

Operation

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Introduction

Qualified Persons

WARNING

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

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

- The skills and techniques necessary to distinguish exposed live parts from 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 the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

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

Read this Instruction Sheet

NOTICE

Read this instruction sheet thoroughly and carefully before installing or operating your S&C IntelliCap Automatic Capacitor Control. Familiarize yourself with the Safety Information on page 4 and Safety Precautions on page 5. 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 S&C IntelliCap Automatic Capacitor Control. Designate a location where you can easily retrieve and refer to this publication.

Proper Application

WARNING

The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the selected equipment.

Special Warranty Provisions

The standard warranty contained in S&C's standard conditions of sale, as set forth in Price Sheets 150 and 181, applies to the S&C IntelliCap Automatic Capacitor Control, except that the first paragraph of the said warranty is replaced by the following:

(1) General: The seller warrants to the immediate purchaser or end user for a period of 10 years from the date of shipment that the equipment delivered will be of the kind and quality specified in the contract description and will be free of defects of workmanship and material. Should any failure to conform to this warranty appear under proper and normal use within 10 years after the date of shipment, the seller agrees, upon prompt notification thereof and confirmation that the equipment has been stored, installed, operated, inspected, and maintained in accordance with the recommendations of the seller and standard industry practice, to correct the nonconformity either by repairing any damaged or defective parts of the equipment or (at the seller's option) by shipment of necessary replacement parts. The seller's warranty does not apply to any equipment that has been disassembled, repaired, or altered by anyone other than the seller. This limited warranty is granted only to the immediate purchaser or, if the equipment is purchased by a third party for installation in third-party equipment, the end user of the equipment. The seller's duty to perform under any warranty may be delayed, at the seller's sole option, until the seller has been paid in full for all goods purchased by the immediate purchaser. No such delay shall extend the warranty period.

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

Warranty of the S&C IntelliCap Automatic Capacitor Control is contingent upon the installation, configuration, and use of the control or software in accordance with S&C's applicable instruction sheets.

This warranty does not apply to major components not of S&C manufacture. However, S&C will assign to the immediate purchaser or end user all manufacturer's warranties that apply to such major components.

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

Safety Information

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels attached to the S&C IntelliCap Automatic Capacitor 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 S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

NOTICE

Read this instruction sheet thoroughly and carefully before installing or operating your S&C IntelliCap Automatic Capacitor Control.



Replacement Instructions and Labels

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

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

⚠ DANGER



The S&C IntelliCap Automatic Capacitor 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 IntelliCap Automatic Capacitor Control must be restricted only to Qualified Persons.

2. SAFETY PROCEDURES. Always follow safe operating procedures and rules. Always maintain proper clearance from energized components.

3. PERSONAL PROTECTIVE EQUIPMENT. Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, arc-flash

clothing, and fall protection, in accordance with safe operating procedures and rules.

4. SAFETY LABELS AND TAGS. Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels and tags. Remove tags ONLY if instructed to do so.

5. MAINTAINING PROPER CLEARANCE. Always maintain proper clearance from energized components.

This section explains how the control components monitor the distribution feeder and manage capacitor bank operation.

The faceplate LCD screen and switches are shown in Figure 1.

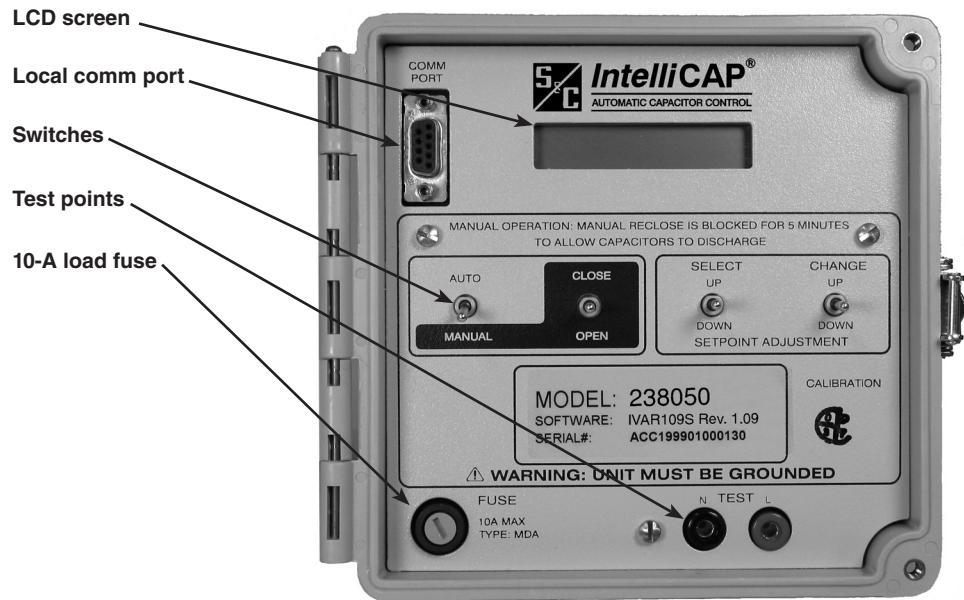


Figure 1. The IntelliCap Control faceplate.

Faceplate Features

AUTO/MANUAL switch—Toggle this switch up to enable **Automatic** control operation and block commands from the faceplate CLOSE/OPEN switch. Toggle this switch down to disable **Automatic** operation.

CLOSE/OPEN switch—Toggle this switch up to send a **Close** command to the capacitor bank switch. Toggle this switch down to send an **Open** command to the bank switch.

Note: When the AUTO/MANUAL switch is in the **Auto** position, toggling the CLOSE/OPEN switch has no effect.

SELECT SETPOINT switch—Toggle this switch up or down to scroll through setpoint parameters on the LCD screen.

CHANGE SETPOINT switch—Toggle this switch up or down to change selected setpoint.

Note: When the **Faceplate Setpoints Adjustment** setpoint on the *Setup>Miscellaneous* screen is set to the **Protected** state or the AUTO/MANUAL switch is in the **Auto** mode, toggling the CHANGE SETPOINT switch has no effect. When the **Faceplate Setpoints Adjustment** setpoint is set to the **Protected** mode, use of a computer with IntelliLink® software is required to change the settings.

Faceplate LCD Screen

The control has a 16-character LCD screen that cycles through the list of real-time data, operating information, logged data, and setpoints. Other operating information, such as a temperature sensor error or a manual operation delay, are also displayed. When the LCD screen is cycling automatically, only setpoints for the presently active control strategy are shown. If the setpoints are scrolled with a faceplate command, the LCD screen shows all available setpoints. Table 1 on page 7 lists the real-time data, operating information, and logged data that appears on the LCD screen.

Note: Because of rounding differences, the IntelliLink software screens and the LCD screen may display slightly different values for the real-time data and setpoints.

