Three-Phase Switches

COOPER Power Systems

Service Information

iMC Switch Control Installation and Operation Instructions

S260-80-2

Figure 1.
iMC switch control.

Contents

SAFETY FOR LIFE

Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment and support our "Safety For Life" mission.

SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER: Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

WARNING: Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage. G101.0

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

WARNING: Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install, or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

PRODUCT INFORMATION

Introduction

Service Information S260-80-2 provides installation and operation instructions for the iMC switch control.

Read This Manual First

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment.

This switch control is used in conjuction with the Automated M-Force switch. Refer to *Service Information S260-80-1 Automated M-Force Switch Installation and Operation Instructions*.

Additional Information

These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, contact your Cooper Power Systems sales representative.

Quality Standards

ISO 9001:2000-Certified Quality Management System

Acceptance and Initial Inspection

Each iMC switch control is completely assembled, tested, and inspected at the factory. It is carefully calibrated, adjusted and in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the carton for signs of damage. Unpack the switch control and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and Storage

Be careful during handling and storage of the switch control to minimize the possibility of damage. If the switch control is to be stored for any length of time prior to installation, provide a clean, dry storage area. If storage is in a humid atmosphere, make provisions to power the control heaters.

Note: To energize the control, apply ac power to the ac supply input terminal block located in the lower left-hand corner of the back panel of the control. Refer to the **Customer Connections for AC Power** section in this manual.

If the control will be stored for 3 months or more before installation, follow the instructions under **Control Battery Storage and Charging** section of this manual.

Control Power Requirements

Operational power for the iMC switch control and switch motor operator is provided solely by two 26 Amp-hour, 12 V dc lead-acid batteries connected in series.

120 or 240 V ac is required to power an onboard battery charger and internal control heaters. A selector switch located on the power supply board allows selection of either 120 or 240 V ac operation.

Note: The selector switch is factory-set for each control based upon the customer order requirement.

Note: The control will not initially power up on battery power alone.

Operation Upon Loss of AC Power

Upon loss of ac power for 60 seconds or more, the LOSS OF AC POWER LED will illuminate, and the control will begin monitoring and testing the health of the batteries. This will occur at various temperature dependent time and motor operation intervals.

If either the number of switch operations or time period intervals exceeds the values listed in Table 1, the control will initiate a Motor Battery Test. During the Motor Battery Test, the Automated M-Force switch motor is operated for approximately one second while the motor clutch is disengaged, preventing operation of the switch blades. As the test is executed the control monitors the voltage drop across the battery to determine the relative health of the battery.

TABLE 1
Battery Check Operation

Temp Range °C	Switch Operations Since Last Batt Check	Accrued Time Since Last Batt Check
Temp < -15°	6	6 hrs
-15° ≤ Temp < 15°	12	12 hrs
Temp ≥ 15°	20	24 hrs

If the batteries are found to be at a level of health too poor to operate the motor operator, the motor inhibit function will assert accompanied by illumination of the ALARM, LOW BATTERY VOLTAGE, and MOTOR INHIBIT LEDs. Operation of the motor operator will be inhibited indefinitely until the health of the batteries is restored to a level high enough to pass a motor battery test.

If the batteries are found to be in good health, the control will conduct another motor battery test after an additional 3 motor operations or 6 hours have accrued since the last motor battery test. The cycle will repeat indefinitely until the battery fails the motor battery test or ac power is re-established and the battery returns to normal operational health.

In the event that the ac power has not returned within the times listed above, the control will cease to operate and the LOW BATTERY VOLTAGE and MOTOR INHIBIT LED will illuminate.

Control programming settings and parameters – including event recorder – are stored in non-volatile memory and retained upon loss of ac or dc control power. The time/date clock will continue to operate for approximately 30 days after loss of control power.

The control clock may require resetting if the operating power has been disconnected for more than thirty days.

Note: When ac power is present, the control will continue to communicate with other SCADA devices regardless of the status of battery power levels.

Operation on AC Power Only

The iMC switch control continuously monitors the battery voltage. To prevent battery damage, the control shuts down automatically upon detection of low battery voltage (below 22 V dc) for 60 seconds.

During such occurrence the Automated M-Force switch will be electrically inoperable as the batteries are the only source of power for the motor operator. However, the iMC switch control CPU will remain functional for front panel viewing, ProView software configuring, and automation operations as long as ac power is present.

Control Battery Storage and Charging

The 12 V dc control batteries contained in the iMC switch control are fully charged prior to shipment and are ready for use.

Temperature has an effect on battery life. Sealed lead acid batteries should be stored, fully charged, at room temperature. Never store lead acid batteries at temperatures exceeding 47°C (117°F), as damage can result in approximately one month.

IMPORTANT: To maintain sufficient charge to operate the control and prevent battery cell damage, the sealed lead-acid batteries should be charged before three months of storage time has elapsed.

To keep the batteries charged, energize the control's built-in charger with ac power applied to the TB7 ac supply terminal block. See **Customer Connections for AC Power** section of this manual. If it is not possible to power the control during storage, a separate portable 120 V ac charger accessory, Catalog Number KME5-60-1, is available to maintain an acceptable level of charge within the batteries.

Note: When shipped from the factory, the battery source is disconnected and its output plugs are taped to the cabinet. Connect the battery plugs into the mating connectors to complete the battery circuit.

Battery Replacement and Disposal

The 12 V dc control batteries, used in the iMC switch control, have a life expectancy of four to six years. It is recommended that the batteries be replaced in pairs after four years.

Dispose expired batteries in an environmentally responsible manner. Consult local regulations for proper battery disposal.

iMC SWITCH CONTROL DESCRIPTION

Description

The iMC switch control is designed to supervise the Automated M-Force switch. The control provides phase and ground fault identification with inrush restraint for operation purposes. The iMC switch control does not provide fault current protection. Front panel pushbuttons provide simple control of the switch mechanism and access to other features such as battery test. The iMC control comes standard with SCADA protocols DNP 3.0, 2179 and Modbus for easy integration.

The iMC switch control provides full-featured metering including:

- Instantaneous Per Phase and Three Phase Metering (volts and amps)
- Instantaneous Power Factor and Power Metering (real, reactive and apparent)
- Demand Metering (amps and watts)
- Harmonic Metering up to 15th Harmonic
- Four quadrant energy metering (kw-h delivered/ received, kvar-h delivered/received)
- Symmetrical Components

The iMC switch control includes ProView software technology to provide advanced automated switch control functionality including custom configuration of user-selected inputs and outputs, events and alarm data, and selectable communication points for serial communication. Analysis tools include sequence of event recording, Idea Workbench software, Data Profiler, and oscillography functions, including oscillography replay.

The front panel LCD display is used to configure the operating settings for the control. It is also used to display metering, counter information, control parameters, reset alarms, and provide diagnostic information.

Control parameters can also be programmed via a personal computer connected to the control through the front panel RS-232 port. Control programming, interrogation, and operations are performed with ProView interface software on a personal computer.

The control operates on 50 and 60 Hz systems.

The control can be configured, by the factory or by the user, for a wide variety of applications. If user requirements change, the control functions can be modified to meet the new requirements.

Theory of Operation

A functional block diagram of the control is shown in Figure 2. Current sensing is provided by three customer supplied current transformers interfaced to the control via TERMINAL BLOCK TB10. Voltages for metering are connected to the analog input module through terminal block TB8.

Data sampling occurs at a rate of 64 times per cycle. The CPU contains a data acquisition section that uses the acquired samples to compute the fundamental currents and voltage for use in fault targets and metering functions.

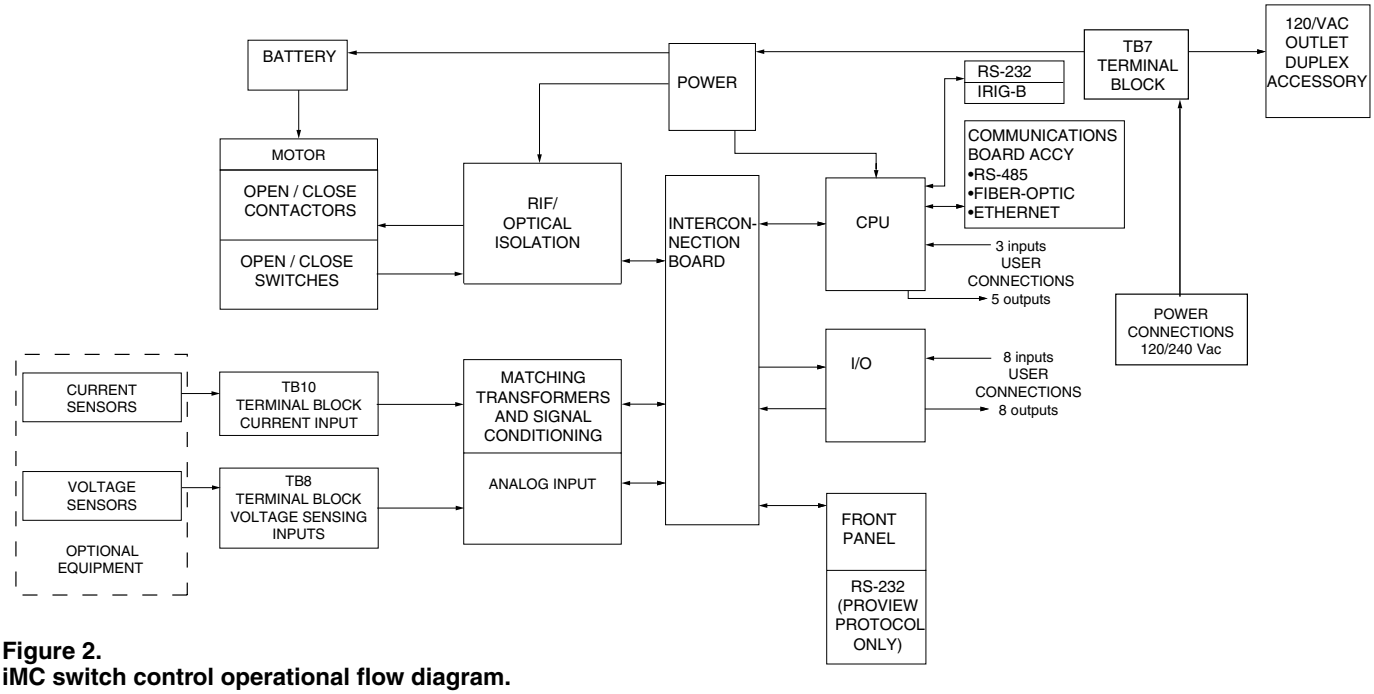


Figure 2.
iMC switch control operational flow diagram.

Control Front Panel

The iMC switch control front panel is illustrated in Figure 3.

The front panel consists of a interactive Programming panel, informative LCD display, and LED status indicator bank for quick verification of key operational parameters and functions.

The control includes a Power Save feature that will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within five minutes. Pressing the LAMP TEST key will re-activate the display and LEDs.

Note: The Power Save feature is a ProView interface software default setting. The timer duration can be changed or disabled via the ProView interface software.

The control includes a Reset Menu feature that will cause the LCD display to revert to the root menu after ten minutes of inactivity.

Note: The five minute timer and MMI Reset Menu is a ProView interface software default setting. The Reset menu selection and timer duration can be changed via the ProView interface software.

Front Panel Text Messaging

The LCD messages are accessed from the front panel by following the Text Messages menu path. This menu displays any active user-configured text messages.

Up to fourteen user-configurable text messages can be programmed via the Idea Workbench software. These text messages appear on the front panel LCD and can be programmed to appear for alarm or other conditions.

Text messages displayed on the front panel are limited to four lines of 20 characters each (including spaces). Text messages can also be accessed by pressing the LAMP TEST one-touch analysis key on the front panel.

Programming Panel

The Programming keypad has the following sections.

One-Touch Hot Keys

There are eight hot keys (Figure 4) that allow one-button access to a variety of control and monitoring functions that appear in the LCD display. Pressing these buttons causes the following information to display or function to occur:

MOTOR INHIBIT: Prevents operation of the open, close, clutch, or brake functions. With this function enabled, the electrical open and close circuits are disabled.

BATTERY TEST: Causes Battery Test sub-menu to be displayed within the LCD information screen. User may then select either a control or motor battery test.

RESET TARGETS: Resets the fault target indicators on the operator panel.

Asserted targets may be manually reset by depressing the RESET TARGETS hot key on the front panel or automatically reset by selecting the factory defaulted automatic mode check box found within the Control Set-up dialog box of the Settings drop-down menu.

Automatic reset of this target, which can be enabled or disabled within the control setup drop-down menu, will reset the target when the current is between 1.5A to the specified phase or ground pickup value for 0.5 sec.

The pickup values for phase and ground are set independently in the Workbench user-accessible, group dependent area.

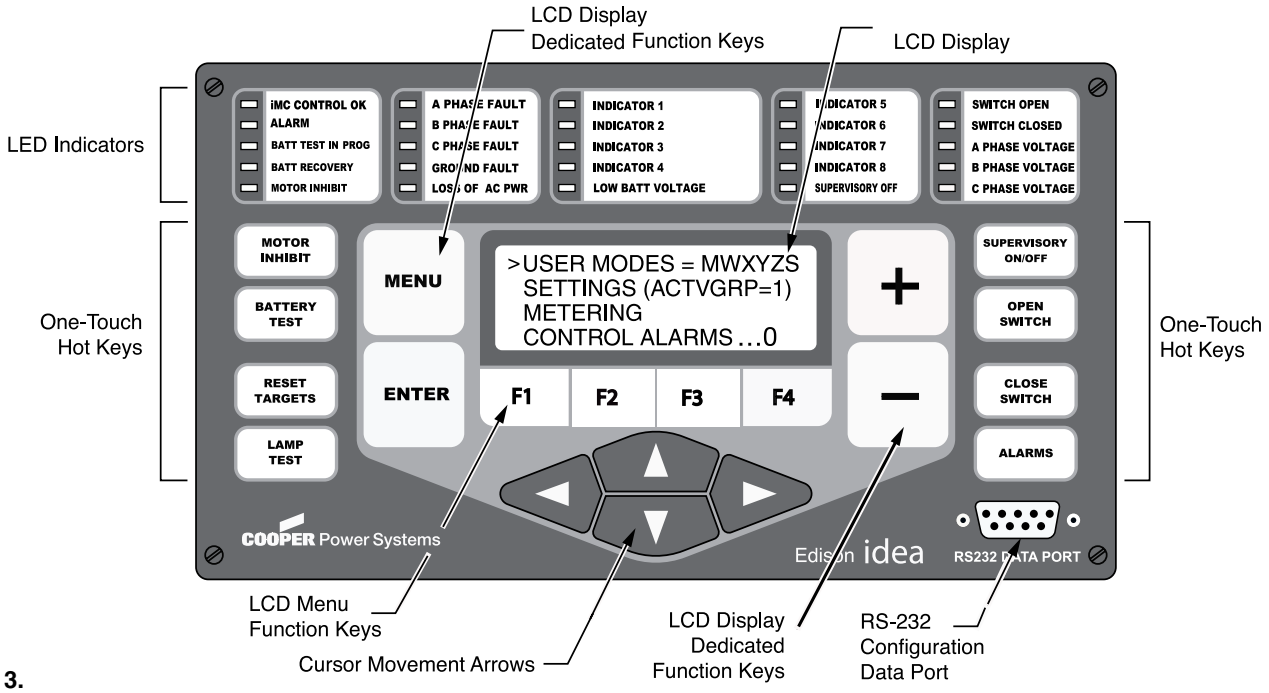


Figure 3.
iMC switch control front panel.

