Operating Instructions

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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 a 5800 Series Automatic Switch Control. Familiarize yourself with the Safety Information and Safety Precautions on pages 3 and 4. 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 your 5800 Series Automatic Switch Control. Designate a location where you 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.

Warranty

The warranty and/or obligations described in S&C's Price Sheet 150, "Standard Conditions of Sale–Immediate Purchasers in the United States," (or Price Sheet 153, "Standard Conditions of Sale–Immediate Purchasers Outside the United States,") plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of the seller's entire liability. In no event shall the seller's liability to the immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150 (or Price Sheet 153), and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 (OR PRICE SHEET 153) IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150 (or PRICE SHEET 153).

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to your 5800 Series Automatic Switch Control. Familiarize yourself with these types of messages and the importance of these various signal words:

⚠ DANGER

"DANGER" identifies the most serious and immediate hazards that will likely 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 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 the S&C Global Support and Monitoring Center at 1-888-762-1100.

NOTICE

Read this instruction sheet thoroughly and carefully before installing your a 5800 Series Automatic Switch Control.

Replacement Instructions and Labels

If additional copies of this instruction sheet are needed, 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.

⚠ DANGER

The 5800 Series Automatic Switch Control line voltage input range is 93 to 276 Vac. 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 the 5800 Series Automatic Switch Control must be restricted only to qualified persons. See the "Qualified Persons" section on page 2.
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. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.

Applicable Software

This instruction sheet was prepared for use with all stand-alone 5800 Series control software available as of September 2004:

SNCD2S0X Rev. 2.37, SNCD2S0V Rev. 2.31, PADD2S0X Rev. 2.37, USBD2S0X Rev. 2.30, and UDSD2S0X Rev. 2.26.

The revision number is on the setup disk label and on the IntelliLink® Setup Software *TROUBLESHOOTING: Control & Switch Information* screen. For questions regarding the applicability of information in this instruction sheet to future product releases, please contact S&C.

Switch Control Components

This section describes various switch control components. The following "Overview of Switch Control Operations" section explains how these components work together to monitor the distribution feeder and manage switch operation.

The Switch Control Modules

The switch control electronics modules are described in this section and are shown in Figure 1.

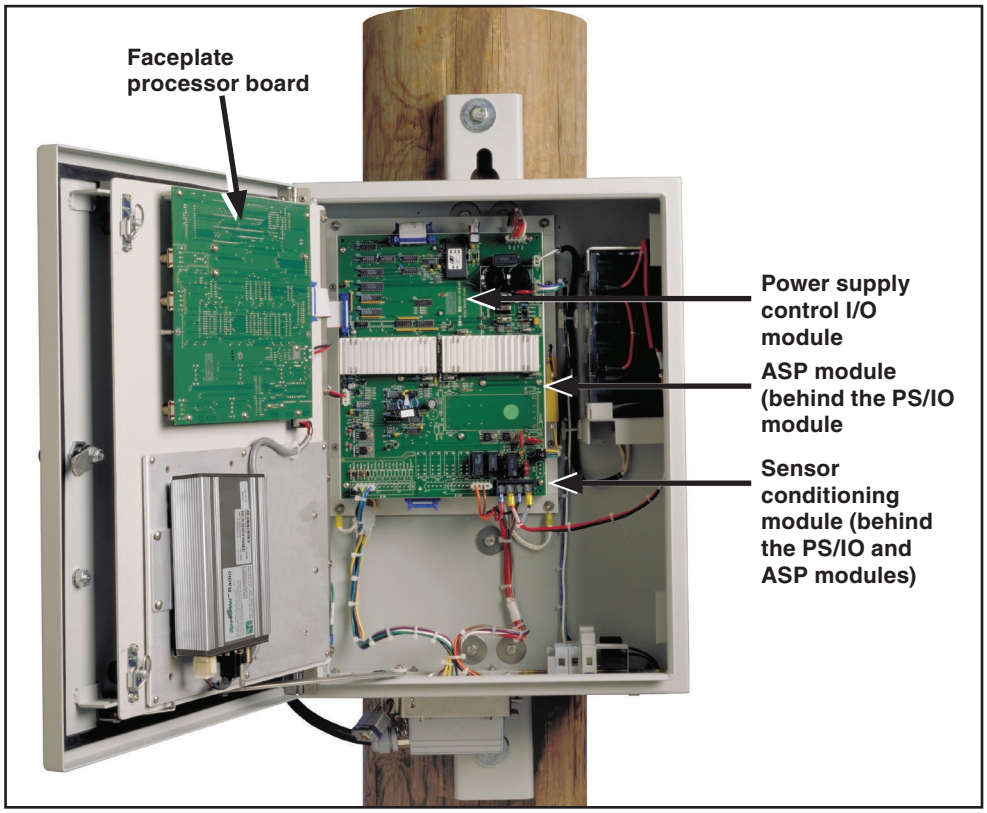


Figure 1. Location of the switch control modules (front view).

Faceplate/5800 control module. This printed circuit board is attached to the back of the faceplate. It includes all the electronics and toggle switches for the faceplate and the 5800 control microprocessor.

Power Supply/Control I/O module (PS/IO). This is the source for all low-voltage power the switch control uses and any associated communications equipment. It is also responsible for all digital interfacing. The PS/IO module performs all data-acquisition, control, and basic communication interfacing functions. For more about the power management system, see the "Power Supply/Control I/O Module" section on page 13.

ASP module. This module is responsible for waveform processing. It is located behind the Power Supply/Control I/O module.

Sensor Conditioning module. This module conditions ac waveforms to standard low-voltage AC levels and provides analog I/O interfacing. The module is located behind PS/IO and ASP modules.

The Faceplate

The 5800 Series control faceplate includes LEDs and switches for monitoring and controlling the line switches and the switch control. It also includes an LCD screen and two DATA SCROLL switches. See Figure 2.

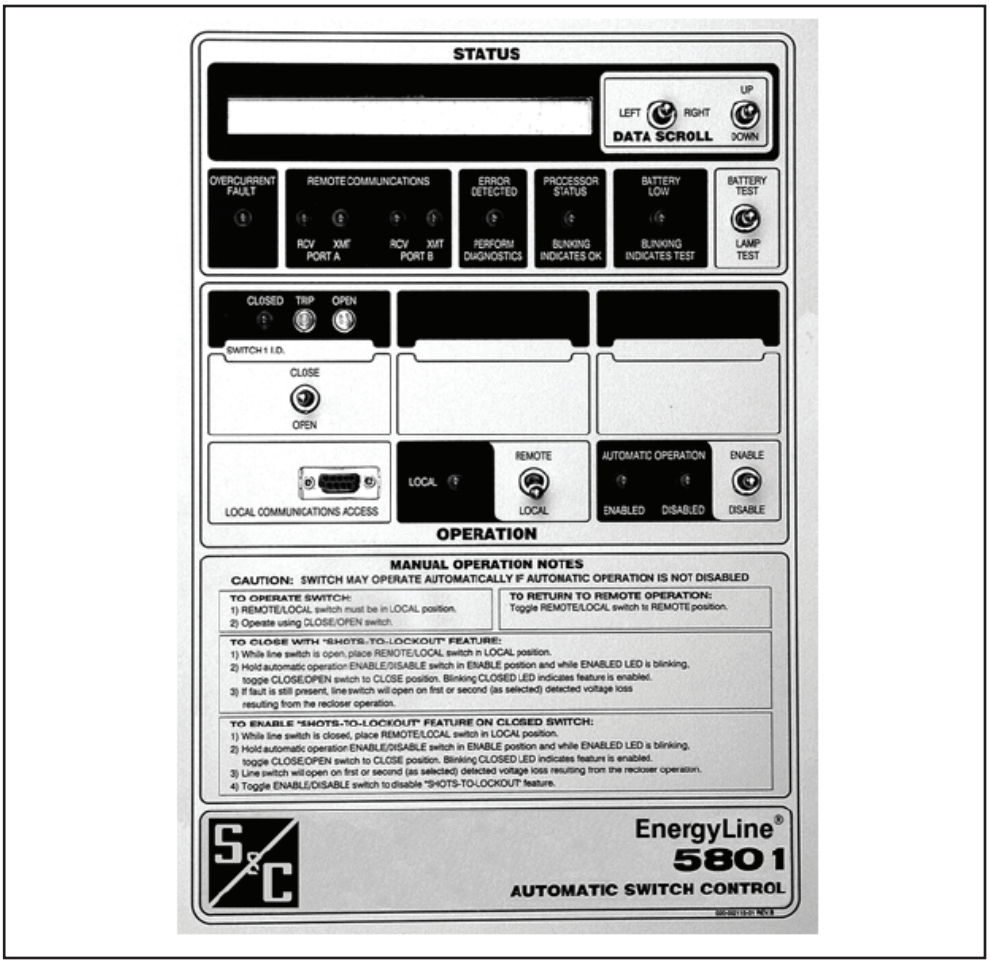


Figure 2. The 5801 Series control faceplate.

Note: To extend battery carryover time, the switch control turns off power to the faceplate (including the LEDs and the LCD screen) when the enclosure door or low-voltage cabinet door is closed.

Faceplate LEDs

The faceplate includes the following LEDs:

Overcurrent Fault LED

This LED becomes lit when the switch control detects an **Overcurrent** condition. For a normally closed switch, the LED turns off when all of the following are true:

- Three-phase line voltage has been sensed.
- The switch is closed.
- Forty-five minutes have elapsed.

The LED also turns OFF when the switch is closed and someone toggles the switch on the faceplate The REMOTE/LOCAL switch or clears the LED via SCADA.

For the normally open switch, the LED turns off when doing one of the following:

- Toggle the REMOTE/LOCAL switch or clear the LED via SCADA. (The line switch can be open or closed.)
- Close the switch from the faceplate or via SCADA.

Note: The LED cannot be cleared via SCADA if the REMOTE/LOCAL switch is in the **Local** position.

Note: When reinitializing the switch control using the IntelliLink software, the LED turns off regardless of whether the conditions above are met.

Remote Communication RCV/XMT LEDs

These LEDs blink when the switch control sends or receives signals through remote-communication equipment installed in the control enclosure. There are separate sets of LEDs for Port A and Port B.

RCV LED – Blinks when the switch control detects an incoming character

XMT LED – Blinks when the switch control sends one or more characters

Note: Activity on both of these LEDs will be seen only if remote-communications equipment is installed, properly connected, and receiving power. The XMT LED blinks any time a transmit is attempted, regardless of whether communications equipment is properly installed.

Error Detected LED

This LED lights up if the switch control detects any of the following conditions:

- **Battery charger overvoltage**. If the charger attempts to overcharge the battery, the switch control turns the charger off and turns on the LED.
- **Open/close contacts are not mutually exclusive**. The switch position contacts are either both open or both closed.
- **Temperature sensor failure**. The temperature sensor (on the PS/IO) reads abnormally high or low (generally caused by an open/shorted circuit).
- **Switch error (5801 control)**. There is an error with the switch, such as open visual disconnect contacts (Scada-Mate) or low pressure (Joslyn).
- **Switch in Local mode (5802/5803 controls)**. The switch control senses that one of the switches is in **Local** mode (a manual mode for the switch, selected at the low voltage cabinet).

Processor Status LED

This LED blinks once per second when the switch control has power and the control's software is running normally.

Battery Low LED

This LED is off when the battery system is working normally and the battery is charged.

The LED becomes lit when the battery power level drops below the **Battery Voltage Low** value on the *TROUBLESHOOTING: Battery System* screen. It is normal for this LED to be ON when the switch control is operating on battery power and the normal battery carryover period is nearly over. If this LED is lit when ac power is on and the battery normally would contain an adequate charge, the battery may be defective.

The LED blinks during any battery test. The switch control automatically runs the battery test at scheduled intervals. In addition, a SCADA command or the faceplate BATTERY TEST/LAMP TEST switch can be used to start a battery test at any time. See the Battery Test/Lamp Test switch" section on page 9 for more details.

Note: When replacing a defective battery, initiate a battery test immediately to update the battery status.

Closed LED

This red LED lights up when the line switch is closed. The LED indicates the sensed position of the line switch based on the state of the **Closed** status input from the switch. It also blinks while S**hots-to-Lockout** mode is enabled. Each CLOSED LED provides information about one line switch.

Trip LED

This yellow LED becomes lit when the switch control trips open the line switch using automatic logic (**Sectionalizing, Phase Loss Protection**, etc.). It turns off when the switch is closed. For the normally open switch, the LED also turns off when toggling the REMOTE/LOCAL switch. Each TRIP LED provides information about one line switch.

