

S&C M Series® Switch Operator Reciprocating and Rotating Switch Operation

Setup

Table of Contents

Section	Page	Section	Page
Introduction		M Series Switch Operator Setup	
Qualified Persons	2	Start IntelliLink Software	8
Read this Instruction Sheet	2	Menu Tree	9
Retain this Instruction Sheet	2	Entering Information on a Screen	9
Warranty	2	Setup Menu	10
Safety Information		Setup: Miscellaneous	11
Understanding Safety-Alert Messages	4	Setup: Switch Operator	14
Following Safety Instructions	4	Setup: Site-Related	17
Replacement Instructions and Labels	4	Setup: Fault Detection	20
IntelliLink® Software		Setup: Automatic Operation	22
Applicable Software	5	Setup: Communications	26
Introduction	6	Enable Normal Switch Operation	31
Computer Requirements	6	Calculating the Connecting Rod Spring Constant	31



Qualified Persons

WARNING

The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead electric power distribution equipment along with the associated hazards.

A qualified person is one who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from non-live 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 the special precautionary techniques, personal protective equipment, insulating 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

Thoroughly and carefully read this instruction sheet before programming, operating, or maintaining your S&C M Series Switch Operator. Familiarize yourself with the safety information on page 3. The latest version of this instruction sheet is available online in PDF format at sandc.com/Support/Product-Literature.asp

Retain this Instruction Sheet

This instruction sheet is a permanent part of your S&C M Series Switch Operator. Designate a location where you can easily retrieve and refer to this publication.

Warranty

SPECIAL WARRANTY PROVISIONS: The standard warranty contained in seller's standard conditions of sale, as set forth in Price Sheet 150, applies to S&C M Series Switch Operator, except that the first paragraph of said warranty is replaced by the following:

(1) General: Seller warrants to the immediate purchaser or end user for a period of 2 years from the date of shipment that the equipment delivered 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 ten years after the date of shipment the seller agrees, upon prompt notification thereof and confirmation that the equipment has been stored, installed, operated, inspected, 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.

Replacement parts provided by seller or repairs performed by seller under the warranty for the original equipment will be covered by the above special warranty provision for its duration. Replacement parts purchased separately will be covered by the above special warranty provision.

WARRANTY QUALIFICATIONS: Warranty of S&C M Series Switch Operators is contingent upon the installation, configuration, and use of the operator or software in accordance with S&C's applicable instruction sheets. This warranty does not apply to major components not of S&C manufacture, such as batteries, communication devices, and remote terminal units. However, S&C will assign to immediate purchaser or end user all manufacturers' warranties that apply to such major components. S&C does not warrant that the switching device ratings will be unaffected by the use of the M Series Switch Operator. Contact S&C to discuss possible limitations. S&C's Power System Services can provide validation testing services if desired. Contact S&C for a quotation.

END USER LICENSE AGREEMENT: End user is granted a nontransferable, non-sublicensable, nonexclusive license to use the LinkStart Connection Management Software, IntelliLink® Remote Setup Software, IntelliTeam® SG Automatic Restoration Software, Automatic Sectionalizing Software, and/or other Software furnished with M Series Switch Operators only upon acceptance of all the terms and conditions of the seller's end user license agreement set forth in Price Sheet 155.

Safety Information

Understanding Safety-Alert Messages

There are several types of safety-alert messages which may appear throughout this instruction sheet as well as on labels attached to the S&C M Series Switch Operator. Familiarize yourself with these types of messages and the importance of the various signal words, as explained below.

DANGER

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

WARNING

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

CAUTION

“CAUTION” identifies hazards or unsafe practices which *can* result in minor personal injury or product or property damage 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 you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website sandc.com Or call S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

NOTICE

Read this instruction sheet thoroughly and carefully before installing or operating your S&C M Series Switch Operator.



Replacement Instructions and Labels

If you need additional copies of this instruction sheet, contact your 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 your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

Applicable Software

These instructions are used with S&C **MORD2S0S Rev 1.04** and **MORD2S0X Rev 5.04**.

For questions regarding the applicability of information in this instruction sheet to future software releases, please contact S&C.

CAUTION

Serious risk of personal injury or death may result from contact with electric distribution equipment when electrical isolation and grounding procedures are not followed. The equipment described in this document must be operated and maintained by qualified persons who are thoroughly trained and understand any hazards that may be involved. This document is written only for such qualified persons and is not a substitute for adequate training and experience in safety procedures for accessing high-voltage equipment.

WARNING

These instructions do **NOT** replace the need for utility operation standards. Any conflict between the information in this document and utility practices should be reviewed by appropriate utility personnel and a decision made as to the correct procedures to follow.

The S&C M Series Switch Operator is connected to switchgear operating at primary voltage levels. High voltage may be present in the wiring to the switch operator or the switch operator itself during certain failures of the switchgear wiring or grounding system, or due to a failure of the switch itself. For this reason, access to the switch operator should be treated with the same safety precautions that would be applied when accessing other high-voltage lines and equipment. Follow all locally-approved safety procedures when working on or around this switch operator.

Before attempting to access an existing switch installation, check carefully for visible or audible signs of electrical or physical malfunction (do this before touching or operating the switch operator or any other part of the installation). These warning signs include such things as smoke, fire, open fuses, crackling noises, loud buzzing, etc. If a malfunction is suspected, treat all components of the installation, including the switch operator and associated mounting hardware, as if they were elevated to primary (high) voltage.

Whenever you are manually reconfiguring the circuit (for example, during repairs), follow your company's operating procedures to disable automatic operation of the S&C M Series Switch Operator.

Introduction

This instruction sheet explains how to set up the S&C M Series Switch Operator, and how to enable normal Switch Operator operation after the setup is completed. Depending on the communications equipment installed in the M Series Switch Operator, you may also be able to change the setup parameters from a SCADA master station, or other remote location with S&C IntelliLink® Remote Setup Software.

NOTICE

Optional IntelliLink Remote Setup Software is purchased separately, and you will be issued a License Key. See S&C Instruction Sheet 1032-500 *S&C IntelliLink Remote Setup Software Installation*.

Computer Requirements

To install M Series Switch Operator Software on your computer you will need:

1. A portable PC computer with Microsoft® Windows® 7 (Windows® XP is referenced in this document for customer convenience, but is no longer supported for use with S&C Control Software), an Intel® Core™ i7 Processor with 8 GB of Ram (recommended), or a Dual-Core Processor with 4 GB Ram (minimum), a wireless card (onboard or USB), an internet browser, and access to **sandc.com**. An onboard Ethernet card is required for IntelliTeam® Designer Software.
2. Administrative Privileges.
3. Microsoft .Net Framework Version 4.5. You can verify that it has been installed on your computer by opening *C:\Windows\Microsoft.Net\Framework* with Windows Explorer. If v4.5 has not been installed, download it from this link: <http://www.microsoft.com/net>. Windows XP SP3 uses Microsoft .Net v4.0 and .Net v4.02. Install v4.0 first, then v4.02. If the correct version of .Net is not detected by the installer, it will not install IntelliLink6.
4. Windows Installer 3.1 (Required by Microsoft® Windows® XP Service Pack 3 only).
To verify that you have Windows Installer 3.1:
 - Click the Windows *Start* button and open *Settings > Control Panel*
 - Double Click: *Add or Remove Programs*
 - Scroll down the list and verify that Windows Installer 3.1 is present.
5. Windows WZC–Wireless Zero Configuration (recommended)
To verify that you have Windows Wireless Zero Configuration:
 - Click the Windows *Start* button and open *Settings > Control Panel*
 - Double Click: *Administrative Tools*
 - Double Click: *Services*
 - Scroll down the list and verify that Wireless Zero Configuration is present.
6. Windows PowerShell 2.0 is set for an execution policy of *AllSigned*. Execution policies of *RemoteSigned* and *Unrestricted* will also work. Policy selection should be based on security policy set forth by your IT department. The *AllSigned* execution policy will result in the appearance of a dialog, shown in Figure 1, after a firmware upgrade has begun. In order to perform the firmware upgrade the *Run once* or *Always run* button must be selected. Selection should be based on the security policy set forth by your IT department. Windows PowerShell 2.0 is preinstalled on Windows 7 and 8, but will need to be downloaded for Windows XP. Windows PowerShell 2.0 can be downloaded from this link: <http://support.microsoft.com/kb/968929>. To set and verify the execution policy you will need to be logged in as an administrator.

The procedure is as follows:

- Click the Windows **Start** button and open *All Programs > Accessories > Windows PowerShell > Windows PowerShell (x86)* to start the application
- In the PowerShell console type: *set-executionpolicy AllSigned* to set the policy
- In the PowerShell console type: *get-executionpolicy* to verify the policy setting.

The latest M Series Switch Operator software release is posted at the S&C Automation Customer Support Portal. This library of current and legacy software requires a password, and gives users access to the software needed for S&C equipment operated by their utility. sandc.com/support/automation-customer-support-portal.asp. See Figure 1. You can request a Portal password by using this link.

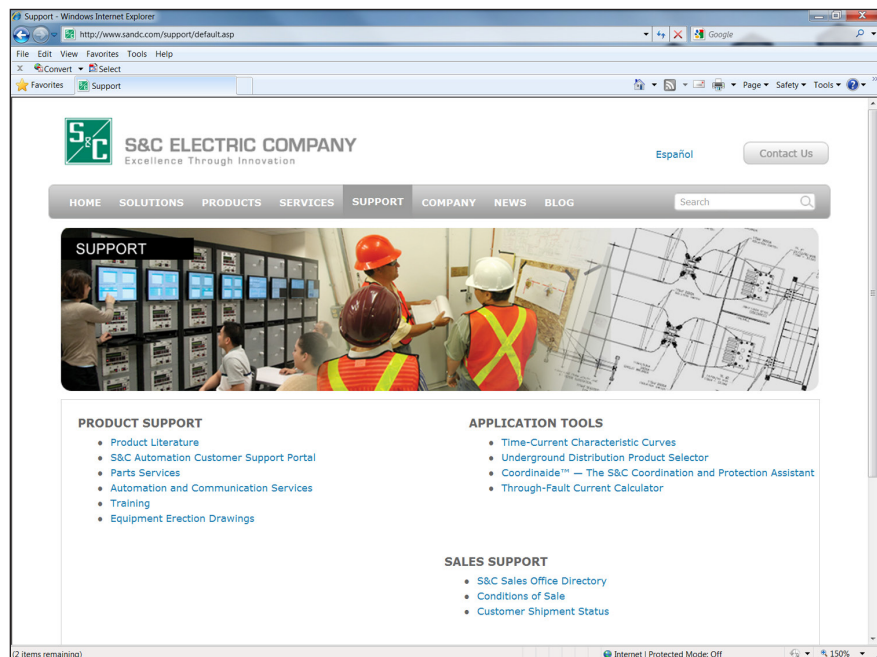


Figure 1. The S&C Automation Customer Support Portal is accessed on the Support page at sandc.com.