LAMP TEST: All operator panel LEDs are illuminated for verification of proper connection and operating status of all indicator lights. All status indicators will then return to their previous state. While in the LAMP TEST mode, the control response to operator panel keys is disabled, except for the OPEN and CLOSE switches.

SUPERVISORY ON/OFF: Pushing this button will toggle the control between Supervisory OFF and Supervisory ON modes. While in Supervisory OFF, all supervisory operations via SCADA will be blocked. All manual front panel operations may still be executed regardless of the status of the supervisory switch Hot Key.

OPEN SWITCH: Issues an OPEN signal to the Automated M-Force switch.

CLOSE SWITCH: Issues a CLOSE signal to the Automated M-Force switch.

ALARMS: Initiates display of the Alarms Menu within the LCD information display.

LCD Display

The LCD Display is a backlit 4-line, 20-character display that provides extensive distribution system, switch, and control status information accessed by using the control's interactive navigation keypads (Figure 4).

Note: The LCD display panel contrast is field-adjustable to allow for various mounting heights and applications. Press the MENU key and then press the (+) or (–) key to increase or decrease the contrast.

The four LCD navigation buttons are as follows:

MENU: Identifies the LCD Display menu options. Pressing this keypad will cause the display to step back one level in the menu hierarchy.

ENTER: Pressing this keypad will open the menu selection highlighted by the cursor within the LCD display and will confirm settings.

+: Increases the value of a setting by one increment.

–: Decreases the value of a setting by one increment.

The four LCD menu function keys activate specific menu commands. When a command appears in the LCD display directly above one of the four LCD menu function keys, the user can press the key to accept/select the command.

The four LCD menu function keys are as follows:

F1 F2 F3 F4

The four cursor movement arrows allow movement in the following directions:

- ◄ Moves the cursor left.
- ► Moves the cursor right.
- ▲ Moves the cursor up one line.
- ▼ Moves the cursor down one line.

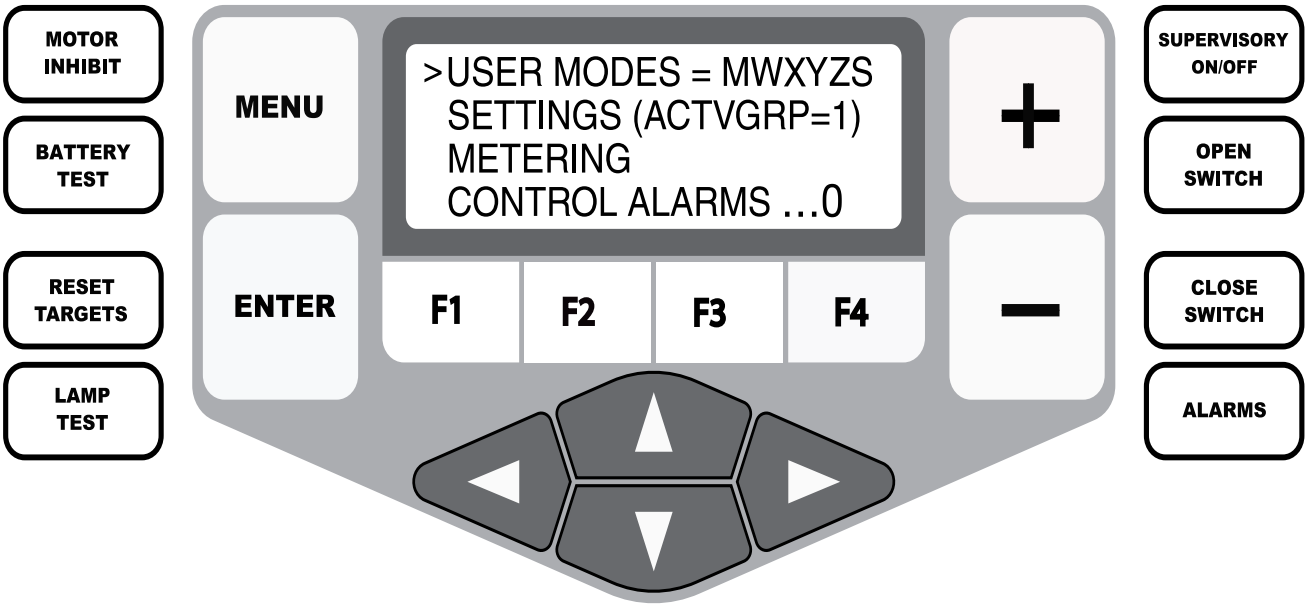


Figure 4.
Analysis keys, LCD display, LCD menu function keys, and cursor movement arrows.

Status Indicator LEDs

The status indicator LEDs (Figure 5) in the Programming section of the Operator Panel give instant information regarding the control and switch status.

All of the default status indicators LEDs (except for iMC CONTROL OK and ALARM) can be reconfigured via the Idea Workbench software.

The descriptive LED label inserts can be user-customized. Refer to **Using Removable Inserts** section of this manual for additional information.

iMC CONTROL OK: The green LED indicates the control is operating normally and not in an alarm state. If the control detects an abnormal condition, the ALARM LED will illuminate and the iMC CONTROL OK LED will blink.

ALARM: Factory assigned, blinking illumination indicates one of the following alarm conditions exist. If any alarms are logged, the LCD menu display will show “CONTROL ALARMS=1”. To view the control alarms in more detail, place the cursor next to the ALARMS line and press the ENTER key. If there are no alarms logged, there will be a 0 next to the LCD menu display. By pressing the ENTER key all the control alarms will display as below and those that are logged will indicate a 1 next to that particular alarm.

- Reset Alarms – Access Reset Alarms screen to reset alarms.
- Battery Alarm – Indicates a battery alarm, view Sequence of Events for further details. This alarm asserts when battery voltage drops below 23.5 V dc continuously for 60 seconds or when the battery voltage drops below 22.8 V dc for one second during a control battery test.
- Fail to Open – Indicates the device failed to open.
- Fail to Close – Indicates the device failed to close.

WARNING: Equipment misoperation. Never attempt to open an energized M-Force switch giving indication of a partial close operation. In this state the M-Force switch may not safely interrupt. Failure to comply can result in equipment damage and serious injury. T325.0

- Partial Close Operation – Indicates the device closed, but did not reach fully close limit switch. The device may be carrying current, but cannot be safely opened under load.
- Open Maintenance Alarm – Indicates the open time maintenance alarm conditions have been exceeded.
- Close Maintenance Alarm – Indicates the close time maintenance alarm conditions have been exceeded.
- Status Disagreement – Indicates the switch is BOTH open and closed (both limit switches asserted).
- Loss of Status – Indicates the switch is NEITHER open nor closed (neither limit switch asserted).
- 50 DCB Alarm – Indicates the switch is open, however current (greater than what is considered noise) is being detected.
- Power Supplies – Indicates loss of the 5 VDC CPU voltage for greater than 20 seconds.
- RAM Failure – Indicates a failed memory test.
- ROM Failure – Indicates a failed memory test
- RIF Communication Failure – Indicates a loss of communication between the Switch Interface circuit board to the main CPU circuit board. This alarm is self-resetting if communications is re-established.

To reset Alarms, advance to the Alarms menu. Place the curser next to the Reset Alarms line and press the ENTER KEY. (This will provide a message that confirms the reset action.) Press the F4 function key “RESET” to reset Alarms.

BATTERY TEST IN PROGRESS: Indicates either a control or motor battery test is in progress.

BATTERY RECOVERY: Will be in combination with the MOTOR INHIBIT LED. Indicates the switch is in a Battery Recovery Mode and will not allow an operation to be performed (Motor Inhibited). Battery Recovery Mode allows the battery to recover from the applied load in order to prevent partial operations. The following conditions will cause assertion of the BATTERY RECOVERY LED:

- Following a Motor Battery Test. The LED will remain asserted for temperature dependent time period.
- Following an Open or Close operation. The LED will remain asserted for a temperature dependent time period.

MOTOR INHIBIT: An operation can not be performed while the MOTOR INHIBIT LED is illuminated. The following conditions will cause the assertion of the LED:

- Activation of the MOTOR INHIBIT hot key.
- Batteries are in recovery from a switch operation or motor battery test.
- Battery health is not sufficient to perform an operation. Refer to ALARM LED definition for additional information regarding Battery Alarm.

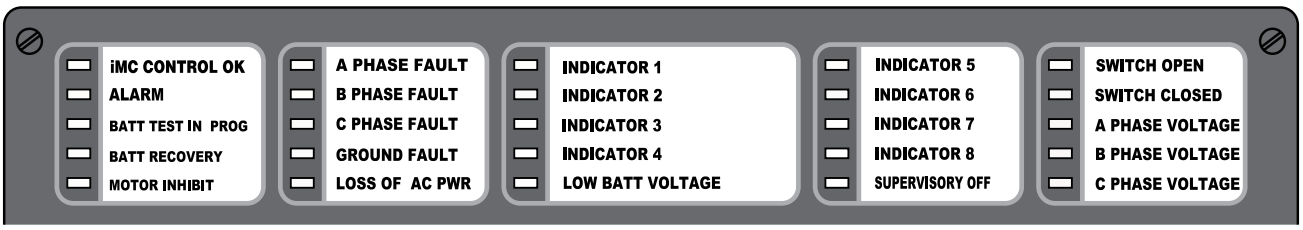


Figure 5.
iMC switch control status indicator LEDs.

- In combination with only the ALARM LED – Indicates one or more of several possible conditions. Press the ALARMS analysis key and scroll the menu and/or view the Sequence of Events for further details.
- The switch is in a partial close state. If neither the SWITCH OPEN nor the SWITCH CLOSE LEDs are illuminated and the ALARM LED is illuminated – a Partial Close Operation close operation has occurred.

WARNING: Equipment misoperation. Never attempt to open an energized M-Force switch giving indication of a partial close operation. In this state the M-Force switch may not safely interrupt. Failure to comply can result in equipment damage and serious injury. T325.0

The switch needs immediate attention before resetting the alarms and targets. Refer to the **Switch Operation** section of this manual for information regarding how to reset the switch.

- If none of the above conditions exist, the MOTOR INHIBIT LED has been asserted via the MOTOR INHIBIT analysis key. Pressing the analysis key again will toggle the Motor Inhibit function.

A PHASE FAULT: If Current Sensors are connected, indicates an A-phase fault target.

B PHASE FAULT: If Current Sensors are connected, indicates a B-phase fault target.

C PHASE FAULT: If Current Sensors are connected, indicates a C-phase fault target.

GROUND FAULT: If Current Sensors are connected, indicates an Ground fault target.

LOSS OF AC PWR: Will assert if ac power is lost for sixty (60) seconds. This LED is self-resetting upon return of ac power.

INDICATORS 1-8: Customizable LEDs that are used with functions programmed through the Idea Workbench software. The LED indicators do not have active default values. The LEDs are illuminated when the status configured via the Idea Workbench software is present.

LOW BATT VOLTAGE: Any low battery test; Control test alarm, motor test alarm and low battery alarm (continuous battery monitoring feature).

SUPERVISORY OFF: When illuminated indicates that the control/switch will not respond to remote SCADA commands, allowing operation of the switch/control only at the pole. When the Supervisory OFF is not illuminated, the control/switch will respond to SCADA commands.

SWITCH OPEN (green): Indicates the switch is in the open position.

SWITCH CLOSED: Indicates the switch is in the closed position.

A PHASE VOLTAGE: If PTs are connected, indicates A-phase voltage is present.

B PHASE VOLTAGE: If PTs are connected, indicates B-phase voltage is present.

C PHASE VOLTAGE: If PTs are connected, indicates C-phase voltage is present.

RS-232 CONFIGURATION DATA PORT

The RS-232 connector (shown in Figure 3) on the front operating panel allows direct connection to a personal computer without any special cables or connectors.

IMPORTANT: This port is used only for configuring the control with ProView application software.

All settings, metering, events, and oscillography data are available from this port. The port is Data Communication Equipment (DCE) wired for direct connection to a personal computer.

A 9-pin RS-232 cable (Catalog Number KME5-66) to connect from the PC to the RS-232 data port is available as an accessory.

Optional Motor Battery Test and Open/Close Switch Accessory Panel

The iMC switch control may be provided with oversize Motor Battery Test and Open/Close switches on the front plate of the control for quick and easy interaction with the Automated M-Force switch.

The OPEN and CLOSE switches duplicate the functionality of the OPEN SWITCH and CLOSE SWITCH Hot Keys found upon standard units. The MOTOR BATTERY TEST push button duplicates the functionality of the Motor Battery Test function selected under the “BATTERY TEST” one-touch hot key found upon standard units.

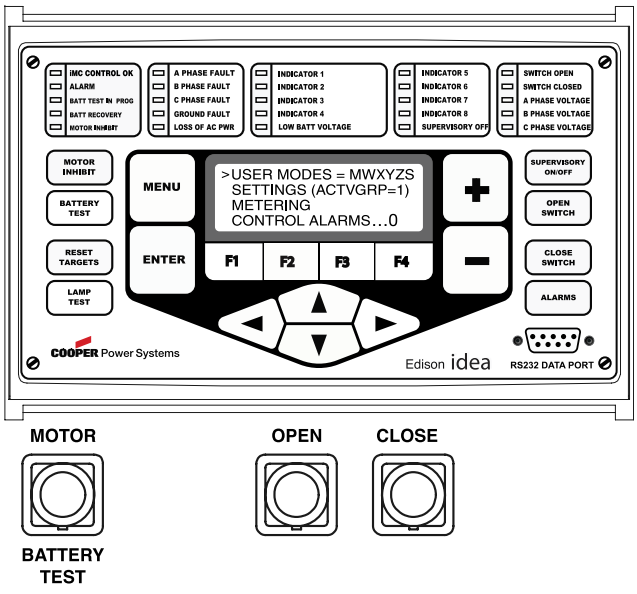


Figure 6.
Optional Motor Battery Test and Open/Close push-button switches located on lower front panel.

Control Features

The iMC switch control offers numerous standard features and accessories that allow the user the utmost flexibility applying the switch control.

Control Security

The iMC switch control has multiple customer-programmable security codes to limit control programming and viewing function access to authorized personnel. The front panel Man-Machine Interface (MMI) includes a user-selected security code to access the settings. Plus, the ProView interface software has it's own security levels for multiple-user access.

Control Set-up Settings

The Control Setup menu, found within the Settings drop down, menu enables selection and specification of key operational control characteristics and applicable parameter ranges. The control and setting parameters include:

- Phase Fault Targets
- Ground Fault Targets
- Auto Fault Target Reset
- Inrush Restraint Duration
- Auto Fault Target Reset (Enable)
- Phase Voltage Present Percent
- Manual Close Delay
- CT/PT Ratio
- CT/PT Correction Angles

Thermostatically Controlled Heater

The control has a standard 15 Watt thermostatically controlled heater (ON 70°F, OFF 85°F) for humidity control. The heater is powered from the power supply board.

