Installation

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NOTICE

The latest 6801M Automatic Switch Operator instruction sheets are posted as PDF files at **sandc.com/en/support/product-literature/**. 6801M software (all revisions) can be downloaded at **sandc.com/en/support/sc-customer-portal/**. If requiring assistance, contact:

sandc.com/en/support/technical-support/ or call our 24/7 support center at (888) 762-1100.

Qualified Persons

⚠ WARNING

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

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

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

Read this Instruction Sheet

NOTICE

Thoroughly and carefully read this instruction sheet and all materials included in the product's instruction handbook before installing or operating the 6801M Automatic Switch Operator. Familiarize yourself with the Safety Information and Safety Precautions on pages 4 and 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 the 6801M Automatic Switch Operator. Designate a location where this publication can be easily retrieved.

Proper Application

⚠ WARNING

The equipment in this publication is only intended for a specific application. The application must be within the ratings furnished for the equipment. See S&C Specification Bulletin 1045M-31.

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 6801M Automatic Switch Operator, 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.

For equipment/services packages, the seller warrants for a period of one year after commissioning that the 6801M Automatic Switch Operator will provide automatic fault isolation and system reconfiguration per agreed-upon service levels. The remedy shall be additional system analysis and reconfiguration of the IntelliTeam® SG Automatic Restoration System until the desired result is achieved.

Warranty of the 6801M Automatic Switch Operator 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, such as batteries and communication devices. 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.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to the 6801M Automatic Switch Operator. 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 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 the nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C's website **sandc.com**, or call the S&C Global Support and Monitoring Center at 1-888-762-1100.

NOTICE

Read this instruction sheet thoroughly and carefully before installing the 6801M Automatic Switch Operator.

Replacement Instructions and Labels

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

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

⚠ DANGER

The 6801M Automatic Switch Operator 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 6801M Automatic Switch Operator must be restricted only to qualified persons. See the "Qualified Persons" section on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
5. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components.
6. The 6801M Switch Operator is capable of generating tremendous torque and speed. Make sure the 24-Vdc circuit breaker is Off before putting hands or other body parts near the actuator shaft. There is risk of serious injury if these precautions are not observed.

Applicable Software

This instruction sheet is used with software versions ST6801MSS-7.1.x and SG6801MSX-7.1.x. The "x" can indicate any number from 0 to 255. Other related software component version information is found on the *Setup>General>Revisions* screen.

The software revision is shown in the installer file name (-7.1.x) and on the *Setup>General>Revisions* screen. For questions regarding the applicability of information in this instruction sheet to future software releases, contact S&C Electric Company.

Although the 6801M Switch Operator will work acceptably with most distribution switches, be sure to check with S&C Electric Company before using the switch operator with any switch not on the list of switches on the *Setup>General>Switch Operator* screen. See S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*."

NOTICE

With firmware later than version 7.3.100, the default passwords for all user accounts, including the Admin user, must be changed before the IntelliLink software can connect to and configure a control. See S&C Instruction Sheet 1045M-530, "6801M Series Automatic Switch Operators: *Setup,*" for more information.

NOTICE

Operating a switch with a 6801M Automatic Switch Operator may result in a reduction of its fault-closing rating.

The fault-closing ratings for S&C switches applied with a 6801M Automatic Switch Operators can be found in the following publications:

- Omni-Rupter® Switches (see S&C Specification Bulletin 765-31)
- Alduti-Rupter® Switches (see S&C Specification Bulletin 771-31)

For switches that are not made by S&C, contact the switch manufacturer to determine whether there is an impact on their electrical ratings.

Pre-Installation Inspection and Setup

Before installing the 6801M Switch Operator, carry out the following steps. This is best done in the service center before leaving for the installation site. Even if these steps are not performed before installing the switch operator on the pole, S&C recommends doing so before mechanically coupling it to the switch for operation.

NOTICE

Store the 6801M Switch Operator indoors or with 120-Vac power on when not in service. The switch operator includes a drive-train assembly that can hold its temperature for an extended period of time.

Under conditions of varying temperatures, this can promote buildup of moisture in the enclosure caused by condensation.

Failure to store the product properly can void the warranty and promote conditions leading to mechanical or electrical component failure.

The 6801M Switch Operator comes with the U-channel already installed. To stand it up vertically, place it either on a very strong workbench or on two 4-inch (102-mm) x 8-inch (203-mm) x 24-inch (610-mm) wood blocks, and be careful not to damage the components on the bottom of the enclosure.

NOTICE

The 6801M Switch Operator, with batteries, weighs approximately 260 pounds (118 kg). Use a lifting device (forklift, hoist, line truck, etc.) or get assistance from others before attempting to lift the switch operator. A single point lifting bracket is provided on the rotating operator, and a lifting hole is provided in the reciprocating operator mounting channel.

STEP 1. Inspect the switch operator for visible damage. Make sure there is no obvious damage to the switch operator enclosure or any internal components. Also examine the inside of the enclosure for excessive moisture.

STEP 2. Connect ac power to the switch operator. Although this is not required for the pre-installation inspection, it is required when updating the switch operator software. S&C also recommends charging the batteries before attempting to put the switch operator into service. Refer to Label G-6226 attached to the enclosure door handle.

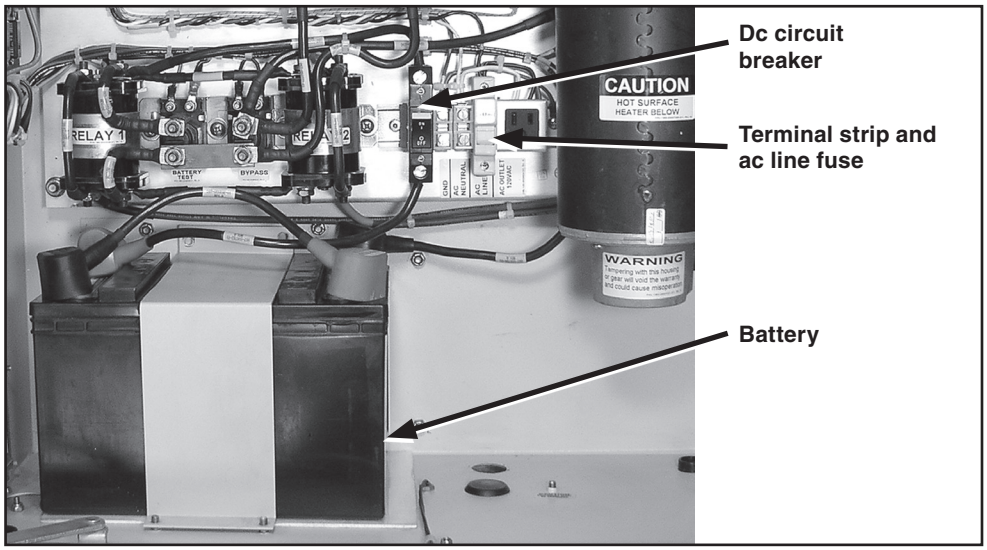


Figure 1. The 6801M Switch Operator power wiring.

(a) Open the faceplate and make sure the 24-volt circuit breaker (near the center of the enclosure) is in the Off setting. Remove the ac line fuse (see Figure 1).

(b) Remove the shipping plug from the conduit hole, and install 120-Vac control power. Figure 1 shows the location of the terminal strip.

NOTICE

The neutral is connected to ground inside the switch operator. This means power may not be supplied from a circuit protected by a ground fault circuit interrupter (GFCI). If GFCIs are installed on all available sources of ac power, use an isolation transformer to power the switch operator.

STEP 3. Check the batteries. The 6801M Switch Operator is shipped with two C&D Technologies UPS12-150MR 12-volt batteries (or other approved batteries). Check with S&C Electric Company before using batteries of a type or capacity other than those supplied.

⚠ WARNING

The 6801M batteries are capable of short circuit currents exceeding 2,000 amperes. Electrical fires and physical harm can be caused by allowing the terminals of the batteries to be shorted. Handle the batteries with care and be sure to fasten the batteries securely to the enclosure during installation. Use insulated tools to tighten/loosen the battery connections, and turn off the 24-volt circuit breaker before installing or removing the batteries.

NOTICE

Operation of the switch operator for extended periods below -30°C (-22°F) requires fully charged batteries. New batteries are shipped from the manufacturer at approximately 95% capacity. Prior to use at extremely low temperatures, be sure to charge the batteries long enough to bring them to full capacity.

(a) Inspect the batteries for signs of damage. The cases should not be cut or nicked. **Note:** Some bulging of the battery case is normal, but it should not exceed ⅛-inch (3 mm).

(b) Use a voltmeter to check the voltage for each battery. Assuming the batteries have not been charged in the last 12 hours, replace them if their voltage at room temperature is below 12.25 Vdc each.

STEP 4. If necessary, install the batteries. If the batteries were not installed at the factory, use the insulated jumper and hardware provided to install them now. Make sure the battery connections are tight and the battery hold-down clamp is securely fastened.

(a) Open the faceplate and make sure the 24-Volt circuit breaker (near the center of the enclosure) is in the **Off** setting.

(b) Find the studs on the back and floor of the enclosure (left side for the rotating unit, right side for the reciprocating unit).

(c) Attach the black insulated terminal lead connected to the shunt to the (–) negative terminal on one battery.

(d) Attach the red insulated terminal lead connected to the dc breaker to the (+) positive terminal on the other battery.

(e) Slide the batteries in place, with the connections toward the back of the enclosure.

(f) Align the holes in the battery hold-down clamp with the studs. Place the clamp on the batteries, and use retaining nuts to secure it. See Figure 1 on page 8.

(g) Use the insulated jumper to connect the remaining (–) negative terminal (black) on one battery to the remaining (+) positive terminal (red) on the other.

Figure 2. The 6801M Switch Operator faceplate (shown for the 6801M Switch Operator with the IntelliTeam SG software option).

STEP 5. Test the faceplate functions. At this point, test most of the faceplate LEDs and buttons. See Figure 2. Reinstall the ac line fuse, and then turn on the 24-Volt circuit breaker. To test the LEDs and switches:

(a) Check that the PROCESSOR STATUS LED on the faceplate is blinking. If it is not blinking, see S&C Instruction Sheet 1045M-550, 6801M Automatic Switch Operators: *Troubleshooting.*"

(b) Press the TEST LAMPS button and check that all the faceplate LEDs blink.

(c) Press the TEST BATTERY button. The BATTERY LOW LED will begin blinking when the button is released. It will blink for approximately one minute. When the LED stops blinking, if the battery system is good and the batteries are at least 30%-40% charged. If it does not go off, see S&C Instruction Sheet 1045M-550, "Automatic Switch Operators: *Troubleshooting.*"

(d) Check that the LCD screen is backlit and data are displayed. Then, press the PREV, NEXT, +, and – buttons to make sure the display will scroll in all four directions.

(e) Check that the SCADA CONTROL switch on the faceplate is set to **Local** mode. The LOCAL LED should be on.

(f) Press the Automatic Operation CHANGE button and check that the ENABLED or DISABLED LEDs are on.

(g) If the **Features Enabled** setpoint on the *Setup>Automatic Operation* screen is set to the **None** state, the DISABLED LED remains on and the ENABLED LED display remains off when pressing the CHANGE button. See S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*," for details.

(h) When finished checking the faceplate operation, leave the SCADA CONTROL button in the **Local** state and leave the AUTOMATIC OPERATION button in the **Disabled** state.

⚠ WARNING

The AUTOMATIC OPERATION and REMOTE/LOCAL buttons must be set to the **Disabled** and **Local** states to avoid unexpected operation of the switch during installation or setup operations. Unexpected operation could cause injury.

NOTICE

If the **Features Enabled** setpoint on the *Setup>Automatic Operation* screen is set to the **None** state, pushing the ENABLE/DISABLE button has no effect. See S&C Instruction Sheet 1045M-530, "Automatic Switch Operators: *Setup,*" for details.

STEP 6. Prepare the computer and load the software if performing switch operator setup, troubleshooting, or hardware diagnostics. To make the switch operator fully operational, use the setup software to enter information into the switch operator. The setup software can also diagnose certain types of switch operator hardware problems.

Review the "Computer Requirements" section in S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*," for details, and install the latest software on the computer.

STEP 7. Locate all tools needed for installing the switch operator and connecting it to the overhead switch. See the "Installation" section on page 12 and the "Installing the Switch Operator and Connecting the Wiring" section on page 31.

STEP 8. If necessary, use IntelliLink® Setup Software to select setpoint values for this installation. See S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*," for details.

STEP 9. When testing is complete, turn the dc circuit breaker off. If the dc breaker is not turned off, the batteries will discharge during storage.

Installation

For new switch installations, follow all manufacturer-recommended instructions when installing the overhead switch. The following installation instructions are intended to ensure optimal S&C 6801M Automatic Switch Operator performance.

STEP 1. Read and fully understand the following warning before beginning installation or operation of this equipment.

WARNING

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

This switch operator uses two 12-Vdc batteries that are capable of short-circuit currents exceeding 2,000 amps. Electrical fires and physical harm can be caused by allowing the terminals of the batteries to be shorted. Handle the batteries with care and be sure to fasten the batteries securely to the enclosure during installation. Use insulated tools to tighten/loosen the battery connections, and turn off the 24-volt circuit breaker before installing or removing the batteries.

The 6801M Switch Operator is capable of generating tremendous torque and speed. Make sure the 24-Vdc circuit breaker is off before putting hands or other body parts near the actuator shaft. Be sure the switch operator is completely de-coupled from the switch and stand clear before executing the hardware diagnostics.

