Trip** sequence.

When system voltage is present on one terminal and the other terminal voltage remains above the **Backfeed Voltage Level** setting for more than 5 minutes, the IntelliRupter fault interrupter goes to **Lockout** state.

When the **Test on Backfeed** mode is disabled, this function is only enforced when all three poles are open and not in a **Pole Mismatch** state. For example, not during a **Single-Phase Trip** operation.

Circuit Testing

When enabled this function allows a **PulseClosing Technology** or **Close Test** operation after an initial trip. When blocked, the IntelliRupter fault interrupter goes immediately into **Lockout** state after tripping.

Sensitive Earth Trip

When enabled, this function allows the IntelliRupter fault interrupter to trip because of a **Sensitive Earth Overcurrent** element. This function does not activate a **Sensitive Earth Overcurrent** element if one has not been set in the profile.

Single Phase Operation

When set to the **Block** mode, this function prevents the IntelliRupter fault interrupter from performing in **Single Phase Operation** mode. This function does not activate **Single Phase Operation** mode if it has not been set in the active profile.

For each of the command functions:

- Enter a command label that will display on the *Operation* screen.
- Enter an active label that will display on the *Operation* screen.
- Enter an inactive label that will display on the *Operation* screen.

NOTICE

Changing the text on an active or inactive command label does not change the function. Because of display changes from previous software versions, the previously defined labels may be ambiguous and should be reevaluated when upgrading to this version.

Ground Trip Lever Operation

The Ground Trip Lever Blocked Position configuration check boxes are only displayed on this window when the IntelliRupter fault interrupter has a GROUND TRIP BLOCK lever. IntelliRupter fault interrupters manufactured before mid-2010 did not have a GROUND TRIP BLOCK lever and the ability to configure a **Ground Trip Block** operation is misleading for those devices.

When the GROUND TRIP lever is moved to the **Blocked** position:

- And the **Block Ground and Negative Sequence Overcurrent Elements** option is checked, all **Ground Overcurrent** and **Negative Sequence Overcurrent** elements are immediately disabled and reset, even when they were timing for a fault when the lever was moved
- And the **Block Sensitive Earth Overcurrent Elements** option is checked, all **Sensitive Earth Overcurrent** elements are immediately disabled and reset, even if they were timing for a fault when the lever was moved
- And the **Block Circuit Testing** option is checked, **PulseClosing Technology** or **Close Test** operations after an initial trip are disallowed, and the IntelliRupter fault interrupter goes immediately into the **Lockout** state after tripping (This will not prevent a **Close** operation after the IntelliRupter fault interrupter is in the **Lockout** state.)
- And the **Block DTAP Compensator Detection and Wattmetric Element** option is checked, the **DTAP Compensator Detection** and **Wattmetric Element** features are immediately disabled and reset, even if they were timing for an event when the lever was moved
- And the **Change to an Alternative General Profile** option is checked, the designated **General** profile becomes the active profile (**Closing** and **Hot Line Tag** profiles are not affected by the position of the GROUND TRIP BLOCK lever, SCADA, or IntelliLink software commands to change the **General** profile while using the alternate profile are accepted, but will not revert to the commanded **General** profile until the GROUND TRIP BLOCK lever is returned to the **Unblocked** position.)

NOTICE

The Ground Trip Lever Blocked Position configuration check boxes are only displayed on this window when the communicating fault interrupter has a GROUND TRIP BLOCK lever. Fault interrupters manufactured before mid-2010 did not have a GROUND TRIP BLOCK lever, so the ability to configure ground trip block operation would be misleading for those devices.

External LED Flash Pattern Configuration

The LED flash pattern can be configured to indicate optional information. Use the **Local Battery Indication** and **Remote Off Indication** settings to change the LED flash pattern.

Local Battery Indication

The LED flash pattern for local battery indication ($\frac{1}{2}$ second on, $\frac{1}{2}$ second off) can be turned on or off. This should be set to the **Off** setting when no battery is installed because a low battery or bad battery indication is unnecessary.

Remote Off Indication

The LED flash pattern (solid on) indicating the **Remote Operation** mode is set to the **Off** mode can be turned on or off, and the default is the **Off** setting.

Blink Pattern Priority

Only one blink pattern can be displayed at a time. The highest priority condition (indicated by lower number) will always be displayed:

1. Error (or Battery Low/Bad if enabled) = Flashes $\frac{1}{2}$ second every second
2. Remote Off = Solid On (A **Manual Lever** command causes a temporary 10-second solid On.)
3. Wi-Fi connected = Pulses dim to bright
4. Loop Restoration is timing or Ready or IntelliTeam is Ready = Flashes 3 times ($\frac{1}{2}$ second On— $\frac{1}{2}$ second Off) every 30 seconds
5. Normal operation = On $\frac{1}{2}$ second every 30 seconds
6. IntelliRupter fault interrupter not powered or inoperative = Off

Open Source Operation Screen Control

When this setpoint is set to the **Show Control** mode, the **Open-Source Sectionalizing** (Enabled/Blocked) button is shown at the lower-right side of the *Operation* screen.

Block Manual Lever If Maintenance Mode (SDA-4540R2 control only)

When the **Block Manual Lever If Maintenance Mode** setpoint is set to the **Yes** state and the External Interface Maintenance Mode input is active, the OPEN and CLOSE manual control levers will be prevented from opening or closing the IntelliRupter fault interrupter.

Block External Trip Inputs When Maintenance Mode (SDA-4540R2 control only)

When the **Block External Trip Inputs When Maintenance Mode** setpoint is set to the **Yes** state and the **External Interface Maintenance Mode** command is active, the **External Interface Trip**, **Open**, and **Close** commands will be prevented from opening or closing the IntelliRupter fault interrupter.

NOTICE

When the external interface maintenance mode input is active, **Open** and **Close** commands from SCADA, the IntelliTeam SG system, and the *Operation* screen are blocked.

Time

The clock synchronization source and daylight savings time are configured on this screen. See Figure 14.

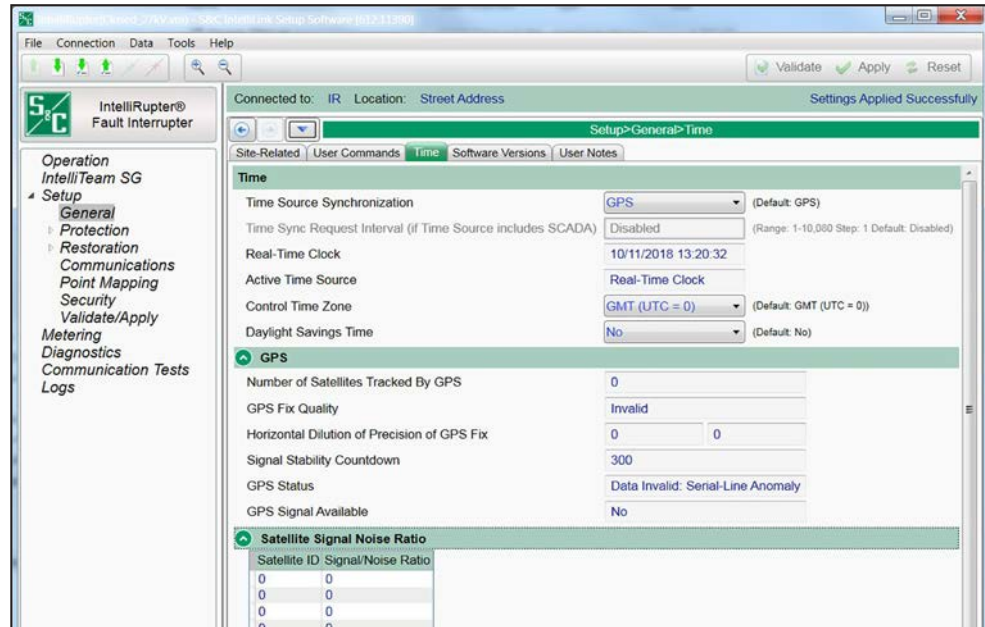


Figure 14. The Setup>General>Time screen.

Time Source Synchronization

Select from the drop-down list: GPS (default), SCADA, GPS and SCADA, or User Set. SCADA can only function for Master 1.

When **SCADA** mode is selected, the real-time clock will be synchronized to the time and date specified in the SCADA master's time synchronization request. Configuration of the **Time Sync Request Interval** setting is required.

When **GPS and SCADA** mode is selected, the GPS signal will be used when available. If the GPS signal is not available, the real-time clock will be synchronized to the time and date specified in the SCADA master's time synchronization request. Otherwise, the master's time synchronization request is ignored. Configuration of the **Time Sync Request Interval** setting is required.

When **User Set** mode is selected, the real-time clock will synchronize once to the time indicated on a user-furnished computer or the time entered by the user. Go to the **Tools** menu, select the **Device Maintenance** option from the drop-down list, and click on either the **Set Control Time** button to enter the user-set time or click on the **Synchronize with PC** button.

Time Sync Request Interval (if Time Source=SCADA or Time Source=GPS and SCADA)

When this interval (in minutes) expires the control will assert IIN1.4 (Need Time) on every response until the master successfully writes absolute time and date using Object 50 variation 1. (Minimum: 1; Maximum: 10080; Step: 1; Default: Disabled)

Real-Time Clock Display

This is the date and 24-hour time display.

Active Time Source

This display indicates the time source as the Internal Clock (R3 control) or Real-Time Clock (R2 control), or GPS Source.

Control Time Zone

Select from the drop-down list. **GMT (UTC = 0)** is the default.

All time-stamped files and the internal time are Universal Time, Coordinated (UTC), also known as Greenwich Mean Time (GMT). Local time also can be displayed by using the **Control Time Zone** and **Daylight Savings Time** settings.

Daylight Savings Time

Select from the drop-down list: **No** (default) or **Yes** mode.

Note: Select the **Start Day**, **End Day**, and **Offset** settings for the **Daylight Savings Time** feature.

GPS**Number of Satellites Tracked by GPS**

This is the number of satellites used in the calculation of the position and time displays. Triangulation of three satellites at a minimum is required to determine position, but three satellites in a straight line cannot determine position. Only one satellite is required to determine time.

GPS Fix Quality

This statement indicates the GPS Fix Quality:

- Invalid
- GPS fix (SPS)
- DGPS fix
- PPS fix
- Real Time Kinematic
- Float RTK
- Estimated (dead reckoning)
- **Manual Input** mode
- **Simulation** mode

Horizontal Dilution of Precision of GPS Fix

This statement indicates the relative estimate of GPS horizontal position fix accuracy:

- <1 = Ideal—This is the highest confidence level.
- 1-2 = Excellent—The position measurements are accurate for most applications.
- 2-5 = Good—This is the minimum information appropriate for making business decisions.
- 5-10 = Moderate—This information could be used for calculation, but a more open sky view is recommended.
- 10-20 = Fair—This indicates a low confidence level, producing a very rough estimate of the present location.
- >20 = Poor—This information can be inaccurate by as much as 300 meters with a 6-meter accurate device.

Signal Stability Countdown

This counter starts when a signal returns after it had been lost. It counts down from 300 seconds, and when the timer reaches 0 (the signal has persisted for 300 seconds) the signal is considered stable.

GPS Status

This statement indicates the status of **Time**, **Position**, and **Reception** conditions:

- Time and Position OK
- Time and Pos OK, Pending Stability
- Time and Pos OK, No Pulse Signal
- Time and Position Invalid
- Data Invalid: Serial-Line Anomaly
- Data Invalid: Serial-Line Error
- Data Invalid: Serial-Line Silence
- Disabled By User
- Not Initialized

GPS Signal Available

A **Yes** display indicates the GPS signal is adequate to permit GPS time synchronization.

Satellite Signal Noise Ratio

This displays the satellites in view by ID number and the signal to noise ratio in dB for each satellite. The number of satellites in the list can be higher than the number shown in the **Number of Satellites Tracked by GPS** field. 30 dB+ is a good signal, 20 dB to 30 dB is an acceptable signal, 10 dB to 20 dB is a poor signal, and less than 10 dB is unreliable.

Software Versions

Data for the installed version update whenever a new software revision is installed. See Figure 15. The expected value is stored in the IntelliLink software, and the installed version is loaded from the connected control.

The latest control software revisions are available at the S&C Automation Customer Support Portal, which requires an assigned user name and password.

Register for portal access at this link: www.sandc.com/en/support/sc-customer-portal/.

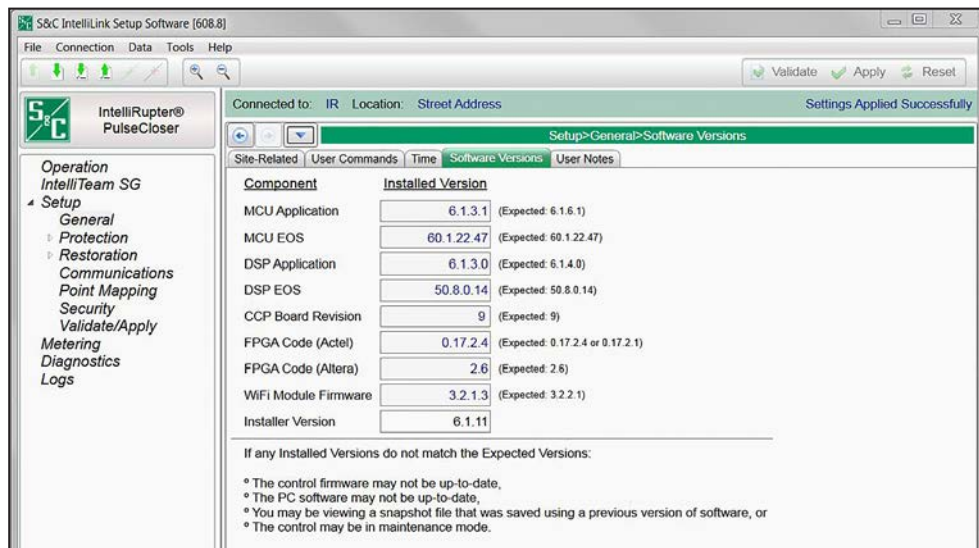


Figure 15. The Setup>General>Software Versions screen.

User Notes

Enter any character used in a standard text file. Field capacity is 1000 characters. See Figure 16.

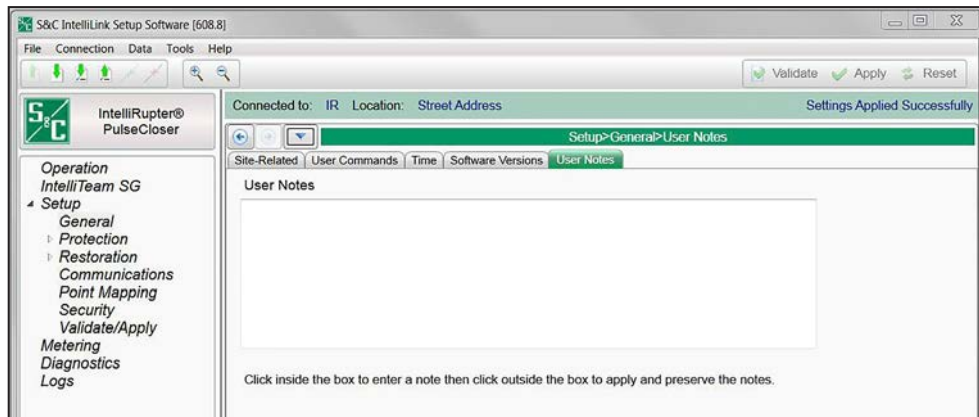


Figure 16. The Setup>General>User Notes screen.

CEC Operation

When precision TCC coordination is not possible, the **Communication Enhanced Coordination (CEC)** feature enables a group of IntelliRupter fault interrupters to share the same coordination curve but open only the device closest to the fault. With CEC, more IntelliRupter fault interrupters can be installed on a feeder, which reduces line-segment size, so fewer customers will be involved when a fault is isolated.

Communication-enhanced coordination is a feature of the IntelliTeam SG Automatic Restoration System, but because it's a protection function, it operates even when restoration is not enabled. Because CEC functionality is dependent on the underlying IntelliTeam SG system architecture, it is only available for IntelliRupter fault interrupters when the proper IntelliTeam SG license has been enabled.

CEC doesn't have to be used by all the IntelliRupter fault interrupters on a feeder. However, both IntelliRupter fault interrupters in a CEC pair must have CEC enabled, use the correct **General** profile (i.e. not Hot Line Tag), and have no errors. CEC messages are sent to the source-side IntelliRupter fault interrupter. If that device is not ready, CEC goes out of ready for that pair, and no further CEC messages are sent.

CEC can only be used by IntelliRupter fault interrupters that have a SpeedNet™ Radio or fiber-optic transceiver because CEC operation requires a minimum bandwidth of 500 kbs and a latency of less than 10 ms.

When a CEC-configured IntelliRupter fault interrupter senses fault current, it sends a curve-shift message to its source-side neighbor, asking that device to change to a slower protection curve.

All the CEC-configured IntelliRupter fault interrupters sense fault at the same time and send a curve-shift request to their source-side neighbor.

Only the IntelliRupter fault interrupter at the faulted line segment will not receive a curve-shift message because it does not have a load-side neighbor sensing fault current. It will not change to the slow protection curve and trip before the other IntelliRupter fault interrupters.

The TCC graph in Figure 17 on page 41 shows how communication-enhanced coordination relates to other protection curves on a feeder. The discrete TCCs coordinate for IntelliRupter fault interrupters A1, A2, and A3. The other IntelliRupter fault interrupters share TCC curve A4. When a fault event in a line segment protected by one of the "A4" IntelliRupter fault interrupters crosses the pickup setting of the slowest IntelliRupter fault interrupter, all IntelliRupter fault interrupters sharing TCC A4 start communication-enhanced coordination.

Sensing a fault, transmitting the curve-shift command, and receiving the curve-shift command typically take less than 100 ms. (This time value is dependent on communication system latency—fiber-optic transceivers operate faster, and radio repeater latency will slow transmission.)

The IntelliRupter fault interrupter closest to the fault opens on TCC A4. The other "A4" IntelliRupter fault interrupters either did not sense fault current or have switched to a slower TCC curve, so only the IntelliRupter fault interrupter protecting the faulted line section opens for the fault. If the fault occurs in a line section protected by an A1, A2, or A3 IntelliRupter fault interrupter, the appropriate TCC for that line section will be used and source-side IntelliRupter fault interrupters will be coordinated to stay closed for the duration of the fault.

When the open CEC-coordinated IntelliRupter fault interrupter is testing fault persistence, it sends messages to its source-side neighbor to keep the slower curve in use. If the fault is persistent and the IntelliRupter fault interrupter trips, it sends an **Event Done** command to all the CEC IntelliRupter fault interrupters, and they curve-shift back to the fast curve (TCC A4) and become ready for a second event. If the fault is temporary and the IntelliRupter fault interrupter can close, the **Event Done** command will be sent after the **Sequence** timer expires.

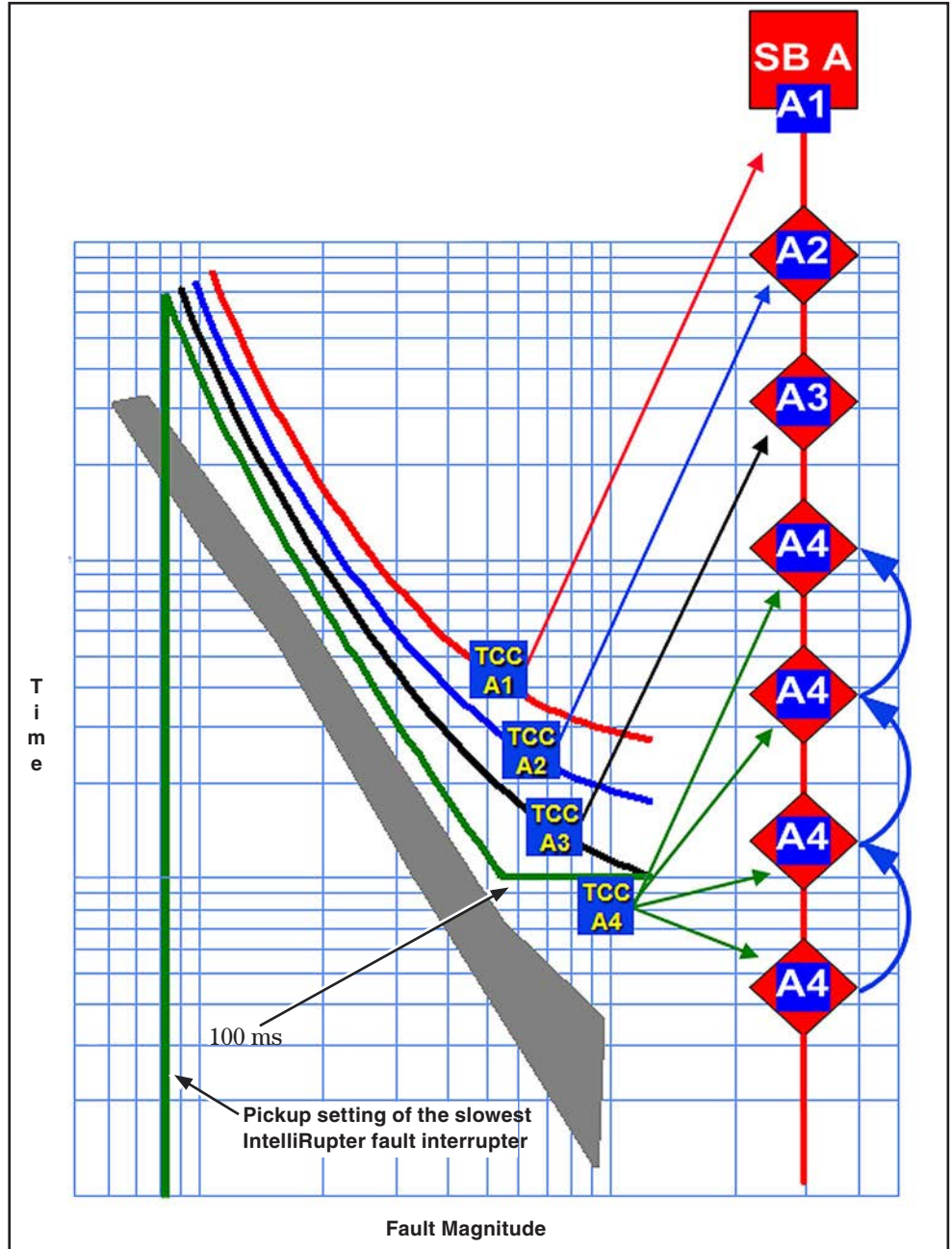


Figure 17. TCC curves and communication-enhanced coordination.

CEC Example for a Temporary Fault

This example, where IR represents an IntelliRupter fault interrupter, shows communication-enhanced coordination for a temporary fault.

- All IntelliRupter fault interrupters are closed and coordinated where possible. See Figure 18.
- IntelliRupter fault interrupters IR3 and IR4 detect the fault and send curve-shift messages to their source-side neighbors. See Figure 19.
- IR2 and IR3 shift to a slower TCC curve. See Figure 20.
- IR4 trips and begins testing. See Figure 21 on page 43.
- The temporary fault at IR4 clears and IR4 recloses and sends an Event Done message to the other CEC-coordinated IntelliRupter fault interrupters.
- IR2 and IR3 change back to the original TCC curves. See Figure 22 on page 43.

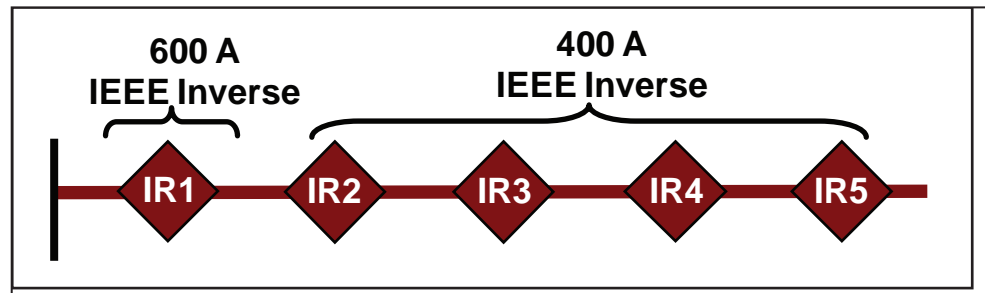


Figure 18. CEC temporary fault; all IntelliRupter fault interrupters are closed and coordinated.

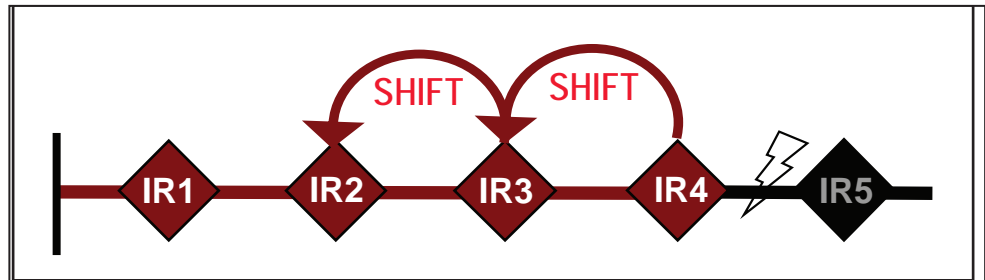


Figure 19. CEC temporary fault; IR3 and IR4 detect fault and send a curve-shift message.

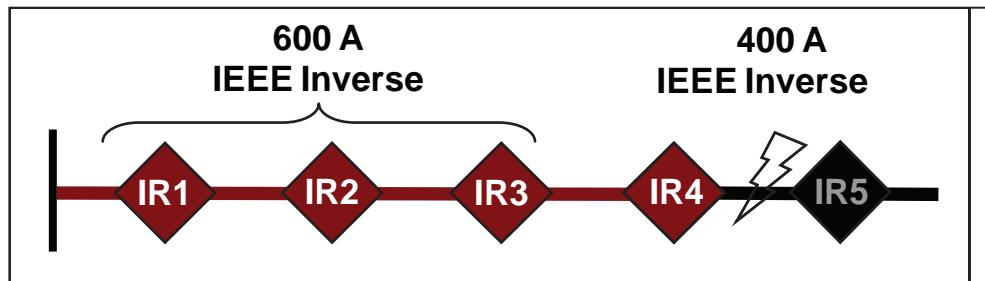


Figure 20. CEC temporary fault; IR2 and IR3 shift to a slower TCC curve.

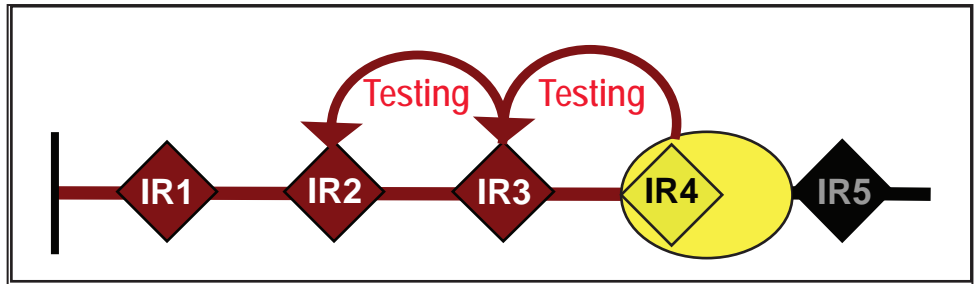


Figure 21. CEC temporary fault; IR4 trips and begins testing.

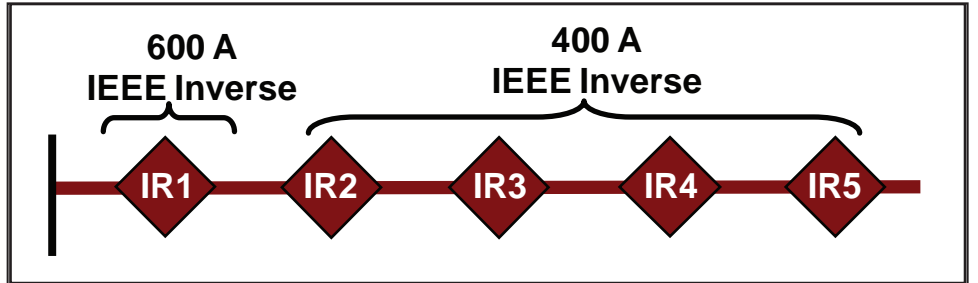


Figure 22. CEC temporary fault; IR2 and IR3 return to the fast CEC curve.

CEC Example for a Permanent Fault

This example shows communication-enhanced coordination for a permanent fault.

- All IntelliRupter fault interrupters are closed and coordinated where possible. See Figure 23 on page 44.
- IntelliRupter fault interrupters IR3 and IR4 detect the fault and send curve-shift messages to their source-side neighbors. See Figure 24 on page 44.
- IR2 and IR3 shift to a slower TCC curve. See Figure 25 on page 44.
- IR4 trips and locks out after testing is completed.
- IR2 and IR3 change back to the original CEC fast curve. See Figure 26 on page 44.

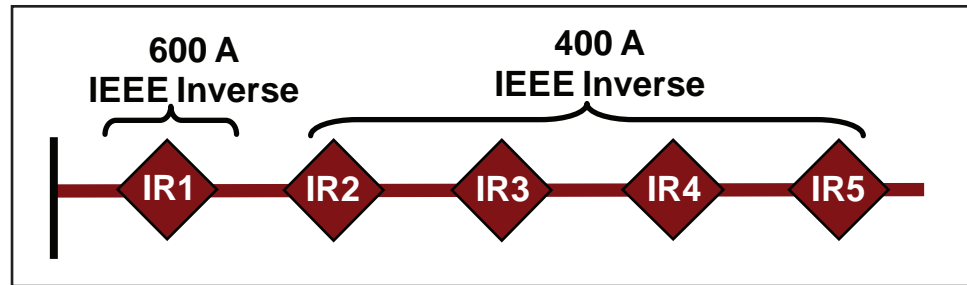


Figure 23. CEC permanent fault; all IntelliRupter fault interrupters are closed and coordinated.

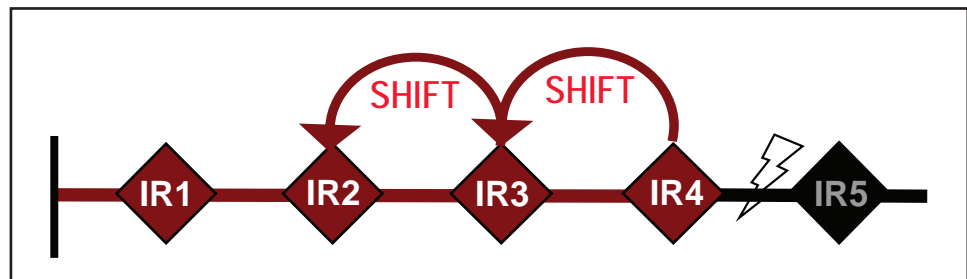


Figure 24. CEC permanent fault; IR3 and IR4 detect the fault and send a curve-shift message.

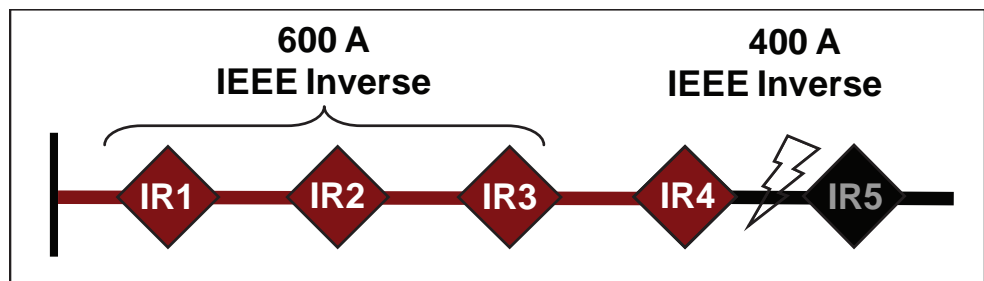


Figure 25. CEC permanent fault; IR2 and IR3 shift to a slower TCC curve.

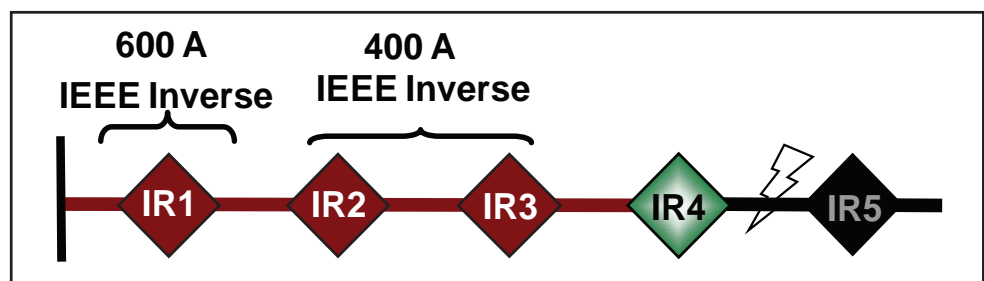


Figure 26. CEC permanent fault; IR2 and IR3 return to the fast CEC curve.

CEC Example for a Complex Network

Although the diagrams in the preceding examples only show radial feeders, CEC can be used in complex networks to coordinate IntelliRupter fault interrupters on a bifurcated circuit and to coordinate devices after the IntelliTeam SG system has reconfigured the system. Figures 27 and 28 show an example.

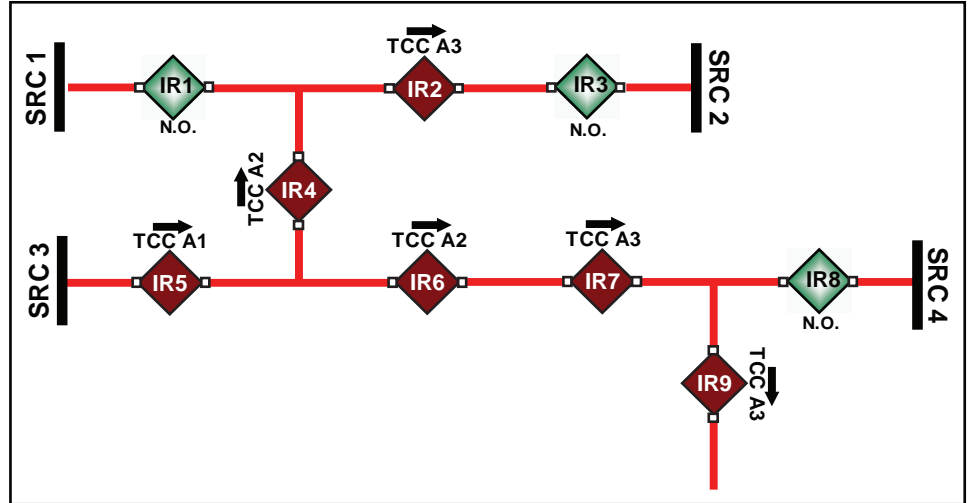


Figure 27. CEC coordination before loss of primary source 3.

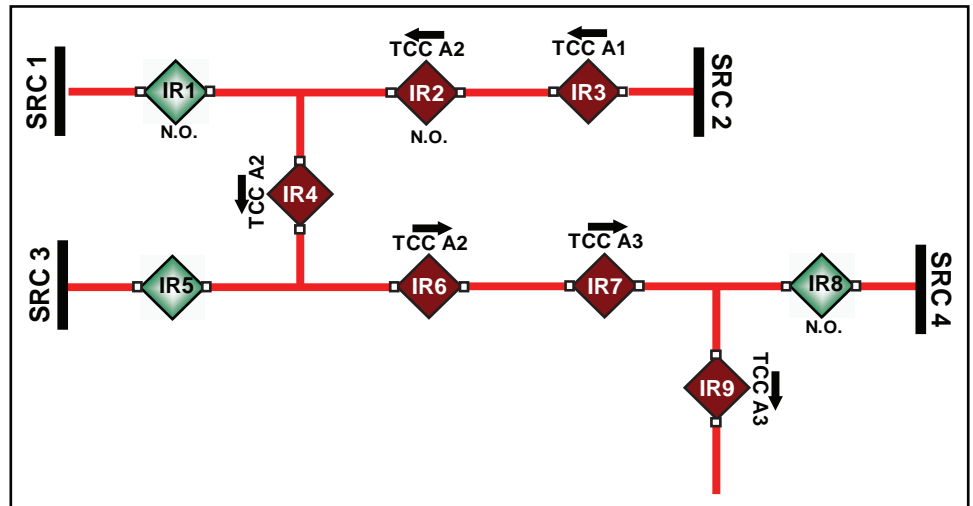


Figure 28. CEC coordination after source switches from source 3 to source 2.

Initial Trip Settings— Direction 1

Initial Trip

Profile Name

Follow these steps to enter the profile name:

- STEP 1.** Enter a custom profile name, up to 12 characters, for each of the four **General** Profiles. This entry is edited here (in the *Setup>Protection>General Profile 1>Direction 1 Current>Initial Trip* screen) and will be displayed on each screen and sub-screen for the profile. This label is also displayed on the *Main* screen for the active **General** profile. See Figure 29.

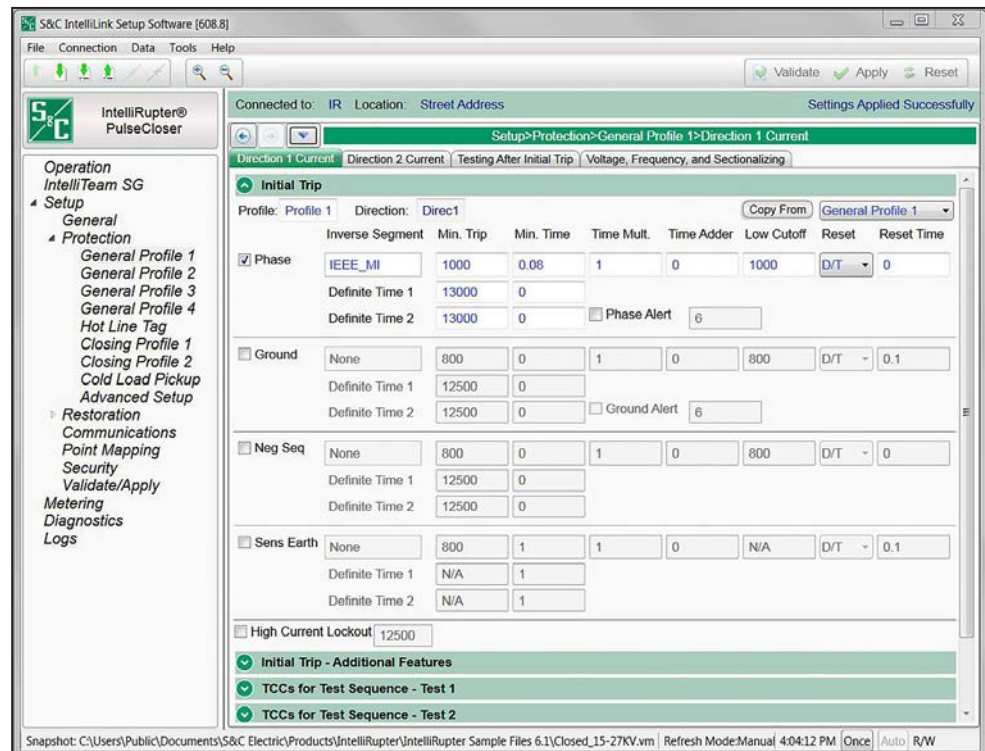


Figure 29. The *Setup>Protection>General Profile 1>Direction 1 Current>Initial Trip* screen.

- STEP 2.** Enter the overcurrent selections and settings that define the initial trip for General Profile 1, Direction 1. The labels previously entered for the terminals on the *Setup>General>Site Related* screen identify the directions. Overcurrent selections for both directions must be entered. The settings entered for Direction 1 can be copied to Direction 2 and modified as necessary.

Four **General** profiles are available and include a complete set of protection elements that determine how the IntelliRupter fault interrupter will perform **Open** and **Circuit Test** operations.

Copy From button

Follow these steps to use the **Copy From** button:

- STEP 1.** For Direction 1, copy settings from another **General** profile to minimize data entry when there are only a few profile differences. The **Copy From** button only works when the computer is connected to a control.
- STEP 2.** Select the **General** profile to copy and click on the **Copy From** button. The settings boxes on the screen are populated with the copied selections and values. For Direction 2, the settings are always copied from Direction 1, not from the selected **General** profile.

Phase Overcurrent

The **Phase Overcurrent** element trips the IntelliRupter fault interrupter when current on one or more phases exceeds the pickup value for the selected **Inverse Curve** or **Definite Time** settings. See Figure 30 on page 49.

Phase Check box—Select to configure this element.

Inverse Segment—Select the segment from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings are used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse-curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum. This value must be greater than the **Minimum Trip** current setting, greater than the **Low Current Cutoff** setting, less than or equal to the interrupting rating of the device, and smaller than the **High Current Cutoff** setting.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001) This value must be less than or equal to the time on inverse curve segment at Definite Time 1 current. Setting this time greater than the inverse curve segment will result in a slower response than would otherwise result from the inverse curve segment.

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum. This value must be greater than **Definite Time 1** current setting, less than or equal to the interrupting rating of the device, and smaller than the **High Current Cutoff** setting.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. This value must be less than **Definite Time 1** time setting. (Range: 0.000-600.000; Step: 0.001)

NOTICE

There is an order of precedence between the Inverse Curve segment, Definite Time 1, and Definite Time 2. Definite Time 2 must be higher in pickup magnitude and faster in time than Definite Time 1. Definite Time 1 must be higher pickup magnitude and faster in time than the Inverse Curve segment.

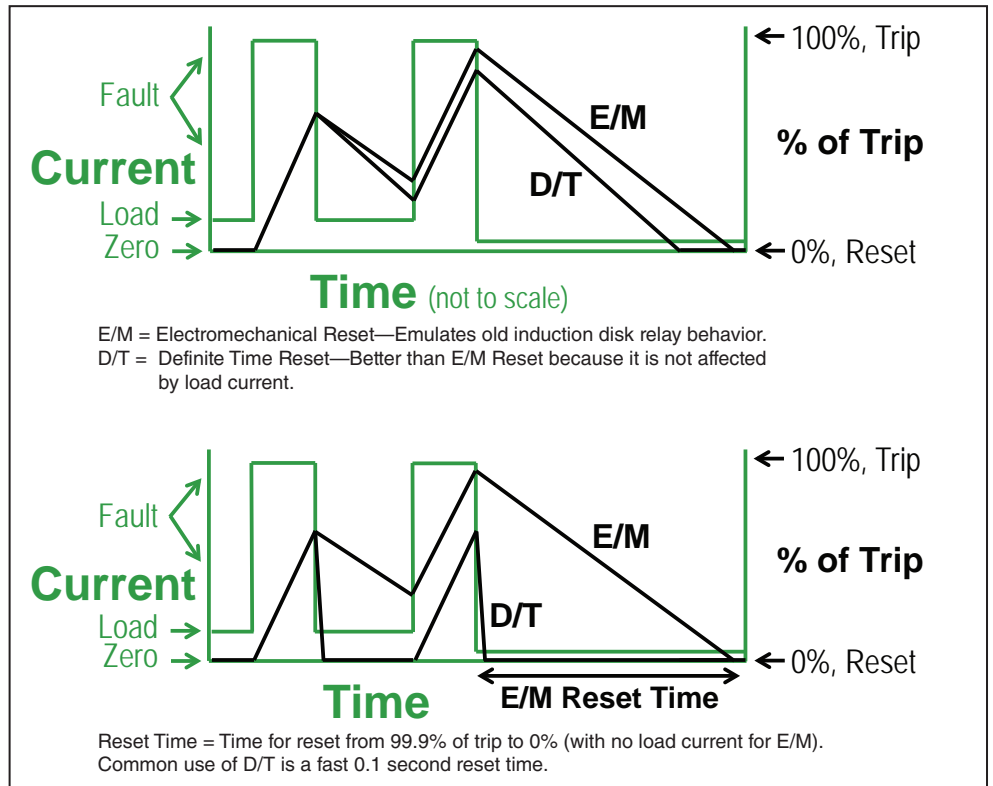


Figure 30. Overcurrent Element reset characteristics.

Setting Examples:

Case 1—This case shows an inverse curve unaltered by a **Definite Time** setting.

Inverse Curve Segment: SEL U5; Min Trip = 280 A; Min Time = 0; Time Mult = 0.1; Time Adder = 0; Low Current Cutoff = N/A

Definite Time 1: N/A

See Figure 31 on page 51.

Case 2—This case shows why Definite Time 1 must be faster than the Inverse Curve Segment. If it is not the definite time will have the unexpected effect of slowing the response time.

Inverse Curve Segment: SEL U5; Min Trip = 280 A; Min Time = 0; Time Mult = 0.1; Time Adder = 0; Low Current Cutoff = N/A

Definite Time 1: Min Trip = 281 A; Min Time = 0.05

See Figure 32 on page 52.

Case 3—This case shows an inverse curve altered by a Definite Time 1 that complies with the order of precedence.

Inverse Curve Segment: SEL U5; Min Trip = 280 A; Min Time = 0; Time Mult = 1.0; Time Adder = 0; Low Current Cutoff = N/A

Definite Time 1: Min Trip = 3000 A; Min Time = 0.02

See Figure 33 on page 53.

Case 4—This case shows an inverse curve altered by a Definite Time 1 and Definite Time 2 that complies with the order of precedence.

Inverse Curve Segment: SEL U5; Min Trip = 280 A; Min Time = 0; Time Mult = 2.0; Time Adder = 0; Low Current Cutoff = N/A

Definite Time 1: Min Trip = 2,000 A; Min Time = 0.05

Definite Time 2: Min Trip = 5,000 A; Min Time = 0.0

See Figure 34 on page 54.

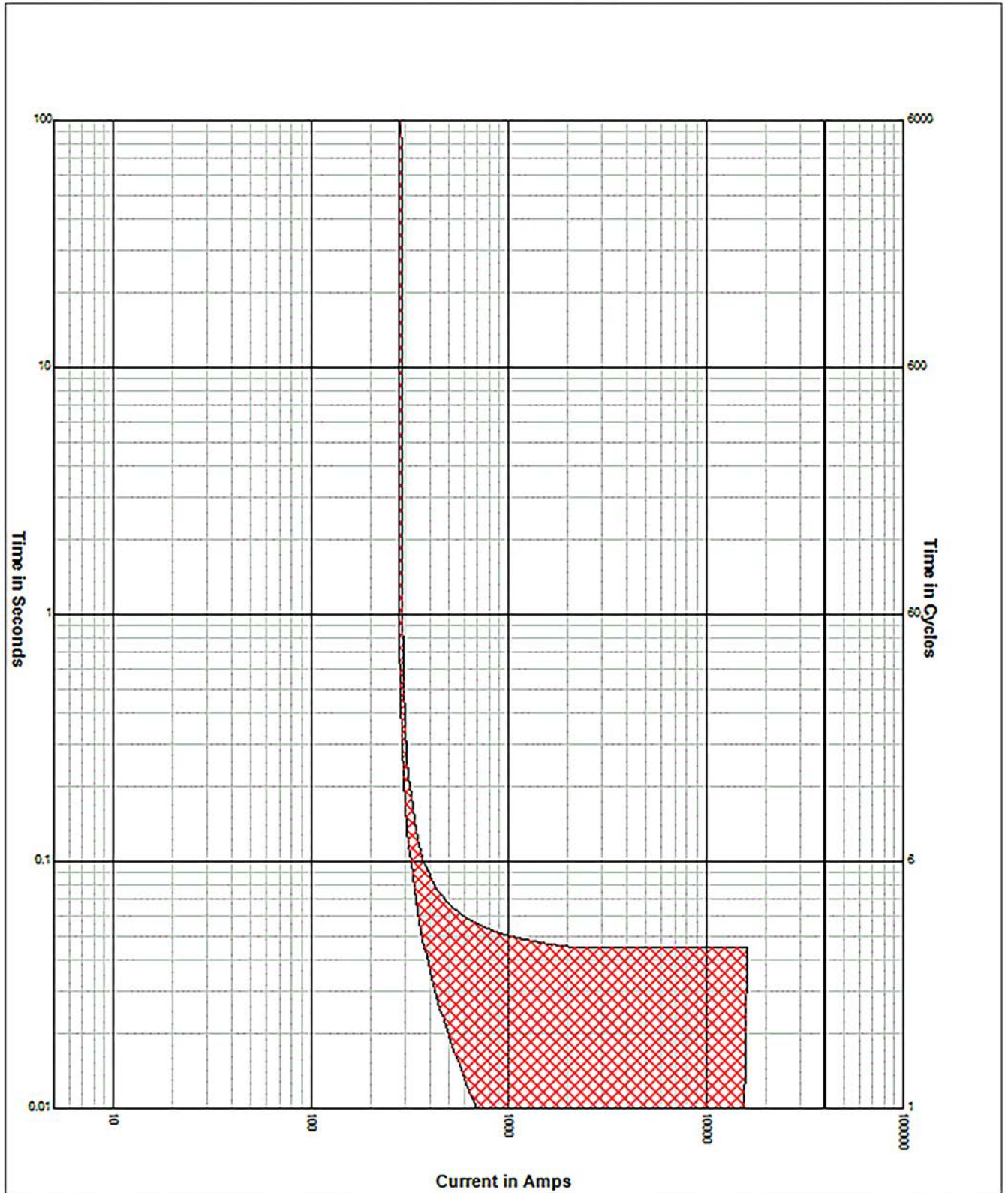


Figure 31. Phase Overcurrent - Definite Time settings example Case 1 on page 50.



Figure 32. Phase Overcurrent - Definite Time settings example Case 2 on page 50.

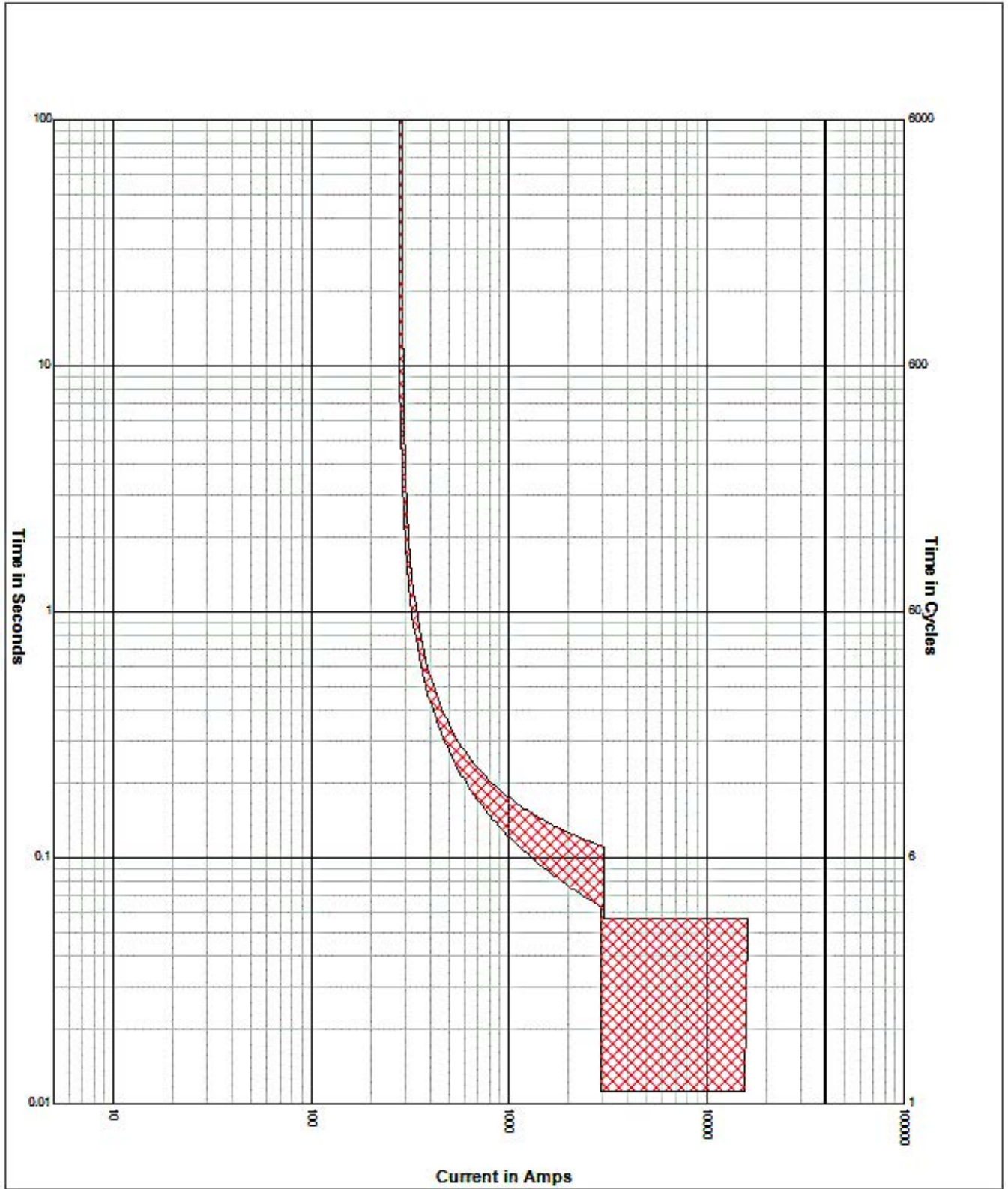


Figure 33. Phase Overcurrent - Definite Time settings example Case 3 on page 50.

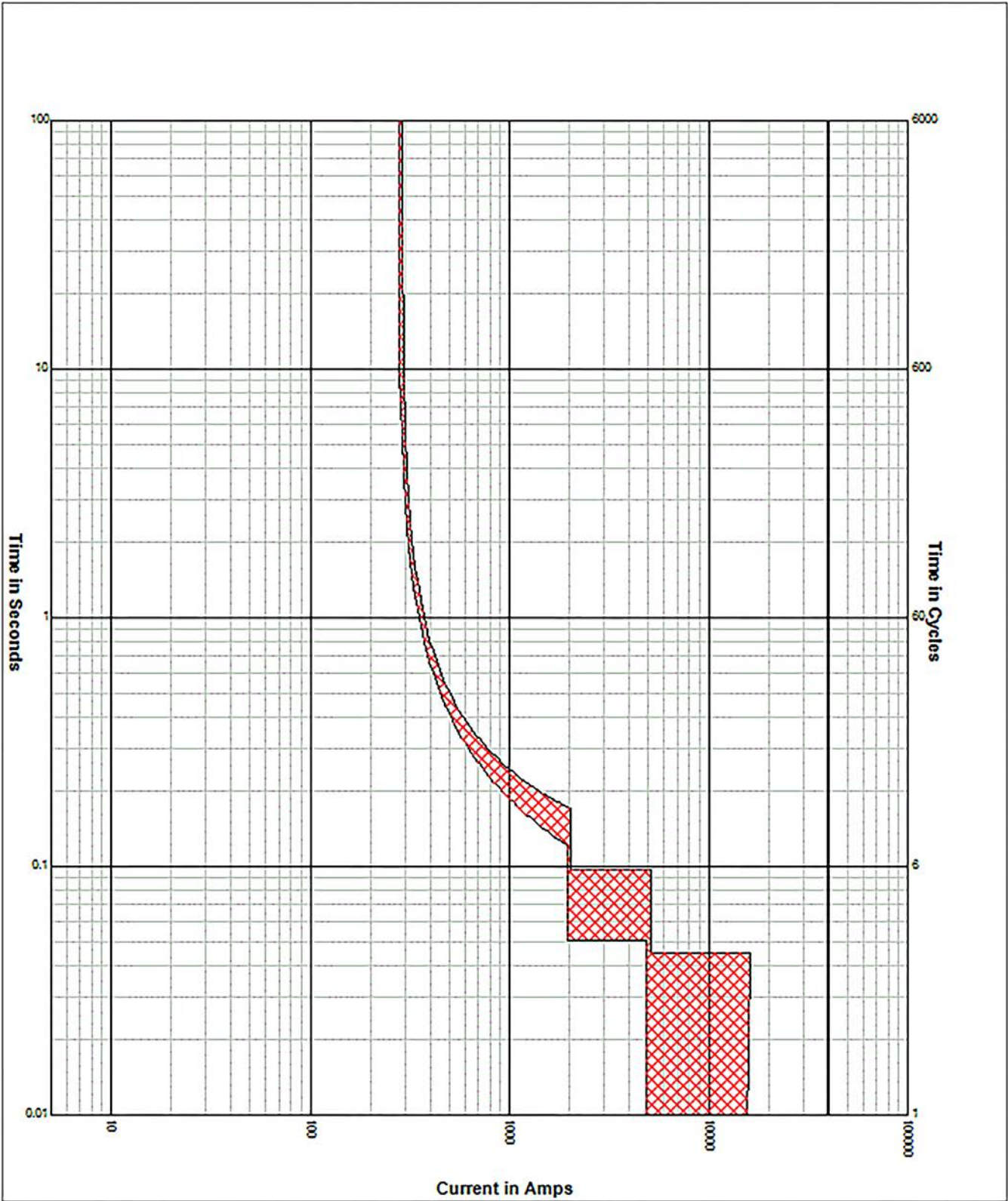


Figure 34. Phase Overcurrent - Definite Time settings example Case 4 on page 50.

Phase Overcurrent Alert

This feature is based on the **Phase Overcurrent Trip** element, but it is not a protection element and will not lead to any IntelliRupter fault interrupter action. Instead, it is used to notify the user via the *Operation* screen and SCADA that an overcurrent condition exists. To enable this feature check the Phase Alert check box and enter the **Current** threshold. (Range: 6-16,000; Step: 1)

Ground Overcurrent

The **Ground Overcurrent** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value selected for the time value set by the **Inverse Curve** or **Definite Time** settings. See Figure 35.