Metering

The control provides instantaneous and/or demand metering with programmable integration intervals for the following functions:

- Real and reactive power for each phase and total, including directional, on an individual phase basis.
- Demand currents on a per phase basis.
- Instantaneous currents, including ground current.
- Instantaneous voltage on a per phase basis.
- Instantaneous frequency.
- Positive, negative, and zero sequence voltages.
- Instantaneous power factor on a per phase basis.

Event Recorder

The iMC switch control contains capabilities to perform Sequence of Events time-stamping for up to 29 event types. An additional 32 inputs can be user-defined through the Idea Workbench.

Factory-defined event types include:

- Open/Close Operations
- Alarm Conditions
- Supervisory Status
- Partial Switch Operations
- A, B, C and Ground Faults
- Failure to Open/Close
- Loss of ac
- Motor Inhibit Status
- Battery Tests
- Loss of Phase Voltage

The Event Recorder maintains a minimum of 90 event records. The last 25 events are viewable on the front panel LCD display.

Discrete SCADA Communications

The control provides six configurable output status contacts and four configurable input control contacts as standard. Each status contact is configurable using graphical interface software to combine status functionality along with Boolean algebra. Default output status contacts are: Operation Fail, Switch Status, Alarm, Control OK Status, Control Fail Status, Motor Inhibit Status. One output status contact is a solid state output (SS1) with a pickup time no longer than two milliseconds.

The control also provides a minimum of four configurable input control contacts. Each control contact is configurable using a graphical interface software. Contacts accept a whetting voltage range of 12–250 V dc, 120/240 V ac. Default input control contacts are: Supervisory Close, OPEN, and Battery Test.

A Discrete Interface Board is also available as an accessory to provide an additional eight output status contacts and eight input control contacts. The expansion I/O board is completely user-configurable.

Oscillography

Oscillography is provided to present current and voltage waveforms, along with fault identification element and switch response status changes. Filtered and unfiltered data are provided for viewing.

The recorded values are superimposed on the control scheme, and the state or value at any point in the scheme is displayed. The user has the capability to move through the event and watch the response of every function. All analog signals, digital inputs, and contact outputs are monitored. Analog oscillography is displayed at 16 amples per cycle.

Oscillographic data is recorded to analyze multiple events during a permanent fault or other event type. The oscillographic data shows two cycles before the trigger point and eight cycles after the trigger point (default).

Note: The configuration settings are programmable.

Oscillography automatically initiates trigger points for the following functions:

- A-B-C Phase Fault Targets
- Loss of Phase Voltage
- Open Signal Issued
- Close Signal Issued

Removable Inserts

Removable inserts are included with the control design for customization of specific control requirements. Inserts are available for the status indicator LEDs, the operator panel function keys, and the analysis keys. The removable inserts are designed for use without adhesives, label makers, or temporary labels. Refer to **Using Removable Inserts** for more information.

An electronic label template is included on the ProView application software CD and can be accessed through the following default address: C: /Program Files/Cooper/ Proview401/iMC/iMC Inserts.doc.

Idea Workbench

The Idea Workbench software provides access to various inputs, intermediate variables, and internal alarms, status, and targets to allow user-customization of the iMC switch control to meet specific and unique applications. The Idea Workbench software also gives the user the ability to perform logical functions with these variables by using a simple graphical user interface. Use of the Idea Workbench software is not a requirement for operation.

Data Profiler

A fully-configurable data profiler is available which allows the user to collect analog information by sampling data at selectable intervals. These time-stamped values can then be viewed to determine information such as weekly load profiles, daily harmonic disturbances or hourly voltage fluctuations. The number of days of information the data profiler can provide depends upon configuration parameters.

Manual Close Delay

Manual Close Delay provides a delay from the time that the manual CLOSE button is pushed to the time the manual close operation is performed.

The delay is programmable from 0 to 60 seconds in 1 second increments. A programmed delay value can be overridden for immediate closing by pressing the CLOSE button a second time.

An active Manual Close Delay can be canceled by pressing the OPEN button.

The default setting has the feature disabled (0 seconds). A countdown on the front panel LCD screen indicates Manual Close Delay is active.

Communications

Communication Ports

The iMC switch control has two back panel communication ports and a front panel configuration data port.

The front panel configuration data port is described in the **Control Front Panel** section of this manual.

There is one standard 9-pin RS-232 and one optional communication port (RS-485, serial fiber, Ethernet wire or fiber or both) on the back operator panel, as well as a standard IRIG-B port for user time-syncing. See Figure 7.

Communication Protocols

Five communication protocols are available for the iMC switch control:

- Modbus
- DNP3
- 2179
- IEC 870-5-101
- DNP-TCP-IP

One communication protocol can be selected for either the back panel RS-232 or the optional communication port.

All three protocols are selected and configured by the user with the ProView Communications Workbench application software.

Front port requires straight through cable.

Nameplate Information

Control nameplate information can be displayed in the front panel LCD screen (Figure 3) by scrolling downward through the root menu to the NAMEPLATE DATA selection and pressing the ENTER function key. Scheme Number, Customer Engineering Number, Scheme Date, and ProView Release version will be displayed.

Control Back Panel

The back panel of the iMC switch control module is accessible from the backside of the hinged swing plate located within the control cabinet with readily identifiable serial ports and connections Figure 7.

CONTROL WEIGHT: 72.7 kg (160 lbs)

Note: Weight of one iMC switch control.

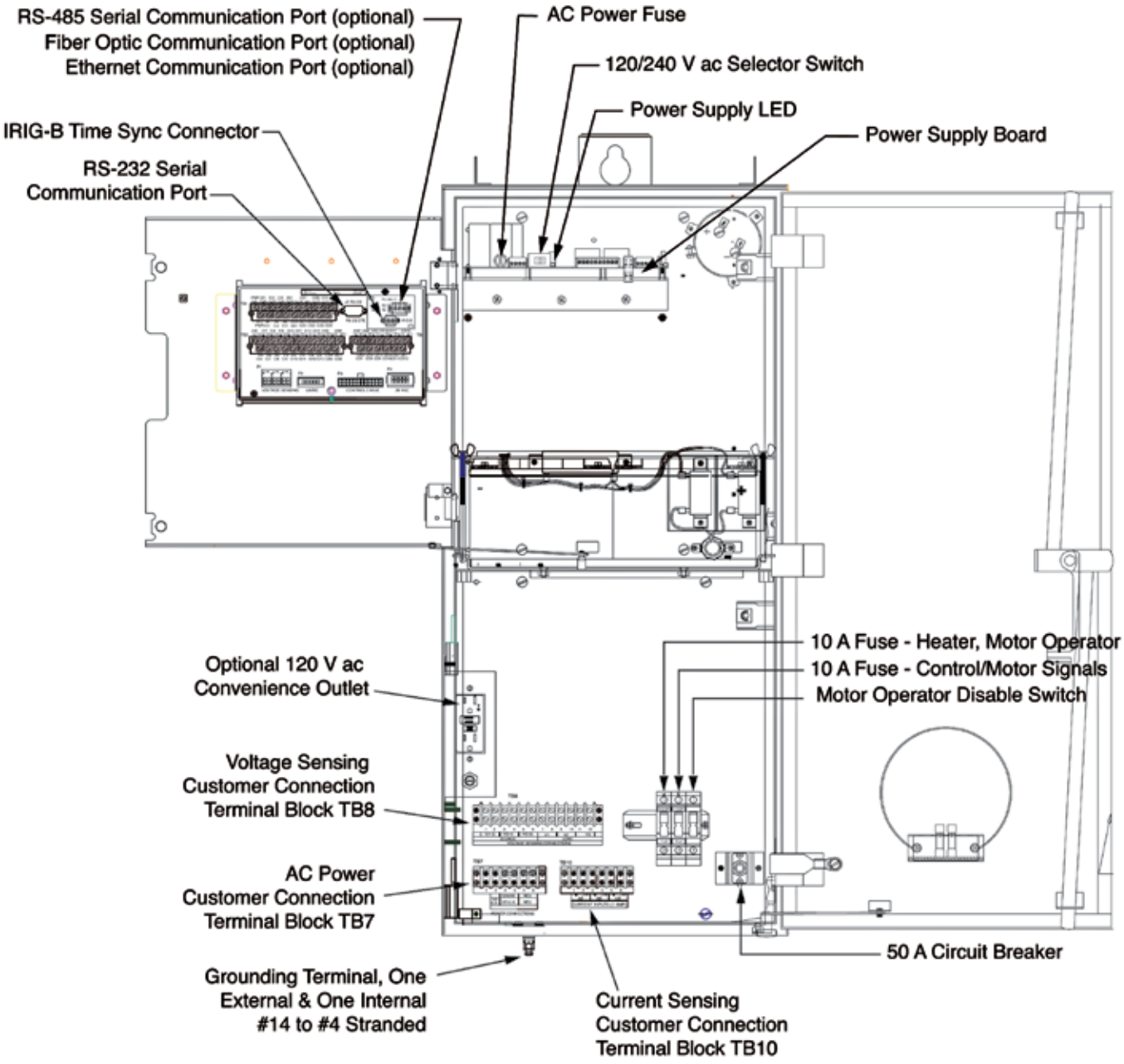


Figure 7.
iMC switch control back panel terminal block and communication port identification.

Internal Protective Overload Circuits

The Automated M-Force switch and control are protected by three protective overload circuits. Refer to Figure 8.

FU1-Motor Heater Overload -10 Amp Fuse

FU2-Motor/Control Signal Protection-10 Amp Fuse

CB1-Battery Overload 50 Amp Circuit Breaker

IMPORTANT: Before resetting circuit breaker CB1, disable SCADA functionality by placing the control into the SUPERVISORY OFF mode. Press the SUPERVISORY ON/OFF hot key until the SUPERVISORY OFF LED illuminates. Failure to comply could result in an inadvertent operation of the Automated M-Force switch in the event of the control receiving a SCADA open/close command immediately prior to resetting circuit breaker CB1.

Motor Operator Disable Switch

Opening switch SW1 (Figure 9) opens the close circuit between the iMC switch control and Automated M-Force switch. Removing the conductor bar (Figure 10) from the switch disables all electrical closing of the switch and provides a physical disconnect to the Automated M-Force switch closing circuit. This disconnect overrides all electrical close functions and makes a remote or local electrical closing operation impossible. The SW1 switch is electrically isolated at both poles when it is in the open position.

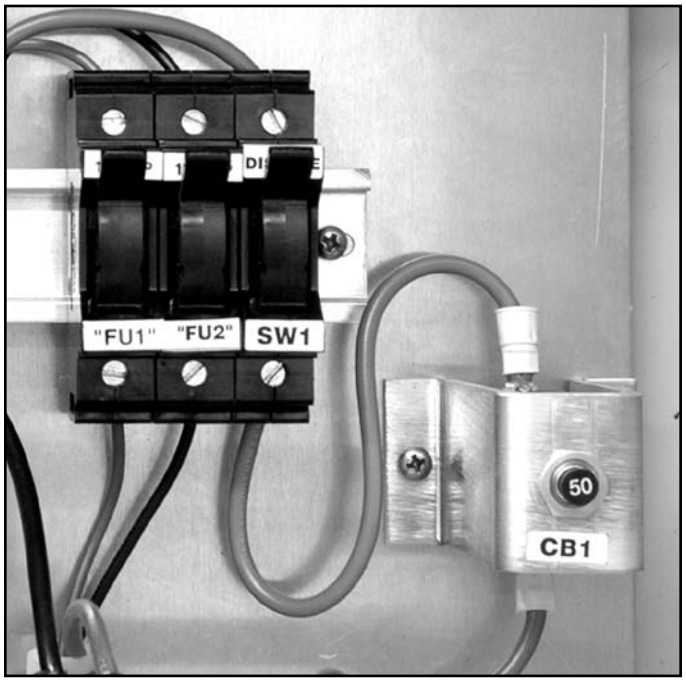


Figure 8.
Fuse terminals FU1, FU2, and Circuit Breaker CB1 located in he lower right-hand corner of switch control cabinet.

IMPORTANT: Motor Operator Disable Switch SW1 is not meant to protect life. If fail-safe lock-out protection is required, personnel working on Automated M-Force switch systems should utilize commercially available lock-out devices to properly secure the SW1 switch in the open position.

Before closing switch SW1, disable SCADA functionality by placing the control into the SUPERVISORY OFF mode. Press the SUPERVISORY ON/OFF hot key until the SUPERVISORY OFF LED illuminates. Failure to comply could result in inadvertent operation of the Automated M-Force switch in the event of the control receiving a SCADA open/close command immediately prior to closing switch SW1.

Do not substitute any item or material for the conductor bar provided with the SW1 switch. Failure to comply could result in misoperation of the SW1 switch.

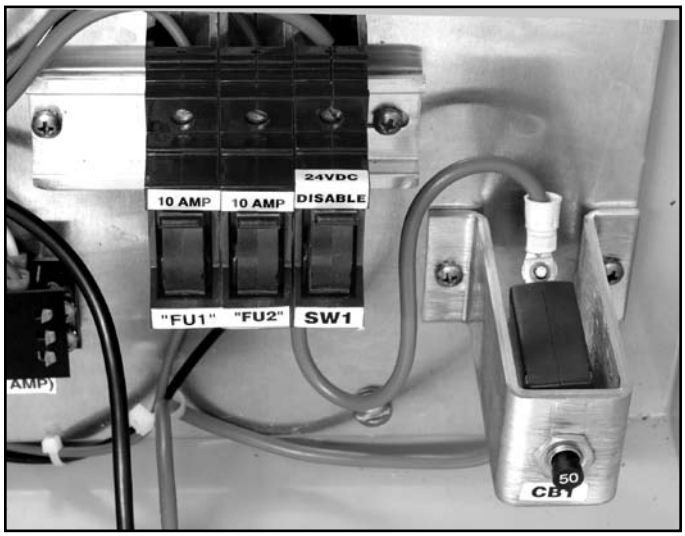


Figure 9.
SW1- Motor operator disable switch.

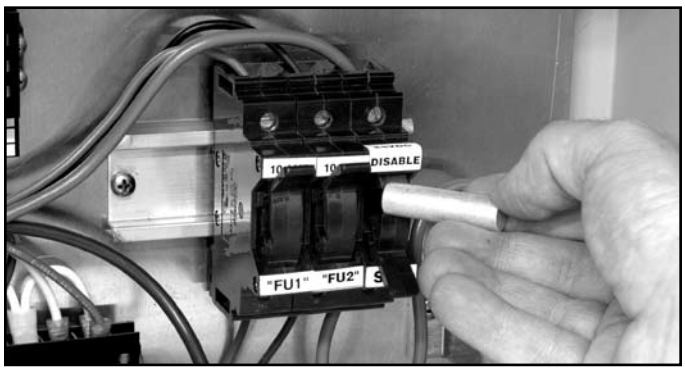


Figure 10.
SW1 switch in open position with conductor bar removed.

INSTALLATION PROCEDURE

Initial Programming Prior to Installation

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply may result in death, severe personal injury and equipment damage. G102.1

CAUTION: Equipment misoperation. Do not connect this control to a switch until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and switch misoperation, equipment damage, and personal injury. G147.0

The control must be programmed with all necessary operating settings, all alternate profiles, and parameters prior to operation with an Automated M-Force switch.

Note: Initial programming of the control is the responsibility of a qualified technician or engineer familiar with control functions and programming parameters required for the specific switch installation.