Table 1. Data Displayed on the LCD Screen

Display	Meaning
Date, time	Present time and date
[Volt]; [Ovr]	Line voltage (true RMS measured voltage); whether a voltage override is in effect
[Line kV]	Primary voltage (var control only)
[Line Amps]	Primary current (var control only)
[PF]; [Dir]	Power factor; normal or reversed power-flow direction (var control only)
[Line kVAR]	Line kvar level (var control only)
[Line kW]	Line kW level (var control only)
[Line kVA]	Line kVA level (var control only)
[Temperature]	Present ambient temperature
[Stat]	Closed/open status of the capacitor bank
[Evt]	Active event; if no event is active, the display reads **None/Unit OK**
[OperMode]	The present operating mode of the IntelliCAP (hardware manual, software manual, or automatic)
[AUTO]	The automatic control strategy for the present season
[SoftVer]	The ID of the control software in the IntelliCap control
[OperCount]	Total number of complete switching cycles since installation
[SwIn]	The reason for the last switch in
[SwOut]	The reason for the last switch out

Table 2 shows other possible operational information displayed, in order of precedence:

Table 2. Other Operating Information Displayed on the LCD Screen

Display	Meaning
[Faceplate Sw.Err]	Indicates a problem with one of the faceplate switches
[Voltage Sen Err]	Indicates the voltage sensor is reading outside its valid range or is faulty
[Temperat Sen Err]	Indicates the temperature sensor is reading outside its valid range or is faulty
[HiLoVoltBand Err]	Indicates the Bank Voltage Change + Margin setpoint is greater than the difference between the High Voltage Override setpoint and the Low Voltage Override setpoint
[Close In ## secs]	Indicates the number of seconds left until the control operates the bank
[Open In ## secs]	Indicates the number of seconds left until the control operates the bank
[Reclose Block]	Displays when trying to close the bank while the reclose block delay is in effect

See Instruction Sheet 1022-550, “S&C IntelliCap® Automatic Capacitor Control: Troubleshooting,” for more information about correcting errors.

Control Software

S&C control operation is software-driven. IntelliCap controls include factory-installed control software. IntelliLink Setup Software must be installed on the computer used with the control.

The control software manages minute-by-minute functioning of the IntelliCap control. It continually monitors:

- Voltage on the feeder
- The position of faceplate switches
- Ambient air temperature at the control
- The control clock and calendar
- Software setpoint values
- Various other setpoints and data values

Based on this information, the control software decides how to respond to a change in voltage, a faceplate command, and other conditions. The control software, setpoint values, and historical data are stored in non-volatile memory that will survive a power interruption.

IntelliLink® Setup Software

IntelliLink Setup Software is used to communicate with the control at the capacitor-bank site. IntelliLink software enables:

- Entering installation-dependent operating parameters (setpoints), such as a physical location, the temperature-change time threshold, the voltage override level, etc.
- Monitoring real-time data, such as present line voltage
- Examining the performance and operating history of an installed control
- Exporting configuration, operating, and historical data from the control to a report file on a computer
- Downloading new control software into the IntelliCap control
- Troubleshooting installation problems

The IntelliCap control reports voltage, current, and phase-related data in units of volts, amps, kvars, kW, and kVA. The rated accuracy of these measurements ($\pm 0.3\%$ of full scale) is based on the combined accuracy of all control components, exclusive of the sensor and sensor cable, but including all sensor conditioning components.

Voltage readings are accurate for all distribution voltages. For IntelliCap with Var controls, phase-angle detection requires a minimum current of 0.5% of full-scale values. Current magnitudes are still detected and displayed below the 0.5% threshold. The control uses the phase-angle offset values to correct all ac waveform data sampled from the line sensor.

Signal Processing

RMS Ac Waveform Analysis

The control uses true RMS detectors, with accuracy to the 100th 60-Hz harmonic, to produce RMS data for voltage and current (if applicable) waveforms.

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

The control uses the 1.6-second averaged values for real-time display on the faceplate LCD screen and most data logging. Reported daily-high and daily-low values are the raw sample (unaveraged) values; they are saved for the present day and the preceding 31 days.

The 1.6-second averaged values are used to create interval averaged values (data averaged over the logging interval) for voltage, temperature, current, kvars, power factor, and kW, if applicable. Select a data-logging interval of 1, 5, 10, 15, 30, or 60 minutes. The period of logged interval averaged values depends on the configured interval. See Table 3 on page 18.

Phase Angle Measurements

The IntelliCap with Var 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 angle between the voltage and current waveforms. Phase-angle measurements have a 0 to 360-degree range.

The **Installation Phase Offset** setpoint compensates for various installation-dependent phase-angle errors.

Automatic Operation

The control automatically switches the bank using a variety of control strategies: Temperature, Timeclock, Voltage Only, Time-Biased Voltage, Time-Biased Temperature, Automatic Online, or Automatic Offline. The IntelliCap with Var control has two additional control strategies: Current and Var.

The control switches the bank based on a prioritized set of conditions. From highest to lowest priority, these are:

Five-minute reclose delay—After opening the bank, the control will not close it for 5 minutes. This allows the capacitors to discharge. The **Reclose Delay Block** field on the *Operation* screen shows the time remaining before the control can close the bank.

State of the faceplate switches—When the AUTO/MANUAL switch is set to **Manual** mode, the control blocks automatic operation of the bank. The CLOSE/OPEN faceplate switch is the only way to operate the bank.

Manual software commands—When the **SOFTWARE CONTROL SETTINGS: Manual Operation** field displays the **Enabled** state, the control accepts **Close** and **Open** commands from IntelliLink Setup Software.

The anti-cycling limit—When the control is in **Automatic** mode, the **Maximum Automatic Control Cycles Per Day** setpoint on the *Setup>Miscellaneous* screen determines the maximum number of automatic switching cycles per calendar day. When this limit is reached, the capacitor bank remains switched out until the next calendar day.

The High- and Low-Voltage Override setpoints—If the voltage remains outside the normal range for the specified time period, the control switches the bank.

The present control strategy—The control switches the bank according to the control strategy in effect.

If the control was in **Manual** mode and is returned to **Automatic** mode, it waits 60 seconds before switching the bank to allow the operator to step away from the bank.

Timeclock Control Mode

When **Automatic** mode is enabled and the control is configured for **Timeclock** mode, the control switches the bank based on a time schedule. Two different time schedules can be configured, and the control uses the following logic to determine when to switch the bank:

- (a) The control checks to see whether the present time is in one of the scheduled On periods.
- (b) If the present time is within a scheduled On period and the calendar day is not a holiday, the control closes the bank switch. If the bank is already switched in, it remains switched in.
- (c) When the time is no longer in a scheduled On period or the calendar day becomes a holiday, the control switches the bank out. If the bank is already switched out, it remains switched out.

Note: The voltage level must remain in a range where switching the bank will not cause a voltage-override condition. Otherwise, the control will not switch the bank.

Temperature Control Mode

When **Automatic** mode is enabled and **Temperature** mode is active, the control switches the bank based on the present air temperature. The control can operate in both **High-** and **Low-Temperature** modes and uses the following logic to determine when to switch the bank:

- (a) The control monitors air temperature.
- (b) When the temperature passes the **Temperature at Which Bank Switches In** or **Temperature at Which Bank Switches Out** setpoint, the **Temperature Change Time Threshold** timer starts.
- (c) For high-temperature operation, if the temperature remains continuously above the **Temperature at Which Bank Switches In** setpoint for the duration of the timer, the control switches the bank in. If it remains below the **Temperature at Which Bank Switches Out** setpoint for the duration of the timer, the control switches the bank out.
- (d) For low-temperature operation, if the temperature remains continuously below the **Temperature at Which Bank Switches In** setpoint for the duration of the timer, the control switches the bank in. If it remains above the **Temperature at Which Bank Switches Out** setpoint for the duration of the timer, the control switches the bank out.