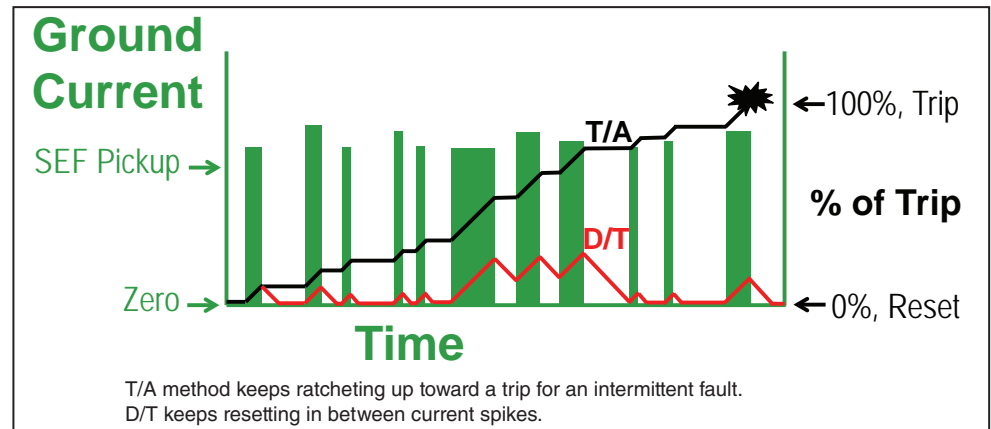


Figure 35. Ground Overcurrent Element reset characteristics.

Ground Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings are used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: 10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Ground Overcurrent Alert

This feature is based on the **Ground Overcurrent Trip** element, but it is not a protection element and will not lead to any IntelliRupter fault interrupter action. Instead, it is used to notify the user via the *Operation* screen and SCADA that an overcurrent condition exists. To enable this feature check the Ground Alert check box and enter the current threshold. (Range: 6-16,000; Step: 1)

Negative Sequence

The **Negative Sequence** element trips the IntelliRupter fault interrupter when the negative-sequence component (I_2) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or the **Definite Time** settings.

Negative Sequence Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Sensitive Earth

The **Sensitive Earth** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or the **Definite Time** settings.

Sensitive Earth Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the Inverse Curve begins timing. (Range: 3.0-16,000.0; Step: 0.1. When the **Voltage Supervised Sensitive Earth** element is selected, Range: 1.0-16,000.0, Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 1.000-6000.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Current Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. (Range: 3.0-16,000.0; Step: 0.1. When the **Voltage Supervised Sensitive Earth** element is selected. (Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—The reset method for the inverse curve is configurable for **D/T** (Definite Time) or **T/A** (Time Accumulation) mode. The **Time Accumulation** mode times when current is above the **Minimum Trip** value and does not time when current is below the **Minimum Trip** value. The timer continues to run until either the **SEF** element trips or the element does not pick up for the duration of the user-specified **SEF Element Reset Time** setting and the element resets. The **Time Accumulation** setting is the default.

Reset Time—When the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-6,000.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 3.0-16,000.0; Step: 0.1) When the **Voltage Supervised Sensitive Earth** element is selected. (Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 1.000-6000.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 3.0-16,000.0; Step: 0.1) When the **Voltage Supervised Sensitive Earth** element is selected. (Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 1.000-6,000.000; Step: 0.001)

High Current Lockout

Select this check box to specify a **High-Current Lockout Level** setting (in primary amperes). No testing is performed at current above this level. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

The six test cases in Table 2 demonstrate the influences of Reset Characteristic, Reset Time, and Time Multiplier. For each test, 50 amperes of current were used to start the test under normal load conditions using an IEEE VI curve and a 185-A minimum trip. The current was increased to 300 A and then removed just prior to the element tripping (14.4 s for Time Multiplier of 1.0, or 7.2 s for a Time Multiplier of 0.5), and returned to 50 A of load.

- The D/T Reset Characteristic is not affected by the 50 A of load, so the expected time to reset is just under the **Reset Time** setting, as confirmed by Tests 1 and 3.
- The E/M Reset Characteristic is slowed down by the existence of 50 A of load current, so the expected time to reset is a bit longer than the **Reset Time** setting, as confirmed by Tests 2 and 4.
- When the Time Multiplier is off-nominal, it affects the actual reset time proportionally for the E/M Reset Characteristic only, as confirmed by Tests 5 and 6.

Table 2. Examples of Reset Time Tests for Phase, Ground, and Negative Sequence Overcurrent Elements

	Time Multiplier	Reset Characteristic	Reset Time Setting	Expected Reset Time	Actual Time to Reset (Test Result)
Test 1	1	D/T	21.6	Just under 21.6 s	21.2 s
Test 2	1	E/M	21.6	Longer than 21.6 s	22.6 s
Test 3	1	D/T	10.8	Just under 10.8 s	10.6 s
Test 4	1	E/M	10.8	Longer than 10.8 s	11.3 s
Test 5	0.5	D/T	21.6	Just under 21.6 s	21.2 s
Test 6	0.5	E/M	21.6	Longer than 10.8 s	11.3 s

The E/M Reset Time is defined by the following equation:

$$t_r = (\text{Reset Time} * \text{Time Multiplier}) / (1 - M^2)$$

Where,

- Reset Time is entered by the user. Some standard curves have default **Reset Time** values.
- $M = I_{\text{load current}} / \text{MAX}(I_{\text{minimum pickup}}, I_{\text{low current cutoff}})$

The D/T Reset Time is not affected by the Time Multiplier or load current, so the equation simplifies to: $t_r = \text{Reset Time}$.

Initial Trip – Additional Features

Intelligent Fuse Saving

The **Intelligent Fuse Saving (IFS)** element is only active in the **Initial Trip** state. When the **IFS** element (**Phase** and/or **Ground**) picks up and starts timing for a minimum of 2 cycles, and current goes below both the **Phase Minimum Trip** and **Ground Minimum Trip** settings for at least two cycles, the **IFS** elements are turned off for the duration of the **O/C Reset** and **IFS Sequence Reset** timers. See Figure 36.

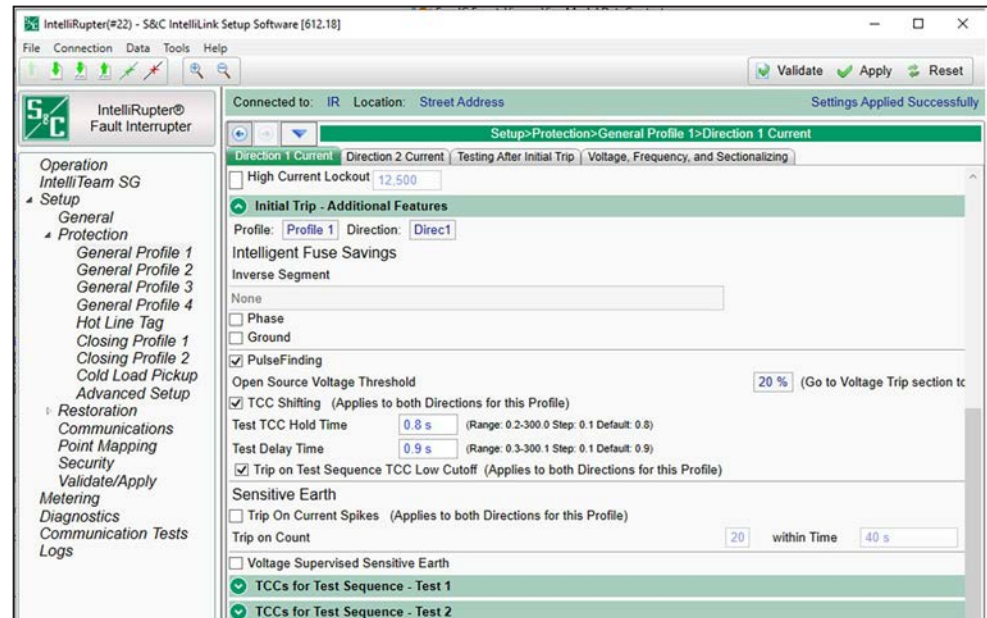


Figure 36. The Setup>Protection>General Profile 1>Direction 1 Current>Initial Trip>Additional Features screen.

If another fault occurs within the **Sequence Reset** timer, only the base curve is active and it would time and potentially trip the IntelliRupter fault interrupter, which then enters the test sequence as usual. The IntelliRupter fault interrupter will stay in its **Initial Trip** state unless it trips on the base curve.

After the **Sequence Reset** timer expires and no elements have been picked up, the **IFS** mode is re-initiated and the IntelliRupter fault interrupter is reset to the **Initial Trip** state.

Inverse Segment

Select the fuse type and speed to be saved. Select from the drop-down list of inverse curve names or select the **None** option. This curve applies to the enabled **Phase** or **Ground IFS** element. If the **None** option is selected, only the **Definite Time** settings will be used.

Phase check box—Select this check box to specify the phase overcurrent inverse curve.

Ground check box—Select this check box to specify the ground overcurrent inverse curve.

PulseFinding™ Fault Location Technique

In the “Initial Trip – Additional Features” panel of each **Direction** profile, select this check box to enable PulseFinding Fault Location Technique for that direction. The PulseFinding technique uses the **Open-Source Voltage Threshold** value specified on the *Setup>Protection>General Profiles>Voltage Trip* screen in combination with the *Setup>Protection>Advanced Setup>Advanced PulseFinding* **Percent of Phase Overcurrent Trip Reached** setpoint, and/or the **Percent of Ground Overcurrent Trip Reached** setpoint to open IntelliRupter fault interrupters that have not tripped. This means an IntelliRupter fault interrupter will only open using the PulseFinding technique provided its source voltage is below the **Open-Source Voltage Threshold** setpoint and the percent of overcurrent trip timing has been reached or exceeded.

Open Source Voltage Threshold

This is the percentage of system voltage below which the PulseFinding technique is enabled. (Range: 5-100; Step: 1; Default: 20)

TCC Shifting

When checked, all TCCs for Test Sequence Test-n are initiated for the duration of the **Test TCC Hold Time** setpoint. **Note:** n = 1 through 4. When the **Test TCC Hold Time** setting expires and all TCCs for Test Sequence Test-n are quiet, the Initial Trip TCCs are re-instantiated.

Because the **Test-n Delay** setpoint is active and timing when fault interrupters using the PulseFinding technique trip, the **Test Delay Time** setting is needed to delay testing until the upstream IntelliRupter fault interrupter has shifted back to the slower Initial Trip TCC. Configure the **Test Delay Time** setting with a value \geq the **Test TCC Hold Time** setting + 100 ms.

This feature is used with the PulseFinding technique when there are concerns about faults reinitializing because of dense vegetation and/or upstream conductor slap after the PulseClosing Technology and closing events have completed.

Check the PulseFinding Technique and TCC Shifting check boxes for all series devices configured with the same Initial Trip TCCs including the IntelliRupter fault interrupter closest to the source.

For the IntelliRupter fault interrupter closest to the source, on the *Setup>Protection>Advanced Setup>Advanced PulseFinding* screen, set the **Percent of Phase Overcurrent Trip Reached**, **Percent of Ground Overcurrent Trip Reached** and **Percent of Negative Sequence Overcurrent Trip Reached** setpoints to “Off.” See Figure 37.

The screenshot shows the 'Setup>Protection>Advanced Setup' configuration screen. It features a green header bar with navigation icons (back, forward, search) and the title 'Setup>Protection>Advanced Setup'. Below the header, there are two main sections: 'PulseClosing' and 'Advanced PulseFinding'. The 'Advanced PulseFinding' section is expanded, showing three settings, each with a dropdown menu set to 'Off' and a default value in parentheses:

Setting	Value	Default
Percent of Phase Overcurrent Trip Reached	Off	50 %
Percent of Ground Overcurrent Trip Reached	Off	80 %
Percent of Neg. Sequence Overcurrent Trip Reached	Off	50 %

Figure 37. The Percent of Trip Reached setpoints.

Set the **Inverse Segment** setpoint to “None” for each selected element in each of the TCCs for Test.

Note: When using the **TCC Shifting** feature, the options in the **For Close Operations** and **For Pulse Operations** setting in the *Setup>Protection>General Profile n>Direction n Current TCCs for Test Sequence-Test n* screen sections must be set to the **Use New TCCs, with all elements completely reset** setting. See Figure 38.

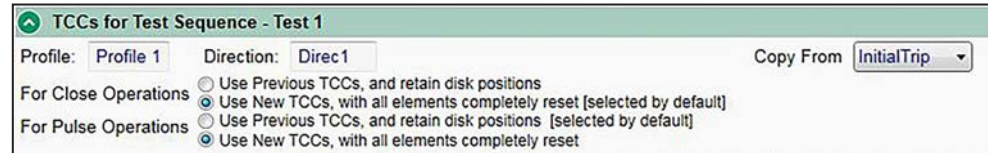


Figure 38. The TCC selection setpoints.

For all PulseFinding technique configured IntelliRupter fault interrupters set the **Inverse Segment** setpoint to “None” for each of the selected elements in each of the TCCs for Test Sequence - Test n sections. **Note:** n = 1 through 4.

Set the **Test-n Delay** setpoint of the adjacent downstream IntelliRupter fault interrupter to be greater than or equal to the longer of **Test TCC Hold Time** setpoint + **Min. Time 1** setpoint + 0.1 seconds or **Test TCC Hold Time** setpoint + **Min. Time 2** setpoint + 0.1 seconds. **Note:** n = 1 through 4.

TCC Shifting check box

Select this check box to enable faster and more sensitive TCCs for Test Sequence to be momentarily used after a **PulseClosing Technology** operation and then closing. TCCs for test sequence remain active for the user-selectable **Test TCC Hold Time** setpoint. After the PulseClosing Technology and then closing events, and provided all TCCs for **Test Sequence** elements are quiet and the Test TCC Hold Time has expired, TCCs for Test Sequence de-assert, and the slower Initial Trip TCCs re-assert. Use this feature when using the PulseFinding technique on a system prone to reinitializing faults.

Test TCC Hold Time

The **Test TCC Hold Time** setting controls when the TCCs for Test Sequence are active. When the **Test TCC Hold Time** timer expires and provided all **TCCs for Test Sequence** elements are quiet, the TCCs for Test Sequence de-assert and the Initial Trip TCCs re-assert. This time value should provide faults that reinitiate, e.g., tree limbs, adequate time to redevelop after a circuit is reenergized. This time value plus the maximum response time of any TCCs for Test Sequence Test-n should also be less than the **Test-n Delay** setpoint of the adjacent downstream IntelliRupter fault interrupter. **Note:** n = 1 through 4. (Range: 0.2-300.0 seconds; Step: 0.1 seconds; Default: 0.8 seconds)

This setting must be shorter than the shortest delay time of the test sequence configured in the downstream or down line-device that has the PulseFinding technique enabled. S&C recommends the same delay times be used at all the devices with the PulseFinding technique enabled.

Test Delay Time

This is the amount of time testing is delayed after the **Good Source Voltage Indication** threshold has been met. This time applies to all test sequences. (Range: 0.3-300.1; Step: 0.1; Default: 0.9)

Trip on Test Sequence TCC Low Cutoff (Applies to both directions for this profile)

When checked, the **TCC Shifting** function performs an instantaneous trip whenever the fault current reaches the **Minimum Trip Level** setting of any configured element for the active Test Sequence TCCs before the **Test TCC Hold Time** timer expires. The **For Close Operations** and the **For Pulse Operations** settings (see Figure 38 on page 62) are all valid for the **Trip on Test Sequence TCC Minimum Pickup** function. The Low Current Cutoff of the resulting TCC is the **Instantaneous Trip Level** setting for the **Test TCC Hold Time** setting. When the Low Current Cutoff of the resulting TCC is set to “N/A,” the Minimum Trip Level of the resulting TCC becomes the Instantaneous Trip Level.

The timing diagram in Figure 39 shows the relationship between the **Test-n Delay Time** setpoint on the *Setup>Protection>General Profile n>Testing After Initial Trip* screen, the **Test TCC Hold Time**, and the **Test Delay Time** setpoints.

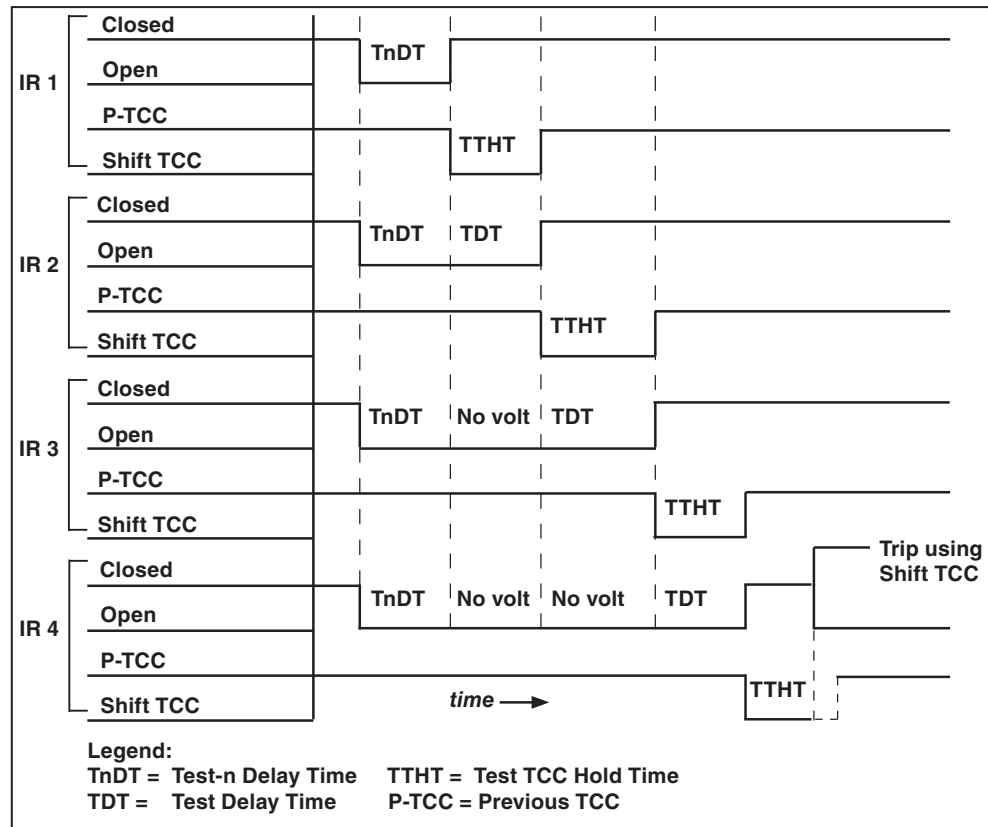


Figure 39. The timing example for the PulseFinding technique with the TCC Shifting; the margin setting is not accounted for.

Using TCC Shifting With PulseFinding Fault Location

As stated above, the PulseFinding technique is used for series-connected IntelliRupter fault interrupters that cannot be selectively time-current coordinated, enabling some or all of them to trip open when downstream faults occur. The fault is quickly located by sequential **PulseClosing Technology** operations, starting at the open device closest to the source. Each successive downstream device will perform a **PulseClosing Technology** operation, find no fault and, quickly close. But the device nearest the fault will perform a **PulseClosing Technology** operation, sense the fault, and stay open.

In some areas, local vegetation can produce faults known as reinitiating faults because they require time to redevelop after a circuit is reenergized and can result in multiple PulseFinding technique sequences occurring for a single fault. TCC shifting mitigates this condition by ensuring the device using PulseClosing Technology has a faster response

than the upstream devices that have already closed. See Figure 40 on page 66 for an example TCC. Depending on the conditions, after being reenergized, a reinitiating fault can take from a couple of cycles to a few seconds to reach fault levels. A few cycles may be adequate, but historical data (if available) are the best reference when determining a reasonable time frame for use on the system. The example assumes the majority of these faults reinitiate in 5 cycles. Therefore, 5 cycles is used as the baseline for setting this feature in this example. See Figure 41 on page 67.

Identical **Delay Time** settings should be configured in the “Testing After Initial Trip” panel for all configured tests in all the series connected devices that are set up for the PulseFinding technique with TCC shifting. For example, if there are three configured tests and device 1 has a **Delay Time** setting of 2 seconds for Test 1, 5 seconds for Test 2, and 10 seconds for Test 3, then, devices 2 and 3 should also have **Delay Times** settings of 2 seconds for Test 1, 5 seconds for Test 2, and 10 seconds for Test 3.

Also, the Test 1 **Delay Time** setting must be less than the Test 2 **Delay Time** setting, which must be less than Test 3 **Delay Time** setting.

Follow these steps to use TCC shifting with the PulseFinding technique.

- STEP 1.** Configure the “Initial Trip” section for each direction of the selected General Profile.
- STEP 2.** Check the PulseFinding Technique check box.
- STEP 3.** Check the TCC Shifting check box.
- STEP 4.** Set the **Test TCC Hold** setpoint.

This setting must be shorter than the shortest **Delay Time** setting in the “Testing After Initial Trip,” “Overcurrent,” and “IFS Element” sections. It must also be 100 ms longer than the longest **Time Min. Time** settings for TCC for Test Sequence Test 1 through Test 4

For this example, faults will reinitiate after five cycles. So, the **Test for TCC Hold** setting time should be a minimum of 84 ms + 100 ms, or 184 ms. Therefore, the shortest **Delay Time** setting for Testing After Initial Trip must be greater than or equal to 185 ms. That also defines the longest **Time Min. Time** setpoint as less than or equal to 84 ms.

- STEP 5.** Choose the TCC curve to be active during the shifting for each Test Sequence Test-n test.
- STEP 6.** Set the **Time Min. Time** setpoint as indicated in Step 4.
- STEP 7.** Set the “Testing After Initial Trip,” “Overcurrent,” and “IFS Element” sections making sure the **Delay Time** settings are set as indicated in Step 4.

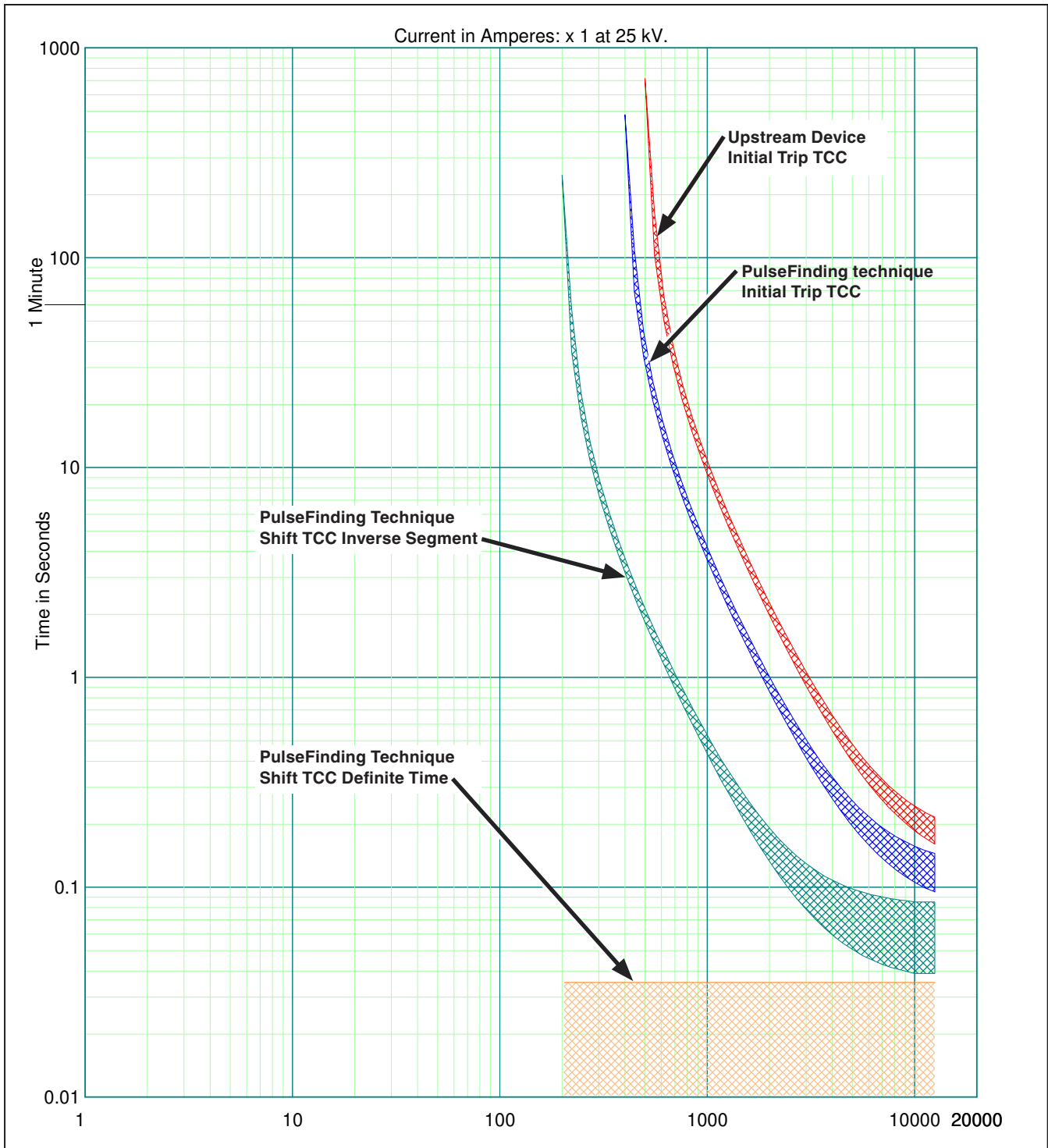


Figure 40. A PulseFinding Technique Shift TCC curve.

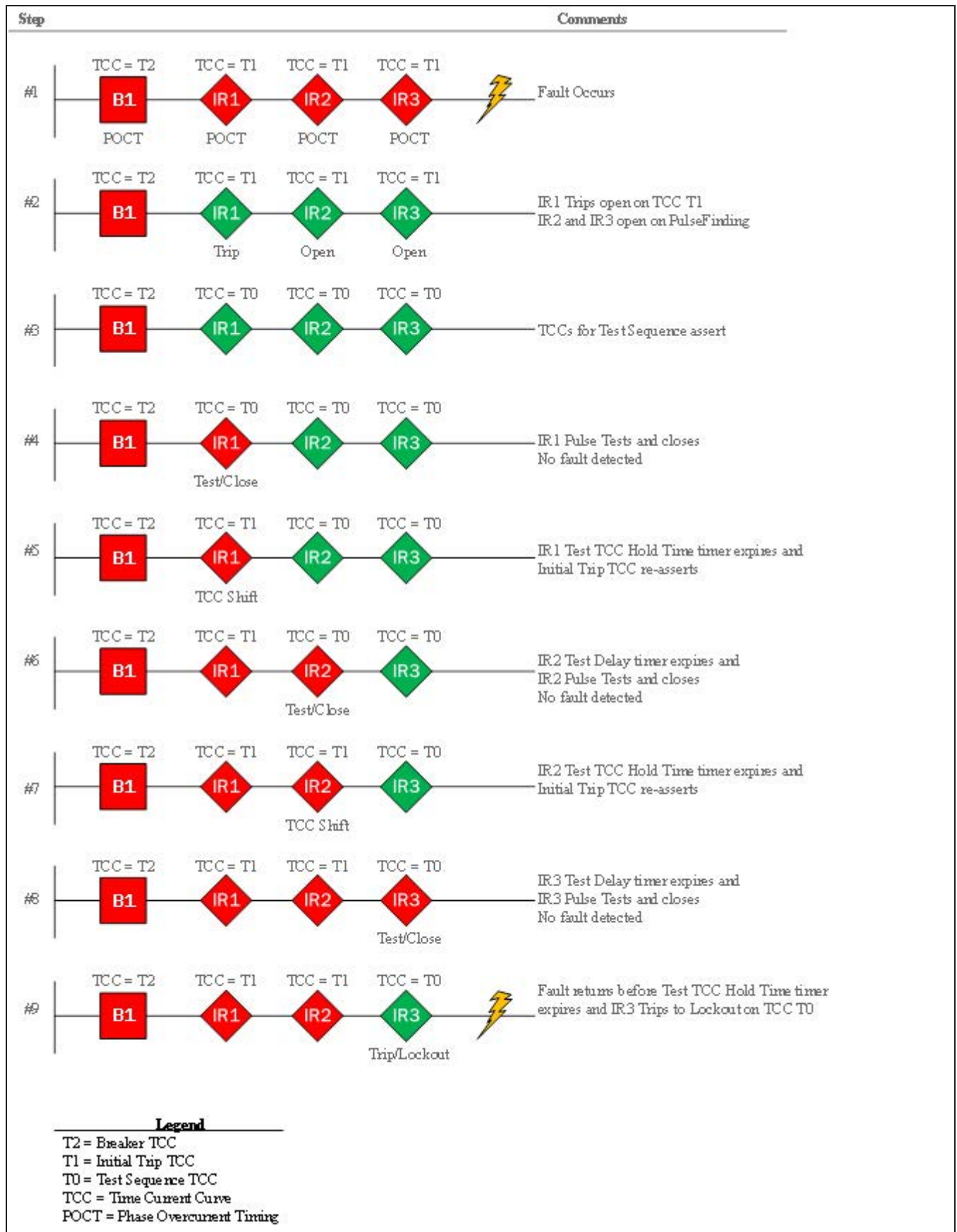


Figure 41. A test sequence example of the PulseFinding technique using TCC-shifting.

Sensitive Earth

Trip on Current Spikes

When enabled, the **Sensitive Earth Trip on Current Spikes** setting causes the IntelliRupter fault interrupter to trip and immediately lock out if the user-specified number of current spikes occurs within the user-specified time period. The **Current Spike** counter is incremented each time current goes above the **Sensitive Earth Min Trip** setting. The timer is a constant rolling window, so when no current spikes occur within the user-specified **Trip Within Time** timer, the **Current Spike Counter** element is fully reset. The **Sensitive Earth Current Spike Trip** element and the **Sensitive Earth Overcurrent** element can both be enabled and will operate independently of each other. (Default: Disabled) See the **Minimum Time Between SEF Current Spikes** setting on the *Setup>Protection>Advanced Setup* screen.

Trip on Count

This is the number of current spikes counted that determine when the **SEF** element trips. (Range: 1-100; Step: 1; Default: 20) This setting applies to both directions.

Trip Within Time

The time period in which the **Trip on Current Spikes** mode must occur for the **SEF** element to trip. The **Trip Within Time** timer is a constant rolling window, so when no current spikes occur within the configured time period the **Trip on Current Spikes** counter is fully reset. (Range: 1-600 seconds; Step: 1 second; Default: 40 seconds) This setting applies to both directions.

Application Notes for the SEF Trip on Current Spikes mode

Reclose and **PulseClosing Technology** operations from other devices on the system will likely register as a current spike.

- A recloser or breaker three-phase operation (upline or downline) may only put a total of four current spikes on the system for a full-test.
- A recloser or IntelliRupter fault interrupter single-phase operation (upline or downline) may create a current unbalance that will count as a current spike. If the current unbalance remains above the **SEF Minimum Trip** setting until all three phases are closed, the event will appear as a single current spike to the counter.
- An IntelliRupter fault interrupter could see the initial trip plus eight pulses for a permanent fault at a downline IntelliRupter fault interrupter, and the **SEF Current Spike** counter could see many current spikes depending on the test sequence used. Most **PulseClosing Technology** events will generate 2-4 spikes per test sequence, depending on the type of fault and the load that occurs when the first phase is closed.
- When a full overcurrent sequence is used, the recommended minimum value of current spike counts to trip is on the order of 15-20 counts. However, in scenarios where only an initial trip is used (with no test sequence), the number of current spikes generated could be a low single-digit number. There is no **Sensitive Earth** element in the **Closing** profile configurations.

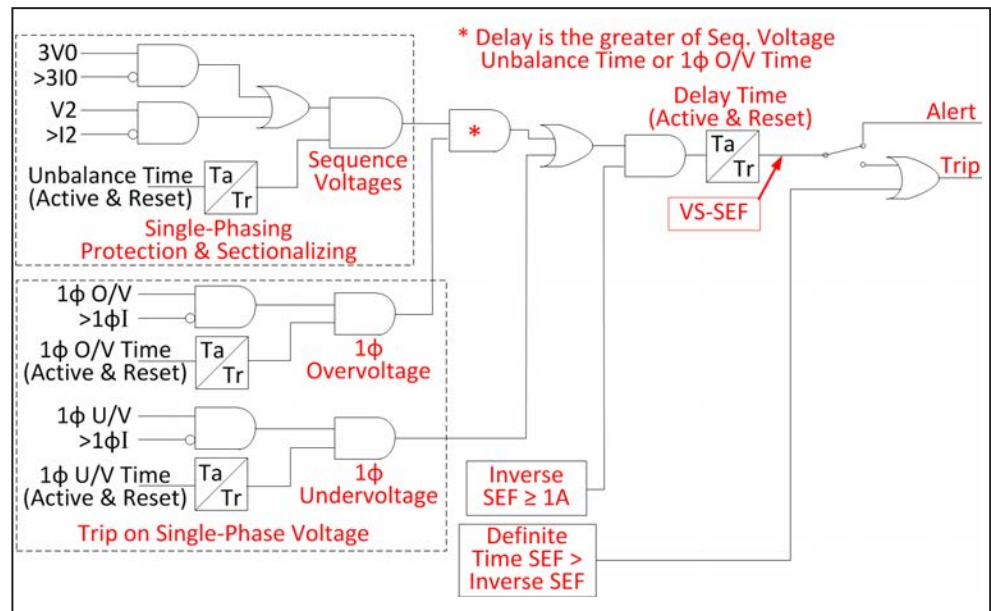


Figure 42. A logic diagram explaining how the voltage supervised Sensitive Earth function works.

Voltage Supervised Sensitive Earth

Voltage Supervised Sensitive Earth check box

Checking the box opens the screen settings in this panel. This function increases sensitivity and provides quicker response during a fire season. The Inverse Section of the **Sensitive Earth** element is directed through the logic shown on the screen. See Figure 42 for a detailed logic diagram explaining how this function works.

Note: When the Voltage Supervised Sensitive Earth check box is checked, the **Single-Phase Protection and Sectionalizing** and **Trip on Single Phase** setpoints on the *Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing>Voltage Trip* screen must be set for the **VS-SEF** state.

Disable Trip check box

When checked, the output of the Inverse Section only activates the **Alert/DNP** status and will not trip the IntelliRupter fault interrupter. However, a Sensitive Earth Element Definite Time Trip event still can trip the IntelliRupter fault interrupter.

Delay Timer

The **Delay** timer starts when the logic shown on the screen has been satisfied. The **Delay** timer stops timing when this logic is no longer satisfied and begins resetting per the **Delay Timer Reset Time** setting. (Range: 0-600 seconds; Step: 0.1 seconds; Default: 1 second)

Delay Timer Reset Time

When the **Delay** timer stops timing, it begins resetting per the **Delay Timer Reset Time** setting. (Range: 0-600 seconds; Step: 0.1 seconds; Default: 1 second)

TCCs for Test Sequence

TCCs for Test Sequence – Test 1 through Test 4

TCC values must be entered for **Direction 1** and **Direction 2** profiles when the **Close Test** mode is used. See Figure 43.

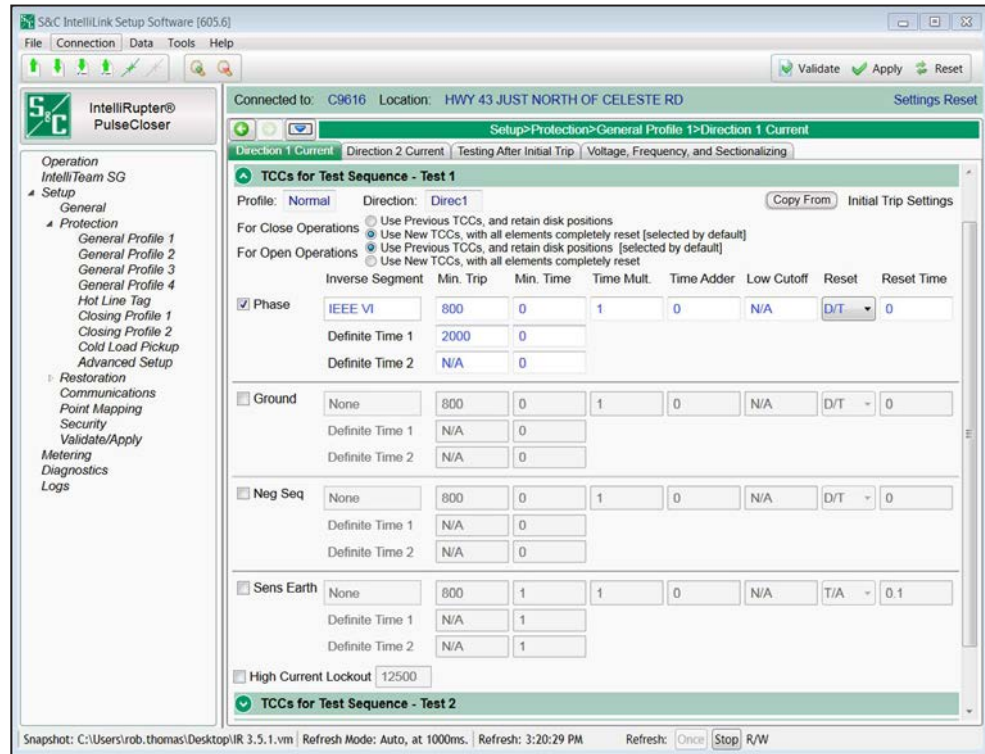


Figure 43. The Setup>Protection>General Profile 1>Direction 1 Current>TCCs for Test Sequence-Test 1 screen.

Up to four operations (Test 1 to Test 4) can be specified to follow the **Initial Trip** event. The settings entered for Direction 1 can be copied to Direction 2 and then modified as necessary.

For each **Close** operation specified in the test sequence, either new TCC curves need to be entered or the **Use Previous TCCs, and retain disk positions** mode must be selected with the radio button for that function.

When the **Use Previous TCCs** mode is selected, the TCCs active for the previous operation will be used. They may be fully or partially reset when the **Close** operation occurs. There is no need to enter new TCCs on this screen.

When the **Use New TCCs** mode is selected, the TCCs specified on this screen are initiated at the time of the **Close** operation, with all elements fully reset.

The Phase, Ground, Neg. Seq., Sens. Earth, and High Current Lockout configurations found in Test 2, Test 3, and Test 4 are the same as the configurations in Test 1 and the “Initial Trip” panel of the *Setup>Protection>General Profile 1>Direction 1 Current* screen. All options and ranges are the same as described for the “Initial Trip” panel. The options and ranges can be copied by selecting the **Initial Trip** mode or a specific test on the **Copy From** drop-down menu.

Phase Overcurrent

The **Phase Overcurrent** element trips the IntelliRupter fault interrupter when current on one or more phases exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Phase Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.01-15.00; Step: 0.01)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Ground Overcurrent

The **Ground Overcurrent** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Ground Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** setting. When the **None** setting is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.01-15.00; Step: 0.01)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Negative Sequence

The **Negative Sequence** element trips the IntelliRupter fault interrupter when the negative sequence component (I_2) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Negative Sequence Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) Also see the **Maximum Interrupting Current** setting on the *Setup>General>Site-Related* screen.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters, 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Sensitive Earth

The **Sensitive Earth** element trips the IntelliRupter fault interrupter when the computed residual of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Sensitive Earth Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 3.0-16,000.0; Step: 0.1) When the **Voltage Supervised Sensitive Earth** element is selected, Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 1.000-6000.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.01-15.00; Step: 0.01)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. (Range: 3.0-16,000.0; Step: 0.1) When the **Voltage Supervised Sensitive Earth** element is selected. (Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—The reset method for the inverse curve is configurable for **D/T** (Definite Time) or **T/A** (Time Accumulation) mode. The **Time Accumulation** timer runs when current is above the **Minimum Trip** setting and does not run when current is below the **Minimum Trip** setting. The timer continues to count until either the **SEF** element trips or the element does not pickup for the duration of the user-specified **SEF Reset Time** setting and the **SEF** element resets. The **Time Accumulation** mode is the default.

Reset Time—When the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-6000.000; Step: 0.001);

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 3.0-16,000.0; Step: 0.1—when the **Voltage Supervised Sensitive Earth** element is selected, Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 1.000-6000.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 3.0-16,000.0; Step: 0.1—when the **Voltage Supervised Sensitive Earth** element is selected, Range: 1.0-16,000.0; Step: 0.1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 1.000-6,000.000; Step: 0.001)

High Current Lockout

Select this check box to specify the **High-Current Lockout Level** setting (in primary amperes). No testing is performed at current above this level. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

TCCs for Coordination

The **Sequence Coordination** element maintains proper coordination between the IntelliRupter fault interrupter and downstream reclosers. When a fault is cleared by a downstream recloser, the IntelliRupter fault interrupter shifts to a slower curve for subsequent fault testing before the **Close** operation. When the **Sequence Coordination** mode is used, TCC values must be entered for Direction 1 and Direction 2. Settings are similar to those for the **Initial Trip** settings. See Figure 44.

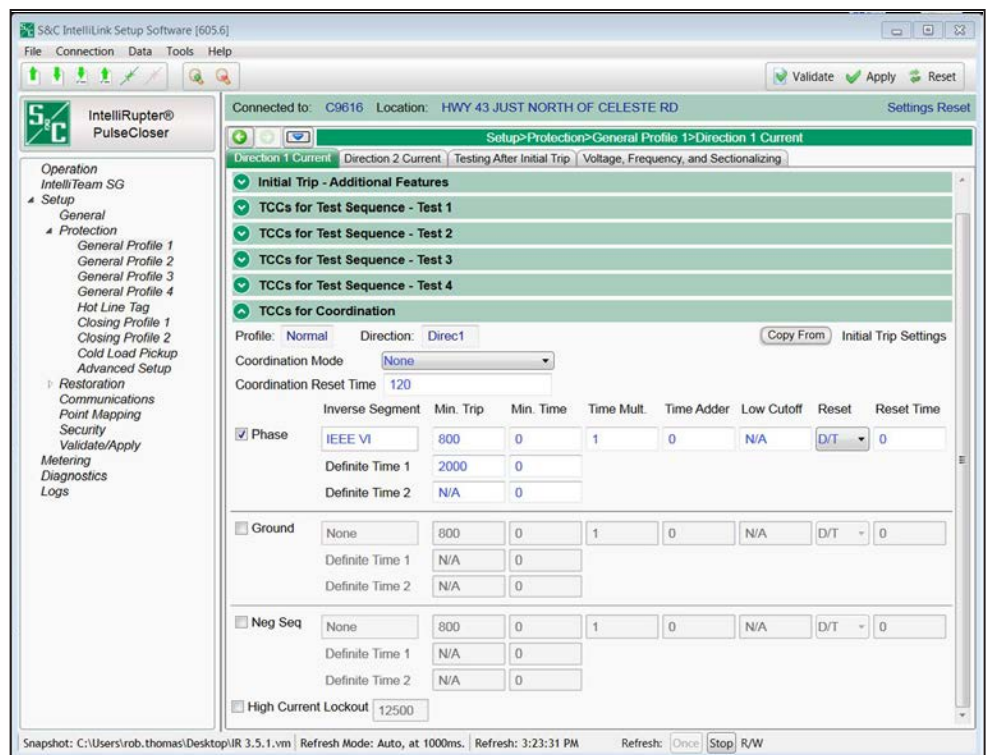


Figure 44. The Setup>Protection>General Profile 1>Direction 1 Current>TCCs for Coordination screen.

Coordination Mode

Settings are: **None**, **Sequence Coordination**, or **Communication Enhanced Coordination**. When **Sequence Coordination** mode or **Communication Enhanced Coordination** mode is used, TCC values must be entered for Direction 1 and/or Direction 2. Settings are similar to those for the **Initial Trip** settings.

Sequence Coordination

When **Sequence Coordination** mode is selected, Initial Trip TCCs are deactivated and Sequence Coordination TCCs are activated after Initial Trip TCCs have been timing for an overcurrent event that doesn't result in a trip command. This transition occurs when **Initial Trip Overcurrent** elements reset, which means Initial Trip TCC reset methods (**E/M** or **D/T** mode), and their related time value settings (**Reset Time** value), have no effect on this transition.

Sequence Coordination mode is typically selected to enable proper coordination between the IntelliRupter fault interrupter and a downstream recloser using fast and slow TCCs. Reclosers with fast and slow TCCs will usually trip once or twice using a fast TCC in an attempt to save a downstream fuse. After tripping with the fast TCC, the recloser control then transitions to a slow TCC, enabling the fuse to blow if it was previously saved. If the fault is not cleared after tripping twice using the slow TCC, the recloser will then lock out.

Consequently, **Sequence Coordination** mode enables the IntelliRupter fault interrupter to transition from **Initial Trip** (fast TCCs) to **Sequence Coordination** (slow TCCs) settings to coordinate with the downstream recloser tripping behavior. After the downstream recloser trips once using its fast TCC, the IntelliRupter fault interrupter transitions to Sequence Coordination TCCs regardless of whether the recloser has one or two fast trips.

Communication Enhanced Coordination

Communication Enhanced Coordination (CEC) mode allows a group of IntelliRupter fault interrupters to share the same faster Initial Trip TCCs and slower Sequence Coordination TCCs.

Each IntelliRupter fault interrupter's Initial Trip TCCs remain active until a curve-shift signal is received from an adjacent downstream neighbor. When the curve-shift signal is received, the Initial Trip TCCs are deactivated and the Sequence Coordination TCCs are activated.

All CEC IntelliRupter fault interrupters sharing the same Initial Trip TCCs and Sequence Coordination TCCs will experience a fault at the same time and send a curve-shift signal to their adjacent upstream neighbor. The only IntelliRupter fault interrupter that will not receive a curve-shift signal is the one closest to the fault, which will react using its faster Initial Trip TCCs and trip before the other upstream IntelliRupter fault interrupters trip.

Sequence Coordination TCCs remain active until an IntelliRupter fault interrupter receives a shift-back signal from an adjacent downstream neighbor. Upon receipt of the shift-back signal, Sequence Coordination TCCs are deactivated and Initial Trip TCCs are reactivated.

Transmission of the shift-back signal originates from the IntelliRupter fault interrupter closest to the fault. This IntelliRupter fault interrupter sends a shift-back signal

to its adjacent upstream neighbor when it has progressed to lockout and all poles are open, or it tripped in response to a transient fault that has abated. A transient fault has abated when the **Overcurrent (and IFS) Sequence Reset** timer has expired without the IntelliRupter fault interrupter progressing to the **Lockout** state.

When the upstream neighbor of the IntelliRupter fault interrupter closest to the fault receives this shift-back signal, it transitions from its Sequence Coordination TCCs to its Initial Trip TCCs. After transitioning, it then sends a shift-back signal to its upstream neighbor and so on until the last upstream IntelliRupter fault interrupter receives the shift-back signal. This means the transition from Sequence Coordination TCCs back to Initial Trip TCCs by upstream IntelliRupter fault interrupters occurs sequentially.

Note: The **Coordination Reset Time** setting also controls when Sequence Coordination TCCs are deactivated and Initial Trip TCCs are reactivated. This action is independent of the behavior resulting from the receipt of a shift-back signal from CEC so this time value should be chosen carefully, and a time value of 0 seconds should never be used.

GOOSE Coordination

Goose Coordination mode specifies coordination curves to be used when GOOSE is enabled on the device and a TCC shift is triggered because of a GOOSE configuration. **GOOSE Coordination** mode must be used for both Direction 1 and Direction 2.

To enable **GOOSE** status information on the *Operation* screen, enable the **GOOSE Messaging** feature on the *Setup>Protection>GOOSE Messaging>General* screen.

Coordination Reset Time

This is the duration (in seconds) Sequence Coordination TCC curves remain active. Timing begins after Sequence Coordination TCCs are no longer timing, meaning conditions are below **Phase**, **Ground**, and **Negative Sequence Minimum Trip** settings. At the expiration of the **Coordination Reset Time** timer, Initial Trip TCCs of the selected **General** profile become active. (Range: 0-600; Step: 1)

Phase Check Box

Select to configure this element.

Inverse Segment

Select from the browse for file window of inverse-curve names or select the None option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip

This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time

This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-6000.000; Step: 0.001)

Time Mult.

This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder

This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff

This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset

Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time

If the **Definite Time Reset** mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip

This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time

This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip

This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time

This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Ground Overcurrent

The **Ground Overcurrent** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Ground Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Negative Sequence

The **Negative Sequence** element trips the IntelliRupter fault interrupter when the negative sequence component (I_2) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Negative Sequence Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse-curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

High Current Lockout

Select this check box to specify the **High-Current Lockout** setting (in primary amperes). No testing is performed at current above this level. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum. Also see the **Maximum Interrupting Current** setting on the *Setup>General>Site-Related>System* screen.

The screenshot shows the 'Earth Fault Protection and Sectionalizing' configuration screen. The left-hand navigation tree is expanded to 'Setup > Protection > General Profile 1 > Direction 1 Current > Earth Fault Protection and Sectionalizing'. The main panel displays the following settings:

- Profile:** Profile 1
- Direction:** Direct1
- System Type:** Multi-Grounded (Default: Current System Setting)
- DTAP Sectionalizing:** No (Default: No)
- Wattmetric Protection:** No (Default: No)

Other visible settings include:

- Neg Seq:** Definite Time 1: 12,500, Definite Time 2: 12,500
- Sens Earth:** Definite Time 1: N/A, Definite Time 2: N/A
- High Current Lockout:** 12,500

Figure 45. The Setup>Protection>General Profile 1>Direction 1 Current>Earth Fault Protection and Sectionalizing screen.

Earth Fault Protection and Sectionalizing

Profile Name

This non-editable text box displays the profile text set in the “Initial Trip” panel. See Figure 45.

Direction

This non-editable text box displays the direction text set in the “Initial Trip” panel.

DTAP Sectionalizing

When the **Yes** state is selected for the Directional Transient Active Power (**DTAP**) **Sectionalizing** feature, the “DTAP Sectionalizing settings” panel opens and enables this element with the settings present in this panel. (Range: Yes, No; Default: No)

Wattmetric Protection

When the **Yes** state is selected for **Wattmetric Protection** feature, the “Wattmetric Protection settings” panel opens and enables this element with the settings present in this panel. (Range: Yes, No; Default: No)

DTAP Sectionalizing Information

Zero Sequence Voltage Threshold

This is the **Zero Sequence Voltage** threshold in percent, used for comparison with the measured zero sequence voltage. (Range: 1-100;% Step: 1%; Default: 50%)

-P0 Fault Detection Threshold

This is the **Zero Sequence Power Level** setting used for comparison with the measured zero sequence power during a fault event, and when the DTAP compensator is active. **Note:** The “negative” sign indicates zero sequence power must be flowing toward the source for this element to be active. (Range: -20.0 to +20.0 kW; Step: 0.5 kW; Default: -2.0 kW)

Delay Length

The number of cycles the **True** condition must be present for the DTAP Earth Fault Detection Algorithm Earth Fault Presence Confirmation. The **Fault Detection Algorithm Delay** timer resets whenever there is an open pole. (Range: 1-5 cycles; Step: 1 cycle; Default: 2 cycles)

Sliding Window Filter

This is the length of the **Sliding Window Filter** setting for the Earth Fault Detection Algorithm Sliding Window Filter. The sliding window averaging filter resets whenever there is an open pole. (Range: 1-5 cycles; Step: 1 cycle; Default: 2 cycles)

Indication Only

When the **Yes** state is selected, the **DTAP Sectionalizing** element will not trip the IntelliRupter fault interrupter but instead provide an indication of the element being picked up in the status point log or report DNP point 159/160 over DNP3 to SCADA if these points are mapped and unsolicited reporting is enabled. When the **No** state is selected, this element will trip the IntelliRupter fault interrupter to lock out when it is active. (Range: Yes, No; Default: Yes)

Unbalance Time to Trip

The **Trip To Lockout** operation because of the **DTAP Earth Fault Detection** element is delayed for this duration after detection. (Range: 0.00-600.00 seconds; Step: 0.01 seconds; Default: 3.00 seconds)

Unbalance Reset Time

The DTAP Earth Fault Detection resets if conditions return to levels below the settings for the reset time. (Range: 0.00-600.00 seconds; Step: 0.01 second; Default: 0.10 seconds)

Zero Sequence Voltage Reset Threshold

This is the **Zero Sequence Voltage Reset** threshold, which the zero sequence voltage must stay below for the element to reset. (Range: 1-100%, Step: 1%; Default: 10%)

Zero Sequence Voltage Reset Timer

This is the amount of time the zero sequence voltage must stay below the threshold for the element to be reset. (Range: 1.00-600.00 seconds; Step: 0.01 seconds; Default: Disabled)

Wattmetric Protection Information

Zero Sequence Voltage Threshold

This is the **Zero Sequence Voltage** threshold in percent, used for comparison with the measured zero sequence voltage. (Range: 1-100%; Step: 1%; Default: 50%)

-P0 Fault Detection Threshold

This is the **Zero Sequence Power Level** setting used to compare with the measured zero sequence power during a fault event. **Note:** The “negative” sign indicates zero sequence power must be flowing toward the source for this element to assert. (Range: -2,000.0 to +2,000.0 kW; Step: 0.5 kW; Default: -2.0 kW)

Indication Only

When the **Yes** state is selected, the **Wattmetric** element will not trip the IntelliRupter fault interrupter but instead provide an indication of the element being picked up in the status point log or report DNP point 163/164 over DNP3 to SCADA if these points are mapped and unsolicited reporting is enabled. When the **No** option is selected, this element will trip the IntelliRupter fault interrupter to lock out when it is active. (Range: Yes, No; Default: Yes)

Time to Trip

The **Trip To Lockout** operation because of the **Wattmetric** element is delayed for this duration after detection. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 3.00 seconds)

Reset Time

The **Wattmetric** element resets if conditions return to levels below the settings for the reset time. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 0.10 seconds)

Shift Time

This is used in place of the **Wattmetric Time to Trip** setpoint when **TCC Shifting** mode is selected and the **TCC Shifting** conditions have been satisfied for the duration of the **Test TCC Hold Time** setting. Values can only be set that are less than the **Wattmetric Time to Trip** setpoint. (Range: 0.00 10.00 seconds; Step: 0.01 seconds; Default: 2.00 seconds)

Zero Sequence Voltage Reset Threshold

This is the **Zero Sequence Voltage Reset** threshold, which the zero sequence voltage must stay below for the element to reset. (Range: 1-100%; Step: 1%; Default: 10%)

Zero Sequence Voltage Reset Timer

This is the amount of time the zero sequence voltage must stay below the threshold for the element to be reset. (Range: 1.00-600.00 seconds; Step: 0.01 seconds; Default: Disabled)

Direction 2 Configuration

The sections and setting fields found in *Setup>Protection>General Profile 1>Direction 2* screen are identical in layout, and the options and ranges for each of the setting fields are the same as described for Direction 1 on pages 47 through 83. See Figure 46.

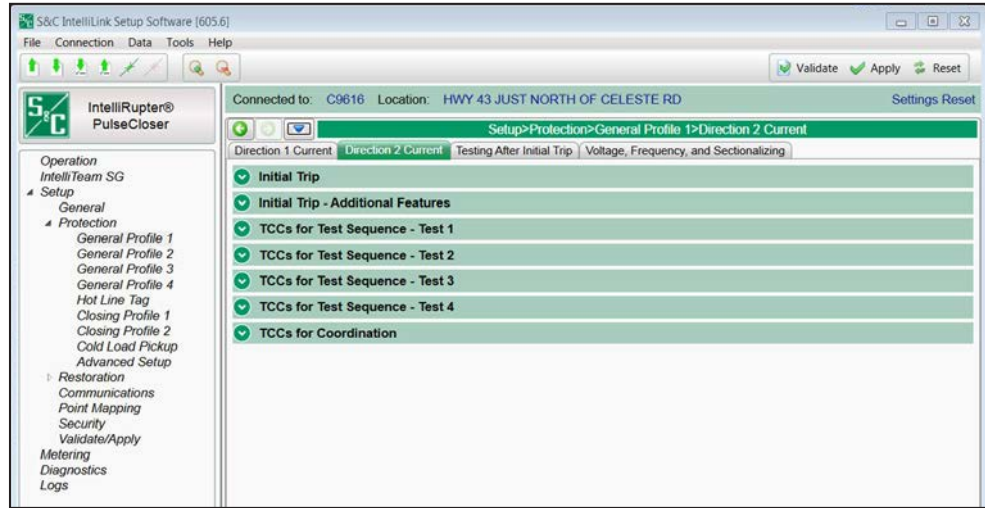


Figure 46. The *Setup>Protection>General Profile 1>Direction 2 Current>Initial Trip* Screen.

GOOSE Messaging

The **GOOSE Messaging** menu item specifies coordination curves to be used when GOOSE messaging is enabled on the device and a TCC shift is triggered because of a GOOSE configuration. **GOOSE Coordination** mode must be used for both Direction 1 and Direction 2.

Note: This feature is only available for the R3 control.

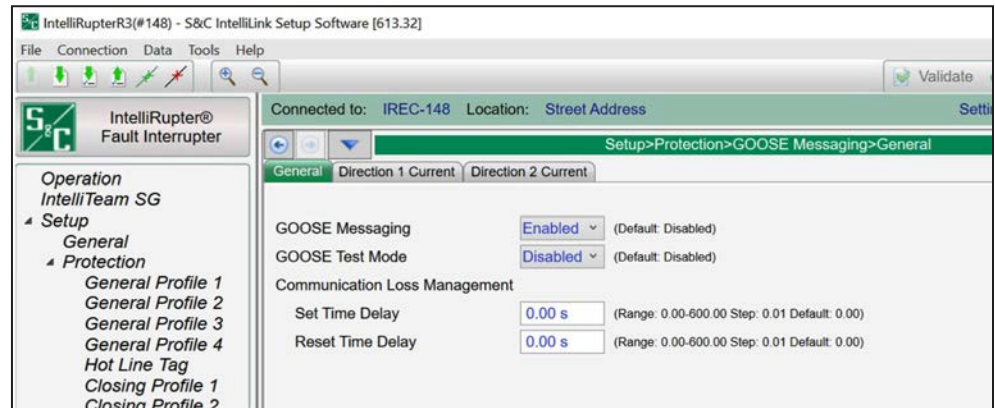


Figure 47. The *Goose Messaging>General* screen.