Control / Switch Compatibility

The iMC switch control is compatible with all electrically actuated cross-arm Automated M-Force switches.

Mounting the Control

Mount the iMC switch control in a convenient, accessible location. Mounting dimensions are provided in Figure 11.

IMPORTANT: To maintain sufficient charge to operate the control and prevent battery cell damage, the sealed lead-acid batteries should be charged after no more than three months of storage.

Note: Unless otherwise specified, dimensions shown in mm (inches).

A hole and keyway in the control mounting bracket accommodates a 16.0 mm (5/8") diameter bolt.

Control Cable

The control cable is fabricated with connectors which mate with the male receptacle of the switch on one end and the female receptacle of the control. The maximum available control cable length is 60 feet.

Note: The control cable must be supported along its length to prevent repeated movement due to wind or other outside forces which can damage the cable.

IMPORTANT: All external inputs to the switch control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5 kV per foot can develop in the conductors. Differences between conductor and ground path lengths can add additional stress to the control components in the event of a power surge.

Automated M-Force Switch Power Cable

The Automated M-Force switch power cable is fabricated with connectors which mate with the male receptacle of the switch on one end, and the female receptacle of the control.

The maximum available Automated M-Force power cable length is 40 feet.

Note: The Automated M-Force switch power cable must be supported along its length to prevent repeated movement due to wind or other outside forces which can damage the cable.

Grounding the Control

WARNING: Hazardous voltage. Switch and control must be solidly grounded. Follow all locally approved procedures and safety practices when grounding this equipment. Improper grounding can result in contact with high voltage, which will cause death or severe personal injury. G155.0

The control cabinet must be grounded. A grounding connector on the underside of the cabinet will accommodate No. 14 solid through No. 4 stranded conductors.

Figure 12 illustrates grounding methods for 4-wire multi-grounded systems with remote supply voltage transformer.

For effective surge protection, all control and power conductors for the iMC switch control must be routed parallel to a corresponding ground path. For example, the ac power supply for the control should be parallel to and equal in length to the transformer ground path. The control cable should be parallel to and routed close to the recloser ground path.

CONTROL WEIGHT: 72.7 kg (160 lbs)

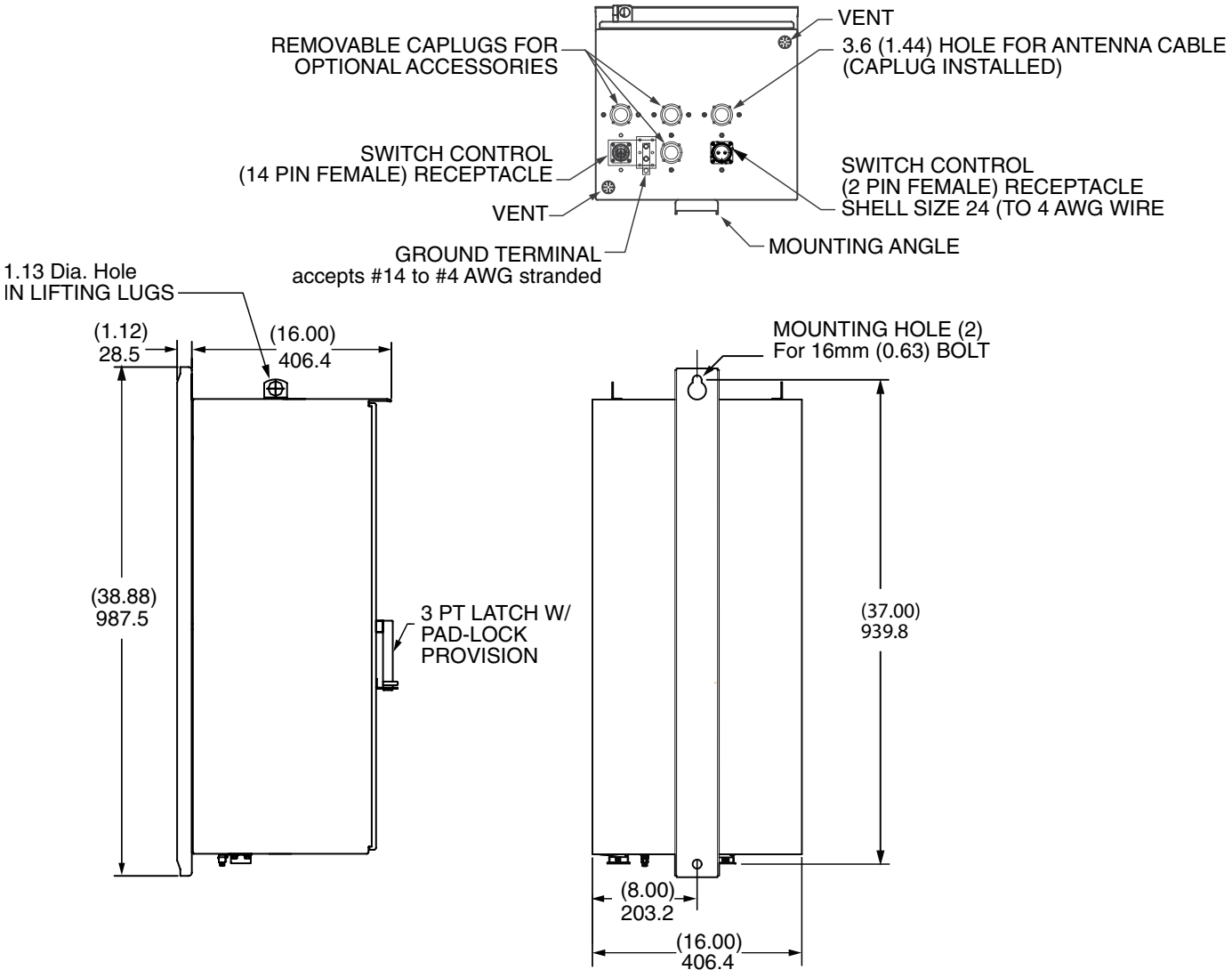


Figure 11.
iMC switch control cabinet mounting dimensions.

Grounding with a Remote Supply Voltage Transformer; 4-Wire Multi-Grounded

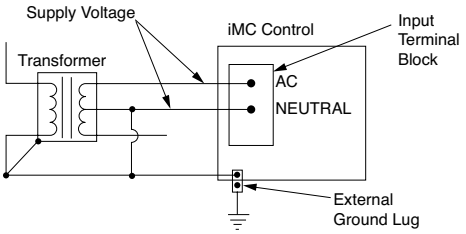
4-Wire Multi-Grounded Systems

Installation of an iMC switch control with a remote supply voltage transformer must include the following:

- Protection of the switch bushings and the supplying transformer with lightning arresters.
- Grounding of the switch bracket and motor operator.
- Grounding of the transformer tank.
- Grounding of the control cabinet.
- Grounding of the SCADA equipment.

IMPORTANT: All external inputs to the switch control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5 kV per foot can develop in the conductors. Differences between conductor and ground path lengths can add additional stress to the control components in the event of a power surge.

IMPORTANT: In pole-mounted applications, a ground connection must be made between the switch, transformer, switch control, and SCADA equipment for proper protection of the equipment. The pole ground must be sized per local utility practices to minimize the impedance between the switch and the control.



ELECTRICAL CONNECTIONS - Remote dedicated supply transformer

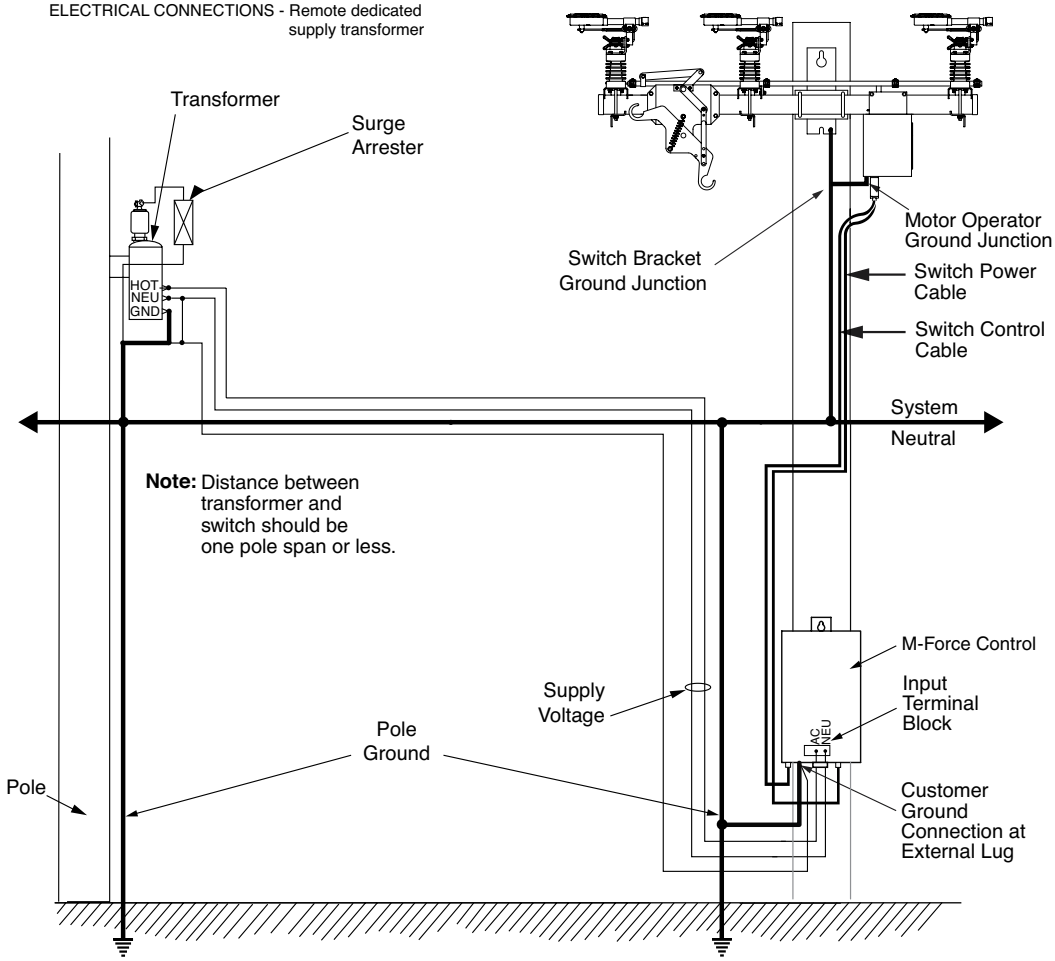


Figure 12.
Recommended grounding method for the iMC switch control and Automated M-Force switch installed on 4-wire multi-grounded with remote supply voltage transformer

Customer Connections for AC Power

CAUTION: Equipment damage. Do not drill connection holes into the top of the cabinet. Connection holes in the top of the cabinet will allow moisture to seep into the control and damage the components or cause control misoperation. Failure to comply will void the control's factory warranty. T249.0

Input power to the iMC switch control is connected to terminal block TB7 for single-phase power. Refer to Figures 14. Single-phase 120/240 V ac incoming supply voltage should be connected to TB7 as shown in Figure 14. Three-phase incoming sensing voltage should be connected to TB8 as shown in Figure 15. Refer to **Accessories** section of this manual for 120 V ac/240 V ac receptacle options.

Input power is required:

- To maintain battery charge
- To provide voltage and power metering
- To power the thermostatically controlled heater
- For the convenience outlet accessory

Power Supply / Battery Charger Board

Incoming ac power is routed to the Power Supply / Battery Charger Board designed to accept either 120 V ac or 240 V ac through a selector switch located directly on the board (Figure 13). The battery charger includes a temperature-compensated design to optimally charge the control battery. The power supply / battery charger board also includes an auxiliary power supply for connection to communication equipment (radios, modems, etc.). The auxiliary power supply is rated 28 V dc, 65 Watts peak. A separate 28 V dc to 13.8 V dc power supply accessory is available for communication equipment rated for 13.8 V dc. Some additional features are as follows:

- Positive LED indicator for power supply presence.
- Selectable 120/240 V ac switch for adapting to multiple transformer connections. The selector switch is factory-set based upon each customer order.
- Self-protective fuse (5 amp, 250 V ac).

IMPORTANT: Prior to energizing the control, the selector switch must be set as follows:

- For 120 V ac incoming power, the selector switch must be set to the 115 V position.
- For 240 V ac incoming power, the selector switch must be set to the 230 V position.

CAUTION: Equipment misoperation. Verify that the 120/240 V ac selector switch is correctly set for incoming voltage. Failure to comply may cause misoperation (unintentional operation) of the control and/or equipment damage resulting in personal injury. T278.0

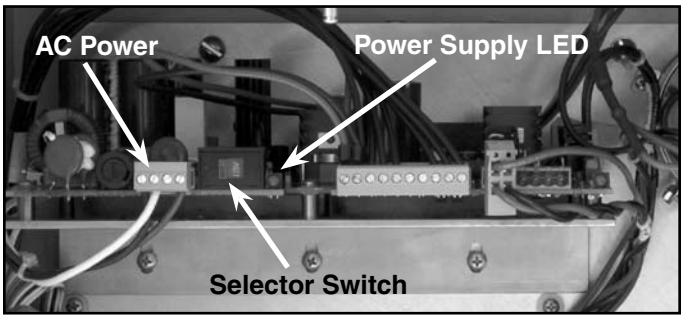


Figure 13.
Power Supply / Battery Charger Board.