M Series Switch Operator Setup

Start IntelliLink Software

The steps below explain how to start IntelliLink software when you want to work with the setpoints or stored data in a switch operator. If you want to edit a snapshot (virtual memory file) or simply view the software without data, see *Using Snapshots* in S&C Instruction Sheet 1045M-540 *Operation*.

NOTICE

If you use a two-wire, ungrounded extension cord to power either your computer OR the switch operator while they are connected, you may damage the USB port on your computer. **ALWAYS** use a grounded, three-wire extension cord or battery power.

1. **Connect your computer to the switch operator.**
Connect your computer to the LOCAL COMMUNICATIONS ACCESS port on the switch operator faceplate, with either a USB to serial adapter, or a straight through serial cable.
2. **Double-click the IntelliLink icon in the S&C Electric folder.**
3. **The software will attempt to communicate with the Switch Operator.**
If the software establishes communication with the switch operator, the *Operation* screen appears. See Figure 2.

If the software does not establish communication, it tries all possible baud rates for communication. Then it asks you whether to try again or exit the process. If you exit the process, you can still view screens and on-line help, but you cannot view “live” data or change setpoints. To view screens, select *File > Open Screenset...* and select a file with a .WMN extension. Then select *File > Open Snapshot...* and select a file with a .VW extension.

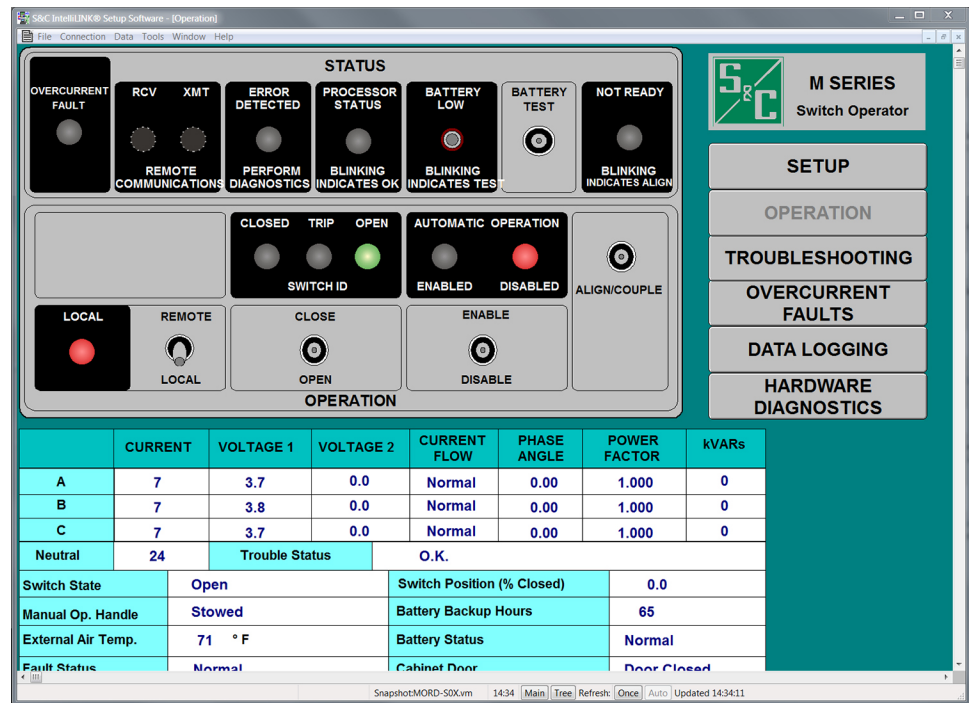


Figure 2. Operation screen for an M Series Switch Operator, with MORD2S0X software.

Menu Tree

Table 1. M Series Switch Operator software navigation

Setup	Operation	Troubleshooting	Overcurrent Fault
Miscellaneous		Event Status	Fault Events
Switch Operator		Chronological Log	Ac Power Outages
Automatic Operation		Control/Switch Info	
Communications		Switch Operations	
Save Configuration		Communications	
		Various Counters (DNP only)	
		Battery System	

Data Logging	Hardware Diagnostics	Report
Daily Hi/Lo Voltage & Temps.		Full
Sensor Profile—Voltage		System Setup & Operation
Sensor Profile—Temperature		Troubleshooting Information
		Historical Data

Entering Information on a Screen

Follow these steps to enter, select, or change information in a screen. For example the *Setup Miscellaneous* screen shown in Figure 4 on page 11.

1. **Move the cursor into a field.**
The field is the particular area in the window that displays the specific information to be entered. When the cursor changes to a double arrow icon, click the left mouse button to activate the field.
2. **Type the entry.**
If the field accepts typed input, use your computer keyboard to enter the new value. If the field does not change when you type the information, click the up or down arrows to change the information. If the field displays a pull-down menu with a list of choices when the left mouse button is clicked, information can be selected from the menu by simply clicking on the appropriate button.
3. **Click OK.**
Click OK to record the new value (or click Cancel to leave the field without changing the value).
4. **Repeat for each field.**
Repeat this process for each field where changes are required to display the correct information for a specific Switch Operator installation. Change only the Present settings, which will always override the Factory settings.

Setup Menu

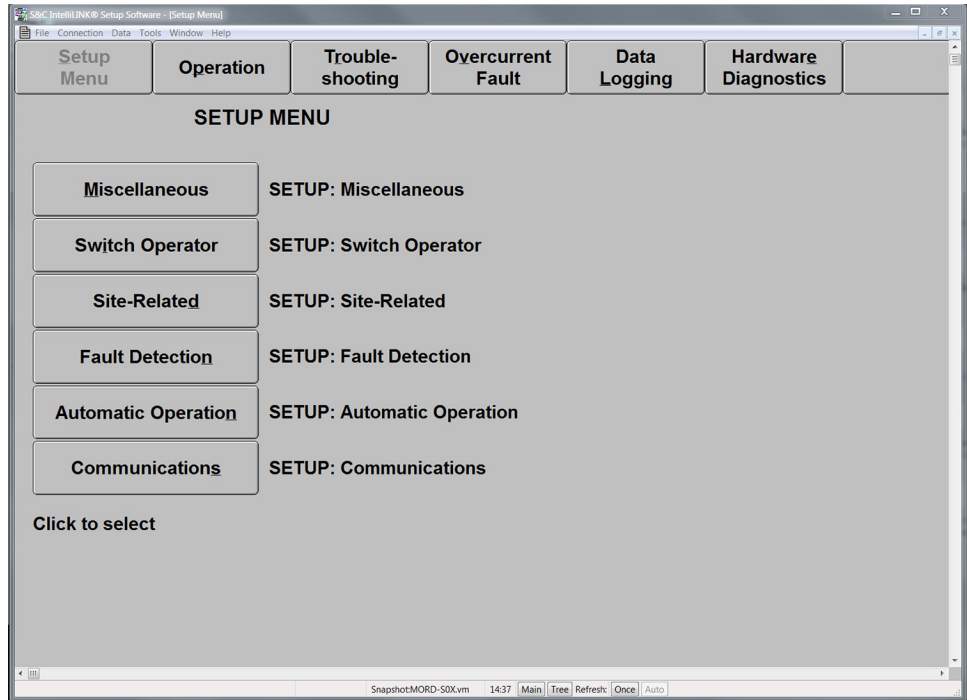


Figure 3. Setup Menu screen.

The *Setup Menu* screen provides access to the Setup screens. You must select or enter the correct details of the Switch Operator installation in these screens so the switch operator can match its operating characteristics to the specific brand and model of the switch to which it is connected.

Click the button for the setup parameter you need to configure.

Setup: Miscellaneous

	Present	Factory
Delay Normal Operations	Disabled	Disabled
Delay Test Operations	Disabled	Disabled
Local Operations Delay (if applicable, seconds)	20	20
Automatic Open on Incomplete Close Operation	Disabled	Disabled
Automatic Close on Incomplete Open Operation	Enabled	Enabled
Remote Operation Via Contact Closure DIs	Disabled	Disabled
Extended Data Logging Interval (minutes)	5 Min	5 Min
Daylight Savings Time Automatic Changeover	Enabled	Enabled
Automatic Daylight Savings Schedule (Number, Day of Week, Month):		
Start	Second	Sunday in March
End	First	Sunday in November
Calendar Timeclock Time/Date		
Tuesday, April 23, 2013 14: 40: 38 Daylight Savings		
Physical Location		
Cabinet Heater Setpoints (Deg. F.)		
Cabinet Heater On Below This Temperature	45	45
Cabinet Heater Off Above This Temperature	60	60

Figure 4. Setup Miscellaneous screen.

You are only concerned with the fields in the *Present* column. The information in the *Factory* column is a reference that cannot be changed. Any information that does not include numbers will be selected from a pull-down menu and is not typed in. For example, when you click on the double arrow icon for the *Delay Normal Operations* field, you will see a menu with two choices, *Enabled* and *Disabled*, no typing is required. All you have to do is use your mouse to left-click the button next to the correct choice. Fields on the *Setup: Miscellaneous* screen include:

Delay Normal Operations

When this field is set to *Enabled*, the switch operator delays normal close and open operations from the faceplate by a period of time specified by the *Local Operations Delay* field. This time delay allows the operator to step away to a safe distance from the switch.

