



AUTOMATION EQUIPMENT



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The INERTIA MSO, motorized switch operator, meets or exceeds ANSI certification standards for substation, transmission and distribution Supervisory Control And Data Acquisition (SCADA). It works as a stand alone, locally controlled device, or it can be fit with a wide variety of SCADA communication equipment including your choice of RTU, modem, radio, antenna, cabling, and analog insulators with current, voltage and fault sensing capabilities.

Two MSO models available:

- MSOD- Distribution Switches 15 kV - 35 kV
- MSOT- Transmission Switches 46 kV - 69 kV

The INERTIA MSO is built with interchangeable communication control modules for upgrading on the shop bench instead of in the field. A basic pushbutton operating device can be upgraded with a variety of SCADA systems in the future. A new or modified module, with your choice of remote control features, can be easily bench tested on an existing MSO series and quickly apply the upgrade in the field.

The INERTIA MSO gives the flexibility needed for your changing remote switching requirements. Inertia's interchangeable modules allow for easy upgrades on the shop bench; not up on the pole.

SPECIFICATIONS:

Physical Characteristics:

Nominal Weight: < 225 lbs.
 Nominal Size: 16" W x 19-½" H x 23" D
 Enclosure Type: 14 Gauge, NEMA 3R,
 S.S. or Mild Steel with ANSI 71 Grey Powder-coat
 Operating Speed: 500 to 700 mS
 Clearance Point Safety:

- Motor Decouple Lamp
- Interlock Decouple Lamp
- Motor Interlocking Pin
- Decoupling Handle

Electrical Characteristics:

120 VAC / 12 VDC 200 W Power Supply
 120 VAC Surge Suppressed Power Supply Input
 Terminal Block
 120 VAC Thermostatically controlled 150 W Cabinet
 Heater
 12 VDC 55AH Sealed Lead Acid AGM Battery
 16 VDC 58 F Supercapacitor Backup
 12 VDC & 24 VDC Communications Power Supply



STANDARD FEATURES

- Remote or Manual Operation
- Factory Adjusted, Ready to Mount
- Modular & Unitized Construction
- Single Point Lifting Eye for Easier Mounting
- G.O. 95 Compliant Operating Mechanical Enclosure
- Isolated Mechanical Drive Components
- No Synchronizing After Manual Operation
- Auto-Regulating Humidity Control Heater
- Meets and exceeds all applicable SCADA, NEMA , IEEE and ANSI standards.

Inertia's MSO-SEL features all the safety and reliability of our standard MSO with the quality of the SEL embedded system. MSO-SEL meets the SCADA needs of the industry with full programmable automation controlling, sensing, and communication.

The SEL Relay rugged environment, best in class, Temperature range: -40 C to +75 C (-40 F to +167 F) allows it to out perform in the worst conditions.

More logic, and less relays, reduces troubleshooting times in the field. Additional functionality can be added down stream without the need for re-wiring.

12V, 55AH Battery paired with a 16V 58F backup supercapacitor provides 50% more battery backup time to power the MSO during outages, and extends the useful service life of the battery.

MSO operating speeds optimized for Inertia's Distribution and Transmission Switches.

SPECIFICATIONS:

Physical Characteristics:

Nominal Weight: < 225 lbs.
Nominal Size: 16" W x 19-½" H x 23" D
Enclosure Type: 14 Gauge, NEMA 3R,
S.S. or Mild Steel with ANSI 71 Grey Powder-coat

Motor Operating Speed: 800mS to 1000mS
(Reciprocating)

G.O. 95 Compliant operating mechanism and enclosure.
14 gauge S.S. NEMA 3R operator enclosure with ANSI 71 grey powder-coat.

All linkage components are nonferrous anticorrosive materials and physically / environmentally isolated from the electronic components.

Switch position status indication when operated either by motor or when operated manually.

A motor de-energizing interlock, physical linkage stop in a padlockable collar is provided for clearance point verification.