Never attempt to run the switch operator diagnostics with the operator coupled to a switch. The diagnostics will not run properly, and the switch will open and close repeatedly and could interrupt service to customers.

The sequence of installation steps outlined in this chapter must be followed to ensure a safe and successful switch operator installation.

STEP 2. For retrofit installations, de-energize or jumper the switch while installing the switch operator.

STEP 3. Remove the existing manual SWITCH OPERATOR handle from the pole. Move the switch to the **Open** position before removing the manual control handle. Leave the existing vertical switch operator rod in place.

STEP 4. Make sure the vertical operating pipe that connects the operator to the switch is straight when it is being guided down the pole.

The switch manufacturer supplies bearings for support, universal joints for minor out-of-alignment conditions in the vertical operating pipe, and straight couplings to join two pieces of vertical operating pipe that are in line with no angular misalignment, and it is best if this pipe is fairly straight when mounted on the pole. For Alduti-Rupter Switches, cut pipe lengths so there is about ¼-inch (6-mm) gap between end of the pipe and corresponding surface in any coupling or universal joints (refer to Figure 3 on page 15 and Figure 4 on page 16). This prevents any jamming that might result from pipe lengths that are too long. This ¼-inch (6-mm) gap applies to all joints in the vertical operating pipe. The pictures show examples of where this gap is on all joint types. These include universal joints and straight couplings. The joint shown is a universal joint. Parts may not be exactly as shown. For Omni-Rupter Switches, provide ¼-inch (6-mm) gap at the bottom of the bottom section only.

STEP 5. Use piercing set screws or ribbed-neck bolts for all pipe couplings and universal joints for connecting components.

⚠ CAUTION

Failure to properly install pipe couplings with piercing set screws can cause slippage of the operating pipe, resulting in improper operation of the switch, arcing, equipment damage, or electrical shock.

To properly install piercing set screws:

(a) Back the piercing set screw out of the coupling so the tip does not protrude into the space for the pipe.

(b) Insert the operating pipe section into the coupling and finger-tighten the clamp bolt(s).

(c) Adjust the operating pipe to the correct length, and then tighten the clamp bolt(s) to final tightness.

(d) Tighten the piercing set screw, piercing the pipe, and continue turning until a firm resistance is felt.

(e) Make sure the clamp bolt(s) are tight.

S&C supplies piercing set screws (see Figure 5 on page 16) and/or ribbed-neck bolts with all the vertical operating pipe couplings and universal joints. They pierce into the vertical operating pipe and keep the pipe from rotating in the various couplings. It is very important to check all piercing set screws. If not properly pierced, the vertical operating pipe will rotate in the couplings. Always make sure to tighten the clamp portion of the joint before piercing the set screw. This makes sure the screw pierces the pipe instead of collapsing the pipe. The piercing screws will be observed to pierce the pipe when the effort to screw them in reduces. When pierced, finish tightening the screw. If there is a gap between the head of the screw and coupling (see Figure 6 on page 17), that is permissible, as long as the screw pierces the pipe.

Note: Leave the piercing set screw that connects the operator output shaft universal coupling to the vertical operating pipe (see Figure 5 on page 16) for the very last screw to pierce the pipe, but do not pierce until Step 8 on page 24.

Make sure the operator is rigidly fastened to pole. A loosely mounted operator can manifest itself as control errors, just like piercing screws that were not pierced. In both these cases, there is nothing wrong with operator, but the customer would see operator errors if one of these conditions exists. The switch should be in the fully **Open** or **Closed** position before piercing the pipe (most likely open, but either is fine). This becomes important when positioning the operator in Step 5 on page 23, so the operator has the full amount of available room to operate. Figure 5 on page 16 shows several example locations of these piercing set screws. Parts may not look exactly like those shown.

The clamp that holds the universal joint to the pipe (see Figure 8 on page 18) must be tightened around the first section of vertical operating pipe (but don't pierce the set screw) so the switch can be operated with the manual handle supplied with the operator. This is necessary for Step 7 on page 23.

STEP 6. Mount the switch operator on the pole at the proper height and alignment.

The switch operator must be mounted immediately underneath the vertical control rod, with the control rod directly above the shaft on the top of the switch operator. The control rod must be close to the switch operator shaft (⅛-inch (3 mm) to ⅜-inch (10 mm) is the preferred distance), but direct contact is not permitted. The vertical position of the switch operator on the pole must be adjusted to allow for this requirement. If necessary, the switch operator rod can be cut shorter or an optional extension joint can be fitted. Manual control of the switch will still be possible by using the manual control lever stored inside the switch operator.

It is essential to mount the switch operator in a manner that will resist loosening as the mounting surface ages and as the installation vibrates due to wind. S&C recommends the use of double-coil lockwashers when mounting the operator to a wood pole. The mounting instructions below are only recommendations to be used along with locally accepted practices. If the switch operator is not pole-mounted, procedure details may vary.

Mount the switch operator (see Figure 9 on page 18) to the pole (see Figure 10 on page 19) with ⅝-inch or ¾-inch through-bolts and flat washers as follows:

(a) Install the top bolt.

(b) Use the lifting hole on the mounting channel and the appropriate lifting gear to hoist the switch operator into position on the pole.

(c) Hang the switch operator on the top bolt.

(d) Install the bottom bolt and vertically align the switch operator on the pole.

(e) Tighten the two bolts.

STEP 7. Using the construction detail approved by your utility, complete the assembly of the mechanical coupling of the switch operator to the switch operator rod.

Figure 3. The universal joint showing the 1/4-inch (6-mm) gap for the bottom pipe.

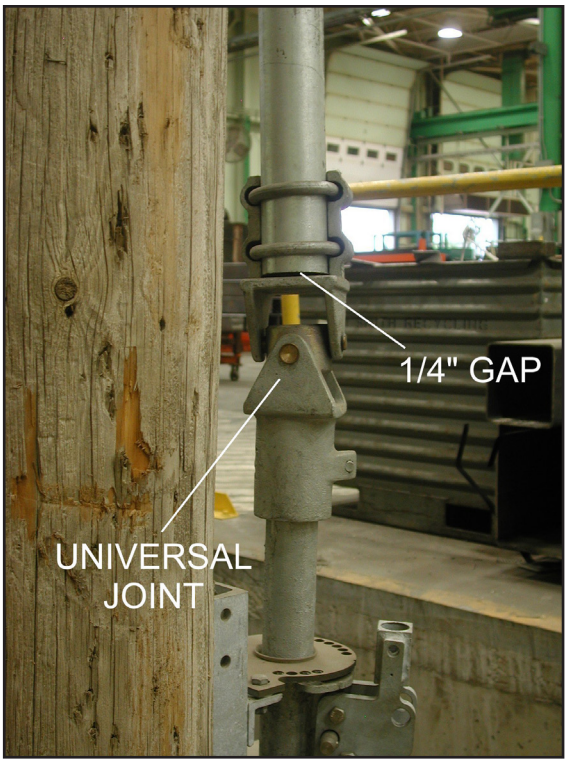


Figure 4. The universal joint showing the ¼-inch (6-mm) gap for the top pipe.

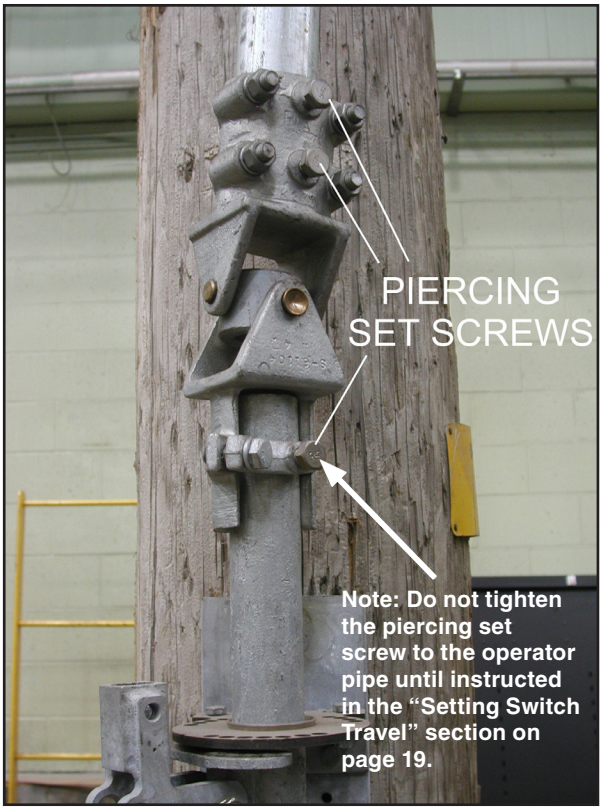


Figure 5. The location of the piercing set screws on the universal joint.

Figure 6. The fully pierced set screw does not need to be flush with the bracket.

Figure 7. The piercing set screw for the switch operator output shaft is the last to tighten.

Figure 8. The universal joint clamp at the first section of pipe.

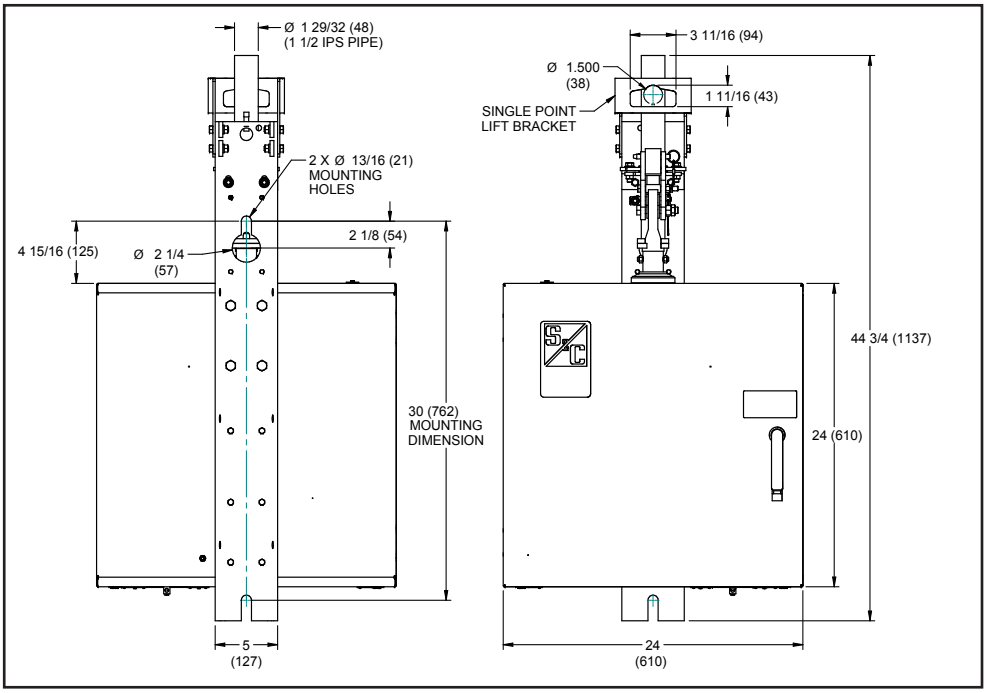


Figure 9. The rear and front view of the rotating switch operator enclosure, dimensions are inches (mm).

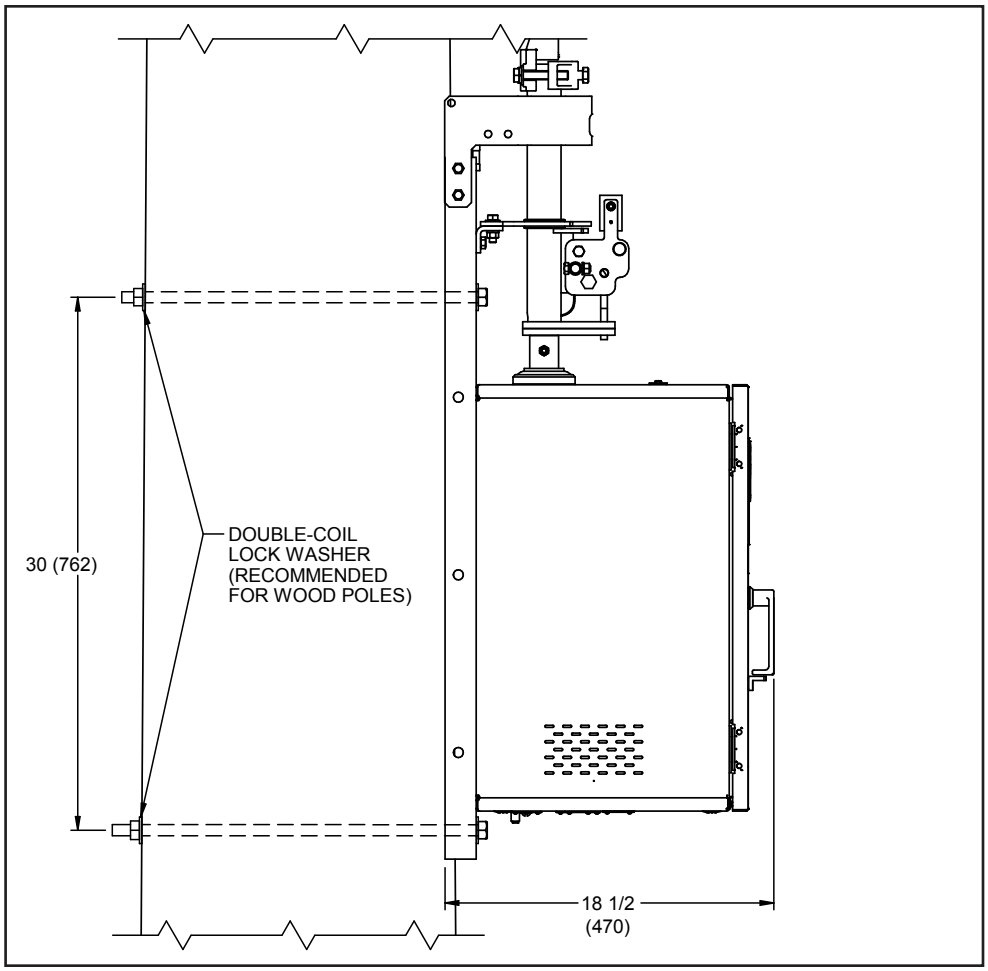


Figure 10. The side view of the rotating switch operator enclosure on pole, dimensions are inches (mm).