Note: Voltage must remain in a range where switching the bank will not cause a **Voltage-Override** condition. Otherwise, the bank will not switch.

Voltage Only Control Mode

When **Automatic** mode is enabled and the control is in **Voltage Only** mode, the control switches the bank based only on the **High-** and **Low-Voltage Override** setpoints. A preferred capacitor bank position can also be configured. Figures 2 and 3 on page 11 and Figure 4 on page 12 show when the capacitor bank switches for each setting of the **Preferred Capacitor Bank Position** setpoint. The control uses the **Voltage Override** setpoint and the **Bank Voltage Change + Margin** setpoint to avoid excess cycling.

The following logic is used to determine when to switch the bank:

- (a) The control monitors the voltage level. When the level stays within the normal range, the control switches the bank based on the **Preferred Capacitor Bank Position** setpoint on the *Setup>Control Strategy-Voltage Only* screen. No action is taken if the **Don't Care** mode is selected or if switching the bank would cause a **Voltage-Override** condition.
- (b) When the voltage level passes the **High-Voltage Override** setpoint or the **Low-Voltage Override** setpoint, the **Over-Voltage Override-Time Threshold** or the **Under-Voltage Override-Time Threshold** timer starts.

- (c) If voltage remains continuously above the **High-Voltage Override** setpoint for the duration of the **Over-Voltage Override-Time** timer, the control switches the bank out. If voltage remains continuously below the **Low-Voltage Override** setpoint for the duration of the **Under-Voltage Override-Time** timer, the control switches the bank in.

Time-Biased Voltage Control Mode

When **Automatic** mode is enabled and the control is in **Time-Biased Voltage** mode, the control switches the bank based on two sets of **High-** and **Low-Voltage** setpoints. **Time-Biased Voltage** mode uses the same logic as **Voltage Only** mode, except:

- The voltage setpoints are different for scheduled and unscheduled times.
- There is only one **Voltage-Change Time-Threshold** timer.
- The control does not use the **Preferred Capacitor Bank Position** setpoint.

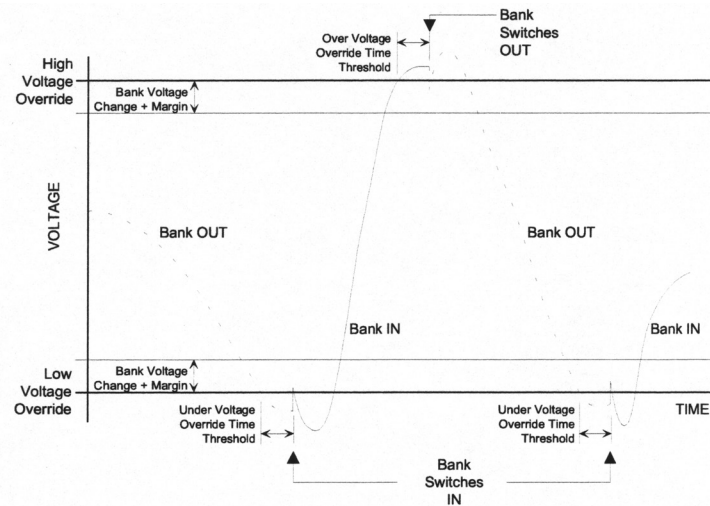


Figure 2. Voltage control switching with no preferred-bank position selected.

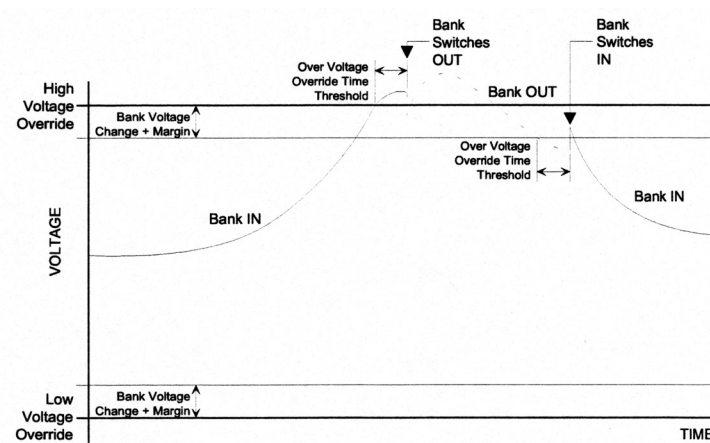


Figure 3. Voltage control switching with the preferred-bank position in Online mode.

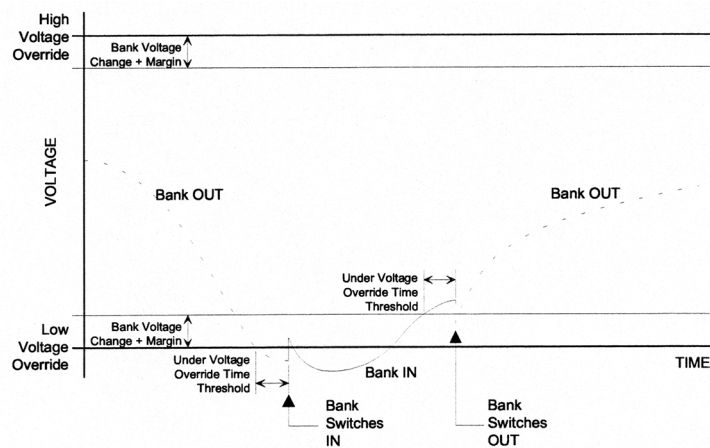


Figure 4. Voltage control switching with the preferred-bank position in Offline mode.

Time-Biased Temperature Control Mode

When **Automatic** operation is enabled and the control is in **Time-Biased Temperature** mode, the control switches the bank based on two sets of temperature setpoints. **Time-Biased Temperature** mode uses the same logic as **Temperature** mode, except:

- There is only one set of temperature setpoints in use per season.
- The bank is offline during unscheduled times.

Note: If the bank is online when the unscheduled period begins and the temperature does not go beyond the **Switch-Out** value, the bank switches back in at the start of the next scheduled period. It does not wait for the temperature to go beyond the **Switch-In** setpoint. For example, the bank is set to switch in at 80°F and switch out at 70°F. The timeclock scheduled period is 8:00–17:00. On Monday at 17:00, the bank switches out. During the unscheduled time, the temperature does not go below 70°F for the length of the **Temperature Time Threshold** setpoint. On Tuesday at 8:00, the bank switches in again, even if the temperature is below 80°F.

Note: The voltage must remain in a range where switching the bank will not cause a voltage-override condition. Otherwise, the bank will not switch to avoid excess cycling.

Automatic Online Control Mode

When **Automatic** mode is enabled and the control is in **Automatic Online** mode, the bank is always switched in. The control does not even switch the bank for a **Voltage-Override** condition.

If the bank is switched offline in **Manual** mode, the control switches it back online when it returns to **Automatic** mode (after the reclose-delay block).

Automatic Offline Control Mode

When **Automatic** mode is enabled and the control is in **Automatic Offline** mode, the bank is always switched out. The control does not even switch the bank for a voltage-override condition.