GOOSE Messaging

The **GOOSE Messaging** feature may be enabled or disabled with this setting. Enabling/disabling GOOSE Messaging with this setting or with the DNP control point have equal priority. The **GOOSE Messaging** status shows the most recently received control input. (Default: Disabled)

GOOSE Test Mode

When enabled, **GOOSE Test** mode allows the user to confirm whether a device is receiving configured GOOSE subscriptions without executing the resulting configured protection action. Note that **GOOSE Test** mode is not a persistent setting. (Default: Disabled)

Communication Loss Management

Set Time Delay

When the **Set Time Delay** value = 0, Comm Loss Status behavior is based on the **Time Allowed to Live** setting associated with individual GOOSE subscriptions. When the **Set Time Delay** value is non-zero, the **Communication Loss** status remains a logical “False” until the **Set Time Delay** timer has elapsed. (Range: 0.00-600.00; Step: 0.01; Default: 0.00)

Reset Time Delay

When the **Reset Time Delay** value = 0, Comm Loss Status behavior is based on the **Time Allowed to Live** setting associated with individual GOOSE subscriptions. When the **Reset Time Delay** value is non-zero, the delayed **Communication Loss** status remains a logical “True” until the **Reset Time Delay** timer has elapsed. (Range: 0.00-600.00; Step: 0.01; Default: 0.00)

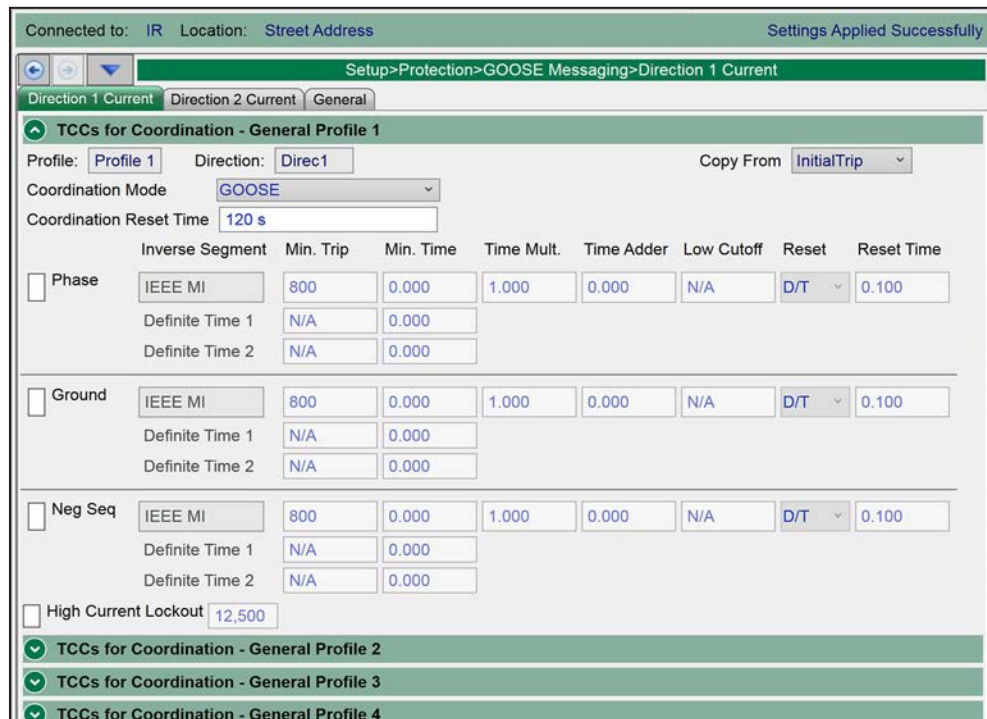


Figure 48. The *Goose Messaging>Direction 1 Current* screen.

Goose Coordination Mode

To enable GOOSE coordination status information on the *Operation* screen, the **Coordination Mode** setpoint in one or more of the **General** profiles must be set to **GOOSE Coordination** mode. See Figure 47.

Coordination Reset Time

This is the duration (in seconds) sequence coordination TCC curves remain active. Timing begins after sequence coordination TCCs are no longer timing, meaning conditions are below **Phase**, **Ground**, and **Negative Sequence Min. Trip** settings. At the expiration of the **Coordination Reset Time** timer, initial trip TCCs of the selected **General** profile become active. (Range: 0-600 seconds; Step: 1 second)

Note: A time value of 0 seconds should never be used when **Communication Enhanced Coordination** mode or **GOOSE Coordination** mode is selected.

Phase Check

Select to configure this element.

Inverse Segment

Select from the browse for file window of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip

This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000 A; Step: 1 A) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time

This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-6000.000 seconds; Step: 0.001 seconds)

Time Mult.

This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder

This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff

This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000 A; Step: 1 A) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset

Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time

If the **Definite Time Reset** mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000 seconds; Step: 0.001 seconds)

Definite Time 1 Min. Trip

This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000 A; Step: 1 A) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time

This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000 seconds; Step: 0.001 seconds)

Definite Time 2 Min. Trip

This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000 A; Step: 1 A) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time

This is the time delay (in seconds) after which the Definite Time 2 element trips. (Range: 0.000-600.000 seconds; Step: 0.001 seconds)

Testing After Initial Trip

After the initial trip for an **Overcurrent** element, testing can be performed to determine whether the fault is temporary or permanent. Two different test sequences are available, depending on the **Overcurrent** element that caused the initial trip. The same test sequence is used for faults in either direction. See Figure 49.

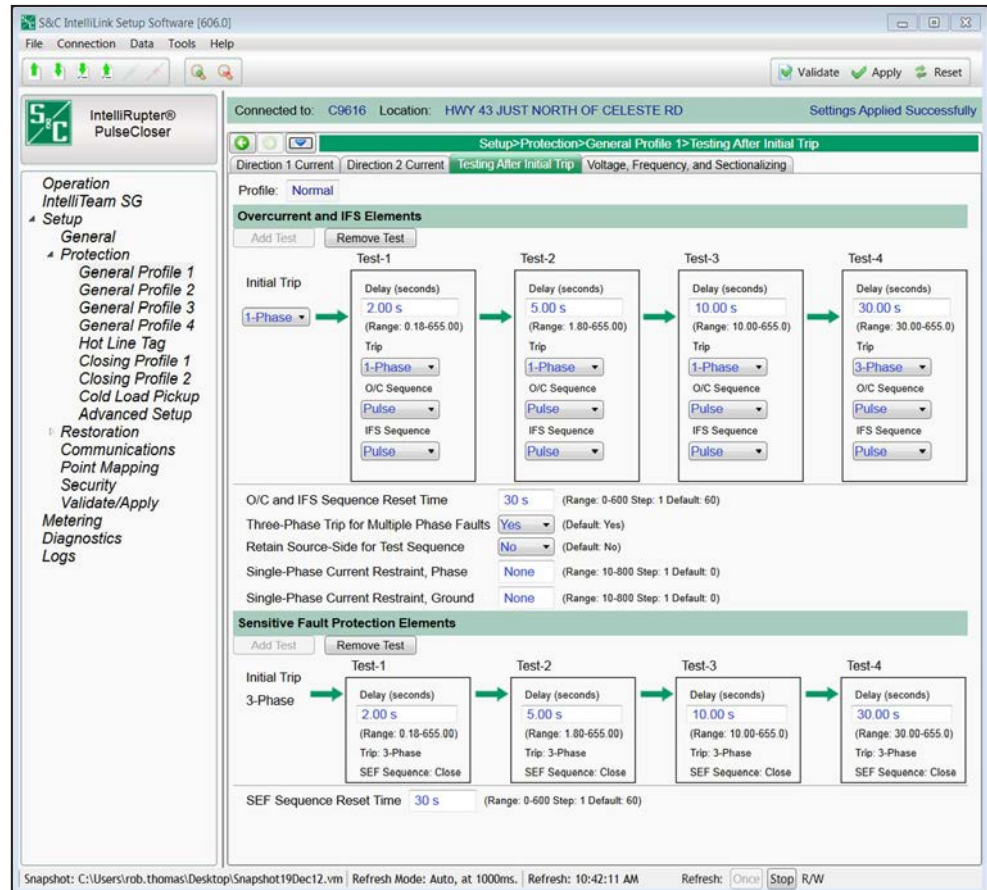


Figure 49. The Setup>Protection>General Profile 1>Testing After Initial Trip screen.

Each test sequence has a specified number of tests. Each test can use a **PulseClosing Technology** or a **Close** operation followed by the configured **Open Time** setting.

The IntelliRupter fault interrupter does not continue a test sequence when no source voltage is present during an open sequence. If source voltage does not return within the configured **Loss-of-Source Timeout** setting (default is 300 seconds and configuration is in the Setup>Protection>Advanced Setup screen) the IntelliRupter fault interrupter will go directly to the **Lockout** state.

Overcurrent and IFS (Intelligent Fuse Saving) Elements

Number of Tests

Specify the number of tests to be performed (up to four) by clicking on the **Add Test** or **Remove Test** button.

Initial Trip: 1-phase or 3-phase

This setting selects either a **1-Phase** or **3-Phase Trip** operation for overcurrent events related to the **Base O/C** and **Intelligent Fuse Saving** elements. Each test can be independently configured for either **1-Phase** or **3-Phase** operation. The last test configuration defines whether a **Single-Phase** or **Three-Phase Lockout** mode will be used. The **3-Phase** mode is the default.

When the IntelliRupter fault interrupter is set for **1-Phase** mode and responds to an overcurrent event, any phase that has timed beyond 20% of trip will be tripped. If the **Three-Phase Trip for Multiple Phase Faults** setting has been set to the **Yes** state and more than one phase has timed beyond 20%, all phases will be tripped. When set for **3-Phase** mode, all three phases trip. When the IntelliRupter fault interrupter is set for **1-Phase** mode and responds to a ground overcurrent event, any phase picked up will be tripped. If none of the phases have picked up or if **Three-Phase Trip for Multiple Phase Faults** setting has been set to the **Yes** state and more than one phase has picked up, all phases will be tripped. When set for **3-Phase** mode all three phases trip.

The *Operation* screen **Fault** flags indicate which phases have been involved in an event. The **Fault** flags are also communicated as DNP Status Points described in Instruction Sheet 766-560, “IntelliRupter® PulseCloser® Fault Interrupter: *DNP Points List and Implementation.*”

A **Fault** flag is set in response to an **Overcurrent** event for any phase that has timed beyond 20% of trip when an **Overcurrent** element has tripped or for any phase that was timing when a **Ground Overcurrent** element tripped. If a **Ground Overcurrent** element trips and none of the phases are picked up, a **Fault** flag will be set for each phase. See Figure 50.

Figure 50. The Setup>Protection>General Profile 1>Direction 1 Current>Testing After Initial Trip>Overcurrent and IFS Elements screen.

Test-1 Delay, Test-2 Delay, Test-3 Delay, Test-4 Delay

Specify the open time (in seconds) between each test. (Minimum: 0.18 for Time-1, 1.80 for Time-2, 10.00 for Time-3, and 30.00 for Time-4; Maximum: 655.00; Increment: 0.01.)

Trip

Specify from the drop-down list **1-Phase** or **3-Phase** mode.

O/C Sequence (R2 control)

Specify the action to be performed during each phase overcurrent test. Select from the drop-down list: the **Pulse** option for a test using PulseClosing Technology or the **Close** option.

O/C Sequence (R3 control)

For the **Overcurrent Sequence** setpoint specify the action to be performed during each phase overcurrent test. Select from the drop-down list: the **Pulse Close** option for a test using PulseClosing Technology or the **Point-On-Wave (POW) Close** option.

IFS Sequence (R2 control)

Specify the action to be performed during each intelligent fuse saving test. Select from the drop-down list: the **Pulse** option for a test using PulseClosing Technology or the **Close** option.

IFS Sequence (R3 control)

Specify the action to be performed during each intelligent fuse saving test. Select from the drop-down list: the **Pulse Close** option for a test using PulseClosing Technology or the **Point-On-Wave (POW) Close** option.

O/C and IFS Sequence Reset Time

Specify the test **Sequence Reset Time** setting (in seconds). (Range: 0-600; Step: 1) The same **Sequence Reset Time** setting is used for all test sequences. If the IntelliRupter fault interrupter remains in the **Closed** state at the completion of an action in the test sequence and no overcurrent element has picked up and started timing within this setting, the **Test Counter** indicator resets and any TCC that has changed will reset to its initial trip setting. When the **Intelligent Fuse Saving (IFS)** setting is configured and the **IFS** element (phase and/or ground) picks up and starts timing for a minimum of two cycles and then the current goes below both the **Phase Minimum Trip** and **Ground Minimum Trip** settings for at least two cycles, the **IFS** elements are turned off for the duration of the configured **O/C and IFS Sequence Reset Time** period.

When another fault occurs within the **O/C and IFS Sequence Reset Time** setting, only the base curve will be active. When the IntelliRupter fault interrupter trips using the base curve, it enters the test sequence as usual. The IntelliRupter fault interrupter stays in the **Initial Trip** state unless it trips on the base curve. This is not the **Sequence Coordination** feature that is exclusive to the **IFS** mode.

When the **O/C and IFS Sequence Reset Time** setting expires and no elements are picked up, the **IFS** mode is reinstated and the IntelliRupter fault interrupter is reset to the **Initial Trip** state. The **IFS** mode is only active in the **Initial Trip** state, and this feature only applies when the **IFS** mode is active.

Three-Phase Trip for Multiple Phase Faults

When set to the **Yes** option and two or three phases are faulted at the time of an **Overcurrent Element** trip, all three phases for the present **Test** operation and all subsequent **Test** operations. When set to the **No** option, each phase will trip independently.

Retain Source Side for Test Sequence

Select the **No** state to allow the IntelliRupter fault interrupter to respond to faults in both directions at any time. Select the **Yes** state to restrict circuit testing for the rest of the test sequence to the fault direction identified by the **Initial Trip** operation. Simultaneous bi-directional overcurrent protection is maintained for the **Initial Trip** operation for either setting. The **No** state is the default and recommended setting for general applications.

This feature prevents backfeeding a substation caused by a restoration event returning voltage from the opposite side. When set to the **Yes** state, the source side is determined at the time of the **Initial Trip** operation and is the side that is not faulted. If the **Directionality** element determines the fault is on the Direction 1 terminals, then the Direction 2 terminals are the source side for the duration of the test sequence. If directionality cannot be determined, the test sequence is ended and goes to the **Lockout** state. If source-side voltage is not present for the duration of the **Test Sequence** or **Pulse Finding Loss-of-Source Timeout** setting, the IntelliRupter fault interrupter goes to the **Lockout** state.

Single-Phase Current Restraint, Phase

Specify a phase current above which a **Single-Phase Trip** operation will not be allowed, and all **Trip** operations will be performed three-phase. (Range: 10-800; Step: 1 amp; Default: None)

Single-Phase Current Restraint, Ground

Specify a ground current above which a **Single-Phase Trip** operation will not be allowed and all **Trip** operations will be performed three-phase. (Range: 10-800; Step: 1 amp; Default: None)

Sensitive Earth Fault Protection Element

The **SEF** element will always trip three-phase and will always close after each time delay preceding an SEF trip. See Figure 51.

Number of Tests

Specify the number of tests to be performed (up to four).

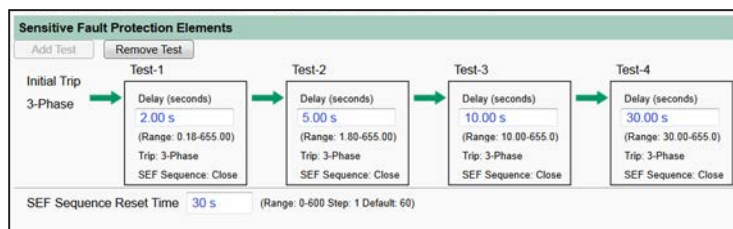


Figure 51. The Setup>Protection>General Profile 1>Direction 1 Current>Testing After Initial Trip>Sensitive Fault Protection Elements screen.

Initial Trip

3-Phase mode is the only option available.

Test-1 Delay, Test-2 Delay, Test-3 Delay, Test-4 Delay

Specify the open time (in seconds) between each test. (Minimum: 0.18 for Time-1, 1.80 for Time-2, 10.00 for Time-3, 30.00 for Time-4; Maximum: 655.00; Increment: 0.01)

SEF Sequence

Close-testing mode is the only option available.

SEF Sequence Reset Time

Specify the test sequence reset time (in seconds). (Range: 0-600; Step: 1) The same **Sequence Reset Time** setting is used for all test sequences. When the IntelliRupter fault interrupter remains in the **Closed** state at the completion of an action in the test sequence and no **Overcurrent** element has picked up and started timing within this setting, the test counter resets and any TCC curve that has changed will reset to its **Initial Trip** setting. When the **Intelligent Fuse Saving (IFS)** mode is configured and the **IFS** element (phase and/or ground) picks up and starts timing for a minimum of two cycles and then the current goes below both the **Phase Minimum Trip** and **Ground Minimum Trip** settings for at least two cycles, the **IFS** elements are turned off for the duration of the **O/C and IFS Sequence Reset Time** setting.

When another fault occurs within the **O/C and IFS Sequence Reset Time** setting, only the base curve will be active. When the IntelliRupter fault interrupter trips on the base curve, it enters a test sequence as usual. The IntelliRupter fault interrupter stays in its **Initial Trip** state unless it trips on the base curve. This is not the **Sequence Coordination** feature exclusive to the **IFS** mode.

When the **O/C and IFS Sequence Reset Time** setting expires and no elements have picked up, the **IFS** mode is reinstated and the IntelliRupter fault interrupter is reset to the **Initial Trip** state. The **IFS** mode is only active in the **Initial Trip** state, and this feature only applies when the **IFS** mode is active.

Voltage Trip

Each **General Profile** feature has settings for multiple **Voltage Trip** elements. See Figure 52.

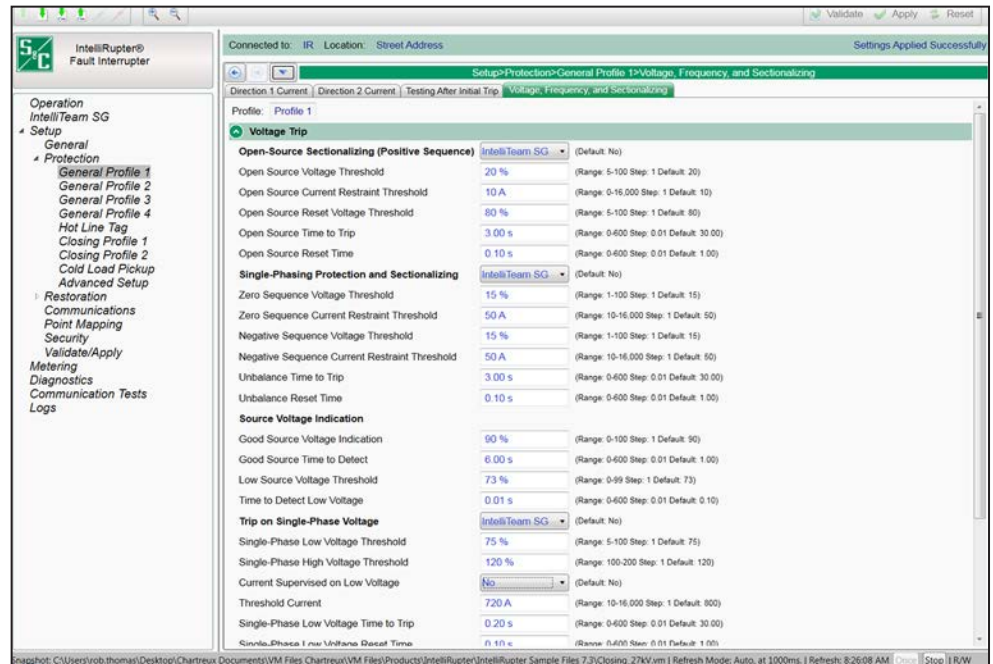


Figure 52. The Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing> Voltage Trip screen.

Open-Source Sectionalizing (Positive Sequence)

Specify a **Yes**, **No** (default), **IntelliTeam SG**, or **Loops Only** option. The **IntelliTeam SG** setting will cause this element to be active only when the IntelliTeam SG system is in the **Ready** state.

This is an **Undervoltage** element and uses positive-sequence voltage to determine whether it should trip. The element is current-supervised and uses positive-sequence current to determine when the **Undervoltage** element is allowed to accumulate time. When positive-sequence current is above the set threshold, the **Open-Source Sectionalizing** element does not accumulate time. This gives priority to the overcurrent elements during a high-current condition.

- **Input** values for the **Voltage** threshold are in percentages.
- The **Base** value is the line-to-ground RMS system voltage.
- The actual value measured is the resulting positive sequence voltage.

For example, if the line-to-ground nominal RMS voltage is 10 kV and the **Open Source Voltage Threshold** setting is 75%, the IntelliRupter fault interrupter will trip when the positive-sequence voltage measured is less than $0.75 \times 10 \text{ kV} = 7.5 \text{ kV}$ and if the positive-sequence current is less than the configured **Current Restraint Threshold** setting.

The **Current Threshold** setpoint is in primary amps.

For example, if the **Current Restraint Threshold** setting is set for 20 A and the positive-sequence current measured is greater than 20 A, the **Open-Source** element will not accumulate time.

Open-Source Voltage Threshold

This is the percentage of system voltage below which a **Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 20%)

Open-Source Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 0-16,000; Step: 1; Default: 10) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum. When set to 0, the current restraint is disabled.

Open-Source Reset Voltage Threshold

This is the percentage of system voltage above which the **Open-Source Voltage** element is reset. (Range: 5-100%; Step: 1%; Default: 80%)

Open-Source Time to Trip

This is the time (in seconds) the **Open-Source Voltage** element must be below its threshold for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Open-Source Reset Time

This is the time (in seconds) a reset-voltage level must be present for the **Open-Source Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Single-Phasing Protection and Sectionalizing

Specify the **Yes**, **No** (default), **VS-SEF**, or **IntelliTeam SG** option or this element. The **IntelliTeam SG** setting causes this element to only be active when the IntelliTeam SG system is in the **Ready** state.

This is an **Overvoltage** element and it uses zero-sequence and negative-sequence voltage to determine when it should trip. The two **Voltage** elements are current-supervised and use zero-sequence and negative-sequence current to determine when the **Overvoltage** elements should accumulate time. If zero- or negative-sequence currents are above the set thresholds, the respective **Zero-** or **Negative-Sequence Voltage** elements do not accumulate time. This gives priority to the **Overcurrent** elements during a high-current condition.

Zero Sequence Voltage (V_0) Threshold

When setting the **Zero Sequence Voltage (V0) Threshold** value, the protection logic in the device translates this value as the **Residual Voltage (3 x V0)** value. This is the percentage of system voltage above which a **Trip** operation will occur. (Range: 1-100%; Step: 1%; Default: 15%)

Note: This setting always uses **Phase-to-Ground** mode even when the **Voltage Reporting** setpoint on the *Setup>General>Site Related>System* screen is set to **Phase-to-Phase** mode. For example, when the **System Phase-to-Phase Voltage** setpoint

on the *Setup>General>Site Related>System* screen is set to 12.47 kV (7.2 kV phase to ground), and the **Zero Sequence Voltage (V0) Threshold** setpoint is set to 5%, when the residual X-side and Y-side voltage (3V0) is 1,100 Volts, then the **Residual Voltage (3 x V0) Threshold** setting has been exceeded ($1,100/7,200 = 15.3\% > 3 \times 5\%$) and a Trip Request event will occur.

Zero Sequence Current (I_0) Restraint Threshold

When setting the **Zero Sequence Current (I_0) Restraint Threshold** value, the protection logic in the device translates this value as the **Residual Current ($3 \times I_0$)** value. This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 10-16,000; Step: 1; Default: 50) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Note: The **Zero Sequence Current Restraint Threshold** limit is effectively disabled when set to 16000. This would be the recommended setting for distributed energy resource (DER) applications where the intent is to open as fast as possible on voltage loss.

Negative Sequence Voltage Threshold

This is the percentage of system voltage above which a **Trip** operation will occur. (Range: 1-100%; Step: 1%; Default: 15%) This setting always uses **Phase-to-Ground** mode even when the **Voltage Reporting** setpoint on the *Setup>General>Site Related>System* screen is set to **Phase-to-Phase** mode. For example, when the **System Phase-to-Phase Voltage** setpoint on the *Setup>General>Site Related>System* screen is set to 12.47 kV (7.2 kV phase-to-ground), the **Negative Sequence Voltage Threshold** setpoint is set to 15%, and the Negative Sequence X-Side and Y-Side Voltage (V2) is 1,100 volts, the **Negative Sequence Voltage Threshold** setting has been exceeded ($1,100/7,200 = 15.3\%$).

Negative Sequence Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 10-16,000; Step: 1; Default: 50) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Note: The **Negative Sequence Current Restraint** threshold is effectively disabled when set to 16,000. This would be the recommended setting for DER applications where the intent is to open as fast as possible on voltage loss.

Unbalance Time to Trip

This is the time (in seconds) the **Voltage Unbalance** element must be above its threshold for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Unbalance Reset Time

This is the time (in seconds) reset voltage must be present for the **Unbalance Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Source Voltage Indication

Source voltage is always indicated.

Good Source Voltage Indication

This is the percentage of system voltage above which the source is considered good. (Range: 0-100%; Step: 1%; Default: 90%)

Good Source Time to Detect

This is the time (in seconds) good source voltage must be present for the source to be reported good. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Low Source Voltage Threshold

This is the percentage of system voltage below which the source is considered low. (Range: 0-99%; Step: 1%; Default: 73%)

Time to Detect Low Voltage

This is the time (in seconds) low source voltage must be present for the source to be reported low. (Range: 0.00-600.00; Step: 0.01; Default: 0.10)

Trip on Single Phase Voltage

Specify the **Yes**, **No** (Default), **VS-SEF**, or **IntelliTeam SG** option to configure this element. The **IntelliTeam SG** option causes this element to only be active when the IntelliTeam SG system is in the **Ready** state.

This is both an **Undervoltage** and **Overvoltage** element that uses the lowest and highest line-to-ground RMS phase-voltage magnitude, respectively, to determine when it should trip. The element is current-supervised and uses the highest magnitude RMS current to determine when the element will accumulate time. When RMS current is above the configured threshold, the **Trip on Single-Phase Voltage** element does not accumulate time. This gives priority to the **Overcurrent** elements during a **High-Current** condition.

Single-Phase Low Voltage Threshold

This is the percentage of phase voltage below which a **Three-Phase Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 75%)

Single-Phase High Voltage Threshold

This is the percentage of phase voltage above which a **Three-Phase Trip** operation will occur. (Range: 100-200%; Step: 1%; Default: 120%)

Current Supervised on Low Voltage

Specify the **Yes** or **No** (default) option.

Threshold Current

When the **Current Supervised on Low Voltage** mode is enabled, this setting specifies primary current for the threshold. (Range: 10-16,000; Step: 1; Default: 800) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Single-Phase Low Voltage Time to Trip

This is the time (in seconds) the **Low-Voltage** threshold must be exceeded for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Single-Phase Low Voltage Reset Time

This is the time (in seconds) voltage above the **Low-Voltage** threshold must be present for the **Single-Phase Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Single-Phase High Voltage Time to Trip

This is the time (in seconds) the **High-Voltage** threshold must be exceeded for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Single-Phase High Voltage Reset Time

This is the time (in seconds) voltage below the **High-Voltage** threshold must be present for the **Single-Phase Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Low Single-Phase Voltage Alert

This feature is based on the **Trip on Single-Phase Voltage** element but is not a protection element and will not lead to any IntelliRupter fault interrupter action. Instead, it notifies the user via the *Operation* screen and a SCADA message that a **Low-Voltage** condition exists on one or two phases. There is no SCADA-acknowledge functionality. The DNP point will be active when voltage is below the **Alert** setting for approximately one second. The DNP point clears when voltage is above the threshold. To avoid flooding the logs and creating a flurry of SCADA alerts when voltage hovers at the threshold level, the DNP point is not allowed more than one transition (on or off) per minute. (Setting options: Yes or No; Default = No)

Low Single-Phase Low Voltage Threshold

This is the percentage of line-to-ground RMS phase voltage below which a **Single-Phase Voltage Alert** state occurs. (Range: 5-100%; Step: 1%; Default: 75%)

Trip on Three Phase Voltage

Specify the **Yes**, **No** (Default), or **IntelliTeam SG** option to configure this element. The **IntelliTeam SG** option will cause this element only to be active when the IntelliTeam SG system is in the **Ready** state.

Three-Phase Low Voltage Threshold

This is the percentage of system voltage below which a **Three-Phase Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 75%)

Three-Phase High Voltage Threshold

This is the percentage of system voltage above which a **Three-Phase Trip** operation will occur. (Range: 100-200%; Step: 1%; Default: 120%)

Current Supervised on Low Voltage

Specify the **Yes** or **No** (default) option.

Threshold Current

When the **Current Supervised on Low Voltage** mode is enabled, specify the value of primary current. (Range: 10-16,000; Step: 1; Default: 800) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Three-Phase Time to Trip

This is the time (in seconds) the low-voltage or high-voltage threshold must be exceeded for a trip operation to occur. (Range: 0.00-600.00, Step: 0.01, Default: 30.00)

Three-Phase Reset Time

This is the time (in seconds) voltage must be present for the **Three-Phase Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Low Three-Phase Voltage Alert

This feature is based on the **Trip on Three-Phase Voltage** element but is not a protection element and will not lead to any IntelliRupter fault interrupter action. Instead, it notifies the user via the *Operation* screen and a SCADA message that a **Low-Voltage** condition exists on three phases. There is no SCADA-acknowledge functionality. The DNP point will be active when voltage is below the **Alert** setting for approximately one second. The DNP point clears when voltage is above the threshold. To avoid flooding the logs and creating a flurry of SCADA alerts when the voltage hovers at the threshold level, the DNP point is not allowed more than one transition (on or off) per minute. (Setting options: Yes or No; default = No)

Low Three-Phase Low Voltage Threshold

This is the percentage of line-to-ground RMS phase voltage below which a **Three-Phase Voltage Alert** state occurs. (Range: 5-100%; Step: 1%; Default: 75%)

Frequency Trip

Each **General Profile** feature has settings for multiple **Frequency Trip** elements. See Figure 53.

Connected to: IR Location: Street Address Settings Applied Successfully

Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing

Direction 1 Current Direction 2 Current Testing After Initial Trip Voltage, Frequency, and Sectionalizing ROCOF Protection

Profile: Profile 1

Frequency Trip

Viable Voltage (Range: 50-100 Step: 1 Default: 85)

Under Frequency Enabled (Default: No)

Under Frequency Threshold (Default: System Frequency - 0.50 Hz)

Over Frequency Enabled (Default: No)

Over Frequency Threshold (Default: System Frequency + 0.50 Hz)

Frequency Time To Trip (Range: 0.06-600.00 Step: 0.02 Default: 30.00)

Reset Time (Range: 0.06-600.00 Step: 0.02 Default: 1.00)

Low Frequency Indication (IntelliTeam SG and Loop Restoration Only)

Under Frequency Enabled (Default: No)

Under Frequency Threshold (Default: System Frequency - 0.50 Hz)

Under Frequency Minimum Time to Detect (Range: 0.06-600.00 Step: 0.02 Default: 30.00)

Reset Time (Range: 0.06-600.00 Step: 0.02 Default: 1.00)

Low Frequency Output Function (Default: OR)

Sectionalizing Trip

Figure 53. The Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing>Frequency Trip screen.

Viable Voltage

This is the percentage of system phase-to-phase voltage for determining a valid voltage used in the frequency algorithm. (Range: 50-100%; Step: 1%; Default: 85%)

Under Frequency Enabled

Specify the **Yes** or **No** (default) option.

Under Frequency Threshold

This is the frequency (in Hertz) below which a **Trip** operation will occur. Between 47 and 60 Hz may be entered, but the setting is valid only if it falls within the range (System Frequency - 3 Hz to System Frequency). (Minimum: System Frequency - 3 Hz; Maximum: System Frequency; Default: System Frequency - 0.5 Hz; Increment: 0.02 Hz)

Over Frequency Enabled

Specify the **Yes** or **No** (default) option.

Over Frequency Threshold

This is the frequency (in Hertz) above which a **Trip** operation will occur. Between 50 and 62 Hz may be entered, but the setting will be valid only if it falls within the range (System Frequency to System Frequency + 2 Hz). (Minimum: System Frequency; Maximum: System Frequency + 2 Hz; Default: System Frequency + 0.5 Hz; Increment: 0.02 Hz)

Frequency Time to Trip

This is the time (in seconds) the underfrequency or overfrequency threshold must be exceeded for a **Trip** operation to occur. (Range: 0.06-600.00; Step: 0.02; Default: 30.00)

Reset Time

This is the time (in seconds) good frequency must be present for the **Frequency** element to reset. (Range: 0.06-600.00; Step: 0.02; Default: 1.00)

Low Frequency Indication (*IntelliTeam SG System and Loop Restoration Only*)

The **Low-Frequency Indication** feature detects an underfrequency event immediately before loss of voltage so the Loop Restoration system will not issue a **Close** command, or the IntelliTeam SG Automatic Restoration System can be taken out of the **Ready** state to prevent automatic load pick up during an underfrequency load-shedding event.

This feature should be coordinated with the underfrequency-detection scheme that will result in the load-shedding operation. The **Under Frequency Minimum Time Detect** setpoint must be faster than the load-shedding underfrequency-detection scheme to ensure the **Low Frequency Indication** feature will prohibit restoration before an underfrequency load-shed event. Similarly, when the IntelliRupter fault interrupter's **Under Frequency Trip** element is used to open the device with IntelliTeam SG restoration software, the **Under Minimum Time Detect** setpoint must be faster than the **Frequency Time to Trip** setpoint to ensure restoration is prohibited before the **Trip** operation. The **Under Frequency Trip** element will not disable the Loop Restoration system or IntelliTeam SG system-restoration features when it trips open the IntelliRupter fault interrupter.

When the **Low Frequency Indication Under Frequency Enable** setpoint is enabled, a loop restoration system **Close** command is only allowed when the **Low Frequency Indication** setting for the profile designated on the *Setup>Restoration>Loop* screen has not detected an underfrequency event within the last 5 seconds that voltage has been above 85% of nominal system voltage.

When the **Low Frequency Indication Under Frequency Enable** setpoint is enabled, an IntelliTeam SG system **Close** command will be prohibited immediately if the **Low Frequency Indication** setting for the profile has detected an underfrequency event. The prohibited devices will require IntelliTeam system restoration to be manually enabled to return them to the **Ready** state.

The accuracy of the **Under Frequency Threshold** setting is better than or equal to +/- 0.002 Hz for settings above 49.7 Hz. For frequencies below 49.7 Hz, the error increases, with the worst case being +/- 0.19 Hz at 47 Hz.

Loop Restoration: When the **Low Frequency Indication** mode is enabled, a loop restoration **Close** command will be blocked if the frequency is below the **Under Frequency Threshold** setpoint for the configured **Under Frequency Minimum Time to Detect** setting. **Loop Restoration** mode must be manually enabled after the **Low Frequency** condition has cleared. (The **Under Frequency Threshold** default value = System Frequency – 0.5 Hz to 49.50 Hz when *Setup>General>Site-Related>System Frequency* = 50 Hz or 59.50 Hz when *Setup>General>Site-Related>System Frequency* = 60 Hz; Minimum = System Frequency – 3 Hz; Maximum = System Frequency; Increment = 0.01 Hz) (The **Under Frequency Minimum Time to Detect** setting range: 0.10-10.0 seconds; Step: 0.02 seconds)

IntelliTeam SG System: When the **Low Frequency Indication** mode is enabled, and the **Low Frequency Indication** element identifies an underfrequency load-shed event (the under-frequency is at or below the **Under Frequency Threshold** setpoint for the duration of the **Under Frequency Minimum Time to Detect** setting), it sets the IntelliTeam SG system to the **Prohibit Restoration** state, and the IntelliRupter fault interrupter goes out of the **Ready** state at that location. When an IntelliRupter fault interrupter is not in the **Ready** state, restoration must be manually enabled to return the IntelliTeam SG system to the **Normal** state.

Under Frequency Enabled

Specify the **Yes** or **No** (default) option.

Under Frequency Threshold

This is the frequency (in hertz) below which a Loop Restoration **Close** command will be blocked or the IntelliTeam SG system will be set to the **Prohibit Restoration** mode. Enter between 47 and 60 Hz, but the setting is valid only if it falls within the range (System Frequency - 3 to System Frequency). (Minimum: System Frequency - 3 Hz; Maximum: System Frequency; Default: System Frequency - 0.5 Hz; Increment: 0.02 Hz).

The accuracy of the **Under Frequency Threshold** setpoint at 50 Hz will be better than or equal to +/- 0.002 Hz for settings above 49.7 Hz. For frequencies below 49.7 Hz, the measurement tolerance increases to a maximum of +/- 0.19 Hz at 47 Hz. See Figure 54 on page 102. The accuracy of the **Under Frequency Threshold** setpoint at 60 Hz will be better than or equal to +/- 0.002 Hz for settings above 59.6 Hz. For frequencies below 59.6 Hz, the measurement tolerance increases to a maximum of +/- 0.15 Hz at 57 Hz. See Figure 55 on page 102.

Under Frequency Minimum Time to Detect

This is the time (in seconds) the **Under-Frequency Threshold** setpoint must be exceeded for a Loop Restoration **Close** command to be blocked or IntelliTeam SG system to be set to the **Prohibit Restoration** mode. (Range: 0.06-600.00; Step: 0.02; Default: 30.00)

Reset Time

This is the time (in seconds) good frequency must be present for the **Frequency** element to reset before the **Under Frequency Minimum Time to Detect** setting expires. (Range: 0.06-600.00; Step: 0.02; Default: 1.00) After the **Under Frequency Minimum Time to Detect** setting has expired, when frequency above the **Under Frequency Threshold** setting persists for more than 5 seconds the **Low-Frequency Indication** state is removed.

Low Frequency Output Function

The Low Frequency Output Function is an **OR** or **AND** state of the individual outputs of the elements for the X and Y terminals. (Default: OR)

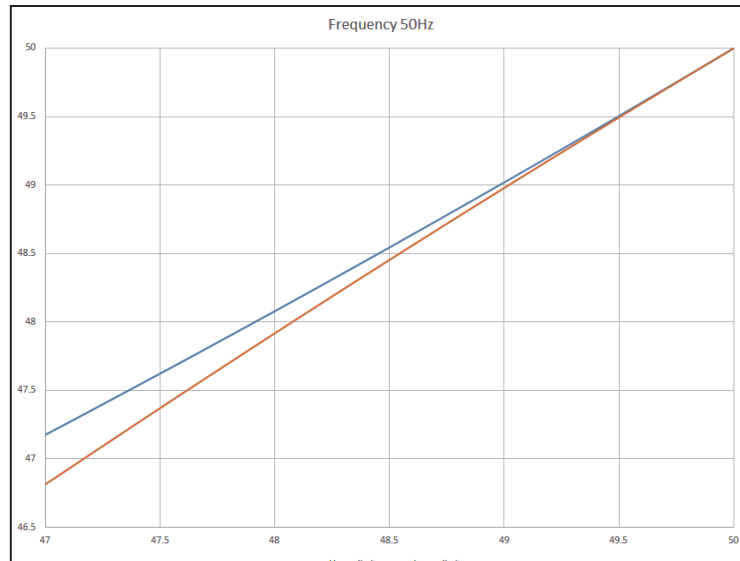


Figure 54. Under Frequency Threshold accuracy at 50 Hz.

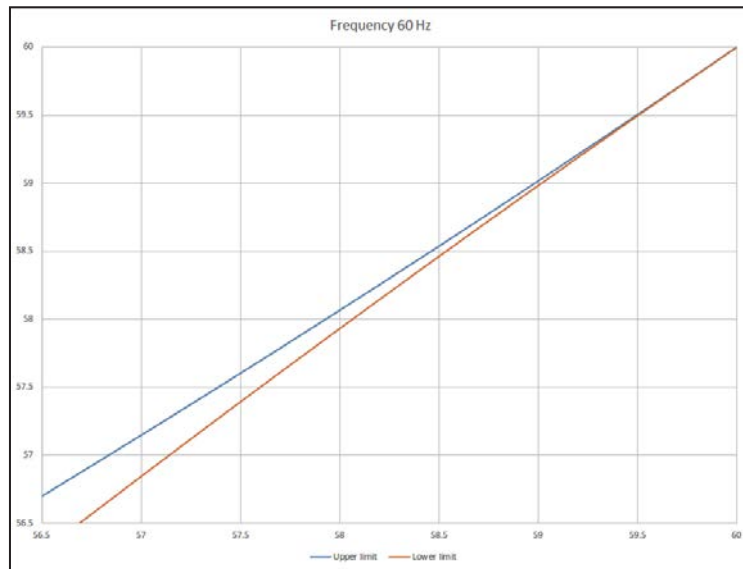


Figure 55. Under Frequency Threshold accuracy at 60 Hz.

Sectionalizing Trip

Sectionalizing elements can be used in place of **Overcurrent** elements when coordination is a concern. They can also be used in systems comprised of IntelliRupter fault interrupters and 6800 Series Automatic Switch Controls. There is no directionality associated with the **Sectionalizing** elements. The **Fault-Current** settings used for counting apply to both directions. When sectionalizing is used with the IntelliTeam II or IntelliTeam SG system, the IntelliTeam system uses the **Good Source Voltage Indication** and **Good Source Time to Detect** settings found on the *Setup>Protection>General Profile>Voltage, Frequency, and Sectionalizing>Voltage Trip* screen to determine when the source returns. See Figure 56.

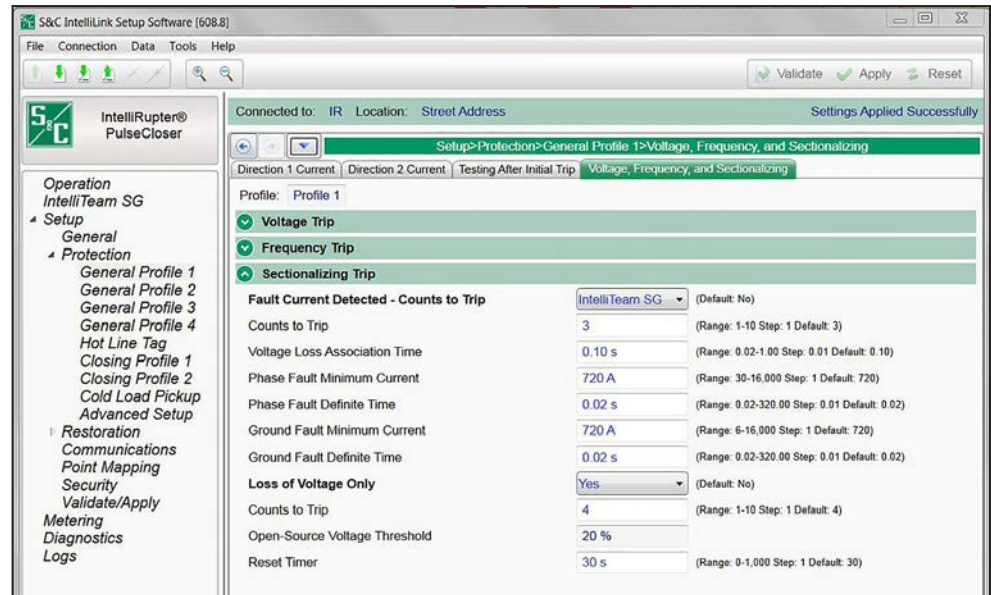


Figure 56. The *Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing>Sectionalizing Trip* screen.

Fault Current Detected – Counts to Trip

Specify the **Yes**, **No** (Default), or **IT SG Only** option to configure this element. When the **IT SG Only** option is selected, this element is only active when the IntelliTeam SG system is in the **Ready** state. A fault-current count is defined as a fault current event followed by a three-phase voltage loss. (Range: 1-10; Step: 1; Default: 3)

Counts to Trip

A fault-current count is defined as a fault current event followed by a three-phase voltage loss. (Range: 1-10; Step: 1; Default: 3)

Voltage Loss Association Time

This is the interval (in seconds) between the end of an overcurrent event and the start of the three-phase voltage loss that associates the two events to the count breaker operations. (Range: 0.02-6.00; Step: 0.01; Default: 0.10) Use the default value unless line voltage will be supported for a protracted period following the breaker operation.

Phase Fault Minimum Current

This is the primary current required to record a phase-fault event. (Range: 30-16,000; Step: 1; Default: 720) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Phase Fault Definite Time

This is the time (in seconds) required to record a phase-fault event. (Range: 0.02-320.00; Step: 0.01; Default: 0.02)

Ground Fault Minimum Current

This is the primary current required to record a ground-fault event. (Range: 6-16,000; Step: 1; Default: 720) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Ground Fault Definite Time

This is the time (in seconds) required to record a ground-fault event. (Range: 0.02-320.00; Step: 0.01; Default: 0.02)

Loss of Voltage Only

Specify the **Yes**, **No** (default), **IntelliTeam SG**, or **Loops Only** option to configure this element. The **IntelliTeam SG** or **Loops Only** setting causes this element to only be active when the IntelliTeam II or IntelliTeam SG system is in the **Ready** state or the **Loop Restoration** mode is configured. The **Loss of Voltage Only** element has a 10-ampere current threshold that inhibits the element from counting. Current must be below the 10-ampere threshold and voltage must be below the **Open-Source Voltage** threshold. Both conditions must be met for a minimum of 20 ms for the **Loss of Voltage Only** element to count.

Counts to Trip

A voltage-loss count is defined as normal voltage followed by a three-phase voltage loss event. (Range: 1-10; Step: 1; Default: 4)

Open-Source Voltage Threshold

This is the voltage below which a Trip event occurs, as specified on the *Setup>Protection>General Profiles>Voltage, Frequency, and Sectionalizing>Voltage Trip* screen.

Reset Timer

This is the time (in seconds) for the IntelliRupter fault interrupter to be in the **Open** state before the **Sectionalizing** timer resets. (Range: 0-1,000; Step: 1; Default: 30)

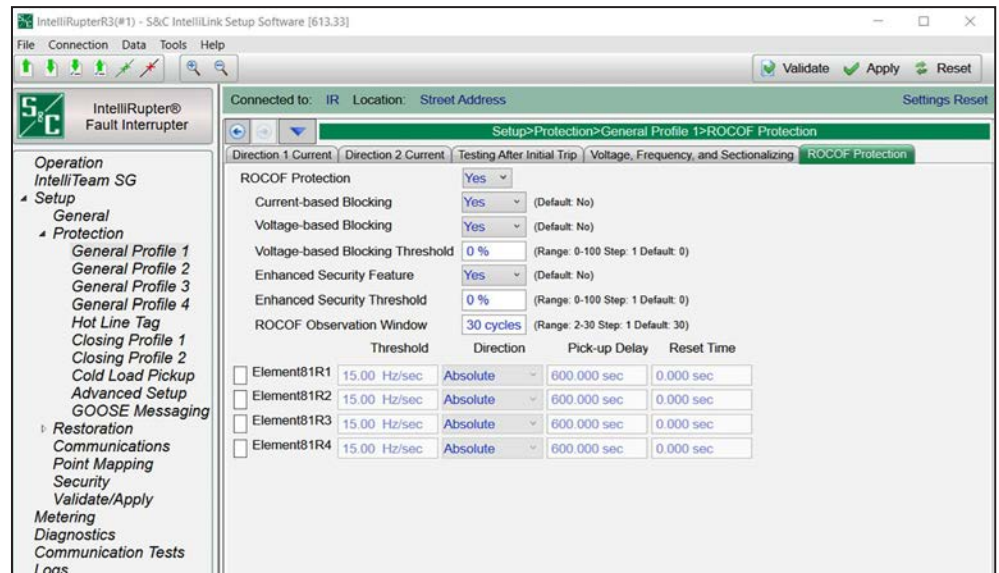


Figure 57. The Setup>Protection>General Profile 1>ROCOF Protection screen.

ROCOF Protection

For each **Closing** profile, the following **ROCOF** settings are configurable:

This setting makes the **ROCOF** feature available to configure across profiles. (Range: Yes, No; Default: No)

Current-based Blocking

This is a configurable mode. It is a single signal derived from the logical **OR** setting of all enabled elements for Direction 1 and Direction 2. The current blocking signal is a **True** condition when any **Overcurrent** element is not fully reset. When **Current-Based Blocking** mode is selected and the blocking signal is a **True** condition, tripping and **Trip** timer of the **ROCOF** element are blocked. (Range: Yes, No; Default: No)

Voltage-based Blocking

This is based on the positive sequence voltage. Tripping and trip timing are blocked if the positive sequence voltage magnitude is less than the **Voltage-based Blocking ROCOF Protection Threshold** setting expressed in percent (%) of the nominal voltage. Pickup and dropout time are not applied to the minimum voltage magnitude. (Range: Yes, No; Default: No)

Voltage-based Blocking Threshold

This is the threshold setting used to determine whether **Voltage-based ROCOF Protection** mode is applied. (Range: 0 – 39 100%; Step 1%; Default: 0%)

Enhanced Security Feature

When the ROCOF **Enhanced Security** feature is enabled, it provides a mechanism to empty the input observation window contents when a disturbance is detected. (Range: Yes, No; Default: No)

Enhanced Security Threshold

The **Enhanced Security** threshold, also called the **Disturbance** threshold, is expressed in % of nominal voltage. Sudden changes in voltage magnitude or phase angle greater than this threshold activate the **Enhanced Security** feature when enabled. (Range: 0-100%; Step: 1%; Default: 0%)

ROCOF Observation Window

This setting specifies the number of cycles the element uses to estimate the frequency change. This is applicable to all four **ROCOF** elements (Range: 2 – 30 cycles; Step 1 cycle; Default: 30 cycles)

Threshold

When the calculated **ROCOF** value exceeds the user configured threshold for a **ROCOF** element, the corresponding **Definite-Time Delay** setting is initiated for tripping. (Range: 0.01 – 15.00 Hz/sec; Step: 0.01 Hz/sec; Default: 15.00 Hz/sec)

Direction

This shows the ROCOF trend categorized as “Absolute,” “Rising,” or “Falling.” (Range: Rising, Falling, Absolute; Default: Absolute)

Pick-up Delay

(Range 0.00 - 600.00 sec; Step 0.01 sec; Default: 600.00 sec)

Reset Time

(Range 0.00 - 600.00 sec; Step 0.01 sec; Default: 0.00 sec)

Hot Line Tag

The **Hot Line Tag** mode can be applied locally using the external manual HOT LINE TAG lever, by a command from the *Operation* screen sent through IntelliLink Setup Software or a SCADA DNP Point command. The **Hot Line Tag Profile** function provides much more sensitive overcurrent protection when hot-line work is being performed. No **Test** operation is allowed after the **Initial Trip** operation, and the **Trip** operation goes directly to the **Lockout** state and all **Close** commands are blocked. See Figure 58.

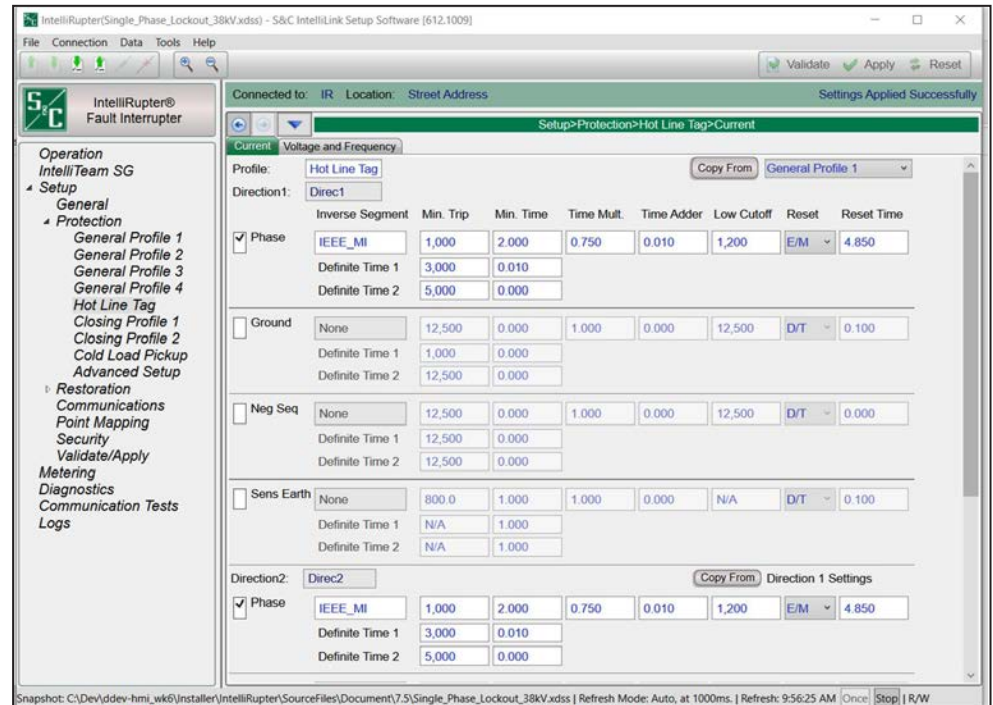


Figure 58. The Setup>Protection>Hot Line Tag>Current screen.

The **Overcurrent Trip** function operates in both directions.

The **Hot Line Tag Profile** settings can be copied from another profile by clicking on the **Copy From** button.

Phase Overcurrent

The **Phase Overcurrent** element will trip the IntelliRupter fault interrupter if current on one or more phases exceeds the pickup value for the time value set by the inverse curve or the **Definite Time** setpoint.

Phase Check box—Select this box to configure the **Phase Overcurrent** element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings are used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse-curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult.—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Current Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: Select the **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Ground Overcurrent

The **Ground Overcurrent** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** setting.

Ground Check box—Select this box to configure the **Ground Overcurrent** element.

Inverse Segment—Select the curve from the drop-down list of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse-curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult.—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: select the **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Negative Sequence

The **Negative Sequence** element will trip the IntelliRupter fault interrupter if the negative-sequence component (I_2) of the three-phase elements exceeds the pickup value for the time value set by the inverse curve or the **Definite Time** setting.

Negative Sequence Check box—Select this box to configure the **Negative Sequence** element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult.—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Current Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 8-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: select the **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-6000.000; Step: 0.001)

Sensitive Earth

The **Sensitive Earth** element will trip the IntelliRupter fault interrupter if the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the inverse curve or the **Definite Time** setting.

Sensitive Earth Check box—Select this box to configure the **Sensitive Earth** element.

Inverse Segment—Select from the drop-down list of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 1.000-6000.000; Step: 0.001)

Time Mult.—This is the time multiplier for the inverse curve. (Range: 0.001-15.000, Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—The reset method for the inverse curve is configurable for the **D/T** (Definite Time) or **T/A** (Time Accumulation) modes. The **Time Accumulation** mode times when current is above the **Minimum Trip** value and stops the timer when current is below the **Minimum Trip** value. The timer continues to count until either the **SEF** element trips, or the element does not pick up for the duration of the user-specified **SEF Element Reset Time** setting and the element resets. The **Time Accumulation** mode is the default.

Reset Time—When the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-6000.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 1.000-6000.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 1.000-600.000; Step: 0.001)

Ground Trip Block Radio Buttons

When the **Allow Ground Trip Block** mode is active (the default), the **Ground Trip** element blocks commands from SCADA and IntelliLink software, and the manual GROUND TRIP BLOCK lever will operate normally. The **Ground Trip** element will be blocked even in the **Hot Line Tag** profile.

When the **Do not allow Ground Trip Block** setting is active, the **Ground** element will be implemented as configured for the **Hot Line Tag** profile, overriding any **Ground Trip Block** commands from SCADA, IntelliLink software, or a manual GROUND TRIP BLOCK lever operation. This override only applies to the **Hot Line Tag** profile.

Earth Fault Protection and Sectionalizing

Profile Name

This non-editable text box displays the profile text set in the “Initial Trip” panel.

Direction

This non-editable text box displays the direction text set in the “Initial Trip” panel.