Delay Test Operations

This option is the same as *Delay Local Operations*, but applies exclusively to *Test* operations. Once again, the purpose of this delay is to allow the operator to step back from the switch to ensure personal safety. The actual delay will be the same as the delay set for *Delay Local Operations*.

Local Operations Delay (if applicable, seconds)

If *Delay Local Operations* and/or *Delay Test Operations* is enabled, this is the amount of time (in seconds) that close and open operations from the faceplate are delayed.

NOTICE

We strongly recommend that your company adopt a standard, consistent policy on the use of operation delay features. This will let field personnel know in advance how quickly each switch operator will respond to commands from the faceplate.

Automatic Open on Incomplete Close Operation

When this field is set to *Enabled* and a close operation does not complete successfully, the switch automatically opens.

Automatic Close on Incomplete Open Operation

When this field is set to *Enabled* and an open operation does not complete successfully, the switch automatically closes.

Remote Operation via Contact Closure DIs

DIs are discrete inputs. Remote operation must be enabled. To remotely command the M Series operator to operate—apply a 12 - 24 Vdc wetting voltage (either polarity) to the PSIO Board between contacts J1-1 and J1-2 to command Open operation, or between contacts J1-1 and J1-3 to command Close operation. The contacts must be latched for at least 100 milliseconds, and 250 milliseconds is recommended to ensure operation.

The M Series operator provides switch operation feedback with a 0.2 second relay pulse. Apply wetting voltage to the PSIO Board contacts J2-1 and J2-2 to sense the pulse indicating switch closed or between contacts J2-1 and J2-3 to sense the pulse indicating switch open. Relay contacts are rated: 16A at 250 Vac, 0.5A at 125 Vdc, 16A at 24 Vdc.

PSIO Board 006-001045-01 has the contacts and relays to support remote operation, but PSIO Board 006-001037-01 has no contacts or relays for remote operation.

Loss of Voltage Threshold

The *Voltage Threshold* value is set by entering a number in the Change Value window. When the drop in voltage exceeds this value, as compared to a normal input value of 120 Vac, then the switch operator will conclude that power is no longer being supplied to the phase being monitored. For example, if the Voltage Threshold is set at 20 V, then the switch operator will detect a loss of power at 20 Vac input. For more information, refer to *Fault Detection and Automatic Operation* in Instruction Sheet 1051-540 *Operations*.

For customer transformers connected phase-to-neutral, you can normally leave this setting at the factory default value 20.0.

For customer transformers connected phase-to-phase, the loss of one phase results in sensor readings with magnitudes slightly more than 1/2 of normal phase-to-phase voltage. To detect phase loss with the loss of one phase, set the *Loss of Voltage Threshold* to a slightly higher value than the expected voltage level. A threshold of approximately 75% of the normal phase voltage is recommended.

The speed of detecting voltage loss is affected by backfeed from customer loads. We therefore recommend entering a *Loss of Voltage Threshold* that will be high enough to detect the loss of voltage before service is resumed (typically no less than 0.6 seconds for a fast reclose cycle), and low enough to insure that loss of voltage will not be falsely detected due to system overload or persistent backfeed.

Extended Data Logging Interval

This is the interval (in minutes) used for logging voltage and temperature data. Logged data is averaged over this interval. The intervals available for selection on the pulldown menu are 1, 5, 10, 15, 30, and 60 minutes.

NOTICE

If you change the data logging interval, previously stored data will be overwritten. To save older data, generate a report BEFORE changing the interval (see Instruction Sheet 1051-540 *Operations* for details).

Daylight Savings Time Automatic Changeover

When this field is set to *Enabled*, the switch operator automatically adjusts the timeclock for the start and end of United States standard daylight savings time. If you do not want to use this option, set the field to *Disabled* by clicking the button next to *Disabled* in the pull-down Change Value window.

If you selected *Enabled* for the *Daylight Savings Time Automatic Changeover*, you may also change the dates when the automatic daylight savings time changeover occurs. The dates are in the format [First, Second, Third, Fourth, Last] [day of week] in [month]. For example, *Last Sunday in October*. The default values are the start and end dates used in the United States.

Calendar Timeclock Time/Date

The correct time and date are set at the factory before shipment. If the switch operator is installed in a different time zone, you may need to reset the time and perhaps even the date. There are separate Change Value windows for every element of the information in this field, including the hours, minutes, and seconds, as well as the day, month, and date. To change any part of this field, simply position the double arrow icon over the specific area of interest and left-click your mouse to gain access to the relevant Change Value window.

If *Daylight Savings Time Automatic Changeover* is enabled, the time/date statement includes the current daylight savings time status, for example:

Wednesday, March 30, 1998 10:43:08 Standard Time

The switch operator uses this information for data logging and event recording. Note that the *Daylight Savings Time Automatic Changeover* can be either enabled or disabled, but the date of the changeover if enabled will always occur at the standard changeover date that is presently used in the United States. The date of the changeover cannot be reset.

Physical Location

Enter your company's standard location identification information (for example, "Switch #2248, 863 Main St., Centerville"). This information can help identify the switch and appears on all reports generated from the Switch Operator. Note that this information does not affect the actual function of the Switch Operator. The actions of the Switch Operator will not change in any way if this field is left blank.

Cabinet Heater On Below this Temperature and Off Above this Temperature

The cabinet heater provides heat to improve battery carryover in cold weather, and reduce condensation buildup on the mechanical components. You can normally leave these setpoints at the factory default values. If you observe excessive moisture inside the cabinet after several weeks or months of operation, raise the values for better protection. Do not lower the values unless you are confident that condensation will not be a problem through all seasons.

NOTICE

It is important to maintain a 15 degree spread between the *Heater On* and *Heater Off* temperatures. If this spread is too narrow, the heater will cycle on and off excessively.

Setup: Switch Operator

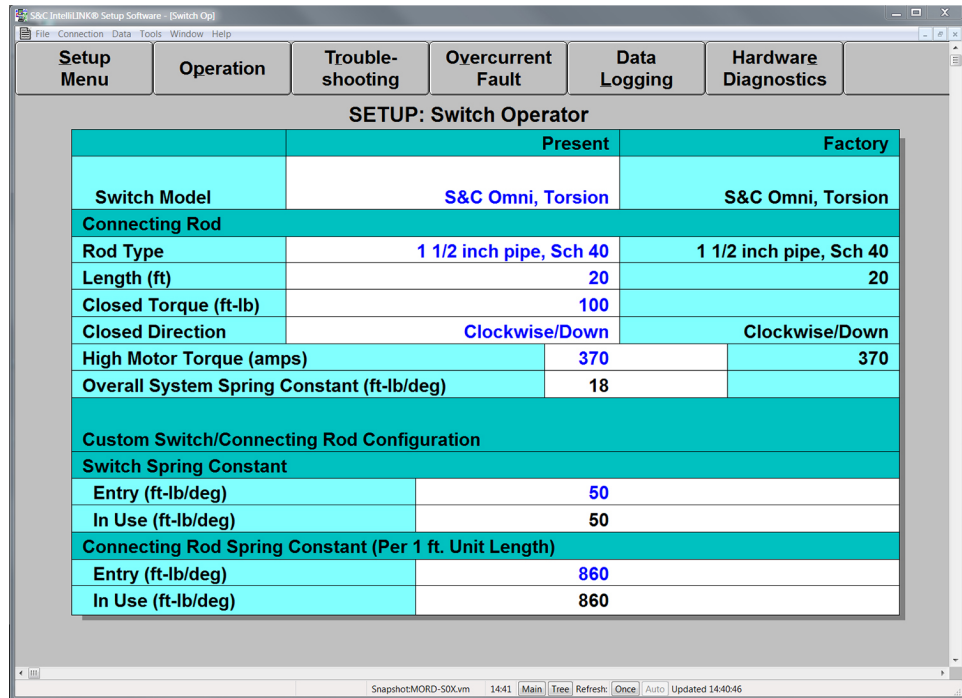


Figure 5. Setup Switch Operator screen.

Switch Model

The pull-down menu for this field lists five commonly used switch types. If the switch in use at your present location is not available as a selection, click on *Other Torsion* (for a rotational operator) or *Other Recip* (for a reciprocating operator). You will note that when you select one of the five switches named in the field, other information in the Setup window such as the *Closed Direction* and the *Overall System Spring Constant* will change automatically. The switch operator software is programmed to provide this information.

When the *Switch Model* field is reset, the default *Closed Direction* (see below) is also reset and the travel limits must be reset. Be sure to review the *Closed Direction* setting after modifying the *Switch Model*.

Rod Type

The pull-down menu for this field lists four common control rod types, along with an *Other/Custom* setting. It is important to give an accurate specification for the control rod, because the switch operator uses this information when determining the amount of rotation of the gearbox output shaft that is necessary to apply a given amount of force to hold the switch contacts in the closed position. A thinner, weaker control rod will require additional gearbox rotation to provide the desired amount of closing force or torque, and this extra rotation will be accurately calculated by the switch operator software only if correct control rod information is entered in the Switch Operator window. For this reason, installation will be simpler if you select one of the frequently-used types of control rod. A custom or non-standard control rod may require the services of an engineer to make the required spring constant measurement. Note that when you select a different type of control rod from the menu list, you will immediately see a corresponding change in the *Connecting Rod Spring Constant In Use* field at the bottom of the window.

Length (ft)

This is the length (in feet) of the connecting rod. A longer rod will have a smaller spring constant (force per displacement) than a shorter rod of the same material. This will affect the closing force applied to the switch, so it is important to measure the connecting rod length accurately.

Closed Torque (ft-lb)

This value is the desired final resting torque (in ft-lb) that the switch operator applies to the switch to hold the switch closed after a normal close operation. You can use this setpoint to apply additional torque beyond that selected in the control hardware (see below). This setpoint causes the motor to be turned off later during the operation, forcing the control rod to a higher final torque. The maximum value that can be set is *300 ft-lb*.