Terminal Blocks

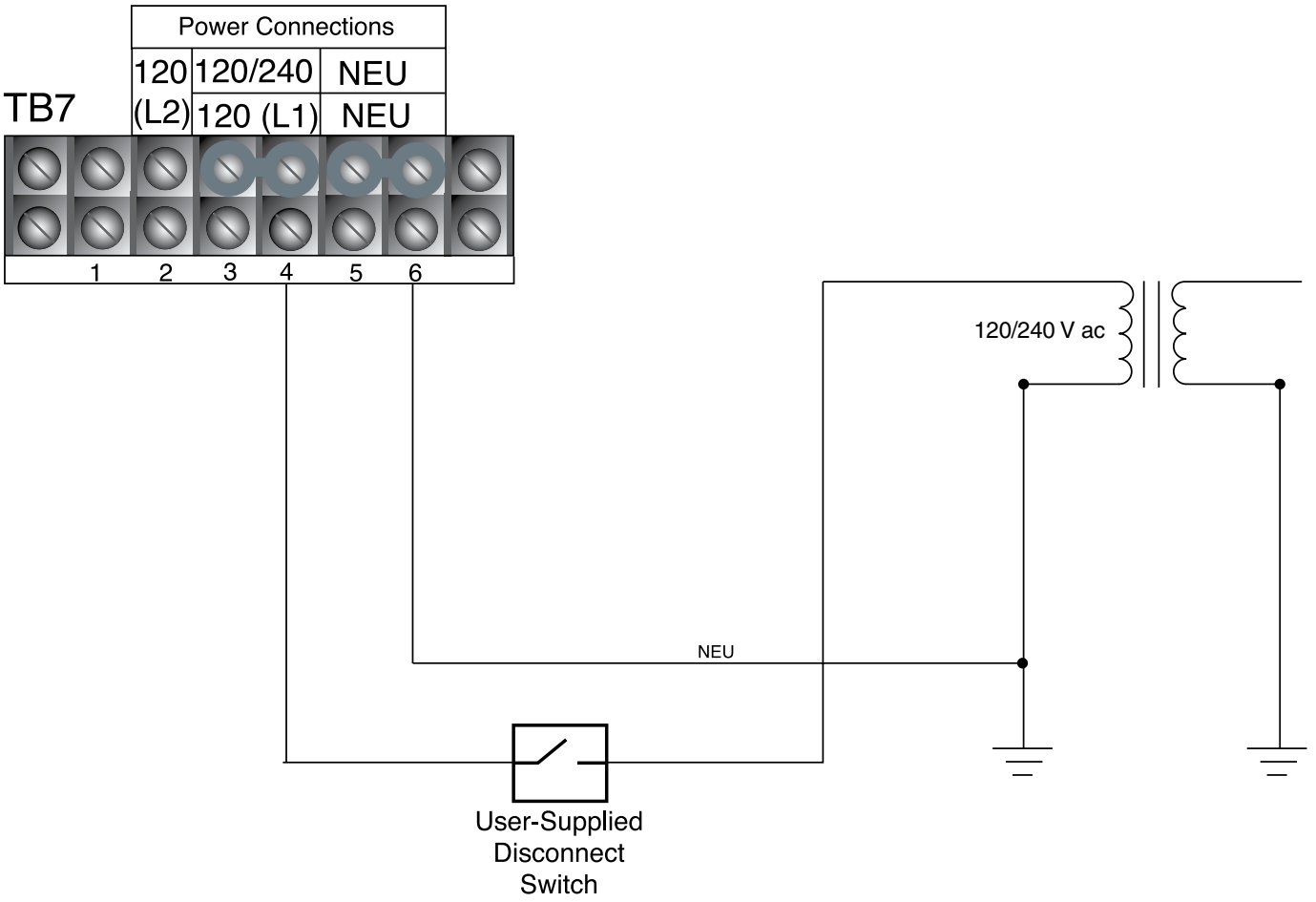
Two terminal blocks are used for connection to the iMC switch control. Both terminal blocks are fit for a #6 screw which enables a maximum ring size of #10 AWG for metering.

Terminal Block TB7 provides power to the iMC switch control and is directly connected to the power supply circuit board. Terminal Block TB8 is used to connect sensing transformer voltage only. The wiring of the transformers should follow the application illustrations per Figures 15, and 16.

Figure 16 shows user connections for TB8, 120 V ac Delta connection.

Power Connections

The transformer required for power should be a minimum of 1 kVA.



Note: Terminal Block positions TB7-3 and TB7-4 are factory-jumpered together.

Terminal Block positions TB7-5 and TB7-6 are factory-jumpered together.

Figure 14.
Single-phase 120/240 V ac transformer connections.

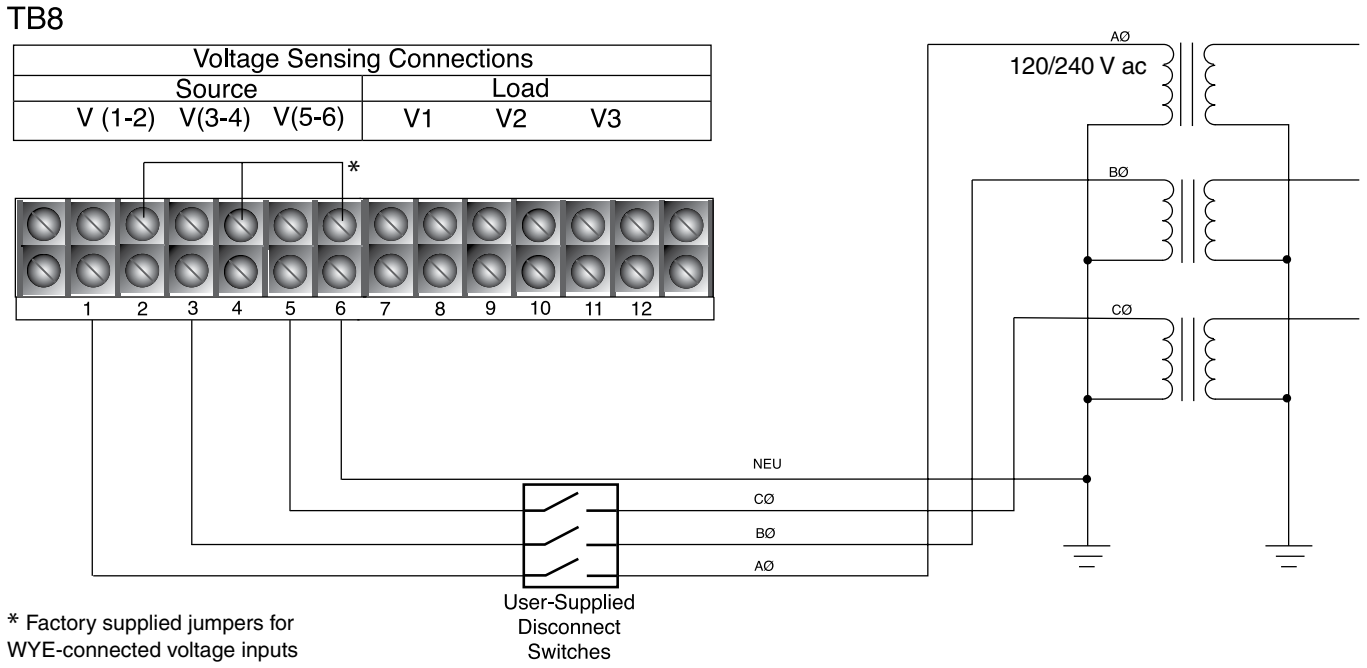
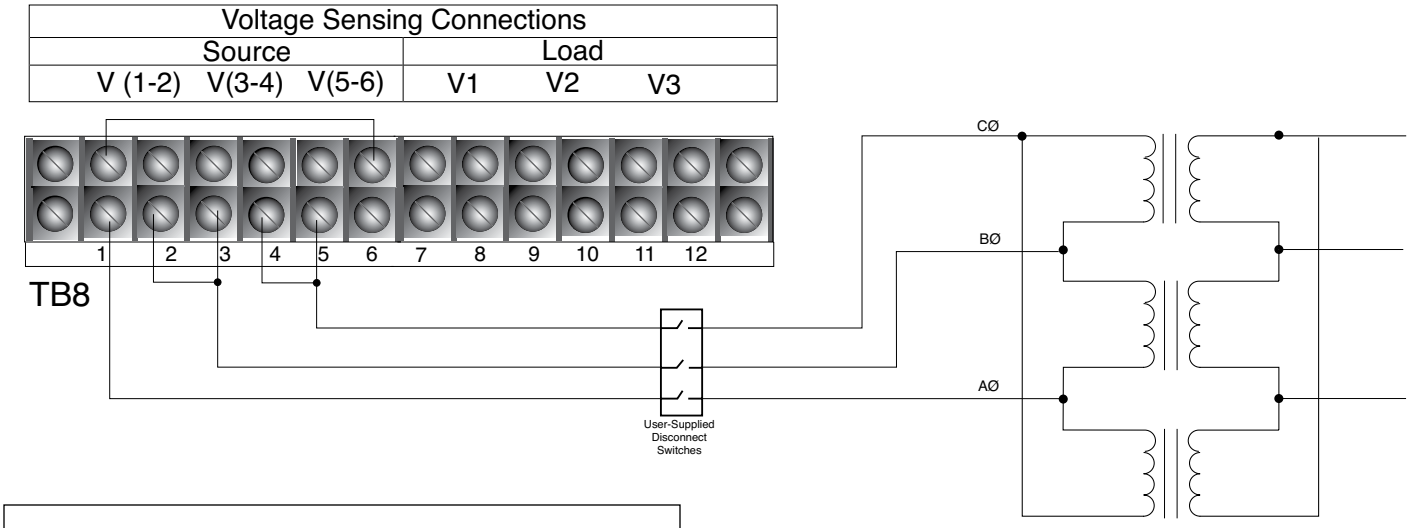


Figure 15.
Three-phase transformer connection, Wye configuration for sensing only (TB8 terminal block connection).



Note: Terminal Block positions TB8-1 and TB8-6 are factory-jumpered together for Delta connection only.

Terminal Block positions TB8-2 and TB8-3 are factory-jumpered together for Delta connection only.

Terminal Block positions TB8-4 and TB8-5 are factory-jumpered together for Delta connection only.

Remove factory jumpers for Wye application.

Figure 16.
Customer connections to TB8, 120 V ac Delta connection for sensing only.

Standard Default Supervisory Input Control and Output Status Contacts

Standard customer connections TB1 and accessory customer connections are TB3 and TB4. Refer to Figures 17 and 18 and Tables 2, 3, and 4. The Idea Workbench software allows customization of all the control and status points.

IMPORTANT: All supervisory operation and control monitor leads must be protected within shielded cables. Refer to Figure 19.

CAUTION: Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 V ac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

TABLE 2
Operating Current Requirements for Standard and Optional Supervisory Inputs

Input Voltage	Nominal Current	Minimum Operating Time
12 V dc – 250 V dc, 120/240 V ac	2.5 mA	5 milliseconds

TABLE 3
Ratings Table for Output Status Contacts CO1 through CO12 (Resistive Load – Pickup Time 8 ms, Dropout 5 ms)

Input Voltage	Contact Rating
120 V ac	8 A
12 V dc	8 A
24 V dc	8 A
48 V dc	1 A
125 V dc	0.4 A

TABLE 4
Ratings Table for Output Status Contact SS1 (Resistive Load – Pickup Time 2 ms, Dropout 15 ms)

Input Voltage	Contact Rating
120 V ac	8 A
12 V dc	8 A
24 V dc	8 A
48 V dc	8 A
125 V dc	8 A

IMPORTANT: All supervisory operation and control monitor leads must be protected within shielded cables. Refer to Figure 19.

CAUTION: Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 V ac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

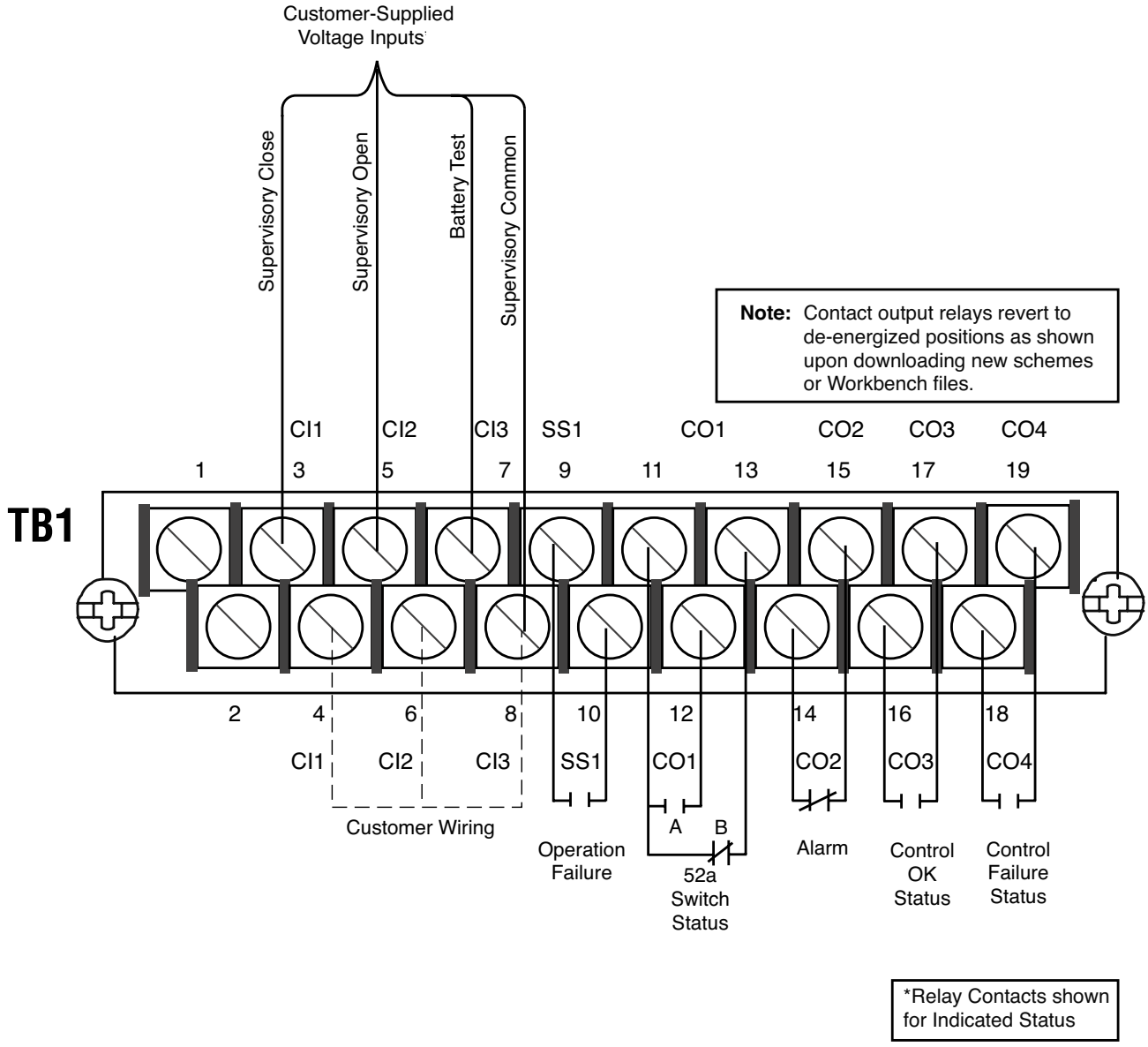


Figure 17.
iMC switch control standard default supervisory input control and output status contacts.

IMPORTANT: All supervisory operation and control monitor leads must be protected within shielded cables. Refer to Figure 19.