DTAP Sectionalizing

When the **Yes** option is selected for the Directional Transient Active Power (**DTAP**) **Sectionalizing** feature, the “DTAP Sectionalizing settings” panel opens and enables this element with the settings present in this panel. (Range: Yes, No; Default: No)

Wattmetric Protection

When the **Yes** option is selected for the **Wattmetric Protection** feature, the “Wattmetric Protection settings” panel opens and enables this element with the settings present in this panel. (Range: Yes, No; Default: No)

DTAP Sectionalizing Information

Zero Sequence Voltage Threshold

This is the **Zero Sequence Voltage Threshold** setting in percent, used to compare with the measured zero sequence voltage. (Range: 1 to 100%; Step: 1%; Default: 50%)

-P0 Fault Detection Threshold

This is the **Zero Sequence Power Level** setting used to compare with the measured zero sequence power during a fault event and when the **DTAP Compensator** feature is active. **Note:** The “negative” sign indicates zero sequence power must be flowing toward the source for this element to be active. (Range: -20.0 to +20.0 kW; Step: 0.5 kW; Default: -2.0 kW)

Delay Length

The number of cycles the **True** condition must be present for the **DTAP Earth Fault Detection Algorithm** feature earth fault presence confirmation. The **Fault Detection Algorithm Delay** timer resets whenever there is an open pole. (Range: 1-5 cycles; Step: 1 cycle; Default: 2 cycles)

Sliding Window Filter

This is the length of the **Sliding Window Filter** setting for the **Earth Fault Detection Algorithm Sliding Window Filter** feature. The **Sliding Window Averaging Filter** feature resets whenever there is an open pole. (Range: 1-5 cycles; Step: 1 cycle; Default: 2 cycles)

Indication Only

When the **Yes** option is selected, the **DTAP Sectionalizing** element will not trip the IntelliRupter fault interrupter but instead provide an indication of the element being picked up in the status point log or report DNP point 159/160 over DNP3 to SCADA if these points are mapped and unsolicited reporting is enabled. When the **No** option is selected, this element will trip the IntelliRupter fault interrupter to lock out when it operates. (Range: Yes, No; Default: Yes)

Unbalance Time to Trip

The **Trip to Lockout** operation because of the **DTAP Earth Fault Detection** element is delayed for this duration after detection. (Range: 0.00-600.00 seconds; Step: 0.01 seconds; Default: 3.00 seconds)

Unbalance Reset Time

The **DTAP Earth Fault Detection** feature resets if conditions return to levels below the settings for the reset time. (Range: 0.00-600.00 seconds; Step: 0.01 seconds; Default: 0.10 seconds)

Zero Sequence Voltage Reset Threshold

This is the **Zero Sequence Voltage Reset Threshold** setting, which the zero sequence must stay below for the element to reset. (Range: 1-100%, Step: 1%; Default: 10%)

Zero Sequence Voltage Reset Timer

This is the amount of time the zero sequence voltage must stay below the threshold for the element to be reset. (Range: 1.00-600.00 seconds; Step: 0.01 seconds; Default: Disabled)

Wattmetric Protection Information**Zero Sequence Voltage Threshold**

This is the **Zero Sequence Voltage Threshold** setting in percent, used to compare with the measured zero sequence voltage. (Range: 1 to 100%; Step: 1%; Default: 50%)

-P0 Fault Detection Threshold

This is the **Zero Sequence Power Level** setting used to compare with the measured zero sequence power during a fault event. **Note:** The “negative” sign indicates zero sequence power must be flowing toward the source for this element to assert. (Range: -2,000.0 to +2,000.0 kW; Step: 0.5 kW; Default: -2.0 kW)

Indication Only

When the **Yes** option is selected, the **Wattmetric** element will not trip the IntelliRupter fault interrupter but instead provide an indication of the element being picked up in the status point log or report DNP point 163/164 over DNP3 to SCADA if these points are mapped and unsolicited reporting is enabled. When the **No** option is selected, this element will trip the IntelliRupter fault interrupter to lock out when it operates. (Range: Yes, No; Default: Yes)

Time to Trip

The **Trip to Lockout** operation because of the **Wattmetric** element is delayed for this duration after detection. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 3.00 seconds)

Reset Time

The **Wattmetric** element resets if conditions return to levels below the settings for the reset time. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 0.10 seconds)

Shift Time

This is used in place of the **Wattmetric Time to Trip** setpoint when **TCC Shifting** mode is selected and the **TCC Shifting** conditions have been satisfied for the duration of the **Test TCC Hold Time** setting. Values can only be set that are less than the **Wattmetric Time to Trip** setpoint. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 2.00 seconds)

Zero Sequence Voltage Reset Threshold

This is the **Zero Sequence Voltage Reset Threshold** setting, which the zero sequence must stay below for the element to reset. (Range: 1-100%; Step: 1%; Default: 10%)

Zero Sequence Voltage Reset Timer

This is the amount of time the zero sequence voltage must stay below the threshold for the element to be reset. (Range: 1.00-600.00 seconds; Step: 0.01 seconds; Default: Disabled)

Voltage Trip

The **Hot Line Tag** profile has settings for multiple **Voltage Trip** elements. See Figure 59.

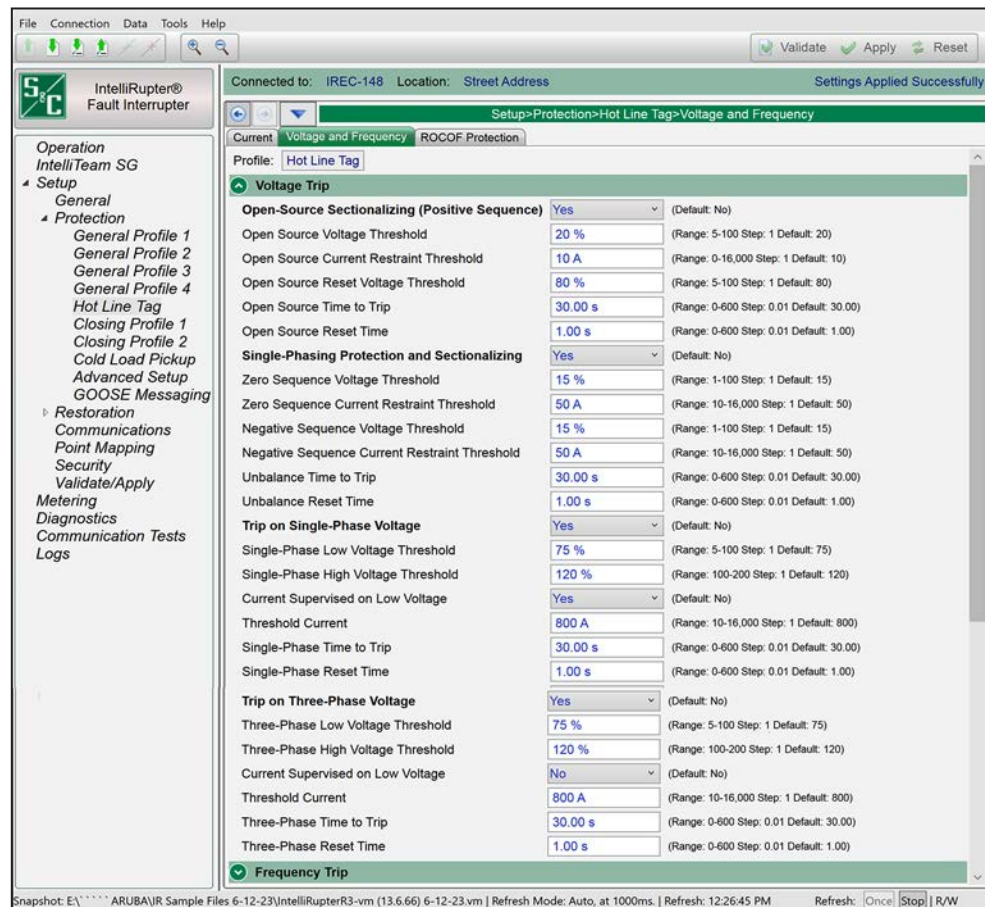


Figure 59. The Setup>Protection>Hot Line Tag>Voltage and Frequency>Voltage Trip screen.

Open-Source Sectionalizing (Positive Sequence)

Specify the **Yes**, **No** (default), **IntelliTeam SG**, or **Loops Only** option. The **IntelliTeam SG** setting causes this element to be active only when the IntelliTeam SG system is in the **Ready** state.

Open-Source Voltage Threshold

This is the percentage of system voltage below which a **Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 20%)

Open-Source Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 0-16,000; Step: 1; Default: 10) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Open-Source Reset Voltage Threshold

This is the percentage of system voltage above which the **Open-Source Voltage** element is reset. (Range: 5-100%; Step: 1%; Default: 80%)

Open-Source Time to Trip

This is the time (in seconds) the **Open-Source Voltage** element must be below its threshold for a **Trip** operation to occur. (Range: 0-600; Step: 0.0; Default: 30.00)

Open-Source Reset Time

This is the time (in seconds) good voltage must be present for the **Open-Source Voltage** element to reset. (Range: 0.-600; Step: 0.01; Default: 1.00)

Single-Phasing Protection and Sectionalizing

Specify the **Yes**, **No** (default), or **IntelliTeam SG** option to enable this element. The **IntelliTeam SG** setting causes this element to only be active when the IntelliTeam SG system is in the **Ready** state.

Zero Sequence Voltage Threshold

This is the percentage of system voltage above which a **Trip** operation will occur. (Range: 1-100%; Step: 1%; Default: 15%)

Zero Sequence Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 10-16,000; Step: 1; Default: 50) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Negative Sequence Voltage Threshold

This is the percentage of system voltage above which a **Trip** operation will occur. (Range: 1-100%; Step: 1%; Default: 15%)

Negative Sequence Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 10-16,000; Step: 1; Default: 50) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Unbalance Time to Trip

This is the time (in seconds) the **Voltage Unbalance** element must be above its threshold for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Unbalance Reset Time

This is the time (in seconds) good voltage must be present for the **Voltage Unbalance** element to reset. (Range: 0-600; Step: 0.01; Default: 1.00)

Trip on Single Phase Voltage

Specify the **Yes**, **No** (Default), or **IntelliTeam SG** option to enable this element. The **IntelliTeam SG** setting causes this element to only be active when the IntelliTeam SG system is in the **Ready** state.

Single Phase Low Voltage Threshold

This is the percentage of phase voltage below which a **Three-Phase Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 75%)

Single Phase High Voltage Threshold

This is the percentage of phase voltage above which a **Three-Phase Trip** operation will occur. (Range: 100-200%; Step: 1%; Default: 120%)

Current Supervised on Low Voltage

Specify the **Yes** or **No** (default) option.

Threshold Current

When the **Current Supervised on Low Voltage** mode is selected, specify the primary current value. (Range: 10-16,000; Step: 1; Default: 800) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Single Phase Time to Trip

This is the time (in seconds) the **Low-Voltage** or **High-Voltage Threshold** setting must be exceeded for a **Trip** operation to occur. (Range: 0-600; Step: 0.01; Default: 30.00)

Single Phase Reset Time

This is the time (in seconds) good voltage must be present for the **Single-Phase Voltage** element to reset. (Range: 0-600; Step: 0.01; Default: 1.00)

Trip on Three Phase Voltage

Specify the **Yes**, **No** (Default), or **IntelliTeam SG** option to enable this element. The **IntelliTeam SG** setting causes this element to only be active when the IntelliTeam SG system is in the **Ready** state.

Three Phase Low Voltage Threshold

This is the percentage of system voltage below which a **Three-Phase Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 75%)

Three Phase High Voltage Threshold

This is the percentage of system voltage above which a **Three-Phase Trip** operation will occur. (Range: 100-200%; Step: 1%; Default: 120%)

Current Supervised on Low Voltage

Specify the **Yes** or **No** (default) option.

Threshold Current

When the **Current Supervised on Low Voltage** mode is selected, specify the primary current value. (Range: 10-16,000; Step: 1; Default: 800) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Three Phase Time to Trip

This is the time (in seconds) the **Low-Voltage** or **High-Voltage Threshold** setting must be exceeded for a **Trip** operation to occur. (Range: 0-600; Step: 0.01; Default: 30.00)

Three Phase Reset Time

This is the time (in seconds) good voltage must be present for a **Three-Phase Voltage** element to reset. (Range: 0-600; Step: 0.01; Default: 1.00)

Frequency Trip

Each **Hot Line Tag** profile has settings for multiple **Frequency Trip** elements. See Figure 60.

Connected to: IR Location: Street Address Settings Applied Successfully

Setup>Protection>Hot Line Tag>Voltage and Frequency

Current: Voltage and Frequency ROCOF Protection

Profile: Hot Line Tag

Voltage Trip

Frequency Trip

Viable Voltage	85.00 %	(Range: 50-100 Step: 1 Default: 85)
Under Frequency Enabled	No	(Default: No)
Over Frequency Enabled	No	(Default: No)
Frequency Time To Trip	30.00 s	(Range: 0.06-600.00 Step: 0.02 Default: 30.00)
Reset Time	1.00 s	(Range: 0.06-600.00 Step: 0.02 Default: 1.00)

Figure 60. The Setup>Protection>Hot Line Tag>Voltage and Frequency>Frequency Trip screen.

Viable Voltage

This is the percentage of system phase-to-phase voltage for determining a valid voltage used in the frequency algorithm. (Range: 50-100%; Step: 1%; Default: 85%)

Under Frequency Enabled

Specify the **Yes** or **No** (default) option.

Under Frequency Threshold

This is the frequency (in hertz) below which a **Trip** operation will occur. Enter between 47 and 60 Hz, but the setting will be valid only if it falls within the range: System Frequency – 3 to System Frequency. (Minimum: System Frequency - 3 Hz; Maximum: System Frequency; Increment: 0.01 Hz; Default: System Frequency - 0.5 Hz)

Over Frequency Enabled

Specify the **Yes** or **No** (default) option.

Over Frequency Threshold

This is the frequency (in hertz) above which a **Trip** operation will occur. Enter between 50 and 62 Hz, but the setting will be valid only if it falls within the range: System Frequency to System Frequency + 2 Hz. (Minimum: System Frequency; Maximum: System Frequency + 2 Hz; Increment: 0.01 Hz; Default: System Frequency + 0.50 Hz)

Frequency Time to Trip

This is the time (in seconds) the **Underfrequency or Overfrequency Threshold** setting must be exceeded for a **Trip** operation to occur. (Range: 0.06-600.00; Step: 0.02; Default: 30.00)

Reset Time

This is the time (in seconds) good frequency must be present for the **Frequency** element to reset. (Range: 0.06-600.00; Step: 0.02; Default: 1.00)

Good Frequency Indication (only for the IntelliTeam SG system or Loop Restoration)

Loop Restoration: When the **Good Frequency Indication** mode is enabled, a **Loop Restoration Close** command will be blocked if the frequency is below the configured **Under Frequency Threshold** setpoint for the **Under Frequency Minimum Time to Detect** setpoint. The **Under Frequency Threshold** setpoint is calculated as: (Default: System Frequency – 0.5 Hz, 49.50 Hz when *Setup>General Site-Related>System Frequency* = 50 Hz, or 59.50 Hz when *Setup>General Site-Related>System Frequency* = 60 Hz; Minimum: System Frequency – 1 Hz; Maximum: System Frequency; Increment: 0.01 Hz) Configure the **Under Frequency Minimum Time to Detect** setpoint. (Range: 6-16,000 seconds; Step: 1 second; Default: 0.10 seconds)

IntelliTeam SG system: When the **Good Frequency Indication** mode is enabled, and the **Good Frequency Indication** element identifies an under-frequency load-shed event (the under frequency is at or below the **Under Frequency Threshold** setting for the **Under Frequency Minimum Time to Detect** setting of the **Good Frequency Indication** mode), it will set the IntelliTeam SG system to the **Prohibit Restoration** state, which also causes the IntelliRupter fault interrupter to go into an **Out of Ready** state at that location). When an IntelliRupter fault interrupter is in the **Out of Ready** state, manually enable restoration for each IntelliRupter fault interrupter and return the IntelliTeam SG system to its **Normal** state.

Under Frequency Enabled

Specify the **Yes** or **No** (default) option.

Under Frequency Threshold

This is the frequency (in Hertz) below which a loop restoration **Close** command will be blocked or the IntelliTeam SG system will be set to the **Prohibit Restoration** state. Enter between 47 and 60 Hz, but the setting will be valid only if it falls within the Range: System Frequency – 1 Hz to System Frequency; Minimum: System Frequency - 1 Hz; Maximum: System Frequency; Increment: 0.01 Hz; Default: System Frequency - 0.5 Hz)

Under Frequency Minimum Time to Detect

This is the time (in seconds) the **Under Frequency Threshold** setting must be exceeded for a **Loop Restoration Close** command to be blocked, or the IntelliTeam SG system to be set to the **Prohibit Restoration** state. (Range: 0.00-10.00; Step: 0.01; Default: 0.01)

Reset Time

This is the time (in seconds) good frequency must be present for the **Frequency** element to reset. (Range: 0.06-600.00, Step: 0.02, Default: 1.00)

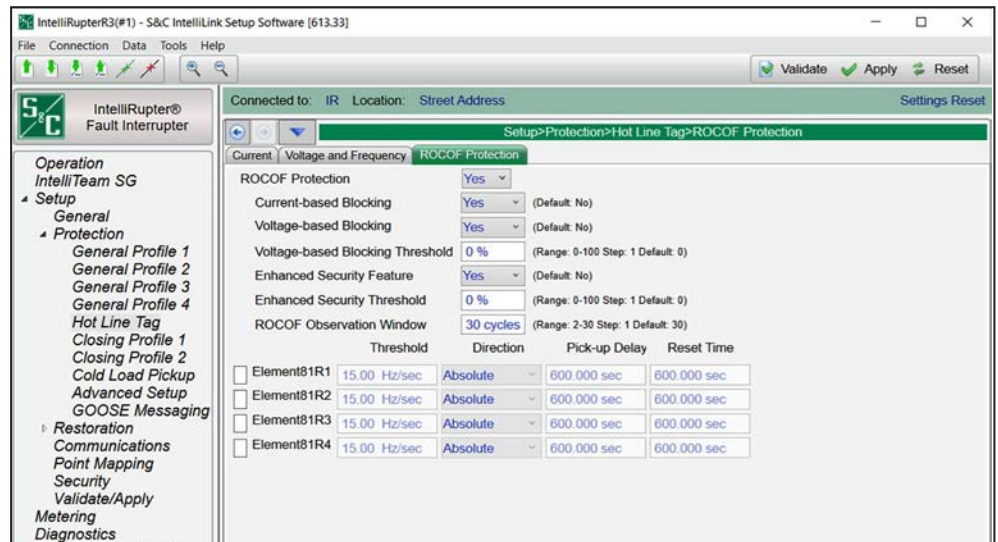


Figure 61. The Setup>Protection>Hot Line Tag>ROCOF Protection screen.

ROCOF Protection

For each **Closing** profile, the following **ROCOF** settings are configurable:

This setting makes the **ROCOF** feature available to configure across profiles. (Range: Yes, No; Default: No)

Current-based Blocking

This is a configurable mode. It is a single signal derived from the logical **OR** setting of all enabled elements for Direction 1 and Direction 2. The current blocking signal is a **True** condition when any **Overcurrent** element is not fully reset. When **Current-Based Blocking** mode is selected and the blocking signal is a **True** condition, tripping, and **Trip** timer of the **ROCOF** element are blocked. (Range: Yes, No; Default: No)

Voltage-based Blocking

This is based on the positive sequence voltage. Tripping and trip timing is blocked if the positive sequence voltage magnitude is less than the **Voltage-based Blocking ROCOF Protection Threshold** setting expressed in percent (%) of the nominal voltage. Pickup and dropout time is not applied to the minimum voltage magnitude. (Range: Yes, No; Default: No)

Voltage-based Blocking Threshold

This is the threshold setting used to determine whether **Voltage-based ROCOF Protection** mode is applied. (Range: 0 – 39 100%; Step 1%; Default: 0%)

Enhanced Security Feature

When the ROCOF **Enhanced Security** feature is enabled, it provides a mechanism to empty the input observation window contents when a disturbance is detected. (Range: Yes, No; Default: No)

Enhanced Security Threshold

The **Enhanced Security** threshold, also called the **Disturbance** threshold, is expressed in % of nominal voltage. Sudden changes in voltage magnitude or phase angle greater than this threshold activate the **Enhanced Security** feature when enabled. (Range: 0-100%; Step: 1%; Default: 0%)

ROCOF Observation Window

This setting specifies the number of cycles the element uses to estimate the frequency change. This is applicable to all four **ROCOF** elements (Range: 2 – 30 cycles; Step 1 cycle; Default: 30 cycles)

Threshold

When the calculated **ROCOF** value exceeds the user configured threshold for a **ROCOF** element, the corresponding **Definite-Time Delay** setting is initiated for tripping. (Range: 0.01 – 15.00 Hz/sec; Step: 0.01 Hz/sec; Default: 15.00 Hz/sec)

Direction

This shows the ROCOF trend categorized as “Absolute,” “Rising,” or “Falling.” (Range: Rising, Falling, Absolute; Default: Absolute)

Pick-up Delay

(Range 0.00 - 600.00 sec; Step 0.01 sec; Default: 600.00 sec)

Reset Time

(Range 0.00 - 600.00 sec; Step 0.01 sec; Default: 0.00 sec)

Closing Profile

Profile Name

Specify the name for the **Closing Profile 1** option, up to 12 characters in length. It is edited in the “Closing Profile Main” panel of the **Closing Profile 1** option (this tab and panel) and is displayed on each screen and sub-screen for the profile. See Figure 62.

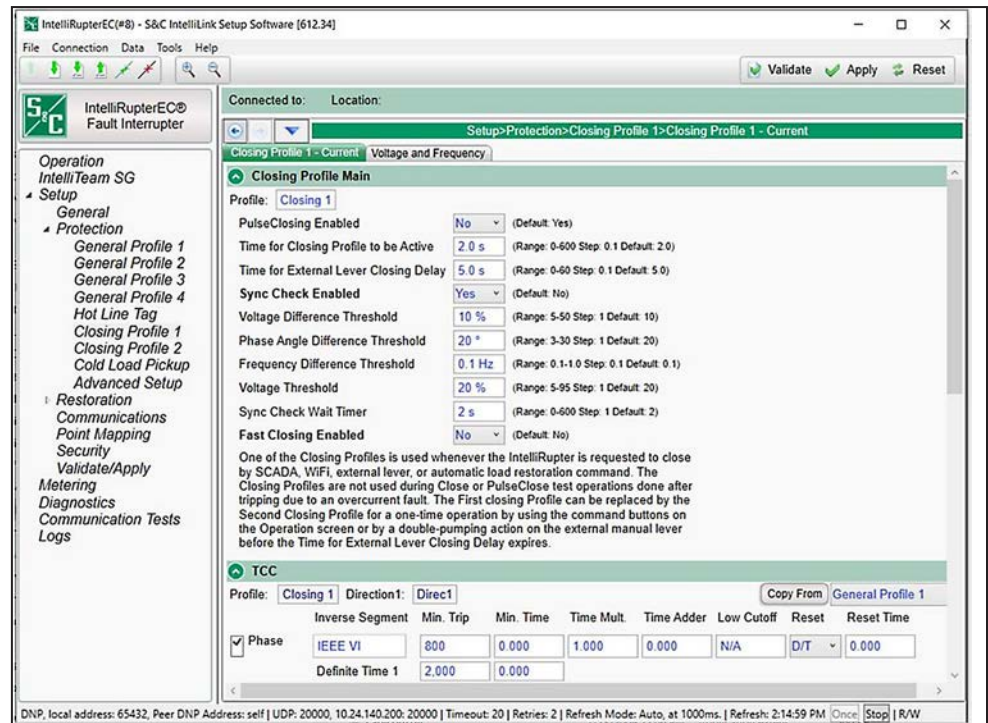


Figure 62. The Setup>Protection>Closing Profile 1>Closing Profile 1 – Current>Closing Profile Main screen.

The **Closing Profile 2** option can be used instead of the **Closing Profile 1** option on a one-time basis by setting it as the selected closing profile on the *Operation* screen. It can also be applied by operating the IntelliRupter fault interrupter OPEN/CLOSE/READY lever twice within the configured **Time for External Lever Closing Delay** timer.

The **Closing Profile 2** option is typically implemented when difficulties such as false trips are encountered during closing using the **Closing Profile 1** option. The **Closing Profile 2** option is setup in the same manner as the **Closing Profile 1** option, with one major difference. To ensure successful closing, S&C recommends the **PulseClosing Technology** and **Sync Check** modes not be enabled in the **Closing Profile 2** option. These parameters should remain configured in the default **No** setting.

The closing profiles are time-limited by the configuration of the **Time for Closing Profile to be Active** timer. The **Sync Check** function may be performed before executing a **Closing Profile** operation when both sides of the IntelliRupter fault interrupter are energized.

PulseClosing Technology Enabled

When set to **Yes** mode, an operation using PulseClosing Technology will be performed before executing the closing profile to determine whether a fault is present. When a fault is detected, the IntelliRupter fault interrupter will not complete the closing operation and the line will not be subjected to damaging fault current. The **Yes** mode is typically selected for the first **Closing Profile** operation, and the **No** mode is selected for the second **Closing Profile** operation.

Time for Closing Profile to be Active

This is the time (in seconds) the closing profile remains active after the commanded poles have closed. The assigned general profile will be active after this timer expires when no elements in the closing profile are picked up and timing. The TCC panel of this profile should be set to coordinate with upstream devices while this profile is active. The timer starts after the last commanded pole is closed. (Range: 0.0-600.0; Step: 0.1; Default: 2.0)

Time for External Lever Closing Delay

When the OPEN/CLOSE/READY lever is operated, this timer must expire before the **Close** operation starts. This delay does not apply to Wi-Fi or SCADA closing commands. When this timer is set to 0 seconds, the second **Closing Profile** operation cannot be set by the IntelliRupter fault interrupter OPEN/CLOSE/READY lever. (Range: 0.0-60.0; Step: 0.1; Default: 5.0)

Sync Check Enabled

The **No** setting is the default for both closing profiles. Typically, the **Yes** setting is selected for the first **Closing Profile** operation and the **No** setting is selected for the second **Closing Profile** operation.

Voltage Difference Threshold

This is the percentage voltage difference between the X and Y sides above which a **Close** operation is prevented. (Range: 5-50%; Step: 1%)

Phase Angle Difference Threshold

This is the phase-angle difference (in degrees) between the X and Y sides above which a **Close** operation is prevented. (Range: 3-30 degrees; Step: 1 degree)

Frequency Difference Threshold

This is the frequency difference (in Hertz) between the X and Y sides above which a **Close** operation is prevented. (Range: 0.1-1.0 Hz; Step: 0.1 Hz)

Voltage Threshold

This is the phase-voltage level below which a **Sync Check** operation will not be performed. The **Sync Check** mode is active when the voltage level on at least one pole on each side exceeds the **Voltage Threshold** setting. (Range: 5-95 V; Step: 1 V)

Sync Check Wait Timer

This is the time (in seconds) to wait for the above conditions to be met before the **Close** operation is blocked by a **Sync Check** operation. For the duration of this timer, the **Close Pending Sync Check** status point is on. See Instruction Sheet 766-560 for the complete list of DNP points. When the IntelliTeam SG system commands a **Close** operation, it will wait the duration of the **Wait Timer** setpoint before determining whether it is unable to close the device. When the IntelliTeam SG system has determined it cannot close the device, it will look for another device to restore the affected team. If another source is not available, the team will not be restored. (Range: 0-600; Step: 1; Default: 2)

Fast Close Enabled (R3 control only)

The **Fast Close Enabled** option is only available during the following conditions: **PulseClosing Enabled** mode is in the **No** state and **Sync Check Enabled** mode is in the **Yes** state. In this combination, the **Fast Close Enabled** setting will have the default **No** state. When set to the **Yes** state, the **Fast Close** operation will close all three poles in ≤ 2 milliseconds.

TCC

Enter the overcurrent selections that define the Second Closing Profile, Direction 1. The overcurrent selections must be entered for both directions. The settings entered for Direction 1 can be copied to Direction 2 by clicking on the **Copy From** button. The selections can be modified as necessary.

Phase Overcurrent

The **Phase Overcurrent** element will trip the IntelliRupter fault interrupter if current on one or more phases exceeds the pickup value for the time value set by the inverse curve or definite time delay.

Phase Check box—Check to enable this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. Only the **Definite Time** settings will be used when the **None** option is selected.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) that defines the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—Select the inverse curve reset method from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** mode is selected, enter the reset delay time (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Ground Overcurrent

The **Ground Overcurrent** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the inverse curve or the definite time delay.

Ground Check box—Check to enable this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. Only the **Definite Time** settings will be used when the **None** option is selected.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) that defines the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list. Select the **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** mode is selected, enter the reset delay time (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Negative Sequence

The **Negative Sequence** element trips the IntelliRupter fault interrupter when the negative sequence component (I_2) of the three-phase elements exceeds the pickup value for the time value set by the inverse curve or the **Definite Time** delay.

Negative Sequence Check box—Check to enable this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. Only the **Definite Time** settings will be used when the **None** option is selected.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list. Select the **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—When the **Definite Time** mode is selected, enter the reset delay time (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Sensitive Earth

The **Sensitive Earth** element trips the IntelliRupter fault interrupter if the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the inverse curve or the definite time delay.

Sensitive Earth Check box—Check to enable this element.

Inverse Segment—Select from the drop-down list of inverse curve names or select the **None** option. Only the **Definite Time** settings will be used when the **None** option is selected.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 1.000-6000.000; Step: 0.001)

Time Mult—This is the time modifier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time modifier for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Reset—The reset for the inverse curve is configurable for either the **D/T** (Definite Time) or the **T/A** (Time Accumulation) mode. The **Time Accumulation** mode times when current is above the **Minimum Trip** value, and it holds the time value when current is below the **Minimum Trip** value. The timer continues to count until either the **SEF** element trips or the element does not pick up for the duration of the user-specified **SEF Element Reset Time** setting and the element resets. The **Time Accumulation** mode is the default.

Reset Time—When the **Definite Time** mode is selected, enter the reset delay time (in seconds). (Range: 0.000-6000.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 1.000-6000.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 3-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 1.000-6000.000; Step: 0.001)

Earth Fault Protection and Sectionalizing

Profile Name

This non-editable text box displays the profile text set in the “Initial Trip” panel.

Direction

This non-editable text box displays the direction text set in the “Initial Trip” panel.

DTAP Sectionalizing

When the **Yes** option is selected for the Directional Transient Active Power (**DTAP Sectionalizing**) feature, the “DTAP Sectionalizing settings” panel opens and enables this element with the settings present in this panel. (Range: Yes, No; Default: No)

Wattmetric Protection

When the **Yes** option is selected for the **Wattmetric Protection** feature, the “Wattmetric Protection settings” panel opens and enables this element with the settings present in this panel. (Range: Yes, No; Default: No)

DTAP Sectionalizing Information

Zero Sequence Voltage Threshold

This is the **Zero Sequence Voltage Threshold** setting in percent, used to compare with the measured zero sequence voltage. (Range: 1 to 100%; Step: 1%; Default: 50%)

-P0 Fault Detection Threshold

This is the **Zero Sequence Power Level** setting used to compare with the measured zero sequence power during a fault event and when the **DTAP Compensator** feature is active. **Note:** The “negative” sign indicates zero sequence power must be flowing toward the source for this element to assert. (Range: -20.0 to +20.0 kW; Step: 0.5 kW; Default: -2.0 kW)

Delay Length

The number of cycles the **True** condition must be present for the **DTAP Earth Fault Detection Algorithm** feature earth fault presence confirmation. The **Fault Detection Algorithm Delay** timer resets whenever there is an open pole. (Range: 1-5 cycles; Step: 1 cycle; Default: 2 cycles)

Sliding Window Filter

This is the **Sliding Window Filter** setting for the **Earth Fault Detection Algorithm** feature. The filter resets whenever there is an open pole. (Range: 1-5 cycles; Step: 1 cycle; Default: 2 cycles)

Indication Only

When the **Yes** option is selected, the **DTAP Sectionalizing** element will not trip the IntelliRupter fault interrupter. When the **No** option is selected, this element will trip the IntelliRupter fault interrupter to lock out when it operates. (Range: Yes, No; Default: Yes)

Unbalance Time to Trip

The **Trip to Lockout** operation because of the **DTAP Earth Fault Detection** element is delayed for this duration after detection. (Range: 0.00-600.00 seconds; Step: 0.01 seconds; Default: 3.00 seconds)

Unbalance Reset Time

The **DTAP Earth Fault Detection** feature resets if conditions return to levels below the setting for the reset time. (Range: 0.00-600.00 seconds; Step: 0.01 seconds; Default: 0.10 seconds)

Zero Sequence Voltage Reset Threshold

This is the **Zero Sequence Voltage Reset Threshold** setting, which the zero sequence must stay below for the element to reset. (Range: 1-100%, Step: 1%; Default: 10%)

Zero Sequence Voltage Reset Timer

This is the amount of time the zero sequence voltage must stay below the threshold for the element to be reset. (Range: 1.00-600.00 seconds; Step: 0.01 seconds; Default: Disabled)

Wattmetric Protection Information

Zero Sequence Voltage Threshold

This is the **Zero Sequence Voltage Threshold** setting in percent, used to compare with the measured zero sequence voltage. (Range: 1 to 100%; Step: 1%; Default: 50%)

-P0 Fault Detection Threshold

This is the **Zero Sequence Power Level** setting used to compare with the measured zero sequence power during a fault event. **Note:** The “negative” sign indicates zero sequence power must be flowing toward the source for this element to be active. (Range: -2,000.0 to +2,000.0 kW; Step: 0.5 kW; Default: -2.0 kW)

Indication Only

When the **Yes** option is selected, the **Wattmetric** element will not trip the IntelliRupter fault interrupter, and when the **No** option is selected, this element will trip the IntelliRupter fault interrupter to lock out when it operates. (Range: Yes, No; Default: Yes)

Time to Trip

The **Trip to Lockout** operation because of the **Wattmetric** element is delayed for this duration after detection. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 3.00 seconds)

Reset Time

The **Wattmetric** element resets if conditions return to levels below the setting for the reset time. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 0.10 seconds)

Shift Time

This is used in place of the **Wattmetric Time to Trip** setpoint when **TCC Shifting** mode is selected and the **TCC Shifting** conditions have been satisfied for the duration of the **Test**

TCC Hold Time setting. Values can only be set that are less than the **Wattmetric Time to Trip** setpoint. (Range: 0.00-10.00 seconds; Step: 0.01 seconds; Default: 2.00 seconds)

Zero Sequence Voltage Reset Threshold

This is the **Zero Sequence Voltage Reset Threshold** setting, which the zero sequence voltage must stay below for the element to reset. (Range: 1-100%; Step: 1%; Default: 10%)

Zero Sequence Voltage Reset Timer

This is the amount of time the zero sequence voltage must stay below the threshold for the element to be reset. (Range: 1.00-600.00 seconds; Step: 0.01 seconds; Default: Disabled)

Voltage Trip

Each **Closing** profile can be configured for multiple **Voltage Trip** elements. See Figure 63.

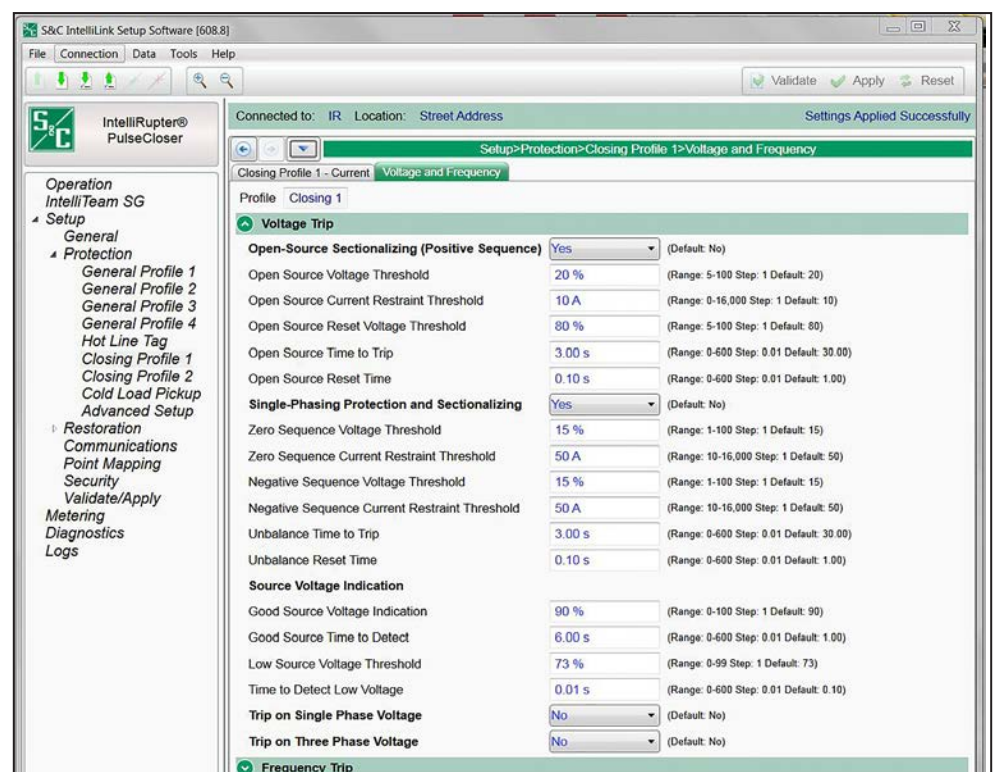


Figure 63. The Setup>Protection>Closing Profile 1>Voltage and Frequency>Voltage Trip screen.

Open-Source Sectionalizing (Positive Sequence)

Specify the **Yes**, **No** (default), or **IT SG Only** setting. The **IT SG Only** setting will cause this element to be active only when the IntelliTeam SG system is in the **Ready** state.

Open-Source Voltage Threshold

This is the percentage of system voltage below which a **Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 20%)

Open-Source Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 0-16,000; Step: 1; Default: 10) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum. When set to “0,” the current restraint is disabled.

Open-Source Reset Voltage Threshold

This is the percentage of system voltage above which the **Open-Source Voltage** element is reset. (Range: 5-100%; Step: 1%; Default: 80%)

Open-Source Time to Trip

This is the time (in seconds) the **Open-Source Voltage** element must be below its threshold for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Open-Source Reset Time

This is the time (in seconds) voltage must be present for the **Open-Source Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Single-Phasing Protection and Sectionalizing

Specify **No** (default), **Yes**, or **IntelliTeam SG** state to enable this element. The **IntelliTeam SG** state will cause this element to only be active when the IntelliTeam SG system is in the **Ready** state.

Zero Sequence Voltage Threshold

This is the percentage of system voltage above which tripping will occur. (Range: 1-100%; Step: 1%; Default: 15%)

Zero Sequence Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 10-16,000; Step: 1; Default: 50) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Note: The current restraint is effectively disabled when set to “16,000.” This is the recommended setting for DER applications where the intent is to open as fast as possible on voltage loss.

Negative Sequence Voltage Threshold

This is the percentage of system voltage above which tripping will occur. (Range: 1-100; Step: 1; Default: 15)

Negative Sequence Current Restraint Threshold

This is the current (in primary amperes) above which a **Trip** operation is prevented. (Range: 10-16,000; Step: 1; Default: 50) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Note: The current restraint is effectively disabled when set to 16,000. This is the recommended setting for DER applications where the intent is to open as fast as possible on voltage loss.

Unbalance Time to Trip

This is the time (in seconds) the **Voltage Unbalance** element must be above its threshold for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Unbalance Reset Time

This is the time (in seconds) voltage must be present for the **Voltage Unbalance** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Source Voltage Indication**Good Source Voltage Indication**

This is the percentage of system voltage above which the source is considered good. (Range: 0-100%; Step: 1%; Default: 90%)

Good Source Time to Detect

This is the time (in seconds) the **Good Source Voltage** indication must be present for source to be reported good. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Low Source Voltage Threshold

This is the percentage of system voltage below which the source is considered low. (Range: 0-99%; Step: 1%; Default: 73%)

Time to Detect Low Voltage

This is the time (in seconds) the **Low Source Voltage** indication must be present for source to be reported low. (Range: 0.00-600.00; Step: 0.01; Default: 0.10)

Trip on Single Phase Voltage

Specify the **Yes**, **No** (Default), or **IntelliTeam SG** state to configure this element. The **IntelliTeam SG** mode will cause this element to only be active when the IntelliTeam SG system is in the **Ready** state.

Single Phase Low Voltage Threshold

This is the percentage of phase voltage below which a **Single-Phase Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 75%)

Single Phase High Voltage Threshold

This is the percentage of phase voltage above which a **Single-Phase Trip** operation will occur. (Range: 100-200%; Step: 1%; Default: 120%)

Current Supervised on Low Voltage

Specify the **Yes** or **No** (default) state.

Threshold Current

If the **Current Supervised on Low Voltage** mode is specified, specify the value of primary current. (Range: 10-16,000; Step: 1; Default: 800) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Single Phase Time to Trip

This is the time (in seconds) the **Low-Voltage** or **High-Voltage** threshold must be exceeded for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Single Phase Reset Time

This is the time (in seconds) voltage must be present for the **Single-Phase Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Trip on Three Phase Voltage

Specify the **Yes**, **No** (Default), or **IntelliTeam SG** state to configure this element. The **IntelliTeam SG** state will cause this element to only be active when the IntelliTeam SG system is in the **Ready** state.

Three Phase Low Voltage Threshold

This is the percentage of system voltage below which a **Three-Phase Trip** operation will occur. (Range: 5-100%; Step: 1%; Default: 75%)

Three Phase High Voltage Threshold

This is the percentage of system voltage above which a **Three-Phase Trip** operation will occur. (Range: 100-200%; Step: 1%; Default: 120%)

Current Supervised on Low Voltage

Specify the **Yes** or **No** (default) state.

Threshold Current

If the **Current Supervised on Low Voltage** mode is specified, specify the value of primary current. (Range: 10-16,000; Step: 1; Default: 800) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV are limited to 12,500 amps maximum.

Three Phase Time to Trip

This is the time (in seconds) the **Low-Voltage** or **High-Voltage Threshold** settings must be exceeded for a **Trip** operation to occur. (Range: 0.00-600.00; Step: 0.01; Default: 30.00)

Three Phase Reset Time

This is the time (in seconds) voltage must be present for the **Three-Phase Voltage** element to reset. (Range: 0.00-600.00; Step: 0.01; Default: 1.00)

Frequency Trip

Each **Closing** profile has settings for multiple **Frequency Trip** elements.

Viable Voltage

This is the percentage of system phase-to-phase voltage for determining a valid voltage used in the frequency algorithm. (Range: 50%-100%; Step: 1%; Default: 85%)

Under Frequency Enabled

Specify the **Yes** or **No** (default) state.

Under Frequency Threshold

This is the frequency (in hertz) below which a **Trip** operation will occur. Enter between 47 and 60 Hz, but the setting will be valid only if it falls within the range (System Frequency - 3 Hz to System Frequency). (Minimum: System Frequency - 3 Hz; Maximum: System Frequency; Default: System Frequency - 0.5 Hz; Increment: 0.01 Hz)

Over Frequency Enabled

Specify the **Yes** or **No** (default) state.

Over Frequency Threshold

This is the frequency (in hertz) above which a **Trip** operation will occur. Enter between 50 and 62 Hz, but the setting will be valid only if it falls within the range (System Frequency to System Frequency + 2 Hz). (Minimum: System Frequency; Maximum: System Frequency + 2 Hz; Default: System Frequency + 0.5 Hz; Increment: 0.01 Hz)

Frequency Time to Trip

This is the time (in seconds) the **Under Frequency** or **Over Frequency Threshold** settings must be exceeded for a **Trip** operation to occur. (Range: 0.06-600.00; Step: 0.02; Default: 30.00)

Reset Time

This is the time (in seconds) frequency must be present for the **Frequency** element to reset. (Range: 0.06-600.00; Step: 0.02; Default: 1.00)

Good Frequency Indication (Loop Restoration Only)

When the **Good-Frequency Indication** mode is enabled, a **Loop Restoration Close** command will be blocked if the frequency is below the **Under Frequency Threshold** setting for the **Under Frequency Minimum Time to Detect** setting. The **Under Frequency Threshold** setting is (Default: System Frequency - 0.5 Hz. 49.50 Hz when *Setup>General Site-Related>System Frequency* = 50 Hz, or 59.50 Hz when *Setup>General Site-Related>System Frequency* = 60 Hz; Minimum: System Frequency - 1 Hz; Maximum: System Frequency; Increment: 0.01 Hz) The **Under Frequency Min Time to Detect** setting is (Default: 0.10 seconds; Maximum: 10.0 seconds; Increment 0.001 seconds)

Under Frequency Enabled

Specify the **Yes** or **No** (default) state.

Under Frequency Threshold

This is the frequency (in Hertz) below which a **Trip** operation will occur. Enter between 47 and 60 Hz, but the setting will be valid only if it falls within the range (System Frequency - 1, System Frequency). (Minimum: System Frequency - 1 Hz; Maximum: System Frequency; Default: System Frequency - 0.5 Hz; Increment: 0.01)

Under Minimum Time to Detect

This is the time (in seconds) the **Under Frequency Threshold** setting must be exceeded for a **Trip** operation to occur. (Range: 0.00-10.00; Step: 0.01; Default: 0.01)

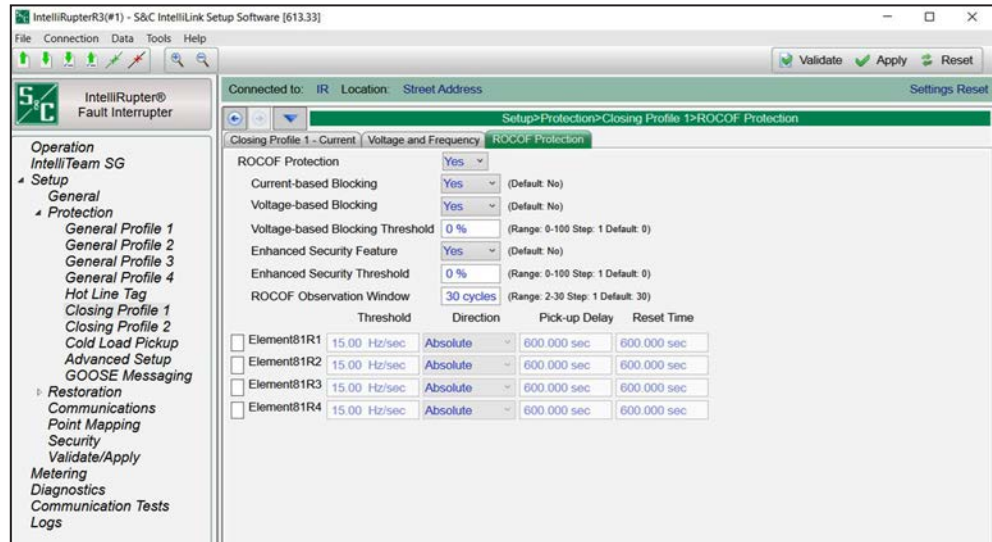


Figure 64. The Setup>Protection>Closing Profile 1>ROCOF Protection screen.

ROCOF Protection

For each **Closing** profile, the following **ROCOF** settings are configurable:

This setting makes the **ROCOF** feature available to configure across profiles. (Range: Yes, No; Default: No)

Current-based Blocking

This is a configurable mode. It is a single signal derived from the logical **OR** setting of all enabled elements for Direction 1 and Direction 2. The current blocking signal is a **True** condition when any **Overcurrent** element is not fully reset. When **Current-Based Blocking** mode is selected and the blocking signal is a **True** condition, tripping and **Trip** timer of the **ROCOF** element are blocked. (Range: Yes, No; Default: No)

Voltage-based Blocking

This is based on the positive sequence voltage. Tripping and trip timing is blocked if the positive sequence voltage magnitude is less than the **Voltage-based Blocking ROCOF Protection Threshold** setting expressed in percent (%) of the nominal voltage. Pickup and dropout time is not applied to the minimum voltage magnitude. (Range: Yes, No; Default: No)

Voltage-based Blocking Threshold

This is the threshold setting used to determine whether **Voltage-based ROCOF Protection** mode is applied. (Range: 0 – 39 100%; Step 1%; Default: 0%)

Enhanced Security Feature

When the ROCOF **Enhanced Security** feature is enabled, it provides a mechanism to empty the input observation window contents when a disturbance is detected. (Range: Yes, No; Default: No)

Enhanced Security Threshold

The **Enhanced Security** threshold, also called the **Disturbance** threshold, is expressed in % of nominal voltage. Sudden changes in voltage magnitude or phase angle greater than this threshold activate the **Enhanced Security** feature when enabled. (Range: 0-100%; Step: 1%; Default: 0%)

ROCOF Observation Window

This setting specifies the number of cycles the element uses to estimate the frequency change. This is applicable to all four **ROCOF** elements (Range: 2 – 30 cycles; Step 1 cycle; Default: 30 cycles)

Threshold

When the calculated **ROCOF** value exceeds the user configured threshold for a **ROCOF** element, the corresponding **Definite-Time Delay** setting is initiated for tripping. (Range: 0.01 – 15.00 Hz/sec; Step: 0.01 Hz/sec; Default: 15.00 Hz/sec)

Direction

This shows the ROCOF trend categorized as “Absolute,” “Rising,” or “Falling.” (Range: Rising, Falling, Absolute; Default: Absolute)

Pick-up Delay

(Range 0.00 - 600.00 sec; Step 0.01 sec; Default: 600.00 sec)

Reset Time

(Range 0.00 - 600.00 sec; Step 0.01 sec; Default: 0.00 sec)

Closing Profile 2 Configuration

The **Second Closing** profile is typically implemented when difficulties such as false trips are encountered during closing using the **First Closing** profile. The **Second Closing** profile is set up in the same manner as the First Closing Profile. See Figure 65.

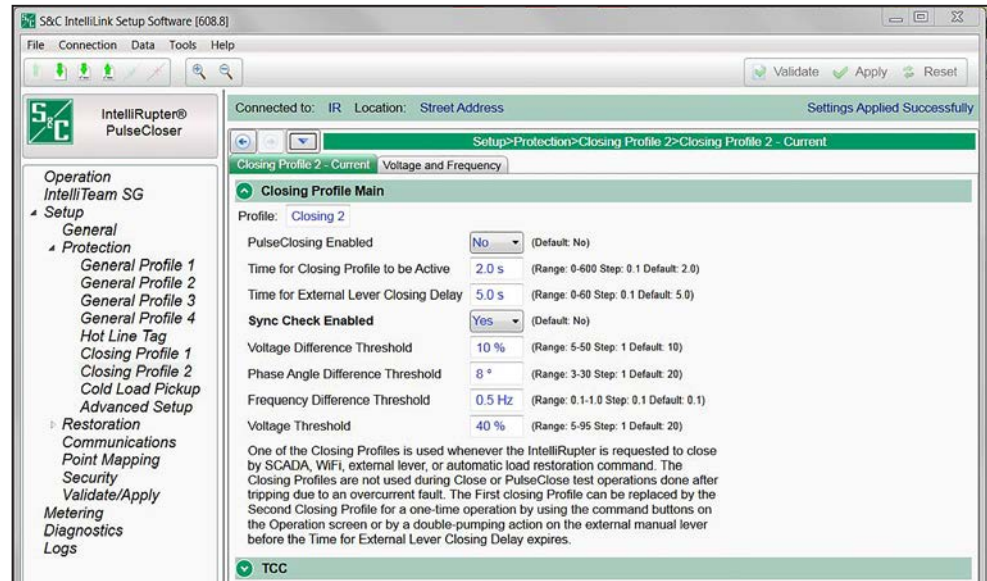


Figure 65. The Setup>Protection>Closing Profile 2>Closing Profile 2 – Current>Closing Profile Main screen.

Cold Load Pickup

The cold load pickup modifier increases the **Minimum Trip/Low Current Cutoff** values of the **Time Overcurrent** elements in the active profile configuration when power is first restored after an extended outage. The modifier values start ramping up from 100% when the outage duration exceeds the **T1 – Start Applying Modifier after Outage** timer. The ramp-up reaches maximum value at the end of the **T2 – Ramp to Full Modifier Value after T1** timer. When power is restored and all poles are closed, the modifier begins ramping down when the **T3 – Start Ramping Modifier Down after Return** timer expires. The modifier returns to the 100% level when the **T4 – Modifier Completely Off after T3** timer expires. See Figure 66 on page 137.

The screenshot shows the S&C IntelliLink Setup Software interface. The main window is titled "Setup>Protection>Cold Load Pickup". The left sidebar contains a tree view with categories like Operation, Setup, Protection, and Restoration. The main area displays the following settings:

- Cold Load Pickup Activated: **Enabled** (Default: Disabled)
- Max Modifier - Percent of Min Trip/Low Current Cutoff: **200 %** (Range: 100-500 Step: 1 Default: 200)
- T1 - Start Applying Modifier after Outage: **240 min** (Range: 1-600 Step: 1 Default: 15)
- T2 - Ramp to Full Modifier Value after T1: **480 min** (Range: 0-600 Step: 1 Default: 15)
- T3 - Start Ramping Modifier Down after Return: **120 min** (Range: 0-600 Step: 1 Default: 15)
- T4 - Modifier Completely Off after T3: **240 min** (Range: 1-600 Step: 1 Default: 15)
- Viable Voltage Setting: **85 %** (Range: 5-95 Step: 1 Default: 90)

Below the settings is a graph titled "Maximum Cold Load Modifier". The y-axis represents the modifier percentage, with a dashed line at 100%. The x-axis shows the timeline of a power outage, divided into "Loss of Voltage" and "Return of Voltage". The graph shows the modifier starting at 100% during the outage, ramping up to a maximum value (200%) at time T2, and then ramping down to 100% at time T3. The modifier is completely reset back to 100% by time T4 after power is restored.

The Cold Load Pickup function increases the Min Trip/Low Current Cutoff current values for the time-overcurrent elements on the Active Profile when power is first restored after some extended outage. The Modifier value starts to ramp up from 100% when the outage has been longer than time T1. The Modifier reaches its maximum value when the outage has reached the end of time T2. When power is restored and all poles are closed, the Modifier starts ramping down at the end of time T3. The Modifier is then completely reset back to 100% by time T4 after power is restored.

Figure 66. The Setup>Protection>Cold Load Pickup screen.

Cold Load Pickup Activated

Select the **Enabled** state to configure the **Cold Load Pickup** mode settings.

Max Modifier – Percent of Minimum Trip/Low Current Cutoff

This is the percent of the **Min Trip/Low Current Cutoff** setpoint at which timing is inhibited. Pickup and timing above this level will follow the configured inverse characteristics. (Range: 100-500%; Step: 1%; Default: 200%)

T1—Start Applying Modifier after Outage

This is the duration of the power outage (in minutes) when the modifier is applied at its minimum value. (Range: 1-600; Step: 1; Default: 15)

T2—Ramp to Full Modifier Value after T1

This is the time after T1 (in minutes) when the modifier has ramped up to its maximum value. (Range: 0-600; Step: 1; Default: 15)

T3—Start Ramping Modifier Down after Return

This is the duration of power restoration (in minutes) when the modifier is ramped down from its maximum value. (Range: 0-600; Step: 1; Default: 15) S&C recommends avoiding a value equal to zero for this timer.

T4—Modifier Completely Off after T3

This is the time after T3 (in minutes) when the modifier is removed at its minimum value. (Range: 1-600; Step: 1; Default: 15) S&C recommends avoiding a value equal to zero for this timer.

Viable Voltage Setting

This is the percentage of system phase-to-phase voltage at which the **Cold Load Pickup** timer starts. (Range: 5%-95%; Step: 1%; Default: 90%)

Advanced Setup

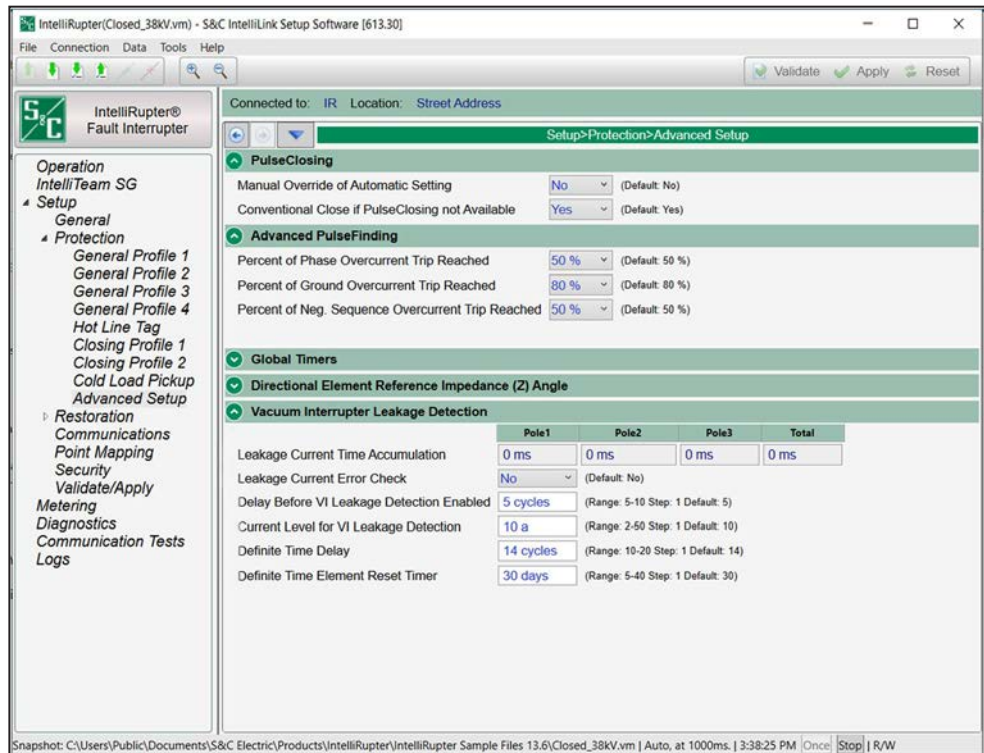


Figure 67. The Setup>Protection>Advanced Setup screen.

PulseClosing Technology

Manual Override of Automatic Setting

Select the Yes or No (default) option.

If the **Manual Override of Automatic Setting** mode is set to the **Yes** option, the fault detection is based on the **PulseClosing Fault Current Threshold** setting. Set the **PulseClosing Fault Current Threshold** setting to the calculated minimum fault current (single-line to ground) provided the load current is less than or equal to 50% of the minimum fault current (single-line to ground) of the circuit. If load current is greater than 50% of calculated minimum single-line to ground fault current, consult your S&C representative. See Figure 67 on page 138.

When set to the **No** setting, the test requires a minimum fault current of 400 amperes \pm 20% to detect a fault, and the fault current must also be a minimum of 150 amperes above the configured **Minimum Trip** setting. For example, 480 amperes is required with a **Minimum Trip** setting of 330 amperes or less.