If the switch tripped because of phase-loss protection and **Phase Loss Protection with Automatic Reclose** mode is enabled, the LED blinks while waiting to reclose the switch. For the normally open switch, the LED also turns off when toggling the REMOTE/LOCAL switch.

Note: When reinitializing the switch control using the IntelliLink software, the LED turns off regardless of whether the switch is closed.

Open LED

This green LED becomes lit when the line switch is open. The LED indicates the sensed position of the line switch based on the state of the **Open** status input from the switch. Each OPEN LED provides information about one line switch.

Local LED

This LED is lit when remote (SCADA) operation of the switch control is blocked and local operation is allowed. The LED is off when local operation is blocked and remote operation is allowed.

Automatic Operation Enabled LED

This LED is lit when automatic operation of the switch control is enabled.

⚠ CAUTION

If automatic operation is enabled, the **Automatic Control** logic may trip the switch regardless of the state of the REMOTE/LOCAL switch.

Automatic Operation Disabled LED

This LED is lit when automatic operation of the switch control is disabled.

Faceplate Switches

The faceplate includes the following switches:

Data Scroll Switches

Use these switches to scroll the LCD screen data into view. For more details, see "The Faceplate LCD Screen" section on page 10, Figure 3 on page 11, and Figure 4 on page 12.

Battery Test/Lamp Test switch

Toggle this switch to the **Up** position to start a battery test. The test lasts approximately 30 seconds if the control is operating on battery power or approximately 3 minutes if the control is operating on ac power. The BATTERY LOW LED blinks during the test. See the "Power Supply/Control I/O Module" section on page 13 for more details.

Hold this switch in the Down position to test the LEDs on the faceplate (all LEDs should blink).

Close/Open switch

Toggle this switch to the Up position to transmit a "Close" pulse to the line switch. Toggle this switch to the **Down** position to transmit an "Open" pulse to the switch. It is also used to enable **Shots-to-Lockout** mode. See the "Automatic Operations" section on page 21. Each CLOSE/OPEN switch operates one line switch.

Note: If the REMOTE/LOCAL switch is in the **Remote** position, toggling a CLOSE/OPEN switch has no effect.

Remote/Local switch

Toggle this switch to the **Up** position to enable remote (SCADA) control of the line switch(es) and disable commands from the faceplate CLOSE/OPEN switches and automatic operation ENABLE/DISABLE switch.

Toggle this switch to the **Down** position to disable remote (SCADA) operation of the line switch(es) and enable commands from the faceplate CLOSE/OPEN switch(es) and automatic operation ENABLE/DISABLE switch. (The LOCAL LED becomes lit when this switch is set to **Local** mode.)

Note: To disable local automatic operation and have full control of the switch(es), the faceplate ENABLE/DISABLE switch must be toggled to the **Disable** position. If automatic operation is disabled on the *SETUP: Automatic Operation* screen (for both switches, if applicable), toggling the ENABLE/DISABLE switch has no effect.

Enable/Disable switch

Toggle this switch to the **Up** position to enable automatic switch operation of the control. Toggle this switch to the **Down** position to disable automatic operation. This switch affects automatic operation of both line switches, if applicable. It is also used in enabling **Shots-to-Lockout** mode. See the "Automatic Operations" section on page 21.

Note: If automatic operation is disabled on the *SETUP: Automatic Operation* screen (for both switches, if applicable), toggling this switch has no effect.

Faceplate LCD Screen

The LCD screen enables quick access to key information while at the switch control installation site. The LCD screen displays several categories of information:

Real-time Data. Displays the total operation count, and the present phase and ground current levels, line voltage, reverse current conditions, phase angles, and total kvar flows, for both feeders if applicable (This information is also displayed on the *SETUP: Site- Related* screen.)

Auto Operation (Switch 1 and Switch 2, if applicable). Displays the automatic operation features that are enabled, and the present value for the automatic operations setpoints (These values are also displayed on the *SETUP: Automatic Operation* screens.)

Fault Events. Displays the date, time, event, switch control interpretation, and action for the 62 most recent protection-related fault events. These fault messages are coded versions of the messages displayed on the *OVERCURRENT FAULT: Fault Events* screen (See "Fault Events Log" section on page 26 for an explanation of each code.)

Fault Magnitudes. Displays the date, time, phase, peak magnitude, and duration for the 16 (5801 control) or 32 (5802/5803 controls) most recent overcurrent fault events (This information is also displayed on the *OVERCURRENT FAULT: Fault Magnitudes* screen.)

Maintenance. Displays the software version installed in the switch control, assorted battery status information, and the present cabinet temperature (The software version is also displayed on the *TROUBLESHOOTING: Control & Switch Information* screen. The battery and temperature information is also displayed on the *TROUBLESHOOTING: Battery System* screen.)

Fault Settings. Displays the present value for each of the fault-detection setpoints, for Switch 1 and Switch 2 if applicable (These values are also displayed on the *SETUP: Fault Detection* screen.)

The 2 x 40 character LCD screen always displays one field from a large data page. See Figure 3 on page 11 and Figure 4 on page 12.

Use the DATA SCROLL switches to scroll each field into view.

- To move left or right across the page (from one category to another category), toggle the LEFT/RIGHT switch.
- To move up or down between fields within a category, toggle the UP/DOWN switch.
- The Fault Events and Fault Magnitude logs are circular buffers. The most recent event is normally displayed on the LCD screen. To see the second-most-recent event, toggle the switch to the **Up** position.

For an explanation of the codes used in the Fault Events column, see "Fault Events Log" section on page 30.

Categories						
Fields	1. Real-Time Data	2. Auto Operation	3. Fault Events	4. Fault Magnitude	5. Maintenance	6. Fault Settings
	Operations Counter Line Current (Amps) Ground Current (Amps) Line Voltage (Volts) Phase Angle (Degrees) Reverse Current (Active or None) Line kVARs	Automatic Operation Features Enabled Transfer Process Time Limit Return to Normal Delay Time Sectionalizer Reset and Extended Voltage Loss Time Successful Reclose Rest Time Fault Current Required before First/ All Voltage Loss(es) Recloser Counts to Trip, w/Fault (Minimum) Recloser Counts to Trip, w/Fault (Maximum) Recloser Counts to Trip, Voltage Loss Only Number of Shots Required for Lockout Shots-To-Lockout Time Threshold (Tenths) Phase Loss Protection Voltage Loss Threshold Phase Loss Protection Time Threshold Phase Loss Protection Current Threshold Automatic Reclose Time Threshold Present Transfer Capacity, Left Feeder Present Transfer Capacity, Right Feeder	Most Recent Oldest 3rd Most Recent 2nd Most Recent	Most Recent Oldest 3rd Most Recent 2nd Most Recent	Software Version AC Power/Battery Status Battery Low/Bad Setpoints Battery Voltage w/o Surface Charge Predicted Voltage Under Load Power Supply Voltage/ Battery Impedance Cabinet Temperature	Phase Fault Detected Current Level (Amps) Ground Fault Detected Current Level (Amps) Phase Fault Duration Time Threshold (msec) Ground Fault Duration Time Threshold (msec) Phase Current Inrush Restraint Time (msec) Ground Current Inrush Restraint Time (msec) Phase Current Inrush Restraint Multiplier Ground Current Inrush Restraint Multiplier

Figure 3. LCD screen data page for the 5801 control.

Categories							
Fields	1. Real-Time Data	2. Auto Operation	3. Sw. 2 Auto Operation	4. Fault Events	5. Fault Magnitude	6. Maintenance	7. Fault Settings
	Cloose/Open Status [Sw. 1, 2, 3] Operations Counter [Sw. 1, 2, 3] Switch 1 Line Current (Amps) Switch 2 Line Current (Amps) Switch 3 Line Current (Amps) Ground Current (Amps) [Sw. 1, 2, 3] Switch 1 Line Voltage (Volts) Switch 2 Line Voltage (Volts) Switch 1 Phase Angle (Degrees) Switch 2 Phase Angle (Degrees) Switch 1 Reverse Current (Active or None) Switch 2 Reverse Current (Active or None) Switch 1 Line kVARs Switch 2	Automatic Operation Features Enabled Transfer Process Time Limit Return to Normal Delay Time Sectionalizer Reset + Extended Voltage Loss Time Successful Reclose Rest Time Fault Current before First/All Voltage Loss(es) Recloser Counts to Trip, w/Fault Recloser Counts to Trip, Voltage loss Only Number of Shots Required for Lockout Shots-To-Lockout Time Threshold (Tenths) Phase Loss Protection Voltage Loss Threshold Phase Loss Protection Time Threshold Phase Loss Protection Current Threshold Automatic Reclose Time Threshold Present Transfer Capacity, Left Feeder Present Transfer Capacity, Right Feeder	Automatic Operation Features Enabled Transfer Process Time Limit Return to Normal Delay Time Sectionalizer Reset + Extended Voltage Loss Time Successful Reclose Rest Time Fault Current before First/All Voltage Loss(es) Recloser Counts to Trip, w/Fault Recloser Counts to Trip, Voltage loss Only Number of Shots Required for Lockout Shots-To-Lockout Time Threshold (Tenths) Phase Loss Protection Voltage Loss Threshold Phase Loss Protection Time Threshold Phase Loss Protection Current Threshold Automatic Reclose Time Threshold Present Transfer Capacity, Left Feeder Present Transfer Capacity, Right Feeder	Most Recent Oldest 3rd Most Recent 2nd Most	Most Recent Oldest 3rd Most Recent 2nd Most	Software Version AC Power/ Battery Status Battery Low/Bad Setpoints Battery Voltage w/o Surface Charge Predicted Voltage Under Load Power Supply Voltage/ Battery Impedance Cabinet Temperature	Phase Fault Detected Current Level (Amps) [Sw. 1, 2] Ground Fault Detected Current Level (Amps) [Sw. 1, 2] Phase Fault Duration Time Threshold (msec) [Sw. 1, 2] Ground Fault Duration Time Threshold (msec) [Sw. 1, 2] Phase Current Inrush Restraint Time (msec) [Sw. 1, 2] Ground Current Inrush Restraint Time (msec) [Sw. 1, 2] Phase Current Inrush Restraint Multiplier [Sw. 1, 2] Ground Current Inrush Restraint Multiplier [Sw. 1, 2]

Figure 4. LCD screen data page for 5802/5803 controls.

Power Supply/ Control I/O Module

The Power Supply/Control I/O (PS/IO) module is a highly efficient, computer-controlled, uninterrupted power supply system specifically designed to meet the specialized power requirements of automated electric power distribution equipment.

The PS/IO module provides steady-state current flow for switch control operation, pulsed current flow for communications equipment, and occasional large current surges for line switch operation. It also provides 12 Vdc, battery charging (24 or 36 Vdc) and other dc voltages from a single 24- or 36-Vdc source. (This design provides superior battery lifetime and carryover compared to systems that "center tap" a 24- or 36-Vdc system to supply their 12-Vdc requirements or that use multiple, non-interchangeable batteries.)

The PS/IO module supplies accurate, temperature-compensated charging voltages, with current-limiting and other safety mechanisms to maximize battery carryover and to minimize the possibility of battery off-gassing or explosion. This system meets or exceeds ANSI surge-withstand and dielectric specifications (including ANSI C62.41 -1992 6KV3KA surge and C37.90a 2.5-kV 125-MHz ring wave and 5-kV "Fast Transient" waveform specifications).

The power-management system consists of the PS/IO module, and a Hawker/Gates 24- Vdc or 36-Vdc battery. When ac power is available, the PS/IO converts the ac power to dc, and then uses the dc power to run the switch control, charge the battery, and operate the communications equipment. It draws on the battery only for the current needed to operate the switch. When external ac power is not available, the PS/IO uses power from the sensors instead (if applicable). When neither external ac power nor power from the sensors is available, the PS/IO draws on the stored battery power for all switch control operations.

Users can monitor and control the power management system from the switch control faceplate, with the IntelliLink software, or from a SCADA master station.

Power Supply/Control I/O Module LEDs

The PS/IO module LEDs provide information about the state of the battery and ac power.

Ac On

This LED comes becomes lit when the switch control has a power source (either external AC or sensor power). It is located on the middle left of the module.

NOTE: The Ac Line fuse is not intended for field replacement. Replacing a blown fuse may result in further damage.