CAUTION: Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 V ac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

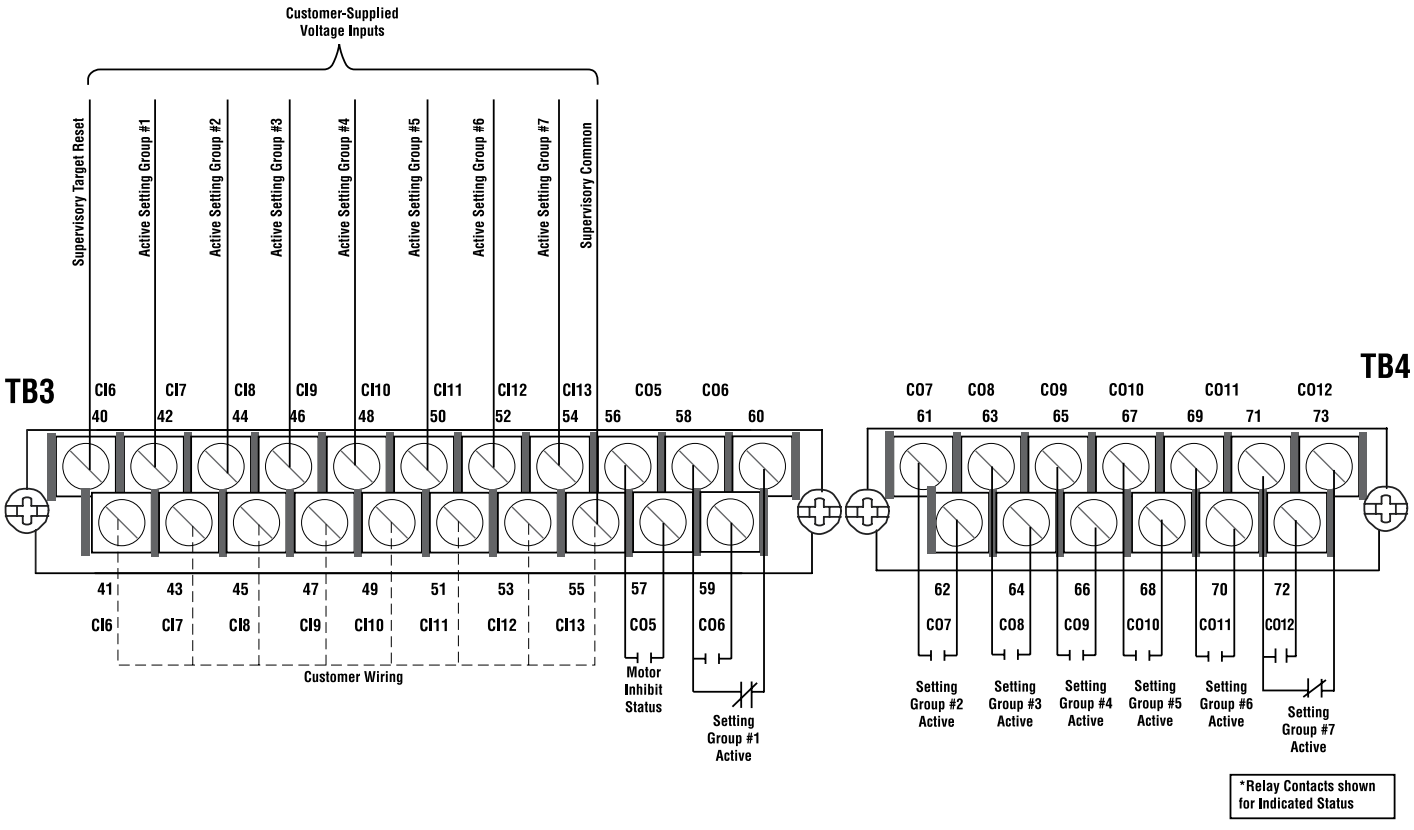
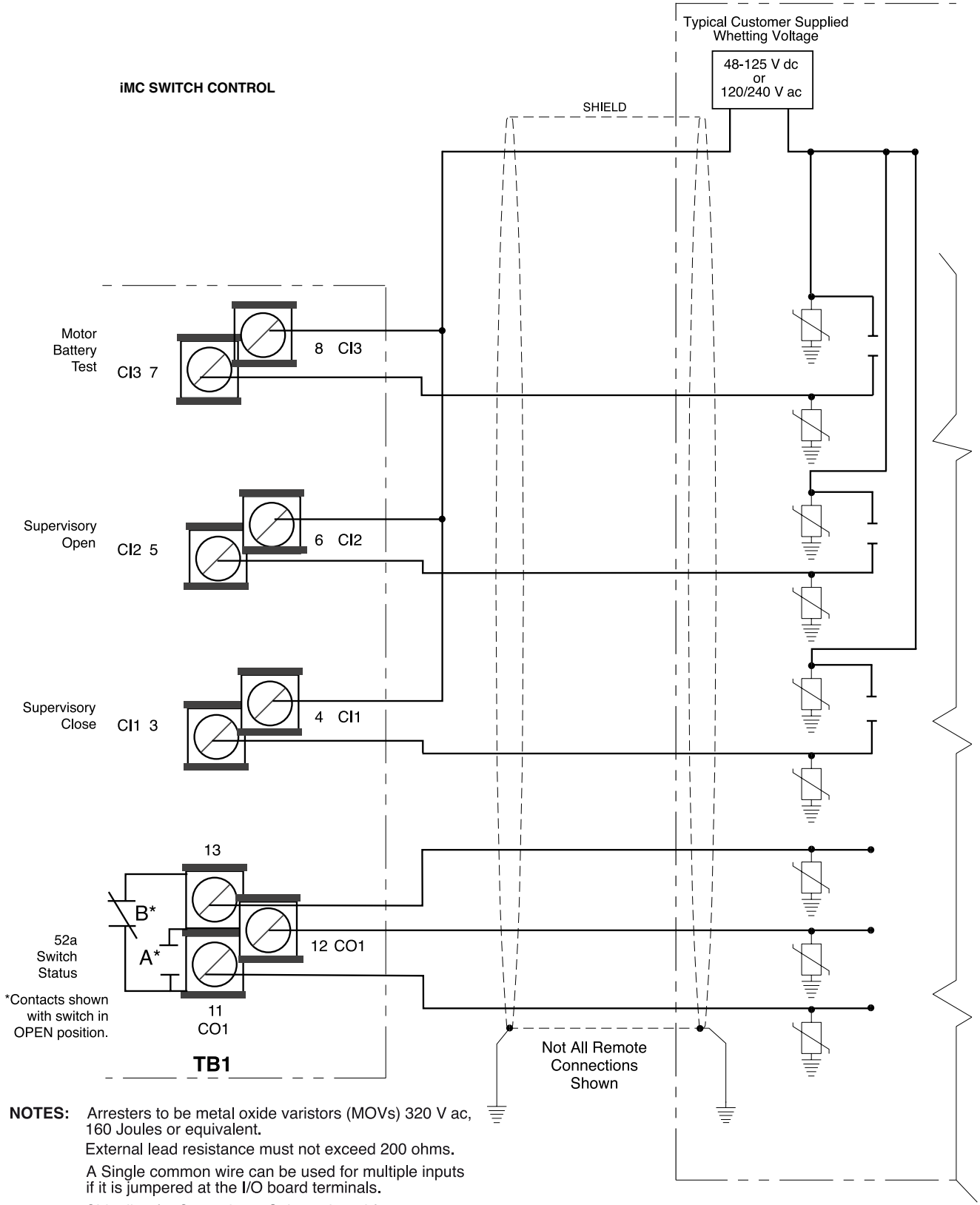


Figure 18.
iMC switch control discrete interface board accessory default supervisory input control and output status contacts.



NOTES: Arresters to be metal oxide varistors (MOVs) 320 V ac, 160 Joules or equivalent.

External lead resistance must not exceed 200 ohms.

A Single common wire can be used for multiple inputs if it is jumpered at the I/O board terminals.

Shielding for Supervisory Cables should follow the representative input control contacts and output status contacts as shown.

Supervisory and Remote Functions are default functions.

Figure 19.
Shielding and surge protection for supervisory and remote cables.

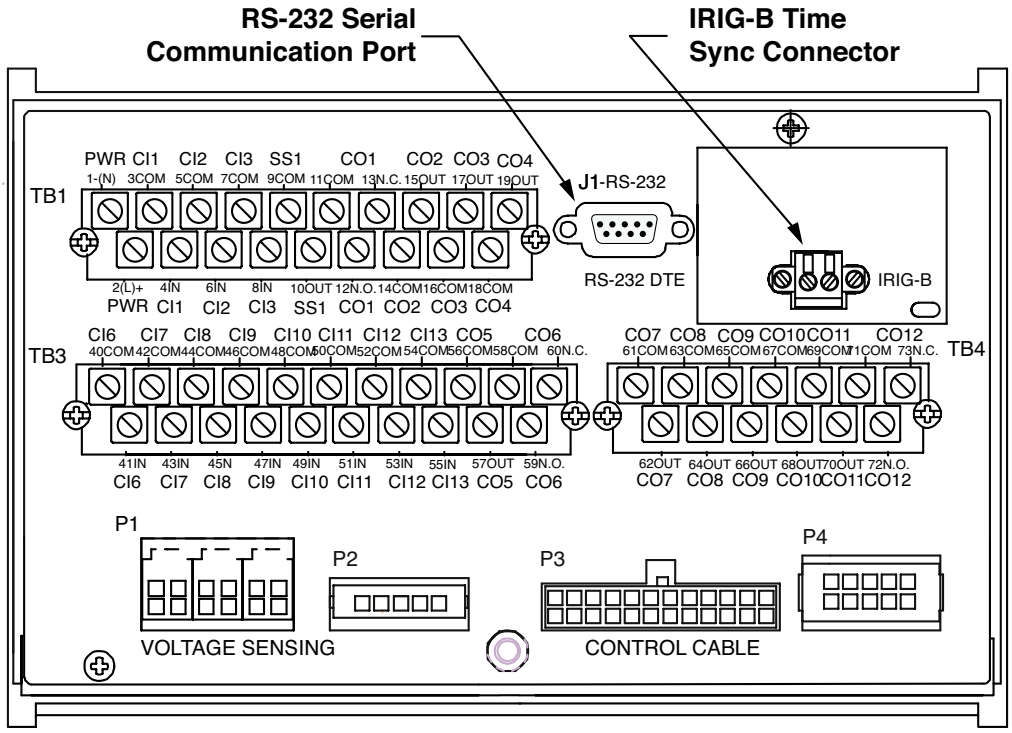


Figure 20.
iMC switch control rear panel RS-232 communication ports (standard configuration).

TABLE 5
Rear Panel RS-232 Communication Port Pin Assignments

Pin Number	Signal Name
1 DCD	Carrier Detect
2 RXD	Receive Data
3 TXD	Transmit Data
4 DTR	Data Terminal Ready (Not Connected)
5 GND	Signal Ground
6 DSR	Data Set Ready (Not Connected)
7 RTS	Request to Send
8 CTS	Clear to Send
9 NC	Not Used
10 (Shroud)	Chassis Ground

Rear Panel RS-232 Communication Port Pin Assignments

Table 5 indicates the pin assignments for the rear panel RS-232 communication port (Figure 20). Refer to Figure 21 for pin identification.

Refer to the **Accessories** section of this manual for additional communication options.

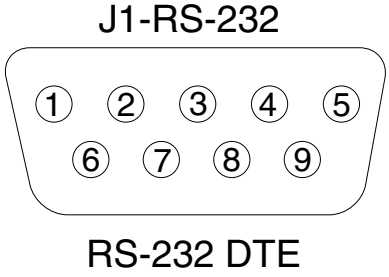


Figure 21.
Rear panel RS-232 communication port pin identification.

Before Placing the Control and Switch into Service

CAUTION: Equipment misoperation. Do not connect this control to a switch until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and switch misoperation, equipment damage, and personal injury. G147.0

Prior to placing the control and switch into service, the following installation procedures must be properly completed and verified:

1. Front panel label inserts changed (if applicable).

   Note: Refer to **Using Removable Inserts** in this manual.

2. Control properly mounted for the installation.
3. Switch and control installed according to all locally approved standards and practices.
4. Control and switch properly grounded in accordance with guidelines detailed in this manual and the application switch manual.
5. Control and motor operator cables properly connected and supported.

CAUTION: Equipment misoperation. Verify that the 120/240 V ac selector switch is correctly set for incoming voltage. Failure to comply may cause misoperation (unintentional operation) of the control and/or equipment damage resulting in personal injury. T278.0

6. Verify the selector switch on the Power Supply/ Battery Charger Board is set to the correct position based upon the incoming power supply:
   - For 120 V ac incoming power, the selector switch must be set to the 115 V position.
   - For 240 V ac incoming power, the selector switch must be set to the 230 V position.
7. Connect control batteries using the following procedure (Refer to Figure 22) :
   - **A.** Connect black (–) #16 AWG and red (+) #16 AWG battery cables to corresponding #16 AWG black and red twisted pair ac power/battery charger leads.
   - **B.** Connect black (–) #10 AWG battery cable to black #10 AWG motor operator cable.
   - **C.** Connect red (+) #10 AWG battery cable to red #10 AWG motor operator cable.
   - **D.** Connect the blue connector on the white #10 AWG positive polarity battery cable of battery 1 to the blue connector on white #10 AWG negative polarity battery cable of battery 2.
8. Verify dc operation of the control and switch by conducting a motor battery test as described in the **General Battery Test and Charging Procedures** section of this manual.

   Note: The battery test is blocked for 60 seconds upon power-up of the control.

9. Connect ac power to the control. (Control OK LED should illuminate.)

   Note: The control Power Save feature will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within five minutes. Pressing the LAMP TEST key will reactivate the display and active LEDs.

10. All control programming entered and verified by appropriate personnel.
11. Verify control clock is set to the correct time.

CAUTION: Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 V ac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

12. Verify customer connections for remote and supervisory operation are completed in accordance with proper shielding and surge protection (Figure 19).

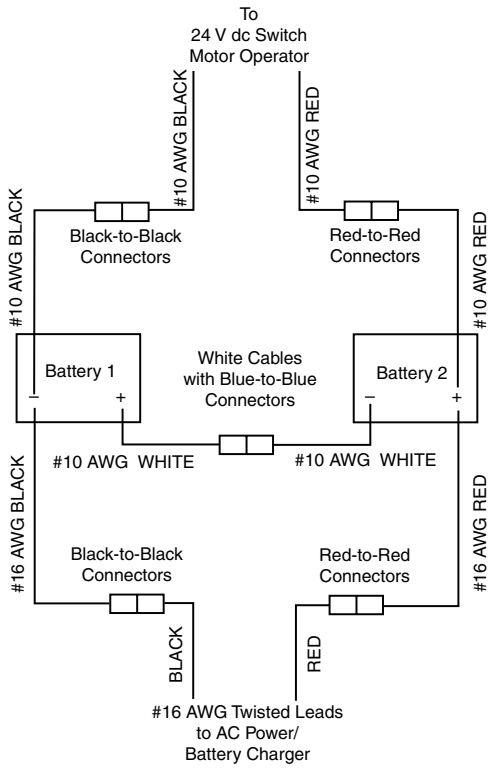


Figure 22.
Battery connection diagram.

Using Removable Inserts

CAUTION: Control damage. De-energize both ac and dc power prior to removing or installing any internal connections or circuit boards in the control. Failure to comply can result in damage to the control. T241.1

CAUTION: Equipment damage. Always wear a grounding wrist strap to control static electricity before handling circuit boards. Failure to use this strap may result in circuit board damage. T253.1

The descriptive front panel inserts can be changed to accommodate assignment of new LED indicator and hot key functionalities.

1. De-energize both ac and dc power.
2. Use a screwdriver to unscrew the four front panel screws.
3. Carefully swing the keypad assembly away from the control bezel (Figure 23).

   Note: Various connecting wires will keep the keypad attached to the control. Do not disconnect any of wires.

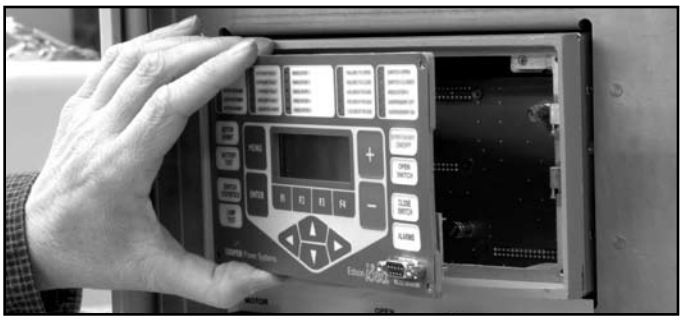


Figure 23.
Opening of front panel in preparation of inserting new inserts.