Clearance Point Safety:

- Motor Decouple Lamp
- Interlock Decouple Lamp
- Motor Interlocking Pin
- Decoupling Handle



STANDARD FEATURES:

- 120 VAC surge suppressed power supply input terminal block
- 120 VAC thermostatically controlled 150 W cabinet heater to reduce condensation
- 120 VAC / 12 VDC 240 W power supply
- 12 VDC 55 AH sealed lead acid AGM battery
- 16 VDC 58 F supercapacitor backup
- 12 VDC and 24 VDC power sources for communication devices
- Battery / power supply / backup supercapacitor, high / low voltage monitoring
- Automatic low battery voltage shutdown procedure
- Automatic battery testing (3 hr intervals)
- Automatic backup supercapacitor testing (1 week intervals)
- SEL Relay HMI Panel (4 pushbuttons, 6 status).
Note: see "SEL Relay Point Descriptions"
- Control panel indicator lamps for "Interlock Pin Removed", and "Motor Decoupled" features

MSO Selection Guide

Motor Switch Operator = M → **MDR1SXX-XXXXXXXX**

Voltage Class:

Distribution (15.5 kV - 38.0 kV) = D
Transmission (48.0 kV - 72.5 kV) = T

Control Mechanism Type:

Reciprocating Handle (↕) = R

Control Rod Type:

Reciprocating (↕)
1-3/4" Square Fiberglass = 1
1" Round Fiberglass = 2
3/4" Galvanized Pipe = 3
1" IPS Pipe = 4

Configuration:

MSO-SEL¹ = SXX
Standard MSO¹ = MXX

Options²:

Alternate Power Supply Input (120VAC Std. "A1" = 48 VDC, "A2" = 125 VDC)	= A
Modem / Radio (Specify Make and Model)	= B
Antenna Bulkhead Connector	= C
Fiber Optic Transceiver (Specify Make and Model)	= D
Fiber Optic Splice Tray	= E
Overhead Fault Circuit Indicators (Specify Fault Current, Qty: 3, 6, 9, 12)	= F
Provisions for Current Sensors	= G
Provisions for Voltage Sensors	= H
Provisions for Current / Voltage Sensors	= J
Wet Control Relays (Specify Qty, Control Point, and Control Voltage)	= K
Dry Status Relays (Specify Qty, Status Point)	= L
Control Rod Standoff Bracket	= M
Control Rod Safety Cover	= N
80 W Battery Warming Blanket	= P
Conformal Coating for SEL Relay	= Q
Antenna with 20 ft. Coaxial Cable (Specify Antenna Type, Make, and Model)	= R
Special / Custom Design (Specify)	= S
ArmorGalv® (Thermal Diffusion Galvanizing) Components	= T

¹ Controller/RTU Type will be determined by factory unless otherwise specified.
² Consult factory for any options not listed.

Note: Consult the factory for any options not listed, including; arrestors, sensors, support brackets etc..



16" Wide Body
Standard MSO Enclosure



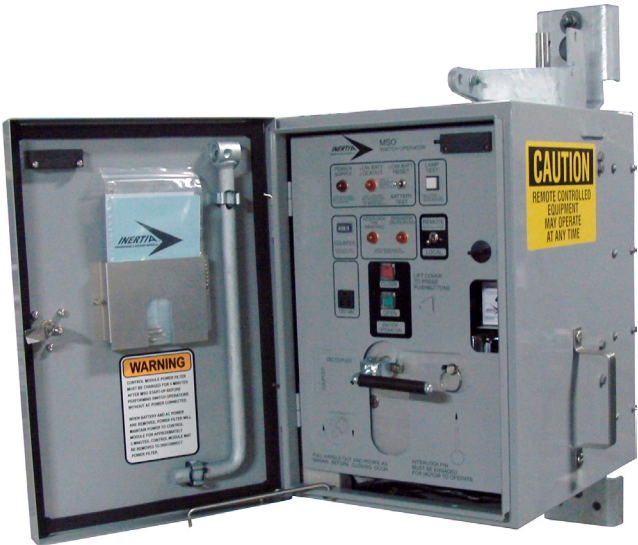
Standard MSO Module



28" Wide Body
MSO-SEL Enclosure



SEL Interface



Standard MSO Interface Panel



MSO-SEL Interface Panel

Company Name _____
Address 1 _____
Address 2 _____
City _____ State _____ Zip code _____

Contact Name _____
Telephone Number _____
Facsimile Number _____
E-mail address _____

Make copies of this form to transmit your MSO requirements.