NOTICE

The closed torque setpoint should be configured as follows to maximize the fault close capability of the M Series Switch Operator when used with the S&C Omni-Rupter Switch.

- Switches using a rotating operating rod should have the closed torque set at the maximum of *300 ft-lbs*. No other requirements apply.
- Switches using a reciprocating operating rod (1" fiberglass or steel) should have the closed torque set at *200 ft-lbs*. Refer to Instruction Sheet 1051-510 *Installation* for the installation requirement).

The factory-set spiral wound load resistor adjustment determines the minimum value of the closed torque. This value is applied automatically during the setting of the close setpoint operation.

Closed Direction

This is the direction that the connecting rod must travel to close the overhead switch. For the rotating unit, the direction (Clockwise, Counterclockwise) is defined as viewed from the switch operator looking up towards the overhead switch. For the reciprocating switch, the direction is defined as viewing the movement of the output crank arm through the switch operator front panel (Clockwise is up, Counterclockwise is down on the operating rod).

NOTICE

In the setpoints described below, the term *Spring Constant* refers to a measure of the mechanical capacitance (unit of force per unit of displacement) of the described mechanical component. For a linear spring, it refers to the load required for a given linear displacement resulting from compression and/or bending. For a rotating spring, it refers to the torque required for a given angular displacement (rotation in degrees or radians). It is clear that a weaker spring will have a smaller capacitance than a stronger spring. That is, it will require a smaller force to create a similar angular or linear displacement. In the discussion below, all spring constants relate to the force applied to the control rod with the overhead switch blades being closed, and the connecting rod being torqued or tensioned/compressed in the closed direction.

Example—A rotating component with a spring constant of 20 ft-lb/degree will require 20 ft-lbs of torque for a 1 degree angular displacement, 40 ft-lbs of torque for a 2 degree angular displacement, and 200 ft-lbs of torque for a 10 degree angular displacement.

High Motor Torque (amps)

If the sampled current from 125 mS after the close or open operation has started until 1.6 seconds has elapsed exceeds this setpoint, it is assumed that an obstruction has been encountered or the switch operator has a mechanical problem. A status event and a chronological log entry are performed for this alarm.

NOTE: In the setpoints described below, the term “Spring Constant” refers to a measure of the mechanical capacitance of the described value. For a linear spring, it refers to the load required for a given linear displacement. For a torsional spring, it refers to the torque required for a given angular displacement. (For example, a component with a spring constant of 20 ft-lb/degree will require 20 ft-lbs of torque for a 1 degree angular displacement, 40 ft-lbs of torque for a 2 degree angular displacement and 200 ft-lbs of torque for a 10 degree angular displacement.)

Overall System Spring Constant (ft-lb/deg)

The switch operator software uses information that you select or enter on the *Switch Operator* screen to calculate the overall system spring constant of the installed switch operator (in ft-lb/deg). This calculation is done automatically and you cannot enter information in this field. You will further observe that if you alter, for example, the length of the control rod, the *Overall System Spring Constant* will be immediately recalculated and the number in the window will change. This constant represents a sum of the properties of the overhead switch and control rod components, and is used by the switch operator software for making calculations of stopping distance. Since the control rod is usually much more “springy” than the overhead switch, the properties of the rod will tend to dominate the *Overall System Spring Constant*. The length of the control rod is especially important because long rods have a relatively low spring constant.

Custom Switch/Connecting Rod Configuration

If the switch model or connecting rod type for this installation was not listed in the pull-down menus, you must use these setpoints to enter additional information about the components that you are actually using in your switch operator installation.

Switch Spring Constant Entry

If you selected *Other* for the switch model above, you must enter the correct switch spring constant (in ft-lb/deg). This constant can be obtained from the switch manufacturer or determined experimentally by an engineer.

Switch Spring Constant In Use

This field displays the switch spring constant in use. If the *Switch Model* is *Other*, the switch operator uses the *Switch Spring Constant Entry* (see above). Otherwise, it uses the switch spring constant for the specific switch model chosen.

Connecting Rod Spring Constant Entry

If you selected *Other* for the connecting rod type above, enter the connecting rod spring constant (in ft-lb/deg) per unit length (1 foot). See the discussion at the end of this instruction sheet for more details on calculating the connecting rod spring constant. The assistance of an engineer may be required.

Connecting Rod Spring Constant In Use

This field displays the connecting rod spring constant that the switch operator software uses to calculate the overall system spring constant. If the *Connecting Rod Type* is *Other*, the Switch Operator uses the *Connecting Rod Spring Constant Entry*. Otherwise, it uses the connecting rod spring constant for the specific connecting rod type chosen.

CAUTION

For the connecting rod used in a reciprocating-type switch operator, the *Spring Constant* refers to a bending or buckling type of deformation, not a twisting or torque (in this case, compression is relatively unimportant compared to bending). As a reciprocating-type connecting rod gets longer, this bending type of deformation will increase very rapidly. For this reason, when planning the installation of a reciprocating switch operator, you can help to avoid potential connecting rod problems by keeping the rod as short as possible. You should also make sure that any required guide rings are properly positioned and do not add excessive friction to the movement of the connecting rod.

Setup: Site-Related

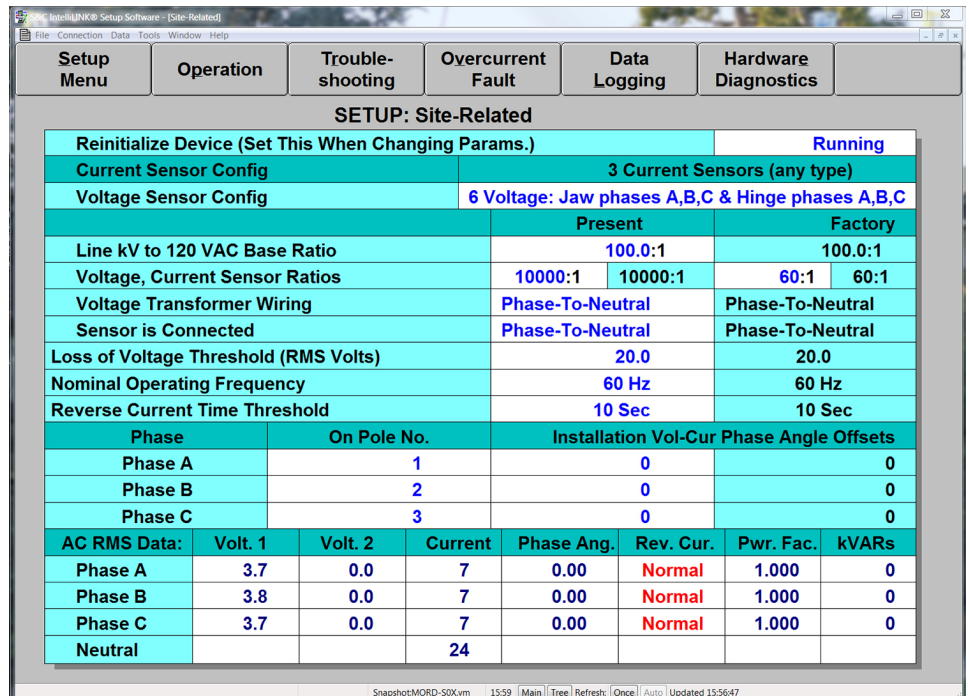


Figure 6. Setup Site Related screen.

The upper part of this setup screen allows you to enter all the installation-dependent parameters associated with ac waveform analysis. The lower part of the screen displays real-time data produced by the ac waveform analysis.

The switch operator supports the reporting of voltage as either *phase-to-phase* (delta) or *phase-to-neutral* (wye) and always displays voltage on a nominal 120 VAC base. This is useful for comparing the measured voltages against those seen by customer loads.

About Delta Voltage Reporting

The switch operator sensor conditioning module measures primary phase-to-phase voltage. The switch operator scales this voltage, using the specified *Voltage Sensor Ratio* and the *Line kV to 120 VAC Base Ratio* to yield a nominal 120 Vac value.

NOTE: For delta voltage reporting, be sure that the *delta* jumper is installed on the sensor conditioning module. Also be sure to specify the value *Phase-To-Phase* for the *Voltage Transformer Wiring* parameter.

About Wye Voltage Reporting

For wye voltage reporting, the switch operator sensor conditioning module measures primary phase-to-neutral voltage, and the switch operator scales the voltage to a nominal 120 Vac value.

NOTE: For wye voltage reporting, be sure that the *wye* jumper is installed on the sensor conditioning module. Also be sure to specify the value *Phase-To-Neutral* for the *Voltage Transformer Wiring* parameter.

For more information about how the switch operator processes sensor data, see Instruction Sheet 1051-540 *Operation*.

Reinitialize Device (set this after any parameter change)

The switch operator looks at the setup information only on startup. To have new information take effect, you must *Reinitialize* the switch operator.

Current Sensor Configuration

The switch operator presumes a factory-determined *Three Current Sensors*. The current sensor ratio is set below.

Voltage Sensor Configuration

This is the number (and location) of sensors on the line switch. Leave this field at the factory default *3 Voltage: Jaw phases A, B, C*, unless the switch operator has the proper hardware to support additional voltage sensors on the hinge side of the switch.

Selecting *6 Voltage: Jaw phases A, B, C & Hinge phases A, B, C* supports use of up to three additional sensors on the hinge side. These voltage sensors are not used in sectionalizing, and are for voltage reporting on the other side of the switch. Either 1 or 3 sensors can be configured, and the same number of voltage sensors are used on each side of the switch when this sensor arrangement is selected. The switch operator still supports either one or three voltage sensors on the jaw-side. Confirm that your switch operator has proper hardware support for the selected voltage sensor configuration.

Line kV to 120 VAC Base Ratio

This is the voltage step-down ratio of customer load transformers on the feeder. The switch operator records, displays, and manipulates voltages normalized on a 120 volt base. This parameter provides the conversion ratio to the 120 volt base.