4. Locate the insert to be replaced and gently pull the removable insert toward the outer edge of the front panel and away from the control (Figure 24).
5. Change the existing label or slide in a new label with the name of the new programmed option.

   An electronic label template is included on the ProView application software CD and can be accessed through the following default address: C:/ProgramFiles/Cooper/ProView401/iMC/iMC Inserts.doc.

IMPORTANT: Laminate the removable inserts prior to installing. This will seal the ink/toner and avoid damage to the front panel.

6. Gently push the removable insert into the programming panel LED indicator section.

   Place the front cover panel back onto the control. Using a flathead screwdriver screw the screws into the control and tighten all hardware completely.

Figure 24.
Removal of inserts from front operation panel of iMC switch control.

SWITCH OPERATION

Electrical Operation

Opening Switch:

The switch may be opened and closed by using the following procedure:

1. Press the OPEN SWITCH hot key located on the front panel.
2. Verify the SWITCH OPEN LED located on the front panel illuminates.

Closing Switch:

1. Press the CLOSE SWITCH hot key located on the front panel.
2. Verify the SWITCH CLOSED LED located on the front panel illuminates.

If the general ALARM LED is illuminated but neither the SWITCH OPEN nor the SWITCH CLOSE LED is illuminated, the Automated M-Force switch is in a partial-close state .

WARNING: Equipment misoperation. Never attempt to open an energized M-Force switch giving indication of a partial close operation. In this state the M-Force switch may not safely interrupt. Failure to comply can result in equipment damage and serious injury. T325.0

In the partial close state, the Automated M-Force switch closed, but may not have picked-up the Reliabreak load-breaking mechanisms. The M-Force switch may be carrying current and should not be opened under these conditions. The switch must be manually returned to the fully closed position prior to attempting any further switching operations and/or resetting the alarms and targets.

Resetting the Automated M-Force Switch After a Partial Close Operation

1. Using a hotstick, drive the switch fully into the closed position by quickly and forcefully pulling the inboard handle of the switch bellcrank downward.

WARNING: Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

2. Verify that the SWITCH CLOSE LED is illuminated.

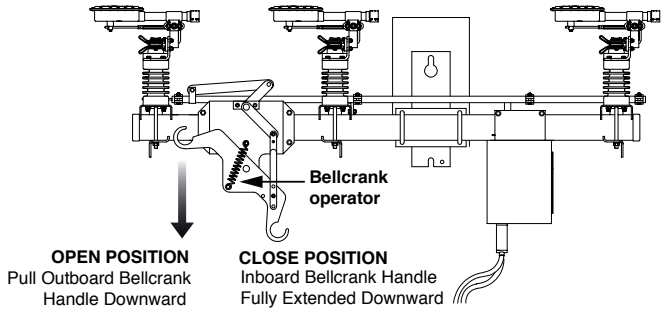


Figure 25.
Open and Close positions of Automated M-Force switch manual operation handles.

Manual Switch Operation

WARNING: Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

IMPORTANT: The hotstick tip must be placed in the groove under the eyelet of the manual operating handle when closing the switch.

The Automated M-Force switch is opened and closed by applying downward force upon the pivoting bellcrank operator. A hotstick must always be used to operate the bellcrank operator. Follow these steps to manually open and close the Automated M-Force switch. Refer to Figure 25.

WARNING: Hazardous voltage. Do not rely on the open position of the hotstick-operated bellcrank; it does not ensure that the line has been de-energized. Always establish a visible disconnect and observe the position of the switch blades. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G156.0

Opening Switch:

- Using a hotstick, quickly and forcefully pull the outboard handle of the manual bellcrank operator downward to open the switch.

Closing Switch:

- Using a hotstick, quickly and forcefully pull the inboard handle of the manual bellcrank operator to close the switch.

ACCESSORIES

iMC switch controls are available with the following listed accessories for varying application requirements. Contact your Cooper Power Systems representative for additional information regarding these accessories.

Incoming Power Receptacles

The incoming power receptacle allows the user to conveniently plug the power cable into the control, eliminating the need for hardwiring to the control. Various options are available based upon the input power voltage, and phase sensing requirements. Table 6 includes the available input receptacles and cables for the iMC switch control.

Cable Locking Sleeves

To prevent detachment of the cables from the control cabinet by unauthorized personnel, a cable-locking sleeve (Catalog Number KME6-1772-1) is available to enclose the cable plugs of incoming control, power and sensing cables. The plug is passed through the sleeve and the sleeve is then fastened from inside the control cabinet. There is no access to the cable receptacle without opening the locked cabinet door and detaching the sleeve.

120 V ac GFI Duplex Outlet

The GFI Duplex Outlet (Catalog Number KME6-1776) is available for controls powered by 120 V ac or 240 V ac three-wire supply power. This convenience outlet is rated for 15 Amperes and is accessible through the front door in the control cabinet. The 120 V ac GFI Duplex Outlet is used for many applications such as power for the auxiliary measurement equipment, supplemental lighting, and notebook computers.

Cabinet Ordering Accessories

- AISI 304 stainless steel cabinet construction

TABLE 6
Low-Voltage Closing and Input Receptacles and Cables

Description	Catalog Number
Receptacle, 120 V ac or 240 V ac input, 2-pin	KME6-1775-H
Receptacle, 120 V ac input, 3-pin	KME6-1775-J
Receptacle, 240 V ac input, 3-pin	KME6-1775-K
Input Cable, 120 or 240 V ac, 2-wire for 2-pin input, for use with KME6-1775-H receptacles Replace X with desired length. Select from 10 to 80 feet.	KA11ME1-X
Input Cable, 240 V ac, 3-wire for 3-pin input, for use with KME6-1775-K receptacles. Replace X with desired length. Select from 10 to 80 feet.	KME4-67-2-X
Input Cable, 120 V ac, 3-wire for 3-pin, input for use with KME6-1775-J receptacles. Replace X with desired length. Select from 10 to 80 feet.	KME4-67-3-X

Discrete Interface Board (DIF) Option Accessory

A Discrete Interface Board Option accessory provides eight configurable input control contacts and eight configurable output status contacts (Figure 26). The ordering options include: Standard *(3 inputs / 5 outputs)* or an additional 8 inputs / 8 outputs for a total of 11 inputs / 13 outputs.

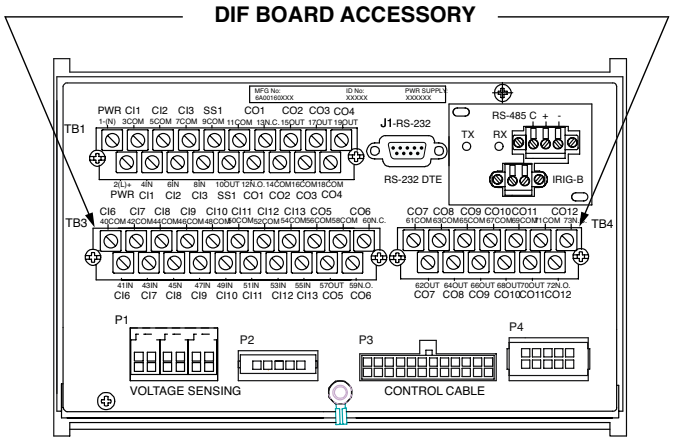


Figure 26.
iMC switch control discrete interface board accessory.

Radio Mounting Accessory

The radio mounting accessory (Figure 27) is powered from a voltage regulated power supply factory-calibrated with an output of 13.8 V dc.

Note: This output cannot be field-calibrated.

The radio will continue to operate during the loss of ac power as long as power is supplied from the battery. The power supply is designed to provide up to 40 Watts (peak) and is fused to isolate any potential radio problems without disturbing the operational features in the iMC switch control. Refer to Table 7.

Contact your Cooper Power Systems representative for any additional voltage requirements.

TABLE 7
Radio Mounting Accessories

Description	Catalog Number
Full Automation accessory 12 V dc radio provision (Radio and fiber-optic/RS232 interface not included)	KME6-1774-9
Automation accessory (bracket only) 12 V dc provision	KME6-1774-8

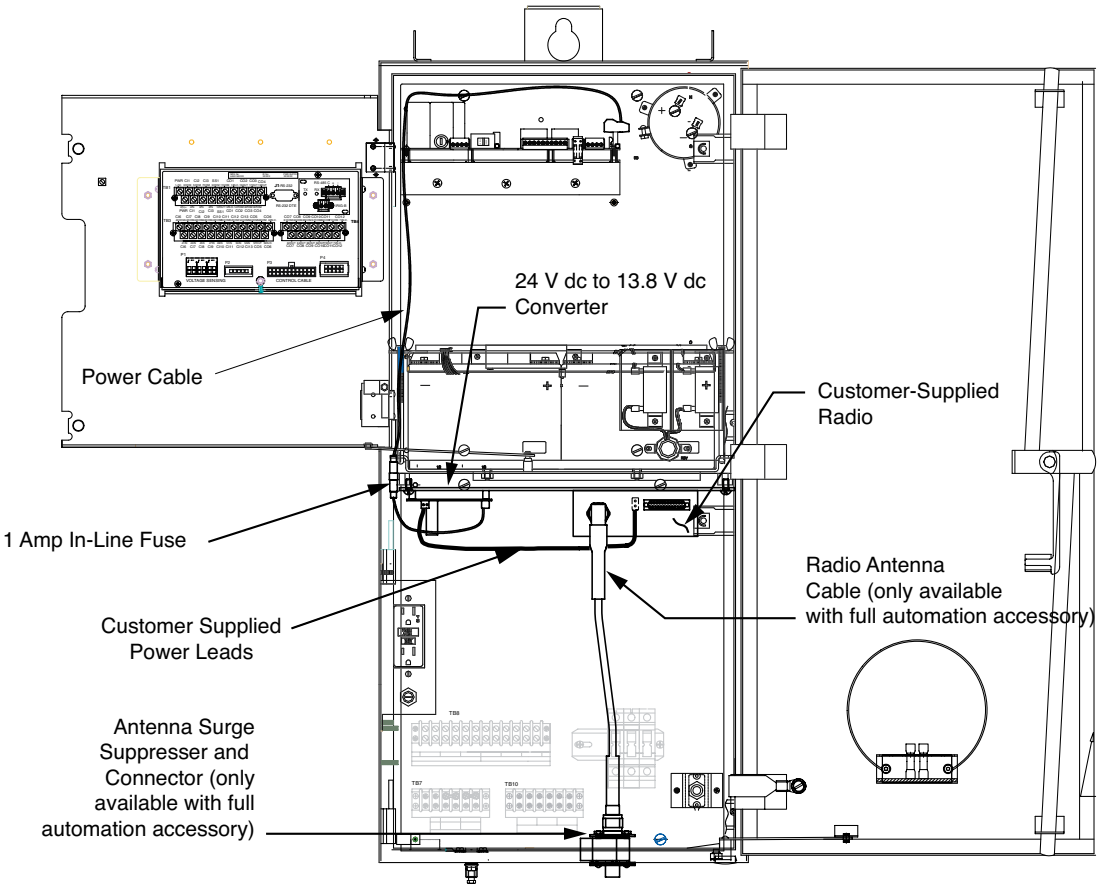


Figure 27.
iMC switch control radio mounting accessory.

Communication Board Accessories

The iMC switch control is equipped with a Communication Board Accessory (expansion bay) offering versatile support for modern communication media. Seven distinct communication options (Figure 28) are available, providing two-way, real time digital communications with a remote terminal unit (RTU), wireless, telephone modem, Ethernet network, or other communication devices. The following options are available:

- No auxiliary communication card installed (standard)
- RS485 (isolated) Serial communication card
- Fiber-optic-based Serial Communication Card (ST)
- 10/100 Base-T dual Ethernet communication card (2 * RJ-45)
- 100 Base-FX dual Ethernet communication card (2 * MT-RJ)
- 10/100 Base-T, 100 Base-FX Ethernet communication card (RJ-45 + MT-RJ)
- 100 Base-FX dual Ethernet communication card (2 * LC)

The expansion bay based Communication Board Accessory concept offers high versatility with respect to communication medium and protocol support. Additional accessories are being continuously developed. Contact your Cooper Power Systems representative for the latest information regarding particular media and communication protocol support.

RS485 Serial Communication Card

The RS485 serial communication card accessory provides means for establishing asynchronous link-based digital communications with the iMC switch control. The Galvanic isolated (1000V DC) RS485 port uses a single shielded twisted pair connection and can support 16 devices in multi-drop configuration. Communication speed is controlled through software and can be set at: 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, and 115kBPS.

Digital communications must be programmed through the Communications Workbench to ensure proper operation of the RS485 communication card accessory. Refer to *S260-80-3 iMC Programming Guide* for additional protocol support information.

Fiber-Optic Based Serial Communication Card

The Fiber-Optic based Serial Communication Card offers means of establishing asynchronous (RS-232 like) digital communications through multi-mode fiber media. The use of the fiber-optic based serial communication card accessory can enhance communication reliability, and provides excellent electrical isolation thus protecting transmitted data from extraneous electrical interference.

A pair of industry standard ST type fiber-optic connectors are mounted on the back of the board enabling customer connection to a digital communication system using fiber-optic cables (customer-supplied).

The fiber-optic link has separate receive (RX) and transmit (TX) ports operating at 820nm. Typical transmission distance is 2000m with 62.5/125µm multi-mode fiber. Consult your Cooper Power Systems representative for availability of long haul and single mode fiber solutions. Link communication speed is controlled through software and can be set at: 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, and 115kBPS.

The fiber-optic accessory must be programmed through the Communications Workbench for the appropriate protocol. Refer to *S260-80-3 iMC Programming Guide* for additional information.

The fiber-optic based serial accessory includes TX and RX indicating LEDs for verifying communications along with an ECHO / NON-ECHO switch for supporting ring / star fiber topologies.

When operated in a ring configuration, the toggle switch must be set in the ECHO position. In this mode, the fiber-optic card will repeat (pass through) all messages received on the RX fiber, and will respond to the Master station by first echoing the incoming command and then sending the response. This arrangement is best suited for creation of low cost multi device fiber loops. For reliable communications, the fiber loop system requires that all devices in the loop remain powered at all times, thus enabling unobstructed flow of information throughout the loop.

A more resilient system can be designed by using the fiber-optic ports in a point-to-point or multiple point-to-point (star) configuration. For this mode, the toggle switch must be set in the NON-ECHO mode. The iMC switch control will respond to the Master station by sending a response only (total separation of Receive and Transmit fibers). Additional hardware (fiber-optic star coupler) is required to support the multiple point-to-point device configurations.