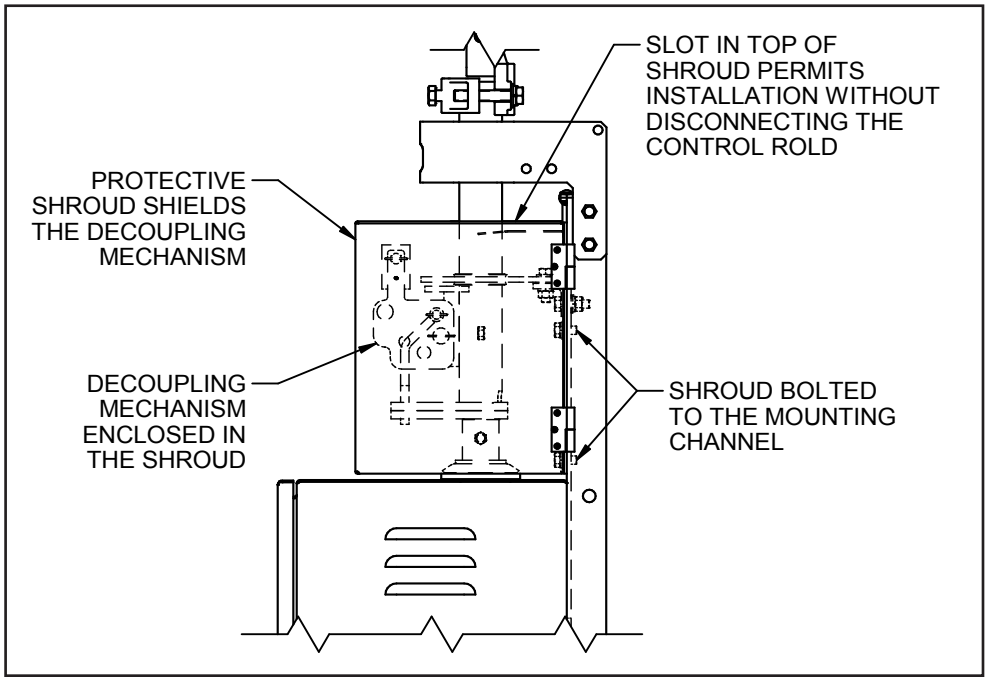


Figure 11. The side view of optional protective shroud on rotating switch operator.

NOTICE

The switch operator is designed to minimize problems caused by minor variation in operator-switch geometry due to age and environmental effects. However, if it is not securely fastened to the pole, excessive movement of the switch operator can result in incomplete switch operation and potentially serious damage to the switch mechanism.

Periodic inspection and maintenance of switch operator mountings and control linkages is essential for identifying problems.

STEP 8. Ground the enclosure. Use the ground lug that is located on the bottom of the switch operator enclosure (see Figure 12) to ground the enclosure. The ground lug will accommodate up to #2 copper or aluminum, solid or stranded wire.

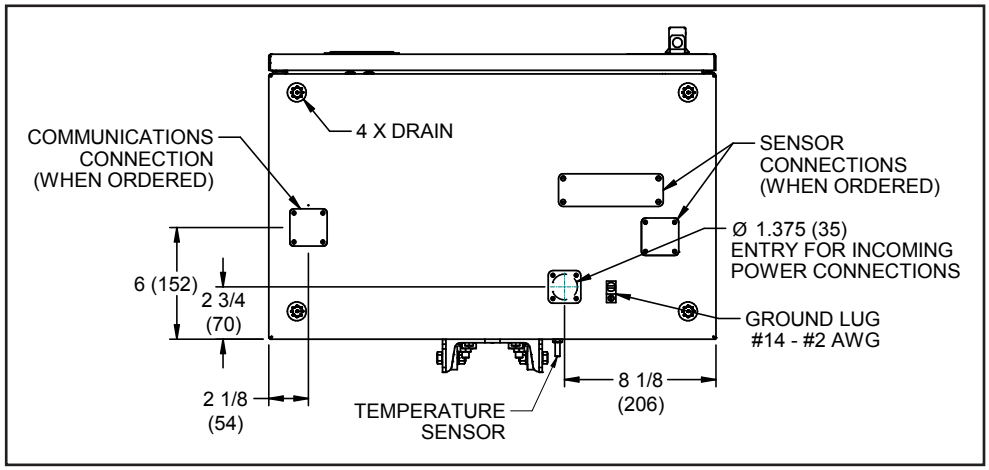


Figure 12. The bottom view of switch operator showing the ground lug, dimensions are inches (mm).

NOTICE

Proper operation of the switch requires that all of the blades move in unison and that all blades contact their mating surfaces simultaneously during operation. Failure to make proper contact can result in switch failure.

STEP 9. The switch operator may contain communications equipment (radio, modem, etc.). Toggle the faceplate REMOTE/LOCAL switch to **Local** state to ensure the switch operator does not carry out remote switching commands. Remote switching must be disabled until after the software is set up for this switch operator installation.

STEP 10. Remove the ac line fuse and make sure the dc breaker is off. Inside the switch operator enclosure, remove the 10-A ac line fuse and make sure the 24-Vdc breaker is off.

⚠ WARNING

Leave the 10-A ac line fuse out and the dc breaker off until instructed otherwise in the installation process. Unexpected operation could cause serious injury.

STEP 11. If necessary, adjust the tap position on the spiral-wound load resistor. See the "Adjusting the Tap Position on the Load Resistor" section on page 29 for details.

STEP 12. Bring ac power to the switch operator.

(a) Locate the conduit hole that accepts a 1-inch (25-mm) conduit adapter on the bottom of the floor of the switch operator enclosure. See Figure 12.

(b) Using conduit, bring an appropriate, de-energized 120-Vac power line to the switch operator enclosure.

STEP 13. Connect the ac power line to the switch operator. Verify the neutral and connect it to the neutral lug (see Figure 1 on page 8) and then connect the line to the source side (bottom) of the 10-A ac line fuse holder.

⚠ CAUTION

The switch operator must be properly grounded. In addition to the typical reasons for properly grounding electrical equipment, the electrical surge suppression and power supply systems contain transient filtering that discharges to ground.

Users must read and understand all applicable grounding codes and requirements for your service area before installing this device.

Adding Ac Power

Follow these steps to add ac power:

STEP 1. Energize the ac power line into the switch operator enclosure.

STEP 2. Insert the ac line fuse and turn on the dc breaker.

STEP 3. Check the AC ON, BAT ON, and CHG ON LEDs on the Battery Charger/Control I/O board.

When inserting the 10-A ac line fuse, the red AC ON LED should illuminate. When turning on the dc breaker, the BAT ON and CHG ON LEDs should illuminate. (The Battery Charger/Control I/O board is on the left side of the enclosure.)

If any of these LEDs do not illuminate, see Instruction Sheet 1045M-550, "S&C 6801M Automatic Switch Operators: *Troubleshooting*."

Setting Switch Travel

⚠ DANGER

The following procedure requires that the switch be fully bypassed or de-energized. Operating an energized switch that is not bypassed will result in serious personal injury or death, as well as damage to the switch.

Follow these steps to set the switch travel distance:

STEP 1. The switch operator, switch, and operating pipe must already be installed on the pole.

(a) The clamp on the universal joint should be tightened.

(b) The lower piercing screw should be loose. Loosen it if it's tight; it will be tightened later in the procedure. See Figure 7 on page 17.

STEP 2. Decouple the operator from the switch so the switch can be operated by the manual handle.

(a) Open the enclosure door.

(b) Remove the manual handle from the faceplate.

(c) When the handle is removed, the NOT READY LED will be lit continuously to indicate operation is disabled.

(d) Close the enclosure door.

(e) Remove the handle pin from the decoupling mechanism. See Figure 13 on page 24.

(f) Insert the handle in the mechanism with the bend down.

(g) Re-insert the handle pin.

(h) Remove the coupling pin from the decoupling mechanism.

(i) Pull down on the manual handle so it is perpendicular to the drive pipe.

(j) Pull the lock wedge out of the coupling slot.

(k) Put the decoupler pin in the lower set of holes, behind the wedge. This holds the wedge in the raised position to ensure it will not jam the mechanism during manual operation.

STEP 3. Use the manual handle to place the switch in the **Closed** position. Note the direction of rotation.

A rotating switch operator is factory set to operate clockwise from closed to open as viewed from above. Operation can be configured to operate counterclockwise when the switch requires it. Use the **Closed Direction** setpoint on the *Setup>General>Switch Operator* screen to configure operator rotation.

STEP 4. Loosen the clamp on the universal joint that holds the decoupling pipe, so the pipe rotates freely in the universal joint.

STEP 5. Use the manual handle to move the decoupling pipe until one of the padlock holes in the locking plate lines up with the padlock hole on the decoupling pipe. The ideal position for the handle is approximately 45 degrees from the center of the enclosure front. See Figure 14 on page 24.

STEP 6. Tighten the clamp on the universal joint that holds the decoupling pipe. See Figure 5 on page 16.

STEP 7. Check the handle operation position by swinging the handle 90 degrees clockwise and 90 degrees counterclockwise to open and close the switch. If the decoupling mechanism hits either side of the back plate, the universal joint must be readjusted so the 90-degree swing centers on the front side of the switch operator.

STEP 8. Tighten the lower piercing bolt on the universal joint into the decoupling pipe.

STEP 9. Remove the handle and replace the handle pin in the handle bracket.

STEP 10. Leave the operator decoupled from the switch.

STEP 11. Open the enclosure door and store the manual handle on the faceplate. The NOT READY LED will extinguish.

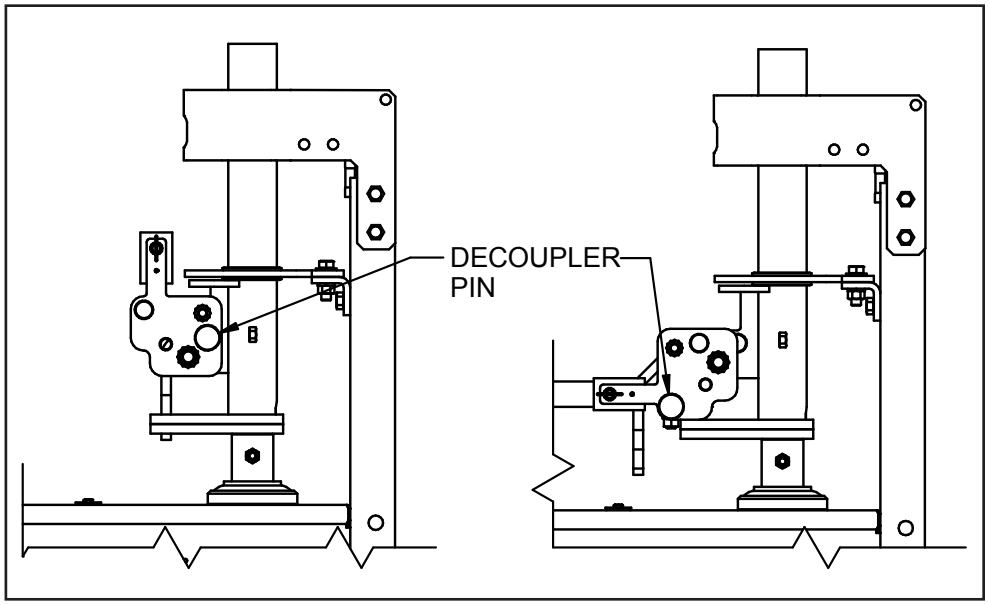


Figure 13. The rotational operator decoupling mechanism.

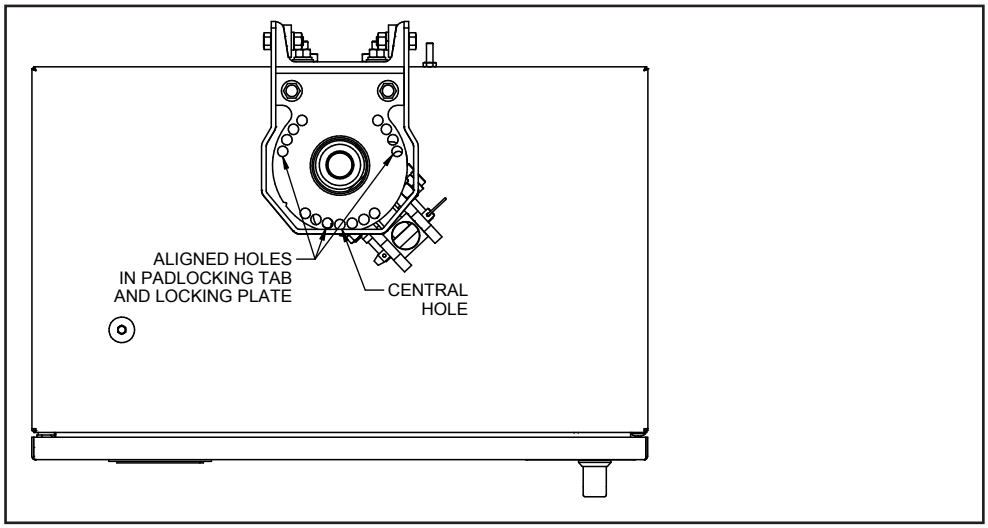


Figure 14. Align the holes for padlocking (top view, rotating operator).