CHG ON

This LED becomes lit when the battery charger is connected to the battery, the AC ON LED is lit, and the battery charger and battery are within the proper voltage range (20- 30.5 Volts for 24-Vdc batteries, 30-45.75 Volts for 36-Vdc batteries). It is located on the middle left of the module.

BAT ON

This LED becomes lit when the battery is connected to the 24- or 36-Vdc power supply bus. It is located on the bottom right of the module.

ANALOG PWR

This LED becomes lit when power is being supplied to the analog processors. It is located on the top middle of the module.

Battery Management

The purpose of the S&C battery-management system is to ensure the switch control can operate the line switch with the available battery capacity and to provide advanced warning of a weak battery. Battery capacity is affected by several variables, including age, temperature, load cycling, and loading.

The switch control continuously monitors the battery voltage. In addition, it tests the battery at regular, scheduled intervals. The interval depends on the power conditions:

- During battery discharge, the test is run hourly.
- After a power outage, the test is run every two hours for 24 hours to monitor the battery status while the battery is recharged.
- After 24 hours of continuous operation on ac power (or power from the sensors, if applicable), the test is run once a day.

Note: The BATTERY TEST/LAMP TEST switch or a SCADA command can be used to manually test the battery at any time.

During the battery test, the switch control applies various loads to the battery to determine how it will perform under load. These tests include:

Actual battery voltage. Determines the true open circuit battery voltage

Battery impedance. Determines the internal impedance of the battery

Calculated voltage under load. Determines the minimum voltage predicted during switch operation (When the switch control is operating on battery power, the control reevaluates this "calculated voltage under load" continuously. Otherwise, it evaluates this value only during battery test cycles.)

Based on the results of the above monitoring and tests, the switch control may take the following actions:

- If the battery "calculated voltage under load" drops below the **Battery Low** value, the switch control displays a "Battery Low" message and turns on the faceplate BATTERY LOW LED. (At voltages below this value, switch operation is still possible but only for a limited time.)
- If the "calculated voltage under load" drops below the **Battery Bad** value, the switch control sets the **Battery Bad** status indication for the SCADA operator and displays a "Battery Bad" message on certain IntelliLink software screens. (The switch will not reliably operate at voltages below this value.)
- If the battery steady-state voltage drops below 22 Volts (for a 24-Vdc battery) or 33 volts (for a 36-Vdc battery) while the switch control is operating on battery power, the switch control automatically disconnects all loads to prevent deep discharge. Power is restored to loads once ac power (or sensor power, if applicable) is restored or the battery is replaced.
- If the battery voltage falls outside the proper range (20-30.5 Volts for 24-Vdc batteries, 30-45.75 Volts for 36-Vdc batteries) while the switch control is operating on ac power (or sensor power, if applicable), the switch control disconnects the battery from the system and turns off the BAT ON LED on the Power Supply/Control I/O module.

Because the battery is used for the wetting voltage of certain switch status contacts, disconnecting the battery will also generate alarms.

Based on field experience, a weak battery may fail the battery test in very cold temperatures but pass when the ambient temperature rises. If a **Battery Low** or **Battery Bad** alarm occurs, schedule the battery for replacement. In warmer climates or seasons, if a battery test indicates a **Battery Low** condition, the battery may last 1-2 weeks longer.

Battery Care and Maintenance

Typical battery life for 5800 Series controls is five to seven years. The battery should be replaced when capacity is reduced to 80% of capacity when new. Increased temperature accelerates battery aging, so installations in warmer climates will have a shorter battery life.

5800 Series controls automatically test and record battery capacity, and the only routine maintenance they require is battery replacement. Yearly site inspection of the BATTERY LOW LED and the physical condition of the battery is recommended for noncommunicating controls. More frequent inspection should be scheduled for older batteries. Batteries should be replaced every five years. Communicating controls report "Battery Low" to SCADA when capacity is near 80%, and the battery will still power the switch operator.

The following suggestions can help with battery maintenance:

- Store batteries at room temperature. To maximize battery life, store all gel-cell batteries at or below room temperature. Once in service, the battery will probably be exposed to higher temperatures that will affect its life. However, proper storage can avoid accelerating the process.
- Keep stored batteries charged. Gel-cell batteries are generally designed with a 6-month maximum shelf life. This means they can survive sitting on the shelf without being recharged and without incurring substantial damage for 6 months. If having to store them longer, it is critical to recharge them periodically. If recharging them every month, they can sit on the shelf for years without significant damage. To recharge a battery, connect it to a switch control or to an independent battery charger. See Table 8 in S&C Specification Bulletin 1045-33 for available charger options.
- The best approach to storing batteries is to maintain the smallest inventory possible. Make sure a procedure is in place for rotating the inventory, removing the oldest batteries first.
- Use batteries known to be good. Do not install used batteries in battery-backed equipment unless they have been properly tested. The cost of a service call to replace a bad battery is usually higher than the cost of a new battery. Although a battery might be good enough to provide temporary standby power, the line switch has a brief but large power requirement that may exceed a weak battery's ability to deliver charge rapidly.
- Avoid installing the enclosure in a sunny location. If at all possible, install the switch control enclosure in a shady area. Because batteries do not do as well in warm/hot environments, do everything possible to minimize the peak operating temperature.

Switch Control Software

5800 Series switch controls are entirely software-driven. Each switch control is shipped with control and IntelliLink software.

The Control Software

The control software is preloaded into the switch control in the factory. This software manages the minute-by-minute functioning of the switch control. It continually monitors:

- Voltage and current on the feeder
- Incoming SCADA commands
- The position of the faceplate switches
- The condition of the battery
- Ambient air temperature inside the control enclosure
- The internal switch control clock/calendar
- The software setpoint values
- Fault and voltage loss information already stored in the control
- Various other setpoints and data values as needed

Based on this information, the Control software decides how to respond to a possible overcurrent fault, a change in voltage, a command from the faceplate or SCADA master station, and other conditions.

The control software, the setpoint values, and historical data are all stored in non-volatile switch control memory. This memory survives power interruptions, including complete loss of the battery system.

Battery Backed Non-volatile SRAM

The memory and perpetual calender are implemented with battery-backed non-volatile SRAM with a 10-year battery life in the non-powered state; this is no battery draw when control power is connected. The real time clock IC is battery-backed as well which counts seconds, minutes, hours, days, day of the week, date, month and year with leap year compensation up to 2100.

The IntelliLink software

The IntelliLink software is supplied on the Setup disk and runs on IBM/PC-compatible computers. This software enables communication with the control software while at the switch control site. Using the IntelliLink software, users can:

- Enter installation-dependent operating parameters (setpoints), such as a network address, automatic operation features, etc.
- Monitor real-time data, such as the present line voltage and current
- Examine the performance and operating history of an installed switch control
- Transfer all configuration, operating, and historical data from the switch control to a “report” file on your computer
- Download new control software into the switch control
- Troubleshoot assorted types of switch control installation problems

SCADA Communications Equipment

5800 Series switch controls include two remote communications access ports. When combined with suitable communications equipment and protocols, this permits users to remotely monitor, control, and change setpoints for the switch control installation.

S&C supports the 5800 Series controls with a variety of communications hardware options and software protocols, including:

- DNP 3.0 (default protocol)
- PG&E SCADA (Cooper 2179)
- Landis & Gyr Telegyr 8979
- Schlumberger’s UtiliNet®
- Schlumberger’s CellNet®
- Cellular telephones
- Fiber optics
- Phone lines

The communications hardware (radio, modem, etc.) is mounted inside the switch control enclosure on the universal communications mounting plate on the back of the faceplate. This eliminates clutter and provides a higher level of reliability for the overall installation.

For more details, see the manufacturer’s documentation or contact S&C.

This section explains how the switch control components work together to detect and respond to "faults" and voltage outages.

Signal Processing

The switch control includes separate electronic paths to accommodate the different requirements for peak versus normal operating current measurements. For normal operating current measurements, full scale is 800 amps RMS. For peak measurements, full scale varies with the switch type. For S&C switches, the value is approximately 4000 amps RMS and depends on the switch model. See Table 1 on page 18 for details.

Peak detection focuses on speed, with several samplings taken for each sinusoidal peak and instantaneous analysis of the incoming data. Measurement of normal operating current is slower and includes a finer degree of accuracy.

The switch control reports current, voltage, and phase-related data in units of amperes, volts, and kvars. The rated accuracy of these measurements is based on the combined accuracy of all the control components (exclusive of the sensor and sensor cable but inclusive of all sensor conditioning components). The switch control uses the switch calibration data and the phase angle offset values to correct all ac waveform data sampled from the switch sensors.

Using the jumpers that come with the switch control, users can configure it in the field for wye or delta distribution line applications. Based on the selected configuration and certain setpoint values, the control normalizes voltages to nominal 120- or 240-Vac values.

RMS Ac Waveform Analysis

The switch control uses RMS detectors (with accuracy to the 100th 60 Hz harmonic) to produce true RMS amplitude data for current, neutral current, and voltage waveforms. This is particularly important when measuring neutral current because the effects of harmonic distortion of any single phase are multiplied in the summing of the phases.

Because there is some response latency associated with this circuitry, voltage and current changes that occur within a few tenths of a second are sensed as a single, steady value.

For real-time, steady state monitoring and data logging, the switch control collects data at 0.2-second intervals. It then averages eight samples and reports the "1.6-second averaged" value. This results in a net response time of 1.6 seconds.

The switch control uses these "1.6-second averaged" values for the real-time display, reporting via SCADA communication, and data logging. Daily high and low values are kept for the current day and the preceding 7 days.

Waveform Analysis for Power System with Delta-Connected Customer Transformers

The switch control treats power systems with delta-connected customer transformers as a special case.

When the line switch has three voltage sensors and the Sensor Conditioning module is configured with a "delta" jumper, the switch control reproduces the delta voltage waveform before any transducer functions are performed. This is useful for comparing the measured voltage against that seen by customers served by phase-to-phase connected transformers. For S&C voltage sensors, this configuration is necessary for accurate phase-to-phase voltage measurements because these sensors measure phase-to-neutral voltages even in a delta distribution system.

For switches with one voltage transformer for voltage sensing and control power and three CVMI current sensors, the Sensor Conditioning module must always be configured with a "wye" jumper. Voltage sensing and reporting are determined by the way the voltage transformer is connected: phase to phase (delta) or phase to neutral (wye).

Voltage Sensing for S&C Switches

The 5800 Series control software supports 15-kV, 25-kV, and 34.5-kV S&C switches.

The nominal voltage sensor ratios for the line switch(es), with corresponding maximum voltage levels, are shown in the Table 1.

Table 1. Maximum Voltage Levels Supported in S&C Switches

S&C Switch Model	S&C Nominal Voltage Sensor Ratio	Maximum Phase-to-Phase Voltage (Delta Jumper)	Maximum Phase-to-Ground Voltage (Wye Jumper)
15 kV	1386:1	20.0 kV	15.0 kV
25 kV	2440:1	27.3 kV	20.4 kV
34.5 kV	3389:1	38.7 kV	29.0 kV

The Maximum Voltage levels represent the highest voltage measurements supported by the control software. The maximum voltage levels in Table 1 are based on nominal sensor ratios. Actual maximum voltages may vary slightly based on the S&C factory-supplied sensor calibration data (supplied with each switch). (For information on the physical and electrical specifications for each switch, see the applicable S&C literature. If support for higher voltage levels is required, contact S&C.)

The third column in Table 1 shows the maximum voltage levels supported for installations configured for phase-to-phase (delta) voltage reporting. These installations require the presence of a delta-configured Sensor Conditioning module.

The fourth column in Table 1 shows the maximum voltage levels supported for installations configured for phase-to-ground (wye) voltage reporting. These installations require the presence of a wye-configured Sensor Conditioning module.

Accurate voltage reporting requires proper configuration of the setpoints. This includes entering the actual sensor ratios (as supplied by S&C) for each sensor. It also includes selection of a voltage-reporting method (phase to phase or phase to neutral) consistent with customer transformers on the feeder and their associated step-down ratios.

Phase Angle Measurements

The switch control uses a highly accurate, proprietary, zero-crossing detection scheme (that is not tricked by multiple zero-crossings of noisy or harmonic-contaminated signals) to measure the phase angles between the voltage and current waveforms on each phase.

The switch control samples the phase angle reading every 0.2 seconds and then averages eight samples and reports the "1.6-second averaged" value. Phase-angle measurements are on a 0-360 degree range.

As part of the switch control setup, users can enter **Phase Angle Offset** values to compensate for both sensor-dependent and installation-dependent phase-angle characteristics.