Step 1. Motor Operator Class (check one): ☐ Distribution (15.5-38 kV) ☐ Transmission (48-72.5kV)

Step 2. Control Mechanism Type: ☐ Reciprocating* (↑↓)

***Note: Reciprocating control is the only control mechanism type available at this time.**

Step 3. Switch Control Rod Type (check one):

- ☐ 1-3/4" Square Fiberglass ☐ 1" O.D. Round Fiberglass
☐ 3/4" IPS Pipe (1" O.D.) ☐ 1" IPS Pipe (1.31" O.D.)

Step 4. Control Panel / User Interface (check one):

- ☐ Inertia Control Panel (Standard MSO) ☐ SEL-700G (MSO-SEL)
☐ SEL-751 (MSO-SEL) ☐ SEL-751A (MSO-SEL)
☐ SEL-2411 (MSO-SEL)

***Note: See Table for RTU/SEL Relay Sensor Input Capabilities.**

Step 5. Remote Terminal Unit (RTU) or SEL Relay Needed? (Check one): ☐ YES ☐ NO

***Note: Select YES if a MSO-SEL (SEL-Relay) is selected in step 4 above and answer questions 5a. through 5d. below; otherwise skip to step 6.**

5a. RTU or SEL Relay Supplied by Inertia, or by Customer? (Check one): ☐ Inertia ☐ Customer

5b. RTU or SEL Relay Type (Model Number): _____

***Note: Inertia's Standard MSO RTU Type if not specified: Cleaveland Price RTU3220, DNP3 Protocol**

5c. MSO-SEL's only: SEL-3505 required? (Check one): ☐ YES ☐ NO

5d. MSO-SEL's only: Conformal Coated SEL Relay (check one): ☐ YES ☐ NO

Step 6. Hardwired Status / Control Board? (Check one): ☐ YES ☐ NO

***Note: Answer questions 6a. and 6b. below if YES is selected; otherwise skip to step 7.**

6a. Select desired hardwired status points and number of dry contacts for each status.

Status Points / (Qty. of Dry Contact):

- | | |
|---|--|
| <input type="checkbox"/> Open Switch / (Qty.: _____) | <input type="checkbox"/> Close Switch / (Qty.: _____) |
| <input type="checkbox"/> Remote - Local. / (Qty.: _____) | <input type="checkbox"/> Motor Decoupled / (Qty.: _____) |
| <input type="checkbox"/> Battery Lockout. / (Qty.: _____) | <input type="checkbox"/> Battery Test in Progress. / (Qty.: _____) |
| <input type="checkbox"/> Interlock Pin Removed. / (Qty.: _____) | <input type="checkbox"/> Cabinet Door Open. / (Qty.: _____) |

Other Status (Specify): _____

6b. Select desired hardwired control points, control voltage, and number of each control point.

Control Points / Control Voltage / (Qty.):

- | | |
|---|---|
| <input type="checkbox"/> Open Switch / Voltage: _____ / (Qty.: _____) | <input type="checkbox"/> Close Switch / Voltage: _____ / (Qty.: _____) |
| <input type="checkbox"/> Battery Test / Voltage: _____ / (Qty.: _____) | <input type="checkbox"/> Other (Specify): _____ |

Continued on Next Page.