Setting Travel Limits

If the travel limits have not been set, the CLOSED LED will blink. Follow these steps to set the travel limits:

STEP 1. The switch should be in the **Closed** position. If it is not closed, decouple the switch operator from the switch (see Step 2 in the "Setting Switch Travel" section on page 22), and manually close he switch. Visually confirm all blades are fully seated on the close stops and all contacts are fully engaged. Then, recouple the switch operator and switch.

NOTICE

Several conditions can prevent the actuator shaft from being operated from the faceplate. Be sure that all of the following are true:

- The REMOTE/LOCAL switch is in **Local** state.
- The manual handle is stowed in its mounting bracket on the faceplate. This is a safety feature of the switch operator.
- The BATTERY LOW LED display is off. **Note:** Whenever the switch operator is running on ac power with the dc circuit breaker open/tripped, the BATTERY LOW LED will be on. This condition must be cleared before any movement of the actuator shaft is possible. To clear the condition, reset the circuit breaker, make sure the batteries are connected, and execute a battery test cycle by pressing the TEST BATTERY switch on the faceplate. When the LED turns off, operation is enabled.

If all of these are true and the actuator still will not move in low-speed **Align** mode, error diagnostic conditions may be present. Use a computer to examine other possible conditions on the *Diagnostics>Alarms*, *Diagnostics>Warnings*, and *Diagnostics>Errors* screens. Internal errors can be cleared from the appropriate *Diagnostics* screen.

STEP 2. Press the ALIGN button on the faceplate. The NOT READY LED will blink slowly to indicate **Align** mode. The LCD screen will show **Align Mode** on the top line, and "Press the CLOSE or OPEN button to jog the switch position" on the bottom line. This enables slow operation to jog the operator each time an OPEN or CLOSE button is pressed.

STEP 3. Press the CLOSE or OPEN button to jog the operator slot so it aligns with the switch decoupling slot.

STEP 4. Remove the decoupling pin.

STEP 5. Push the coupling wedge forward and push the handle bracket up to lock the wedge in the slots. If it is difficult to seat the coupling wedge, it may be necessary to use the manual handle to align the two slots.

STEP 6. Insert the decoupling pin to lock the wedge.

STEP 7. If the manual handle was used, return it to the faceplate.

STEP 8. Press the ALIGN button on the faceplate to take the switch operator out of **Align** mode.

STEP 9. Press the SET LIMITS button on the faceplate to enter the **Set Limits** mode. The LCD screen will show **Set Limits Mode** on the top line and "Press the CLOSE or OPEN button to jog switch position" on the bottom line.

STEP 10. Press the CLOSE button and the switch will be closed under tension. The CLOSE LED will change from blinking to lit, indicating the close limit is set.

STEP 11. Press the SET LIMITS button to take the operator out of the **Set Limits** mode.

STEP 12. Press the ALIGN button to enter the **Align** mode.

STEP 13. Press the OPEN button many times until the switch is in the fully **Open** position.

STEP 14. Press the ALIGN button to take the operator out of the **Align** mode.

STEP 15. Press the SET LIMITS button to enter the **Set Limits** mode.

STEP 16. Press the OPEN button and the switch will be opened under tension. The OPEN LED will change from blinking to lit, indicating the open limit is set.

STEP 17. Press the SET LIMITS button to take the operator out of the **Set Limits** mode. The NOT READY LED should not be lit and the switch should be in the **Open** state.

STEP 18. Press the SCADA CONTROL CHANGE button to put the switch operator in the **Local** state.

STEP 19. Press the CLOSE button. The switch will go to the **Closed** position and the red CLOSED LED will illuminate.

STEP 20. Operate the switch several times with the OPEN and CLOSE buttons and observe switch operation to make sure it fully opens and closes each time.

NOTICE

Any Inspection Required flag from a previous operation will prevent normal fast operations and cause the NOT READY LED to turn on. To clear the flag, briefly toggle the ENABLE/DISABLE switch.

If the ERROR DETECTED or NOT READY LED is still on or if the CLOSE/OPEN LEDs do not operate as described, see Instruction Sheet 1045M-550, "S&C 6801M Automatic Switch Operators: *Troubleshooting*."

Testing Switch Operation

Follow these steps to test switch operation:

STEP 1. Make sure the REMOTE/LOCAL switch is set to the **Local** state and the AUTOMATIC OPERATION switch is set to the **Disabled** state.

STEP 2. Following your company's operating procedures, use the CLOSE or OPEN button on the faceplate to manually operate the switch. Verify visually that the switch can be both opened and closed and ensure there is no binding or mechanical resistance. Verify the switch operator faceplate LED correctly indicates when the switch is open and closed.

STEP 3. While the switch is open, check that the gap is big enough to avoid flashover. See Table 1 for the ANSI standard C37.32-1990 recommendations.

STEP 4. While the switch is closed, check to make sure the switch contacts are completely engaged. Verify the blades on all phases are against the closed position stop. This ensures connection with an auxiliary shunt contact is not made. (When connected, the interrupter would be in a parallel-current path with the blade and jaw contacts, which is not acceptable.) If the switch contacts are not completely closed, repeat the **Set Limits** procedure. If this does not correct the problem, adjust the tap position on the load resistor to increase the closing force. See the "Adjusting the Tap Position on the Load Resistor" section on page 29.

STEP 5. Repeat until satisfied that the switch is opening and closing properly.

Table 1. Open Gap Distances, ANSI Standard C37.32—1990

Switch Rated Voltage (kV, max.)	BIL Rating (kV)	Recommended Open Gap, in inches (mm)	Flash Over Distance, in inches (mm)
8.3	95	7 (178)	6 (152)
15.5	110	10 (254)	7 (178)
25.8	150	12 (305)	10 (254)
38.0	200	18 (457)	13 (330)
48.3	250	22 (559)	17 (432)
72.5	350	32 (813)	25 (635)

NOTICE

The switch operator is capable of generating tremendous torque. It is essential to install the switch operator rod and linkages with couplings that will not slip under very high torque conditions. The connections should be made with through-hole bolts or straight couplings with piercing set screws. If using straight couplers, pay careful attention to ensure the set screws fully pierce the metal pipe to prevent slippage under load. Avoid overtightening the screws.

The switch operator is capable of stand-alone automatic operation, such as voltage loss-line sectionalizing, as well as remote operation via SCADA. Before coupling or decoupling the switch from the switch operator, or attempting any manual operation with the mechanical operating handle, always:

- Remove the manual operating handle, supplied with the switch operator, from its storage location on the faceplate.
- Set the REMOTE/LOCAL switch to the **Local** state.
- Make sure that the AUTOMATIC OPERATION LED indicates **Disabled** state.
- Open the dc circuit breaker behind the faceplate.

Do not attempt to operate the switch attached to a newly installed switch operator until the setup software has been properly configured for the installation or before the limits of operator travel have been set.

Putting the Switch into Local/Non-automatic Service

Remove any temporarily installed bypass switches, and release the switch for local, non-automatic operation from the faceplate.

⚠ CAUTION

To avoid unexpected operation of the switch, be sure to leave the switch operator in the **Local** state (not **Remote** state) and the **Automatic Operation** setting in the **Disabled** state (not **Enabled** state) until the software in the switch operator is configured for this installation.

This completes the rotating switch operator hardware installation. See S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*," for instructions about configuring the switch operator.

Adjusting the Tap Position on the Load Resistor

The factory-set, spiral-wound load resistor is used both as a battery-test load and a current-limiting (torque-limiting) resistor for setting the closed-reference torque. The closed-reference torque is the torque applied to the control rod after the close limit of travel is set. The resistor setting also adjusts the torque applied to the control rod during low-speed jogging of the operator.

Under most circumstances, the factory setting of the load resistor will be adequate. However, on some switches, as the blades are jogged into their **Closed** position at low speed, additional torque may be necessary to overcome mechanical contact resistance.

Although the setup of the switch can be performed by manually swinging the switch blades into their **Closed** position, it is usually desirable for the load resistor to be adjusted so this function can be performed entirely from the faceplate.

NOTICE

Remove the ac line fuse and turn the dc breaker off before adjusting the resistor tap position. The travel limits will also have to be reset after changing the tap position.

Do not adjust the load-tap resistor to a value less than the minimum tap position shown in Table 2 on page 27.

If the **Closed Torque** setpoint is not modified, the torque after a normal **Close** operation equals the reference value. If a higher value is selected for the **Closed Torque** setpoint, the switch operator adjusts the final **Closed** position, based on the overall spring constant, to obtain the desired closed torque.

NOTICE

Adjusting the load resistor only affects low-speed jogging. The mechanical resistance is easily overcome during normal, high-speed operation.

Also, if additional torque on the control rod at the end of a normal, high-speed close operation is desired, select a new value for the **Closed Torque** setpoint on the *Setup>General>Switch Operator* screen rather than adjusting the load resistor.

Table 2 shows the possible resistor settings and the corresponding closed-reference torque values.

Table 2. Load Resistor Closed Reference Torque

Resistor Turns	Closed Reference Torque (ft-lb)
6 (minimum value)	208
7	180
8	158
9 (factory setting)	141
10	128
11	117
12	107
13	99
14	93
15	87
16	81
17	77
18	73
19	69
20	66

Installing the Switch Operator and Connecting the Wiring

The switch operator installation consists of several operations. The following information is specific to the 6801M Reciprocating Switch Operator.

STEP 1. Read, and make sure to understand, the following functional description and safety instructions before beginning to install or operate this equipment. The reciprocating switch operator functions differently from the rotating switch operator because the opening and closing motion is transmitted to the switch as a reciprocating (up and down) movement instead of a rotating movement. To create this reciprocating movement, the switch operator uses an additional mechanical linkage mounted on the back of the switch operator. This linkage may be protected by an optional, lockable enclosure or shroud.

To operate the switch, the reciprocating switch operator first generates a rotating movement using the same type of motor and gear box used in the rotating switch operator. This rotating movement is then transmitted to a rotating output crank on the back of the switch operator. This output crank creates a reciprocating (up and down) movement that is transmitted to a pivoting yoke with a connecting link. The connecting link is clamped to the rod that operates the switch.

When setting up the switch operator, it is extremely important to make the output crank at the bottom of the control rod move in parallel with the switch operating lever connected to the top of the control rod. In other words, when the switch is open, the output crank and the switch operating lever should both be about 45 degrees below horizontal, and when the switch is closed, they should both be approximately 45 degrees above horizontal. When this is true, the control rod will accurately transfer rotational movement from the switch operator up to the switch itself. If the mechanical setup is done in this way, installing the switch operator will be much easier and faster.

Different brands of switches and installations require different positions for the output crank yoke. The principle is that the lever at the top of the control rod should be the same length as the lever at the bottom. This can be adjusted as necessary by connecting the output crank yoke to a suitable bolt hole in the output crank (see Figure 16 on page 35). Six bolt holes are provided at one-inch (25 mm) intervals, from 6 (152 mm) to 11 (279 mm) inches away from the output drive shaft. Note that when the switch is fully open, the output crank and the switch operating lever should both be approximately 45 degrees below horizontal. Closing the switch requires a vertical push on the control rod that is created by a clockwise, as viewed from the front of the switch operator, rotation of the output crank.

The output crank is fastened to the output drive shaft by the decoupler pin. During operation of the switch operator, the decoupler pin must be secured in place with a ⅜-inch shackle padlock or ⅜-inch bolt (see Figure 16 on page 35). By removing this pin, the output crank will be disconnected from the output drive shaft during the installation procedure (steps 8 through 16, on pages 37 through 44). The **Align** (slow-operation) mode of the switch operator permits a final adjustment of the output drive shaft position to ensure that the decoupler shaft pin can be reinstalled when the output crank is in the correct position.

When manual operation of the switch is required, the decoupler pin is removed. The switch is then operated by the manual crank handle, which is temporarily installed over the end of the output crank. Lockout for the switch, under manual operating conditions, is provided by padlock holes in the lockout bracket that match similar holes in the output crank.

⚠ WARNING

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

This switch operator uses two 12-Vdc batteries that are capable of short circuit currents exceeding 2,000 amps. Electrical fires and physical harm can be caused by allowing the terminals of the batteries to be shorted. Handle the batteries with care and be sure to fasten the batteries securely to the enclosure during installation. Use insulated tools to tighten/loosen the battery connections, and turn off the 24-volt circuit breaker before installing or removing the batteries.

The 6801M Switch Operator is capable of generating tremendous torque and speed. Make sure the 24-volt dc circuit breaker is off before putting hands or other body parts near the actuator shaft. Be sure the switch operator is completely decoupled from the switch and stand clear before executing the hardware diagnostics.

Never attempt to run the switch operator diagnostics with the operator coupled to a switch. The diagnostics will not run properly, and the switch will open and close repeatedly and could interrupt service to customers.

The sequence of installation steps outlined in this chapter must be followed to ensure a safe and successful switch-operator installation.

STEP 2. De-energize or jumper the switch while installing the switch operator.

STEP 3. Move the switch to the **Open** position before removing the manual control handle. Remove the existing manual switch operator handle from the pole. Leave the existing vertical switch operator rod in place.

STEP 4. De-energize or jumper the switch while installing the switch operator.