Overcurrent Fault & Voltage Loss Detection

Overcurrent faults are measured with a combination of peak current detection hardware for phase faults and true RMS amplitude detection hardware for harmonic-sensitive, neutral current faults.

To determine whether an overcurrent fault exists, the switch control compares the sensed current to setpoint values for current level and fault duration. The **Current Level** setpoint value can be specified in 10-amp RMS increments for phase faults and one-amp RMS increments for ground faults.

The **Fault Duration Time Threshold** value can be specified in 6.25-millisecond (approximately ⅓-cycle) increments for phase faults and 50-millisecond increments for ground faults.

This scheme allows the software to measure fault currents with a scaling appropriate to the higher amplitude signals encountered with faults and to detect the peaks of narrow spikes caused by CT saturation that trick many digital sampling schemes.

Phase Overcurrent Detection

Phase overcurrent conditions are sensed using a combination of analog and digital techniques. The switch control provides fault detection with a resolution of 1/3-cycle and peak values of approximately 4000 amps RMS. Overcurrent measurements are accurate to 0.5% of full scale, excluding sensors. (For information about scaling beyond 4000 amps, contact S&C.)

Note: In the 5802/5803 controls, the control monitors each feeder (or branch) independently and responds to changes on that feeder regardless of the condition of the other pad-mounted switch and feeder.

To detect phase overcurrent faults:

STEP 1. The switch control monitors the current on all three phases and compares it to the **Phase Fault Detection Current Level** setpoint.

STEP 2. When at least one peak overcurrent sample is above the setpoint every 18.75 milliseconds (a window of time slightly longer than one cycle), the switch control registers an overcurrent condition (a potential, or pending, "fault") on that phase.

STEP 3. Once the overcurrent condition is registered, the switch control starts the **Phase Fault Duration Time Threshold** timer.

STEP 4. If the overcurrent condition is present continuously for the duration of the timer, the switch control labels it a "phase overcurrent fault" and responds accordingly. If during any 18.75-millisecond window overcurrent is not detected, the switch control considers the "fault" (or the overcurrent condition) to be no longer present and takes appropriate action.

STEP 5. When a recognized "phase overcurrent fault" ends (after the timer has expired), the software records the maximum RMS current measured during the fault and the fault duration. Any fault lasting longer than 6.82 minutes is recorded as 6.82 minutes (409.6 seconds).

Ground Overcurrent Detection

The switch control hardware measures ground current as an analog vector sum of the three individually sensed phase currents. This analog signal is presented to a true RMS-detecting circuit, yielding a very accurate, harmonic-independent measure of the true RMS current integrated over several cycles. Because of this multi-cycle integration, there is some delay in the response time through the hardware. This delay is inversely proportional to the magnitude of the change in ground current. The larger the change in ground current, the faster the circuit responds. The net result is very similar to the time-current characteristics of a protective relay.

The control software samples the true RMS detection hardware on 50-millisecond intervals. On each interval, the current is compared to the **Ground Fault Detection Current Level** setpoint. If the current exceeds the setpoint and this condition persists continuously for a period of time specified by the **Ground Fault Duration Time Threshold** setpoint, an **Overcurrent Fault** condition is indicated and appropriate action taken.

Because the registration of **Overcurrent Fault** conditions is affected by the relationship between the minimum fault current detection level and RMS detector rise and fall times, a family of time-current characteristic curves is generated. See the graph under the "Ground Fault Detection Current Level (RMS Amps)" section in Instruction Sheet 1041-530." Each of these curves corresponds to a single **Ground Fault Detection Current Level** setting.

The points on each curve represent the minimum amount of time the ground current must be present to register a fault. For example, when the **Ground Fault Detection Current Level** setting is set to 150 amps, a 500-amp ground current must be present for approximately 42 milliseconds before the switch control registers a fault.

Voltage Loss Detection

The switch control checks the voltage on all three phases at 50-millisecond intervals. Any voltage drop below the **Loss of Voltage Threshold** setpoint is considered a voltage outage.

Inrush Restraint

The **Inrush Restraint** feature prevents phase or ground overcurrent conditions, which can occur during outage restoration (hot or cold load pickup) from falsely indicating a "fault." It also applies when the switch is closed from the faceplate or via SCADA while power is present. The **Current Inrush Restraint Multiplier** feature enables the switch control to differentiate between moderate overcurrents (caused by cold load pickup) and large overcurrents (caused by a fault condition) during the Inrush Restraint period. See S&C Instruction Sheet 1041-572 for additional information.

The **Inrush Restraint** feature is applied as follows:

(a) During a voltage outage, the switch control continuously monitors the switch status, the RMS voltage sensors, and the phase overcurrent detectors for any indication that the outage has ended

(b) When voltage rises above the L**oss of Voltage Threshold** setpoint on any phase or overcurrent is detected on any phase, the switch control checks the switch position

(c) If the switch is closed, the switch control starts the **Phase Current Inrush Restraint** timer and the **Ground Current Inrush Restraint** timer

(d) If both **Current Inrush Restraint Multiplier** values are set to **TimeBlock** mode, the switch control ignores all overcurrent conditions until the **Inrush Restraint** timers expire

If one or both **Current Inrush Restraint Multiplier** values are set to something other than **Time Block** mode, the switch control considers any overcurrent condition that exceeds the specified multiplier value to be a "fault." See the "Phase Overcurrent Detection" and the "Ground Overcurrent Detection" sections on page 19 for details.

(e) After the inrush restraint timers expire, the switch control responds to overcurrent conditions in the normal manner (See the "Phase Overcurrent Detection" and the "Ground Overcurrent Detection" sections on page 19 for details.)

Note: If the "Inrush Restraint" times are set to "0", no inrush restraint occurs.

Overcurrent and Voltage Loss Events

The switch control's response to an overcurrent condition or voltage loss depends on the settings in effect when the event occurs. For example, the values selected for the **Fault Detection Current Level** and **Fault Duration Time Threshold** setpoints determine whether the switch control recognizes an overcurrent event as a "fault." The **Automatic Operation** features enabled, and the position of the faceplate automatic operation ENABLE/DISABLE switch, determine what the switch control will do when a recognized "fault" occurs.

Overcurrent Data Logging

The switch control keeps a record of each recognized event, the assumed cause of the event, and any action taken. The switch control logs all events, regardless of the position of the automatic operation ENABLE/DISABLE switch and REMOTE/LOCAL switch.

The switch control maintains three separate, chronological logs of event data. Information is stored in these logs in a circular fashion; the newest entry always overwrites the oldest. (The switch control logs each event with millisecond timestamping and 6.25 millisecond resolution.)

The first log is a "sequence of events" buffer. Each record in this log represents one fault event (for example, an **Overcurrent** condition followed by voltage loss) and/or a fault-related action taken by the switch control (for example, the line switch opened because of a **Phase Imbalance** condition). The information in this log is displayed on the IntelliLink software *OVERCURRENT FAULT*: *Fault Events* screen and the LCD screen.

The second log contains the magnitude and duration information for each "fault." The recorded magnitude is the maximum RMS current amplitude encountered during the "fault." The duration is recorded in units of milliseconds, with 6.25-millisecond resolution and a maximum recordable fault duration of 409 seconds (6 minutes, 49 seconds). The information in this log is displayed on the IntelliLink software *OVERCURRENT FAULT: Fault Magnitudes* screen and the LCD.

Note: Because of the delayed rise and fall times of the hardware, the logged time for detection of ground overcurrent faults may be delayed relative to the logged time for phase overcurrent faults caused by the same event. In addition, the accuracy of recorded duration times for ground overcurrent events is affected by the 50-millisecond sampling interval and hardware rise and fall times. Peak magnitude data of ground overcurrent is also affected by the amount of time that the event is present. Accurate magnitude recording requires the condition to be present for approximately 400 milliseconds. See S&C Instruction Sheet 1041-530 for additional details.

Automatic Operations

The 5800 Series switch control can carry out several automatic operations: sectionalizing, phase imbalance protection, phase imbalance protection with automatic reclose, and one- or two-shot-lockout of a faulted circuit. These are explained below.

Note: For any of the automatic operation features to work correctly, the user must enter an appropriate value for the **Loss of Voltage Threshold** setpoint. See the *SETUP: Site- Related* screen explanation in Instruction Sheet 1041-530 for more details.

Line Sectionalizing

The switch control can sectionalize a distribution circuit based on detected fault current and voltage fluctuations associated with source-side recloser operation.

Note: In the 5802/5803 controls, the control monitors each feeder (or branch) independently and responds to changes on that feeder regardless of the condition of the other pad-mounted switch and feeder.

When **Sectionalizing** mode is enabled, the switch control uses the following logic to determine when to trip open the switch:

(a) The switch control continuously monitors all sensed voltage phases and compares the voltage to the **Loss of Voltage Threshold** setpoint value.

(b) *If the voltage drops below the setpoint on all sensed phases*: The switch control starts the **Sectionalizer Reset and Extended Voltage Loss Time** timer. In addition, the control sets an internal counter of recloser operations to "1."

If a phase or ground overcurrent fault was present within 0.6 seconds prior to the detected loss of voltage: The control assumes the voltage loss was caused by a source-side breaker or recloser opening in response to a load-side overcurrent fault.

If an overcurrent fault was not detected prior to the loss of voltage: The control assumes the voltage loss was caused by a source-side breaker or recloser opening in response to a source-side overcurrent fault.

(c) The switch control continues to monitor the voltage levels. The control adds one count to the counter for each time the source-side device opens.

(d) If the "Successful Reclose Reset Time" is greater than zero, then the **Reset on Successful Reclose** logic is also active. If voltage returns on all sensed phases (above the loss of voltage threshold) and current is below the fault-detection threshold, and this condition persists without interruption for longer than the **Successful Reclose Reset Time** setting, the sectionalizing counts and memory timer are reset and sectionalizing is canceled.

(e) If the **Sectionalizer Reset and Extended Voltage Loss Time** timer expires before the counter reaches the appropriate **Recloser Counts to Trip** value, the switch control resets the counter to zero. Later voltage losses are considered part of a different reclose sequence. However, if three-phase voltage is not present when the timer expires, an **Extended Voltage Loss** condition exists and the switch control opens the switch.

If the counter reaches the setpoint value before the timer expires, and the problem was a load-side fault, the control trips open the switch.

Note: When the **Fault Current Required Before First/All Voltage Loss(es)** mode is set to the **All** setting, the switch will not trip open unless all voltage losses were preceded by fault current. However, it may still operate based on the **Recloser Counts to Trip, Voltage Loss Only** setpoint. See the Setup Instruction Sheet 1041-530 for details.

If the counter reaches the setpoint value before the timer expires, and the problem was a source-side fault, the control notes the events but does not trip open the switch.

To enable **Sectionalizing** mode:

STEP 1. In the **Features Enabled** field on the *SETUP: Automatic Operation* screen, select a combination that includes "Sectionalizing."

STEP 2. If desired, at the *SETUP: Automatic Operation* screen, set the S**uccessful Reclose Reset Time** value to coordinate with the reclosers.

STEP 3. Use either the faceplate automatic operation ENABLE/DISABLE switch or a SCADA command to enable automatic operation of the switch control.

Phase Loss Protection

If the **Phase Loss Protection** feature is enabled, the switch control trips open the switch in response to a persistent **Phase Imbalance** condition to prevent damage to customer equipment.

When the **Phase Loss Protection** feature is enabled, the switch control uses the following logic to determine when to trip open the switch:

(a) When the switch control detects a loss of voltage on one or two phases, it starts the **Phase Loss Protection Time Threshold** timer.

(b) If the voltage loss persists, and true RMS current remains below the **Phase Loss Protection Current Threshold** setpoint until the timer expires, the switch control trips open the switch.

(c) If voltage returns before the timer expires, the switch control terminates the timing operation.

(d) If voltage returns on one phase before the timer expires, but is then lost on another phase, the switch control restarts the timer.

Complete the following steps to enable the **Phase Loss Protection** feature:

STEP 1. In the **Features Enabled** field on the *SETUP: Automatic Operation* screen, select a combination that includes "Phase Loss Protection."

STEP 2. At the *SETUP: Automatic Operation* screen, enter values for the **Phase Loss Protection Time Threshold** and the **Phase Loss Protection Current Threshold** timers. A **Phase Loss Protection Voltage Threshold** value can also be entered. Otherwise, the switch control uses the **Loss of Voltage Threshold** value on the *SETUP: Site-Related* screen. See the *SETUP: Automatic Operation* screen explanation in Instruction Sheet 1041-530 for details.