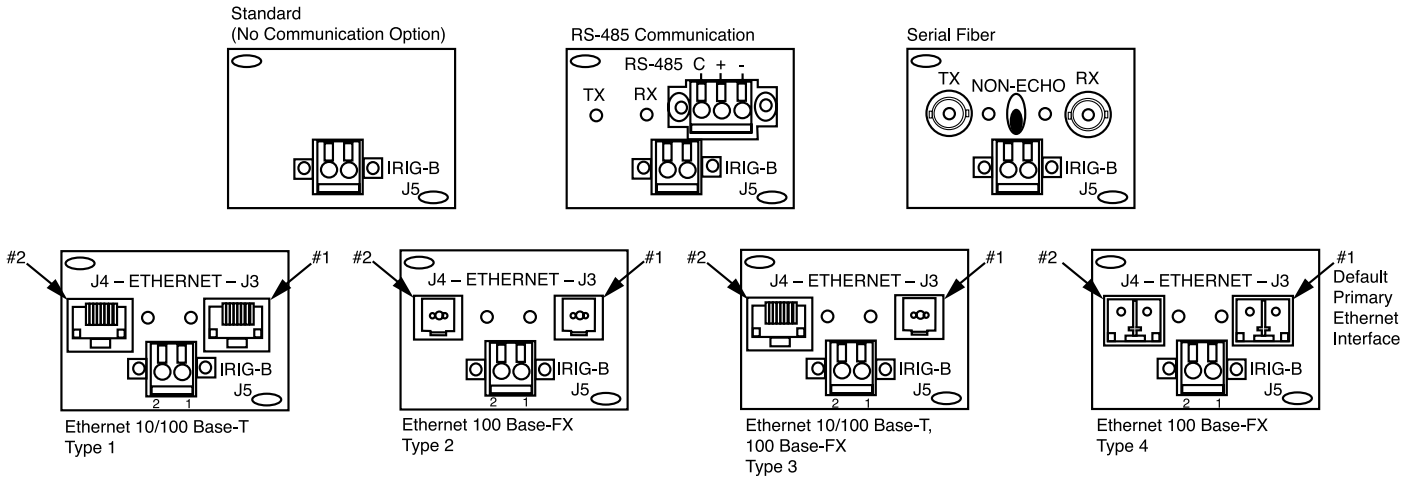


Figure 28.
Back panel Ethernet and communication options.

Ethernet Communication Cards

The Ethernet communication card accessory brings the Ethernet network connectivity to the iMC switch control platform. It is highly flexible, offering simultaneous support for multiple sessions, device management (ProView over TCP/IP) and SCADA communications (DNP3 over TCP/IP).

By natively supporting a set of widely accepted industry standards (TCP/IP, UDP/IP, OSI) the Ethernet communication accessory ensures seamless interoperability with other network devices.

The Ethernet communication card accessory is offered in 3 physical layer configurations (twisted pair and optical-fiber options) as shown in Table 8.

Maximum link length is determined by the use of the particular physical layer implementation, and can be further constrained by the actual network configuration. In case of the 100Base-FX MT-RJ connector based implementation, maximum link length in excess of 2000m can be achieved with 62.5/125µm multi mode fiber. The fiber-optic link uses 1300nm wavelength, and can easily be interfaced to other 100Base-FX solutions (ST connector patch cord solution).

The Ethernet communication accessory card (Figure 28) is equipped with two physical ports configured to act as primary and standby LAN connections. Availability of the backup communication port enables creation of highly redundant Ethernet networks thus increasing the overall system reliability.

Note: Under normal network conditions, all communications will be channeled through the primary port (#1, Figure 28), with the standby port either logically disabled, or configured for fast automatic throw-over in case of the primary Ethernet link failure. *Refer to S260-80-3 iMC Programming Guide* for additional Ethernet accessory configuration information.

TABLE 8
Ethernet Communication Card Configurations

Type	Card Configurations	Output Connectors	Communication Speed
1	10/100 Base-T	2 * RJ-45	10/100MBps (auto switching)
2	100 Base-FX (multi-mode fiber)	2 * MT-RJ	100MBps (full duplex)
3	10/100 Base-T, 100 Base-FX	RJ-45 + MT-RJ	10/100MBps and 100MBps
4	100 Base-FX (single-mode fiber)	2 * LC	100MBps (full duplex)

TESTING

CAUTION: Equipment misoperation. Do not connect this control to a switch until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and switch misoperation, equipment damage, and personal injury.

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IMPORTANT: The iMC switch control can be taken out of service for testing and placed back into service without de-energizing its switch and interrupting the system. However, during the time the control is out of service, the switch can not be electrically operated.

Testing an Installed Control

The following test to verify correct operation of the iMC switch control can be performed while connected to an operating switch.

1. Verify operating status of all indicator lights by pressing and holding the LAMP TEST key for two seconds on the programming panel (Figure 29).
2. Check the operational values for currents, voltages, and other metering information.

   Note: Scroll through the LCD display messages by pressing the ▲ and ▼ cursor movement arrows underneath the LCD display on the programming panel (Figure 29).

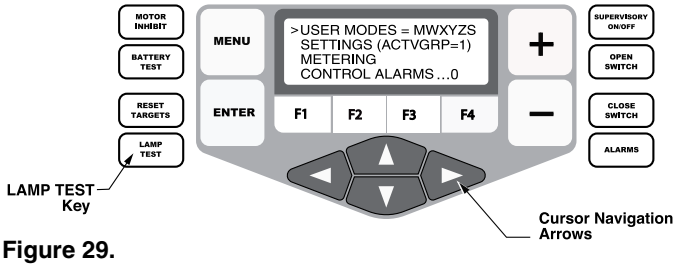

Figure 29.
Lamp Test button, LCD display, and cursor movement arrows.

3. Test control battery operation as follows:

   Note: The battery test is blocked for 60 seconds upon power up of the control.

   Note: AC power can be either connected or disconnected for battery test.

   A. Press BATTERY TEST hot key on front panel.

   B. Using the navigational arrows keypad, navigate down to the CONTROL BATTERY TEST menu displayed in the LCD screen and press ENTER.

   C. Press the F4 LCD Menu Function Key for 1 second to test the battery. The battery test results will display in the battery metering menu.

   Note: This message will appear on the programming panel LCD display: ----TESTING----

   The battery test results will display in the battery metering menu.

   Note: Voltage should be between 25–31 V dc – with the higher voltage at colder temperatures.

   Under normal conditions, with ac connected and a fully charged battery, the charging current should be less than 20 mA.

   With ac connected and a discharged battery, the current range should be 20–450 mA.

   With ac disconnected and the battery supplying the load, current will read -400 to -600 mA depending on accessories connected.

If the control fails the control battery test, further operation of the control will be inhibited until a motor battery test is conducted. Refer to the following **Battery Testing and Charging Procedures** section of this manual for the Motor Battery testing procedure.

Note: To conduct a motor battery test the Automated M-Force control must be connected to an Automated M-Force switch or Automated M-Force bench motor operator.

4. Verify the iMC Control OK LED is illuminated on the control operator panel (Figure 30). This indicates the presence of ac power.

   Note: The control includes a Power Save feature that will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within five minutes. Pressing the LAMP TEST key will reactivate the display and active LEDs.

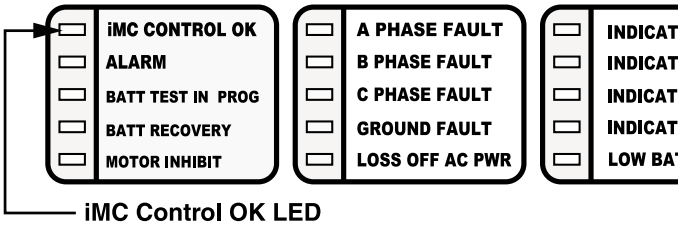

Figure 30.
iMC Control OK LED.

5. Verify the electrical switching functionality of the control.

   A. Press the CLOSE SWITCH hot key located on the front panel.

   B. Observe the switch closing and verify the SWITCH CLOSE LED located on the front panel illuminates.

   C. Press the OPEN SWITCH hot key located on the front panel.

D. Observe the switch opening and verify the SWITCH OPEN LED located on the front panel illuminates.

General Battery Tests and Charging Procedures

Test Procedure for Installed Batteries

Follow the procedure below to perform a battery test in the iMC switch control. The values in the test procedures are based on testing at 25˚C (77˚F).

The condition of the iMC switch control batteries can be determined by using the Battery Test Analysis button on the front of the iMC switch control or using the Battery Test function in the BATTERY MENU.

Note: The battery test functionality is blocked for 60 seconds upon power up of the control.

Note: AC power can be either connected or disconnected for battery testing.

Control Battery Test

During a control battery test a 5Ω, 55 watt resistor is placed across the battery terminals for approximately five seconds. The iMC switch control measures the battery voltage, if the voltage drops below 22.8 V dc for one full second, the ALARM LED (battery alarm) is illuminated. If the control fails the control battery test, a motor battery test must be executed to verify the health of the battery, before the control can be operated.

1. Press BATTERY TEST hot key on front panel.
2. Using the navigational arrows keypad, navigate down to the CONTROL BATTERY TEST menu displayed in the LCD screen and press ENTER.
3. Press the F4 LCD Menu Function Key for 1 second to test the battery. The battery test results will display in the battery metering menu.

Note: This message will appear on the programming panel LCD display: ----TESTING----

The battery test results will display in the battery metering menu.

Note: Voltage should be between 25–31 V dc – with the higher voltage at colder temperatures.

Under normal conditions, with ac connected and a fully charged battery, the charging current should be less than 20 mA.

With ac connected and a discharged battery, the current range should be 20–450 mA.

With ac disconnected and the battery supplying the load, current will read -400 to -600 mA depending on accessories connected.

Motor Battery Test

The motor battery test more closely duplicates the expected load placed upon the battery. During a motor battery test, the Automated M-Force switch motor is operated for approximately one second while the motor clutch is disengaged, preventing operation of the switch blades. If the batteries are found to be at a level of health too poor to operate the motor operator, the motor inhibit function will assert accompanied by illumination of the ALARM, LOW BATTERY VOLTAGE, and MOTOR INHIBIT LEDs. The control will become inoperable until normal battery health is restored.

Note: To conduct a motor battery test the Automated M-Force switch control must be connected to an Automated M-Force switch or M-Force bench motor operator.

1. Press the Battery Test hot key on the front panel.
2. Using the navigational arrows keypad, navigate down to the MOTOR BATTERY TEST menu displayed in the LCD screen and press ENTER.
3. Press the F4 LCD Menu Function Key for 1 second to test the battery. The battery test results will display in the battery metering menu.

Note: Voltage should be between 25–31 V dc with the higher voltage at warmer temperatures.

Under normal conditions, with ac connected and a fully charged battery, the charging current should be less than 20 mA.

With ac connected and a discharged battery the current range should be 20–450 mA.

TABLE 9
iMC switch control – Battery Bench Testing and Replacement Information

Control Type	Battery	Battery Catalog Part #	Voltage	Type	Amp/ Hour	Bench Test Load Condition for 5 sec.	Acceptable Voltage Drop at End of Test Load
iMC switch control	Hawker Genesis	KME6-4026-7	24v (two 12v batteries)	Lead Acid	26	5Ω 55 watt	2v or less

Test Procedure for Uninstalled Batteries

The entire process should be conducted in a clean environment, such as a repair shop.

The following procedure should be used to perform a bench test on a control batteries in a service shop:

1. Remove the control from service. Refer to the **Removing Control from Service** section within this manual.
2. Remove the batteries from the control and carefully transport them to a suitable service facility.
3. Measure battery voltage across the two batteries connected in series.
4. Using a 5 Ohm, 55 watt resister, apply a test load across the two batteries and measure the battery voltage after 5 seconds of load to determine voltage drop. Refer to Table 9 for Bench Test Load Condition.
5. Remove test load.

If the voltage drop at the end of 5 seconds is greater than 2 volts, the batteries should be replaced. Refer to Table 9 for the battery catalog number.

Battery Charging

If it is not possible to charge the battery with the control's built-in charger, a 120 V ac KME5-60-1 portable bench type battery charger is available.

IMPORTANT: Do not attempt to charge lead acid batteries below 19 V dc with the KME-60-1 charger. Attempting to do so will damage the charger.

If the lead acid battery is below 19 V dc, replace the batteries. The expired batteries should be disposed of in an environmentally responsible manner. Consult local regulations for proper battery disposal.

IMPORTANT: The two batteries contained within the Automated M-Force switch must be connected in series, and simultaneously charged using the KME-60-1 charger and provided KME5-325-1 connecting accessory.

Note: A red LED indicator on the body of the charger illuminates when charging.

The charger senses when the battery voltage reaches 2.27 volts per cell, then the charge rate reduces to maintain a trickle charge.

The red LED flickers to indicate the battery has reached a full charge. This process can take up to 48 hours.

Refer to *S280-79-14 KA43ME7001 Portable Lead Acid Battery Charger Instructions* for additional information.

Removing Control from Service

IMPORTANT: The iMC switch control can be taken out of service for testing and placed back into service without de-energizing its switch and interrupting the system. However, during the time the control is out of service, the switch can not be electrically operated.

IMPORTANT: Disconnect switches for ac sensing and power connections are necessary to isolate the iMC switch control for testing and servicing.

1. Open 24 V dc Switch SW1 (Figure 9).
2. Within the control enclosure, disconnect the control batteries by opening the red and black inline battery cable connectors.
3. Isolate the ac voltage sensing and power circuits from the control by opening the user-provided, in-line ac voltage sensing and power disconnect switches.
4. Disconnect voltage sensing cables from Terminal TB-8.
5. Disconnect control cable from control.
6. Remove any control input and status output wiring from terminals TB1, TB3, and TB4 (Figure 26).
7. Disconnect any serial communications ports and IRIG-B timing connections (Figure 26).
8. Disconnect the ground from the control.
9. Using appropriate lifting apparatus remove control from pole.
10. Carefully transport the control to a suitable service facility.

Returning Control to Service

CAUTION: Equipment misoperation. Do not connect this control to a switch until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and switch misoperation, equipment damage, and personal injury.

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The following procedure must be followed to return the control to service upon completion of in-shop service or maintenance operations.

1. Before transporting the control back to the pole, appropriate technical personnel must verify that all control settings are correct.
2. Transport control back to field location.
3. Using appropriate lifting apparatus install control upon pole.
4. Connect the ground cable to the control.
5. Connect applicable serial communications and IRIG-B timing connections.
6. Connect applicable control input and status output wiring to terminals TB1, TB3, and TB4 (Figure 26).
7. Verify the selector switch on the Power Supply/ Battery Charger Board is set to the correct position based upon the incoming power supply:
   - For 120 V ac incoming power, the selector switch must be set to the 115 V position.
   - For 240 V ac incoming power, the selector switch must be set to the 230 V position.
8. Connect control cable from control.
9. Connect applicable voltage sensing cables from Terminal TB-8.
10. Re-connect the ac voltage sensing and power circuits to the control by closing the user-provided, in-line ac voltage sensing and power disconnect switches.
11. Within the control enclosure, reconnect the red and black inline battery cable connectors.
12. Close the 24 V dc Switch SW1 (Figure 9).
13. Verify the control clock is set to the current time after ac power has been reapplied.

    Note: The control clock may require resetting if the operating power has been disconnected for more than thirty days.

ADDITIONAL INFORMATION

Replacement Kits

Replacement kits for the iMC switch control are available through the factory Service Department. To order these kits, refer to the Replacement Parts price list for catalog numbers and pricing. Contact your Cooper Power Systems representative for additional information and order procedures.

Factory-Authorized Service Centers

Factory-authorized service centers are located throughout the continental United States to provide maintenance, repair and testing services for Cooper Power Systems controls and reclosers. For further information, contact your Cooper Power Systems representative.

Factory Maintenance Classes

The factory service department offers a basic testing and troubleshooting course for the electronic recloser control. This course, taught by experienced service technicians, is held at the factory in-house training facility. For additional information, contact your Cooper Power Systems representative.

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