STEP 5. Move the switch to the **Open** position before removing the manual control handle. Remove the existing manual switch operator handle from the pole. Leave the existing vertical switch operator rod in place.

STEP 6. Mount the switch operator on the pole at the proper height and alignment. The switch operator must be mounted immediately underneath the vertical control rod. The end of the control rod must be approximately 12 inches (305 mm) below the top of the switch operator housing when the switch is in the open position. The vertical position of the switch operator on the pole can be adjusted to allow for this requirement or, if necessary, the switch operator rod can be cut shorter.

It is essential to mount the switch operator in a manner that will resist loosening as the mounting surface ages. The mounting instructions below are only recommendations to be used along with locally-accepted practices.

Mount the switch operator (see Figure 15 on page 34) to the pole with ⅝-inch through-bolts and flat washers as follows:

(a) Before mounting the switch operator, drill two horizontal holes in the pole for the mounting bolts. Each hole should pass through the center line of the pole. Position the upper hole 6 inches (152 mm) below the desired height of the top of the switch operator enclosure. The lower hole must be 12 inches (305 mm) below the upper hole. These holes are for two ⅝-inch diameter steel bolts. When laying out bolt hole positions and drilling the holes, work from the switch operator side of the pole. This ensures the bolt hole spacing at the switch operator will be correct even if the drill bit drifts off center while going through the pole.

NOTICE

S&C reserves the right to change and update its products on an ongoing basis. Please double check all dimensions and hole positions against the actual switch operator being installed before drilling any holes.

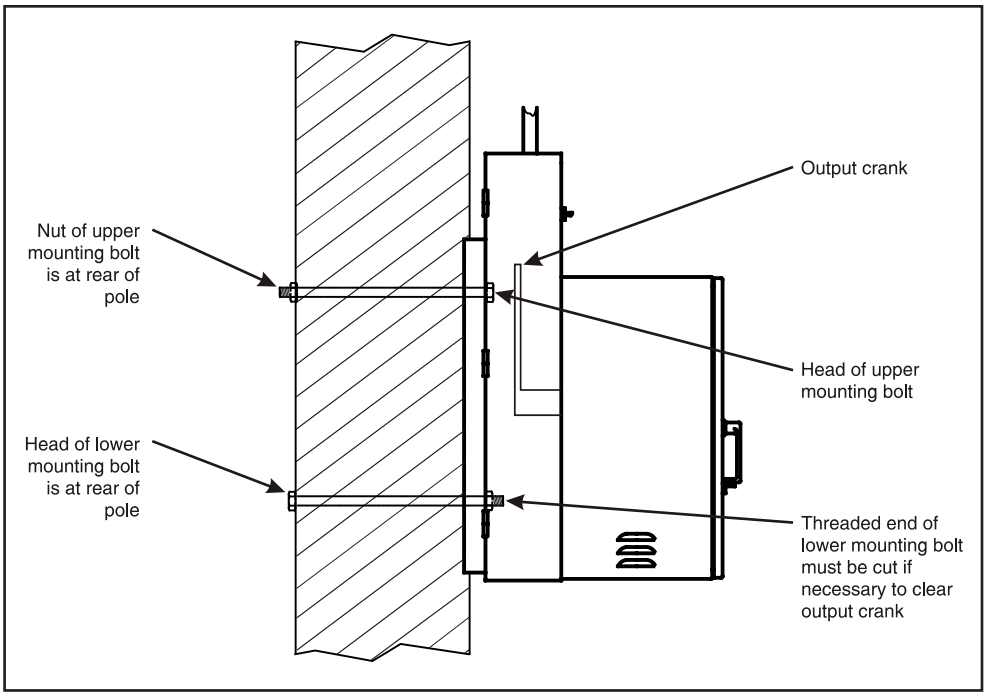


Figure 15. The side view of reciprocating switch operator showing mounting bolts through pole.

(b) The correct length for each ⅝-inch bolt will be the diameter of the pole at the point of insertion plus 3¼ inches (83 mm). Check the pole diameter at the location of each hole and select a bolt of the correct length before beginning the installation.

(c) Insert the top bolt from the operator side of the pole with a round washer that fits through the key hole in the operator mounting channel. Start the nut and washer on the top bolt. Insert the bottom bolt from the back side of the pole, but leave the nut off for the time being.

(d) Hoist the reciprocating switch operator into position with a suitable hoisting rig or hydraulic boom. The hole at the top of the mounting channel can be used as a lifting eye. If the optional protective shroud is installed, temporarily lift the shroud doors off their hinge pins and set the doors aside to get better access to the back of the switch operator. Lift and position the switch operator so the head and washer of the top bolt come through the top keyhole in the mounting channel at the rear of the switch operator. Insert the bottom bolt through the mounting channel and start a nut with washer.

(e) When the switch operator is in position, seat the switch operator firmly against the pole by firmly tightening the mounting bolts. DO NOT release hoisting tension, and DO NOT disconnect and remove the hoisting rig or boom, until sure there is a tight, solid installation and both mounting bolts are fully tightened.

NOTICE

After tightening both bolts, check to make sure the end of the bottom bolt does not extend more than 2 inches (51 mm) from the mounting channel. If the bolt sticks out too far, it could interfere with the movement of the output crank arm. If the bolt sticks out farther than 2 inches (51 mm), replace it with a shorter bolt or cut off the excess length. Do not cut off the bolts completely flush with the nuts because this would make it difficult to reinstall the unit if it had to be taken off the pole for any reason.

NOTICE

The switch operator is designed to minimize problems caused by minor variations in operator-switch geometry due to age and environmental effects. However, if it is not securely fastened to the pole, excessive movement of the switch operator can result in incomplete switch operation and potentially serious damage to the switch mechanism.

Periodic inspection and maintenance of switch operator mountings and control linkages is essential for identifying problems and patterns of problems

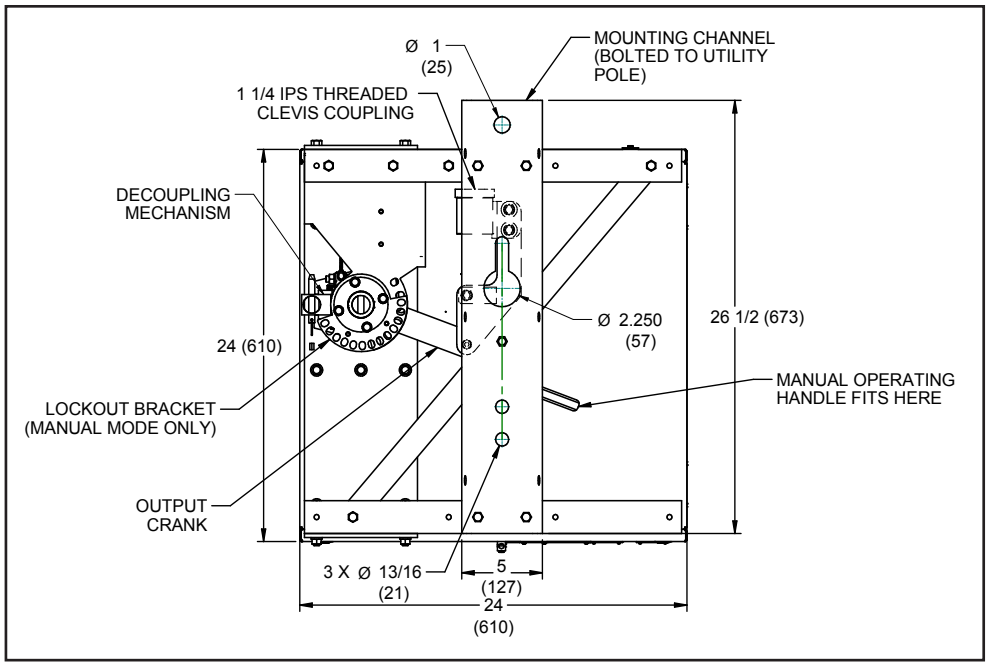


Figure 16. The reciprocating switch output crank mechanism, rear view, dimensions are inches (mm).

STEP 7. Install the operating rod guides. The switch manufacturer's recommendations should be followed for installation and spacing of operating rod guides. If excessive flexing is observed during operational testing of 1-inch (25mm) fiberglass or steel rods, additional and/or smaller diameter guides can be installed. Standard ⅝-inch galvanized eye nuts have been field proven to work well as guides.

STEP 8. Maximizing the fault-close capabilities (if applicable). When the 6801M Switch Operator is applied at circuit locations where fault currents exceed 6-8 kA, S&C recommends that additional steps be taken to maximize the fault close capability of the switch and 6801M Switch Operator.

To obtain the maximum fault-close capability when the switch operator is installed with an S&C Omni-Rupter Switch, using a 1-inch (25 mm) fiberglass or steel operating rod, guides should have a maximum inside diameter of 1½ inches (38 mm). In addition, the lowest and highest guides should be located a maximum of 3 feet (914 mm) from the top of the switch operator and the switch lever arms. All intermediate guides should have a maximum spacing of 4 feet (1219 mm). All operating rod guides should be aligned to minimize drag during operation. The operating rod should be connected to the switch operator output crank in Hole# 5 from the hinge point, next to the outermost hole. The switch operator should also be configured to apply 200 ft-lbs of closing torque on the operating rod. See S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*," for more information.

NOTICE

For information on other manufacturer's switches and specific ratings, please contact S&C Electric Company.

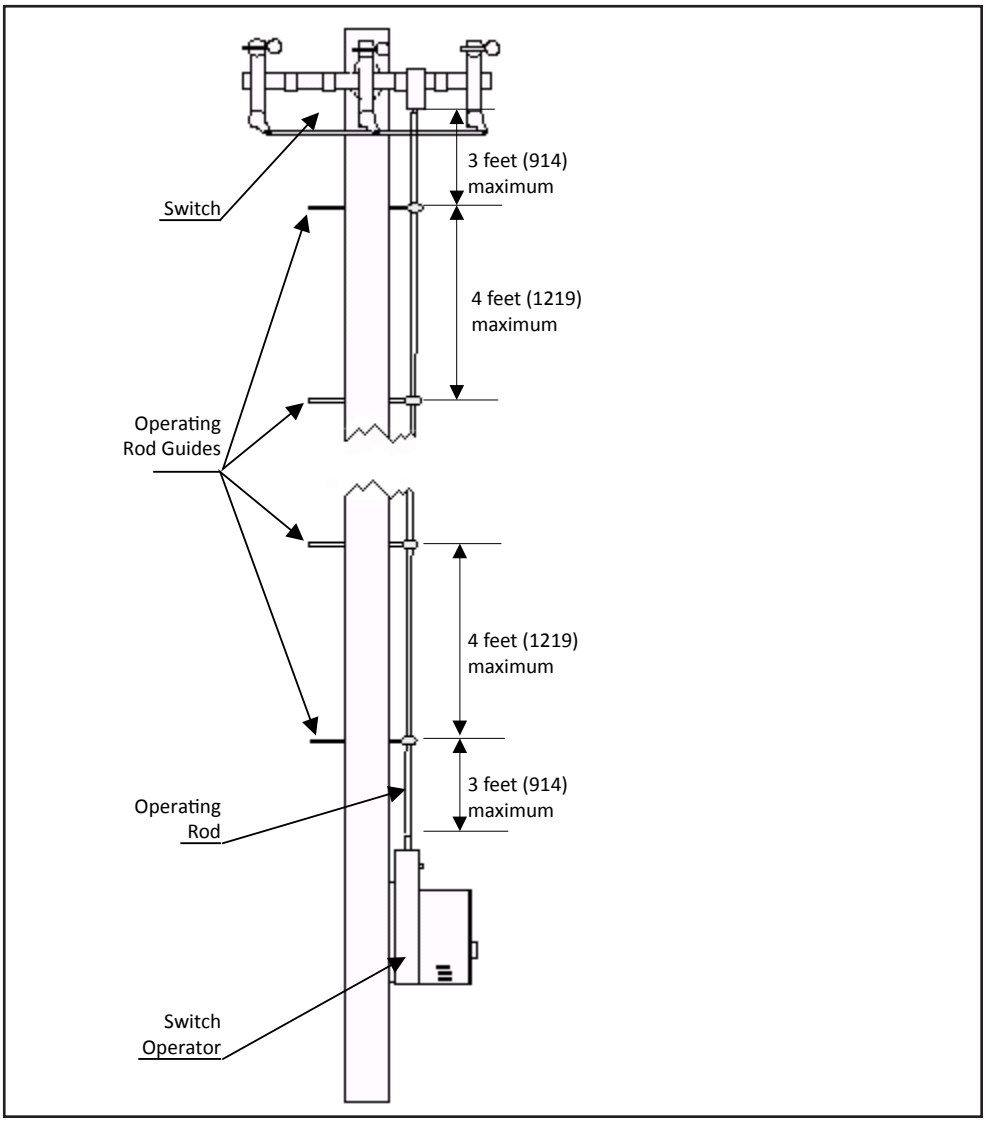


Figure 17. The operating rod guide, maximizing fault close capabilities, dimensions are inches (mm).

STEP 9. Ground the enclosure. Use the ground lug (see Figure 18) located on the bottom of the switch operator enclosure to ground the enclosure. The ground lug will accommodate up to #2 copper or aluminum, solid or stranded wire.

⚠ CAUTION

The switch operator must be properly grounded. In addition to the typical reasons for properly grounding electrical equipment, the electrical surge suppression and power supply systems contain transient filtering circuits that must discharge to ground to function properly. Users must read and understand all applicable grounding codes and requirements for your service area before installing this device.