If the bank is switched online in **Manual** mode, the control switches it back offline when it returns to **Automatic** mode after the 60-second delay.

Current Control Mode (IntelliCap with Var only)

When **Automatic** mode is enabled and the control is in **Current** mode, the control switches the bank based on measured single-phase current flow and uses the following logic to determine when to switch the bank:

- (a) The control monitors single-phase line current.
- (b) When the control senses the current has passed the **Single-Phase Current at Which Bank Switches In** or **Single-Phase Current at Which Bank Switches Out** setpoint, it starts the **Current Change Time Threshold** timer.
- (c) When the single-phase current remains continuously above the **Single-Phase Current at Which Bank Switches In** setpoint for the duration of the timer, the control switches the bank in. When single-phase current remains continuously below the **Single-Phase Current at Which Bank Switches Out** setpoint for the duration of the timer, the control switches the bank out.

Note: Voltage must remain in a range where switching the capacitor bank will not cause a voltage-override condition.

Var Control Mode (IntelliCap with Var only)

When **Automatic** mode is enabled and the control is in **Var** mode, the control switches the bank based on calculated 3-phase kvars (kilovoltamperes, reactive). The control uses the following logic to determine when to switch the bank:

- (a) The control monitors 3-phase kvar level.
- (b) When the control senses the kvar level has passed the **3-Phase kvars at Which Bank Switches In** or **3-Phase kvars at Which Bank Switches Out** setpoint, it starts the **Var Change Time Threshold** timer.
- (c) If the 3-phase kvar level remains continuously above the **3-Phase kvars at Which Bank Switches In** setpoint for the duration of the timer, the control switches the bank in. If the single-phase kvar level remains continuously below the **3-Phase kvars at Which Bank Switches Out** setpoint for the duration of the timer, the control switches the bank out.

Note: Voltage must remain in a range where switching the capacitor bank will not cause a **Voltage-Override** condition.

Current Sensor Location and Reverse Current Flow

For the IntelliCap with Var control, the preferred location of the current sensor is on the source side of the capacitor bank. The sensor can then measure the effect of the bank when it is online. However, the control can still account for the effect of the bank when the sensor is on the load side. This is particularly useful when abnormal circuit switching reverses the direction of power flow, flipping the relative position of the sensor.

The control switches the bank based on the **Adjusted 3-Phase kvars** setpoint on the *Setup>Site-Related* and *Operation* screens. See Instruction Sheet 1022-530, “IntelliCap® Capacitor Control: *Setup*” for more information.

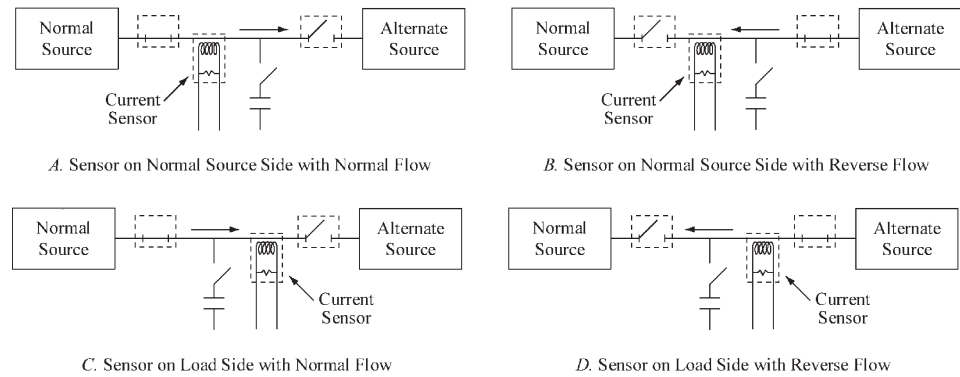


Figure 5. Current sensor location and the direction of current flow combinations.

Figure 5 shows the four possible current-sensor locations and direction of current flow. The operating conditions are described for current-flow direction:

A. Sensor on Normal Source Side with Normal Current Flow

The kvar level measured at the sensor location shows the effect of the bank. The **Adjusted 3-Phase kvars** setpoint equals the **Measured 3-Phase kvars** value.

B. Sensor on Normal Source Side with Reverse Current Flow

Abnormal circuit switching caused the current direction to reverse. The effect of the bank is not shown in the measured kvars at the sensor location. The control calculates the **Adjusted 3-Phase kvars** value by subtracting the **3-Phase Bank Size** setpoint on the *Setup>Miscellaneous* screen, from the **Measured 3-Phase kvars** value.

For example, an online 1200-kvar capacitor bank is set to switch out at -750 kvar. The sensors are on the source side and current flow is reversed. When the load at the sensor location is 450 kvar, the **Adjusted 3-Phase kvars** setpoint is $450 - 1200 = -750$ kvar. The bank then switches out.

C. Sensor on Load Side with Normal Current Flow

This occurs when the current sensor is on the load side of the bank or if permanent circuit switching flips the sensor to the load side of the bank. See Description B “Sensor on Normal Source Side with Reverse Current Flow” above.

D. Sensor on Load Side with Reverse Current Flow

See Description A “Sensor on Normal Source Side with Normal Current Flow” above.

Switching Trouble Conditions

Use the voltage and/or var values recorded before and after switching (on the *Data Logging>Voltage Levels During Switching* and *Data Logging>Var Levels During Switching* screens) to find a possible bank-switch malfunction. A trouble condition exists if the change in voltage (ΔV) is less than the **Minimum Percentage of Average Delta Voltage** setpoint over the last four switching operations or if the change in vars (Δvar) is less than the **Minimum Percentage of Average Delta vars** setpoint over the last four switching operations. The percentage setpoints are configured on the *Setup>Miscellaneous* screen.

If the average ΔV is at least 0.80 V, the control can use ΔV to detect a trouble condition. If the current sensor is on the source side of the bank, the control can use Δvar . When the installation is favorable for both methods, the control uses ΔV and Δvar . It flags a trouble condition only when they agree that a trouble condition has occurred. When the installation is favorable for one method only, the control uses that method to flag a trouble condition.

Note: For trouble-condition detection analysis, the control does not use the ΔV from a **Forced Retry** operation, which is an attempt to manually switch the bank into the state already indicated.

The *Data Logging* screens show high and low values and trend data for voltage amplitude, temperature, and related parameters. When a customer complains of a service outage or low voltage, the information on the *Data Logging* screens can help determine what happened and why it happened. Data graphs can give an overview of trends before the data logs are reviewed in detail.