Be sure to enter the ratio for transformers which are wired the same way (phase-to-phase or phase-to-neutral) as the value you enter for the *Voltage Transformer Wiring* parameter below.

Voltage, Current Sensor Ratios

These ratios are *transfer ratios* rather than *turns ratios*. A transfer ratio is the ratio of maximum positive sensor input to the maximum positive sensor output. Please note that the input/output for a current sensor can be current -> voltage or current -> current—in either case, the transfer ratio should be maximum positive input divided by the maximum positive output.

Voltage Transformer Wiring

This configures the switch operator for customer voltage reporting. It also uses this information when it calculates kVARs.

For delta voltage reporting, specify *Phase-To-Phase* for this parameter. For wye voltage reporting, specify *Phase-To-Neutral* for this parameter.

Loss of Voltage Threshold (RMS Volts)

When the voltage level drops below this value (on a 120 volt base), the switch operator assumes that power is no longer being supplied to the phase being monitored.

For customer transformers connected phase-to-neutral, you can normally leave this at the factory default value 20.0.

For customer transformers connected phase-to-phase, the loss of one phase results in sensor readings with magnitudes slightly more than 1/2 of normal phase-to-phase voltage. To detect phase loss with the loss of one phase, set the *Loss of Voltage Threshold* (or the *Phase Loss Protection Voltage Loss Threshold* on the *Setup: Automatic Operation* screen) to a slightly higher value than the expected voltage level. A threshold of approximately 75% of the normal phase voltage is recommended.

Loss of voltage is detected by the switch operator's true RMS transducer circuits, which have some built-in latency. The following table shows how the *Loss of Voltage Threshold* value affects the speed of detection of complete voltage loss and recloser counting:

Loss Threshold VAC, 120 VAC nominal	Maximum Detection Time	
	Cycles	Seconds
60	11	0.169
15	15	0.244
5	18	0.300
3	20	0.332

NOTE: Backfeed from customer loads also affects the speed of voltage loss detection. You should enter a threshold value that is high enough to detect the loss of voltage before service is resumed (typically no less than 0.6 seconds for a fast reclose cycle), and low enough to insure that loss of voltage is not falsely detected due to system overload or persistent backfeed.

Reverse Current Time Threshold

This parameter dictates how long a detected change in current direction must persist before it is qualified by the control and annunciated. This includes the change from normal current to reverse and the change from the reverse condition back to normal. The allowable qualification times are: *from one to sixty seconds*, *from one to sixty minutes*, *from one to twelve hours*, and *DISABLED*. If the qualification time is set to *DISABLED*, no detected reverse current condition will be annunciated or reported by the switch operator and any existing annunciated reverse current condition will be cleared.

On Pole Number

If your physical lines are not arranged as A:B:C on the poles, use this to map them into a logical A:B:C arrangement.

Installation Volt-Cur Phase Angle Offsets

These setpoints (one for each voltage-current phase) allow you to make installation dependent phase angle corrections. The switch operator uses these corrections to determine the Normal and Reverse directions of current flow. The switch operator also uses these corrections to calculate power factor and kVARs. We recommend that the sensors face the substation end of the feeder. As you make the adjustments, keep in mind that:

Phase angle detection and display require a minimum current of 0.75% of full scale (6A at 800A full scale). Current magnitudes continue to be detected and displayed below this level.

To see the effect of any changed offset values on real-time data, you must reinitialize the switch control.

Real Time Data

The lower part of this screen displays real-time data values for Phases A, B, C, and Neutral. The switch operator creates these values from raw sensor data and the information you enter on the setup screens. You can use the real-time data to immediately check the effect of any change you make in the upper part of the screen.

Voltage

This is the present value of the distribution line voltage, transformed to a nominal 120 Vac base. The switch operator uses this as the input sensed value when it calculates the primary voltage.

Current

This is the current, as measured by the current sensor and scaled according to the correction factors entered on the *Setup: Sensor Configuration* screen.

Phase Angle

This is the corrected phase angle (the offset of the current waveform referenced to the voltage after all setup correction factors have been applied). When the switch operator is properly set up, these corrected phase angles will all be 0 +/- 89.9 degrees. Lagging phase angles are represented as values between 0 and 90 degrees. Leading phase angles are represented as values between 0 and -90 degrees.

Reverse Current

When the switch operator is properly set up and power is flowing through the circuit in the normal direction, these three fields are all blank. If unusual circuit switching conditions cause the direction of current flow to reverse, the value in all three fields changes to *Active*.

Power Factor

This is the power factor calculated as the cosine of the value in the *Phase Ang.* field. Leading power factors are represented by negative numbers.

kVARs

The switch operator uses the line-to-neutral voltage, the current, and the sine of the phase angle to calculate the kVAR (kilovolts-amperes, reactive) value.

Setup: Fault Detection

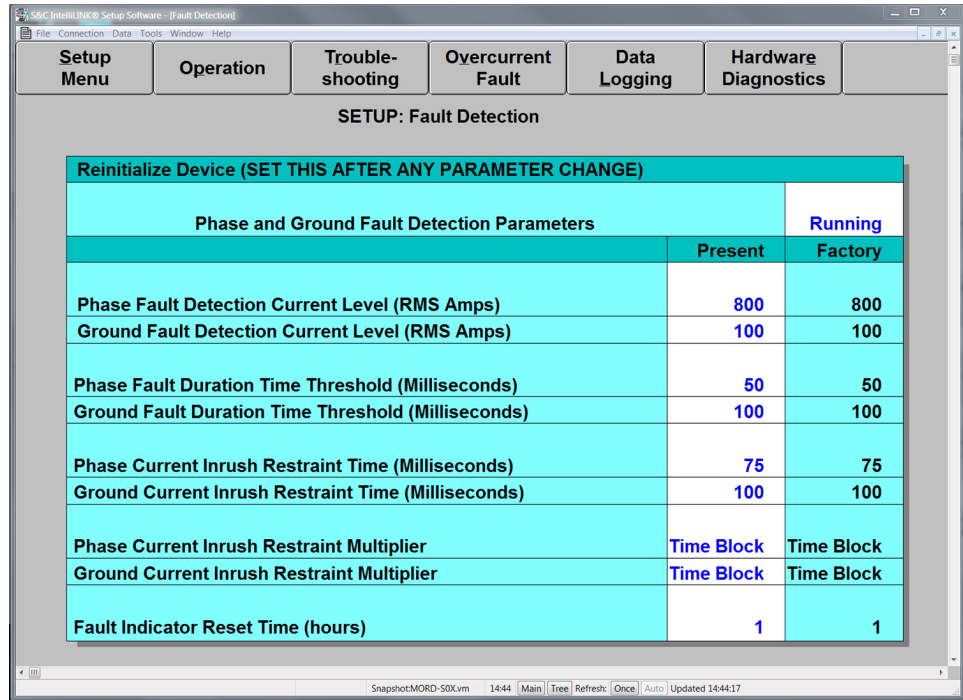


Figure 7. Setup Fault Detection screen.

If power has been continuously present and the switch operator senses that current (on any phase) is greater than the *Phase Fault Detection Current Level* setpoint, the switch operator starts the *Phase Fault Duration Time Threshold* timer.

If the current drops below the *Phase Fault Detection...* setpoint before this timer expires, the switch operator ignores the overcurrent condition. If the phase overcurrent is still continuously present when the timer expires, the switch operator registers an overcurrent fault and takes all appropriate actions.

For ground overcurrent conditions, the switch operator follows the procedure described above, but uses the *Ground Fault Detection...*, and *Ground Fault Duration...* values instead of the *Phase Fault...* values.

NOTE: Following a voltage outage, if the switch is closed and voltage rises above the *Loss of Voltage* threshold on all phases or an overcurrent is detected on any phase, the switch operator starts the *Phase Current Inrush Restraint* timer and the *Ground Current Inrush Restraint* timer. The behavior of the switch operator during the Inrush Restraint period depends on the values selected for the *Phase Current Inrush Restraint Multiplier* and *Ground Current Inrush Restraint Multiplier*.

For more information about the fault detection system, see the following screens and Instruction Sheet 1051-540 *Operation*.

Reinitialize Device (Set this after any parameter change)

The switch operator looks at the setup information only on startup. To have new information take effect immediately, you must reinitialize the switch operator.

Phase Fault Detection Current Level (RMS Amps)

This is the RMS level of current required (on any phase) to indicate the presence of a possible phase overcurrent (fault) condition.

Ground Fault Detection Current Level (RMS Amps)

This is the RMS level of neutral or ground current required to indicate the presence of a possible ground overcurrent (fault) condition.

Set the *Ground Fault Detection Current Level* to the minimum ground trip current of the protective device in use (recloser, breaker, etc.).—Find the time-current for the chosen *Ground Fault Detection Current Level*.—Compare the time-current curves to the time-current curve for the protective device (the curve for the protective device should include the mechanical operating time). We recommend that the switch operator's response time be less than 75% of the protective device's response time.

If necessary, reduce the *Ground Fault Detection Current Level* value until the switch operator's response time is short enough. For more details on ground fault detection, see Instruction Sheet 1051-540 *Operation*.

Phase Fault Duration Time Threshold (Milliseconds)

This is the amount of time that a detected phase overcurrent condition must be continuously present before the switch operator will register a phase overcurrent fault. The resolution of this value is 6.25 milliseconds (approximately 1/3 cycle).

Ground Fault Duration Time Threshold (Milliseconds)

This is the amount of time that a detected ground overcurrent condition must be continuously present before the switch operator will register a ground overcurrent fault.

The resolution of this value is 50 milliseconds (3 cycles). Set the field to the fastest reaction time of the protective device, rounded down to the nearest multiple of 50 milliseconds. (Setting this field to 0 or 50 milliseconds will yield the same effective time threshold of 50 milliseconds.)

NOTE: The switch operator will detect brief, high current faults with a duration shorter than the *Ground Fault Duration Time Threshold*. For more details on ground fault detection, see Instruction Sheet 1051-540 *Operation*.