NOTICE

Be sure to select a conservative value for the **Phase Loss Protection Current Threshold** setting, one that is clearly below the load break rating for the line switch.

Use either the faceplate automatic operation ENABLE/DISABLE switch or a SCADA command to enable automatic operation of the switch control.

Phase Loss Protection with Automatic Reclose

When the **Automatic Reclose** feature is enabled and the switch is tripped open because of a phase imbalance, the switch control recloses the switch once voltage is again present on all three phases. (If **Phase Loss Protection** feature is enabled but **Automatic Reclose** feature is not, an operator must use the faceplate switch or a SCADA command to manually close the tripped switch.)

Note: Automatic reclose is not available in conjunction with automatic transfer.

When Automatic reclose is enabled, the switch control uses the following logic to determine when to reclose the switch:

(a) The switch control monitors the line for the return of all voltage phases.

(b) As soon as the switch control senses voltage is present on all three phases, it starts the "Automatic Reclose" timer.

(c) If voltage remains continuously present for the duration of the timer, the switch control recloses the tripped switch.

Note: Automatic Reclose only occurs if the switch control tripped the switch open because of phase imbalance; switches opened for other reasons must be reclosed manually.

Complete the following steps to enable the **Automatic Reclose** feature:

STEP 1. In the **Features Enabled** field on the *SETUP: Automatic Operation* screen, select a combination that includes "Phase Loss Protection with Automatic Reclose."

STEP 2. At the *SETUP: Automatic Operation* screen, enter values for the **Phase Loss Protection Time Threshold**, the **Phase Loss Protection Current Threshold**, and the **Phase Loss Protection Automatic Reclose Time Threshold** settings. A **Phase Loss Protection Voltage Threshold** value can also be entered. Otherwise, the switch control uses the **Loss of Voltage Threshold** setting on the *SETUP: Site-Related* screen. See the *SETUP: Automatic Operation* screen explanation in S&C Instruction Sheet 1041-530 for details.

STEP 3. Use either the faceplate automatic operation ENABLE/DISABLE switch or a SCADA command to enable automatic operation of the switch control.

Shots-to-Lockout

The **Shots to Lockout** feature allows the field technician or SCADA operator to test a potentially faulted line by reducing the counts to trip to either one or two for a specified time period. If the circuit is then de-energized by a source-side protective device (recloser, breaker, etc.) and the switch control sees the transition from voltage present to loss of voltage, the switch control opens the switch immediately. This allows the faulted line segment to be isolated and prevents the source-side device from reclosing into a fault multiple times.

Note: If the source-side device opens and recloses very quickly, sensors on the load side of the switch may not have enough time to sense both the voltage increase (when the switch closes) and the voltage loss (when the source-side device opens) before the source-side device recloses. Under these conditions, the switch control cannot carry out shots-to-lockout except during a transfer event. For best results, always position the switch so the sensors are on the source side.

NOTICE

It is very important that the end of the **Shots to Lockout** timer and the source breaker operation are coordinated. Operation of the breaker at the same time the switch opens could result in personal injury and damage to the switch.

The **Shots to Lockout** feature can also be enabled when the line switch is closed. This feature is useful for extending the shots-to-lockout functionality to a load-side manual switch. The feature is enabled indefinitely ("latched") until disabled by toggling the faceplate REMOTE/LOCAL switch to **Remote** mode.

When the **Shots to Lockout** feature is enabled:

(a) *When the line switch is open:* If closing the switch into a fault and the source-side protective device (recloser, circuit breaker, etc.) detects the fault, the source-side device opens and voltage is lost on all phases.

When the line switch is closed: If a load-side manual switch on the circuit closes into a fault and the source-side protective device (recloser, circuit breaker, etc.) detects the fault, the source-side device opens and voltage is lost on all phases.

(b) The switch control recognizes that the source-side device opened. If the Number of **Shots Required for Lockout** value is set to "One," the switch control trips open the switch right away. If it is set to "Two," the switch control waits until the source-side device recloses and opens a second time. Then, the switch control trips open its switch. If the "Overcurrent Required before **Shots-To-Lockout Operation** setpoint is also enabled, the switch control only opens the switch if the three-phase voltage loss was preceded by an overcurrent.

Setting the **Number of Shots to Lockout** value to "Two" prevents the switch control from trying to open the switch at the same time as the source-side device is performing its instantaneous reclose. If the **Overcurrent Required Before Shots-To-Lockout Operation** setpoint is also enabled, the relationship between the detection of overcurrent and voltage losses follows the **Fault Current Required Before First/All Voltage Loss(es)** setpoint.

(c) The switch remains open until it is closed with a SCADA command or manually from the switch control faceplate.

Local Shots-to-Lockout

To carry out the **Shots to Lockout** command from the switch control faceplate:

STEP 1. On the first page of the *SETUP: Automatic Operation* screen, make sure:

- The **Features Enabled** setpoint is set to an option that includes "Sectionalizing."
- The **Number of Shots Required for Lockout** setpoint is set to the appropriate number for this switch control.
- The **Shots-To-Lockout Time Threshold** setpoint contains a value higher than zero.
- The **Overcurrent Required before Shots-To-Lockout Operation** setpoint is set to the appropriate value for this switch control.

STEP 2. Set the faceplate REMOTE/LOCAL switch to **Local** mode.

STEP 3. Hold the faceplate automatic operation ENABLE/DISABLE switch in the **Enable** position. This will cause the ENABLED LED to blink while the switch is held.

STEP 4. While holding the ENABLE/DISABLE switch in the **Enable** position, toggle the CLOSE/OPEN faceplate switch (for the circuit being tested) to the **Close** position. This will cause the CLOSED LED for the selected switch to blink. If the line switch is open, this action closes it.

STEP 5. Release the ENABLE/DISABLE switch.

If the line switch was previously open: The **Lockout** mode remains in effect (and the CLOSED LED continues to blink) for the duration of the **Shots-To-Lockout Time Threshold** setting. If the appropriate number of voltage losses is detected during this time, the switch control trips open the switch.

If the line switch was already closed: The **Lockout** mode remains in effect (and the CLOSED LED continues to blink) indefinitely. To disable it, toggle the REMOTE/LOCAL switch to **Remote** mode.

Remote Shots-to-Lockout

The **Shots-to-Lockout** feature can be set with a SCADA command, but the feature cannot be latched with a remote command. The faceplate SCADA CONTROL switch must be in the **Remote** mode and the AUTOMATIC OPERATION switch set to **Enabled** mode for the control to accept a remote **Shots-to-Lockout** feature command.

When a line switch has been tripped (opened automatically) by the switch control, the information on the *OVERCURRENT FAULT* screens can help determine the source and cause of the problem.

Fault Events Log

Click the **Overcurrent Fault** button on any screen to open the *OVERCURRENT FAULT MENU* screen, and then click the **Fault Events** button. See Figure 5.

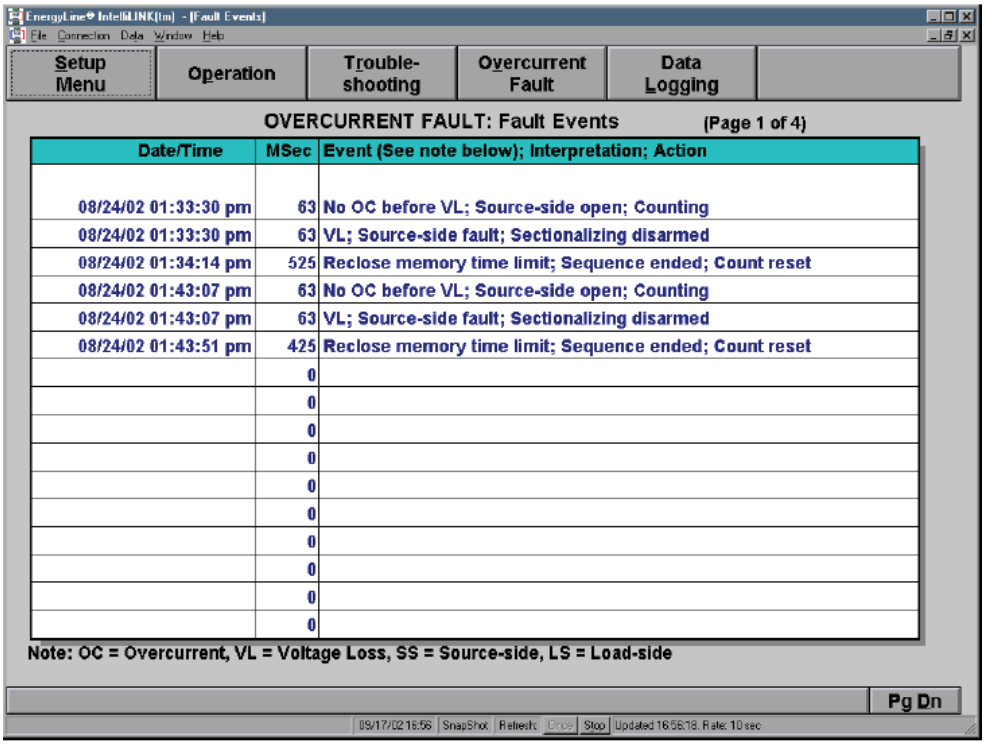


Figure 5. The *OVERCURRENT FAULT: Fault Events* screen.

The *OVERCURRENT FAULT: Fault Events* screen shows a chronological listing of fault-related events for the switch(es). The record for each event includes the time, the switch number (if applicable), the type of event, the switch control's interpretation of the event, and the action taken.

This log includes four pages of data. Once the log is full, each new event overwrites the oldest event in the log. To find the most recent event, look for the message with a timestamp that is older than the time for the message above it.

This screen includes two columns:

Date/Time.....MSec

This is the time (to the nearest 6.25 milliseconds) when the event was logged. The switch control logs the event after the fault event and all described actions are completed.

This is the event message, which describes the event, the assumption the switch control made about the event, and the action(s) taken. These messages are explained below.

Note: For 5802/5803 controls, each event message is specific to one switch/circuit and is preceded by either "Sw1:" for Switch 1 or "Sw2:" for Switch 2. When both circuits are affected, such as by a voltage loss, the message appears twice.

Phase A OC; Fault current sensed & cleared; Noted

The switch control detected an overcurrent fault on Phase A. That overcurrent fault has ended. The switch control is waiting to determine whether voltage will be lost on all three phases. If all voltage is lost, the switch control will begin timing for a possible recloser operation.

Note: The switch control displays similar messages for Phase B, Phase C, and Ground overcurrent conditions.

Phase B OC; Fault current sensed & cleared; Noted

See the "Phase A OC; Fault current sensed & cleared; Noted" section above.

Phase C OC; Fault current sensed & cleared; Noted

See the "Phase A OC; Fault current sensed & cleared; Noted" section above.

Ground OC; Fault current sensed & cleared; Noted

See the "Phase A OC; Fault current sensed & cleared; Noted" section above.

OC then voltage o.k.; Load-side protective open; Noted

The switch control detected an overcurrent fault. This condition was not followed within 0.6 seconds by a loss of voltage on the same phase. The control assumed a load-side fault occurred, but the condition was cleared on the load side by a fuse, recloser, etc.

Note: No timer or other action is started for this type of event.

OC then VL; Source-side protective open; Counting

The switch control detected an overcurrent fault, which was followed within 0.6 seconds by a loss of voltage on all phases. The switch control assumed a load-side fault occurred and the condition was cleared on the source side by a three-phase device, such as a breaker, interrupter, or recloser. The control added one count to the recloser operations counter.

Reclose memory time limit; Sequence ended; Count reset

The **Sectionalizer Reset** timer expired. The switch control will consider future events to be part of a different event sequence.

Note: The switch control always displays this message when the timer expires.

VL; Source-side fault; Sectionalizing disarmed

The switch control detected a three-phase voltage loss but no overcurrent fault condition. The control assumed a source-side fault occurred and the condition was cleared on the source side by a three-phase device, such as a breaker, interrupter, or recloser. The control started the **Sectionalizer Reset** timer and set the value in the recloser operations counter to "1." Because the fault was on the source side, the control will not trip open the switch because of recloser counts with fault current detected, but it will open the switch if the **Recloser Counts to Trip, Voltage Loss Only** count is reached.