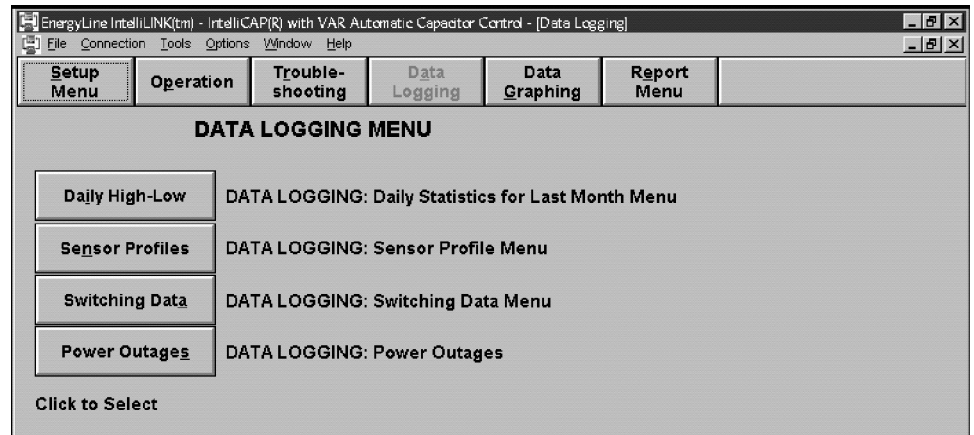


Figure 6. The *Data Logging Menu* screen.

To display the *Data Logging Menu* screen, click on the **Data Logging** button. Screens that show historical information for various time periods can be selected. See Figure 6.

Daily Statistics for the Last Month

To open the *Data Logging: Daily Statistics for Last Month Menu* screen, click on the **Daily High-Low** button on the *Data Logging Menu* screen. See Figure 6. Screens can be selected to show historical information for each day of the last month. Figure 7 shows the menu for the IntelliCap with Var control. The menu for the standard IntelliCap control only contains data for the options it supports.

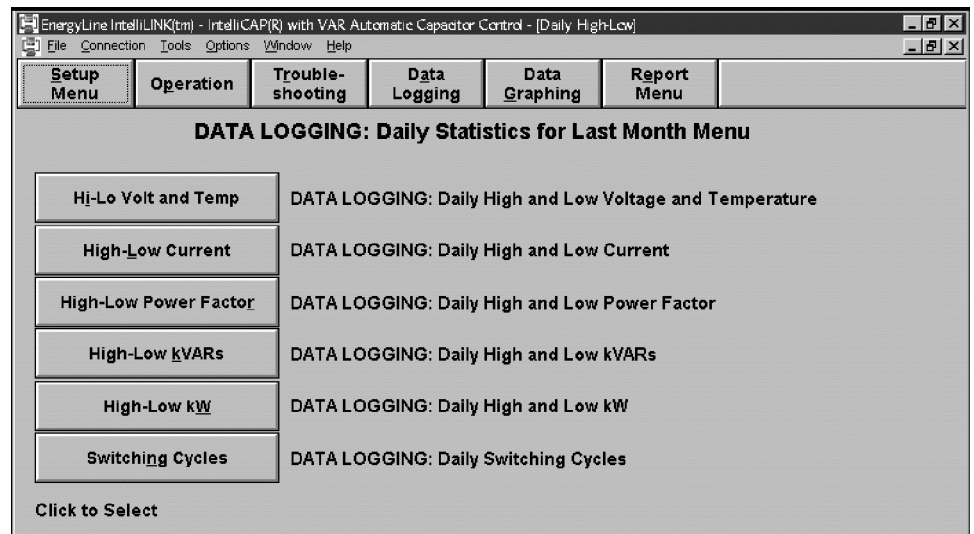


Figure 7. The *Data Logging: Daily Statistics for Last Month Menu* screen.

Daily High and Low Data

The *Daily High and Low* screens show the highest and lowest values for voltage, temperature, current, power factor, kvar, or kW for a 24-hour period (12 midnight to 12 midnight). The high/low data for today and for each of the preceding 31 days is available.

To display a *Daily High and Low* screen, click on the **Data Logging** button. Then click on the **Daily High-Low** button. At the *Data Logging: Daily Statistics for Last Month Menu* screen, click on the button for the type of data to view. If necessary, click on the **PgUp** and **PgDn** buttons to move to the correct day. See Figure 8 on page 17. To return to the *Data Logging: Daily Statistics for Last Month Menu* screen, click on the **Daily High-Low** button.

Each displayed value is the highest or lowest raw sample value for that parameter for the specified day. The control takes a measurement every 0.2 seconds. The temperature sensor located on the bottom of the enclosure measures the external temperature.

View the Daily Switching Cycles

The *Data Logging: Daily Switching Cycles* screen shows the number of bank switching cycles for each day of the preceding 31 days during this calendar year and since installation. Each cycle consists of a **Close** operation and an **Open** operation. The counters record both automatic and manual switching operations.

To display the *Data Logging: Daily Switching Cycles* screen, click on the **Data Logging** button, then click on the **Daily High-Low** button. At the *Data Logging: Daily Statistics for Last Month Menu* screen, click on the **Switching Cycles** button. To return to the *Data Logging: Daily Statistics for Last Month Menu* screen, click on the **Daily High-Low** button on the screen.

The screen includes the following fields:

Total This Year

This is the total number of switching cycles completed during this calendar year. The control updates the counters when it switches the bank out.

Total Since Installation

This is the total number of switching cycles completed since installation of the control. The control updates the counters when it switches the bank out. When the control software is reloaded (not updated), this counter is reset to zero.

Reset All Cycle Counters

When this field is set to the **Enabled** state, the control clears all bank switching cycle counters. This is a momentary operation. When executed, the field displays “Cleared” until the first switch-out event. The field then displays “Disabled.”

Sensor Profiles

View the Sensor Profile Screens

The *Data Logging: Sensor Profile* screens show profile data for voltage and temperature, as well as current, power factor, kvars, and kW (if applicable). See Figure 8 on page 17 for an example.

Follow these steps to display a *Data Logging: Sensor Profile* screen:

- STEP 1.** Click on the **Data Logging** button.
- STEP 2.** Click on the **Sensor Profiles** button.
- STEP 3.** At the *Data Logging: Sensor Profile Menu* screen, click on the button for the type of data to be viewed. If necessary, click on the **PgUp** or **PgDn** buttons to move to the correct day.
- STEP 4.** To return to the *Data Logging: Sensor Profile Menu* screen, click on the **Sensor Profile** button on the screen.

DATA LOGGING: Sensor Profile - Voltage Screen 1 of 20
VOLTAGE PROFILE ON 5-MINUTE INTERVALS

07/29/98 12:00:00 am												
120.7	120.7	120.7	120.7	120.7	120.7	120.7	120.8	120.7	120.8	121.0	121.3	121.4
121.4	121.4	121.3	121.1	121.0	121.0	121.1	121.3	121.4	121.4	121.4	121.4	121.6
07/29/98 02:00:00 am												
121.1	121.0	121.0	121.0	121.0	121.0	121.1	121.3	120.8	120.8	121.0	121.0	121.0
120.8	120.4	120.5	120.5	120.8	120.8	121.0	120.8	120.8	120.7	120.7	120.5	120.5
07/29/98 04:00:00 am												
120.7	120.5	120.7	120.5	120.7	120.7	120.7	120.7	120.7	120.4	120.4	120.2	120.2
120.2	120.4	120.1	120.1	119.9	119.8	119.6	119.8	119.8	120.1	119.8	119.8	119.8
07/29/98 06:00:00 am												
119.8	119.9	119.6	119.6	119.3	119.5	119.5	119.3	119.5	119.5	119.3	119.3	119.3
120.1	120.1	120.1	119.9	119.6	119.6	119.8	119.5	119.3	119.3	119.5	119.5	119.3
07/29/98 08:00:00 am												
119.0	119.3	119.5	119.2	119.2	119.2	119.0	118.9	118.9	118.9	118.7	118.3	118.3
118.4	118.4	118.6	118.7	118.7	118.6	118.7	118.7	118.7	118.4	118.7	118.7	118.7
07/29/98 10:00:00 am												
118.6	118.6	118.7	118.9	118.6	118.6	118.6	118.7	118.6	118.4	118.6	118.6	118.6
118.6	118.4	118.6	118.4	118.4	118.4	118.6	118.4	118.1	118.3	118.3	118.3	118.3

PG. DN.