Phase Current Inrush Restraint Time (Milliseconds)

Following a voltage outage, this is the amount of time that must elapse after restoration of voltage before the switch operator will respond normally to a phase overcurrent fault condition. During this time period, the response of the switch operator is determined by the *Phase Current Inrush Restraint Multiplier* setting.

This specialized response (immediately after restoration of voltage) prevents the switch operator from falsely indicating phase faults due to inrush or cold load pickup conditions.

Ground Current Inrush Restraint Time (Milliseconds)

Following a voltage outage, this is the amount of time that must elapse after restoration of voltage before the switch operator will respond normally to a ground overcurrent fault condition. During this time period, the response of the switch operator is determined by the *Ground Current Inrush Restraint Multiplier* setting.

This specialized response (immediately after restoration of voltage) prevents the switch operator from falsely indicating ground faults due to inrush or cold load pickup conditions.

Phase Current Inrush Restraint Multiplier

The switch operator uses this setting to determine how to respond to phase overcurrent conditions that occur during the specified *Phase Current Inrush Restraint Time*.

If the *Phase Current Inrush Restraint Multiplier* is set to *Time Block*, the switch operator ignores all phase overcurrent conditions during the *Phase Current Inrush Restraint Time*.

If the *Phase Current Inrush Restraint Multiplier* is set to $2x$, $4x$, $8x$, or $16x$, the switch operator responds to fault conditions that exceed the *Phase Fault Detection Current Level* by the specified multiplier value. When the *Phase Current Inrush Restraint Time* expires, the switch operator responds to all faults that exceed the *Phase Fault Detection Current Level* value.

Ground Current Inrush Restraint Multiplier

The switch operator uses this setting to determine how to respond to ground overcurrent conditions that occur during the specified *Ground Current Inrush Restraint Time*. (See *Phase Current Inrush Restraint Multiplier* above for details.)

Setup: Automatic Operation

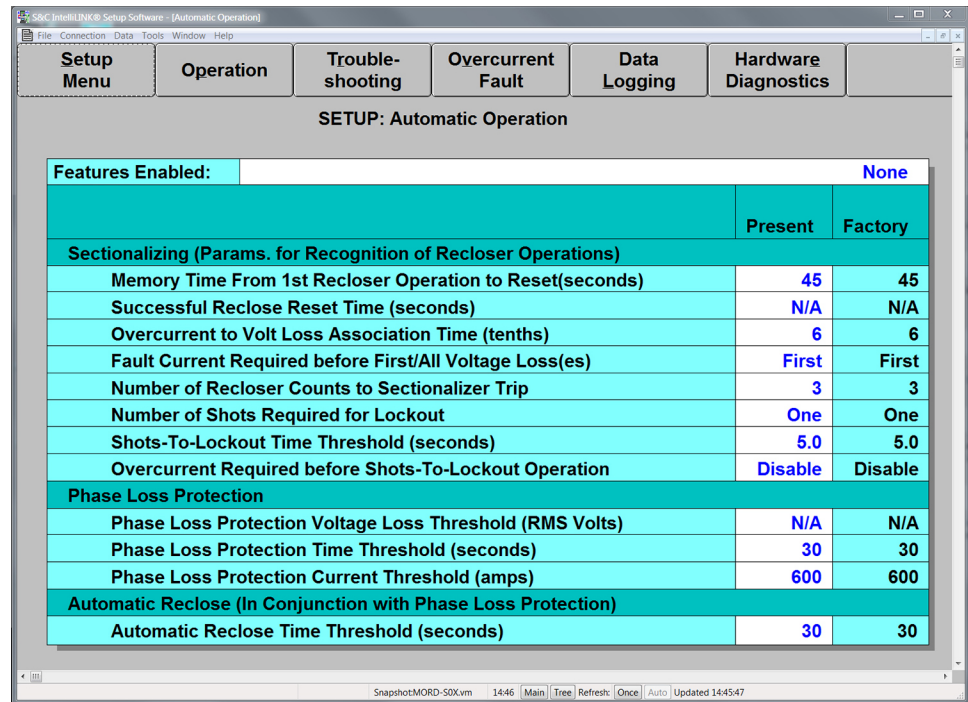


Figure 8. Setup Automatic Operation screen.

Features Enabled (also shown on the *Operation* screen)

The switch operator can carry out the following automatic operations:

- **None**—all automatic-operation features disabled.
- **Sectionalizing**—The switch operator monitors conditions associated with recloser operation, and sectionalizes the line based on a combination of overcurrent, loss-of-voltage, and other sensed parameters.
- **Phase Loss Protection**—The switch operator opens the switch based on loss-of-voltage on one or two individual phases.
- **Phase Loss Protection with Automatic Reclose**—The switch operator opens the switch based on loss-of-voltage on one or two individual phases. Then it recloses the switch once sensed 3-phase voltage is present for a specified length of time. (The software does NOT close the switch if it was opened for any reason other than Phase Loss Protection.)

NOTE: If you select one of the automatic operation options, you can use the faceplate automatic operation ENABLE/DISABLE switch or a SCADA command to disable automatic operation. If you select *None*, the control software puts the switch control in automatic operation DISABLED mode, and ignores all commands from the faceplate automatic operation ENABLE/DISABLE switch. You also cannot enable automatic operation from the SCADA master station.

NOTE: Total loss of power to the switch control (because of complete battery discharge and no AC power) will cancel all automatic operations in progress.

Sectionalizing (Parameters for Recognition of Recloser Operations)

If sectionalizing is enabled and the switch operator recognizes a 3-phase voltage outage, it starts the *Memory Time From 1st Recloser Operation to Reset* timer and begins to count trip operations. If 3-phase voltage is present with no faults detected it starts the *Successful Reclose Reset Time* timer. If the reclose count reaches the *Number of Recloser Counts to Sectionalizer Trip* setpoint before the timer expires, and an overcurrent preceded the appropriate number of outages in the sequence, the control trips open the switch. If the timer expires before the *Number of Recloser Counts...* value is reached, the control resets the timer and the counter to zero.

Memory Time From 1st Recloser Operation to Reset (seconds)

This timer will open the line switch if all three phases are continuously below the *Loss of Voltage Threshold*, in the *Site Related* section, for the duration of this set point.

Set this value to a time five seconds longer than the maximum lockout time for the normal source-side protective device. This ensures that the loss of voltage is not a temporary condition and that the normal source-side protective device has reached its lockout state.

Successful Reclose Reset Time (seconds)

If three-phase voltage is continuously present, without faults, for this amount of time (in seconds), the switch operator considers the source-side protective device to have had a successful reclose. When this timer expires, the control resets the sectionalizing timers and counters to zero.

Use this set point if Successful Reclose Reset Time has been implemented in the source-side protective device. Set the value to the same value as the source-side protective device. If the source-side protective device does not use this reset scheme, set the value to *N/A*; the switch operator will use the *Sectionalizer Reset and Extended Voltage Loss Time* to reset the count.

Overcurrent to Volt Loss Association Time (tenths)

This setpoint defines the time interval between the end of a detected overcurrent event and the start of a detected three-phase voltage loss for the purpose of associating the two events to count breaker operations.

Under normal circuit conditions, you should leave this set to the factory default of *6 tenths*. If you know that your line voltage will be supported for an abnormal period of time following the breaker operation you can adjust this setpoint to account for it.

Fault Current Required before First/All Voltage Loss(es)

For the switch operator to trip open the switch due to a fault, it must detect and count fault current and voltage loss events. If you set this setpoint to *All*, the switch operator only increments the counts if it detected a fault current before every voltage loss. Any voltage loss without an associated fault current disarms the sectionalizer. If you set it to *First*, the switch operator must detect fault current before the first voltage loss only. After that, the recloser operation count increments with each voltage loss. If the count is reset, the next voltage loss must be preceded by fault current for the switch operator to start counting again.

The default value is *First* because the current transformers are load metering CTs (not fault current CTs). After the first fault, they may not register subsequent faults correctly.

Number of Recloser Counts to Sectionalizer Trip, Fault Detected

This is the number of three-phase voltage losses associated with fault current that will cause the control to open the line switch.

The switch operator trips open the line switch when all of the following are true:

- The switch operator detects a number of three-phase voltage losses equal to the *Recloser Counts to Sectionalizer Trip, Fault Detected* set point.
- Sectionalizing is enabled.
- An overcurrent fault preceded the number of voltage losses set by the *Fault Current Required before First/All Voltage Loss(es)* setpoint.

For example, if the applicable value is 3, the switch operator trips open the line switch on the third qualifying voltage outage.

Number of Recloser Counts to Sectionalizer Trip, Voltage Loss Only

When sectionalizing is enabled and the switch operator detects this number of three-phase voltage losses, with no fault current, the control opens the line switch. For example, if you set this value to 3, the switch operator trips open the line switch on the third qualifying voltage outage.

Number of Shots Required for Lockout

Should a source side breaker or switch inadvertently close into a fault, this is the number of three-phase voltage losses that the switch operator must detect during the *Shots-To-Lockout Time Threshold* before it trips open the switch. The switch operator can lock out after either one voltage loss or two voltage losses. You should normally set this value to *One* unless the breaker with which you are coordinating uses an instantaneous reclose feature.

Shots-To-Lockout Time Threshold (seconds)

This is the number of seconds that the *shots-to-lockout* timer runs. If the applicable number of three-phase voltage losses (see *Number of Shots Required for Lockout*) occurs during this time period, the switch operator trips open the switch. To enable the *shots-to-lockout* feature, you must set this time to a value greater than zero.

During circuit reconfiguration the *shots-to-lockout* timer is always used if enabled. When IntelliTeam II closes a switch to restore load it will wait the *Shots-to-Lockout Time Threshold* before progressing to the next switch. This delay helps to verify that each switch will remain closed as the circuit reconfiguration continues.

Overcurrent Required before Shots-To-Lockout Operation

Enable this setpoint if you want the *shots-to-lockout* feature to reopen the switch only if the three-phase voltage loss was preceded by an overcurrent. The *shots-to-lockout* feature was designed to look only at voltage loss to detect a breaker trip. This guards against mis-operation due to an incorrect fault detection or inrush restraint setting. If your system circuit breakers trip on inrush current, we recommend enabling this setpoint.