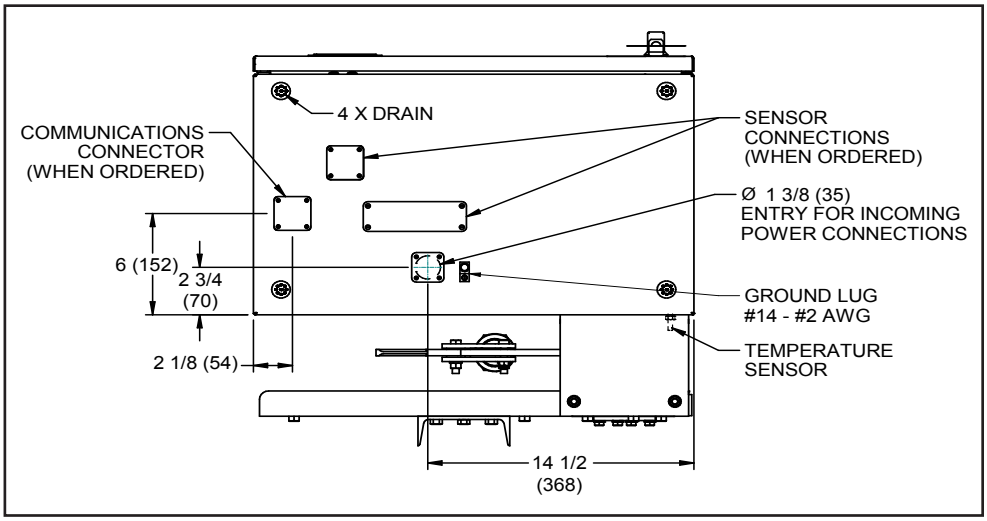


Figure 18. The bottom view of switch operator showing the ground lug, dimensions are inches (mm).

STEP 10. Attach the output crank yoke to the operating rod and the output crank.

(a) Remove the decoupling pin so the output crank can rotate freely. Note that when the decoupling pin is installed, it must be secured by a ⅜-inch bolt or a padlock with a ⅜-inch hasp (see Figure 19). Bolt the bottom end of the output crank yoke to the hole in the output crank suitable for the switch being converted. The distance from the switch operator output drive shaft to the output crank yoke should be about the same as the length of the switch operating lever at the top of the operating rod. The yoke should pivot freely on the output crank.

NOTICE

When the output crank yoke is attached to the hole closest to the end of the output crank, the connecting link must face away from the end of the crank (see Figure 20 on page 40). The opposite is true if the output crank yoke is attached to any other hole on the output crank. This helps to keep the control rod centered and prevents it from hitting the protective shroud. Note also that the control rod can interfere with the movement of the output crank if it sticks out below the connecting link. The rod should be cut off within ¼ inch (6 mm) of the connecting link, but do not do this until the control rod length is definitely determined.

(b) Slide the circular clamp of the connecting link onto the control rod and tighten the clamping bolt with a wrench. The output crank should be in a position 45 to 50 degrees below horizontal with the switch fully open after the bolt is tightened.

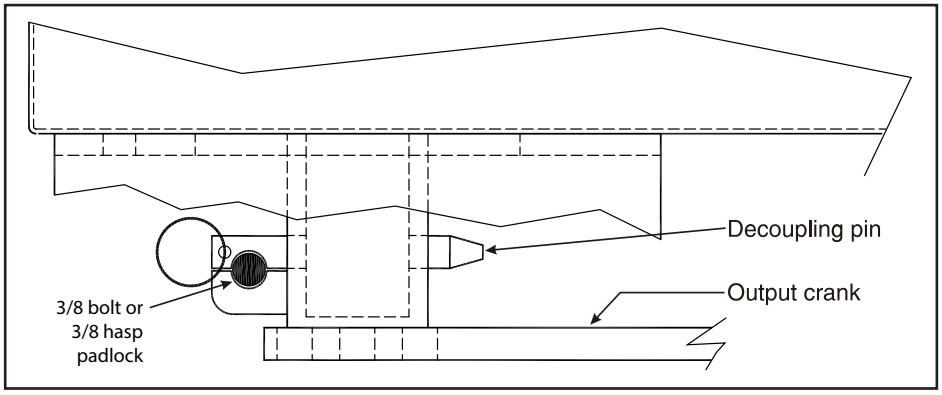


Figure 19. Locking the decoupling pin in position with a ⅜-inch bolt or padlock.

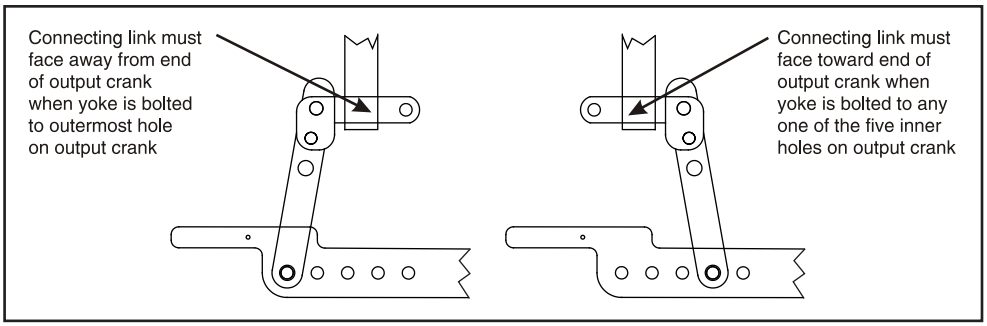


Figure 20. Position linkage as shown to center the operating rod on the pole.

STEP 11. Use the manual handle to close the switch by lifting the crank arm upward.

(a) Open the operating mechanism shroud, if installed (see Figure 21 on page 41). Attach the manual operating handle (see Figure 22 on page 41), and rotate the output crank upward until the switch is firmly closed. This should require an output crank movement of approximately 90 degrees, moving from 45 to 50 degrees below horizontal to approximately 45 degrees above horizontal. The switch operating lever at the top of the control rod should move in parallel with the output crank on the switch operator.

(b) Carefully inspect the switch blades and mating contacts to ensure that all blades are uniformly seated in their mating surfaces. If not, adjust the blades individually according to the switch manufacturer's procedure.

STEP 12. Use the manual handle to reopen the switch. The output crank should now be 45 degrees below horizontal.

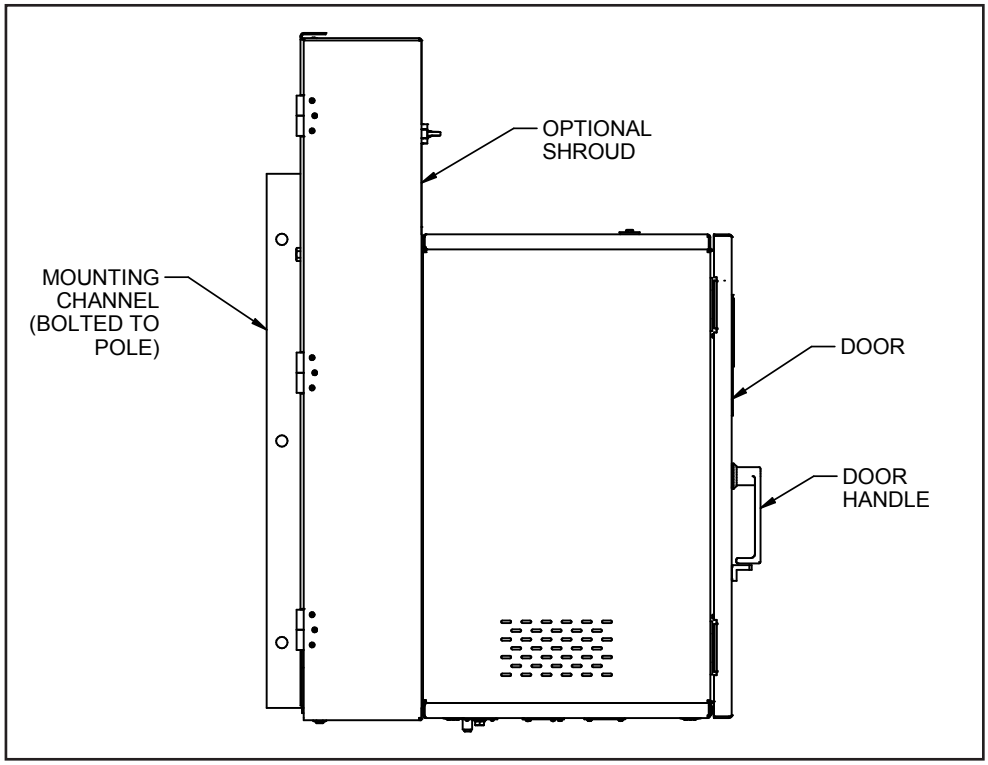


Figure 21. The side view of reciprocating switch operator showing the optional protective shroud at the rear.

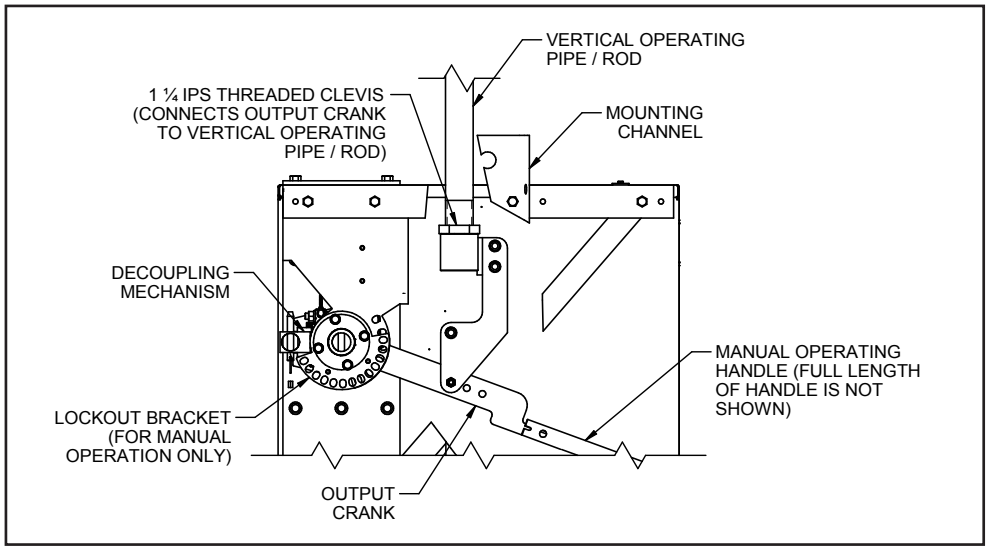


Figure 22. Detail of crank arm assembly viewed from the back of operator.

STEP 13. Cut the switch operator rod to the proper length. After final adjustments have been made to the crank arm linkage, the end of the switch operator rod must not extend below the connecting clamp for a distance greater than ¼-inch (6 mm). If the protruding length of the rod is more than ¼-inch (6 mm) the excess length should be cut off. See Figure 23. If any excess length is left, it will hit the output crank and interfere with the operation of the switch.

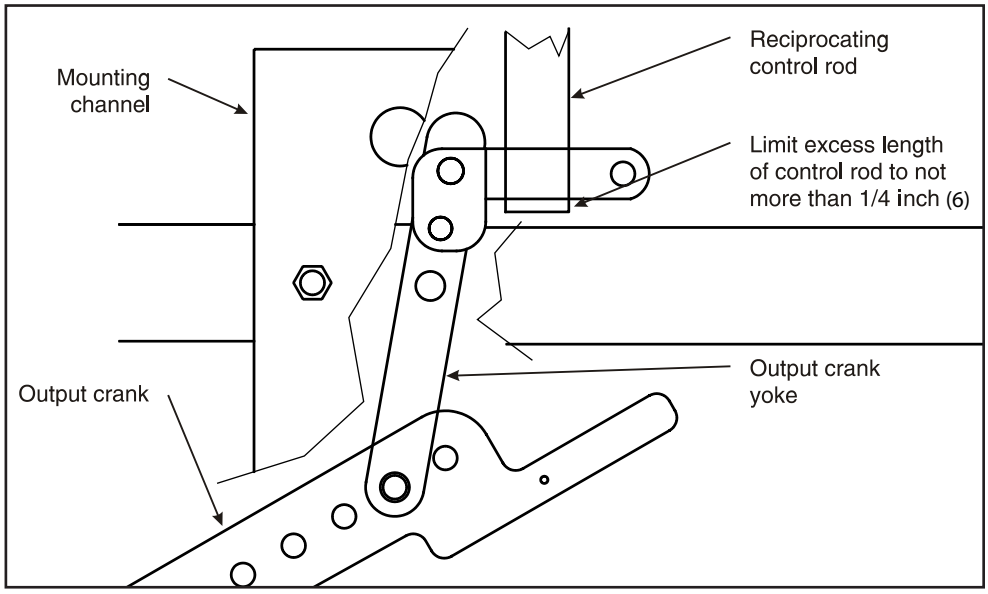


Figure 23. Checking excess length of control rod, viewed from the back of operator, dimensions are inches (mm).

When the switch operator is put in service, the output crank will normally be under considerable tension. This tension will make it impossible to pull out the decoupling pin when necessary to make adjustments or to carry out diagnostic procedures. S&C has provided a convenient way to release the tension on the output crank and permit the easy withdrawal of the decoupling pin without loosening the connecting rod and destroying the accurate adjustment of the switch operator. To release tension on the linkage, remove the indicated bolt on the output crank yoke (see Figure 24 on page 43). When this bolt is removed, the linkage will loosen and the decoupling pin can be removed. To reinstall the decoupling pin, reverse this procedure.