Ready Direct 08/05/98 11:39

Figure 8. One of the *Data Logging: Sensor Profile* screens.

The Sensor Profile log includes data for 120 timestamped records. Each record contains 24 data samples. When the log is full, each new sample overwrites the oldest sample in the log.

The IntelliCap control uses the **Extended Data Logging Interval** setpoint on the *Setup>Miscellaneous* screen for recording these numbers, which are interval-averaged values. The control collects data at 0.2-second intervals. It averages eight samples to yield the 1.6-second averaged value. It then adds together all the 1.6-second averaged values in the interval (for example, 2:46 a.m. to 3:00 a.m. for a 15-minute data-logging interval) and divides the total by the number of values.

The number of days logged depends on the configured interval. The control can log data in 1-, 5-, 10-, 15-, 30-, or 60-minute intervals. Table 3 on page 18 shows how many days of data are logged and how often the data are timestamped for each interval.

Note: If the data-logging interval is changed or when the control experiences a power outage, up to two records (that is, 48 data samples) can be lost. Generate all necessary reports before changing the data-logging interval.

When the data-logging interval is changed, the control starts at the first midnight in the log and finds the record where the sample for the present time would appear if the new interval had been used throughout. The control clears that entire record, timestamps it appropriately, and logs the present sample in the correct location within the record. This could cause gaps or repetitions in the timestamp sequence, depending on the change.

When the correct location for the present sample is after the end of the log, the control clears the first record in the log and timestamps it with the date of the most recent midnight. The control then calculates where the present sample should be (offset from this reset midnight) and logs it. All other records are unaffected.

Similar logic applies to data logging after a power outage. When power is restored, the control finds the correct location for the present sample. If the timestamp for the record is incorrect, the control clears the entire record, timestamps it appropriately, and logs the present sample. If the correct location for the present sample is after the end of the log, the process is the same as for a new data logging interval.

When an IntelliCap control is returned from the field, generate all necessary reports as soon as possible. This minimizes the amount of lost data.

Table 3. Data Logging Intervals for Sensor Data Profiles

Data Logging Interval	Days of Data Logged	Record Timestamp Period
1 minute	2 days	Once every 24 minutes
5 minutes	10 days	Once every 2 hours
10 minutes	20 days	Once every 4 hours
15 minutes	30 days	Once every 6 hours
30 minutes	60 days	Once every 12 hours
60 minutes	120 days	Once every 24 hours

Switching Level Data

View the Voltage Levels During Switching

Every time the capacitor bank switches in or out (manually or automatically), the control records the line voltage before and after switching. These values are shown on the *Data Logging: Voltage Levels During Switching* screen.

Follow these steps to display the *Data Logging: Voltage Levels During Switching* screen:

- STEP 1.** Click on the **Data Logging** button.
- STEP 2.** Click on the **Switching Data** button.
- STEP 3.** At the *Data Logging: Switching Data Menu* screen, click on the **Voltage Levels** button.
- STEP 4.** To return to the *Data Logging: Switching Data Menu* screen, click on the **Switching Data** button.

This log includes data for 14 complete switching cycles. When 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.

For both voltage measurements, before and after switching, the control takes a measurement every 0.2 seconds. It sums eight consecutive samples and divides the total by eight to yield a 1.6-second averaged value. The before-switching measurement is taken just before the bank switches are operated. The after-switching measurement is taken approximately 3.5 seconds after the switches are operated.

Use the information on this screen to look for possible equipment malfunction during switching (see the “Switching Trouble Conditions” section on page 14) and to check the switching times. It is also useful for determining the **Bank Voltage Change + Margin: Estimated Value** setpoint on the *Setup>General* screen. When the **Bank Voltage Change + Margin: Automatic Calculation** mode is enabled, the control uses the delta values shown on this screen in the calculation. See Setup Instructions 1022-530, “S&C IntelliCap® Automatic Capacitor Control: *Setup*” for more details.

This screen includes the following fields:

Date and Time

This is the date and time the switching operation occurred.

Voltage Before

This is the line voltage before the control switched the bank.

Voltage After

This is the line voltage after the control switched the bank, measured approximately 3.5 seconds after the end of a pulse.

Delta

This is the change in voltage because the bank switched.

Note: Because of the way the control rounds and stores voltage values, the delta value displayed may be slightly different from the **Voltage Before** value minus the **Voltage After** value.

View the kvar Levels During Switching

For the IntelliCap with Var control, every time the bank switches in or out (manually or automatically), the control records the kvar levels before and after switching. These values are shown on the *Data Logging: kvar Levels During Switching* screen.

Follow these steps to display the *Data Logging: kvar Levels During Switching* screen:

STEP 1. Click on the **Data Logging** button.

STEP 2. Click on the **Switching Data** button.

STEP 3. At the *Data Logging: Switching Data Menu* screen, click on the **kvar Levels** button.

STEP 4. To return to the *Data Logging: Switching Data Menu* screen, click on the **Switching Data** button on the screen.

This log includes data for 14 complete switching cycles. When the log is full, each new event over-writes the oldest event in the log. To find the most recent event, look for the message with a time stamp older than the time for the message above it.

For both kvar measurements, before and after switching, the control takes a measurement every 0.2 seconds. It sums eight consecutive samples and divides the total by eight to yield a 1.6-second averaged value. The before-switching measurement is taken just before the bank switches are operated. The after-switching measurement is taken approximately 3.5 seconds after the bank switches are operated.

Use the information on this screen to look for possible error conditions during switching to check the switching times and to monitor the health of the capacitor bank. See the “Switching Trouble Conditions” section on page 14.

This screen includes the following fields:

Date and Time

This is the date and time the switching operation occurred.

kvars Before

This is the kvar value before the control switched the bank.

kvars After

This is the kvar value after the control switched the bank.

Delta

This is the change in kvars because of the bank switching. If the bank is operating normally, this is a negative number when the bank is switched in and a positive number when the bank is switched out.

Event Logs

View the Switching Events Log

Whenever the bank switches in or out (manually or automatically), the control records the time, date, and request type. These values are shown on the *Data Logging: Switching Events* screen.

Follow these steps to display the *Data Logging: Switching Events* screen:

STEP 1. Click on the **Data Logging** button.

STEP 2. Click on the **Switching Data** button.

STEP 3. At the *Data Logging: Switching Data Menu* screen, click on the **Switching Events** button.

STEP 4. To return to the *Data Logging: Switching Data Menu* screen, click on the **Switching Data** button on the screen.

This log includes data for 14 complete switching cycles. When the log is full, each new event over writes the oldest event in the log. To find the most recent event, look for the message with a timestamp older than the time for the message above it. This screen includes the following fields:

Viewing Data Logging

Date and Time

This is the date and time when the switching operation occurred.