Step 7. Communication Type (Check all that apply):

☐ Radio ☐ Ethernet ☐ Fiber Optics ☐ Hardwire ☐ None

***Note: If "None" is selected above, skip 7a through 7c and continue to step 8**

7a. Communication Device(s) supplied by Inertia, or by Customer? (Check one): ☐ Inertia ☐ Customer

7b. Communication Device(s) Model Number(s): _____

7c. Communication Protocol:

☐ DNP (Standard) ☐ Modbus ☐ IEC 61850 ☐ Other (Specify): _____

Step 8. MSO overhead Switch Line Sensing or Fault Indication? (Check all that apply):

***Note 1: If 'None' is selected, skip to step 9**

***Note 2: See Table 1 for RTU/SEL Relay Sensor Input Capabilities**

	Load Side	Source Side
3 Ph. Current Sensors:	<input type="checkbox"/>	<input type="checkbox"/>
3 Ph. Voltage Sensors:	<input type="checkbox"/>	<input type="checkbox"/>
3 Ph. CT/PT Combo Sensors:	<input type="checkbox"/>	<input type="checkbox"/>
1 Ph. 120VAC PT Input:	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Fault Circuit Indicators / Qty (Multiples of 3): _____		

Step 9. Additional MSO Features (Check all that apply):

9a. ☐ Alternate Power Supply Input Voltage (120 VAC is standard):

9a-1. Input Voltage: _____ V ☐ VAC ☐ VDC

9a-2. Dual Power Supply Inputs [Preferred/Alternate Setup]: ☐ YES ☐ NO

9b. ☐ Antenna Bulkhead Connector / Polyphasor (select type): ☐ 125-1000 MHz ☐ 700-2700 MHz

9c. ☐ Antenna with 20 ft. coaxial antenna cable.

9d. ☐ Control Rod Standoff Bracket.

9e. ☐ Control Rod Safety Cover.

9f. ☐ 80W Battery Warming Blanket.

9g. ☐ Thermal Diffusion Galvanizing (TDG) Components (Control Handle, Brackets, S.S. Pans, Enclosure).

9h. ☐ Special / Custom Design (If YES, write brief description below)

Table 1: SEL Relay Sensor Input Capabilities Chart

SEL Sensor Input Card Combinations	SEL Relay Type			
	SEL-751	SEL-751A	SEL-2411	SEL-700GT+
3-Phase CT Inputs (5A)	x	x	x	x
3-Phase PT Inputs (300V)	x	x	x	x
3-Phase CT/PT Inputs (5A / 300V)	x	x	x	x
1-Phase PT Input (V-Sync 300V)	x	x	x	x
3-Phase CT/PT (5A / 300V) + 1-Phase PT (300V)	x	x		x
3-Phase CT/PT (5A / 300V) + 3-Phase PT (300V)				x
3-Phase CT/PT (5A / 300V) + 3-Phase CT (5A)			x	x
3-Phase CT/PT (5A / 300V) + 3-Phase CT/PT (5A / 300V)				x
8V LEA (Low Energy Analog) Input Voltage Option*	x		x	

*Note: 8V LEA (Low Energy Analog) inputs can be substituted in place of 300V inputs for voltage sensor cards for 751 and 2411 relays only.



Closer Look From the Outside . . .

The MSO is available in a choice of powder-coated mild steel or stainless steel enclosures. All enclosures have the following features:

- Drive mechanism in a partitioned subcabinet to isolate the drive components in the subcabinet from the electronic components.
- Four full inches of belt clearance between the pole and the MSO
- One inch conduit hole (plugged) provided for AC power
- Twelve-pin receptacle provided in the bottom of the cabinet, prewired for external equipment, e.g. sensors, fault indicators etc.
- Pad-lockable door and drive collar (clearance point)
- Integrated manual operating mechanism
- Auto-regulating heater for humidity control
- Single point lifting eye for easier mounting
- Easy access to operator/module without removal from crate

Closer Look From the Inside . . . CONTROL PANEL

The inside panel isolates the user from the energized components during a routine maintenance check and during normal local operation.