If the *Number of Shots Required for Lockout* is set to 2, the relationship between the detection of overcurrent and voltage losses follows the *Fault Current Required before First/All Voltage Loss(es)* setpoint.

Phase Loss Protection

If Phase Loss Protection is enabled and the switch operator detects a loss-of-voltage on one or two phases, it starts the *Phase Loss Protection Time Threshold*. If the voltage loss persists and true RMS current remains below the setpoint until the timer expires, the control trips open the switch. If voltage returns on one phase but is then lost on another phase, the switch operator restarts the timer.

With a wye-configured sensor conditioning module, if a phase loses voltage, the voltage reading is 0 for that phase. A phase imbalance is easily detected.

With a delta-configured sensor conditioning module, the loss of one phase results in sensor readings with magnitudes slightly more than 1/2 of normal phase-to-phase voltage.

NOTE: With a delta-configured sensor conditioning module, simultaneous loss of two phases is not detectable as a phase imbalance condition.

Phase Loss Protection Voltage Loss Threshold (RMS Volts)

When voltage on one or two phases drops below this value, the switch operator starts the *Phase Loss Protection Time Threshold*. If the voltage stays continuously below this voltage until the timer expires, the control opens the line switch. When this setpoint is set to *N/A*, the switch operator uses the *Loss of Voltage Threshold* (on the *SETUP: Site-Related* screen) for both three-phase voltage loss and for phase loss protection. A higher value for this setpoint lets the switch operator detect phase loss conditions where there are delta-connected transformers and still provide accurate sensing of true three-phase outages. A threshold of approximately 75% of the normal phase voltage is recommended, that is 90 volts on a 120-volt base.

When this setpoint is set to other than *N/A* it is also used as the *Return of Voltage* threshold.

Phase Loss Protection Time Threshold (seconds)

This is the number of seconds that the switch operator waits after it detects a loss of phase voltage before it trips open the switch. When the timer expires, if the voltage on one or two phases has remained below the *Phase Loss Protection Voltage Loss Threshold*, and the current has remained continuously below the *Phase Loss Protection Current Threshold* (see below), the control trips open the line switch.

At a minimum, this time should exceed the reaction time of any single-phase sourceside protective device.

Phase Loss Protection Current Threshold (amps)

If there is a phase imbalance condition and the true RMS current on each energized phase remains continuously below this value for the time specified for the *Phase Loss Protection Time Threshold* (see above), the switch control trips open the switch.

If the current fluctuates above and below this value, the switch control will delay the Open operation indefinitely.

NOTE: The response time for the true RMS detectors is several tenths of a second. Be sure to select a conservative value for the *Phase Loss Protection Current Threshold*—one that is clearly below the load break rating for the switch.

Automatic Reclose (In Conjunction with Phase Loss Protection)

When Automatic Reclose is enabled and the switch is tripped open because of a phase imbalance, the switch operator recloses the switch once voltage is again present on all three phases.

Automatic Reclose Time Threshold (seconds)

When *Automatic Reclose* is enabled, this is the number of seconds that the switch operator waits (after three-phase voltage is sensed) before it recloses the switch.

Setup: Communications

	Present	Factory
Communications RTU Address	0	0
Application Layer Confirmations	Enabled	Enabled
Number of Confirmation Attempts	3	3
Time Delay Between Attempts	10 Sec	10 Sec
Unsolicited-Response Mode	Enabled-V3	Enabled-V3
Time Delay Between Restart Messages	60 Sec	60 Sec
Master Station RTU Address	0	0
Device Restart Message Transmit Delay	10 Sec	10 Sec

Figure 9. Setup Communications screen page 1.

This screen contains setpoints related to SCADA communications.

Communications RTU Address

If this switch operator will be accessed via SCADA communications, enter the network address for this switch operator installation.

CAUTION

If you move an already-configured switch operator to a new location, be sure to enter the NEW DNP address into the switch operator. If you leave the old address in the switch operator, it may respond to instructions meant for a different switch location.

Application Layer Confirmations

When this setpoint is configured *Enabled*, the switch operator requests an application layer confirmation from the SCADA master station every time an event message is transmitted. This includes null unsolicited response (restart) messages. If the operator does not receive a confirmation within a specified time period given by the setpoint, *Time Delay Between Attempts*, as described below, it retransmits the response. If this setpoint is configured *Disabled*, the operator will not request confirmation for event messages. Any event messages, including the null unsolicited response (restart) message, will be transmitted **one time only** regardless of whether the *Unsolicited-Response Mode*, described above, is configured *Enabled-V2* or *Enabled-V3*.

NOTE: Disabling this feature is NOT compliant with the DNP level-2 specification, but enabling this feature may add significant communication traffic to your communication network.

Number of Confirmation Attempts

If the **Application Layer Confirmations** setpoint is set to *Enabled*, the *Number of Confirmation Attempts* setpoint establishes the maximum number of times that the switch operator will transmit the unsolicited response when the switch operator does not receive an application layer confirmation from the SCADA master station in response to a transmitted event message. This maximum number also applies to the null unsolicited

response (restart) message transmitted upon device restart, if the *Unsolicited Response Mode*, described above, is configured *Enabled-V2*. Conversely, this set point does not apply in the special case of such restart messages if the *Unsolicited-Response Mode* is configured *Enabled-V3*. In the case where *Unsolicited Response Mode* is configured *Enabled-V3*, the start-up message is retransmitted indefinitely until it is confirmed. If the *Application Layer Confirmations* setpoint is configured *Disabled*, then all event messages, whether data-filled or not, are sent one time only regardless of the setting value of the *Unsolicited-Response Mode* setpoint. Each time the same unsolicited response message is retransmitted to the master station, a count of the number of attempts is incremented and compared with the maximum number of attempts, given by this set point. Whenever a new, unique, unsolicited response message is constructed and transmitted the count of the number of attempts is reset to one.

Time Delay Between Attempts

If the *Application Layer Confirmations* setpoint is set to *Enabled*, and the switch operator does not receive a confirmation within the time period defined by this set point, it retransmits the response, unless the message transmission is subject to limitation by the *Number of Confirmation Attempts*, defined above, and this limit has been reached. If a new event occurs while the operator is waiting for a previous unsolicited response message to be confirmed, the operator will wait until one of two conditions is true before acting on the new event. If the previous message is confirmed before this time delay expires, the operator will clear from the event queue, all of the events contained in the previous message, now confirmed. It will then immediately build a new unsolicited response message containing the new event(s) and transmit it. If the time defined by this setpoint expires before a confirmation of the previous message is received, the operator will build a new message, containing all of the events presently in the queue and transmit it to the master.

Unsolicited-Response Mode

This setpoint determines how the control behaves with respect to event messages. There are three possible settings: *Disabled*, *Enabled-V2*, and *Enabled-V3*.

When this setpoint is *Disabled*, the switch operator behavior will conform to the latest DNP level-2 specification for disabling the transmission of unsolicited event messages. No event messages of any kind will be transmitted to the SCADA master station. This includes null unsolicited response (restart) messages when the control restarts. If an *Enable Unsolicited DNP message*, application function code 0x14, is sent to the operator, the operator will respond by setting the Second IIN Octet, bit 0: Bad Function Code. Note that configuring this setpoint to *Disabled* will render the set points described above and below non-applicable and irrelevant to the behavior of the control.

When this setpoint is configured to any enabled setting, the switch operator sends an event to the SCADA master station every time a status point changes state or an analog event is generated. If this feature is enabled, you must also enter a master station address on this screen. See *Master Station Address*, below.

When this setpoint is configured *Enabled-V2*, the operator will re-transmit any unconfirmed event message, including null unsolicited response (restart) messages, until the count of the number of transmission attempts is equal to the number given by the *Number of Confirmation Attempts* set point, described below. Furthermore, the control will not wait to receive an *Enable Unsolicited DNP message* command, application function code 0x14, before transmitting event-containing unsolicited response messages to the SCADA master station. Note that the behavior given by the *Enabled-V2* setting is not DNP level-2 specification compliant. It is included to support previous communication functionality. Using this setting, may significantly reduce the amount of network traffic because the number of restart messages is limited when the SCADA master cannot or does not confirm. Conversely, use of this setting may increase traffic after a power loss and device restart because the devices do not wait for the *Enable Unsolicited DNP message* command, application function code 0x14, to be received before starting to transmit unsolicited response messages to the master station.

When this setpoint is configured *Enabled-V3*, the operator behavior conforms to the present DNP Level-2 requirements regarding event messages, unless this behavior is overridden by setting the *Application Layer Confirmations* set point, as described above, to the *Disabled* setting. This means that, at power up, null unsolicited responses are sent until a master station confirmation is received. Also, the control will not transmit any data-filled unsolicited response until it has received an *Enable Unsolicited DNP message* command, application function code 0x14.

NOTE: Enabling this feature may add significant communications traffic to your communications network.

Time Delay Between Restart Messages

If the *Application Layer Confirmations* setpoint is set to *Enabled*, this setpoint gives the unsolicited-retry time interval for null unsolicited response (restart) messages. If the switch operator did not receive a confirmation following a null unsolicited response (restart) message within this time period, it retransmits this unsolicited response. If the *Unsolicited-Response Mode* setpoint, described above, is configured *Enabled-V2*, an unconfirmed restart message will be retransmitted until the *Number of Confirmation Attempts* has been reached. If the *Unsolicited-Response Mode* setpoint is configured *Enabled-V3*, a restart message will be retransmitted at this time interval indefinitely, until it is confirmed.

Master Station RTU Address

This is the master station RTU address to which the switch operator sends all unsolicited responses. Leaving this address at “0” prevents the switch operator from generating unsolicited responses, whether or not the *Unsolicited Responses to Master Station* has been enabled.