NOTICE

Proper operation of the switch requires that all of the blades move in unison and that all blades contact their mating surfaces simultaneously during operation. Failure to make proper contact can result in switch failure and possible injury or death.

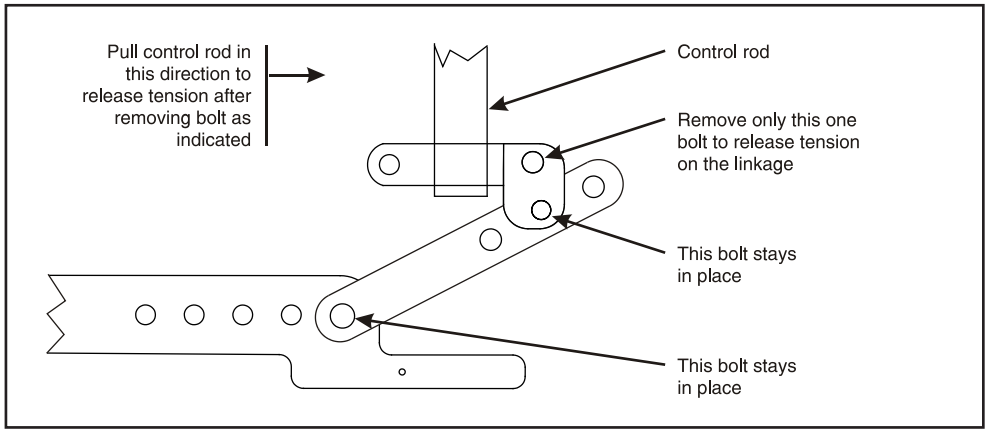


Figure 24. Release tension on output crank yoke to remove the decoupling pin.

STEP 14. The switch operator may contain communications equipment (radio, modem, etc.). Toggle the faceplate REMOTE/LOCAL switch to **Local** state to ensure the switch operator does not carry out remote switching commands. Remote switching must be disabled until after the software is set up for this switch operator installation.

STEP 15. Remove the ac line fuse and make sure the dc breaker is off. Inside the switch operator enclosure, remove the 10-A ac line fuse and make sure the 24-Vdc breaker is off.

⚠ CAUTION

Leave the 10-A ac line fuse out and the dc breaker off until instructed otherwise in the installation process.

STEP 16. If necessary, adjust the tap position on the spiral wound load resistor. See the "Adjusting the Tap Position on the Load Resistor" section on page 29 for details.

STEP 17. Bring ac power to the switch operator.

(a) Locate the conduit hole that accepts a 1-inch (25-mm) conduit adapter on the bottom of the floor of the switch operator enclosure (see Figure 18 on page 38).

(b) Using conduit, bring an appropriate, de-energized 120-Volt power line to the switch operator enclosure.

STEP 18. Connect the ac power line to the switch operator. Verify neutral and connect it to the neutral lug. Then, connect the line to the source side (bottom) of the 10-A ac line fuse holder.

Adding Ac Power

Follow these steps to add ac power:

STEP 1. Energize the ac power line into the switch operator enclosure.

STEP 2. Insert the ac line fuse and turn on the dc breaker.

STEP 3. Check the AC ON, BAT ON, and CHG ON LEDs on the Battery Charger/Control I/O board. When the 10-A ac line fuse is inserted, the red AC ON LED should illuminate. When the dc breaker is turned on, the BAT ON and CHG ON LEDs should illuminate. The Battery Charger/Control I/O board is on the left side of the enclosure.

If any of these LEDs does not illuminate, see Instruction Sheet 1045M-550, "S&C 6801M Automatic Switch Operator: *Troubleshooting.*"

Setting Travel Limits

⚠ DANGER

The following procedure requires that the switch be fully bypassed or de-energized. Operating an energized switch that is not bypassed will result in serious personal injury or death, as well as damage to the switch.

If the travel limits have not been set, the CLOSE LED will blink. Follow these steps to set the travel limits:

STEP 1. The switch should be in the **Closed** position. If it is not closed, decouple the switch and manually close it. Visually confirm all blades are fully seated on the close stops and all contacts are fully engaged. Then, recouple the switch operator and switch.

NOTICE

Several conditions can prevent the actuator shaft from being operated from the faceplate. Be sure all of the following are true:

- The REMOTE/LOCAL switch is in he **Local** state.
- The manual handle is stowed in its mounting bracket on the faceplate. This is a safety feature of the switch operator.
- The BATTERY LOW LED display is off. Note that whenever the switch operator is running on ac power with the dc circuit breaker open/tripped, the BATTERY LOW LED will be on. This condition must be cleared before any movement of the actuator arm is possible. To clear the condition, reset the circuit breaker, make sure the batteries are connected, and execute a battery test cycle by pressing the TEST BATTERY switch on the faceplate. When the LED turns off, operation is enabled.

If all of these are true and the actuator still will not move in low-speed **Align** mode, error diagnostic conditions may be present. Use a computer to examine other possible conditions on the *Diagnostics>Alarms*, *Diagnostics>Warnings*, and *Diagnostics>Errors* screens. Internal errors can be cleared from the appropriate *Diagnostics* screens.

STEP 2. Press the ALIGN button on the faceplate. The NOT READY LED will blink slowly to indicate **Align** mode. The LCD screen will show **Align Mode** on the top line, and "Press the CLOSE or OPEN button to jog the switch position" on the bottom line. This enables slow operation to jog the operator each time an OPEN or CLOSE button is pressed.

STEP 3. Press the CLOSE or OPEN button to jog the operator slot so it aligns with the switch decoupling slot.

STEP 4. Remove the decoupling pin.

STEP 5. Push the coupling wedge forward and push the handle bracket up to lock the wedge in the slots. If it is difficult to seat the coupling wedge, it may be necessary to use the manual handle to align the two slots.

STEP 6. Insert the decoupling pin to lock the wedge.

STEP 7. If the manual handle was used, return it to the faceplate.

STEP 8. Press the ALIGN button on the faceplate to take the switch operator out of **Align** mode.

STEP 9. Press the SET LIMITS button on the faceplate to enter the **Set Limits** mode. The LCD screen will show **Set Limits Mode** on the top line and "Press the CLOSE or OPEN button to jog switch position" on the bottom line.

STEP 10. Press the CLOSE button and the switch will be closed under tension. The CLOSE LED will change from blinking to lit, indicating the close limit is set.

STEP 11. Press the SET LIMITS button to take the operator out of the **Set Limits** mode.

STEP 12. Press the ALIGN button to enter the **Align** mode.

STEP 13. Press the OPEN button many times until the switch is in the fully **Open** position. Leave clearance (⅛-inch (3 mm) to ¼-inch (6 mm)) for over travel between the switch blades and blade stops.

STEP 14. Press the ALIGN button to take the operator out of the **Align** mode.

STEP 15. Press the SET LIMITS button to enter the **Set Limits** mode.

STEP 16. Press the OPEN button and the switch will be opened under tension. The OPEN LED will change from blinking to lit, indicating the open limit is set.

STEP 17. Press the SET LIMITS button to take the operator out of the **Set Limits** mode. The NOT READY LED should not be lit and the switch should be in the **Open** state.

STEP 18. Press the SCADA CONTROL CHANGE button to put the switch operator in the **Local** state.

STEP 19. Press the CLOSE button. The switch will go to the closed position and the red CLOSED LED will illuminate.

STEP 20. Operate the switch several times with the OPEN and CLOSE buttons and observe switch operation to make sure it fully opens and closes each time.

NOTICE

Any Inspection Required flag from a previous operation will prevent normal fast operations and cause the NOT READY LED to illuminate. To clear the flag, briefly push the ENABLE/DISABLE switch.

If the ERROR DETECTED or NOT READY LED is still on or if the CLOSE/OPEN LED does not operate as described, see Instruction Sheet 1045M-550, "S&C 6801M Automatic Switch Operators: *Troubleshooting*."

Testing Switch Operation

Follow these steps to test the switch operation:

STEP 1. Make sure the REMOTE/LOCAL switch is in the **Local** state and the AUTOMATIC OPERATION switch is in the **Disabled** state.

STEP 2. Following your company's operating procedures, use the CLOSE or OPEN button on the faceplate to manually operate the switch. Verify visually the switch can both open and close, and make sure there is no binding or mechanical resistance. Verify that the switch operator faceplate LEDs correctly indicate when the switch is open and closed.

STEP 3. While the switch is open, check that the gap is big enough to avoid flashover. See Table 1 on page 27 for the ANSI standard C37.32-1990 recommendations.

STEP 4. While the switch is closed, check to make sure the switch contacts are completely engaged. If they are not, repeat the **Set Limits** procedure. If this does not correct the problem, adjust the tap position on the load resistor to increase the closing force. See the "Adjusting the Tap Position on the Load Resistor" section on page 29.

STEP 5. Repeat until satisfied the switch is opening and closing properly.

⚠ CAUTION

The switch operator is capable of generating tremendous force. It is essential to install the switch operator rod and linkages with couplings that will not slip under very high force conditions. The connections should be made only with the manufacturer's supplied fittings. The ⅜-inch grade 5 link-clamping bolt should be torqued to a setting of 32 foot-pounds with a properly calibrated torque wrench. Under-tightening the fitting may lead to slippage and improper switch operation. Over-tightening the fittings may cause their failure and a subsequent inability to operate the switch.

The switch operator is capable of stand-alone automatic switch operation, such as voltage loss-line sectionalizing, as well as remote operation via SCADA. Before coupling or decoupling the switch from the switch operator, or attempting any manual operation with the mechanical operating handle, always:

- Remove the manual operating handle, supplied with the switch operator, from its storage location on the faceplate.
- Toggle the REMOTE/LOCAL switch to the **Local** state.
- Make sure the ENABLE/DISABLED LED indicates **Disabled** state.
- Open the dc circuit breaker behind the faceplate.

Do not attempt to operate the switch attached to a newly installed switch operator until the setup software has been properly configured for the installation or before the limits of operator travel have been set.

Putting the Switch Into Local/Non-automatic Service

Remove any temporarily installed bypass, and release the switch for local, nonautomatic operation from the faceplate.

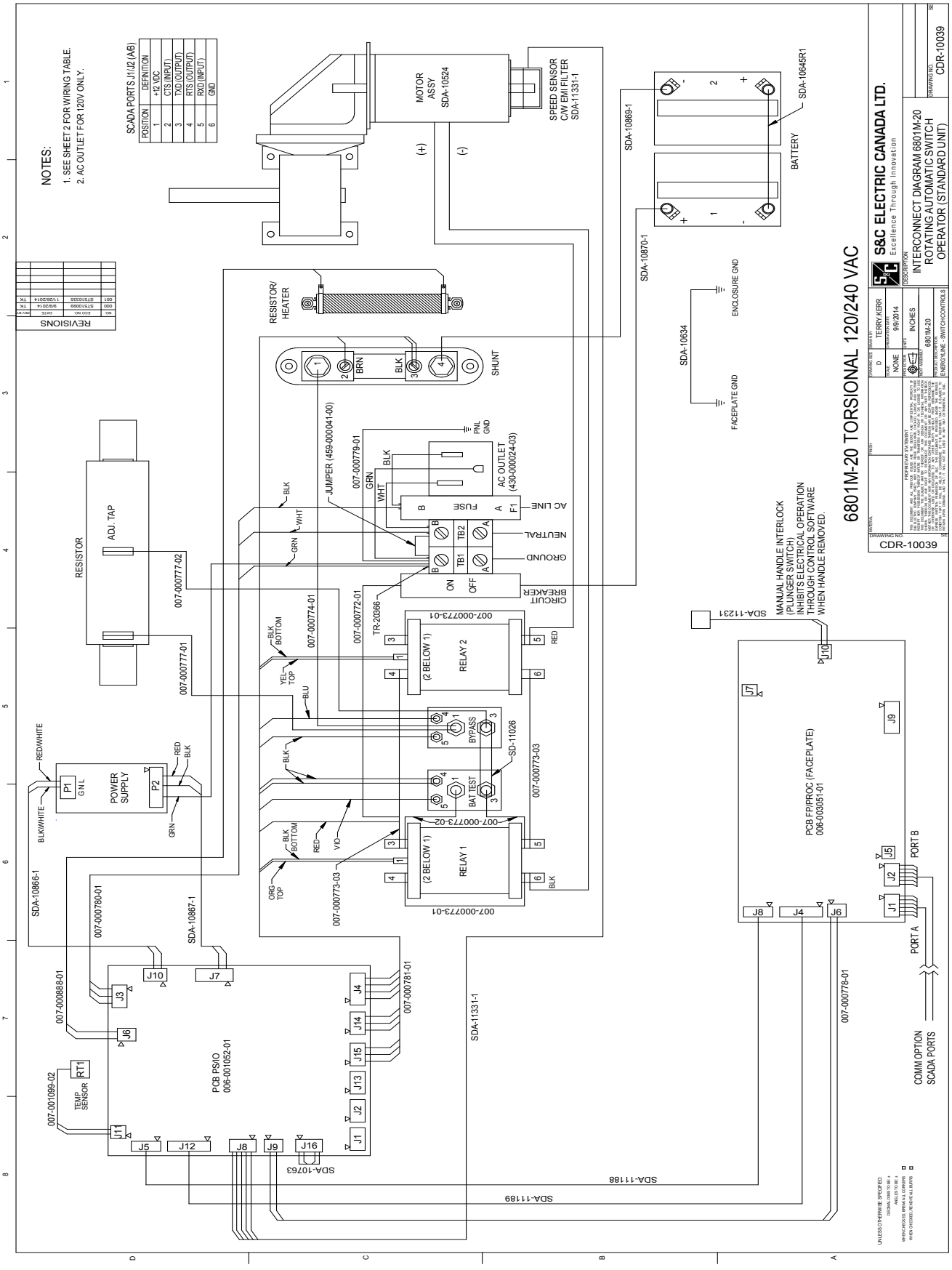
⚠ CAUTION

Be sure to leave the switch operator in **Local** state (not **Remote** state) and AUTOMATIC OPERATION in **Disabled** state (not **Enabled** state) until the software in the switch operator is set up for this installation. Unexpected operation could cause injury.