Request Type

This is the type of request (manual, voltage override, etc.) that caused the bank to switch.

View the Power Outages Log

The *Data Logging: Power Outages* screen shows the date and time of the last 15 power cycles.

To display the *Data Logging: Power Outages* screen, click on the **Data Logging** button. Then, click on the **Power Outages** button.

This log can hold information for 15 power failures and 15 power restorations. When the log is full, each new event over-writes the oldest event in the log. To find the most recent event, look for the message with a timestamp older than the time for the message above it.

Data Graphing

View the Data Graphing Screens

The *Data Graphing* screens provide quick access to historical data displayed as graphs. The control automatically scales each graph to show as much detail as possible. Graphs are available for daily highs and lows for the last month and for sensor profiles.

Follow these steps to display daily highs and lows:

- STEP 1.** Click on the **Data Graphing** button.
- STEP 2.** Click on the **Daily High-Low** button.
- STEP 3.** At the *Data Graphing: Daily Statistics for Last Month Menu* screen, click on the button for the type of data to be viewed. The IntelliLink software reads the appropriate data from the control and displays a graph as a separate screen. See Figure 9.

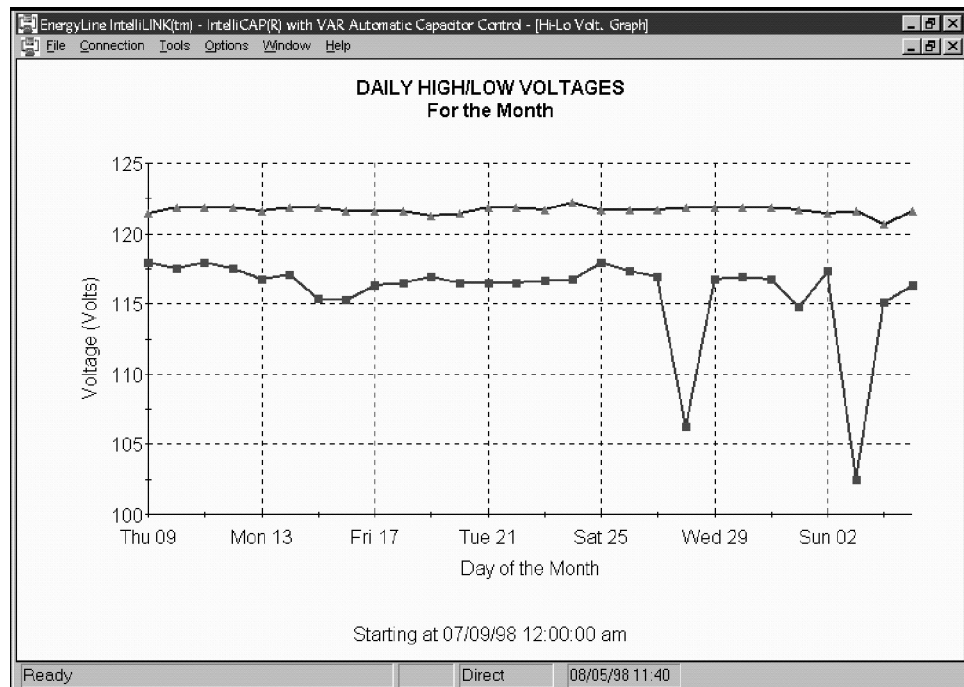


Figure 9. One of the *Data Graphing: Daily Statistic* screens.

The amount of data in the sensor profile graphs depends on the configured data logging interval. See the “View the Sensor Profile Screens” section on page 16 for more details.

Follow these steps to display sensor profiles:

- STEP 1.** Click on the **Data Graphing** button.
- STEP 2.** Click on the **Sensor Profiles** button.
- STEP 3.** At the *Data Graphing: Sensor Profile Menu* screen, click on the button for the type of data to be viewed. The IntelliLink software reads the appropriate data from the control and displays a graph as a separate screen.
- STEP 4.** If necessary, click the **First**, **Previous**, **Next**, or **Last** button to move to the correct day. See Figure 10 for an example.

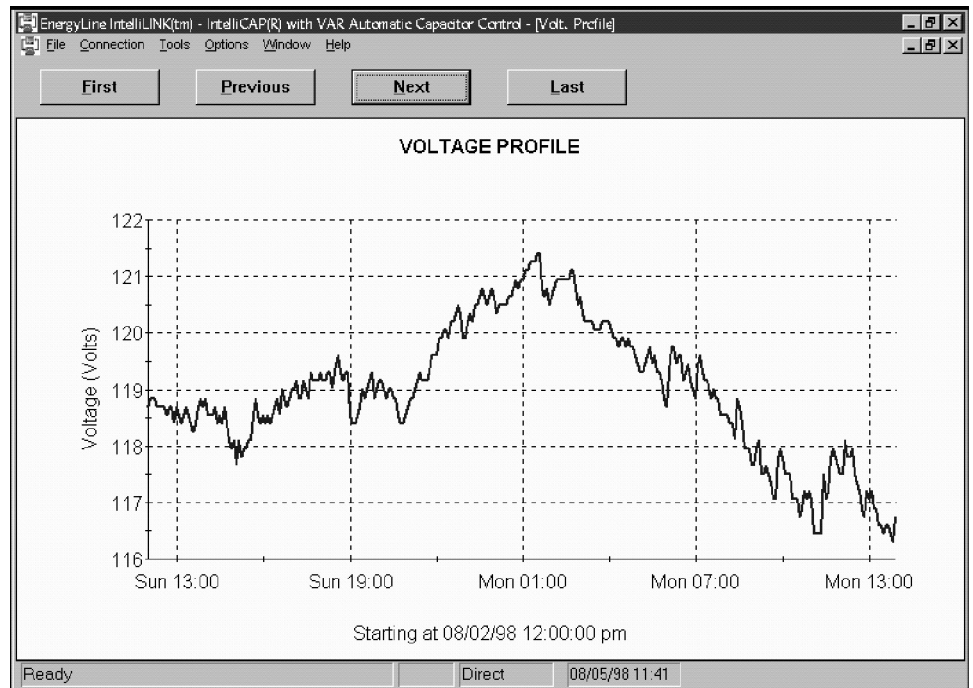


Figure 10. One of the *Data Graphing: Sensor Profile* screens.

Generating Reports

The IntelliCap control report feature will transfer most of the control settings and stored data to a PC as a CSV (comma-separated value) file. The report can be stored as a permanent record and used in spreadsheets or other program types. Follow these steps to generate a report:

STEP 1. Connect a PC to the IntelliCap control and start the IntelliLink software.

STEP 2. Click on the **Reports** button.

STEP 3. Click on the button for the type of report being generated.

There are four report types that can be generated: Full, System Setup and Operation, Troubleshooting Information, and Historical Data.

The System Setup and Operation report contains configuration data for the control. The Troubleshooting report contains the information recorded in the troubleshooting logs. The Historical Data report contains daily statistics, sensor profiles, switching data, and the log of power outages. The Full report includes all the information stored in the control.

STEP 4. In the dialog box, enter a name for the report to be generated. Then, click on the **Save** button.

Specify a full path name (drive and directory) for the file. If a path is not specified, the file is saved in the directory which contains the IntelliLink software files. The extension “.csv” is added automatically.