Device Restart Message Transmit Delay

If the *Unsolicited-Response Mode* setpoint is configured as *Enabled-V2* or *Enabled-V3*, this setpoint establishes the delay between the restart of the switch operator and the transmission of the *Device Restart* unsolicited message. If your communication system needs time for acquisition following a restart, you can adjust this value to match the requirements.

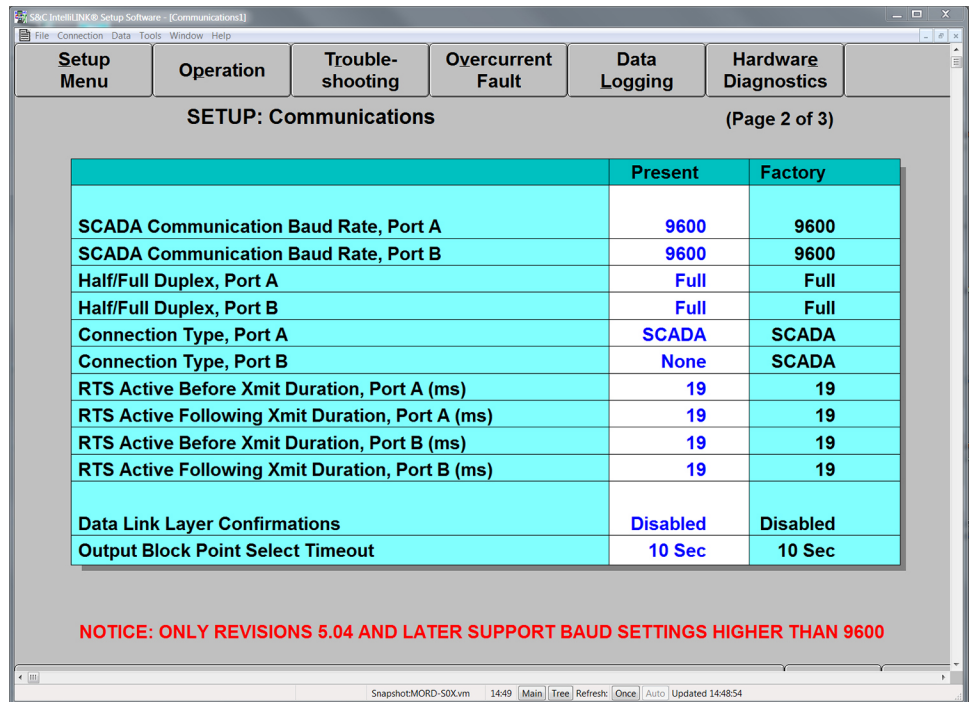


Figure 10. Setup Communications screen page 2.

SCADA Communication Baud Rate (Port A and Port B, if applicable)

If this switch operator is part of a SCADA system, set this value to the baud rate between the switch operator and the directly connected device (radio, modem, etc.). If this setpoint does not match the baud rate for the device, communications will not operate.

The DNP SCADA Communication Baud settings for ports A and B now support faster bauds of 19200 and 38400. Only switch operator software revisions 5.04 and later support baud settings higher than 9600.

Half/Full Duplex (Port A and Port B, if applicable)

Set this value to match the communication device (modem, radio, master station, another switch operator, etc.) connected to this port. Set it to *Full Duplex* when this port is connected to another control, or another full duplex device. Use *Half Duplex* when connected to a device using an intermediate comm buffer board, or other half duplex communications device.

Connection Type (Port A and Port B, if applicable)

This is the type of connection for this port. The setpoint defines how the switch operator handles communications.

- **None**—There is no connection to this port.
- **Non-Relay**—Messages received on this port are not intended for relay to any other directly connected switch operator. This setting also prevents the switch operator from recording errors if this port receives a message not addressed to the local switch operator.
- **SCADA**—This port is connected to a SCADA master station.
- **Direct**—This port is connected directly to another switch operator and is intended to relay messages to it.

RTS Active Before Xmit Duration (Port A and Port B, if applicable)

This is the amount of time (in milliseconds) that RTS “request to send” is active for this port before a transmission takes place. You can usually leave this at the factory-default value.

RTS Active Following Xmit Duration (Port A and Port B, if applicable)

This is the amount of time (in milliseconds) that RTS “request to send” is active after a transmission has taken place. You can usually leave this at the factory default value.

Data Link Layer Confirmations

When this field is set to *Enabled*, a data link layer function of suppresses losses and duplicate messages to a switch operator receiving requests. This function only affects messages that originated from a switch operator, not responses. You can generally leave this field enabled.

Output Block Point Select Timeout

This is the timeout duration of the Select function on control points. If the timeout duration is too short between the Select and the Operate functions during a Select-Before-Operate sequence, the switch operator disables the point and reports a failure to the master station (if applicable).

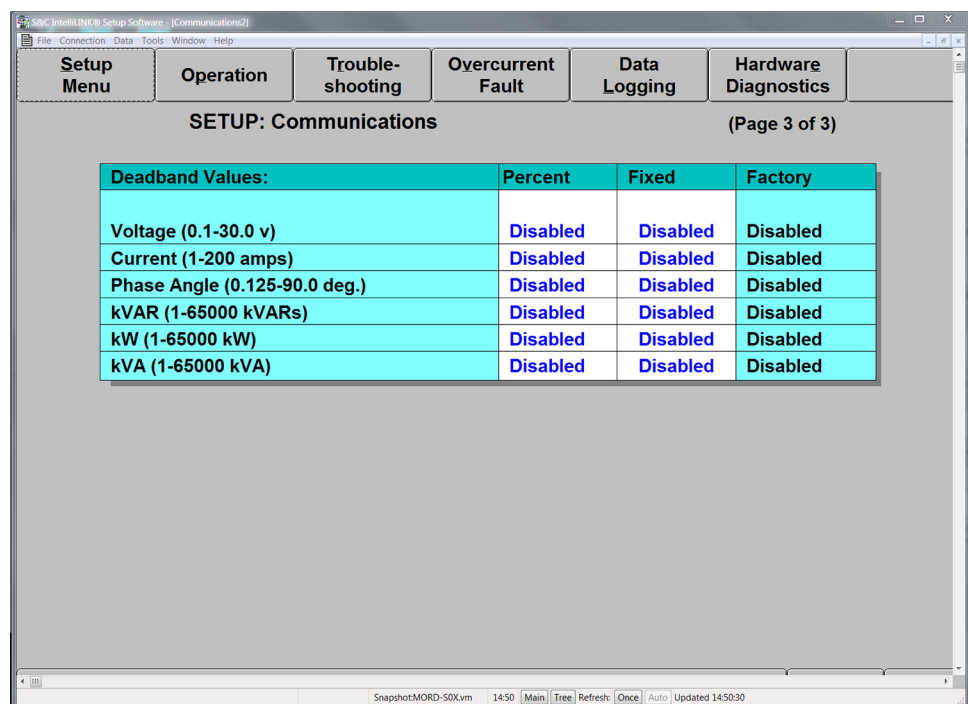


Figure 11. Setup Communications page 3.

Deadband Values

This is a variance value which if exceeded, captures the amount by which a measured parameter (voltage, current, kVARs etc.) deviated from a previously stored reference value. The amount of variance is stored as an Analog Event and the reference is updated to reflect the new measurement. The event threshold is adjustable to a maximum appropriate to the individual parameter. Reference values are initialized to reflect sensor values after a brief stabilization period after system start up. Deadband event sensing can be disabled on a per-parameter type basis by incrementing the value past maximum. The word *Disabled* will be displayed. To find the *Disabled* keyword, enter the last value in the deadband range and then scroll up one more entry.

Fixed deadbanding allows the user to select a fixed amount of variance, for example, 10 volts. Percent deadbanding allows the user to select a percentage variation, for example, if the previous voltage was 120 volts, a 10% deadband would generate a message when the voltage exceeds 120v + or - 10%.

Enable Normal Switch Operator Operation

1. If desired, review the present status of the switch operator on the *Operation* screen.
2. Exit IntelliLink—select *File > Exit*, then click **OK** to exit IntelliLink.
3. Turn off your computer, then disconnect it from the switch operator.
4. On the switch operator faceplate, set the *REMOTE/LOCAL* and *Automatic Operation ENABLE/DISABLE* switches for desired operation.

Calculating the Connecting Rod Spring Constant

If the connecting rod material being used is not one of the selections already available in the software, you must either calculate its spring constant or (preferably) obtain the information from the manufacturer of the material. The assistance of an engineer may be required. This section will help you determine the correct information.

Rotating Operator

The connecting rod spring constant for a rotating unit is described by the formula:

$$K_L = K_R \times L$$

where:

K_L = *Connecting Rod Spring Constant Entry*, as entered on the *Setup: Switch Operator* screen. This is the amount of rotating force (in ft-lbs) necessary to twist a 1-foot section of connecting rod 1°.

K_R = Overall connecting rod spring constant (in ft-lbs/deg). This is the amount of rotating force (in ft-lbs) necessary to twist the entire connecting rod 1°. The spring constant for the overall system is recalculated in real time and displayed on the *Setup: Switch Operator* screen, based on the present values of the related setpoints.

L = The total length of the connecting rod (in feet), as entered on the *Setup: Switch Operator* screen. Typically, a rotating connecting rod will be built in multiple sections, interconnected with flexible U-joints. In this case, “L” is the sum total of the length of the individual sections.

Reciprocating Operator

The connecting rod spring constant for the reciprocating unit is described by the same formula as the rotating unit. However, there are additional considerations based on the type of material and construction detail chosen for the connecting rod.

The spring constant used by the switch operator relates to the force used to hold the switch contacts closed. In a reciprocating installation, this usually requires compression of the connecting rod. Although the reciprocating control rod is compressed linearly, this compression will result in bending of the rod. In addition, the crank arm of the switch operator is rotationally driven. Thus, unless you are using 1-inch fiberglass rod (or another preset option for the material), you may need to actually measure the torque required to produce a given angular displacement of the switch operator crank arm, holding the switch-end of the control rod fixed. The assistance of an engineer may be required.

This completes the M Series Switch Operator Setup operation.