The test sequence uses a varied scale for fault detection designed to increase the probability of continuing the sequence at the beginning of the test sequence and increase the probability of a **Close** operation at the end of the test sequence. To accomplish this, a pulse evaluation equal to or greater than 80% of the **Minimum Trip** setting on the first test will be designated a fault, resulting in the IntelliRupter fault interrupter remaining in the **Open** state and continuing the test sequence.

On the last test of the sequence, a pulse evaluation equal to or less than 150% of the **Minimum Trip** setting will result in the IntelliRupter fault interrupter performing a **Close** operation. Intermediate test steps will vary between these values based on the number of tests chosen.

NOTICE

S&C recommends the **TCC Shifting** feature be used when enabling the **PulseFinding** feature with the **PulseClosing Fault Current Threshold** setting below 400 amps. See the "TCC Shifting" section on page 61 for more information on this feature.

Conventional Close If PulseClosing Not Available

When the **Yes** (default) option is selected, it permits a **Close** operation if the **PulseClosing Technology** operation is not available. Selecting the **No** option will not permit a **Close** operation; no testing is performed, and the IntelliRupter fault interrupter goes into the **Lockout** state after the initial trip.

Advanced PulseFinding Setup

The **PulseFinding Technique** mode is disabled when the **Percent of Phase Overcurrent Trip Reached**, the **Percent of Ground Overcurrent Trip Reached**, and the **Percent of Negative Sequence Overcurrent Trip Reached** setpoints are all set to the **Off** state.

Percent of Phase Overcurrent Trip Reached

This is configurable to improve the sensitivity to lower-magnitude faults. (Default: 50%; Increment: 20%, 50%, 80%, and Off)

Note: When using the PulseFinding technique with the IntelliTeam system this setting must be \geq 50%.

Percent of Ground Overcurrent Trip Reached

This is configurable to improve the sensitivity to lower magnitude faults. (Default: 80%; Increment: 20%, 50%, 80%, and Off)

Note: When using the PulseFinding technique with the IntelliTeam system this setting must be \geq 50%.

Percent of Negative Sequence Overcurrent Trip Reached

This is configurable to improve the sensitivity to lower magnitude faults. (Default: 50%; Increment: 20%, 50%, 80%, and Off)

Note: When using the PulseFinding technique with the IntelliTeam system this setting must be $\geq 50\%$.

Global Timers

Test Sequence or PulseFinding Technique Loss-of-Source Timeout

When this timer expires, the loss of source is considered to be permanent, the **PulseFinding Technique Sequence** or **Test Sequence** operation is cancelled, and further automatic operation is stopped. This timer resets when the IntelliRupter fault interrupter is manually closed after power returns. (Range: 10-600; Step: 1; Default: 300 seconds)

Block Test on Backfeed Timeout

If backfeed voltage remains present for longer than the specified time, the IntelliRupter fault interrupter remains open and goes into the **Lockout** state. (Range: 10-600; Step: 1; Default: 300 seconds)

IntelliTeam Event Memory Timer

The IntelliTeam system considers system protection to be active for the duration of this timer. Configure sufficient time to ensure devices such as substation breakers or upstream protection devices complete automatic operation before this timer expires to indicate the end of the event and the system is stable. (Range: 1-900 seconds; Step: 1; Default: 45)

Minimum Time Between SEF Current Spikes

This configures the minimum time between current spikes before they are counted. (Range: 10-1,000 ms; Step 1; Default: 50) It applies to the **SEF Trip on Current Spike** mode on the *Setup>Protection>General Profile>Initial Trip-Additional Features* screen.

Pulse Test Diagnostic Timer

This timer gives the SCADA user indication the command to test using PulseClosing Technology has been received and the test is proceeding. A command to test using PulseClosing Technology starts this timer, which is indicated by Testing (Status Point 53) and Any Automatic Timer in Progress (Status Point 122). When the timer expires, Status Point 53 will automatically clear. (Range: 1 to 900 seconds; Step: 1; Default: 30)

Auto Clear Reported Fault Current DNP Points Enabled

This setting enables or disables the **Auto Clear Reported Fault Current DNP Points Timer** feature. (Default: No)

Auto Clear Reported Fault Current DNP Points Timer

When enabled, this is the time delay between the **IntelliRupter Closed Automatically After Experiencing a Fault Current** operation and the IntelliRupter PulseCloser Fault Interrupter automatically clearing the reported fault current DNP Analog Input points 14, 15, and 16. (Range: 1-600 seconds; Step:1 second; Default: 300 seconds)

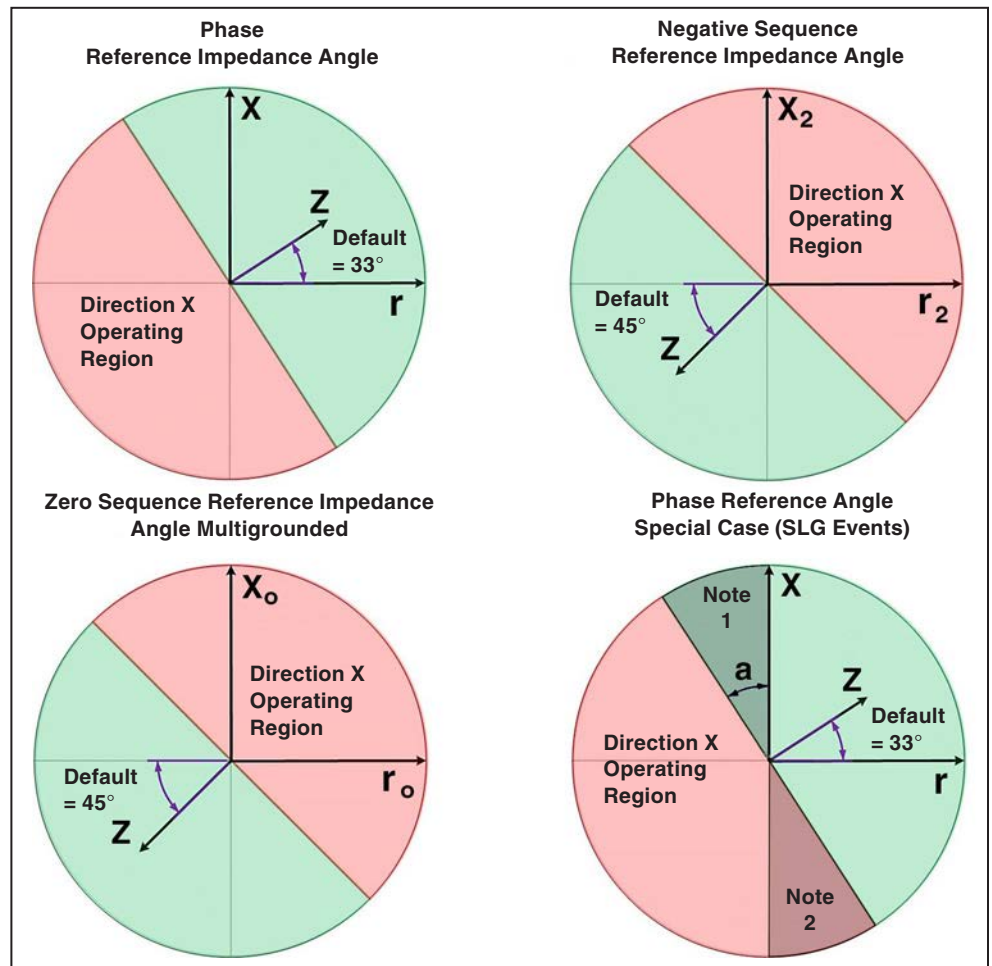


Figure 68. Default Reference Impedance (Z) Angle diagrams as plotted on their respective resistance and reactance (r/x) planes, Direction X operating area is red, Direction Y operating area is green. Note 1: Default Blocking Region for Direction Y ($a=33^\circ$). Note 2: Default Blocking Region for Direction X.

Directional Element Reference Impedance (Z) Angle Section

The use of Z Angle or impedance angle is a departure from the previous use of Maximum Torque Angle (MTA) and follows other (non-S&C) descriptions of directional angles. Further, the diagrams in Figure 68 on page 141 give better definitions of the direction X and Y boundaries, especially for single-phase to ground faults because there are two regions where directional determination is blocked.

NOTICE

Changing the default-phase Z Angle for the Special Case SLG events (SLG = single-phase to ground) can affect the directional element's ability to determine direction when fault current and load current are approximately equal.

Phase Z Angle

When the system type is Ungrounded: (Range: 0° to 90°; Step: 0.01°; Default: 33.75°)

When the system type is Uni-Grounded Resonant: (Range: 0° to 90°; Step: 0.01°; Default: 33.75°)

When the system type is Multi-Grounded, Uni-Grounded Solid, Uni-Grounded Resistive, or Uni-Grounded Reactive: (Range: 0° to 90°; Step: 0.01°; Default: 33.75°)

Zero Sequence Z Angle, Other Grounded System

When the system type is Ungrounded: Range: -90° to 0°; Step: 0.01°; Default: -90.00°)

When the system type is Uni-Grounded Resonant: Range: -90° to 90°; Step: 0.01°; Default: 0.00°)

When the system type is Multi-Grounded, Uni-Grounded Solid, Uni-Grounded Resistive, or Uni-Grounded Reactive: Range: 0° to 90°; Step: 0.01°; Default: 45.00°)

Negative Sequence Z Angle

When the system type is Ungrounded: Range: 0° to 90°; Step: 0.01°; Default: 45.00°)

When the system type is Uni-Grounded Resonant: Range: 0° to 90°; Step: 0.01°; Default: 45.00°)

When the system type is Multi-Grounded, Uni-Grounded Solid, Uni-Grounded Resistive, or Uni-Grounded Reactive: (Range: 0° to 90°; Step: 0.01°; Default: 45.00°)

Vacuum Interrupter Leakage Detection

When the **Yes** option is chosen for the **Leakage Current Error Check** mode, after every **Open** operation leakage current sensing is delayed by the **Delay Before VI Leakage Detection Enabled** setpoint. Only current above the **Current Level for VI Leakage Detection** setpoint is considered leakage current.

The duration of leakage current at each pole is totaled by the **Leakage Current Definite Time Element** timers. At 60 Hz, one cycle = 16 ms. When the number of milliseconds recorded by any of the **Leakage Current Definite Time Element** timers equals the number of cycles configured for the **Definite Time Delay** setpoint, a **VI Leakage Detection** error is reported.

When any pole timer reaches 50% of the **Definite Time Delay** setpoint, an alarm is reported, and at 80% of the **Definite Time Delay** setpoint, a warning is reported. When no VI leakage current is detected for the duration of the **Definite Time Element Reset Timer** setpoint, all **Leakage Current Definite Time Element** timers are reset to 0.

A **Clear Alarm** command clears the leakage current alarm and counts unless the **Leakage Current Warning** state is already active. A **Clear Warning** command clears the leakage current warning, alarm, and counts unless the **Leakage Current Error** state is already active. A **Clear Error** command clears the leakage current error, warning, alarm, and counts.

Leakage Current Time Accumulation

This is the total time in milliseconds leakage current above the **Current Level for VI Leakage Detection** setpoint has been detected.

Leakage Current Error Check

When the **Yes** option is chosen for the **Leakage Current Error Check** mode, leakage current will be monitored. It is not monitored when set to the **No** option. (Default: No)

Delay Before VI Leakage Detection Enabled

When the vacuum interrupter opens, leakage detection is delayed by the number of cycles configured for this setpoint. (Range: 5-10; Step: 1; Default: 5)

Current Level for VI Leakage Detection

VI leakage current must be above this setpoint to register. Current level units are in amperes, as measured through the VI phase current sensor. (Range: 2-50; Step: 1; Default: 10)

Definite Time Delay

When the duration of VI leakage current at any pole reaches this setpoint, a **VI Leakage Current Error** state is issued. An alarm is issued at 50% of this setpoint, and a warning is issued at 80% of this setpoint. Definite time delay units are in fundamental frequency cycles. (Range: 10-20; Step: 1; Default: 14)

Definite Time Element Reset Timer

All **Leakage Current Counts** timers are reset to 0 when leakage current has not occurred for the duration of this setpoint in days. (Range: 5-40; Step: 1; Default: 30)

GOOSE Messaging

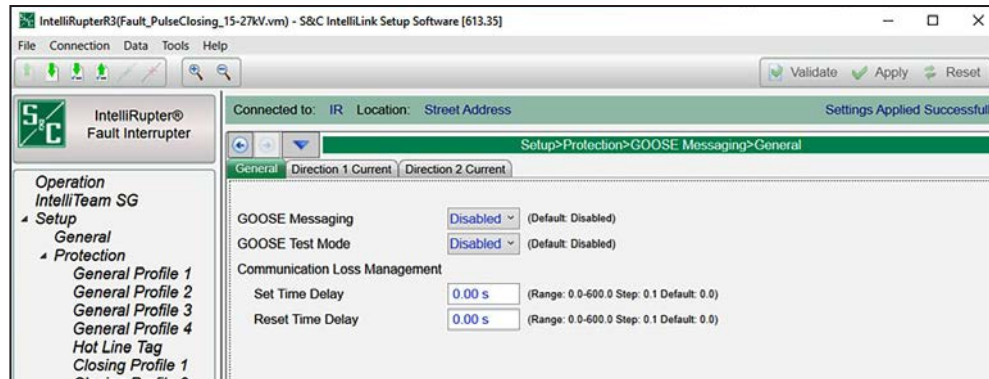


Figure 69. The Setup>Protection>GOOSE Messaging screen.

General Tab

GOOSE Messaging

The **GOOSE Messaging** feature may be enabled or disabled with this setting. Enabling/disabling GOOSE messaging with this setting or with the DNP control point have equal priority. The **GOOSE Messaging** status shows the most recently received control input. (Default: Disabled)

GOOSE Test Mode

When enabled, **GOOSE Test** mode allows the user to confirm whether a device is receiving configured GOOSE subscriptions without executing the resulting configured protection action. (Note that **GOOSE Test** mode is not a persistent setting.) (Default: Disabled)

Communication Loss Management

Set Time Delay

When the **Set Time Delay** value = 0, Comm Loss Status behavior is based on the **Time Allowed to Live** setting associated with individual GOOSE subscriptions. When the **Set Time Delay** value is non-zero, the **Communication Loss** status remains a logical “False” until the **Set Time Delay** timer has elapsed. (Range: 0.0-600.0; Step: 0.1; Default: 0.0)

Reset Time Delay

When the **Reset Time Delay** value = 0, Comm Loss Status behavior is based on the **Time Allowed to Live** setting associated with individual GOOSE subscriptions. When the **Reset Time Delay** value is non-zero, the **Delayed Communication Loss** status remains a logical “True” until the **Reset Time Delay** timer has elapsed. (Range: 0.0-600.0; Step: 0.1; Default: 0.0)

Direction 1/2 Current Tab

GOOSE Coordination mode specifies coordination curves to be used when GOOSE is enabled on the device and a TCC shift is triggered because of a GOOSE configuration. **GOOSE Coordination** mode must be used for both Direction 1 and Direction 2.

To enable communication-enhanced coordination (CEC) status information on the *Operation* screen, both the **Coordination Mode** setpoint in one or more of the **General** profiles must be set to the **Communication Enhanced Coordination** feature on the *Setup>Protection>General Profile 1-4>Direction 1 Current>TCCs for Coordination* screen, and the **Mode of Operation** setpoint must be set to the **IntelliTeam SG** mode on the *Setup>General>Site-Related* screen.

Coordination Reset Time

The duration (in seconds) Sequence Coordination TCC curves remain active. Timing begins after Sequence Coordination TCCs are no longer timing, meaning conditions are below **Phase**, **Ground**, and **Negative Sequence Min. Trip** settings. At the expiration of the **Coordination Reset Time** timer, Initial Trip TCCs of the selected **General** profile become active. (Range: 0-600; Step: 1)

Note: A time value of 0 seconds should never be used when **Communication Enhanced Coordination** mode or **GOOSE Coordination** mode is selected.

Phase Check box

Select to configure this element.

Inverse Segment

Select from the browse for file window of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip

This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time

This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-6000.000; Step: 0.001)

Time Mult.

This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder

This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff

This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset

Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time

If the **Definite Time Reset** mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip

This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time

This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip

This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time

This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Ground Overcurrent

The **Ground Overcurrent** element trips the IntelliRupter fault interrupter when the computed residual ($3I_0$) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Ground Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

Negative Sequence

The **Negative Sequence** element trips the IntelliRupter fault interrupter when the negative sequence component (I_2) of the three-phase elements exceeds the pickup value for the time value set by the **Inverse Curve** or **Definite Time** settings.

Negative Sequence Check box—Select to configure this element.

Inverse Segment—Select from the drop-down list of inverse-curve names or select the **None** option. When the **None** option is selected, only the **Definite Time** settings will be used.

Min. Trip—This is the current (in primary amperes) at which the inverse curve begins timing. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Min. Time—This is the time (in seconds) defining the fastest response of the inverse-curve portion of the TCC curve. (Range: 0.000-100.000; Step: 0.001)

Time Mult—This is the time multiplier for the inverse curve. (Range: 0.001-15.000; Step: 0.001)

Time Adder—This is the time adder for the inverse curve. (Range: -10.000-100.000; Step: 0.001)

Low Cutoff—This is the current (in primary amperes) at which the TCC curve begins timing. This value must be equal to or greater than the lowest pickup value of the inverse curve, the **Definite Time 1** element, and the **Definite Time 2** element. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Reset—Select the reset method for the inverse curve from the drop-down list: **D/T** (Definite Time) or **E/M** (Electromechanical) mode.

Reset Time—If the **Definite Time** reset mode is selected, enter the time delay for the reset (in seconds). (Range: 0.000-600.000; Step: 0.001)

Definite Time 1 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 1** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 1 Min. Time—This is the time delay (in seconds) after which the **Definite Time 1** element trips. (Range: 0.000-600.000; Step: 0.001)

Definite Time 2 Min. Trip—This is the current (in primary amperes) at which the **Definite Time 2** element picks up. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum.

Definite Time 2 Min. Time—This is the time delay (in seconds) after which the **Definite Time 2** element trips. (Range: 0.000-600.000; Step: 0.001)

High Current Lockout

Select this check box to specify the **High-Current Lockout** setting (in primary amperes). No testing is performed at current above this level. (Range: 6-16,000; Step: 1) The stated maximum is for 15-kV IntelliRupter fault interrupters; 27-kV and 38-kV models are limited to 12,500 amps maximum. Also see the **Maximum Interrupting Current** setting on the *Setup>General>Site-Related>System* screen.

Profile Configuration Options

Direction 1 and Direction 2

The direction names were configured on the *Setup>General>Site Related>System* screen and are shown here for reference. See Figure 70.

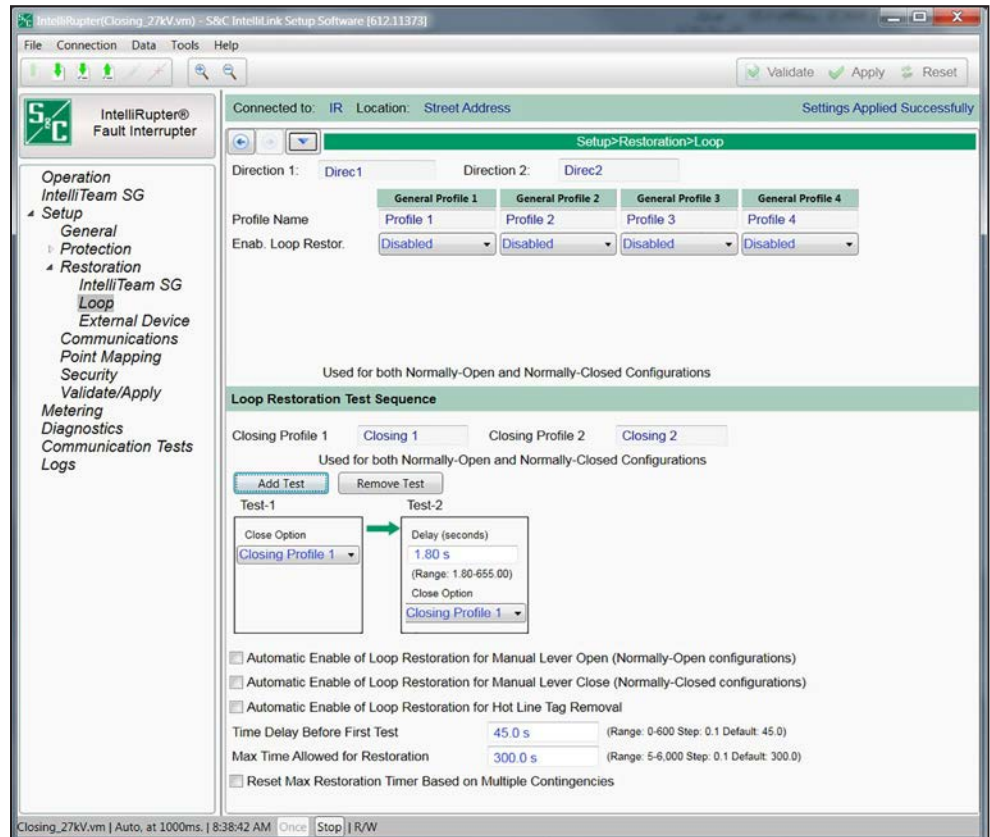


Figure 70. The *Setup>Restoration>Loop* screen.

Profile Name

The profile names were configured on the *Setup>Protection>General Profile x>Direction 1 Current>Initial Trip* screen (on the *Initial Trip* screen for each of the four profiles). They are shown on the *Setup>Restoration>Loop* screen for reference.

Enable Loop Restoration

This setting enables or disables the **Loop Restoration** mode for each **General** profile.

Direction

For each **General** profile, select the direction or directions for which the **Loop Restoration** mode is allowed to pick up load. This parameter is not available if the **Loop Restoration** mode is disabled. For example, if Direction 1 is specified, the **Loop Restoration** mode will only attempt to pick up loads served in Direction 1. Select the **Direction 1** or **Direction**

2 option to configure a one-way tie. Select the **Both Directions** option to allow the **Loop Restoration** mode to pick up load on either side. This setting applies to both the **Normally Closed** and **Normally Open** states.

Normal State

The **Open Normal** state is used for an IntelliRupter fault interrupter at the tie point between two feeders. The **Closed Normal** state is used for any other IntelliRupter fault interrupter on the feeder. This parameter is not available when the **Loop Restoration** mode is disabled.

Protection

Choose the **Voltage Trip** or **Sectionalizing** element for triggering the **Loop-Restoration** mode. The **Voltage Trip** element is usually selected. This parameter is only available when the **Closed Normal** state and the **Loop Restoration** mode are enabled.

Good Frequency to Close

When the **Yes** option is selected for the **Good Frequency to Close** mode, a **Loop Restoration Close** command will be blocked if the frequency is below the active **Under Frequency Threshold** setting for the configured **Under Frequency Minimum Time to Detect** setpoint. When the **No** option is chosen for the **Good Frequency to Close** mode, a **Loop Restoration Close** command will not be blocked.

The **Yes** option is chosen for the **Under Frequency Enabled** setpoint on the *Setup>Protection>General Profiles>Voltage Frequency Sectionalizing>Frequency Trip* screen. The **Loop Restoration** mode must be manually enabled after the **Low-Frequency** condition has cleared.

Loop Restoration Test Sequence

Closing Profile 1 and Closing Profile 2

The **Closing** profile names are shown here for reference. They are configured on the *Setup>Protection>Closing Profile 1 or 2>Closing Profile 1 or 2>Current>Closing Profile Main* screen.

Add Test and Remove Test Buttons

Select the number of loop-restoration tests to be performed. At least one test is always performed and up to four tests can be configured. Each click on the **Add Test** button adds one test. Each click on the **Remove Test** button removes one test.

Close Option—Tests 1-4

Select the specific **Closing** profile to be used for each test. Choose from the **Closing Profile 1** or **Closing Profile 2** options.

Delay (seconds)—Tests 2-4

Specify the delay in seconds between each test. (Minimum: 1.80 for Time 1, 10.00 for Time 2, and 30.00 for Time 3; Maximum: 655.00 seconds; Default: the minimum value; Increment: 0.01)

Automatic Enable of Loop Restoration for Manual Lever Open (Normally Open state)

When checked for a normally open IntelliRupter fault interrupter and after loop restoration has reconfigured the feeder, a manual lever **Open** operation re-enables the **Loop Restoration** mode. This operation returns the IntelliRupter fault interrupter to the **Ready** state without a Wi-Fi or SCADA command. A manual lever **Open** operation re-enables the **Loop Restoration** mode when the IntelliRupter fault interrupter is in either the **Open** or **Closed** state.

Automatic Enable of Loop Restoration for Manual Lever Close (Normally Closed state)

When checked for a normally closed IntelliRupter fault interrupter and after loop restoration has reconfigured the feeder, a manual lever **Close** operation re-enables the **Loop Restoration** mode. This operation returns the IntelliRupter fault interrupter to the **Ready** state without a Wi-Fi or SCADA command. A manual lever **Close** operation re-enables the **Loop Restoration** mode when the IntelliRupter fault interrupter is in either the **Open** or **Closed** state.

Automatic Enable of Loop Restoration for Hot Line Tag Removal

When unchecked, applying the **Hot Line Tag** mode for an IntelliRupter fault interrupter with the **Loop Restoration** mode enabled and in the **Ready** state will result in the **Loop Restoration** mode going to the **Not Ready** state and the **Loop Restoration** mode going to the **Disabled** state.

When checked, applying the **Hot Line Tag** mode for an IntelliRupter fault interrupter with the **Loop Restoration** mode enabled and in the **Ready** state will result in the **Loop Restoration** mode going to the **Not Ready** state, but it will not disable the **Loop Restoration** mode. When the **Hot Line Tag** mode is removed, all **Ready** conditions are met, and the **Loop Restoration** mode was not disabled by a manual operation or a command to disable the **Loop Restoration** mode, the **Loop Restoration** mode will go back to the **Ready** state.

Time Delay Before First Test

This applies to the normally open configuration only. After loss of voltage on one side, the IntelliRupter fault interrupter will wait this time period before executing the Close test or a test using PulseClosing® Technology as configured for Test 1. (Range: 0.0-600.0 seconds; Step: 0.1 seconds; Default 45.0 seconds)

Maximum Time Allowed for Restoration

If the **Loop Restoration** mode is not complete when this timer expires, the **Loop Restoration** mode is set to the **Disabled** state. Protection elements are still active, except those designated **Loops Only** mode. The only exception is an IntelliRupter fault interrupter in the **Closed** state may enter the **Loop Restoration** mode **Ready** state if all other conditions are met.

An IntelliRupter fault interrupter in the **Open** state in the middle of a test sequence will not complete the sequence if the timer expires. Therefore, the **Maximum Time Allowed for Restoration** setpoint must be longer than the combined times of the slowest initial trip response and the **Test Sequence Times** setting configured in the general profile enabled for the **Loop Restoration** mode. The choices are 0 (which sets the value to **None** and indicates no time limit) or a specific time setting. (Range: 0.0-6,000.0 seconds; Step: 0.1 seconds; Default: 300.0 seconds)

Reset Max Restoration Timer Based on Multiple Contingencies—Check Box

For Normally Open IntelliRupter Loop Restoration Logic

Under normal operation, if voltage is lost on one side of the normally open IntelliRupter fault interrupter, the **Maximum Time Allowed for Restoration** timer starts and the **Time Delay Before First Test** timer starts timing to close the normally open IntelliRupter fault interrupter. If voltage returns before the timer expires, in the normal **Loop** mode, the **Maximum Time Allowed for Restoration** timer continues to run (time down).

With this feature enabled for multiple contingencies, the **Maximum Time Allowed for Restoration** timer stops timing and is reset to its configured value. If voltage is subsequently lost, the **Maximum Time Allowed for Restoration** timer will restart. This case is just the restoration of the voltage lost on one side (i.e. the circuit is back to normal) of a normally open IntelliRupter fault interrupter.

When voltage is lost on one side of the normally open IntelliRupter fault interrupter, both the **Maximum Time Allowed for Restoration** and the **Time Delay Before First Test** timers begin timing. When voltage is lost on the other side (both sides have loss-of-voltage conditions), the **Time Delay Before First Test** timer is reset, but the **Maximum Time Allowed for Restoration** timer continues to time down. Should voltage return to one side of the normally open IntelliRupter fault interrupter before the **Maximum Time Allowed for Restoration** timer expires (i.e. reaches zero), the **Time Delay Before First Test** timer begins timing to close the normally open IntelliRupter fault interrupter.

When this feature is enabled, if the **Time Delay Before First Test** timer is actively timing when the **Maximum Time Allowed for Restoration** timer expires, the **Loop Restoration** mode continues to run and lets the **Time Delay Before First Test** timer expire to allow the test close to complete and potentially restore voltage. When the test close is initiated, the **Loop Restoration** mode is disabled (the normal behavior when the **Maximum Time Allowed for Restoration** timer expires). If during the grace period before the **Time Delay Before First Test** timer expires, good source voltage is lost again (i.e. voltage is lost on both sides of the normally open device), the **Loop Restoration** mode is disabled (normal behavior when the **Maximum Time Allowed for Restoration** timer expires).

When **Loop Restoration** mode is making a decision to close and restore the feeder, it uses the profile and test sequence programmed at the *Setup>Restoration>Loop>Loop Restoration Test Sequence* screen.

If voltage is lost on either side of the IntelliRupter fault interrupter for the configured **Time Delay Before First Test** setpoint and the IntelliRupter fault interrupter is in the **Loop Restoration** mode **Ready** state, it will close.

Note: Voltage must also be below the **Backfeed Voltage Level** setpoint for **Loop Restoration** mode to qualify it as a voltage loss. This setpoint is on the *General>Site-Related>System* screen. The default value is 10%. If voltage goes above the **Backfeed Voltage Level** setpoint while timing on the **Time Delay Before First Test** setpoint, this timer is reset.

For Normally Closed IntelliRupter Loop Restoration Logic

The normally closed IntelliRupter **Loop Restoration** mode does not have any opportunities to reset the **Maximum Time Allowed for Restoration** timer because the **Loop Restoration** mode is only active when the IntelliRupter fault interrupter trips open and is in a not normal state and voltage returns to one side of the IntelliRupter fault interrupter. Resetting the **Maximum Time Allowed for Restoration** timer would essentially leave **Loop Restoration** mode armed forever. Should the utility have line crews working on the affected portions of the feeder and voltage is restored to either side of the IntelliRupter fault interrupter, the **Loop Restoration** mode would resume and attempt a **Test/Close** operation when the **Time Delay for Test** timer expires.

IntelliRupter fault interrupters using the **Loop Restoration** mode have specific indications and controls on the *Operation* screen. At the right side of the IntelliRupter fault interrupter graphic are three **Loop Restoration** status indicators that show **Ready**, **Timing**, or **Reconfigured** status. The **Loop Restoration Enable/Disable** button is below the **General Profile** setting. See Figure 71.

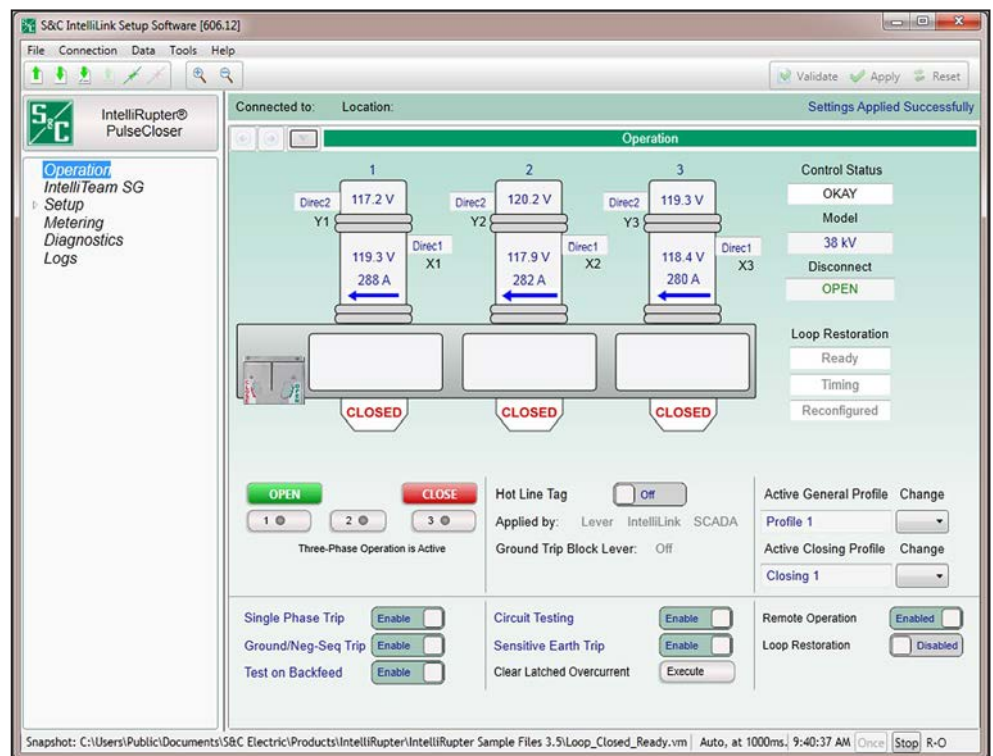


Figure 71. The Loop Restoration Operation screen.

When **Loop Restoration** mode is making a decision to close and restore the feeder, it uses the profile and test sequence programmed at the *Setup>Restoration>Loop>Loop Restoration Test Sequence* screen.

If the IntelliRupter fault interrupter tripped open for the **Voltage Trip** element and then voltage returns to either side for the configured **Time Delay Before First Test** setpoint, and the IntelliRupter fault interrupter is in the **Loop Restoration** mode **Ready** state, it will close.

Normally closed devices do not use the **Time Delay Before First Test** setpoint. They decide when to close based on the **Good Source Voltage Indication** setpoint.

Note: Voltage must also be below the **Backfeed Voltage Level** setpoint on one side for **Loop Restoration** mode to close. This setpoint is on the *Setup>General>Site-Related>System* screen. The default value is 10%. If voltage goes above the **Backfeed Voltage Level** setpoint while timing on the **Time Delay Before First Test** setpoint, this timer is reset.

Ready

If **Loop Restoration** mode is in the **Ready** state when a triggering event occurs, automatic restoration will proceed. The **Ready** state is entered and maintained when these conditions are met:

- Loop restoration is in the **Enabled** setting, both on the *Operation* screen and for the presently active general profile.
- The IntelliRupter fault interrupter is in the **Closed** position and voltage is present on the X and Y terminals if the general profile is configured in the **Normally Closed** mode.
- The IntelliRupter fault interrupter is in the **Open** position and voltage is present on the X and Y terminals if the general profile is configured in the **Normally Open** mode and the IntelliRupter fault interrupter is not in the **Lockout** state.
- The OPEN-CLOSE-READY lever is in the **Ready** position (only required for a normally open IntelliRupter fault interrupter).
- A **General** profile is operative. For example a **Hot Line Tag** mode is not applied.
- An **Error** state is not active.
- If **Overcurrent**, **Voltage**, and **Frequency** elements are timing or reset, the **Ready** state will still be active.

Timing

The **Timing** indicator shows when **Loop Restoration** timers are running. When the **Timing** mode is indicated, the IntelliRupter fault interrupter is testing, and some of the conditions listed above for the **Ready** state may not be valid.

Reconfigured

Loop Restoration Reconfigured status is indicated when:

- An IntelliRupter fault interrupter in a **Normally Closed** state becomes open because of **Loop Restoration** mode.
- An IntelliRupter fault interrupter in a **Normally Closed** state is closed but is serving load in the opposite direction because of **Loop Restoration** mode.
- An IntelliRupter fault interrupter in a **Normally Open** state becomes closed because of **Loop Restoration** mode.

Enable/Disable Loop Restoration

The **Loop Restoration** mode can be enabled or disabled by a SCADA command or with the *Operation* screen. To enable **Loop Restoration** mode, click on the **Loop Restoration** button and select **Enabled** mode. To disable **Loop Restoration** mode, click on the **Loop Restoration** button and select **Disabled** mode.

Normally Open IntelliRupter Fault Interrupter

With **Loop Restoration** mode in the **Ready** state, an IntelliRupter fault interrupter in a **Normally Open** state monitors both the X and Y sides for loss of voltage. For the timers to start voltage must be present on one side. When the voltage drops on the other side, the **Maximum Time Allowed for Restoration** timer starts when the voltage is below the **Source Voltage Indication** settings, and the **Time Delay Before First Test** timer starts when the voltage is below the **Backfeed Voltage Level** setpoint.

Note: Voltage must be below the **Backfeed Voltage Level** setpoint for **Loop Restoration** mode to qualify a voltage loss. This setpoint is on the *General>Site-Related>System* screen. The default value is 10%. See Figure 6 on page 23. If voltage goes above the **Backfeed Voltage Level** setpoint while timing on the **Time Delay Before First Test** setpoint, this timer is reset.

The **Loop Restoration** test sequence is initiated when the **Time Delay Before First Test** timer expires. If voltage returns before the **Time Delay Before First Test** timer expires, the timer stops and resets. If voltage is subsequently lost, the timer starts again.

When voltage is lost on both the X and Y sides before closing is initiated, the **Time Delay Before First Test** timer stops and resets. If voltage returns on only one side the timer starts.

The **Maximum Time Allowed for Restoration** timer stops when one of the following occurs:

- A close attempt is successful and the IntelliRupter fault interrupter has transitioned to a general profile
- **Loop Restoration** mode is disabled for any reason, including when the **Hot Line Tag** mode is applied or a manual command is received to close
- The **Maximum Time Allowed for Restoration** timer expires

- **Loop Restoration** mode is in the **Ready** state (The IntelliRupter fault interrupter remains open, all **Loop Restoration** timers are reset, and **Loop Restoration** logic remains in the **Enabled** mode.)
- **Loop Restoration** mode is not in the **Ready** state (The IntelliRupter fault interrupter remains open and goes to the **Lockout** state, all **Loop Restoration** timers are reset, and **Loop Restoration** mode is in the **Disabled** state.)

The **Automatic Enable of Loop Restoration for Manual Lever Open** mode (only applicable to the Normally Open configuration) only applies when an OPEN-CLOSE-READY lever operation causes the state to change. A state change caused by a fault event will not result in automatically enabling the **Loop Restoration** mode.

Normally Open Loop Restoration Test Sequence

The **Loop Restoration Test** sequence is configured on the *Setup>Restoration>Loop* screen and is used by both Normally Open and Normally Closed configurations.

The **Normally Open Loop Restoration Test** sequence follows this procedure:

- When the **Time Delay Before First Test** timer expires, Closing Attempt #1 starts its **Closing** profile.
- When the **PulseClose Technology** operation detects a fault or the **Close** operation trips because of a fault, the test sequence continues to the next open interval and **Close** operation as specified. This sequence continues for the configured number of close attempts.
- The IntelliRupter fault interrupter goes to the **Lockout** state when a **Voltage** element, **Sectionalizing** element, or **Frequency** element trips during the **Loop Restoration Test** operation.
- When a close attempt is successful, the **Closing** profile is replaced by the active **General** profile. The **Loop Restoration** mode is disabled, and protection functions are normal.
- When the configured number of close attempts has been tried and either a **PulseClosing Technology** operation detected a fault or a **Close** operation tripped because of a fault, the IntelliRupter fault interrupter remains open and goes to the **Lockout** state, all **Loop Restoration** timers are reset, and the **Loop Restoration** mode is disabled.
- If **Loop Restoration** mode is taken out of **Ready** state, all timers associated with loop restoration are reset but do not automatically change the **Open/Close** position of the IntelliRupter fault interrupter. The IntelliRupter fault interrupter state is unknown because it could have been closed and timing or open during an open time interval at the time the **Ready** conditions became unsatisfied.
- To restore the **Loop Restoration** mode **Ready** state, the IntelliRupter fault interrupter must be manually opened with the OPEN/CLOSE/READY lever, a command via Wi-Fi or SCADA, and the **Loop Restoration** mode must be enabled with a command via Wi-Fi or SCADA.
- When the **Automatic Enable of Loop Restoration for Manual Lever Open** mode is selected, the command via Wi-Fi or SCADA to re-enable the **Loop Restoration** mode is not necessary. When the IntelliRupter fault interrupter is manually opened,

it will go to the **Ready** state if the other conditions for the **Loop Restoration** mode **Ready** state have been satisfied.

The **Loop Restoration Test** sequence follows this procedure:

- When there is no voltage on both sides and a **Closing Profile** command is initiated (The command is rejected, and the timers and sequence continue as if the close attempt detected a fault.)
- When a **Closing Profile** command is blocked because of a Sync Check result (The timers and sequence continue as if the close attempt detected a fault.)
- When the IntelliRupter fault interrupter is in the **Open** state and voltage returns to both the X and Y sides or voltage is lost on both the X and Y sides (The **Loop Restoration Test** sequence is suspended and the **Maximum Time Allowed for Restoration** timer continues. When voltage returns to one of the terminals, the test sequence is resumed. When the **Maximum Time Allowed for Restoration** timer expires, the **Loop Restoration** mode remains enabled and all timers associated with loop restoration are reset. When the IntelliRupter fault interrupter is in the **Open** state, it may enter the loop restoration **Ready** state if all other conditions have been met.)
- A **Manual** command to change profiles by either the OPEN/CLOSE/READY lever, a command via Wi-Fi or SCADA that occurs during the test sequence will take loop restoration out of the **Ready** condition, and all timers are stopped and reset. Manual actions are required to return the **Loop Restoration** mode to the **Ready** state.

Normally Closed IntelliRupter Fault Interrupter

When **Loop Restoration** mode is in the **Ready** state, an IntelliRupter fault interrupter in a **Normally Closed** state has all **Overcurrent**, **Voltage**, and **Frequency** protection elements active, the same as it would without the **Loop Restoration** mode active.

Loop Restoration mode is not activated when an **Overcurrent Trip** or **Lockout** state occurs.

The **Time Limit for Loop Restoration** timer starts when any of the enabled **Voltage Trip** or **Sectionalizing** elements in the active **General** profile trip.

The **Loop Restoration Test** sequence starts if voltage returns on one side (X or Y), as determined by a **Good Source Voltage** indication, before the **Maximum Time Allowed for Restoration** timer expires.

When the **Maximum Time Allowed for Restoration** timer expires, the IntelliRupter fault interrupter stays in the **Open** state, goes to the **Lockout** state, and disables **Loop Restoration** mode.

- To return to the **Loop Restoration** mode **Ready** state, manually close the IntelliRupter fault interrupter with the OPEN/CLOSE/READY lever, or a command via Wi-Fi or SCADA. Then, **Loop Restoration** mode must be placed in the **Enabled** state with a command via Wi-Fi or SCADA.

- If **Automatic Enable of Loop Restoration for Manual Lever Close** mode (applicable to Normally Closed configuration) has been configured, then the command via Wi-Fi or SCADA to enable **Loop Restoration** mode is not necessary.

Normally-Closed Loop Restoration Test Sequence

The **Loop Restoration Test** sequence is configured on the *Setup>Restoration>Loop* screen and is used by both Normally Open and Normally Closed configurations.

The **Normally Closed Loop Restoration Test** sequence follows this process:

- When good source voltage returns on one side, Closing Attempt #1 starts its **Closing** profile.
- If there is no voltage when a **Closing** profile starts, the **Closing** profile is rejected, and the timers and sequence continue as if the close attempt detected a fault.
- When a **PulseClosing Technology** operation detects a fault or the **Close** operation trips because of a fault, then Open Time Interval #1 will expire and the **Closing** profile specified for Closing Attempt #2 starts. This sequence continues for the configured number of closing attempts.
- The IntelliRupter fault interrupter will go to the **Lockout** state if a **Voltage**, **Sectionalizing**, or **Frequency** element trips during the **Loop Restoration Test** sequence.
- When a close attempt is successful, the **Closing** profile is replaced by the active **General** profile. **Loop Restoration** mode goes to the **Disabled** state, and protection functions are normal.
- When current-flow direction has not changed, **Loop Restoration** mode will enter the **Ready** state if all **Ready** state conditions have been satisfied.
- When current flow changes direction, **Loop Restoration** mode is disabled, and the reported **Loop Restoration** mode is in the **Reconfigured** state.
- When the configured number of closing attempts has been tried and either a **PulseClosing Technology** operation detects a fault or a **Close** operation has resulted in a trip because of a fault, the IntelliRupter fault interrupter remains open and goes to the **Lockout** state, all **Loop Restoration** timers are reset, and **Loop Restoration** mode goes to the **Disabled** state.
- If **Loop Restoration** mode is taken out of the **Ready** state by a manual operation, by applying the **Hot Line Tag** mode, or by disabling **Loop Restoration** mode, all timers associated with **Loop Restoration** mode are reset but do not automatically change the **Open/Close** position of the IntelliRupter fault interrupter.
- To restore the **Loop Restoration** mode **Ready** state, the IntelliRupter fault interrupter must be manually closed with the OPEN/CLOSE/READY lever or a command via Wi-Fi or SCADA, and the **Loop Restoration** mode must be enabled with a command via Wi-Fi or SCADA.
- If **Automatic Enable of Loop Restoration for Manual Lever Close** mode (only applicable to Normally Closed configuration) has been configured, then the command via Wi-Fi or SCADA to re-enable the **Loop Restoration** mode is not necessary. When the IntelliRupter fault interrupter is manually closed, it will go to the **Ready** state if the other conditions for a **Loop Restoration** mode **Ready** state have been satisfied.

The **Loop Restoration Test** sequence uses this procedure:

- If there is no voltage on both sides during a **Closing Profile** command, the command is rejected, and the timers and sequence continue as though the close attempt detected a fault.
- When a **Closing Profile** command is blocked because of a sync check result, the timers and sequence continue as though the close attempt detected a fault.
- When the IntelliRupter fault interrupter is in the **Open** state and voltage returns to both the X and Y sides or voltage is lost on both the X and Y sides, the **Loop Restoration Test** sequence is suspended and the **Maximum Time Allowed for Restoration** timer continues. If voltage returns to one of the terminals, the test sequence is resumed. When the **Maximum Time Allowed for Restoration** timer expires, **Loop Restoration** mode is disabled. The only exception is if the IntelliRupter fault interrupter is closed, it may enter the **Loop Restoration** mode **Ready** state if all other conditions are met.
- A **Manual** command to change profiles by either the OPEN/CLOSE/READY lever or a Wi-Fi or SCADA command that occurs during the test sequence, this takes **Loop Restoration** mode out of the **Ready** state, and all timers will stop and reset. Manual actions are required to return **Loop Restoration** mode to the **Ready** state.

Loop Restoration Configuration Example

These steps describe the procedure to use the Loop Sample Snapshot.vm file with IntelliLink Offline software to create a custom settings template for **Loop Restoration** mode.

STEP 1. Start the IntelliLink Offline software by clicking on the IntelliLink Offline software icon. See Figure 72.



Figure 72. The IntelliLink Offline software icon.

STEP 2. Open the Loop Sample Snapshot.vm file. In the Open Snapshot dialog box, click on the **Yes** button to allow file modification. See Figure 73.

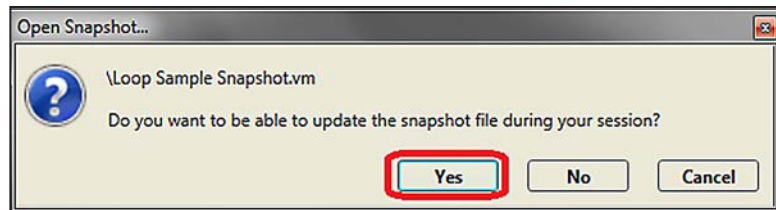


Figure 73. The Open Snapshot dialog box.

STEP 3. On the *Setup>General>Site Related* screen, set the **Mode of Operation** setpoint to the **Loop** mode. See Figure 74. This puts the **Loop Restoration** mode information on the *Operation* screen. See Figure 75.

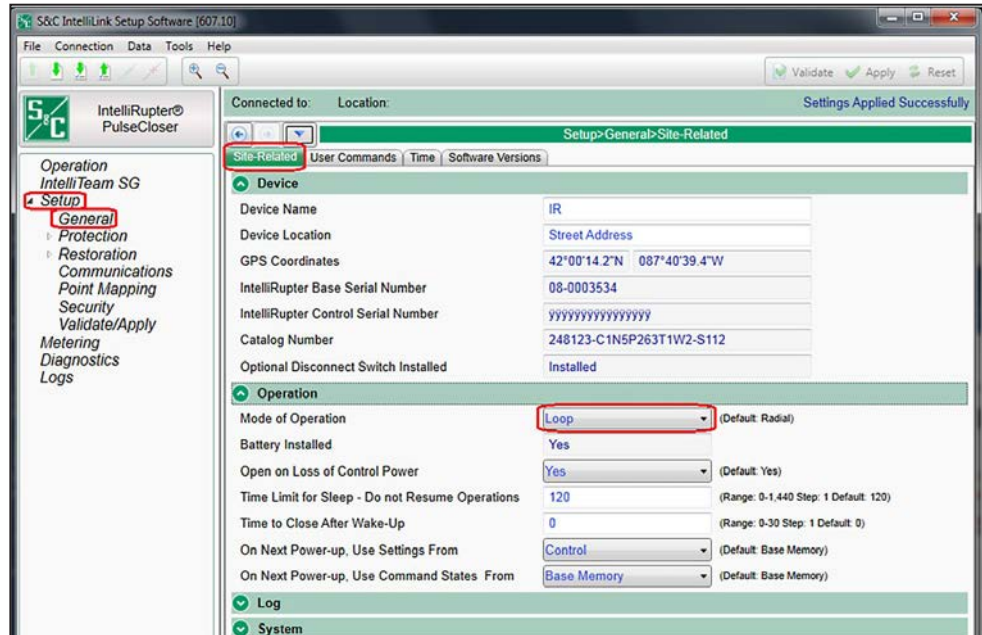


Figure 74. The *Setup>General>Site Related* screen.

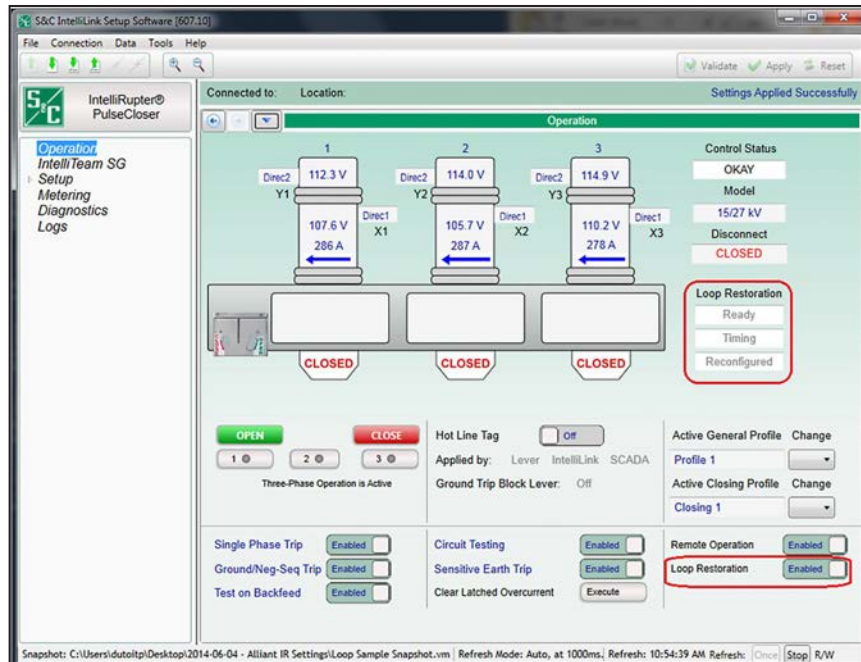


Figure 75. Loop Restoration information on the *Operation* screen.

STEP 4. Set the **Direction 1/Direction 2** setpoint on the *Setup>General>Site-Related>System* screen. See Figure 76.

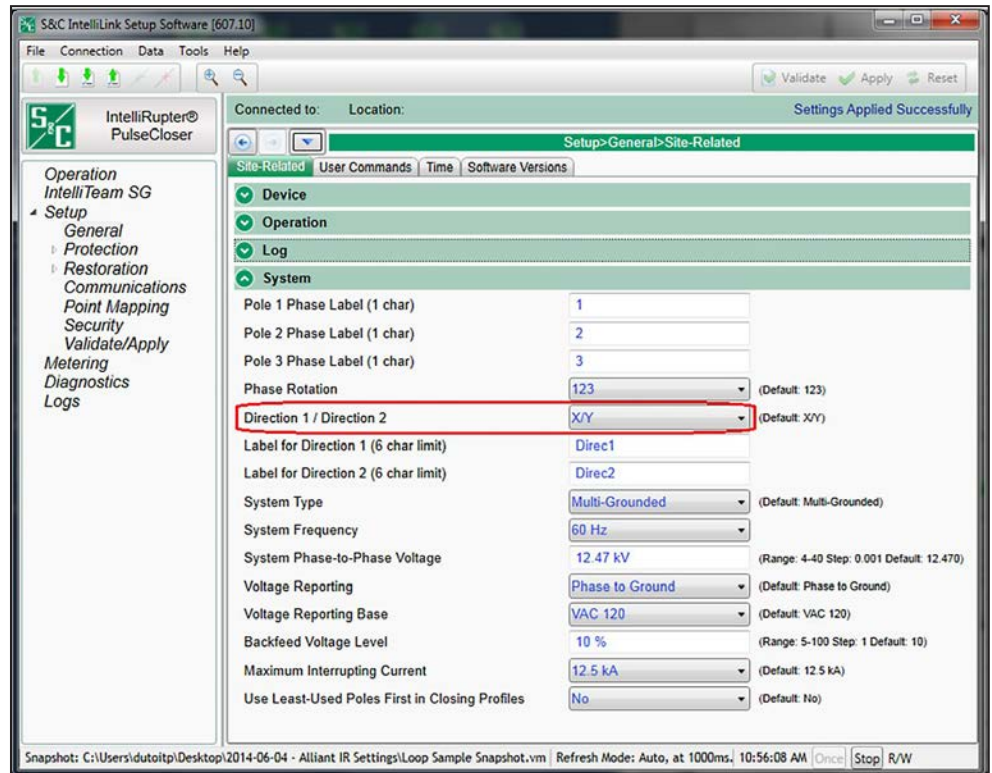


Figure 76. The Direction setpoint on the *Setup>General>Site-Related>System* screen.

STEP 5. Configure the Initial Trip TCC curves for each direction; each test sequence can have a unique curve. See Figure 77 on page 162. The S&C curve library is located in this folder on the computer: C:\Users\Public\Documents\S&C Electric\Curve Library 2.3\Base TCC Curve XDT Files\.

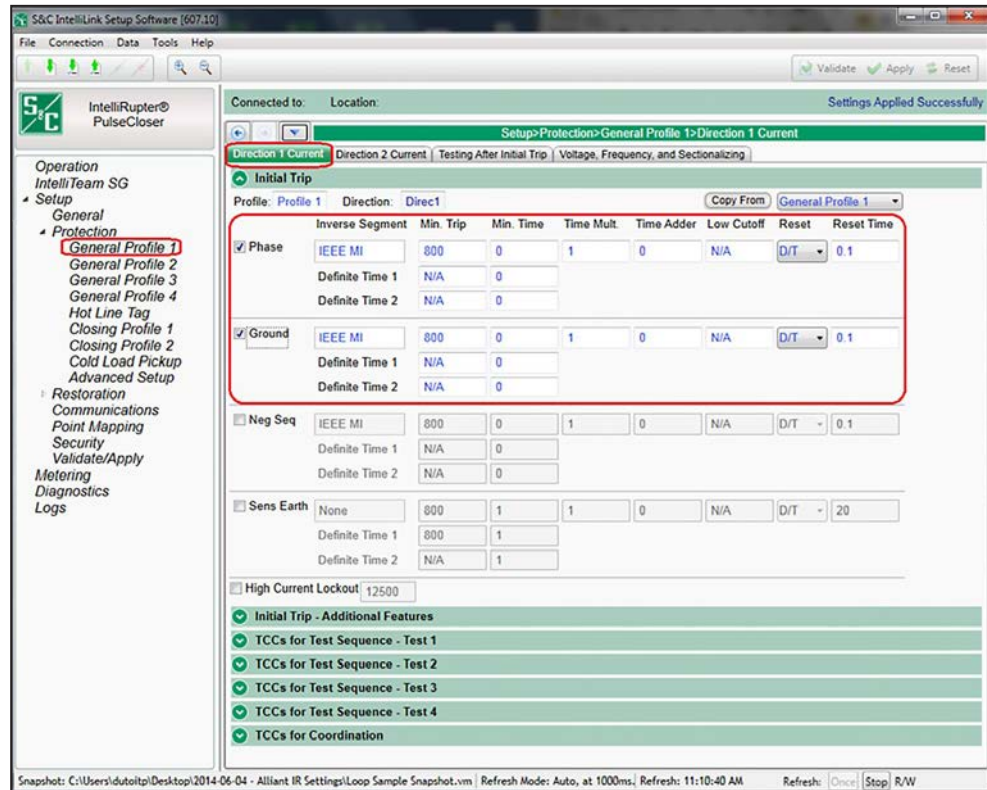


Figure 77. The Initial Trip curve configuration panel on the *Setup>Protection>General Profile 1>Direction 1>Current* screen.

STEP 6. Enable the PulseFinding technique so it can assist in cases where the devices may not be fully coordinated. See Figure 78.