VL; Load-side fault; Sectionalizing armed

The switch control previously detected a phase or ground overcurrent fault followed within 0.6 seconds by three-phase voltage loss. The control then assumed the present voltage loss was associated with the previous load-side fault and the condition was again cleared on the source side by a three-phase device, such as breaker, interrupter, or recloser. The control incremented the recloser operations counter.

Full count reached; Source-side fault; Noted

The full count was reached on the recloser operations counter. Because the first voltage loss in the sequence was not preceded by an overcurrent fault, the control took no sectionalizing action on the **Recloser Counts to Trip, Fault Current Detected** count.

Full count reached; Load-side fault; Noted

The full count was reached on the recloser operations counter. Because the first voltage loss in the sequence was preceded by an overcurrent fault, as well as all subsequent voltage losses, if the **Fault Current Required Before First/All Voltage Loss(es)** value is set to "All", the control will take the appropriate sectionalizing action.

Full count reached with sectional. disabled; Noted

The full count was reached on the recloser operations counter. Because sectionalizing was disabled, the switch control did not trip open the switch.

Note: To identify the exact events that led to this action, review the earlier log messages.

Full count reached; Open operation executed

The full count was reached on the recloser operations counter, so the switch control tripped open the switch.

NOTE: To identify the exact events that led to this action, review the earlier log messages.

No OC before VL; Source-side open; Counting

The switch control detected a three-phase voltage outage that was not preceded by an overcurrent fault. The control assumed a source-side fault occurred and the condition was cleared by a source-side device. The control added one count to the recloser operations counter.

OC then VL; Source-side fuse blown for load-side fault

The switch control detected a phase or ground overcurrent fault. This was followed within 0.6 seconds by a loss of voltage on the same phase, without all other phases losing voltage. The control assumed a load-side fault occurred and the condition was cleared on the source side by a fuse or single-phase recloser.

No OC then VL; Source-side (SS) fuse blown - SS fault

The switch control detected a loss of voltage on one or two phases, which was not preceded by an overcurrent fault. The control assumed that a source-side fault occurred and the condition was cleared on the source side by a fuse or a single-phase recloser.

CLOSE operation executed, shots-to-lockout requested

In response to an automatic transfer command, or a SCADA or faceplate **Shots to Lockout** command, the control closed the switch and started the **Shots to Lockout** timer.

Note: If, before the timer expires, voltage is restored on any phase and then lost on all three phases, the control will trip open the switch. If the **Overcurrent Required before Shots-To-Lockout Operation** feature is enabled, the switch control also detected overcurrent.

Lockout close complete with event after - OPEN executed

An operator requested a **Shots to Lockout** operation. The switch control detected the appropriate number of three-phase voltage losses, within the specified shots-to-lockout time interval, so it tripped open the switch. If the **Overcurrent Required before Shots-To- Lockout Operation** feature is enabled, the switch control also detected overcurrent. If the **Number of Shots Required for Lockout** value 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.

Persistent phase imbalance; OPEN executed

The switch control detected a loss of voltage on one or two phases, but not all three phases. The imbalance continued for the full count of the **Phase Loss Protection Time Threshold** timer. Because this loss occurred while the **Phase Loss Protection** feature and automatic operation were both enabled, the switch control tripped open the switch.

Phase imbalance w. reclose enabled; Waiting

The switch control detected a phase imbalance while **Automatic Reclose** mode was enabled. The control tripped open the line switch and is now waiting for three-phase voltage to return.

Note: When full voltage returns, the control will start the **Automatic Reclose** timer. When voltage is continuously present for the full count of the timer, the control will reclose the switch.

Switch closed; Operator action; Reclose canceled

While the switch control was waiting for three-phase voltage to return, with **Automatic Reclose** mode enabled, an operator manually closed the line switch from the faceplate or via SCADA command. This operator action canceled the pending **Automatic Reclose** operation.

Voltage OK after imbalance; Voltage restored; Waiting

After the switch control tripped open the switch because of a phase imbalance, three-phase voltage returned. Because **Automatic Reclose** mode was enabled, the control started the **Automatic Reclose** timer. The control is waiting for the timer to expire.

Note: When the **Automatic Reclose Time** setpoint value is reached, the control will close the switch.

Imbalance corrected w. reclose enabled; CLOSE executed

After the switch control tripped open the switch because of a phase imbalance, three-phase voltage was restored and remained present for the full count of the **Automatic Reclose** timer. Because **Automatic Reclose** mode was enabled, the control reclosed the switch.

No OC before VL; Voltage Loss Only count reached

The switch control detected a three-phase voltage outage that was not preceded by an overcurrent fault. Sectionalizing on voltage loss only is enabled, and the **Recloser Counts to Trip, Voltage Loss Only** value has been reached.

Open operation executed on Voltage Loss Only

Sectionalizing on voltage loss only is enabled, and the **Recloser Counts to Trip, Voltage Loss Only** value has been reached. The switch control sent the command to open the switch.

Sectionalizing disabled on Voltage Loss Only; None

The necessary criteria for sectionalizing on voltage loss only have been reached, but the feature is disabled. Neither a count of voltage losses nor an extended voltage loss will cause an operation.

Reclose memory time limit; Extended Volt Loss; OPEN

The reclose memory time limit expired without the restoration of voltage on any phase. This constitutes an extended voltage-loss condition. The switch control opened the switch.

Shots-to-lockout latched on

An operator enabled the **Shots to Lockout** operation on a closed switch. The switch control will open the switch if the detected three-phase voltage count equals the **Number of Shots Required for Lockout** value.

Successful reclose; Sequence ended; Count reset

The **Successful Reclose Reset Time** timer has expired. The switch control will consider future events to be part of a different event sequence.

Note: The switch control always displays this message when the timer expires.

Fault Magnitude and Duration Log

Click the **Overcurrent Fault** button on any screen to open the *OVERCURRENT FAULT MENU* screen, and then click the **Fault Magnitudes** button.

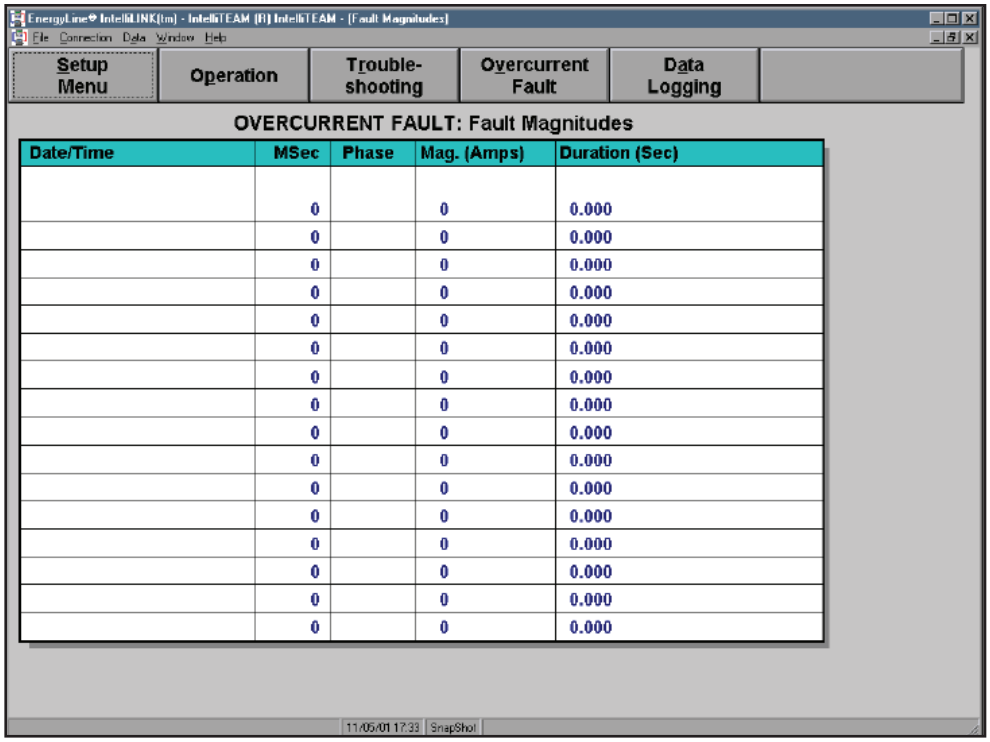


Figure 6. The *OVERCURRENT FAULT: Fault Magnitudes* screen.

The *OVERCURRENT FAULT: Fault Magnitudes* screen shows a chronological listing of peak magnitude and duration data for overcurrent fault events. See Figure 6. The record for each event includes the date, time, phase, magnitude, and fault duration.

The log can hold information for 16 events. Once the log is full, each new event overwrites the oldest event in the log. To find the most recent event, look for the message with a timestamp that is older than the time for the message above it.

The screen includes the following fields:

Date/Time.....MSec

This is the time (to the nearest 6.25 milliseconds) when the event began. The switch control logs each event when it ends.

Phase

This is the phase, and switch if applicable, on which the overcurrent fault occurred, for example, A2, C1, or G2.

Mag. (Amps)

This is the peak (maximum) overcurrent fault magnitude during the event. This is displayed as an RMS, asymmetric number.

Duration (Sec)

This is the duration of the overcurrent fault event. The value is displayed in units of seconds, with resolution to the nearest 0.00625 seconds (6.25 milliseconds). The maximum recorded fault duration is 409.6 seconds (6.82 minutes). Any fault that lasts longer than that is recorded as 409.6 seconds.

Ac Power Outages Log

Click on the **Overcurrent Fault** button on any screen to open the *OVERCURRENT FAULT MENU* screen, and then click the **Power Outages** button.

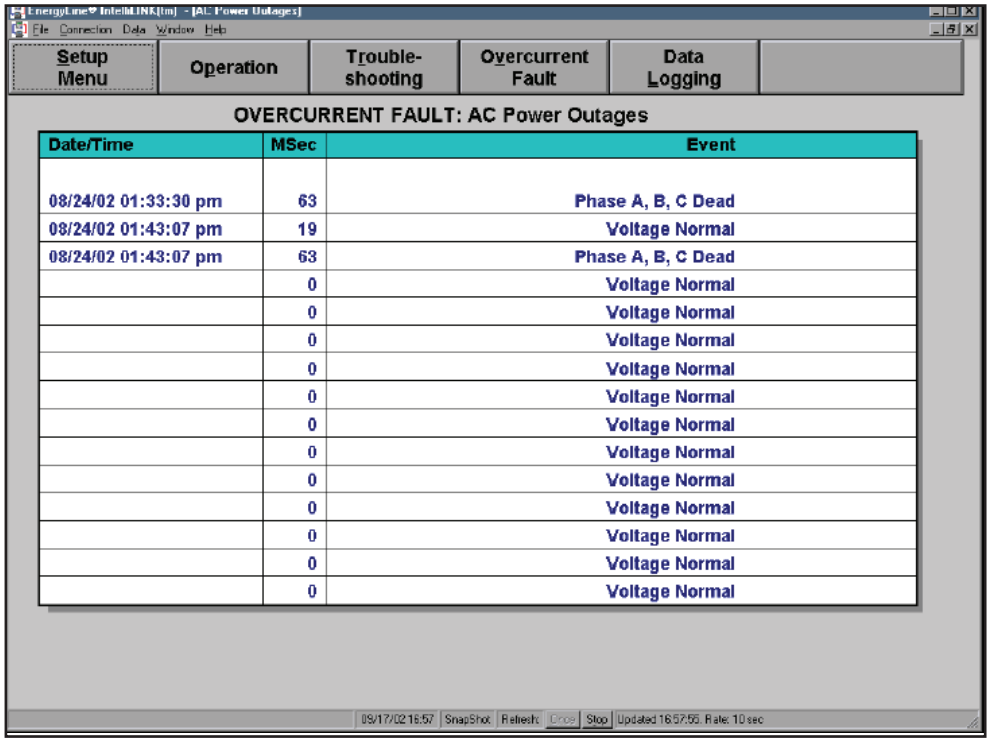


Figure 7. The *OVERCURRENT FAULT: AC Power Outages* screen.

The *OVERCURRENT FAULT: AC Power Outages* screen shows a chronological listing of voltage outage events. See Figure 7. The record for each event includes the date, time, and phase status for each event.

An event is recorded each time:

- Voltage drops below the **Loss of Voltage Threshold** setpoint on any phase.
- Voltage rises above the **Loss of Voltage Threshold** setpoint.

The log can hold information for 16 events. Once the log is full, each new event overwrites the oldest event in the log. To find the most recent event, look for the message with a timestamp that is *older* than the time for the message above it.