*** Power Supply Lamp** indicates a functioning power supply that charges the 24 VDC battery pack.

*** Low Battery Lockout Lamp** illuminates when the voltage monitor has detected a voltage too low to properly operate the switch. If low voltage is detected, the battery successfully pass a deep draw discharge test either locally, remotely, or automatically prior to operation. There is no override.

★ Battery Test/Reset Toggle Switch is a momentary switch that initiates a 5 second battery test. The battery voltage must be sufficient to allow a reset.

*** Door Sensor** turns off lamps when the door is closed and initiates an alarm status when open.

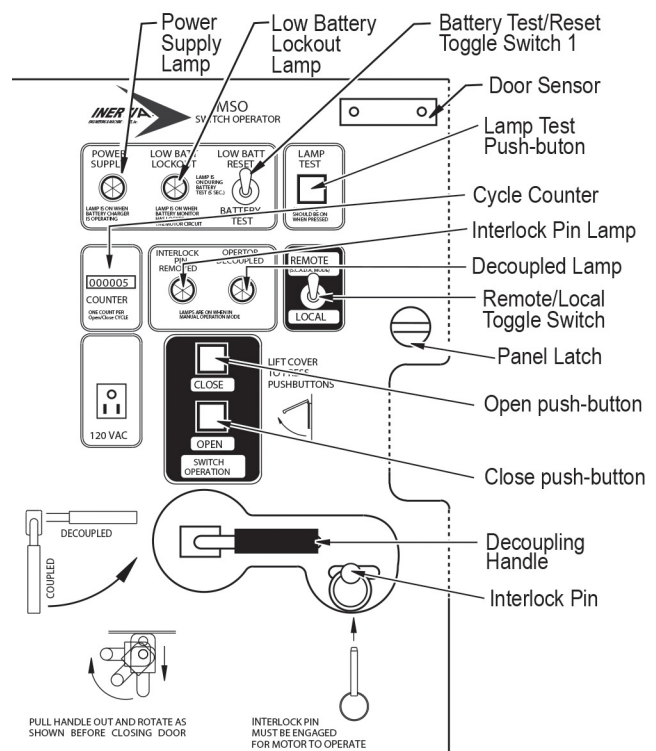
- **Lamp Test Pushbutton** energizes all lamps when depressed to check for burned out lamps.
- **Cycle Counter** counts each closing cycle.

*** Interlock Pin lamp** illuminates whenever the interlock pin is removed from its control panel location. The motor circuit cannot be energized when the interlock pin lamp is illuminated (pin is removed). This is the first clearance point step.

*** Decoupled Lamp** illuminates whenever the motor is decoupled from the output linkage via the decoupling handle. The second clearance point step.

*** Remote/Local Toggle Switch** allows control to be initiated from the control panel, only when in the local position; or remotely, only when in the remote position. This is a third clearance point step.

★ * Open & Close Pushbuttons are covered to prevent inadvertent contact and are illuminated to indicate the current switch position. The illuminated buttons indicate the switch position remotely and locally, whether operated manually or by the motor.



*** Decoupling Handle** physically disengages the motor from the output mechanism. The motor can be run in the local mode by pressing either the open or close pushbutton without operating the switch.

*** Interlock Pin:** The interlock pin is the “Key” to the unit. It must be fully inserted into its position on the control panel for the motor to operate. It is the same pin required for using the manual handle. In a clearance, it creates a physical stop/fourth clearance point step, if other clearance steps are breached.

Behind the Panel . . . Modularity

The slide-in battery and control modules provide easy access for upgrades. Battery-pack change-outs are made quickly and easily by separating the power plug and removing it. The *INERTIA* control module is custom tailored for the customer's requirements. No field wiring of the operator is required. The control modules are interchangeable, so if an upgrade is desired, a backup unit can be programmed and tested in the shop and sent out to the site for replacement. The replaced module can then be returned to the shop for bench testing. There is no need to troubleshoot the module on the pole. Since the modules are interchangeable, the operator never becomes obsolete. As your requirements change, an upgraded module with different capabilities can be inserted with the same ease without the need to take a clearance.