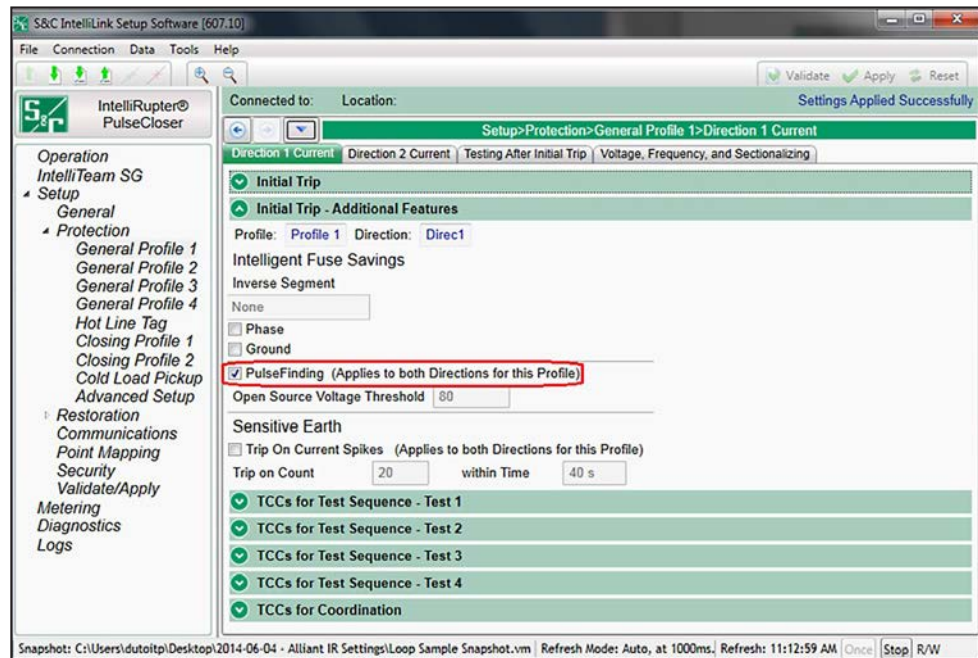


Figure 78. The PulseFinding technique setpoint on the *Setup>Protection>General Profile 1>Direction 1>Current>Initial Trip - Additional Features* screen.

STEP 7. Configure the **Test 1 TCC Curves** setpoint. By using the default **Use Previous TCCs** value, the test 1 and test 2 TCC curves will use the same **Use Previous TCCs** value configured for the **Initial Trip** setpoint, if a **PulseClosing Technology** operation does not detect a fault and the IntelliRupter fault interrupter closes. Configure TCC curves for both Direction 1 and Direction 2. See Figure 79.

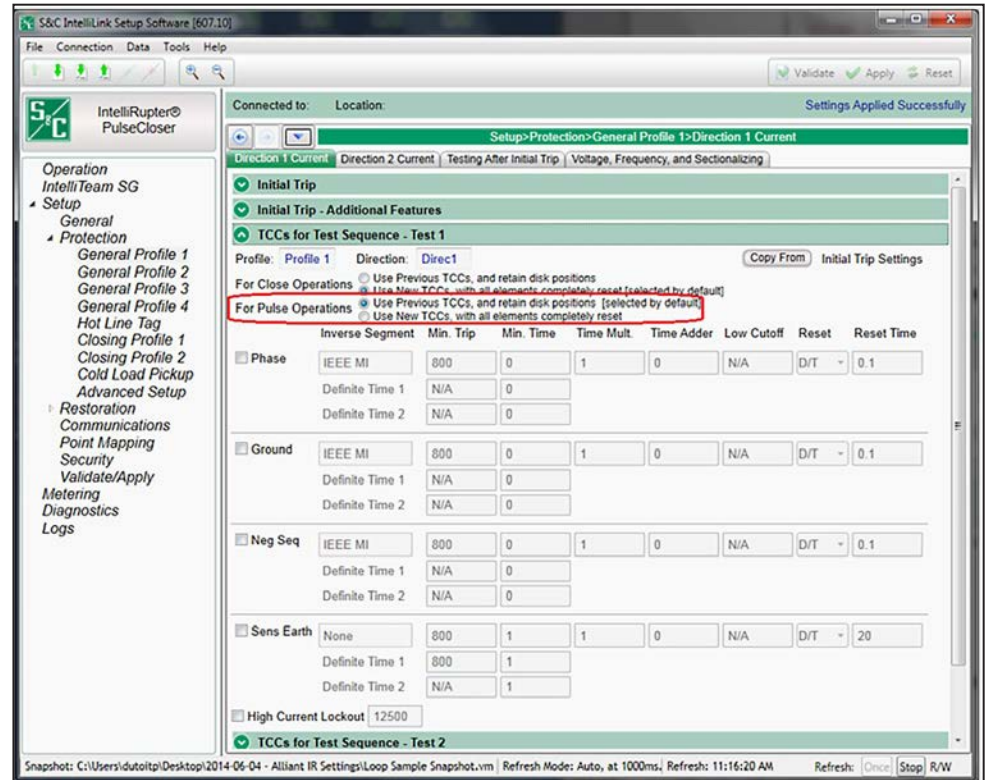


Figure 79. The PulseFinding technique setpoint on the Setup>Protection>General Profile 1>Direction 1>Current>Initial Trip - Additional Features screen for Test 1.

STEP 8. Configure the **Test 2 TCC Curves** setpoint. Configure TCC curves for both Direction 1 and Direction 2. See Figure 80.

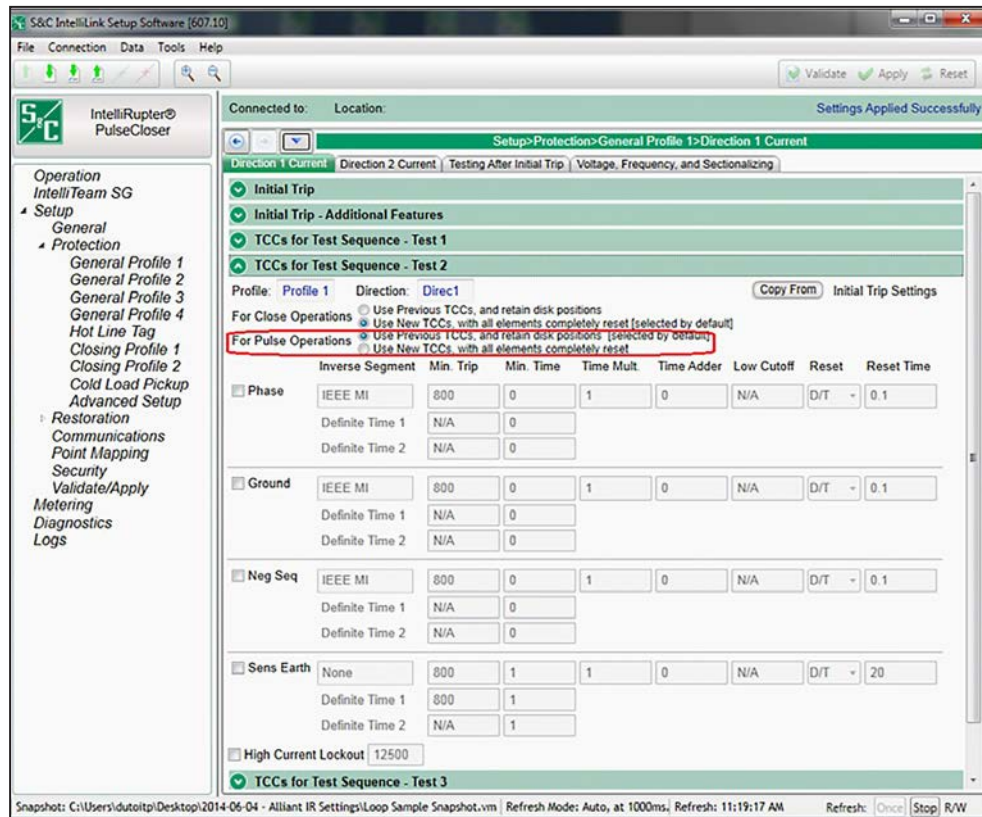


Figure 80. The PulseFinding technique setpoint on the *Setup>Protection>General Profile 1>Direction 1>Current>Initial Trip - Additional Features* screen for Test 2.

STEP 9. Adjust the **Overcurrent and IFS** elements on the *Testing After Initial Trip* screen. See Figure 81 on page 165.

- (a) The **Overcurrent Trip** element can be **1-Phase Trip** or **3-Phase Trip** mode as configured by the **Initial Trip** drop down menu selection.
- (b) The **Delay** setpoint is the time interval between tests.
- (c) When **Pulse** mode is selected for the **O/C Sequence** setpoint, the IntelliRupter fault interrupter will use PulseClosing Technology to test the line for each programmed test.
- (d) Configure an appropriate time for the **O/C and IFS Sequence Reset Time** setpoint. This is the duration after the IntelliRupter fault interrupter has successfully closed during a test sequence (test 1 or test 2) until it resets to the **Initial Trip** state.

- (e) Configure the **Retain Source-Side for Test Sequence** mode to the **Yes** state. This feature prevents backfeeding a substation as the result of a restoration event returning voltage from the opposite side while the IntelliRupter fault interrupter has lost source voltage and is still running the test-sequence procedure.

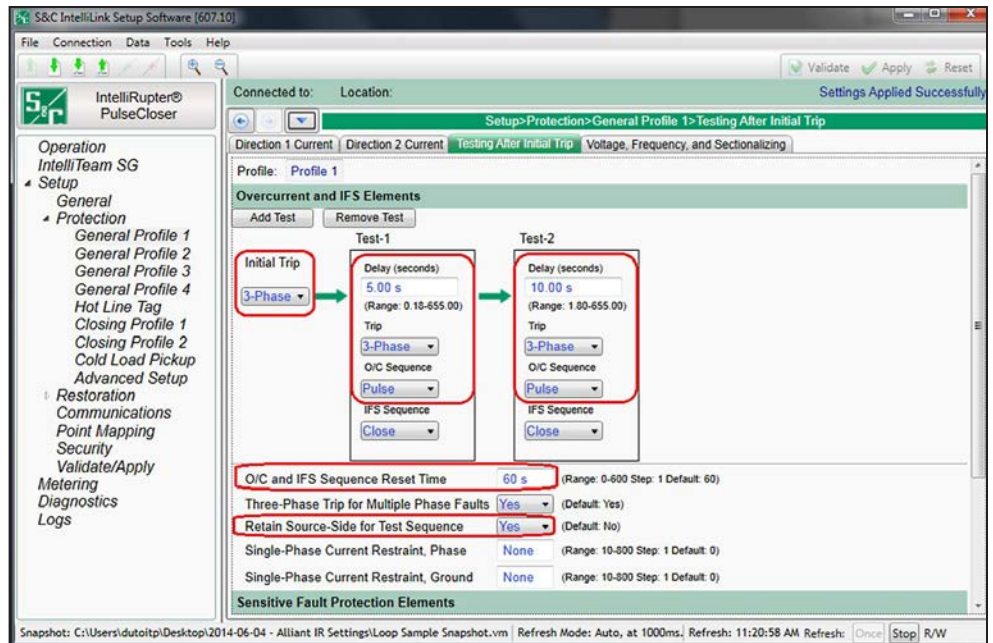


Figure 81. The Setup>Protection>General Profile 1>Testing After Initial Trip>Overcurrent and IFS Elements screen.

STEP 10. Adjust the **Voltage Trip** elements on the *Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing>Voltage Trip* screen. See Figure 82.

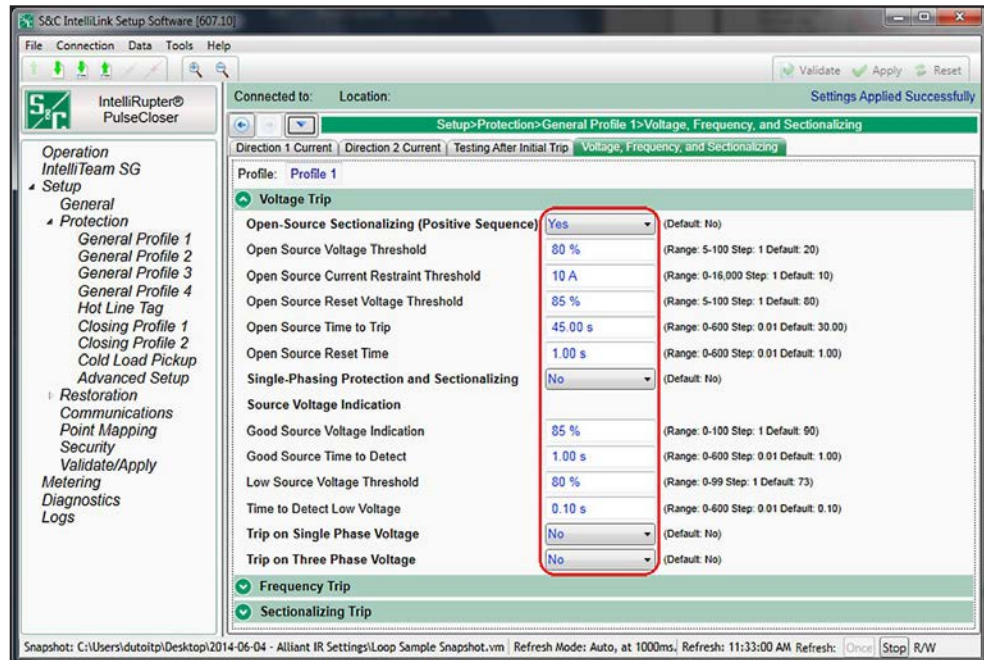


Figure 82. The *Setup>Protection>General Profile 1>Voltage, Frequency, and Sectionalizing>Voltage Trip* screen.

- For the **Open-Source Sectionalizing (Positive Sequence)** setpoint, select the **Yes** setting to enable opening on loss of voltage.
- Configure the **Open Source Voltage Threshold** setpoint to select the system voltage below which tripping will occur.
- For example, on a 120-V base, the **Positive Sequence Voltage** value will be below the 80% threshold of 96 V when one phase drops below 48 V, or two phases drop below 84 V, or all three phases drop below 96 V. A trip occurs when voltage stays below the threshold for the duration of the **Open Source Time to Trip** setpoint.
- The **Open Source Threshold**, **Low Source Voltage Threshold**, and the **Reset Voltage Threshold** setpoints should be matched to the **Good Source Voltage Indication** setpoint to keep things consistent.
- Keep the **Good Source Time to Detect** setpoint and the **Time to Detect Low Voltage** setpoint at the default values. See Figure 82.

STEP 11. Adjust the **Hot Line Tag** mode TCC curves on the *Setup>Protection>Hot Line Tag>Current* screen. See Figure 83.

The IntelliRupter fault interrupter uses these TCC curve configurations when placed into the **Hot Line Tag** mode by the HOT LINE TAG lever, a SCADA command, or an IntelliLink software command.

- (a) The **Inverse Segment** setpoint is usually the **Instantaneous** value.
- (b) Set the **Definite Time 1 Min Trip** setpoint to the same value used for the **General Profile Initial Trip Min Trip** setpoint.
- (c) Set the **Definite Time 1 Min Time** setpoint to 0.
- (d) Remember to configure both the Direction 1 and Direction 2 TCC curves.

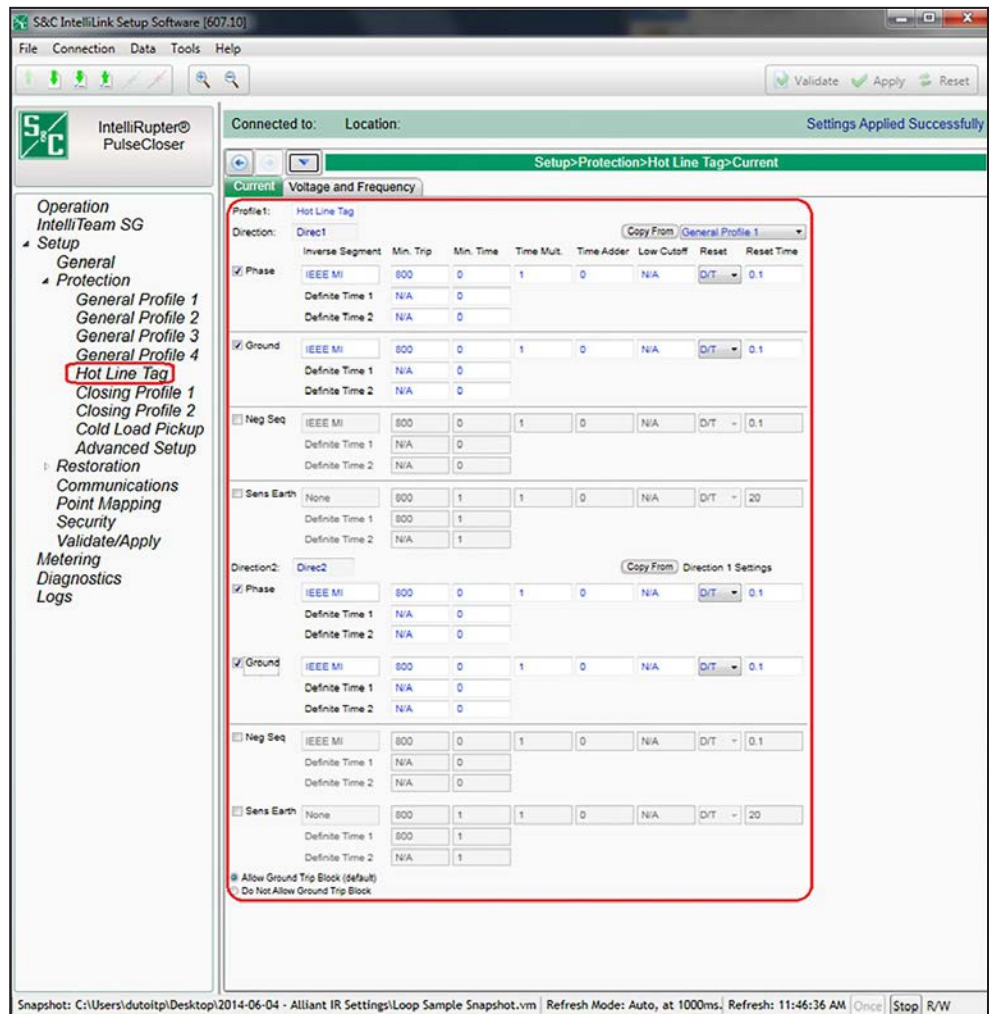


Figure 83. The *Setup>Protection>Hot Line Tag>Current* screen.

STEP 12. Configure the **Closing Profile** modes. See Figure 84 on page 169.

When a **Close** command is received (via CLOSE lever, SCADA command, IntelliLink software command, **Loop Restoration** mode, or IntelliTeam software), the **Closing Profile** mode is used. A separate TCC curve can be configured for each **Closing Profile** mode, and it usually matches or is faster than the **Initial Trip** mode curve.

The closing profile is active for the **Time for Closing Profile to be Active** setpoint before switching back to the normal **General Profile** mode. The **Manual Lever Delay** setting (chicken switch) can also be programmed.

There are two **Closing** profiles; the second **Closing** profile can be initiated by a command via SCADA, a command via IntelliLink, or by pulling down on the manual CLOSE lever twice. In most cases, the second **Closing** profile is setup to not use PulseClosing Technology when closing (hard close).

STEP 13. Match the **Voltage Indication** settings in the **General Profile** mode for both **Closing Profile 1** and **Closing Profile 2** modes. See Figure 85 on page 170.

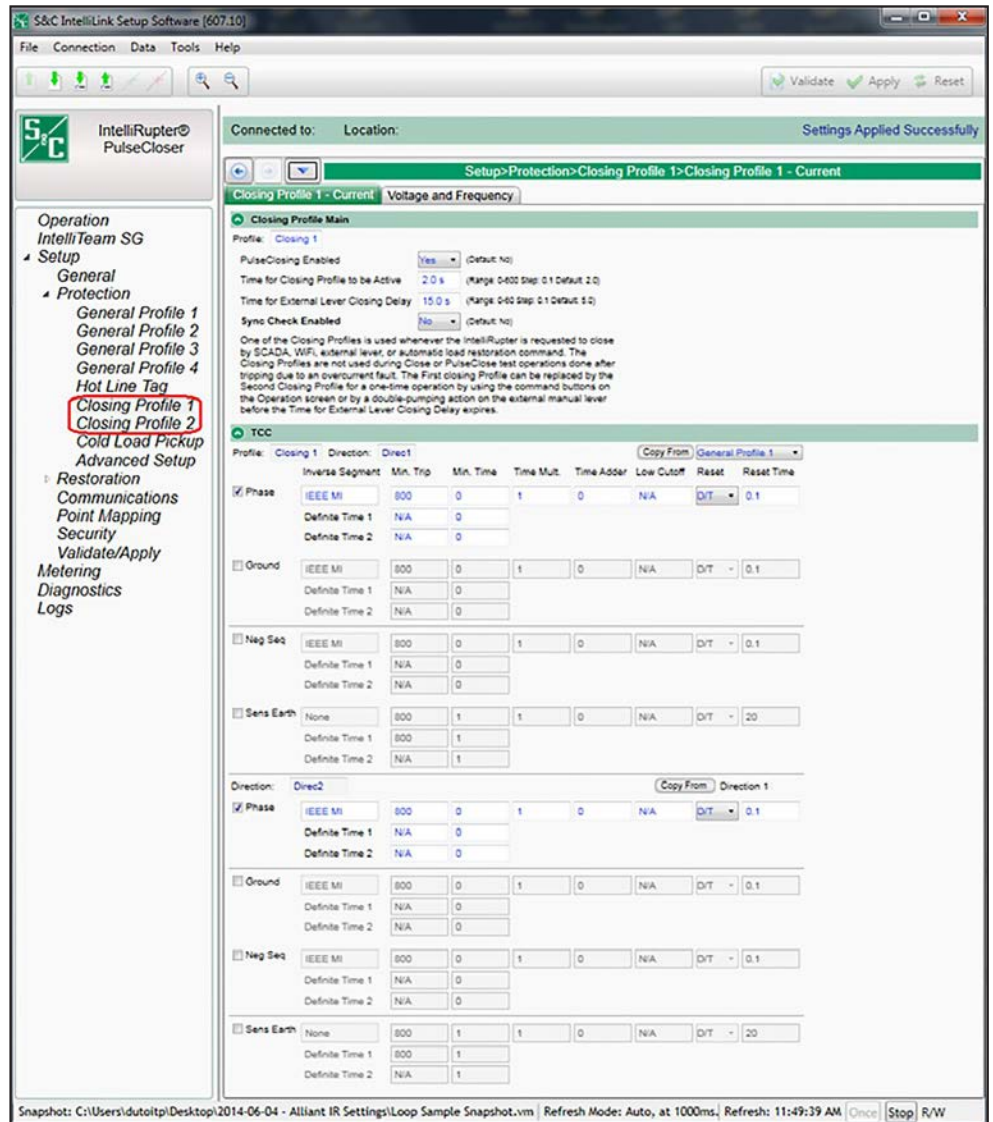


Figure 84. The Setup>Protection>Closing Profile 1>Closing Profile 1 - Current screen.

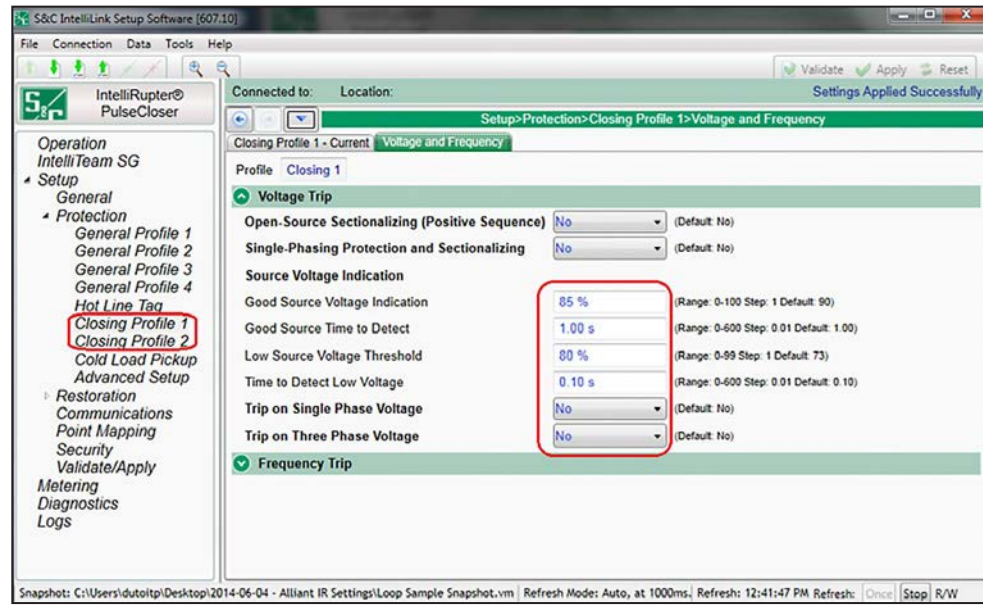


Figure 85. The Setup>Protection>Closing Profile 1>Voltage and Frequency>Voltage Trip screen.

Normally Open Configuration

Follow these steps to configure the **Loop Restoration** mode for a normally open feeder configuration:

- STEP 1.** On the *Setup>Restoration>Loop* screen, enable the **Enable Loop Restoration** setpoint for the desired **General** profile. See Figure 83 on page 167.
- STEP 2.** Select the direction(s) that will use **Loop Restoration** mode with the **Direction** setpoint on the *Setup>Restoration>Loop* screen.
- STEP 3.** Select the **Open** state for the **Normal State** setpoint on the *Setup>Restoration>Loop* screen.

When **Loop Restoration** mode is making a decision to close and restore the feeder, it uses the profile and test sequence programmed at the *Setup>Restoration>Loop>Loop Restoration Test Sequence* screen. See Figure 83 on page 167.

If voltage is lost on either side of the IntelliRupter fault interrupter for the configured **Time Delay Before First Test** setpoint and the IntelliRupter fault interrupter is in the **Loop Restoration** mode **Ready** state, it will close.

Note: Voltage must also be below the **Backfeed Voltage Level** setpoint for **Loop Restoration** mode to qualify it as a voltage loss. This setpoint is on the *General>Site-Related>System* screen. The default value is 10%. See Figure 6 on page 23. If voltage goes above the **Backfeed Voltage Level** setpoint while timing on the **Time Delay Before First Test** setpoint, this timer is reset.

Normally Closed Configuration

Follow these steps to configure the **Loop Restoration** mode for a normally closed feeder configuration:

- STEP 1.** On the *Setup>Restoration>Loop* screen, enable the **Enable Loop Restoration** setpoint for the desired **General** profile. See Figure 86 on page 172.
- STEP 2.** Select the direction(s) that will use **Loop Restoration** mode. Configure the **Direction** setpoint on the *Setup>Restoration>Loop* screen.
- STEP 3.** Select the **Closed** state for the **Normal State** setpoint on the *Setup>Restoration>Loop* screen.

When **Loop Restoration** mode is making a decision to close and restore the feeder, it uses the profile and test sequence programmed at the *Setup>Restoration>Loop>Loop Restoration Test Sequence* screen. See Figure 86 on page 172.

If the IntelliRupter fault interrupter tripped open for the **Voltage Trip** element and then voltage returns to either side for the configured **Time Delay Before First Test** setpoint, and the IntelliRupter fault interrupter is in the **Loop Restoration** mode **Ready** state, it will close.

Normally closed devices do not use the **Time Delay Before First Test** setpoint. They decide when to close based on the **Good Source Voltage Indication** setpoint, configured in Step 10 on page 166.

Note: Voltage must also be below the **Backfeed Voltage Level** setpoint on one side for **Loop Restoration** mode to close. This setpoint is on the *Setup>General>Site-Related>System* screen. The default value is 10%. See Figure 6 on page 23. If voltage goes above the **Backfeed Voltage Level** setpoint while timing on the **Time Delay Before First Test** setpoint, this timer is reset.

Loop Restoration

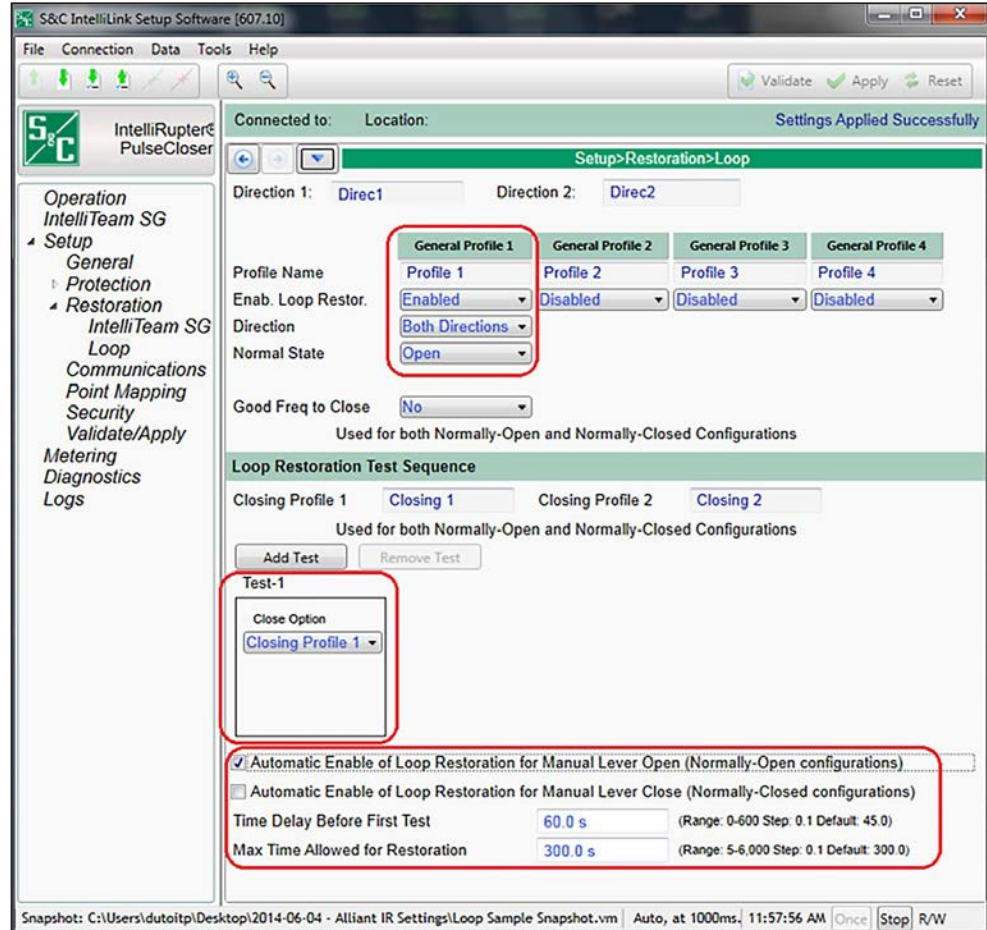


Figure 86. The Setup>Restoration>Loop screen.

The following indicators show **Loop Restoration** mode is in the **Ready** state:

- The *Operation* screen shows the **Ready** state in the **Loop Restoration** state indicator. See Figure 87.
- The control module STATUS indicator blinks three times every 30 seconds to indicate the **Ready** state is active. See Figure 88 on page 174 and Figure 89 on page 174.
- The **Loop Restoration Ready** DNP Status Point is set when the **Ready** state is active. See Figure 87.

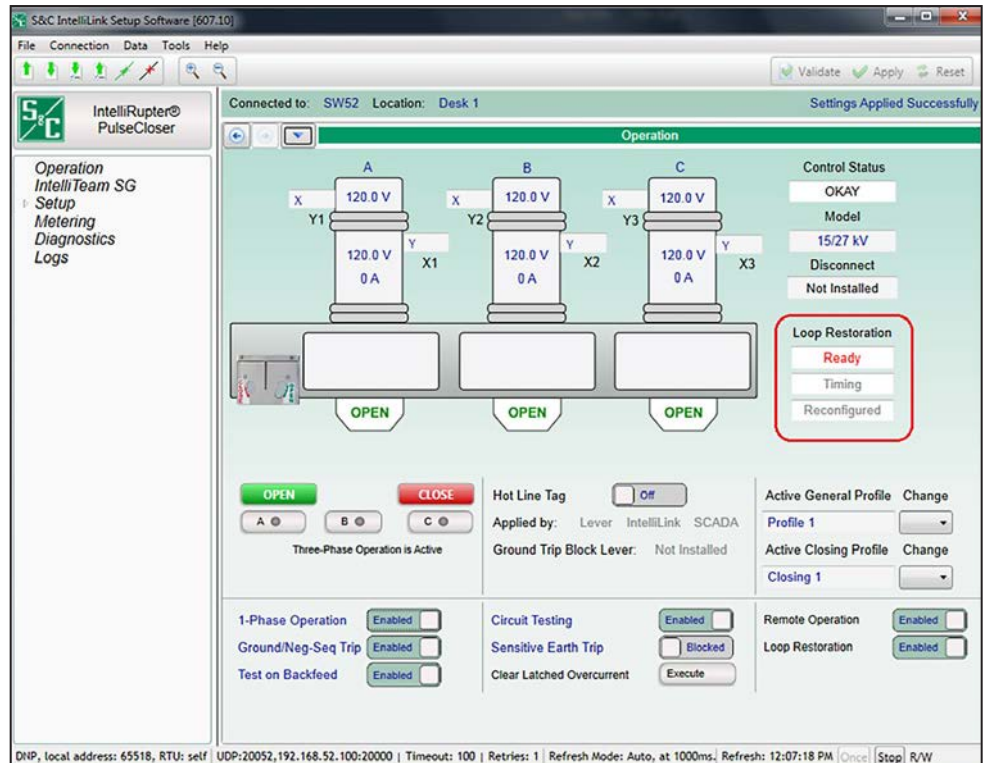


Figure 87. The *Operation* screen displays the Ready state in the Loop Restoration status indicator.



Figure 88. The control module shows the Ready state with a STATUS indicator blink pattern: flashing three times (½ second on, ½ second off) every 30 seconds.

80: Loop Restoration Ready

Figure 89. The Ready state sets the Loop Restoration Ready DNP status point.

These methods can be used to enable or disable the **Loop Restoration** mode **Ready** state:

- The **Loop Restoration** mode can be enabled or disabled with an IntelliLink software command on the *Operation* screen. See Figure 90 on page 175.

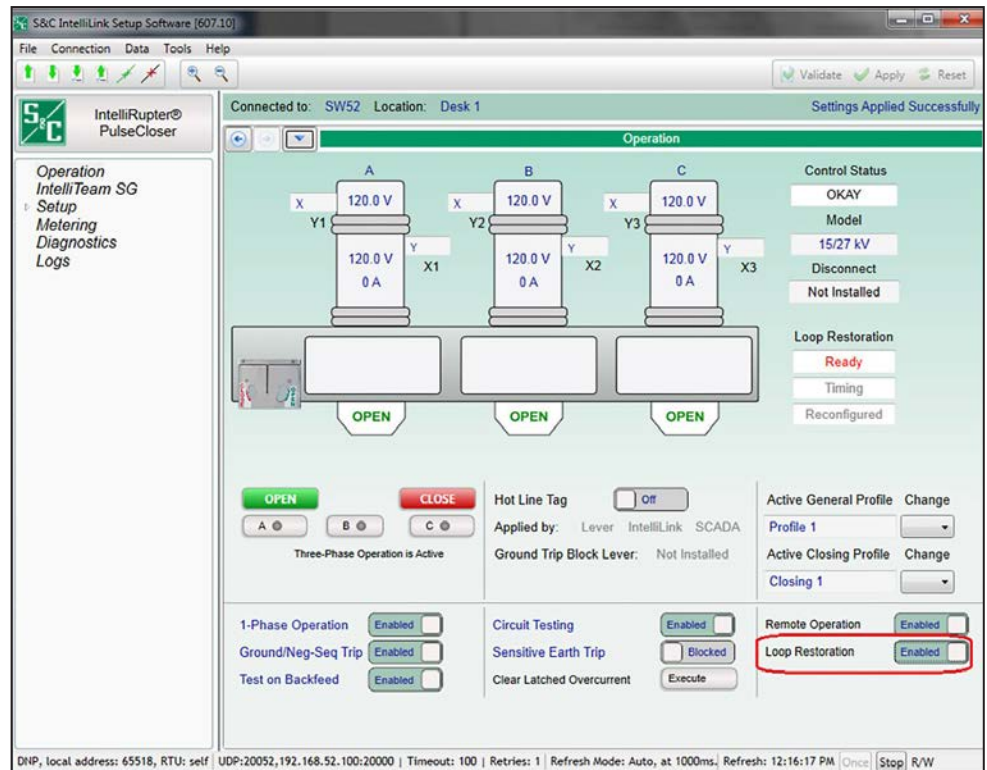


Figure 90. An *Operation* screen command can enable or disable the Loop Restoration mode.

- The **Automatic Enable of Loop Restoration for Manual Lever Open** mode (only applicable to the Normally Open configuration) only applies when an OPEN-CLOSE-READY lever operation causes the state to change. A state change caused by a fault event will not result in automatically enabling **Loop Restoration** mode.
- If **Automatic Enable of Loop Restoration for Manual Lever Close** mode (only applicable to the Normally Closed configuration) has been configured, the command Wi-Fi or SCADA to re-enable the **Loop Restoration** mode is not necessary. When the IntelliRupter fault interrupter is manually closed, it goes to the **Ready** state if the other conditions for a **Loop Restoration** mode **Ready** state have been satisfied.
- A command via SCADA to enable or disable **Loop Restoration** mode. See Figure 91.

Code-Description	Object Type
25: Loop Restoration Enab/Disab	Latch

Figure 91. A command via SCADA can enable or disable the Loop Restoration mode.

When the IntelliRupter fault interrupter **Loop Restoration** timer is running, it is indicated on the *Operation* screen. See Figure 92.

When **Loop Restoration** mode has successfully restored the line segment, it is indicated on the *Operation* screen. See Figure 93 on page 177.

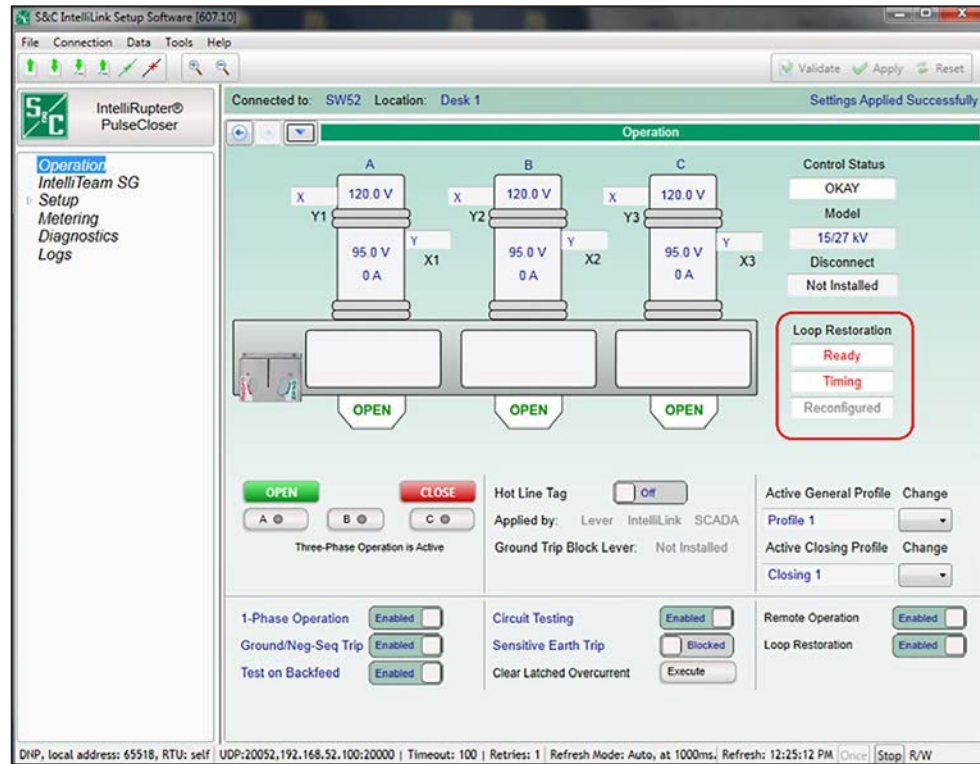


Figure 92. The *Operation* screen shows when the Loop Restoration timer is running.

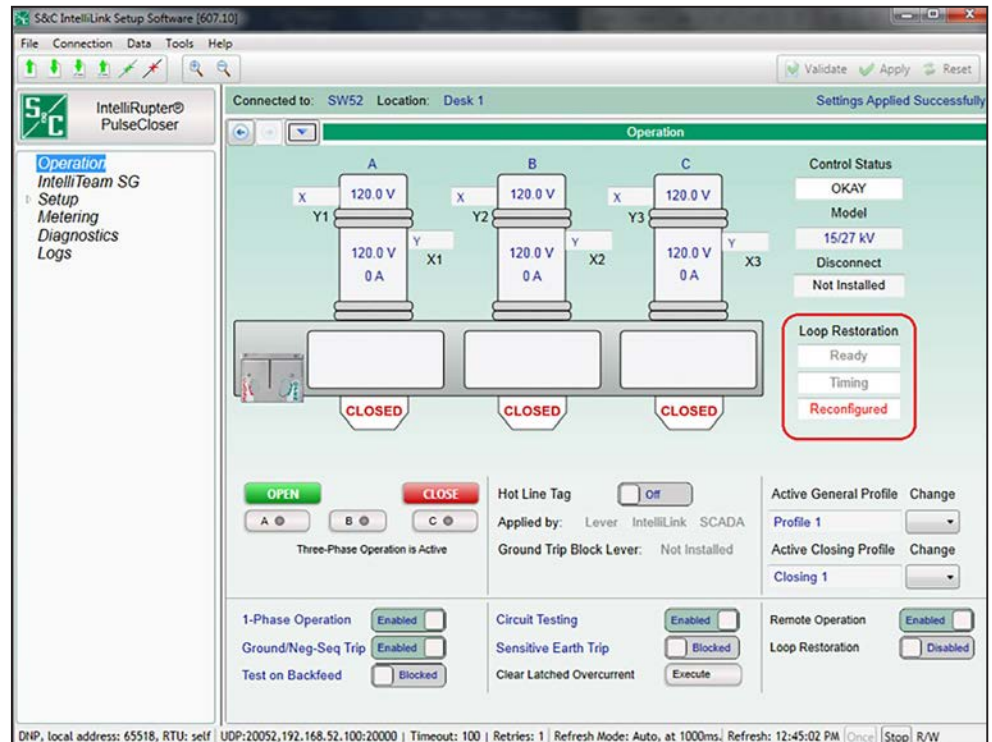


Figure 93. The *Operation* screen shows when the Loop Restoration mode has reconfigured the line segment.

Remote Prohibit Restoration List (when using firmware version 7.3)

The screen shown in Figure 94 contains setpoints specifically related to sending the **Prohibit Restoration** SCADA command to remote devices. The non-zero RTU address in this list must be configured to receive a **Latch On, Direct Operate** SCADA control point when any of the following events are active in the control:

- **Hot Line Tag** mode is active
- A **Frequency Trip** state occurs
- The IntelliTeam SG system determines a Manual Operation event has occurred
- A SCADA **Prohibit Restoration** command was received from a configured master address and the **Enable Remote Transmit from SCADA P. R.** setpoint is enabled
- A **Prohibit Restoration** command is also sent when **Prohibit Restoration** mode is active in the local control, set from the front panel or with an IntelliLink software screen command and the **Enable Remote Transmit from Local P. R.** setpoint is enabled

Note: The **Prohibit Restoration** mode is applied to the device if a **Frequency Trip** event is active. Therefore, the **Prohibit Restoration** mode must be removed from the device to put it and the teams associated to it back into the **Ready** state.

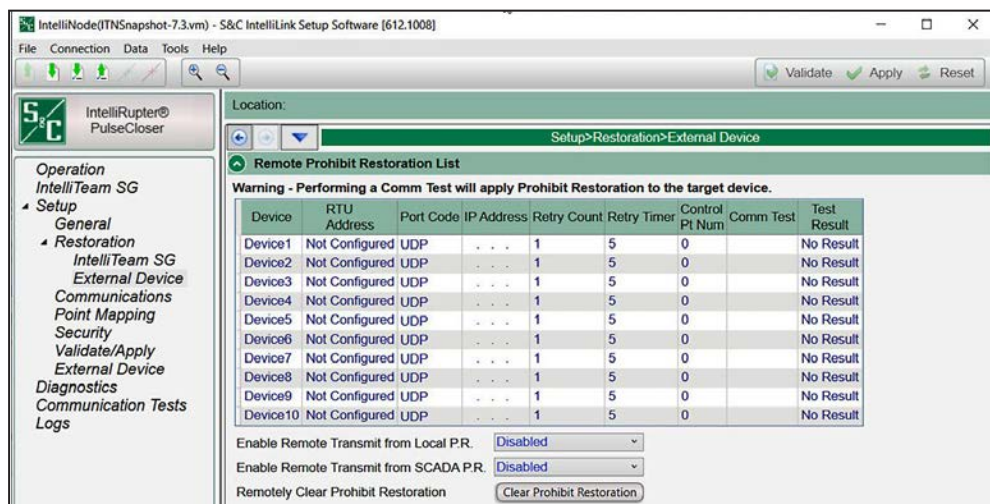


Figure 94. The Setup>Restoration>External Device screen.

Device

This is the Device ID for the remote device. This field is not configurable.

RTU Address

Enter the address of the remote device. (Range: 1-65519; Step: 1; Default: Not Configured)

Port Code

Select the port to use for transmitting to the remote device. (Default: UDP)

IP Address

When the **Port Code** is set to “UDP,” enter the IP address of the remote device here.

Retry Count

Enter the number of retries to perform on any timeout event. (Range: 0-255; Step: 1; Default: 1)

Retry Timer

Enter the amount of time in seconds to wait before a retry is attempted. (Range: 0-255; Step: 1; Default: 5)

Control Point Number

Enter the DNP control point number that activates the **Prohibit Restoration** mode in the remote device. (Range: 0-255; Step: 1; Default: 0)

Commission Test

Selecting the **Execute** option from the drop-down menu sends a **Prohibit Restoration** command to the target device(s) to perform the operation in the exact same manner that will occur when the command is sent during normal operation.

NOTICE

Performing a commission test will apply the **Prohibit Restoration** state to the target device. The **Prohibit Restoration** state must be removed to put the device in the **Ready** state.

Test Result

This indicates “Pass,” “Pending,” “Bad Response,” or “No Result” for the sent **Prohibit Restoration** command. “Pass” means the local device received an acknowledgement from the remote device before the **Retry** timer expired. “Pending” means the local device sent out the test command but is still awaiting a response. “Bad Response” means either the remote device rejected the command or the **Retry** timer expired before the local device received an acknowledgement. “No Result” means no tests have been performed yet.

Note: If DNP association of the peer device cannot be completed due to an incorrect RTU address, IP address, or port code, the **Test Result** field may show a **Pending** status indefinitely until the test is rerun again and the association can be made.

Enable Remote Transmit from Local P.R.

Enabling this option sends a **Prohibit Restoration** command to all devices in the list when the **Prohibit Restoration** state is activated locally via the front panel or IntelliLink screen.

Enable Remote Transmit from SCADA P.R.

Enabling this option will send a **Prohibit Restoration** command to all devices in the list if any the following events are active: **Hot Line Tag** mode, **Frequency Trip** state, **Manual Operation** state, or **Prohibit Restoration** state is activated from a command via SCADA from a configured master station address.

Clear Prohibit Restoration on Hot Line Tag Removal

When both the **Clear P.R. on Hot-Line-Tag Removal** and the **Enable Remote Transmit from SCADA PR** settings are enabled, the **Prohibit Restoration** state will be cleared on

a device when the **Hot Line Tag** state is removed from the device, provided a **Frequency Trip** state is not active. At that point, the device will also send a **Clear PR** SCADA command to all devices listed in its Remote Transmit List table that have the **Prohibit Restoration** function configured. A device receiving this **Clear PR** command will then clear its **Prohibit Restoration** states, other than those PR states that were caused by a Transfer Trip event or a PRLM Do-Not-Restore Load Shed event.

Note: Receiving a propagated **Prohibit Restoration Clear** command will clear the **Prohibit Restoration** state even if any of the local critical conditions are still present, including **Hot Line Tag**, **Frequency Trip** and **Manual Operation**. If these critical conditions are present, they will remain active on the local device, and the local device and its associated team members will remain in the **Out of Ready** state, until the critical conditions are cleared themselves.

Note: The **Clear P.R. on Hot-Line-Tag Removal** setting is hidden until the **Enable Remote Transmit from SCADA PR** setting is set to the **Enabled** state. **Remotely Clear Prohibit Restoration**

Remotely Clear Prohibit Restoration

Clicking on this button sends a **Clear Prohibit Restoration** command to the local device and all devices in the list and will clear the local **Prohibit Restoration** state. If an event is still active (**Hot Line Tag** mode, **Frequency Trip** state, **Manual Operation** state) the **Clear Prohibit Restoration** command will not be sent.

Remote Transfer Trip List Table

Transfer Trip commands are sent from the device to distributed generation (DG) resources within the distribution system immediately upon detection of a circuit anomaly so the DG does not interfere with IntelliTeam system restoration activities. This action is both for safety reasons and for the protection of load.

If the local device trips open because of a Protection or Automatic Sectionalizing event, and the **Transfer Trip** feature is enabled. Then, it sends **Transfer Trip** (TT) commands to all devices, whether S&C controls or third party controls, listed on its Remote Transfer Trip list. The TT messages are sent, no matter what state the DG/DER is in at the time, to ensure it is disconnected from the system. When the trip is because of a protection event the TT messages will initiate following the initial trip. **Lockout** state is not necessary.

Device

This is the Device ID for the remote device. This field is not configurable.

RTU Address

Enter the address of the remote device. (Range: 0-65519; Step: 1; Default: 0 (Not Configured))

Port Code

Select the port to use for transmitting to the remote device. (Default: UDP)

IP Address

When the port code is set to “UDP,” enter the IP address of the remote device here.

Retry Count

Enter the number of retries to perform on any timeout event. (Range: 0-255; Step: 1; Default: 1)

Retry Timer

Enter the amount of time in seconds to wait before a retry is attempted. (Range: 0-255; Step: 1; Default: 5)

Control Point Number

Enter the DNP control point number that activates the **Transfer Trip** mode in the remote device. (Range: 0-255; Step: 1; Default: 0)

Protocol

When the remote device is an S&C device select the peer-to-peer (P2P) protocol. The P2P protocol allows the remote S&C device to report the actual opening of the remote device to the sending device, to allow the IntelliTeam system to proceed with transfer events. When the remote device is not an S&C device, select DNP3 for the protocol.

DNP Control Type

Enter the appropriate control type for the configured **Control PT Number** setpoint: **Pulse On**, **Latch On** or **Breaker Close**. When received, the remote control will issue an **Open** command to the distributed generation switch.

Commission Test

Selecting **Execute** from the drop-down menu sends a **Transfer Trip** command to the target device(s) in the exact same manner that will occur when the command is sent during normal operation.

NOTICE

Performing a commission test will operate the target device by sending it an **Open** command. A **Close** command must be sent to the device and any alarms cleared to put the device in the **Ready** state.

Test Result

This indicates “Pass,” “Pending,” “Bad Response,” or “No Result” for the sent **Prohibit Restoration** command. “Pass” means that the local device received an acknowledgement from the remote device before the **Retry Timer** setting expired. “Pending” means that the local device sent out the test command but is still awaiting a response. “Bad Response” means that either the remote device rejected the command or the **Retry Timer** setting expired before the local device received an acknowledgement. “No Result” means no tests have been performed yet.

Remote Transfer Trip

Selecting the **Enabled** state allows commands from this device to be sent to all non-zero RTU addresses listed on the Remote Transfer Trip list. Selecting the **Disabled** state blocks the commands. When there are no distributed generation resources listed on the Remote Transfer Trip list, set this to the **Disabled** state.

Control Relay Pulse On Time

This sets the control relay output block on time for the distributed generation devices that receive DNP3 transfer trip control requests. Each count is 1 ms. (Range: 0-4,294,967,295; Step: 1; Default:1)

Control Relay Pulse Off Time

This sets the control relay output block off time for the distributed generation devices that receive DNP3 transfer trip control requests. Each count is 1 ms. (Range: 0-4,294,967,295; Step: 1; Default: 0)

Remote Transmit List Table (when using firmware version 7.5.x and later)

With firmware versions 7.5.x and later, the **Remote Prohibit Restoration List** and **Remote Transfer Trip List** functions have been combined into a single table called the “Remote Transmit List.” This table is on the *Setup>Restoration>External Device* screen and includes the same functionality for sending a **Remote Prohibit Restoration** or **Remote Transfer Trip** command to remote devices as was available in the 7.3.x firmware release. See Figure 95.

The screenshot shows the S&C IntelliLink Setup Software interface. The main window is titled "SG6801MSX(#100) - S&C IntelliLink Setup Software [612.1013]". The left sidebar shows a navigation tree with "Restoration" selected. The main area displays the "Remote Transmit List" table with the following data:

Device	Function	RTU Address	Port Code	IP Address	Retry Count	Retry Timer	Control Pt Num	DNP Control Type	Comm Test	Test Result
1	None	Not Configured	UDP	...	1	5	0	N/A		No Result
2	None	Not Configured	UDP	...	1	5	0	N/A		No Result
3	None	Not Configured	UDP	...	1	5	0	N/A		No Result
4	None	Not Configured	UDP	...	1	5	0	N/A		No Result
5	None	Not Configured	UDP	...	1	5	0	N/A		No Result
6	None	Not Configured	UDP	...	1	5	0	N/A		No Result
7	None	Not Configured	UDP	...	1	5	0	N/A		No Result
8	None	Not Configured	UDP	...	1	5	0	N/A		No Result
9	None	Not Configured	UDP	...	1	5	0	N/A		No Result
10	None	Not Configured	UDP	...	1	5	0	N/A		No Result
11	None	Not Configured	UDP	...	1	5	0	N/A		No Result
12	None	Not Configured	UDP	...	1	5	0	N/A		No Result
13	None	Not Configured	UDP	...	1	5	0	N/A		No Result
14	None	Not Configured	UDP	...	1	5	0	N/A		No Result
15	None	Not Configured	UDP	...	1	5	0	N/A		No Result
16	None	Not Configured	UDP	...	1	5	0	N/A		No Result
17	None	Not Configured	UDP	...	1	5	0	N/A		No Result
18	None	Not Configured	UDP	...	1	5	0	N/A		No Result
19	None	Not Configured	UDP	...	1	5	0	N/A		No Result
20	None	Not Configured	UDP	...	1	5	0	N/A		No Result

Below the table, there are configuration fields: "Control Relay Pulse On Time" set to 1 ms, "Control Relay Pulse Off Time" set to 0 ms, and "Transfer Trip" set to "Remote Transfer Trip Disabled".

Figure 95. The *Setup>Restoration>External Device* screen Remote Transmit List.

DEVICE

This is the Device ID of the remote device and is not configurable.

Function

Select the **Xfer Trip** option to send a **Transfer Trip** command to a remote device. Select the **Proh. Rest.** option to send a **Prohibit Restoration** command to a remote device. Default option is “None,” which means no function is selected for the device.

When the **Proh. Rest.** function is selected, the device will send the **Prohibit Restoration** SCADA command to remote devices. The non-zero RTU address in this list must be configured to receive a **Latch On, Direct Operate** SCADA control point when any of the following events are active in the control: **Hot Line Tag** mode is active, a **Frequency Trip** state occurs, the IntelliTeam SG system determines that a Manual Operation event has occurred or a SCADA **Prohibit Restoration** command was received from a configured master address and the **Enable Remote Transmit from SCADA P. R.** setpoint is enabled. A **Prohibit Restoration** command is also sent when **Prohibit Restoration** mode is active in the local control, set from the front panel or with an IntelliLink software screen command and the **Enable Remote Transmit from Local P. R.** setpoint is enabled.

When the **Xfer Trip** function is selected, **Transfer Trip** commands are sent from the device to DG resources within the distribution system immediately upon detection of a circuit anomaly so the DG does not interfere with IntelliTeam system restoration activities. This action is both for safety reasons and for the protection of load.

If the local device trips open because of a Protection or Automatic Sectionalizing event and the **Transfer Trip** mode is enabled, it sends **Transfer Trip** (TT) commands to all devices, whether S&C controls or third party controls, listed on the Remote Transmit List that have a **Xfer Trip** function. The **TT** commands are sent, no matter what state the DG/DER is in at the time, to ensure it is disconnected from the system. When the trip is because of a Protection event, the **TT** commands will initiate following the initial trip. The **Lockout** state is not necessary.

RTU Address

Enter the DNP RTU address of the remote device. (Range: 0-65519; Step: 1; Default: Not Configured)

Port Code

Select the port to use for transmitting to the remote device. (Default: UDP)

IP Address

When the **Port Code** setting is “UDP,” enter the IP address of the remote device here.

Retry Count

Enter the number of retries to perform on any timeout event. (Range: 0-255; Step: 1; Default: 1)

Retry Timer

Enter the amount of time in seconds to wait before a retry is attempted. (Range: 0-255; Step: 1; Default: 5)

Control Point Number

Enter the DNP control point number that activates the **Prohibit Restoration** mode in the remote device. (Range: 0-255; Step: 1; Default: 0)

DNP Control Type

Enter the appropriate **DNP Control Type** value for the configured **Control Point Number** setpoint: **Pulse On, Latch On** or **Breaker Close** command. When received, the remote control will issue an **Open** command to the distributed generation switch.

Commission Test

Selecting the **Execute** command from the drop-down menu sends a **Prohibit Restoration** command to the target device(s) to perform the operation in the exact same manner the command is sent during a normal operation.

NOTICE

A **Commission Test** command will apply the **Prohibit Restoration** state to the target device. The **Prohibit Restoration** state must be removed to put the device in the **Ready** state.