This screen includes the following fields:

Date/Time.....MSec

This is the time (to the nearest 6.25 milliseconds) when the event began. This time is logged as soon as the event occurs.

Event

This is the phase, and switch if applicable, on which the voltage loss event occurred, for example, A2, C1, G2, or Control Power.

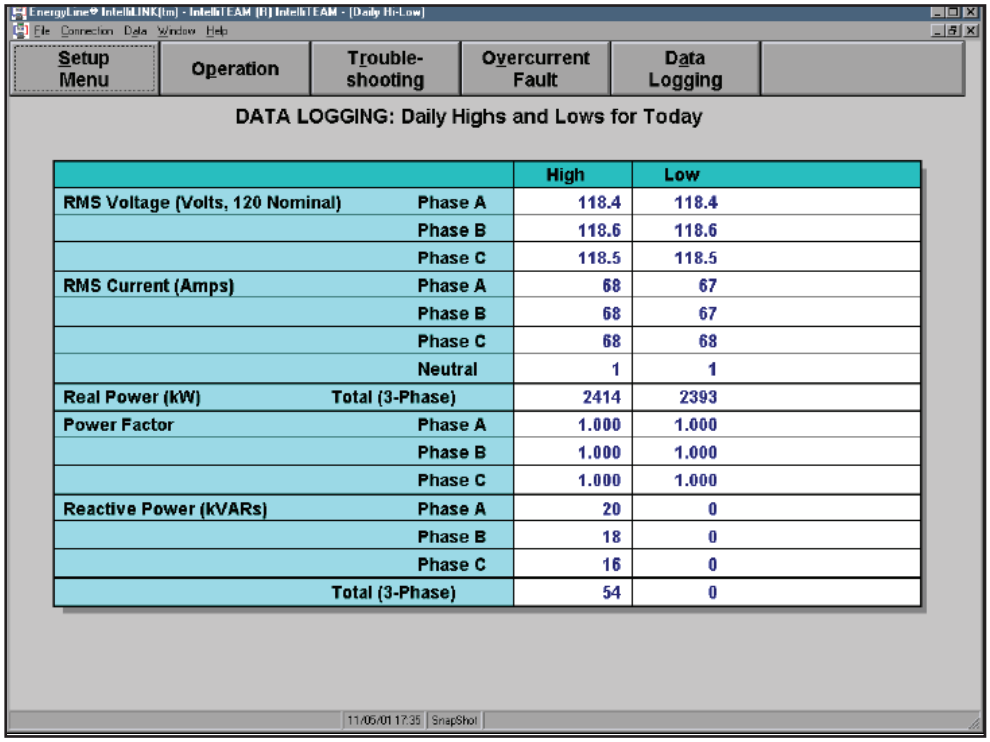
NOTE: The switch control records a control power voltage loss event whenever the Power Supply/Control I/O module detects loss of ac power and switches to battery backup power.

Routine Data-Logging Information

The data-logging screens show high and low values and trend data for voltage and current amplitude, phase, and related parameters. When a customer complains of a service outage or low voltage, the information on the *DATA LOGGING* screens can help you determine what happened and why it happened.

View the Daily Highs and Lows Data

Click the **Data Logging** button on any screen to open the *DATA LOGGING MENU* screen, and then click the button for the time period that contains the day to be viewed. Then, if necessary, click on the **PgUp** and **PgDn** buttons to move to the correct day.



		High	Low
RMS Voltage (Volts, 120 Nominal)	Phase A	118.4	118.4
	Phase B	118.6	118.6
	Phase C	118.5	118.5
RMS Current (Amps)	Phase A	68	67
	Phase B	68	67
	Phase C	68	68
	Neutral	1	1
Real Power (kW)	Total (3-Phase)	2414	2393
Power Factor	Phase A	1.000	1.000
	Phase B	1.000	1.000
	Phase C	1.000	1.000
Reactive Power (kVARs)	Phase A	20	0
	Phase B	18	0
	Phase C	16	0
	Total (3-Phase)	54	0

Figure 8. One of the *DATA LOGGING: Daily Highs and Lows* screens (5801 control is shown)

Each *DATA LOGGING: Daily Highs and Lows* screen shows the highest and lowest voltage and current, along with associated power factor, kvar, and kW values, for each switch for a 24-hour period (12 midnight to 12 midnight). See Figure 8. The high/low data for today and for each of the preceding 7 days can be viewed.

The switch control records the voltage on all three phases when any one phase is higher/lower than the previous high/low recorded on any phase.

The switch control also records the current on all three phases, based on the average three-phase current. In addition, when a new daily high or low occurs, it records the power factor per phase, kvars per phase and total), and total kW at that time.

Each displayed value is the 1.6-second averaged value for that parameter. To obtain a 1.6-second averaged value, the switch control samples the data every 0.2 seconds. It then adds together eight consecutive samples and divides the total by eight.

Data Logging for Most Recent Week

At the *DATA LOGGING: Data for Most Recent Week Menu* screen, users can select the set of daily profile data to view, data for Sunday, data for Monday, etc. See Figure 9. This data consists of 15-minute averaged (5801 control) or 30-minute averaged (5802/5803 controls) values for voltage, current, and kvar for each of the most recent seven days.

Note: For the 5802/5803 controls, there are separate menus for Switch 1, Switch 2, and Switch 3. The screens for Switch 3 contain only RMS current values for each of the most recent seven days.

To display the *DATA LOGGING: Data for Most Recent Week Menu* screen, click the **Most Recent Week** button for the desired switch, if applicable, at the *DATA LOGGING MENU* screen.

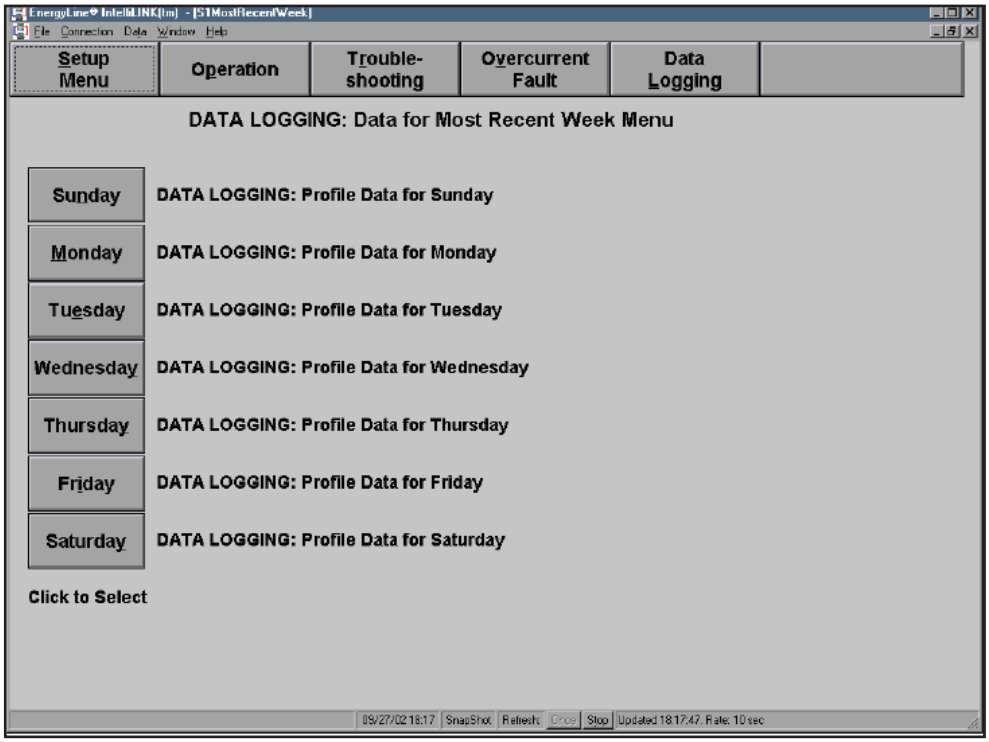


Figure 9. The *DATA LOGGING: Data for Most Recent Week Menu* screen (5801 control is shown)

Profile Data for One Day

Each *DATA LOGGING: Profile Data* screen shows the data for one day (12 midnight to 12 midnight) during the preceding week. See Figure 10 on page 34.

Note: If selecting to view information for today, values from two separate days can be seen. For example, if it is 3:01 p.m. on a Tuesday and **Profile Data for Tuesday** option is selected, all the data entries through 3:00 p.m. are the day's values. All the entries for times after 3:00 p.m. are from the same day the previous week.

To display a *DATA LOGGING: Profile Data* screen, click on the button for the day to be viewed at the *DATA LOGGING: Data for Most Recent Week* screen for the desired switch, if applicable.

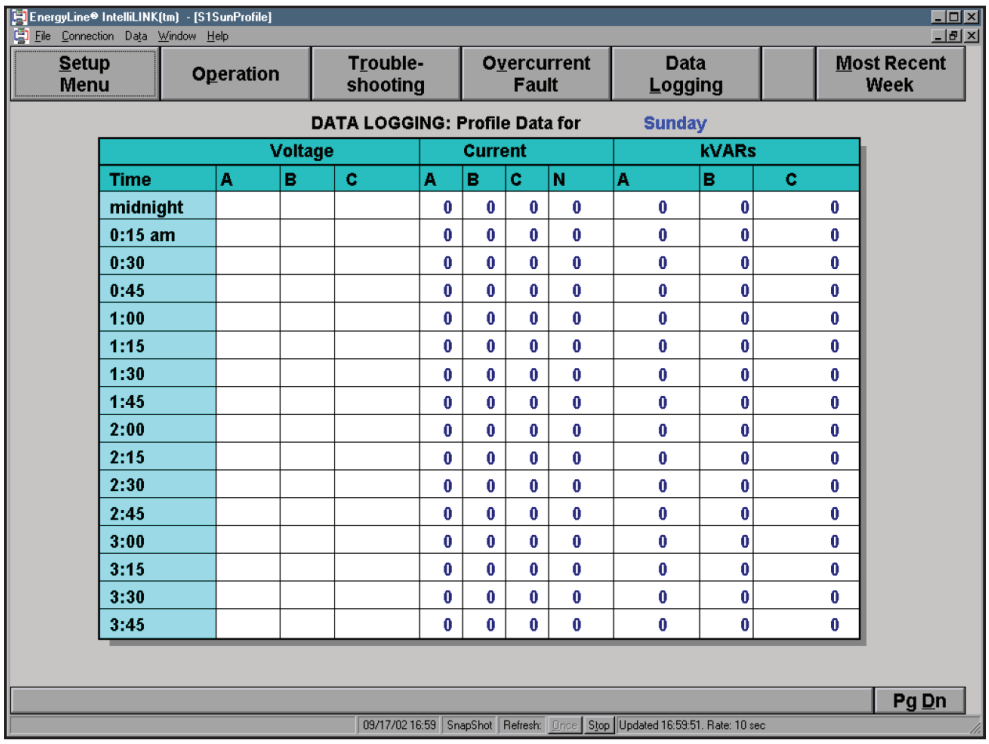


Figure 10. The *DATA LOGGING: Profile Data* screen.

The recorded numbers are 15-minute averaged (5801 control) or 30-minute averaged (5802/5803 controls) values.

The switch control samples the data every 0.2 seconds. It adds together eight consecutive samples and divides the total by eight, to yield a 1.6-second averaged value. It then adds together all the 1.6-second averaged values in the time span (for example, 2:31 a.m. - 3:00 a.m. for a 30-minute time span), and divides that total by the number of values.

Saving Settings and Data

You can use the **Report** feature to save the control software settings and stored data to your computer in a CSV (comma-separated value) file. The report can be kept as a permanent record and the report data can be used in spreadsheets or other types of programs.

Complete the following steps to save settings and data:

STEP 1. Connect a portable computer to the switch control and start the IntelliLink software.

For details, see "To Start IntelliLink" section in Instruction Sheet 1041- 530. If the computer is already connected to the switch control, this step can be skipped.

STEP 2. At any IntelliLink software screen, click the Report Menu button.

STEP 3. At the *REPORT MENU* screen, click the **Full Report** button to generate a report.

The full report includes all the information contained in the switch control.

STEP 4. In the Save Report dialog box, specify a name and location for this report, and then click on the **Save** button.

If a specific location is not chosen, the file is saved to the same directory as the program files for this switch control. For example, the default location for SNCD-S0X report files is C:\ELine\SNCD-S0X\. The extension ".CSV" is added automatically.

When the report is complete, the message "Task completed" appears on the status line of the Writing Report dialog box.