Control Modules

MSO control modules are designed with "open architecture" and are adaptable to customer selected specifications for power input, SCADA status and control, and communication and fault sensing devices.

Substation applications:

The control module can be a "hard-wired" unit without RTU or communications device for substation applications.

Field applications:

The control module can be supplied with factory mounted and wired RTU, communication device or both. When customer supplied, the factory will predrill the control module frame to accept the form factor of the device(s) to be customer installed. The RTU and/or communication device(s) can also be installed external to the MSO in factory supplied weatherproof boxes or it can be supplied with an umbilical cord (instrumentation/control cable) with customer specified connectors.



Control module input, control and status point information:

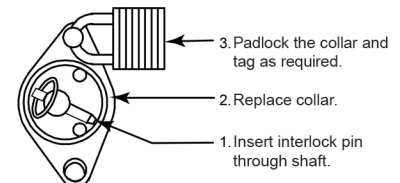
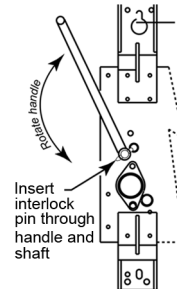
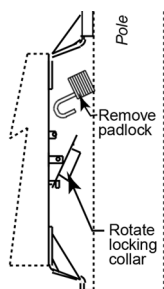
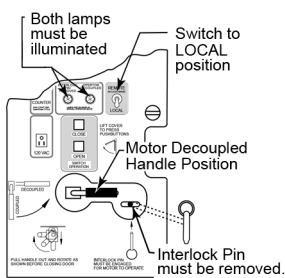
- External power requirement: 720 watts minimum
- Supply voltage input: 120/240 VAC or 24-125 VDC
- Control and drive power: 24 VDC
- Auxiliary power: 12 VDC, 4.5 A
- Control points* (24 VDC Form-A "wetted relays)
- Status points** (24 VDC Form-A "wetted relays)

*Form-A "dry" contact relays are available.

**Status points can be grouped for "Condition Alarm" as requested.

The Inertia MSO's mechanical and electro-mechanical drive components are designed to last for decades. It is not likely that any technological or material advances will improve this drive system. Battery, RTU and communications technologies are very likely to change in the future. The removable battery pack and control module systems allow easy upgrades without field wiring. Future upgrades of the RTU or communications device will be done in the shop on replacement modules. Pretested, pre-programmed modules can then be hot-swapped in the field without taking a clearance.

Manual Operation & Clearance Point Sequence



1. Remove the interlock pin from the front panel and insert it into the output shaft and padlock in place. Decouple the operator.

2. Remove the padlock and rotate the collar out of the way. Place handle over the exposed shaft and insert interlock pin. Switch is now operated like any manual switch.

3. For a clearance, repeat step 1, and place interlock pin through shaft. Replace collar to capture the interlock pin at a mechanical stop. Padlock collar for final clearance point.

The following test have been conducted on the Inertia MSO switch operator in accordance to the applicable ANSI/IEEE standards. Additional test are included that are not part of the ANSI/IEEE test standards.

Insulation Withstand (high potential)

Input line to ground and common to ground tested at 1,500 and 2,600 volts.

Dielectric withstand voltage, (input to output 1 minute): 2,500 VAC.

Insulation resistance, (input to output): 10 M ohm minimum with leakage current, less than 0.83 mA.