Test Result

This indicates “Pass,” “Pending,” “Bad Response,” or “No Result” for the sent **Commission Test** command. “Pass” means the local device received an acknowledgement from the remote device before the **Retry** timer expired. “Pending” means the local device sent the **Commission Test** command but is still waiting for a response. “Bad Response” means either the remote device rejected the message or the **Retry** timer expired before the local device received an acknowledgement. “No Result” means no tests have been performed yet.

Note: If DNP association of the peer device cannot be completed because of an incorrect RTU address, IP address, or port code, the **Test Result** field may show a **Pending** status indefinitely until the test is rerun again and the association can be made.

Enable Remote Transmit from Local P.R.

Enabling this option sends a **Prohibit Restoration** command to all devices in the list when the **Prohibit Restoration** state is activated locally via the front panel or IntelliLink software screen.

Enable Remote Transmit from SCADA P.R.

Enabling this option will send a **Prohibit Restoration** command to all devices in the list if any the following events are active: **Hot Line Tag** mode, **Frequency Trip** state, **Manual Operation** state, or **Prohibit Restoration** state is activated from a SCADA command from a configured master station address.

Clear Prohibit Restoration on Hot Line Tag Removal

When both the **Clear P.R. on Hot-Line-Tag Removal** and the **Enable Remote Transmit from SCADA PR** settings are enabled, the **Prohibit Restoration** state will be cleared on a device when the **Hot Line Tag** state is removed from the device, provided a **Frequency Trip** state is not active. At that point, the device will also send a **Clear PR** SCADA command to all devices listed in its Remote Transmit List table that have the **Prohibit Restoration** function configured. A device receiving this **Clear PR** command will then clear its **Prohibit Restoration** states, other than those PR states that were caused by a Transfer Trip event or a PRLM Do-Not-Restore Load Shed event.

Note: Receiving a propagated **Prohibit Restoration Clear** command will clear the **Prohibit Restoration** state even if any of the local critical conditions are still present, including **Hot Line Tag**, **Frequency Trip** and **Manual Operation**. If these critical conditions are present, they will remain active on the local device, and the local device and its associated team members will remain in the **Out of Ready** state, until the critical conditions are cleared themselves.

Note: The **Clear P.R. on Hot-Line-Tag Removal** setting is hidden until the **Enable Remote Transmit from SCADA PR** setting is set to the **Enabled** state. **Remotely Clear Prohibit Restoration**

Remotely Clear Prohibit Restoration

Clicking on this button sends a **Clear Prohibit Restoration** command to the local device and all devices in the list and will clear the local **Prohibit Restoration** state. If an event is still active (**Hot Line Tag** mode, **Frequency Trip** state, or **Manual Operation** state), the **Clear Prohibit Restoration** command will not be sent.

DNP Configuration

DNP communication settings for the IntelliTeam SG Automatic Restoration System, SCADA, and IntelliLink Setup Software are configured on the *DNP* screen. See Figure 96.

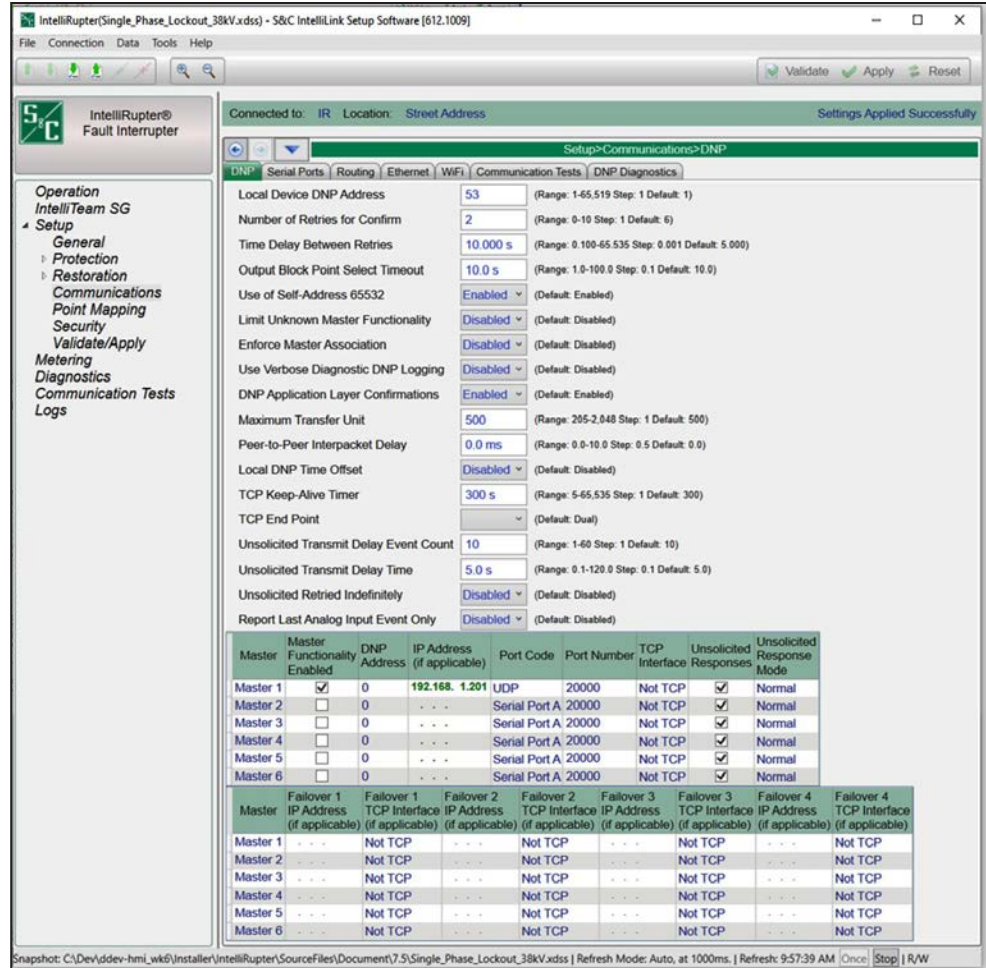


Figure 96. The Setup > Communications > DNP screen.

Local Device DNP Address

Enter the network address for this control. It must be the same as the DNP/RTU address on the Setup > Restoration > IntelliTeam SG > Team Summary screen. Be sure to enter an address even if this control will not be accessed via SCADA or a remote IntelliLink software connection. (Must be greater than 0; Default: 1; Maximum: 65519)

NOTICE

Changing the DNP address or other communication parameter can prevent the control from communicating with other team members in an IntelliTeam SG system and via SCADA or a remote IntelliLink software connection. If communication is lost with a control, go to the site, connect through IntelliLink software, and reset the communication parameter that had been changed.

NOTICE

Relocating a configured control to a new site, be sure to enter its new DNP address. If the new address is not entered, the control may respond to commands intended for a different location.

Number of Retries for Confirm

This is the number of times the control will resend a data-filled unsolicited response to the master station if a confirmation message is not received within the **Time Delay Between Retries** setting. The control will save the event data after this number of retries until it receives a confirmation. If there is no confirmation after the number of retries is exceeded and a new event occurs, the control will resend the saved event data along with any new event data. Setting this parameter at 0 will prevent retries. This setting applies to all masters. (Range: 0-10; Step: 1; Default: 6)

Time Delay Between Retries

This is the time delay between retries for initial unsolicited null and data-filled unsolicited responses. The initial unsolicited null is transmitted indefinitely until the master confirms it. Data-filled unsolicited responses are transmitted until the number of retries specified in the **Number of Retries for Confirm** setting has been reached. Transmission retries stop when an application confirmation is received from the master during this period.

For master event requests, this is the application confirmation timeout period. When the control receives a confirmation after this timer has expired the confirmation will be ignored and the events will remain in the event buffers. This setting applies to all masters. (Range 0.100-65.535 seconds; Step: 0.001; Default: 5.000)

NOTICE

When the master will set or read an Application Layer Confirmation Retry Time longer than 32.767 seconds: To set it, use Group 41 variation 1 (32-bit); to read it, use Group 40 variation 1 (32-bit with flag). Otherwise, a SCADA poll may report a negative value because the default configuration is 16-bit. Please review the DNP Points List and Implementation instruction sheet for more information.

Output Block Point Select Timeout

This is the timeout duration of the **Select** function on control points. See Instruction Sheet 766-560, “IntelliRupter® PulseCloser® Fault Interrupter: *DNP Points List and Implementation.*” If the timeout duration between **Select** and **Operate** functions during a **Select-Before-Operate** sequence exceeds this timeout value, the control will disable the point and return a timeout status code in the subsequent **Operate** request. This setting applies to all masters. (Range: 1.0-100.0; Step: 0.1; Default: 10.0)

Use of Self-Address 65532

NOTICE

Disabling the **Use of Self-Address** setting can prevent the control from communicating with IntelliLink software. If communication with the control is lost, the user must know the **Local Device DNP Address** setting, connect through a remote IntelliLink software connection, and re-enable the **Use of Self-Address** setting to connect locally. Wi-Fi will not work if the **Use of Self-Address** setting is disabled. If the local DNP address is not known and the **Use of Self-Address** setting is disabled, the control will require reprogramming at the factory to re-establish access to the control.

This setting is present to comply with the DNP standard. Care must be used when deciding to change the default. Options are the **Disabled** setting, which blocks the use of DNP Address 65532, and the **Enabled** setting, which allows the use of DNP Address 65532. Default is enabled.

Limit Unknown Master Functionality

NOTICE

Enabling this feature prevents unknown master stations from making any configuration changes. When the **Limit Unknown Master Functionality** setting is enabled, at least one master other than the SCADA master must be enabled. When this feature is enabled, the only way to connect with the control (to make any changes or disable this feature) is with IntelliLink Remote software and a computer set to the configured DNP address of the enabled master that is not the SCADA master. The control must be returned to the factory to be reset to the factory default when the DNP address of the master is unknown.

The default is the **Disabled** setting to allow master station addresses to be entered into the configuration. After those addresses have been entered, this parameter may be enabled and a configured master station address used to complete the configuration process.

When enabled, a master/peer station not included in the configuration of this control is prevented from writing to or controlling it. Master/peer stations configured in this control include any of the six Master Station DNP addresses and team members configured on the *Setup>Restoration>IntelliTeam SG>Team Summary* screen. The default is the **Disabled** setting.

Enforce Master Association

The primary identification for a master station is its DNP address. When a master sends DNP requests to a control and this setting is enabled, the master's port code (i.e. TCP, UDP, or serial), IP address (when the port code is TCP or UDP), and DNP address must match the data configured for that master station in the control.

DNP requests are ignored when this setting is enabled and the IP address and port code do not match the configured data. When this setting is disabled, the IP address and port code are ignored, and only the DNP address is checked and validated with the control configuration. Note that configuring the **Failover IP Address** setting is optional; when the **Enforce Master Association** feature is enabled, the master station IP address must

match either the configured **IP Address** or the **Failover IP Address** setting. For this feature to work, the **Limit Unknown Master Functionality** feature must be enabled. The allowable port values are 20,000 - 20,999 and 49,152 - 65,535.

Use Verbose Diagnostic DNP Logging

When the **Enabled** setting is selected (for diagnosing a communication issue), a message is logged for every source and destination frame. Enabling this function for an extended period will cause historic logs to fill quickly and reduce the number of saved historical events. The **Disabled** setting is the default.

DNP Application Layer Confirmations

When the **Enabled** setting is selected, an application layer confirmation will be requested with every solicited response that includes event data. Event buffers will not be cleared until an application layer confirmation is received from the master station. When disabled, the event buffers are cleared when events are reported. The **Enabled** setting is the default. This setting applies to all masters.

Maximum Transfer Unit

This setting allows the IntelliTeam SG system to make the most efficient use of communication system bandwidth. For SpeedNet™ Radios, set it to 500. For an Ethernet connection, set it to 1500. For other communication devices, set it to the maximum packet size of the device. The **Maximum Transfer Unit** setpoint is only used for IntelliTeam SG system communications and can be set to the default setting for any control not using the IntelliTeam SG system. (Range: 205-2,048; Step: 1; Default: 500)

Note: When pushing Netlists using IntelliTeam® Designer, an **Maximum Transfer Unit** setting of 500 or higher is required.

Peer-to-Peer Interpacket Delay

Set this to zero, unless the IntelliTeam SG system is enabled. Interpacket delay improves communication reliability between team members by adjusting the delay between successive frames of a multi-frame P2P fragment. The **Maximum Transfer Unit** setting defined for that control determines frame size. When data traffic is heavy, a peer's receive buffer may overflow, and messages could be lost. This problem is usually noticed in a direct P2P/UDP system. The **Interpacket Delay** setting increases the time a peer will have to process received data. It is advisable to increase the receive buffers instead of increasing the **Interpacket Delay** setting, which will create artificial delays in the communication system. (Range: 0.0-10.0; Step: 0.5; Default: 0.0)

Local DNP Time Offset

When the **Disabled** setting is selected, UTC time is applied to the DNP timestamps. When a local time offset ranging from +14 hr. to -14 hr. in 15-minute increments has been selected, the offset is applied to the UTC time to allow the DNP time stamp to be adjusted to local time. The **Disabled** setting is the default.

TCP Keep-Alive Timer

Specifies the time between keep-alive messages as defined in the DNP Specification. See Instruction Sheet 766-560, "IntelliRupter® PulseCloser® Fault Interrupter: *DNP Points List and Implementation.*" This setting applies to all masters. (Range: 5-65,535; Step: 1; Default: 300)

TCP End Point

A listening end point can be configured to report unsolicited events, but it cannot initiate a connection. Instead, it must wait for the master to connect and then report unsolicited events. A dual end point can initiate a connection if no active connection is already present.

Unsolicited Transmit Delay Event Count

This is the number of new events that will cause an unsolicited message to be transmitted, provided the **Unsolicited Transmit Delay Time** setting has not been reached. Setting this parameter to 1 results in an unsolicited message generated for every new event. This setting applies to all masters. (Range: 1-60; Step: 1; Default: 10)

Unsolicited Transmit Delay Time

This is the maximum time (in seconds) that may elapse after a new event before an unsolicited message is sent. During this delay, other new events may be added to the message. If the number of events reaches the **Unsolicited Transmit Delay Event Count** setting before the delay time elapses, the unsolicited message will be sent immediately. This setting applies to all masters. (Range: 0.1-120.0; Step: 0.1; Default: 5.0)

Unsolicited Retried Indefinitely

When enabled, the **Unsolicited Retried Indefinitely** setting allows unsolicited message retries to be performed until a confirmation is received, and the **Number of Retries for Confirm** setting will be ignored. Disabled is recommended for normal operation. The **Unsolicited Retried Indefinitely** setting applies to all masters.

Report Last Analog Input Event Only

When **Report Last Analog Event Only** setting is set to the **Enabled** state, only the latest DNP analog input events will be reported for a DNP analog input point (both solicited and unsolicited messages). Otherwise, all analog input point changes will be reported when this setting is in the **Disabled** state, which is the default.

Allow Remote Restart

When the **Allow Remote Restart** setting is set to the **Enabled** state, the control performs a restart on receipt of a request to perform a cold restart or a warm restart from a master station.

Master Stations 1 through 6

Master Station Functionality

When the box is checked to enable master functionality, several features are provided to the master:

- Event data are saved until the master confirms receipt of the data or it just polls the data if the **DNP Application Layer Confirmations** setting is disabled. Each of the masters has its own event data, so if one of the masters has retrieved and confirmed receipt of the data, the other masters can still retrieve data they have not yet received. Unknown/unregistered masters may still receive event data through polling, but they will only receive data that have not yet been confirmed/received by Master 1.

- The **Unsolicited Reporting by Exception** mode for event data is available.
- The **Limit Unknown Master Functionality** setting (if enabled) does not apply to these masters.

No master can have the same DNP address as the local device. All masters must have unique DNP addresses. To properly clear event buffers, the port code must match the connection type, and the proper IP address must be associated with the DNP address.

DNP Address

This is the DNP address to which the control sends all unsolicited responses. This is also used to verify whether a master is one of the registered masters. (Range: 0-65,519; Step: 1; Default: 0)

IP Address (if applicable)

This is the IP address to which the control sends all unsolicited responses (if enabled). It is also used to verify whether a master is one of the registered masters (both DNP and IP addresses must match). An IP address of 0.0.0.0 is represented as blank on the IntelliLink software screen. When using serial communications, specify the DNP master address and the serial port to be used. All other IP related parameters are ignored. The listening port for incoming TCP connections and UDP packets is hard coded at 20,000.

Entering an IP Address

The IP address entry has been simplified, follow these steps to enter an IP address:

- STEP 1.** Click and highlight the character in the first cell.
- STEP 2.** Type one to three characters as needed.
- STEP 3.** Hit the space bar to advance to the next field. Advancing in this fashion automatically highlights the characters in the next field.
- STEP 4.** Repeat typing, followed by the space bar until entry is complete.

To revert to the IP address value presently configured in the control memory, press the <Esc> key or click the **Reset** button in the tool bar.

Port Code

This is the port through which unsolicited report-by-exception DNP frames to the master station are sent. Port A (serial) is the default. Select TCP if the SCADA master is configured for a TCP/IP connection, and select UDP if the SCADA master is configured for UDP/IP.

The port code also is used to check that an incoming message is from a registered master. In addition to the DNP address and IP address (if TCP or UDP is used), the port code must also match.

Port Number

This setting is ignored unless the **TCP** or **UDP** option has been selected for the master station **Port Code** setting. This port is the outgoing port for unsolicited TCP or UDP messages that occur when there isn't an active session with the master. (Range: 1,024-65,535; Step: 1; Default: 20,000)

Note: UDP uses the fixed port 20,000 as source and destination.

Note: When the Enforce Master Association and Limit Unknown Master options are enabled, the valid UDP port number must be in the following range: 20,000-20,999; 49,152-65,535.

TCP Interface

When configuring the IP address (if applicable), set this to the Ethernet port associated with that IP address. This setting is ignored unless the **TCP** option has been selected for the **Master Station Port** setting. Select the **AddOn** or **Native** setting. The **Not TCP** option is a placeholder and is not applicable. Select the **AddOn** setting for IntelliRupter fault interrupters because they do not have a native Ethernet port.

For IntelliRupter fault interrupters, the control module catalog number SDA-4540R3 has Ethernet 1 and Ethernet 2 ports. Ethernet 1 is the Native port and Ethernet 2 is the AddOn port. Either port can be configured for an IP address.

Unsolicited Responses

When enabled (the default), the control sends a message to the master station when new event data are available based on the **Unsolicited Transmit Delay Event Count** setting and the **Unsolicited Transmit Delay Time** setting. A Master Station DNP address and master station port code or master station IP address must be entered. Enabling this feature may add significant traffic to the communication network.

Unsolicited Response Mode

Select the **Normal** (default) or **5800 V2 Mode** setting. The **Normal** mode requires the master station to acknowledge an initial empty (null) unsolicited message at control restart. The SCADA master must send a command to enable unsolicited reporting. If acknowledgment of the initial empty unsolicited message is not received, the control continues to resend these messages at the configured retry interval until an acknowledgment is received. The **5800 V2 Mode** setting is a non-standard mode that bypasses the initial empty unsolicited messages and the requirement for the master station to enable unsolicited reporting with a command via SCADA. It simply starts sending unsolicited responses as events occur, provided the unsolicited responses parameter is enabled.

The **5800 V2 Mode** setting may require restarting the control unless the control is presently sending unsolicited responses in the **Normal** mode or a remote command to enable unsolicited responses can be sent to the control. To restart the control after all configuration changes have been successfully applied, select **Tools>Device Maintenance...** on the menu bar, and then select the **Reset Control** option and click on the **Yes** button in the dialog box. Then log in when the IntelliLink software dialog box opens.

Failover IP Address (if applicable)

Each of the six master stations can have up to four Failover IP addresses registered. The local control sends unsolicited messages (if enabled) to any registered master it has received a message from (provided the master has sent an **Enable Unsolicited Messages** command and the **Unsolicited Response Mode** is set to the **Normal** state). The local control will respond to either the primary master or the failover master, whichever sent the last message. The IP address in use will be highlighted. If there is no **Failover** setting configured for this master, leave this entry blank or enter 0.0.0.0.

Failover TCP Interface (if applicable)

Each of the six master stations can have up to four failover TCP interfaces configured. Select the **AddOn** setting for IntelliRupter fault interrupters.

Serial Ports

This screen contains communication settings related to the IntelliTeam SG Automatic Restoration System, SCADA, and IntelliLink Setup Software. S&C automation products have different serial-ports configurations and the IntelliRupter fault interrupter has only one serial port. See Figure 97.

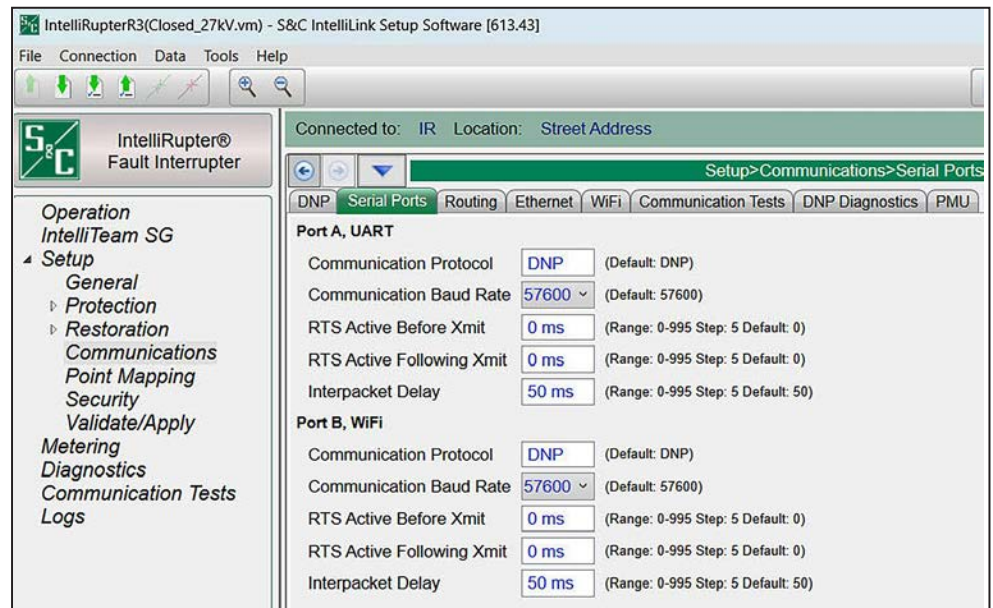


Figure 97. The Setup>Communications>Serial Ports screen.

Port A, UART

Communication Protocol

The **DNP** setting is permanently configured because S&C controls only use the Distributed Network Protocol. (Default: DNP)

Communication Baud Rate

This is the baud rate from the S&C control to the radio, and it must be identical to the baud rate of the radio. (1,200; 2,400; 4,800; 9,600; 19,200; 38,400; 57,600 (default);115,200; and 230,400 baud)

RTS Active Before/Following Xmit

This is the time in milliseconds the request to send (RTS) is active for this port before and after a transmission takes place. The default value is usually suitable. (Range: 0-995; Step: 5; Default: 0)

Interpacket Delay

This is the time in milliseconds between individual message frames of a data stream. Set this parameter appropriately for the radio. (Range: 0-995; Step: 5; Default: 50)

Port B, Wi-Fi

Communication Protocol

The **DNP** setting is permanently configured because S&C controls only use the Distributed Network Protocol. (Default: DNP)

Communication Baud Rate

This is the baud rate from the S&C control to the Wi-Fi module, and it must be identical to the baud rate of the Wi-Fi module. (57,600 (Default); 115,200; and 230,400 baud)

RTS Active Before/Following Xmit

This is the time in milliseconds the request to send (RTS) is active for this port before and after a transmission takes place. The default value is usually suitable. (Range: 0-995; Step 5; Default: 0)

Interpacket Delay

This is the time in milliseconds between individual message frames of a data stream. Set this parameter appropriately for the Wi-Fi module. (Range: 0-995; Step 5; Default 50)

Routing

The screen shown in Figure 98 can display routing information for up to 32 destination devices. If a message frame is received with a destination address other than the local address, this information is used to redirect the message out an adjacent port. The frame will be dropped if the destination address is not included in the routing table and a default pass-through route has not been configured.

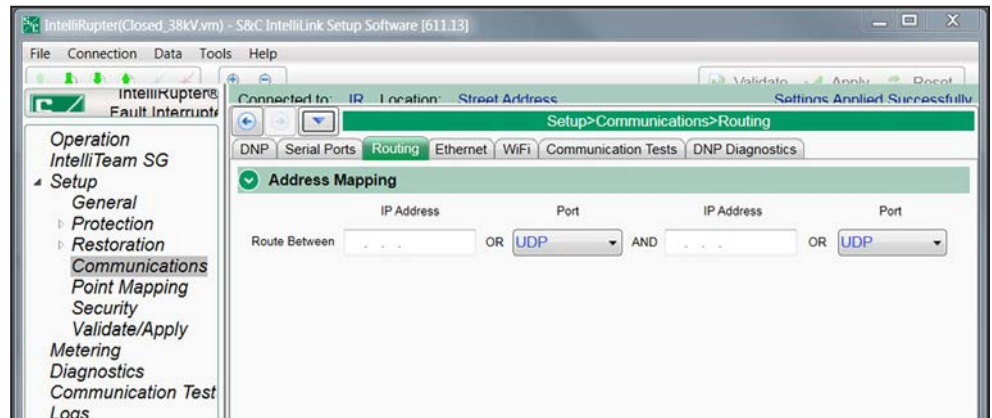


Figure 98. The Setup > Communications > Routing screen.

Address Mapping

RTU Address

When an incoming message frame is received, not destined for the local device, these addresses are searched to find an active route.

IP Address

This parameter should be configured if the destination device is on an IP network. The received frame will be transmitted out the local UDP port.

Port

This parameter should be configured if the destination device may be found through a serial communications port. The received frame will be transmitted out the local serial port.

Local Device DNP Address

Contains entries defining default routing for messages addressed to devices not found in the configured routing table and are not the local device. This default routing performs a simple pass-through functionality between the two interface points. Leave these entries unconfigured if unknown traffic should not be routed through this device.

IP Addresses

This parameter should be configured if the intended destination device may be found on the IP network. This will cause the received frame to be transmitted out the local UDP port.

Port

This parameter should be configured if the intended destination device may be found through a serial communications port. This will cause the received frame to be transmitted out the configured local serial port.

Ethernet

IntelliRupter fault interrupters with the R3 control have two Ethernet ports—Ethernet 1 and Ethernet 2. See Figure 99.

NOTICE

Ethernet 2 is reserved for future applications. When new functionality is implemented it will only be used with IntelliRupter fault interrupters shipping on or after May 6, 2020 with an SDA-4540R3 control installed.

The default Ethernet 2 IP address is 192.168.2.1. The subnet is configured for subnet 192.168.2.0 /24. If necessary change this configuration to avoid conflicts with other subnets used on the network.

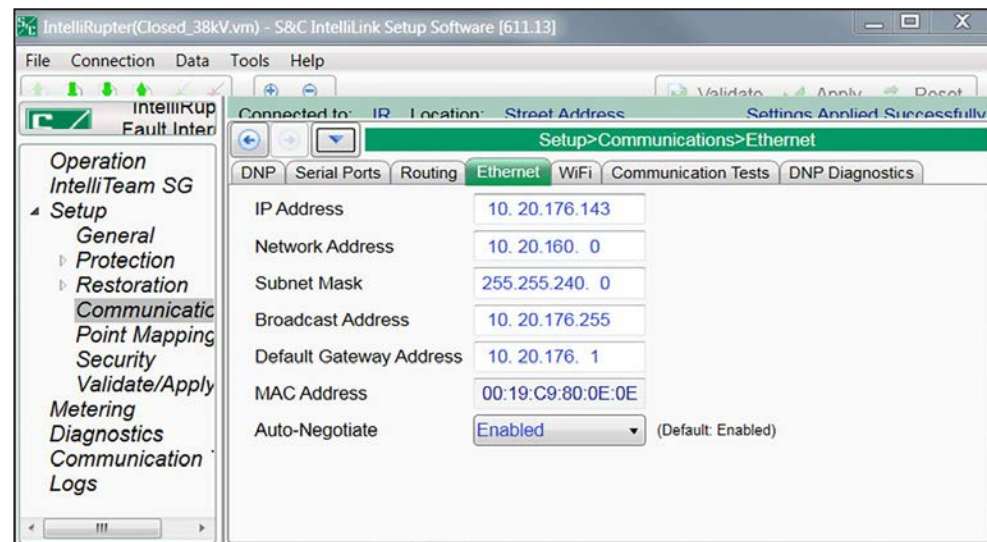


Figure 99. The Setup>Communications>Ethernet screen.

IP Address

This is the IP address of the control.

Network Address

This is the IP address of the network. The IP address entered must be an address within the network. The relationship between the IP address entry and the network address entry is defined by the subnet mask entry.

Subnet Mask

This is a 32-bit mask that divides an IP address into subnets and specifies the available hosts. Two bits are always automatically assigned. For example, in 255.255.255.0, “0” is the assigned network address; and in 255.255.255.255, “255” is the assigned broadcast address. The “0” and “255” are always assigned and cannot be used.

Broadcast Address

This is the address used to distribute a signal across a network. It is commonly used to declare a new device has been connected and to provide information about the device to existing devices on the network. The broadcast address commonly ends with “255.”

MAC Address

This is the MAC address assigned to the control’s Ethernet port.

Auto-Negotiate

The **Auto-Negotiation** setting can be enabled for the Ethernet port. When disabled, the **Duplex Mode** setting and **Data Rate** setting must be configured.

Duplex Mode

The **Full Duplex** setting permits simultaneous communication in both directions. The **Half Duplex** (default) setting permits communication in one direction at a time.

Data Rate

This can be set to 10 Mbit or 100 Mbit. (Default: 10 Mbit)

Default Gateway Address

A gateway is a node (a router) on a computer network that serves as an access point to another network. A default gateway is the node on the computer network chosen when the IP address does not belong to any other entities in the routing table.

The default gateway address is the Ethernet IP address of the radio in the control.

IP Routing Table

This table is presently NOT used for IntelliRupter fault interrupters with the SDA-4540R3 control module but will be implemented in a future firmware revision. All controls (except IntelliRupter fault interrupters with the SDA-4540R2 control module) have two Ethernet ports: Native and AddOn. When both ports have different IP addresses but identical network addresses and subnet masks, issues may exist because packets could mistakenly be sent out of the wrong interface. When both ports are configured with different network addresses and/or subnet masks, then filling out this table is not required.

Wi-Fi Settings

The Wi-Fi module is a separate computer in the Communication Module, that sends Wi-Fi communication information to the MCU computer in the control over a serial port. To initiate Wi-Fi communication with a PC computer, the Wi-Fi module must have the IntelliRupter fault interrupter serial number.

When the Wi-Fi module cannot obtain a serial number from the control, it uses the universal serial number: 00-000000. See Figure 100.

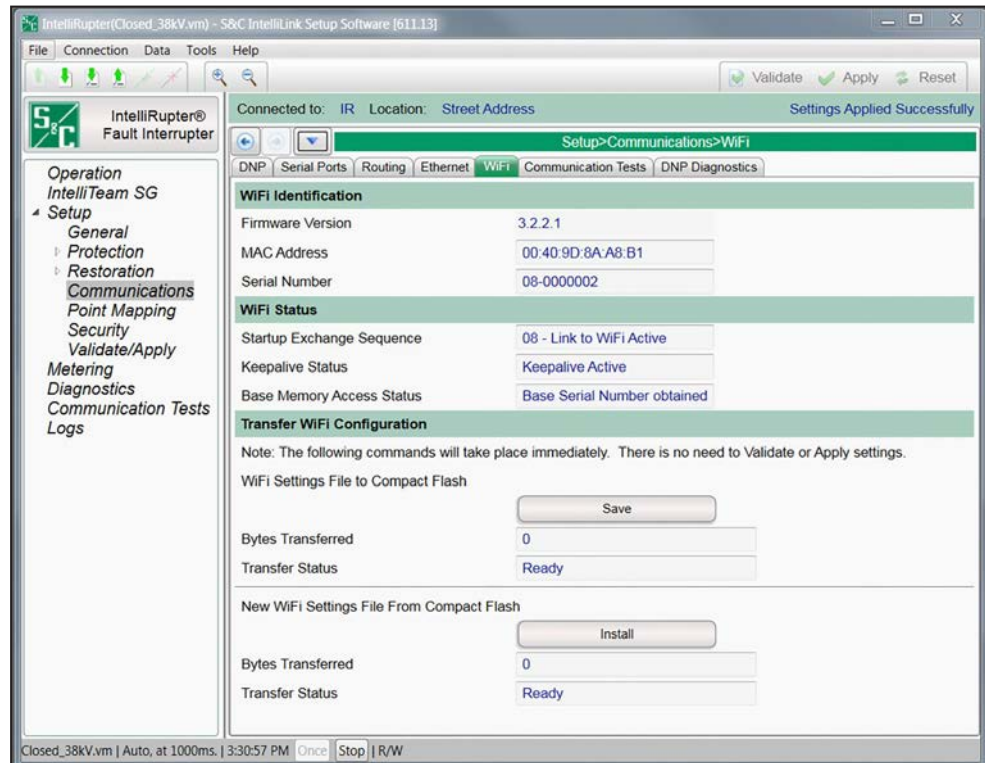


Figure 100. The Setup > Communications > Wi-Fi screen.

Wi-Fi Identification

NOTICE

The Setup > Communications > Wi-Fi screen is only applicable to Wi-Fi modules manufactured on or before December 2019. Boards manufactured after that date do not connect to this screen. To identify IntelliRupter fault interrupter communication modules manufactured after December 2019, look for the R3 label on the faceplate of the module.

Firmware Version

This is the firmware revision assigned by the manufacturer for the Wi-Fi transceiver.

MAC Address

This is the hardware serial number of the Wi-Fi module installed in the communication module and is assigned by the manufacturer.

Serial Number

This is the IntelliRupter fault interrupter serial number obtained by the Wi-Fi sub-system from the base memory module.

Wi-Fi Status

Startup Exchange Sequence

During the Wi-Fi module power-up sequence, it queries the control for specific information, such as the serial number and time of day. The query status is displayed here and can finish at either “04 - Link to Wi-Fi Active” or “08 - Link to Wi-Fi Active.”

Keepalive Status

The Wi-Fi module exchanges a message with the control every 5 seconds. When the control responds, the Wi-Fi module maintains communication and reports “Keepalive Active.”

Base Memory Access Status

“Wi-Fi Signature Record obtained” indicates the Wi-Fi module obtained the required configuration information from flash memory, such as the security passwords.

Transfer Wi-Fi Configuration

Click on the **Save** button to transfer the current Wi-Fi configuration to the compact flash memory. The **Bytes Transferred** field indicates the file size transferred, and the **Transfer Status** field indicates completion by changing from **Ready** to **Done** status.

Click on the **Install** button to upload a new Wi-Fi Settings file from the compact flash memory. The **Bytes Transferred** field indicates the file size transferred, and the **Transfer Status** field indicates completion by changing from **Ready** to **Done** status.

Communications Tests **Scheduled Test**

Diagnostic tests determine nodes are responding to communication and how quickly they respond. Statistics are recorded, such as response time, failure, and retry. Tests are scheduled periodically and typically run for one hour. Any network node can send tests to other network nodes. One or more test message types (Data types, such as a coach or runner) can be configured but do not contain real data. See Figure 101.

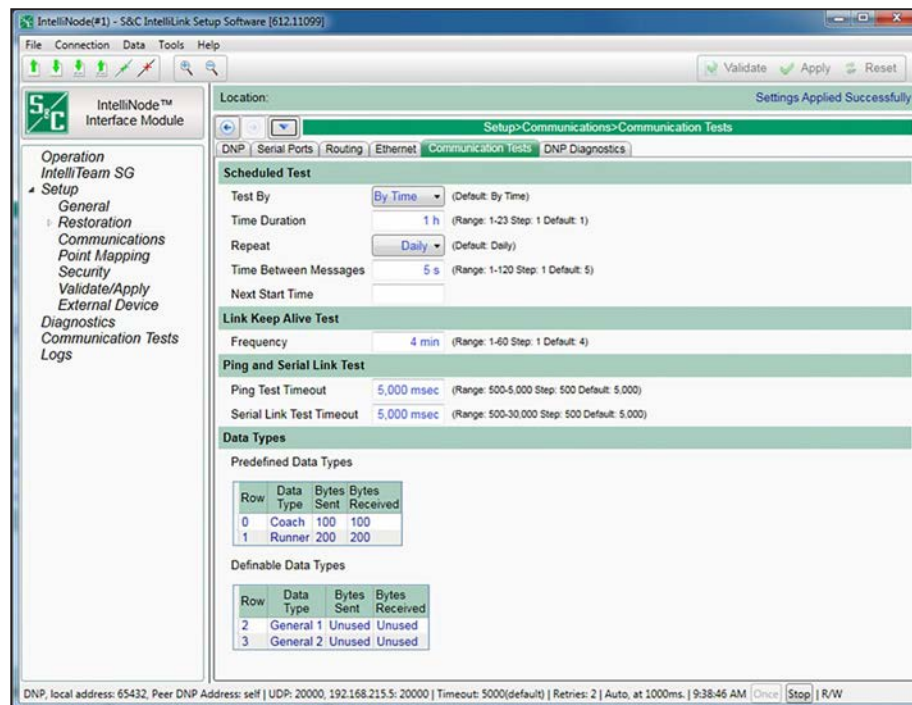


Figure 101. The Setup > Communications > Communications Tests screen.

NOTICE

Running scheduled tests across a slower speed communication network may cause poor performance. It is recommended to keep all settings at their default or lower values when running these tests on slower communication networks.

Note: The tested nodes are determined automatically based on the nodes entered on *IntelliTeam* configuration screens.

Test By

Test duration can be selected: **By Time**—the amount of time it will run, or **By Message**—the total number of messages it will send. (Default: By Time)

Time Duration

When the **Test By Time** mode is selected, the **Time Duration** field sets the number of hours the test will be run. (Range: 1-23; Step: 1; Default: 1)

Message Duration

When the **Test by Message** mode is selected, the **Message Duration** field will set the number of messages that will be sent. (Range: 100-1,000; Step: 100; Default: 100)

Repeat

This is the retest schedule interval: **None**, **Daily**, **Weekly**, or **Monthly** setting. (Default: Daily)

Time Between Messages

This is the number of seconds between each message transmission. The first test message is sent to each node sequentially. Then the second test message is sent to each node sequentially, etc. (Range: 1-120; Step: 1; Default: 5)

Next Start Time

This field is blank until the first start time is entered. After the next test, the field updates automatically to show the next time a test will start. The **Next Start Time** setting is determined by the previous start time (entered manually or updated automatically from the last test) and the configured **Repeat** interval setting. Users are not allowed to set a date or time in the past.

Link Keep Alive Test

When a TCP or UDP connection remains idle it may shut down. A link keep alive event is not a test, but to keep all links active it periodically sends a single message to every node. If more than one message is configured for the scheduled test, the link keep alive event only sends the first configured message. It also records statistics for the message transmissions.

Frequency

This sets how often a link keep alive test is run. (Range: 1-60 minutes; Step: 1 minute; Default: 4 minutes)

Ping and Serial Link Test

A ping test is a manually sent Ethernet ping to a specific IP address. A serial link test is a manually sent ping over a serial port to a specific DNP address.

Ping Test Timeout

If a ping test return takes longer than this configured value, the ping test event will timeout and stop waiting for a response. Set this value in milliseconds. (Range: 500-5,000; Step: 500; Default: 5,000)

Serial Link Test Timeout

If a serial link test return takes longer than this configured value, the serial link test event will timeout and stop waiting for a response. Set this value in milliseconds. (Range: 500-30,000; Step: 500; Default: 5,000)

Data Types

This panel configures each message sent in a scheduled test. The predefined data types messages sent are not actual coach or runner messages, but they're configured to represent the approximate size of an actual average coach or runner message. The **Definable Data Types** setting allows defining message byte size for the sent and received messages.

Predefined Data Types

The Connection ID in Row 0 is always configured "Coach" and Row 1 is always configured "Runner." The **Bytes Sent** and **Bytes Received** fields are not configurable.

Data Types

The Connection IDs in Row 2 and 3 are always configured "Undefined" whereas the **Bytes Sent** and **Bytes Received** fields are user defined. If one "Unused" entry is changed, a numerical entry must also be entered for the other field in that row.

Row

This identifies the row: 0 is the first message type sent, 1 is the second message type sent, etc.

Data Type

This is the name of the configured test message, such as "Coach" or "Runner." The message sent is not an actual coach or runner message, but it should be configured to represent the approximate size of the average coach or runner message by setting the appropriate number of sent and received bytes.

Bytes Sent

This field configures the length of the message being sent for this type. (Range: 1-2048 and Unused, Step: 1, Default: Unused)

Bytes Received

This field configures the length of the response message automatically generated when the remote node receives the sent message. (Range: 1-2048 and Unused, Step: 1, Default: Unused)

DNP Diagnostics

Peer Communications Statistics Configuration

Acknowledge Coach Messages Every “N” Messages

This configures the number of messages required before an acknowledgement is sent, where “N” is the number of messages. When 10 is entered, every 10th coach message will be acknowledged. (Range: 1-100; Step: 1; Default: 1) See Figure 102.

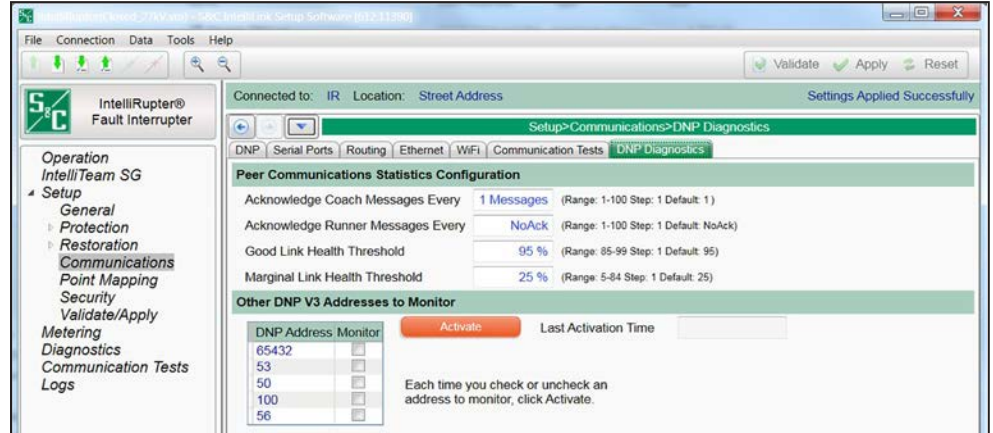


Figure 102. The Setup>Communications>DNP Diagnostics screen.

Acknowledge Runner Messages Every “N” Messages

This configures the number of messages required before an acknowledgement is sent, where “N” is the number of messages. When 10 is entered, every 10th runner message will be acknowledged. (Range: 1-100 and NoAck; Step: 1; Default: NoAck)

Good Link Health Threshold

This configures the percentage of successful message transmissions that will define good link health. (Range: 85-99; Step: 1; Default: 95)

Marginal Link Health Threshold

This configures the percentage of successful message transmissions that will define marginal link health. (Range: 5-84; Step: 1; Default: 25)

Other DNP V3 Addresses to Monitor

DNP Addresses

These DNP addresses can be monitored; check the box to select the addresses. (Default: Unchecked)

Activate button

Every time a DNP address is checked or unchecked for monitoring, click on the **Activate** button.

Last Activation Time

This timestamp indicates the last time the **Activate** button was clicked.

Phasor Measurement Unit

The **Phasor Measurement Unit (PMU)** feature of the IntelliRupter fault interrupter takes voltage and current measurements for the three phases and records them with the UTC time the measurement was taken. The measurements and timestamp are called synchrophasor measurements. The PMU server generates the synchrophasor data. A PMU server may have more than one client. The IntelliRupter fault interrupter PMU server can support two PDC clients. See Figure 103.

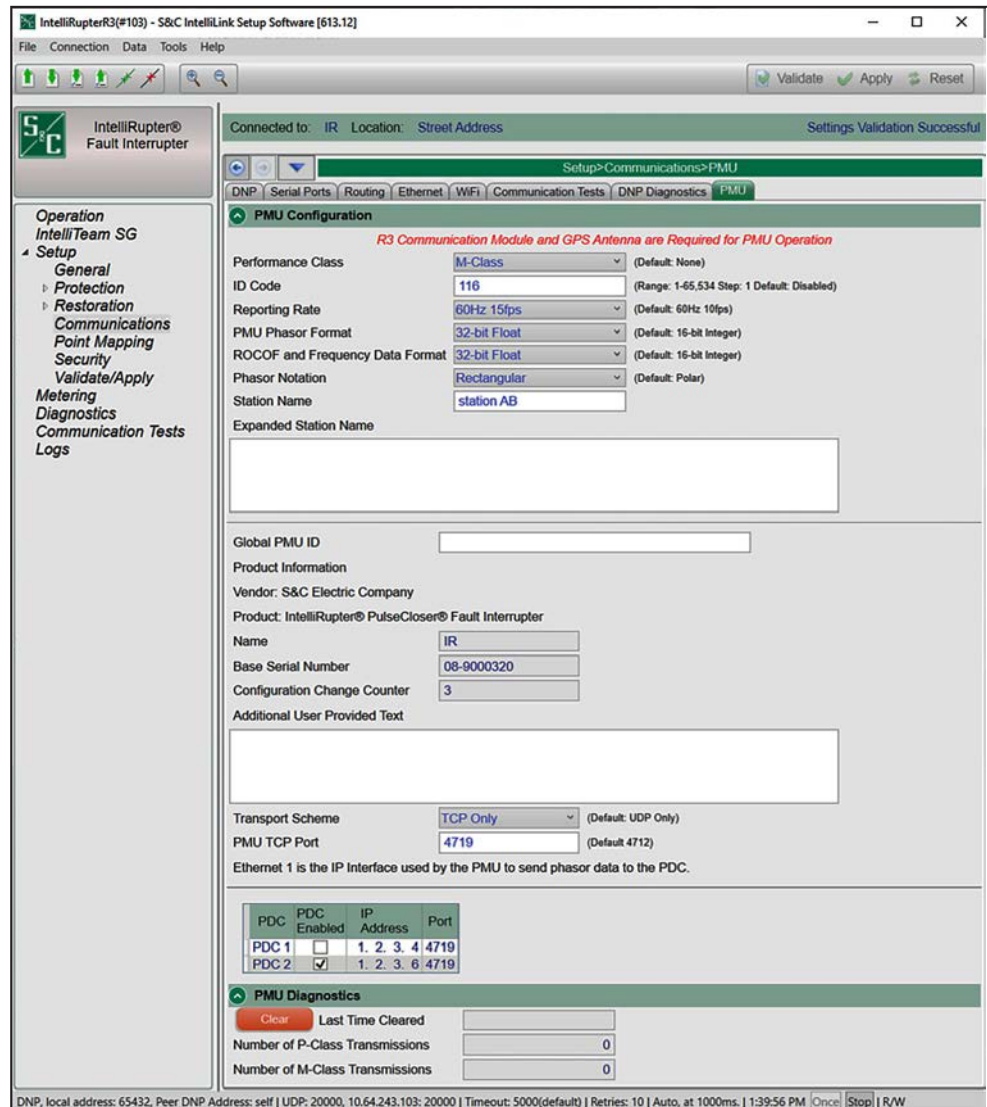


Figure 103. The Setup>Communications>PMU screen.

PDC (PMU Data Concentrator)

The PDC is the client of the PMU. The PDC sends commands to the PMU to request information about the PMU and to request data from the PMU. The PDC is an external device that is part of the customer network.

Synchrophasor Data

Synchrophasor data has two performance classes: Protection Class (P-Class) or Metering Class (M-Class) data.

- P-Class is intended for applications requiring fast response, such as protection applications.
- M-Class is intended for applications that could be adversely affected by aliased signals caused by out-of-band interference but do not require low measurement-reporting latency or short step-response time.

Performance Class

The performance class configures PMU data transmissions. Choose **P-Class** mode data transmissions, **M-Class** mode data transmissions, or **None** mode to disable the PMU data function. (Default: None)

ID Code

This is the ID of the PMU device in the IntelliRupter fault interrupter. It identifies the source PMU data stream. The PDC concentrates many PMU data streams and delivers them to an upstream PDC. The PMU ID Code identifies the source of the Phasor data. This is a required field and must have a decimal value entry to successfully validate. It is blank before data entry. (Range: 1 to 65,534; Step: 1; Default: Disabled)

Reporting Rate

This is the frame rate per second the PMU data messages (i.e., frames) are transmitted. Different rates are available, based on system frequency value.

- System Frequency = 50 Hz

Reporting Rates: 10 fps, 25 fps, 50 fps, 100 fps (Default: 50 Hz 10 fps)

- System Frequency = 60 Hz

Reporting Rates: 10 fps, 12 fps, 15 fps, 20 fps, 30 fps, 60 fps, 120 fps (Default: 60 Hz 10 fps)

PMU Phasor Format

This determines the data format for the PMU Phasor data reported in a data frame. (Range: 16-bit Integer, 32-bit Float; Default: 16-Bit Integer)

ROCOF and Frequency Data Format

This determines the data format for the Rate of Change of Frequency (ROCOF) and Frequency data reported in a data frame. (Range: 16-bit Integer, 32-bit Float; Default: 16-Bit Integer)

Phasor Notation

This determines the notational format for the PMU Phasor data reported in a data frame. (Range: Rectangular, Polar; Default: Polar)

Station Name

This is a name of the PMU device in the IntelliRupter fault interrupter. It is included in configuration 1, 2, and 3 frames. (Range: 1 to 16 ASCII characters). This is a required field when the PMU is enabled. There is no default for this field.

Expanded Station Name

This is the expanded name of the PMU device in the IntelliRupter fault interrupter. It is included in the configuration 3 frame. (Range: 1 to 255 ASCII characters; Default: Blank) This is an optional field.

Global PMU ID

This setting allows an ID string greater than the number 65535 to be supported. It is a 16-byte string with a format defined by the user. It is included in the configuration 3 frame. (Range: 0 to max 39 numeric characters) This is an optional field.

Configuration Change Counter

This is the number of times the PMU configuration is changed. This count is maintained through power cycles. The count is cleared for firmware updates and controller swaps.

Additional User Provided Text

This is free form text included in the header frame sent to the PDC. (Maximum length of the text string: 240 characters). This is an optional field.

Transport Scheme

There are four data-transport schemes supported. Select one scheme from the description list. (Default: UDP Only)

Transport Scheme Description List

1. UDP Only mode

- (a) Client/PDC and Server/PMU send/receive all message frames via UDP.
- (b) This scheme should only be used when some data loss is acceptable.
- (c) Configure these settings on the **PMU** tab: **PDC IP**, **PDC UDP Port**, **PMU UDP Port**. The **PMU IP address** uses the Ethernet 1 IP address and does not require any modification.

2. **TCP Only** mode

- (a) Client/PDC and Server/PMU send/receive all message frames via TCP.
- (b) This scheme is used when it is important to deliver all data.
- (c) This method should not be used for long-latency scenarios because congestion may occur if many retries are required and data reception in a timely fashion would be impacted.
- (d) Configure these settings on the **PMU** tab: **PDC IP**, **PMU TCP Port**. The **PMU IP** setting is set to the Ethernet 1 IP address and does not require any modification.

3. **UDP Spontaneous** mode

- (a) Server/PMU sends configuration 2 message frames once per minute followed by data frames via UDP to Client/PDC(s) when the **PMU** feature is enabled by selecting either **P-Class** mode or **M-Class** mode for the **Performance Class** setting.
- (b) The PMU also allows receipt of commands and will respond to all except the **Begin** command and the **End Data Transmissions** command. Because the transport scheme is spontaneous, data frames cannot be controlled by commands.
- (c) This scheme is a good choice to use for broadcast delivery to multiple clients.
- (d) Use only when some data loss is acceptable.
- (e) Configure these settings on the **PMU** tab: **PDC IP**, **PDC UDP Port**, **PMU UDP Port**. The **PMU IP address** uses the **Ethernet 1 IP address** and does not require any modification.

4. **TCP-UDP Mixed** mode

- (a) Client/PDC sends command frames via TCP to the Server/PMU.
- (b) Server/PMU sends configuration 1, configuration 2, configuration 3, and header frames via TCP to the Client/PDC.
- (c) Server/PMU sends data frames via UDP to the client/PDC.
- (d) Use only when some data loss is acceptable.
- (e) Configure these settings: **PDC IP**, **PDC UDP Port**, **PMU TCP Port**. The **PMU IP address** uses the **Ethernet 1 IP address** and does not require any modification.

PMU IP Address

This is the IP address of the PMU. The PDC sends commands to this IP address. It is an IPv4 address. The **PMU** feature uses Ethernet 1 of the IntelliRupter fault interrupter as its IP address. See Figure 103 on page 204.

PMU Port Type: PMU TCP or UDP Port

The **PMU Port Type** setting is set based on the selected transport scheme. When either **UDP Only** or **UDP Spontaneous** transport scheme modes are selected, this port is configured as a UDP port and the screen label will indicate “UDP Port.” If either **TCP Only** or **TCP – UDP Mixed** transport scheme modes are selected, this port is configured as a TCP port and the screen label will indicate “TCP Port.” This port is used by the PMU to listen for incoming commands from the PDC.

PDC #1 Enabled

If **PDC #1** mode is enabled, the PMU accepts and responds to PDC command frames from that PDC. Any command received at the PMU from a PDC that has not been configured will be silently discarded. No responses or errors are returned to the PDC. At least one PDC must be enabled when the **Performance Class** setting is set to **M-Class** or **P-Class** mode.

PDC #1 IP Address

This is the IP address of PDC #1 that PMU data and configuration frames are sent to. IPv4 unicast and broadcast addresses are supported. If one of the PDC IP addresses is set to a broadcast IP address, then any other PDC must be disabled by the user or verification will fail. The PDC IP #1 address is required to be configured to something other than 0.0.0.0 or 255.255.255.255 when **PDC#1** mode is enabled. The IP address + port for PDC #1 cannot be the exact same combination of IP address + port as for PDC#2 because this will return a failed validation.

PDC #1 UDP Port

The PDC UDP port (if applicable) is the UDP port for the PDC that PMU data and configuration messages are sent to. This port must be configured when any of the following **Transport Scheme** setting modes is configured: **UDP Only**, **UDP Spontaneous**, or **TCP-UDP Mixed**. The valid UDP and TCP port range is 1 - 65535. When the **Transport Scheme** setting is set to **TCP Only** mode, the PDC UDP port number is not needed.

PDC #2 Enabled

When **PDC #2** mode is enabled, the PMU accepts and responds to PDC command frames from that PDC. Any command received at the PMU from a PDC that has not been configured will be silently discarded. No responses or errors are returned to the PDC. At least one PDC must be enabled when the **Performance Class** setting is set to **M-Class** or **P-Class** mode.

PDC #2 IP Address

This is the IP address of PDC #2 that PMU data and configuration frames are sent to. IPv4 unicast and broadcast addresses are supported. If one of the PDC IP addresses is set to a broadcast IP address, then any other PDC must be disabled by the user or verification will fail. The PDC IP #1 address is required to be configured to something other than 0.0.0.0 or 255.255.255.255 when **PDC#1** mode is enabled. The IP address + port for PDC #2 cannot be the exact same combination of IP address + port as for PDC#1 as this will return a failed validation.

PDC #2 UDP Port

The PDC UDP port (if applicable) is the UDP port for the PDC that PMU data and configuration messages are sent to. This port must be configured when any of the following **Transport Scheme** setting modes is configured: **UDP Only**, **UDP Spontaneous**, or **TCP-UDP Mixed**. The valid UDP port range is 1 - 65535. When the **Transport Scheme** setting is set to **TCP Only** mode, the PDC UDP port number is ignored.

Transmission Counter Clear

When activated, this clears both the **M-Class Transmissions** counter and the **P-Class Transmissions** counter to zero.

Transmission Count Last Clear Time

This shows the date and time when the **P-Class Transmission** and **M-Class Transmission** counters were last cleared.

P-Class Transmission Counter

This is the number of P-Class data frames sent by the PMU to all PDCs. This value is maintained over loss of power. The counter may be cleared by clicking on the **Clear** button, by performing a firmware update, or swapping a control.

M-Class Transmission Counter

This is the number of M-Class data frames sent by the PMU to all PDCs. This value is maintained over loss of power. The counter may be cleared by clicking on the **Clear** button, by performing a firmware update, or swapping a control.

DNP Status Points

This screen contains configuration parameters for **DNP** status points. Map these points to make them available in the SCADA system. See Figure 104.