STEP 5. Click on the **OK** button.

The software closes the dialog box and displays the *REPORT MENU* screen.

Saving a Setup Configuration

If two or more switch controls use a similar setup configuration and the same software version, the configuration from one switch control can be saved and loaded into the other(s). The user then only must manually adjust the setpoints that are different for each switch control.

Complete the following steps to save a setup configuration:

STEP 1. Determine which switch control contains the configuration to save.

STEP 2. Connect the computer to the selected switch control and start the IntelliLink software.

For details, see "Start IntelliLink" section in Instruction Sheet 1041-530. If the computer is already connected to the switch control, this step can be skipped.

STEP 3. At any IntelliLink software screen, click on the **Setup Menu** button.

STEP 4. At the *SETUP MENU* screen, click on the **Save Data** button.

STEP 5. In the Save Setpoints dialog box, specify a name and location for this configuration (CFG) file, and then click on the **Save** button.

If a location is not specified, the file is saved to the same directory as the program files for this switch control. For example, the default location for SNCD-S0X report files is C:\ELine\SNCD-S0X\. The extension ".CFG" is added automatically.

Note: This process does not save the "Physical Location" on the *SETUP: Miscellaneous* screen, "Communications RTU Address" on the *SETUP: Communications* screen, or the sensor configuration data on the *SETUP: Sensor Configuration* screen, if applicable.

Loading a Saved Configuration

Complete the following steps to load a saved configuration:

STEP 1. If necessary, connect the computer to the switch control where the configuration will be saved, and then start the IntelliLink software.

For details, see "Start IntelliLink" section in Instruction Sheet 1041-530. If the computer is already connected to the switch control, this step can be skipped.

STEP 2. From the **File** menu, choose the **Load Setpoints** option.

STEP 3. In the dialog box, select the CFG file for the configuration to be loaded , and then click on the **Open** button.

STEP 4. Make any setpoint changes required for this switch control.

For details, see Instruction Sheet 1041-530.

Note: Be sure to enter the correct **Physical Location** value on the *SETUP: Miscellaneous* screen, the Communications RTU Address on the *SETUP: Communications* screen, and the sensor configuration data on the *SETUP: Sensor Configuration* screen, if applicable..

To view the IntelliLink software screens and Help file without connecting to a switch control or a snapshot:

STEP 1. Start the IntelliLink software on the computer.

STEP 2. During startup, click on the **Cancel** button to close the Connect dialog box.

If the IntelliLink software is already running, choose the **Disconnect** option from the **Connection** menu, and then choose the **Close Screenset** option from the **File** menu to clear the present screenset from memory.

STEP 3. From the **File** menu, choose the **Open Screenset** option.

STEP 4. In the Open Screenset dialog box, find and select the WMN file whose name matches the version name on the setup software disk for this switch control.

Using Snapshots

Operational and data-logging information can be saved in snapshot virtual memory files. These snapshots let users view data, generate a report, and save or change setpoint configurations even when they are not connected to a switch control. To access the stored information, open the snapshot instead of connecting to a physical control. Each switch control setup disk includes a sample snapshot.

Saving a Snapshot

Complete the following steps to save a snapshot:

STEP 1. Connect the computer to the switch control that has the information to be saved, and then start the IntelliLink software.

For details, see "Start IntelliLink" section in Instruction Sheet 1041-530. If the computer is already connected to the switch control, this step can be skipped.

STEP 2. From the **Tools** menu, choose the **Snapshot>Save** option .

STEP 3. In the dialog box, specify a file name and location for this snapshot, and then click on the **Save** button.

If a specific location is not specified, the file is saved to the same directory as the program files for this switch control. For example, the default location for SNCD-S0X report files is C:\ELine\SNCD-S0X\. The extension ".VM" is added automatically.

Viewing a Snapshot

Complete the following steps to save a snapshot:

STEP 1. Start the IntelliLink software on the computer. During startup, click on the **Cancel** button to close the Connect dialog box.

If the IntelliLink software is already running, choose the **Disconnect** option from the **Connection** menu, then choose the **Close Screenset** option from the **File** menu to clear the present screenset from memory.

STEP 2. From the **Connection** menu, choose the **Connect to VM File** option. The Open Controller Data File dialog box opens.

STEP 3. Select the snapshot to view, and then click on the **Open** button.

STEP 4. If the configuration settings in the snapshot are to be changed, click on the **Yes** button at the Connect to File dialog box. To avoid accidentally changing a setting, click on the **No** button. The IntelliLink software opens and displays the contents of the selected snapshot.

When saving changes made in the snapshot: All changes made to configuration settings in the snapshot are automatically immediately saved to the disk. Changes don't need to be saved in a separate operation.

When generating a report from a snapshot: Follow the same procedure as when connected to a switch control. For details, see the Generating Reports section on page 35.

Creating a Configuration (CFG) File

Follow this procedure to prepare a setpoint configuration for a switch control in the field while there access to a comparable device is not available:

STEP 1. Connect to the snapshot. For details, see the "Viewing a Snapshot" section on page 37.

STEP 2. Change the configuration settings in the snapshot as needed. For details, see the Instruction Sheet 1041-530.

STEP 3. At any *IntelliLink* screen, click the on the **Setup Menu** button.

STEP 4. At the *SETUP MENU* screen, click the on the **Save Data** button.

STEP 5. In the Save Setpoints dialog box, choose a file name and location for this configuration, and then click on the **Save** button.

If a location is not specified, the file is saved to the same directory as the program files for this switch control. For example, the default location for SNCD-S0X report files is C:\ELine\SNCD-S0X\. The extension ".CFG" is added automatically.

Note: This process does not save the Physical Location on the *SETUP: Miscellaneous* screen, the Communications RTU Address on the *SETUP: Communications* screen, or the sensor configuration data on the *SETUP: Sensor Configuration* screen, if applicable.

The Update Program

Occasionally, the operating system for the switch control or the control software may need to be updated. The Update program, installed with IntelliLink software, easily replace the old control software with the newer version.

Note: The setpoint values and historical data stored in the switch control could be lost during the update process. To be safe, always generate all needed reports using the old IntelliLink and control software before updating the control.

NOTICE

S&C strongly recommends the switch control have ac control power (or sensor power) as well as battery power during the update process.

If the control software must be updated while the control has battery power only, the users **MUST** follow the instructions described in the "Updating Control Software With Battery Power Only" section on page 40. Otherwise, the update process will not run properly.

Complete the following steps to update the program:

STEP 1. Install the contents of the new Setup disk on the computer.

For details, see "Start IntelliLink" section in Instruction Sheet 1041-530.

STEP 2. Connect the computer to the Local Access port on the switch control.

STEP 3. Start the Update program.

(a) In Windows, choose the *Start menu>Programs>EnergyLine>Update* process. The Update window appears. See Figure 11.

(b) Select the desired options, and then click on the **Start Update** button.

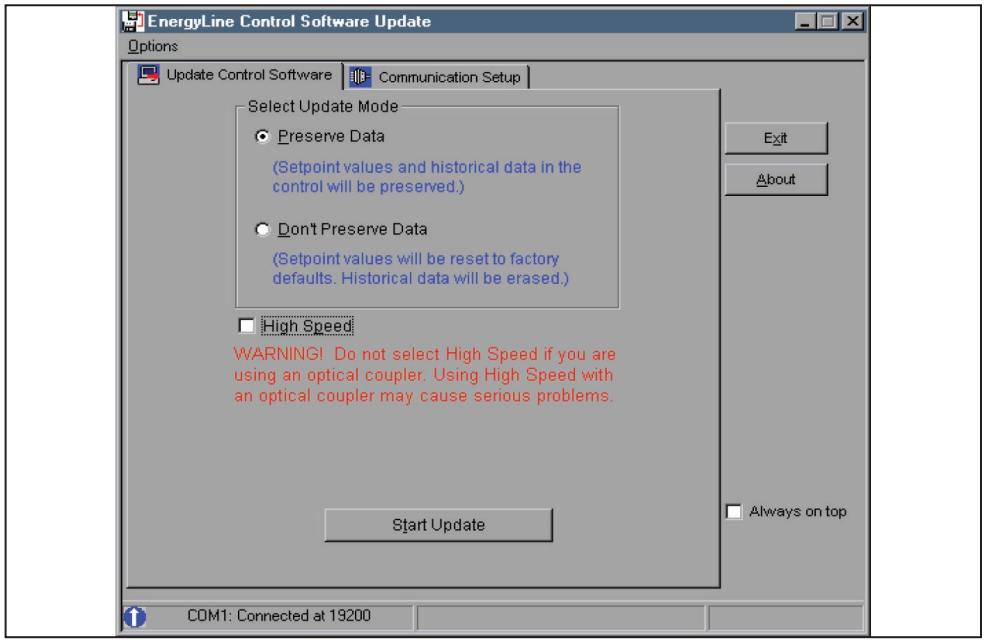


Figure 11. The control software Update window.

Note: If the switch control is not connected to COM1 on the computer, click on the **Communication Setup** tab, select the correct comm port, click on the **Connect** button, return to the **Update Control Software** tab and click on the **Start Update** button.

The update process may take 5 to 20 minutes. The progress is shown in the lower right corner of the window. Once the update is complete, the window automatically closes.

Note: If the software on the disk is not the same type as the software in the switch control, an error message appears. Note which software version is in the switch control, and then press the <Enter> key to abort the update process. After securing the correct new software version, repeat the steps on page 39.

Updating Control Software with Battery Power Only

S&C recommends the switch control have both battery and ac control power (or battery and sensor power, if applicable) when updating the control software. If the control software must be updated at a location where no ac control power is available, then the user must follow the instructions in this document to override the automatic shut-down.

Protection System Logic

All functions of the switch control are directed by the CPU, including charging and monitoring the battery system. If the CPU program stops or hangs, the control will not function and the battery or circuits might be damaged. To indicate the CPU program is functioning properly, it sets a bit on the PS/IO board every few seconds. If that bit goes unset for 60 seconds, the PS/IO board disconnects the battery, shutting down the control and preventing damage to the control circuits and battery.

During the update process, the CPU is unable to function and does not set the bit on the PS/IO board. The protection logic disconnects the battery 60 seconds or less after the update process begins. When ac control power (or sensor power) is present, the control continues to operate without battery power and completes the software update. However, if ac control power (or sensor power) is not present, the control shuts down, terminating the software update. There is no damage to the control, and the update process can be started again.

Manually Overriding the Battery Disconnect Command

The control software can be manually updated using only battery power by manually sending a **Battery On** command to the PS/IO board. To do so, press the BAT ON switch every 30 seconds. This white momentary-contact switch is located on the PS/IO board. See Figure 12.

Updating the control software usually takes less than 5 minutes. Pushing the BAT ON switch is generally easier than moving the control to a location with ac control power or sensor power.

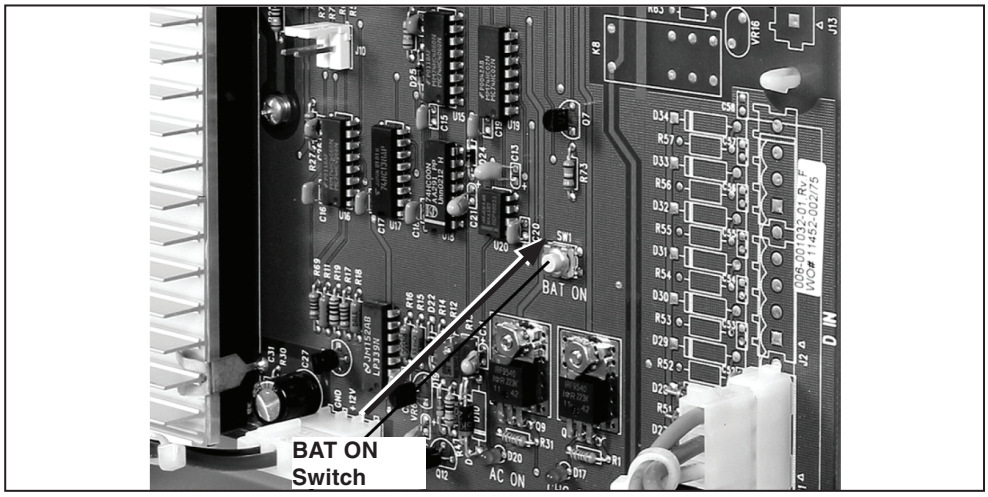


Figure 12. The BAT ON switch on the PS/IO board.