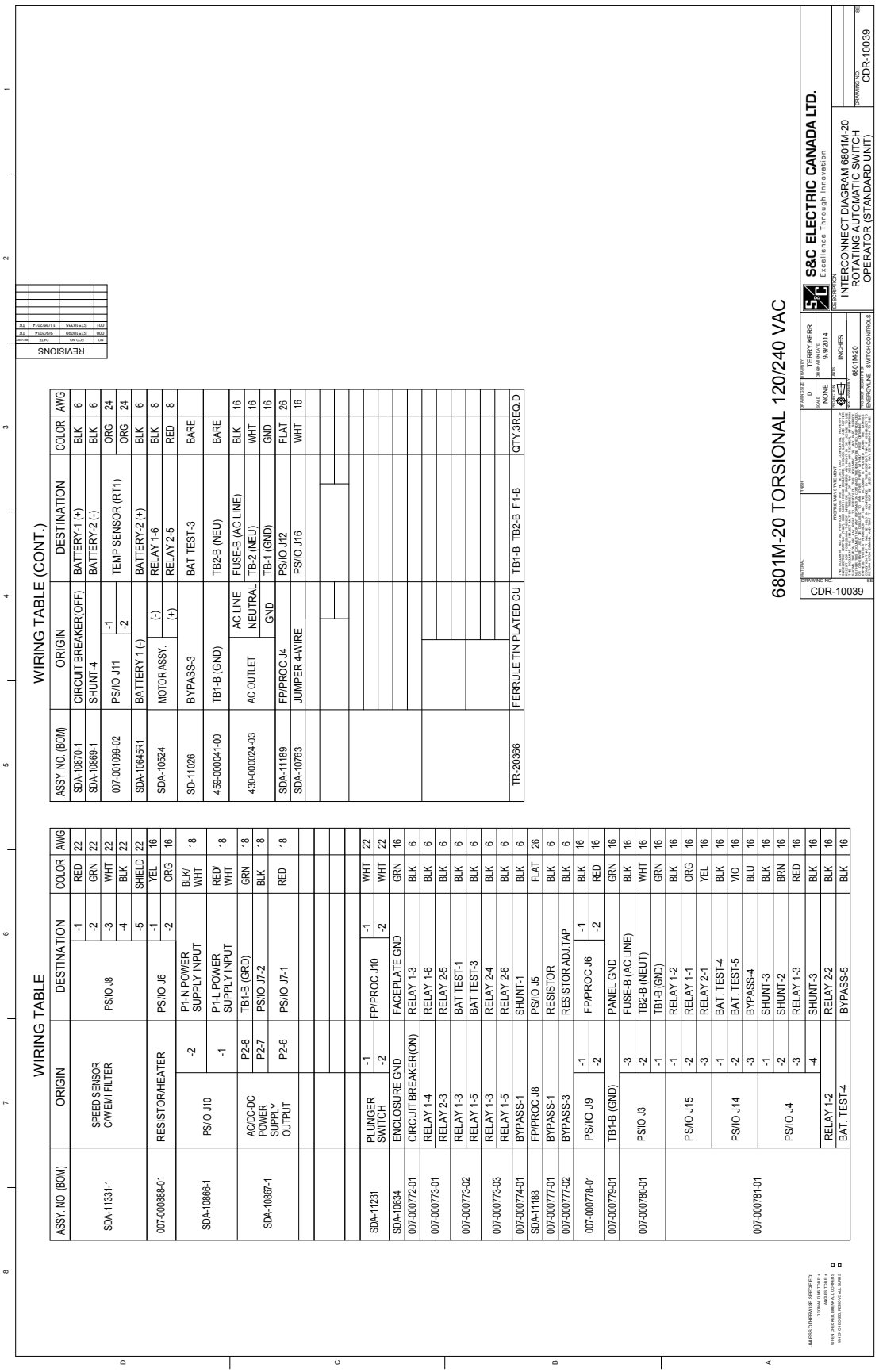
This completes the reciprocating switch operator hardware installation.

See S&C Instruction Sheet 1045M-530, "6801M Automatic Switch Operators: *Setup*," for information about configuring the switch operator.

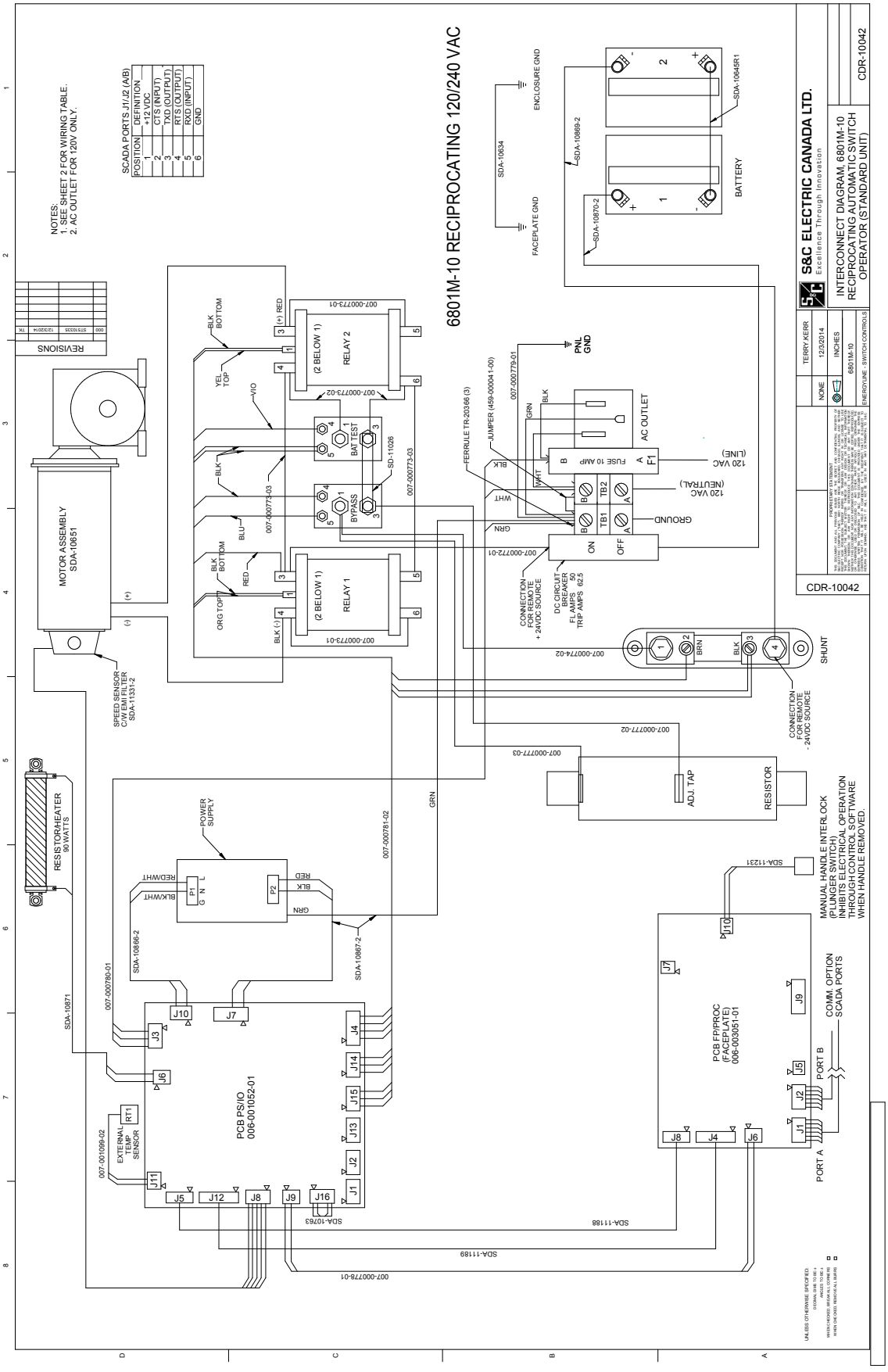
Rotating Switch Operator



Rotating Switch Operator—continued



Reciprocating Switch Operator



Reciprocating Switch Operator—continued

WIRING TABLE

ASSY. NO. (BOM)	ORIGIN		DESTINATION		COLOR	AWG
SDA-11331-2	SPEED SENSOR C/W EMI FILTER		PS/IO J8	-1	RED	22
				-2	GRN	22
				-3	WHT	22
				-4	BLK	22
				-5	SHIELD	22
SDA-10871	PS/IO J6-1		RESISTOR/HEATER-1		YEL	16
	PS/IO J6-2		RESISTOR/HEATER-2		ORG	16
SDA-10866-2	PS/IO J10	-2	P1-N POWER SUPPLY INPUT		BLK/ WHT	18
		-1	P1-L POWER SUPPLY INPUT		RED/ WHT	18
SDA-10867-2	AC/DC-DC POWER SUPPLY OUTPUT	P2-8	TB1-B (GRD)		GRN	18
		P2-7	PS/IO J7-2		BLK	18
		P2-6	PS/IO J7-1		RED	18
SDA-11231	PLUNGER SWITCH	-1	FP/PROC J10	-1	WHT	22
		-2		-2	WHT	22
SDA-10634	ENCLOSURE GND		FACEPLATE GND		GRN	16
007-000772-01	CIRCUIT BREAKER(ON)		RELAY 1-3		BLK	6
007-000773-01	RELAY 1-4		RELAY 1-6		BLK	6
	RELAY 2-3		RELAY 2-5		BLK	6
007-000773-02	RELAY 2-4		BAT TEST-1		BLK	6
	RELAY 2-6		BAT TEST-3		BLK	6
007-000773-03	RELAY 1-3		RELAY 2-4		BLK	6
	RELAY 1-5		RELAY 2-6		BLK	6
007-000774-02	BYPASS-1		SHUNT-1		BLK	6
SDA-11188	FP/PROC J8		PS/IO J5		FLAT	26
007-000777-03	BYPASS-1		RESISTOR		BLK	6
007-000777-02	BYPASS-3		RESISTOR ADJ.TAP		BLK	6
007-000778-01	PS/IO J9	-1	FP/PROC J6	-1	BLK	16
		-2		-2	RED	16
007-000779-01	TB1-B (GND)		PANEL GND		GRN	16
007-000780-01	PS/IO J3	-3	FUSE F1-B (AC LINE)		BLK	16
		-2	TB2-B (NEUT)		WHT	16
		-1	TB1-B (GND)		GRN	16
007-000781-02	PS/IO J15	-1	RELAY 1-2		BLK	16
		-2	RELAY 1-1		ORG	16
		-3	RELAY 2-1		YEL	16
	PS/IO J14	-1	BATT. TEST-5		BLK	16
		-2	BATT. TEST-4		VIO	16
		-3	BYPASS-5		BLU	16
	PS/IO J4	-1	SHUNT-3		BLK	16
		-2	SHUNT-2		BRN	16
		-3	RELAY 1-3		RED	16
		-4	SHUNT-3		BLK	16
	RELAY 1-2		RELAY 2-2		BLK	16
	BATT. TEST-5		BYPASS-4		BLK	16

WIRING TABLE (CONT.)

ASSY. NO. (BOM)	ORIGIN		DESTINATION	COLOR	AWG
SDA-10870-2	CIRCUIT BREAKER(OFF)		BATTERY-1 (+)	BLK	6
SDA-10869-2	SHUNT-4		BATTERY-2 (-)	BLK	6
007-001099-02	PS/IO J11	-1	TEMP SENSOR (RT1)	ORG	24
		-2		ORG	24
SDA-10645R1	BATTERY 1 (-)		BATTERY-2 (+)	BLK	6
SDA-10651	MOTOR ASSY	(-)	RELAY 1-4	BLK	8
		(+)	RELAY 2-3	RED	8
SD-11026	BAT TEST-3		BYPASS-3	BARE	
459-000041-00	TB1-B (GND)		TB2-B (NEU)	BARE	
430-000024-03	AC OUTLET	AC LINE	FUSE F1-B (AC LINE)	BLK	16
		NEUTRAL	TB2-B (NEU)	WHT	16
		GND	TB1-B (GND)	GRN	16
SDA-11189	FP/PROC J4		PS/IO J12	FLAT	26
SDA-10763	JUMPER 4-WIRE		PS/IO J16	WHT	16
TR-20366	FERRULE TIN PLATED CU.		TB1-B TB2-B F1-B	QTY.3 REQ.D	

REVISIONS

000	ST510335	12/3/2014	TK

UNLESS OTHERWISE SPECIFIED:
DECIMAL DIMS TO BE: ±
ANGLES TO BE: ±
WHEN CHECKED, BREAK ALL CORNERS
WHEN CHECKED, REMOVE ALL BURRS

S&C ELECTRIC CANADA LTD.
Excellence Through Innovation

INTERCONNECT DIAGRAM, 6801M-10 RECIPROCATING AUTOMATIC SWITCH OPERATOR (STANDARD UNIT)

TERRY.KERR
NONE
12/3/2014
INCHES
6801M-10
ENERGYLINE - SWITCH CONTROLS

CDR-10042

CDR-10042