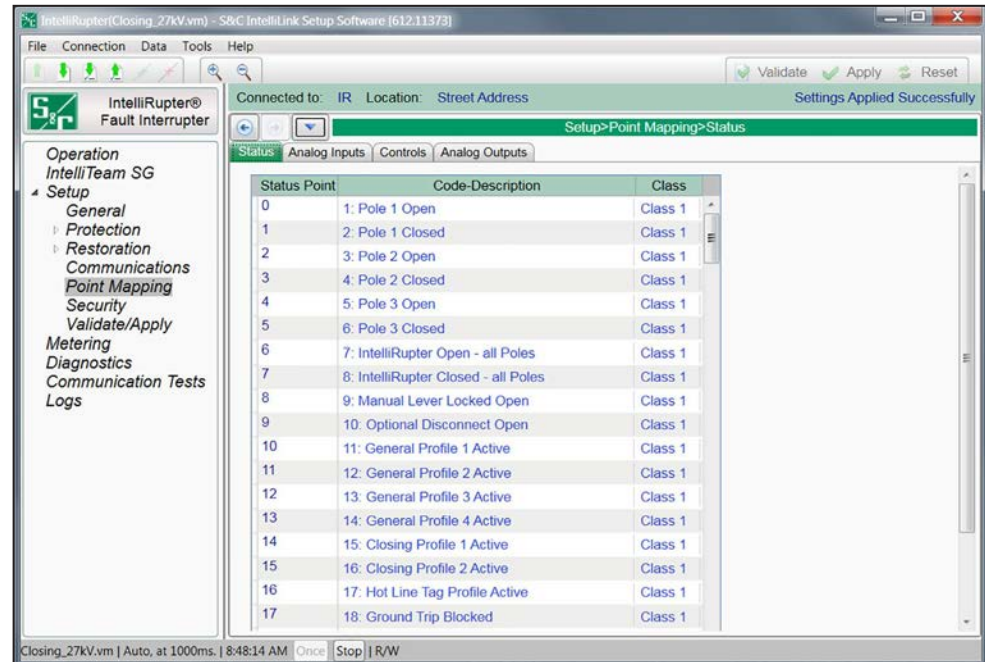


Figure 104. The Setup>Point Mapping>Status screen.

Status Point

This is the point number the SCADA system will see in response to a static or event data request or an unsolicited event response.

Code-Description

These are the point codes representing specific status points that may be assigned to individual SCADA point numbers. Setting a code-description to the **End** option defines the end of the configured points list and the maximum number of status points that can be returned.

Status points received from the external device may be mapped to individual SCADA points. Enter the external device status point number (the range is 0 to 255) in this column. See the external device manufacturer's documentation for definitions of its status points.

Class

This is the DNP event class in which this point can be placed. Specify the **Class 1**, **Class 2**, or **Class 3** setting, or choose the **No Event** setting if event data reporting is turned off for this point.

User-Defined Digital Inputs

User-Defined Input n Label

This user configured label has a 30-character limit and can be displayed on the *Operation* screen.

Show on Operation Screen

These points can be displayed on the *Operation* screen because they can be configured to block an operation. (Default: No)

Require SCADA Acknowledgement

Because these inputs will typically represent some form of alarm condition, when a SCADA acknowledgement is required, it will clear the alarm only if the **User-Defined Input** setting has become inactive. (Default: No)

User-Defined Input n Status

This shows the **Active** or **Inactive** state of the **User-Defined Input** setting.

Clear Input n Button

When the **Yes** option is selected for the **Require SCADA Acknowledgement** setpoint, the **Active** state of the **User-Defined Input** setting will persist after the physical input has become de-active until receipt of this button command or the corresponding control point.

User-Defined Input n On action

These functions are activated by a **User-Defined Input** setting change of state from the **Inactive** to **Active** state and are not locked to the **Active** state. For a command such as the **Prohibit Restoration** command, the **DNP** control point can execute an **Enable Restoration** command to cancel the **Prohibit Restoration** command. A subsequent **User-Defined Input** state change from the **Inactive to Active** state would then re-execute the **Prohibit Restoration** command. (Range: Disable Automatic Operation, Prohibit Restoration, Block Close Operations, Block Open and Close Operations, and None; Default: None)

When User Input n Is On, Block Operation of

This setpoint selects the switch the **User-Defined Input** setting will block. (Range: Switch 1, Switch 2, Switch 3, and All; Default: Switch n)

Front Panel LCD Screen

The “Real-Time Data” section of the LCD screen shows the state of the **User-Defined Input** setting: “User Inputs: 1 2 3” on line one, and “State: 0 1 1” on line two.

When the **Yes** option is selected for the **Require SCADA Acknowledgement** setpoint, the “User Command” section of the LCD screen includes an option to clear each of the configured user-defined inputs. Press the ENTER button on the faceplate to run the **Clear User Input n** command.

Version 6 and later versions of IntelliLink software contains a new tool for table objects. Although shown on the *Status Point* screen the following functions are available on any data set contained in the same table format. Other examples include the *Alarm*, *Warning*, and *Error* screens.

The tool menu shown in Figure 105 can be accessed by right clicking in the upper left hand corner of a table object.

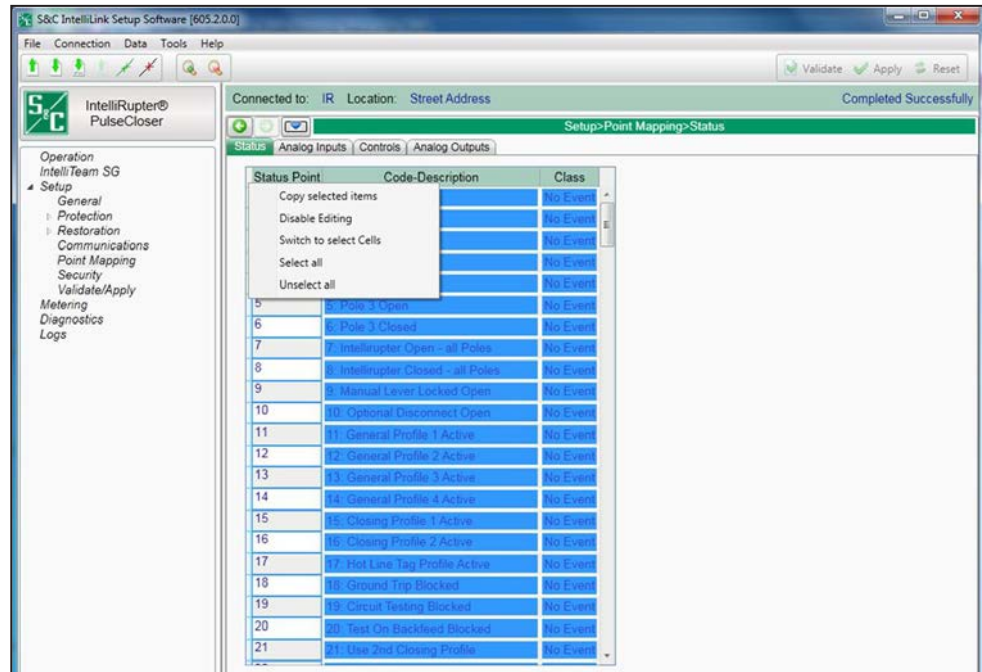


Figure 105. The Setup>Point Mapping>Status (Table Options) screen.

Copy Selected Items

This selection copies any item selected in the table to the clipboard.

Disable Editing

This selection locks the contents of the table.

Switch to selected Cells

This selection sets the focus on the first selected cell.

Select all

This selection selects all items in the table.

Unselect all

This selection unselects all items in the table.

To export table contents to a text file:

- STEP 1.** Right click on the upper-left corner of the table.
- STEP 2.** Click on the **Select All** option.
- STEP 3.** Right click on the upper-left corner of the table again.
- STEP 4.** Click on the **Copy selected items** option. The table contents are converted to a text file. See Figure 106.

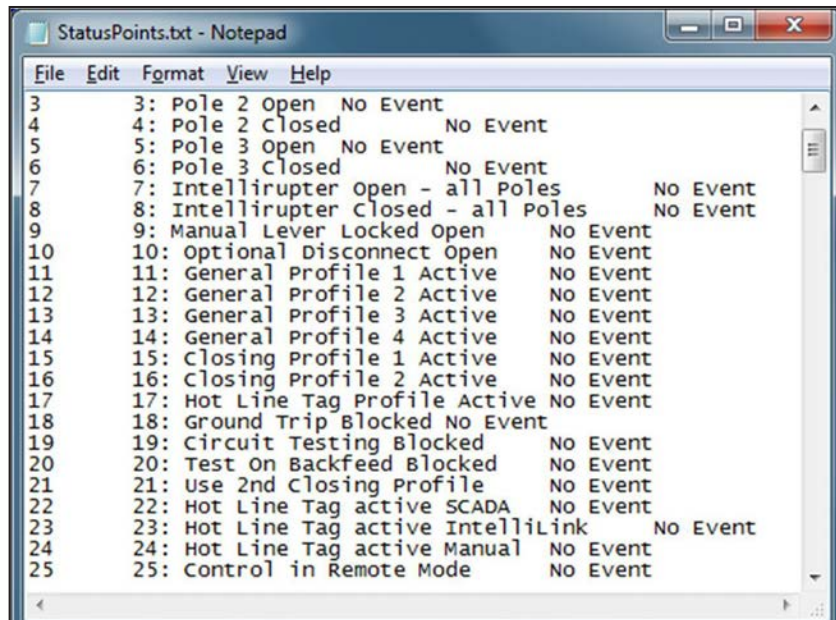


Figure 106. Status points converted to a text file with table options.

DNP Analog Input Points

The screen shown in Figure 107 has configuration parameters for analog input points. Map these points to make them available in your SCADA system.

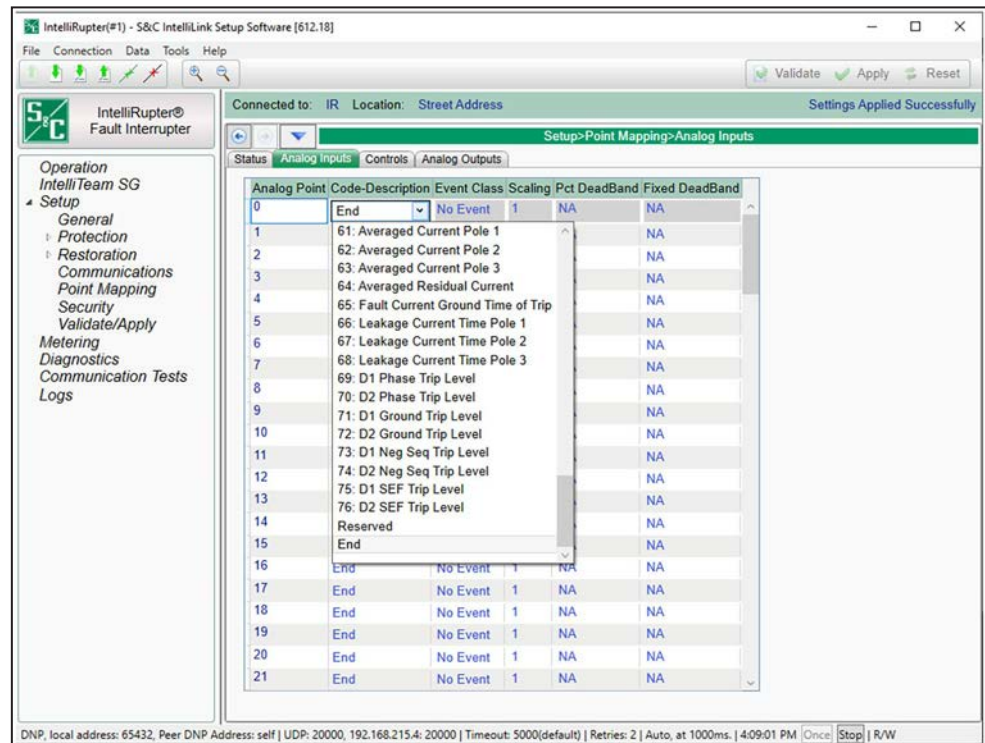


Figure 107. The Setup>Point Mapping>Analog Inputs screen.

Analog Point

This is the point number seen by the SCADA system in response to a static request, event data request, or an unsolicited event response.

Code-Description

These are the point codes that represent specific analog inputs that may be assigned to individual SCADA point numbers. Setting a code-description to the **End** option defines the end of the configured points list and the maximum number of analog inputs that can be returned.

Analog input points received from the external device may be mapped to individual SCADA points. Enter the external device analog point number (the range is 0 to 255) in this column. See the external device documentation for definitions of its analog points.

Event Class

This is the DNP event class assigned to this point. Specify the **Class 1**, **Class 2**, or **Class 3** setting, or choose the **No Event** setting to turn off event data reporting for this point.

Scaling

This is the scaling factor for the analog input data, to match the analog input requirements of the SCADA system.

Pct DeadBand

This is the deadband range expressed as a percentage of the previously reported analog input data. If the analog input data associated with this point exceed the range in either a positive or negative direction, the information will be included in the next event report. Specify the **N/A** setting to turn off deadband reporting as a percentage of the previously reported analog input data.

Fixed DeadBand

This is the deadband range expressed as a fixed value relative to the previously reported analog input data. If the analog input data associated with this point exceed the range in either a positive or negative direction, the information will be included in the next event report. Specify the **N/A** setting to turn off deadband reporting as a fixed value relative to the previously reported analog input data.

DNP Control Points

The screen shown in Figure 108 has configuration parameters for control point mapping. Map these points to make them available in the SCADA system.

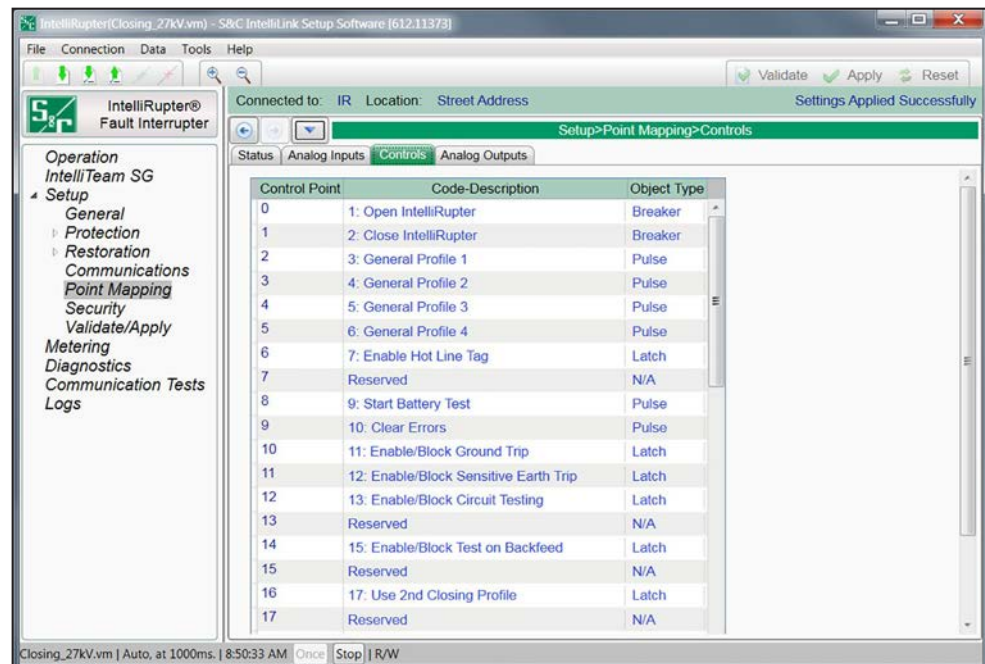


Figure 108. The Setup>Point Mapping>Control Points screen.

Control Point

This is the point number the SCADA system will use when operating the control point.

Code-Description

These are the point codes representing specific control points that may be assigned to individual SCADA point numbers. Setting a code-description to the **End** option defines the end of the configured points list and the maximum number of control points that can be returned.

Object Type

This specifies the type of control code the SCADA master will use in the control relay output block request. Specify the **Breaker** option for a **Trip/Close** operation, the **Latch** option for a **Latched On/Off** operation, the **Pulse** option for a momentary control output, or the **N/A** option if the control point will not be used. The object type must be valid for the selected object. For more information see Instruction Sheet 766-560, "IntelliRupter® PulseCloser® Fault Interrupter: DNP Points List and Implementation." The control operation will be rejected if the object type received is a **Pulse** object type received and there is either a **Breaker** or **Latch** mapped object type, or if there is a **Pulse** mapped object type and either a **Breaker** or **Latch** object type is received.

Every control point configured for breaker accepts **Latch** operations, and every control point configured for latch accepts **Breaker** operations.

Function Code

Control requests may be issued using the **Select/Operate** sequence, the **Direct Operate**, and **Direct Operate No Ack** function codes.

DNP Analog Output Points

The screen shown in Figure 109 has configuration parameters for analog output points. Map these points to make them available in the SCADA system.

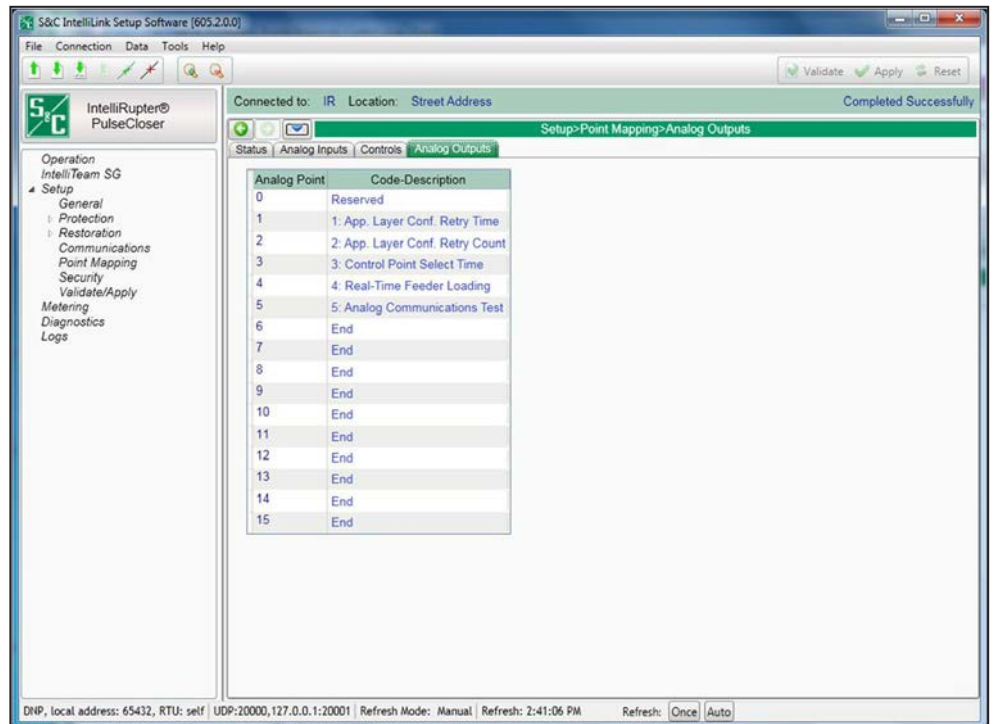


Figure 109. The Setup>Point Mapping>Analog Output Points screen.

Analog Point

This is the point number the SCADA system will use when operating the analog output point.

Code-Description

These are the point codes representing specific analog outputs that may be assigned to individual SCADA point numbers. Setting a code-description to the **End** option defines the end of the configured points list and the maximum number of analog output points that can be returned.

Password Management

Admin User Default Password Change

With software versions later than 7.3.100, a user is required to change the default user passwords in the IntelliLink Setup Software before it will allow the user to access the control and read or modify settings on the control using the IntelliLink software. This is required for all user accounts, including the Admin account, which must be changed first before any user can access a control. See Figure 110.



Figure 110. The Must Be a Non-Default Password dialog box.101

Non-Admin User Default Password Change

If users attempt to log in with one of the non-Admin accounts before the default password is changed, they will be notified via the following message the Admin user must change the default user account password before being allowed to connect to a control. See Figure 111.

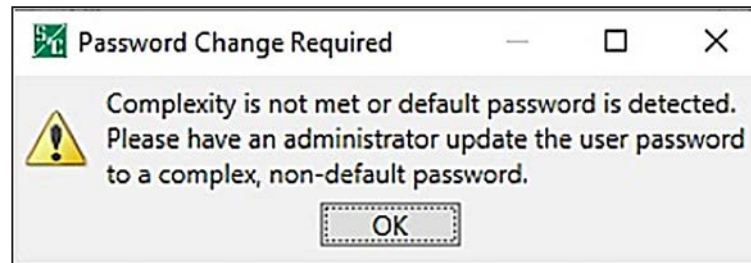


Figure 111. The Default Password Is Detected dialog box.

Password Complexity Rules

When changing a user password using IntelliLink Setup Software, complexity rules are enforced for the new password. See Table 4.

Table 4. Password Complexity Rules

Rule	Description
Password Length	Must be between 8-12 characters long
Alpha Characters	Must have at least one uppercase and one lowercase character
Special Characters	May contain special characters with the exception of the "Space," "Tab," and "&," characters, which are not allowed
Numbers	May contain numbers

When the password entered does not meet the complexity requirements, the error message shown in Figure 112 will open and the Admin user will be required to enter a password meeting the complexity requirements before being allowed to proceed.

Change Admin User Password

With software versions later than 7.3.100, the Admin user account default password must be changed before IntelliLink Setup Software can connect to a control.

Follow these steps to change the Admin user password:

- STEP 1.** After IntelliLink Setup Software is launched and the default admin password is used to connect to a control, the prompt shown in Figure 112 opens to instruct the user to change the Admin user account password.



Figure 112. The Password Change Required dialog box.

- STEP 2.** Enter a new non-default password meeting the complexity requirements into the **Enter Password** and the **Confirm Password** fields. Then, click on the **OK** button. See Figure 113 on page 220.

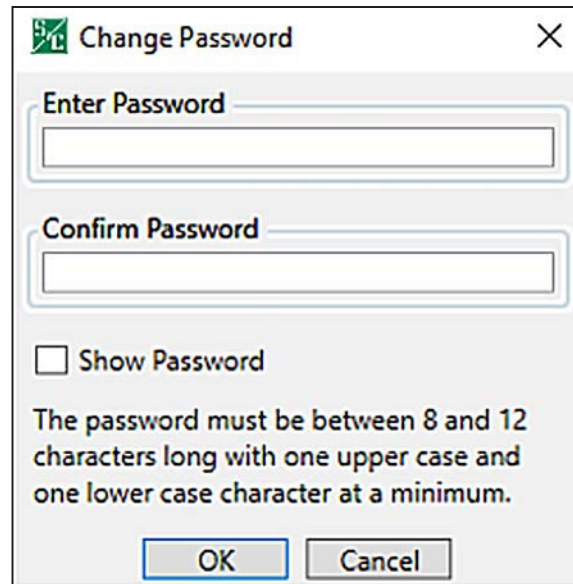


Figure 113. The Change Password dialog box.

STEP 3. When the password is changed successfully, the Successfully Changed dialog box opens. See Figure 114. Click on the **OK** button to finish the change-password process. If the password was not changed successfully, go to Step 4.

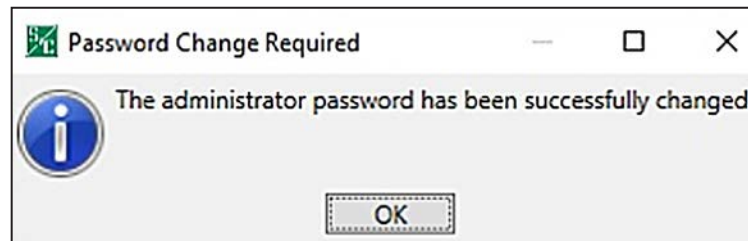


Figure 114. The Administrator Password Successfully Changed success message.

STEP 4. If the password was not successfully changed, the Password Change Required dialog box opens. See Figure 115 on page 221. Click on the **Yes** button to change the password again and go back to Step 2 on page 219.



Figure 115. The Password Change Required dialog box.

Change Non-Admin User Password

With software versions later than 7.3.100, the Non-Admin user accounts (i.e. Engineer1/2, Technician1/2/3, Operator, and Viewer) must have the passwords changed by an Admin user before a control can be connected using IntelliLink Setup Software.

Note: The Admin user password must have been changed to a non-default password before a Non-Admin user can access a control. If this has not been done, go to the “Admin User Default Password Change section on page 218 for instructions on how to change the Admin password before proceeding with the next instructions.

Follow these steps to change a Non-Admin user password:

- STEP 1.** Launch the IntelliLink Setup Software and log in using the Admin account and the non-default Admin password.

STEP 2. Go to the *Setup>Security* screen. See Figure 116.

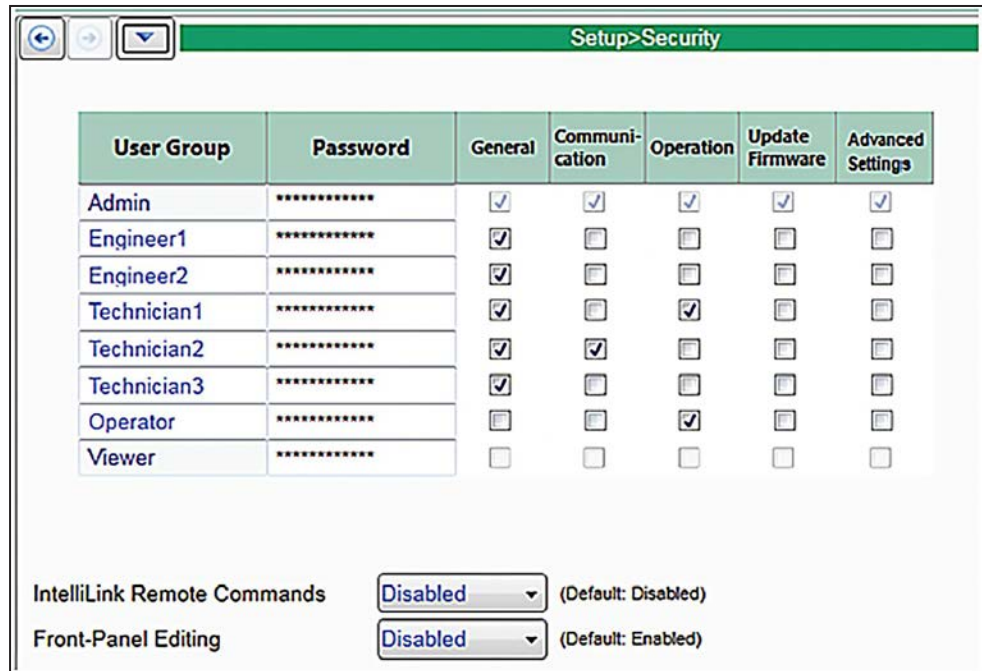
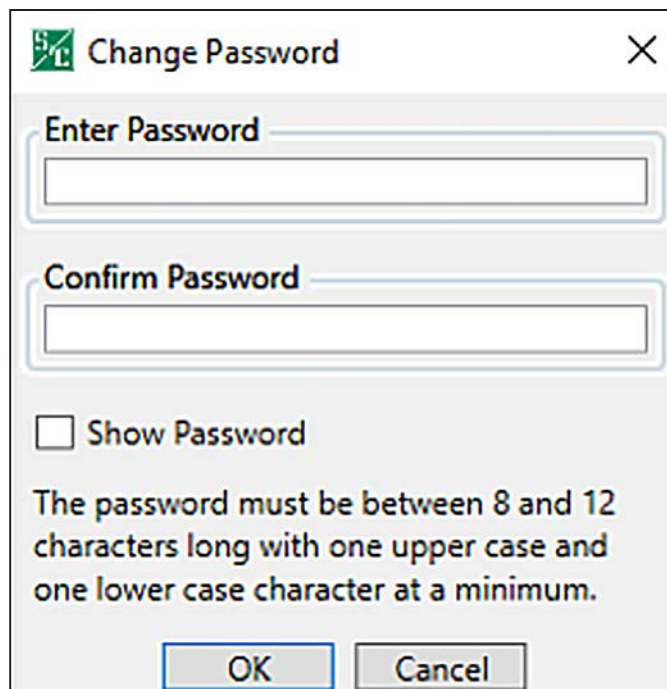


Figure 116. The *Setup>Security* screen.

STEP 3. Click on the **Password** field for a given user and enter a new non-default password meeting the complexity requirements into the **Enter Password** and the **Confirm Password** fields. Then, click the **OK** button. See Figure 117 on page 223.



The image shows a 'Change Password' dialog box with a title bar containing a green icon and a close button. It features two text input fields labeled 'Enter Password' and 'Confirm Password'. Below these fields is a checkbox labeled 'Show Password'. A message states: 'The password must be between 8 and 12 characters long with one upper case and one lower case character at a minimum.' At the bottom are 'OK' and 'Cancel' buttons.

Figure 117. The Change Password dialog box.

STEP 4. When the password has been entered, click on the **Validate** button in the top right corner of the *IntelliLink* software screen. See Figure 118.

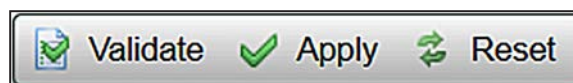


Figure 118. The Validate button.

STEP 5. If the password change validates successfully, click on the **Apply** button to finish the password-change process and configure the new password on the control. See Figure 118. Go to Step 6 if the password change was not validated successfully.

STEP 6. If the password was not successfully validated, the Validation Error dialog box will open. See Figure 119 on page 224. Click on the **OK** button to attempt to change the password again. Go to Step 3 on page 222.

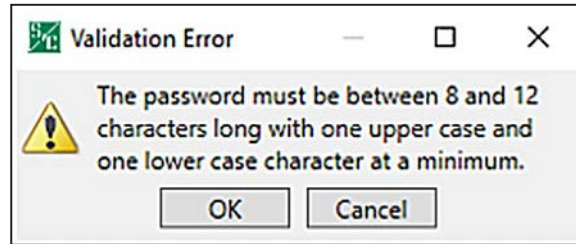


Figure 119. The Validation Error dialog box.

Security Screen

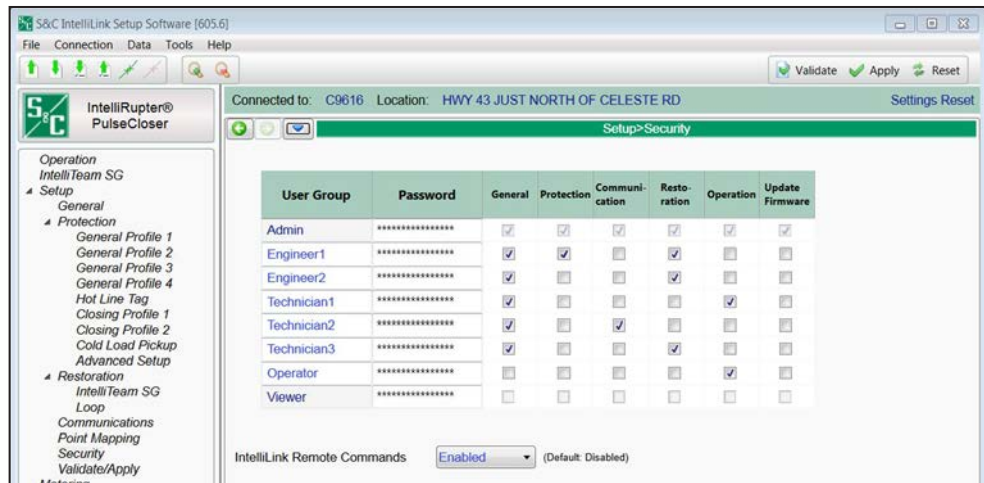


Figure 120. The Setup>Security screen.

Only a user logged in as Admin (administrator) can make changes to this screen. See Figure 120. The User Group name can be changed for all groups except Admin and Viewer. All passwords can be changed, and all default passwords must be changed by the Admin at initial login.

The following security controls are available for selection by the Admin for the various User Groups:

- **General**—When checked, it allows the User Group to configure all configurable settings found on the *Setup>General* screen
- **Protection**—When checked, it allows the User Group to configure all configurable settings found on the *Setup>Protection* screen
- **Communication**—When checked, it allows the User Group to configure all configurable settings found on the *Setup>Communication* screen
- **Restoration**—When checked, it allows the User Group to configure all configurable settings found on the *Setup>Restoration* screen
- **Operation**—When checked, it allows the User Group to configure all configurable settings found on the *Operation* screen
- **UpdateFirmware**—When checked, it allows the User Group to perform a firmware upgrade on the control using the *Tools>Firmware Update* option on the *Tools* menu

Note: When the **Update Firmware** option is checked, all other settings groups (Protection, Communication etc.) become enabled for the user that has been allowed to update firmware by the Admin. If the Admin disables access to any settings group after the **Update Firmware** option is checked and settings are validated, the disabled setting is automatically re-enabled. As long as **Update Firmware** option is enabled, all settings groups will be enabled automatically when the settings **Apply** command is initiated.

Changes will not take effect until the **Apply** command is selected on the *Setup>Validate/Apply* screen.

IntelliLink Remote Commands

When set to the **Enabled** setting, IntelliLink Remote Setup Software can be used to access the device operation commands. The **Disabled** setting is the default.

For all device types, these commands are not available when this is set to the **Disabled** setting:

IntelliTeam SG Restoration—On the *IntelliTeam SG>Team Summary* screen

Clear Manual Operation—On the *IntelliTeam SG>Team Summary* screen

For IntelliRupter fault interrupters, these commands are not available when this setting is set to **Disabled** mode:

Switch Open—On the *Operation* screen

Switch Close—On the *Operation* screen

Hot Line Tag—On the *Operation* screen

Single Phase Trip—On the *Operation* screen

Ground Trip—On the *Operation* screen

Test on Backfeed—On the *Operation* screen

Circuit Testing—On the *Operation* screen

Sensitive Earth Trip—On the *Operation* screen

Clear Latched Overcurrent—On the *Operation* screen

Change—Active General Profile on the *Operation* screen

Change—Active Closing Profile on the *Operation* screen

Remote Operation—On the *Operation* screen

Request Open—On the *Diagnostics>Tests* screen

Request Close—On the *Diagnostics>Tests* screen

Request Pulse Close—On the *Diagnostics>Tests* screen

Pulse Test—On the *Diagnostics>Tests* screen

Battery Test—On the *Diagnostics>Tests* screen

The screen shown in Figure 121 configures the filter settings for viewing log screens. The Admin login is required to execute any of the log-control functions.

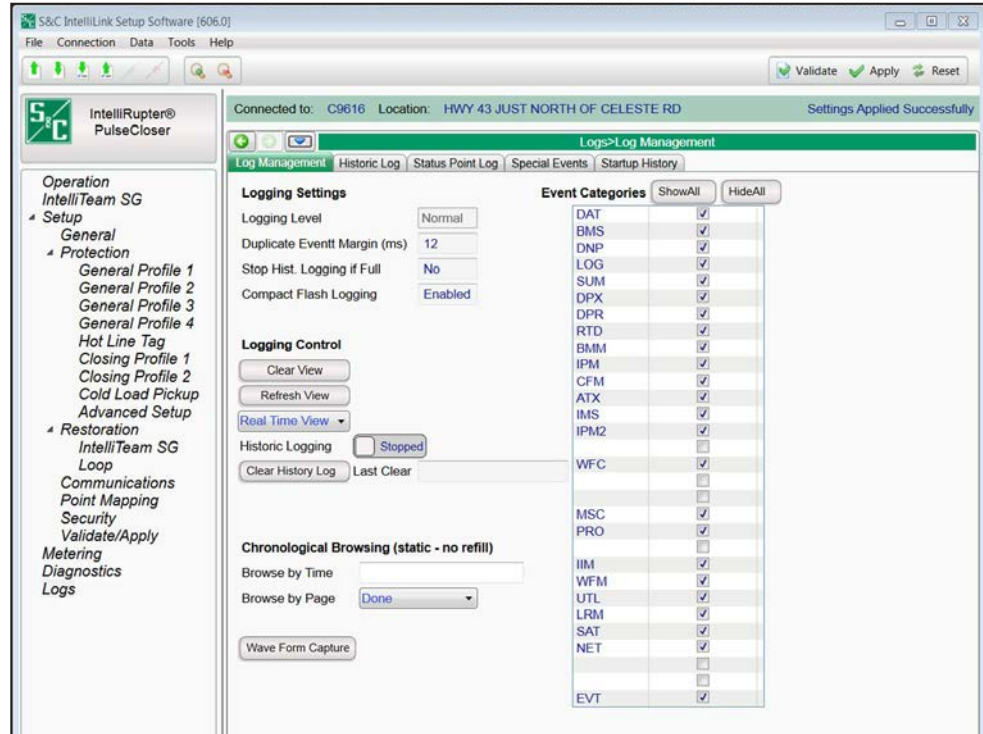


Figure 121. The Setup>Logs>Log Management screen.

Logging Settings

Logging Level

The logging level selected determines the type of data-log messages captured in the base memory module and is displayed on the *Logs>Historic Log* screen. Every data-log message is assigned a specific log level:

Normal—User information

Extended—User information and internal status

All—User information, internal status, and internal trace/debugging information

Duplicate Event Margin (milliseconds)

Storing identical events in a short time period can flood internal memory and does not provide useful diagnostic information. By configuring the time between duplicate-event log entries, this set point determines which data will be stored in the internal memory and be displayed on the *Logs>Historic Log* screen. It has no effect on an alternating sequence of events.

Two events are considered duplicates when every element of their event records match, such as when the **Duplicate Event Margin** setting is 10 ms. and the sequence of events ABABAB (where A and B are different) has every event occur 1 ms after the previous one. The identical events occur within 2 ms, well within the value of the setpoint, but all events will be logged because events are alternating. (Range: 0-30; Increment: 1.)

Stop Historic Logging if Full

This setting stops logging events when the Historic log is full and subsequent events are discarded without overwriting contents of the log. Flash memory logging, the Status Point log, and **Special Events** counter logging are not affected by this setpoint. This setting is factory set to the **No** setting to ensure continued event logging.

Compact Flash Logging

When enabled, every historic event generated is written to flash memory. **Logging Level** and **Duplicate Event Margin** setpoints do not prevent an event from being written to flash memory. Flash memory logging preserves as much data as possible. Flash memory data can be retrieved with IntelliLink software. Open the **Tools** option on the menu bar and click on the **Compact Flash Access** option. Select and save any files needed. S&C strongly recommends enabling the **Compact Flash Logging** setting to simplify diagnostic and troubleshooting work.

Event Categories

Select the categories that will be displayed on the *Logs>Historic Log* screen. To display only the most important operation information, select the EVT category and click the **Refresh View** button. Utility operation data will be displayed and log information for software troubleshooting and debugging will be omitted.

Logging Control

Complete data are stored in the Historic Event log in flash memory. Flash memory files can be downloaded by opening the **File** option on the menu bar and clicking on the **Flash Memory Files** option. The complete Historic log (up to a million events) cannot be viewed through IntelliLink software, but a small subset of the historic event log (160 events) is displayed on the *Logs>Historic Log* screen. Event filters can be applied to the *Logs>Historic Log* screen, but these filters do not affect entry of events in the Historic log.

Clear View

This button clears all data on the *Logs>Historic Log* screen. In **Real-Time View** mode, the next qualifying event will be placed at the top of the *Logs>Historic Log* screen. In **Static View** mode, the *Logs>Historic Log* screen will remain empty until it is completely refilled.

Refresh View

This button clears the present contents of the *Logs>Historic Log* screen and loads up 160 events from the Historic Event log in ascending chronological order. Only events satisfying the checked **Event Categories** options are displayed on the *Logs>Historic Log* screen.

Real Time View or Static View

Use this drop-down menu to select the view mode. **Real Time View** mode loads the latest data on the screen, and **Static View** mode freezes data on the *Logs>Historic Log* screen.

Historic Logging

Running—Starts the Historic log but does not affect flash memory logging, status point log entries, or special events logging.

Stopped—Stops the Historic log but does not affect flash memory logging, Status Point Log entries, or special events logging (Subsequent events will not be put into the Historic log, preventing newer events from overwriting older events. Be sure to return the **Historic Logging** mode to the **Running** setting so future events will be logged.)

Clear History Log

This button clears all data in the Historic log. It does not affect flash memory logging, status point log entries, or special events logging. The date and time of the last **Clear History Log** command are displayed. Clearing the Historic log permanently deletes all event data. If event data should be preserved, generate an HTML report of logged data before clearing the log.

Chronological Browsing (static – no refill)

Chronological browsing is only available in the **Static View** mode. It is not available in the **Real Time View** mode. Because the size of the *Logs>Historic Log* screen is only a fraction of the Historic log, the Historic log must be navigated chronologically, either by **Browse By Time** mode or **Browse By Page** mode.

Browse By Time

This loads up to 160 events that occurred at or after the specific time entered. Only events that satisfy the event categories criterion are placed in the *Logs>Historic Log* screen. If all events in the Historic Event log occurred before the specified time, the oldest-available events are placed in the *Logs>Historic Log* screen. The *Logs>Historic Log* screen is refilled as soon as the specific time is entered; the specified time is cleared when the refill is complete.

Browse By Page

Historic log pages can be browsed four ways:

Oldest 8 Pages—Loads up to 160 of the oldest-qualifying events from the Historic Event log

Newest 8 Pages—Loads up to 160 of the newest-qualifying events from the Historic Event log

Previous 8 Pages—Loads up to 160 previous events relative to the events currently in the *Logs>Historic Log* screen

Next 8 Pages—Loads up to 160 next events relative to the events currently in the *Logs>Historic Log* screen

When the selection is entered, the *Logs>Historic Log* screen is refilled immediately. Because the Historic log is circular, selecting the **Previous 8 Pages** option may cause the newest events to be displayed (if the *Logs>Historic Log* screen presently holds the oldest). Similarly, selecting the **Next 8 Pages** option may cause the oldest events to be displayed (if the *Logs>Historic Log* screen presently holds the newest)

Wave Form Capture

Click on this button to trigger a waveform capture to be stored in the compact flash memory. Select the **Tools>Compact Flash Access** options on the menu to retrieve the file.

Settings are stored in the buffer memory of the control and are not active until they have been applied. The *Validate/Apply* screen provides commands for managing settings between the buffer memory and the active settings area of the control. See Figure 122.

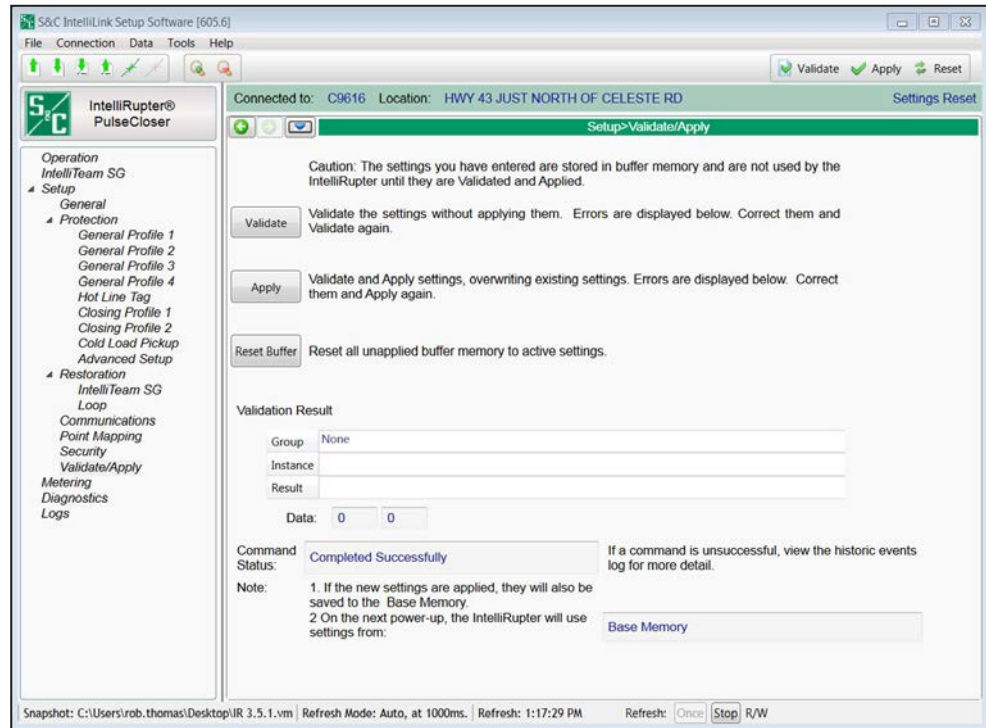


Figure 122. The *Setup>Validate/Apply* screen.

Validate

The **Validate** button evaluates settings in the buffer memory without applying them. When changes are pending, click on the **Validate** button to initiate a logical check of the pending changes for errors. If the validation procedure detects an error or inconsistency, it will be displayed in the **Validation Result** field.

Apply

The **Apply** button evaluates settings in the buffer memory and applies them. When changes are pending, click on the **Apply** button to initiate a logical check of the pending changes for errors and commit the changes to control memory if no errors are detected. A successful check will be indicated in the **Validation Result** field.

Reset Buffer

The **Reset Buffer** button resets settings in the buffer memory to the presently active values. It will not undo an **Apply** command. When changes are pending, click on the **Reset** button to remove pending changes and return to the setting presently located in the control memory. The **Validate**, **Apply**, and **Reset** icons will fade to indicate no changes are pending.

Validation Results

If a **Validation** or **Apply** command is unsuccessful, the **Validation Result** field will provide information related to the violated validation rules.

Command Status

Shows the result of the last **Validation** or **Apply** command.

Base Memory Status

Indicates where settings will originate for the next power up, either from the base memory module or from control memory.

Factory Reset

Factory Reset Using IntelliShell

NOTICE

Factory Reset functionality requires that the default setpoints/setting file is installed on the system for the firmware version the control is running at the time the factory reset is used. Therefore, to proceed with the factory reset, ensure that the default setpoint/settings file is properly installed. If the default setpoints/settings file is not installed, the factory reset procedure will not be executed.

STEP 1. Click on the **IntelliShell** button and click on the **Local Connection (Serial/Wi-Fi)** button. See Figure 123.

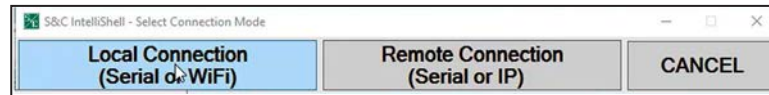


Figure 123. The IntelliShell Local Connection button.

STEP 2. Select the product on which to perform the factory reset and click on the **Serial** button. See Figure 124.

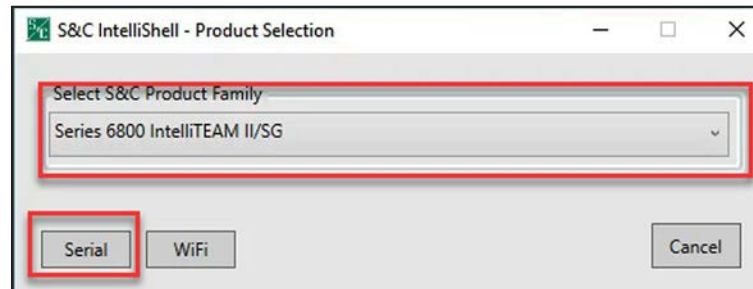


Figure 124. The Product Selection and Serial connection option.

STEP 3. Click on the **Factory Reset** option to launch the **Factory Reset** procedure. See Figure 125.

After clicking on the **Factory Reset** option, the IntelliLink software will launch and the user must login using the Admin account.

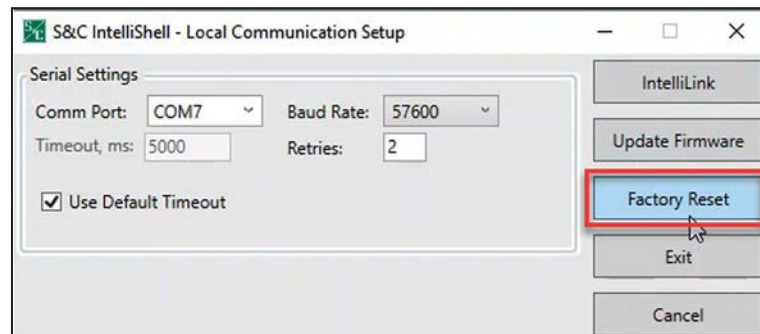


Figure 125. The Factory Reset button.

STEP 4. When prompted, enter “admin” for the username and enter the Admin password in the **Password** field. See Figure 126.

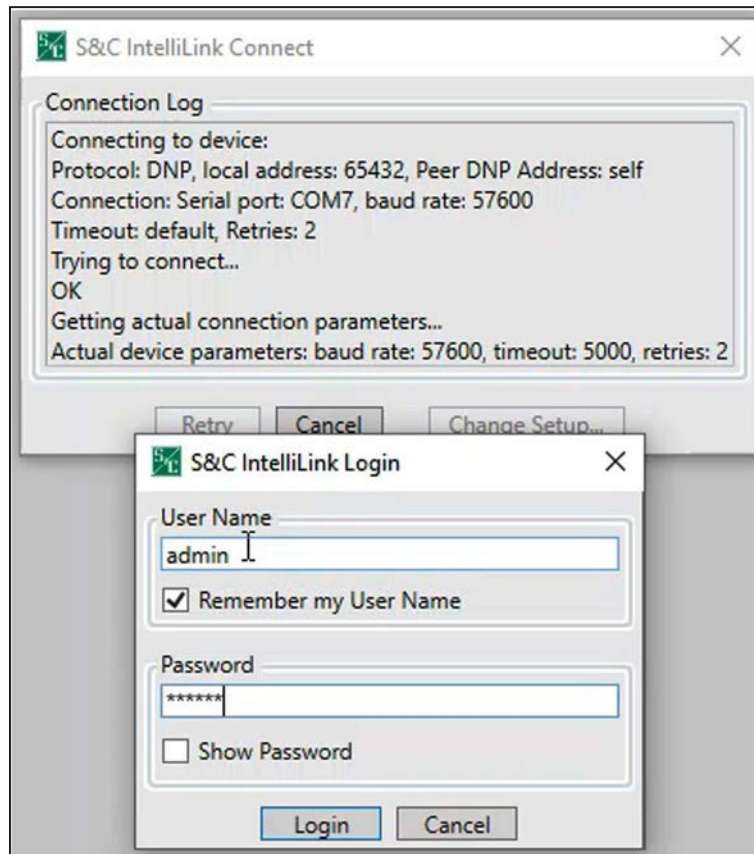


Figure 126. The IntelliLink Login dialog box.

STEP 5. Click on the **Proceed to Factory Reset** button when prompted. See Figure 127.

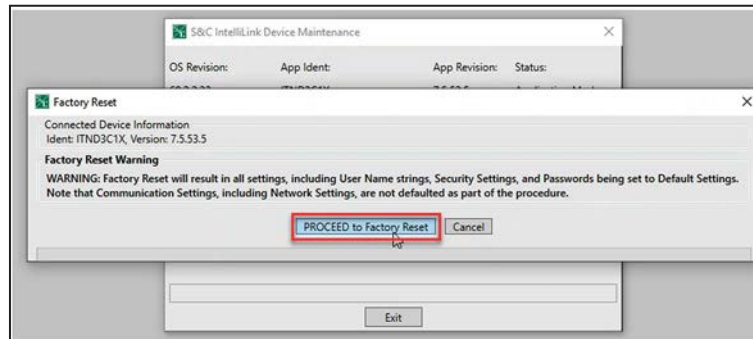


Figure 127. The Proceed to Factory Reset button.

NOTICE

Performing a **Factory Reset** procedure on software versions 7.5 and earlier, results in usernames, passwords, and other security settings being reset to default-setting values. The communication settings are not set to default values as part of this procedure, to allow the IntelliLink software to reconnect to the control when the factory reset is completed.

Performing a **Factory Reset** procedure on software versions 7.6 and later, results in all settings (including usernames, passwords, security, and network settings) being reset to default-setting values. Because the network settings are reset to factory defaults, default network settings must be used to reconnect to the control when the factory reset is completed.

STEP 6. When the **Factory Reset** procedure is completed, click on the **Cancel** button to complete the procedure. See Figure 128.

NOTICE

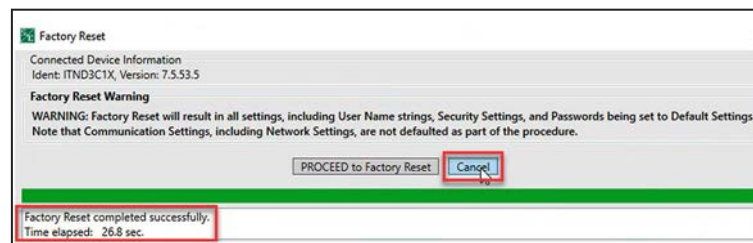


Figure 128. The Factory Reset completed successfully message.

When the factory reset is completed, the Admin password will revert to the default password. At the initial login, the Admin user will be required to change the password to a non-default password that meets the complexity requirements.

Factory Reset Using IntelliLink

- STEP 1.** Login to the IntelliLink software application using the Admin username and password.
- STEP 2.** Click on the **Tools>Device Maintenance** button. See Figure 129.

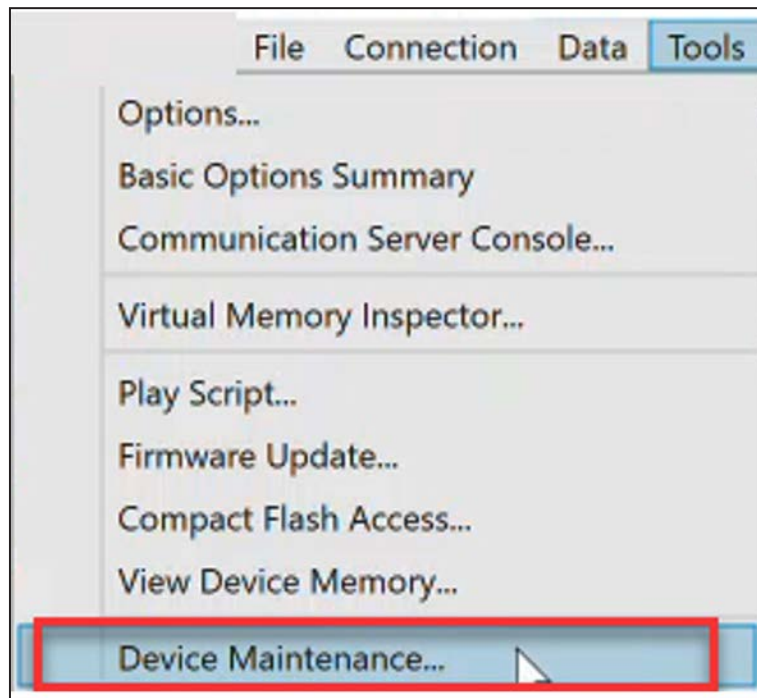


Figure 129. The Tools>Device Maintenance button.

STEP 3. When the Device Maintenance dialog box opens, click on the **Factory Reset** button to launch the **Factory Reset** procedure. See Figure 130.

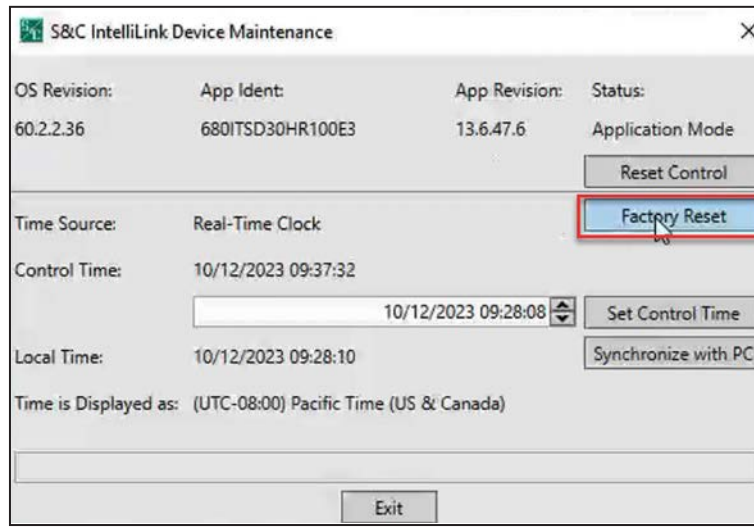


Figure 130. The Factory Reset button.

STEP 4. Click on the **Proceed to Factory Reset** button when prompted. See Figure 131.

NOTICE

Performing a **Factory Reset** procedure on software versions 7.5 and earlier, results in usernames, passwords, and other security settings being reset to default-setting values. The communication settings are not set to default values as part of this procedure, to allow the IntelliLink software to reconnect to the control when the factory reset is completed.

Performing a **Factory Reset** procedure on software versions 7.6 and later, results in all settings (including usernames, passwords, security, and network settings) being reset to default-setting values. Because the network settings are reset to factory defaults, default network settings must be used to reconnect to the control when the factory reset is completed.

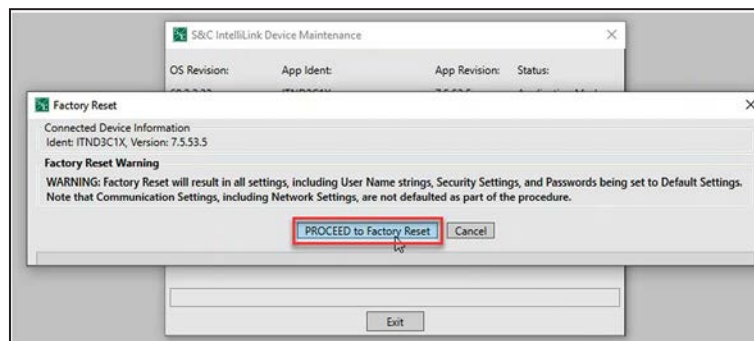


Figure 131. The Proceed to Factory Reset button.

STEP 5. When the **Factory Reset** procedure is completed, click on the **Cancel** button to complete the procedure. See Figure 132.

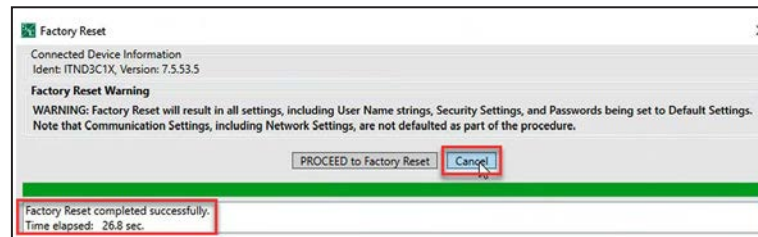


Figure 132. The Factory Reset completed successfully message.

NOTICE

When the **Factory Reset** procedure is completed, the Admin password will revert to the default password. At the initial login, the Admin user will be required to change the password to a non-default password that meets the complexity requirements.