When typing a file name that already exists, the message “Replace existing file?” is displayed. Select the **Yes** option to replace the file. To enter a different file name, select the **No** option. Then, enter a new file name at the prompt.

When the control finishes the report, the message “Task completed” is displayed. Click on the **OK** button. The control automatically returns to the Report menu.

When several IntelliCap controls use a similar setup configuration, the configuration from one control can be saved and loaded into other controls. Only the setpoints that are different for each control need to be configured.

Follow these steps to save a configuration:

STEP 1. Connect a PC to the control and start the IntelliLink software.

STEP 2. Click on the **Setup** button. Then, click on the **Save Data** button.

STEP 3. In the dialog box, choose a file name and location for saving this configuration. The extension “.cfg” is assumed. Then, click on the **Save** button.

Note: This process does not save the **Physical Location** field on the *Setup: General* screen.

Follow these steps to load a saved configuration into a control:

STEP 1. Connect a PC to the control and start the IntelliLink software.

STEP 2. Click on the **Tools** menu. Then, click on the **Load Setpoints** entry.

STEP 3. In the dialog box, choose the file for the configuration being loaded. Click on the **Open** button.

STEP 4. Enter the full path name and file name. Then, press the **<Enter>** key.

STEP 5. Make any necessary setpoint configuration changes.

STEP 6. Enter the correct value in the **Physical Location** field on the *Setup: General* screen.

Using Virtual Memory Files

Operational and data-logging information can be saved as a virtual memory file. These files are used to view data, generate a report, and save or change a setpoint configuration, even when not connected to an IntelliCap control. To access the information, connect to the file stored on the computer instead of the physical control.

Follow these steps to save control data to a file:

- STEP 1.** Check that the PC is connected to the control.
- STEP 2.** Click on the **Tools** menu. Then, click on the **Save Virtual Memory** entry.
- STEP 3.** In the dialog box, choose a file name and location for the saved data. The extension “.VM” is automatically entered.
- STEP 4.** Click on the **Save** button.

Follow these steps to connect to a stored file:

- STEP 1.** When the PC is connected to a control, click on the **Connection** entry and then on the **Disconnect** entry.
- STEP 2.** Click on the **Connection** entry and on the **Connect to VM File** entry.
- STEP 3.** In the dialog box, choose the virtual memory file to open. Then, click on the **Open** button.

When connected to the virtual memory file, data can be viewed or a report can be generated as if connected to a physical IntelliCap control. The setpoint values can also be changed and the configuration saved for loading into other IntelliCap controls. This is particularly helpful when preparing a setpoint configuration for controls in the field but there is no access to a physical control.

The control software may need to be updated. Follow these steps to load new control software:

NOTICE

The historical data stored in the IntelliCap control may be lost during the update process. Always generate all needed reports using the old setup software, before updating the control software.

STEP 1. Connect a PC to the control.

STEP 2. Start the Update program.

- (a) Click on the file *Start menu>Programs>EnergyLine>Update*. The Update dialog box opens. See Figure 11.

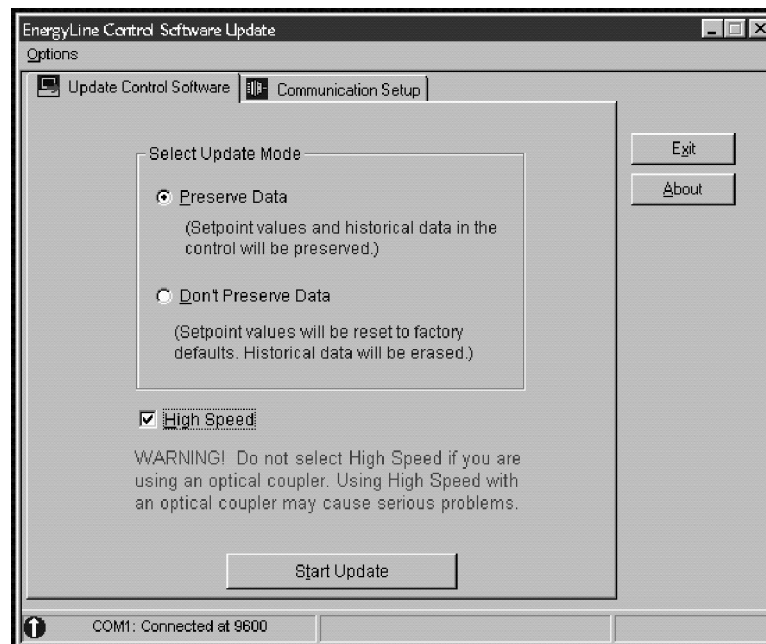


Figure 11. The Software Update dialog box.

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

Note: If the control is not connected to COM1 on the PC, click on the **Communication Setup** tab and select the correct comm port. Then, click on the **Connect** button.

STEP 3. Click on the **OK** button to update the control software.

The process takes 5 to 10 minutes. The progress can be followed in the lower right corner of the dialog box. When the update is complete, the dialog box automatically closes.

NOTICE

If the update process is cancelled after it has started, the software is deactivated in the control. When you must cancel the process, the update process must be started again.

Note: If the software to be loaded is not the same type as the software in the IntelliCap control, an error message is displayed. Note which software version is already in the control. Then, press the <Enter> key to abort the update process. When the correct new software version is obtained, repeat steps 1 through 3 above.

Running Setup Software From DOS

The setup software can be run with Microsoft® DOS commands.

Start the Setup Software from DOS

Follow these steps to automatically start the correct DOS setup software for the type of control connected:

STEP 1. At the MS-DOS prompt, type the command to go to the directory where the setup software files (for example, CD C:\ELINE) are stored, and press the <Enter> key.

STEP 2. Type ACAP, and press the <Enter> key.

Follow these steps to start the setup software for the IntelliCap control from the subdirectory with the IntelliCap files on the computer:

STEP 1. At the MS-DOS prompt, type the command to go to the IntelliCap subdirectory (for example, CD C:\ELINE\ICAP---S), and press the <Enter> key.

STEP 2. To start the setup software, type the name of the batch file that starts the setup software (ICAP for the standard IntelliCap control; IVAR for IntelliCap with Var control), and press the <Enter> key.

Change the Setup Software DOS Startup Information

The command typed when starting the setup software runs a batch file. If the setup software is started with the ACAP command, the program uses a file called MONITOR.IDS This file contains startup information for all different kinds of S&C capacitor controls, including the IntelliCap control. If starting the setup software from the subdirectory, it uses a different batch file: ICAP.BAT or IVAR.BAT.

Under certain conditions, it may be desirable to change the contents of these files, as described below:

- The batch files set the program colors for monochrome monitors. /COL can be added when typing the batch file name. For example, ACAP /COL is used if the computer has a color monitor.
- When normally communicating with the IntelliCap control using the COM2 port on the computer, add /2 when typing the batch file name. For example, ACAP /2.
- To start the setup software every time the computer starts, add the ACAP command to the end of the AUTOEXEC.BAT file on the boot disk for the PC. Be sure to include the directory-change command CD C:\ELINE just before the command to start the setup program. The file can be edited with any text editor or with any word-processing program that can save the finished file as a plain ASCII text file with no formatting codes.