Line Voltage Variation

Input voltage-AC: 85-145 VAC Input frequency-AC: 47-63 Hz

Brown out protection (lowest input voltage that regulation is maintained): 85 VAC_

Power supply drop out voltage : 40 ± 5 VAC

Power supply pick up voltage: 85 ± 5 VAC

The battery failure backup system maintained all control and status I/O and system operability during test

Power Failure Backup

Time to 'no-go' (0.6 amp. load): 50 hours

Recovery time (successful battery test), 25 minutes

Temperature Cycle

Five 24 hour cycles at -20°C to $+85^{\circ}\text{C}$. (One cycle without the switch operator's heater on)

Five 24 hour cycles at $+20^{\circ}\text{C}$ to $+91^{\circ}\text{C}$. The test was conducted with an additional 2.3 ohm load to simulate radio and RTU power consumption. One temperature cycle was conducted without 120 VAC input to the power supply.

Humidity cycle

Relative humidity: non-condensing to 70°C at 95% relative humidity with the door open.

Surge Withstand_____Per ANSI C37.90.1-1989

3.0 kV, 100 kHz oscillatory waveshape, positive and negative polarities, injected into the AC mains and enclosure.

4.0 kV, 100 kHz fast transient waveshape, positive and negative polarities, injected into the AC mains and enclosure.

Powerline Surge Voltage and Current_____Per ANSI C62.41-1991

100 kHz Ring waveshape both positive and negative polarities injected into the AC mains and the enclosure, and

1.2x50 μs , 8x20 μs surge waveshape, positive and negative polarities injected into the AC mains and the enclosure.

4 kV amplitude, over 0-540 degrees phase, 15 degree phase increments

5 kV amplitude, over 0-180 degrees phase, 15 degree phase increments

6 kV amplitude, over 0-180 degrees phase, 15 degree phase increments

Electrostatic Susceptibility___ESD per MIL STD. DOD-HDGK-263, Schaffner 430 ESD Gun

Test all surfaces, switches, buttons and safety neutral terminals or grounds that will be contacted by personnel during operation or installation of the device per the following:

a: Test voltage at 10 kV: Discharge the test device on all the above surfaces.

b: Test voltage at 15 kV: Move the probe 0.5 inches above all contact surfaces (avoiding discharge).

Power On/Off Transition

Input voltage is varied from +20 %, -10%, -15%, -20%, -50% , -100% and nominal while the voltage is rapidly toggled on and off eight cycles. All device functions are verified to be operating correctly at all input voltage settings.

Power supply ratings: Turn-on delay: 1 Sec.

Charger hold up time (110 VAC): 20 mS min.

Operating frequency (switching frequency of main transformer: 22 kHz nom.

Brown-Out and Single Phase

Verify correct device operation at nominal input voltage, and after the following:

a: Nominal input voltage -20% for six hours. b: Nominal input voltage - 50% for six hours.

EMI/RFI Susceptibility_____ Per S.A.M.A. Std. PMC 33.1-1978 (Radiate frequencies from front, right and left sides)

14 kHz-512 kHz, 10V/m, operator energized with 120 VAC, door closed

512 kHz-10GHz, 5V/m, operator energized with 120 VAC, door open

Electromagnetic Radiation

Conducted per FCC part 15 Class B limits

Battery Life

36 amp-hour lead acid batteries (VRL), powering the control module only, for 22 hours prior to low voltage lockout.

A battery shutdown algorithm is employed to prevent deep discharging the batteries during a sustained outage.

Mechanical Operation

Mechanically tested on 35 kV gang switch 3,500 operations, 300 without power supply, no maintenance was performed on the switch or the operator during the test. No appreciable wear or damage was identified.

Description:

Pole mounted 24 VDC reciprocating (↑↓) output motorized switch operator for 4 kV- 138 kV overhead gang operated air break switches. This equipment shall meet or exceed all applicable A.N.S.I./I.E.E.E., F.C.C. , S.A.M.A. and I.E.C. test standards.

General specifications:

1. Operating stroke must be a fourteen inch (14½") nominal and fully operate the switch open or closed within 0.5-0.7 seconds. A sealed DC motor capable of 5,000 lb. stall torque coupled with a multi disk clutch shall provide the output to the switch control rod.
2. Stroke limits (once set) should not require re-setting after manual operation or motor running maintenance.
3. Operator linkage must toggle over center at both extremes of the stroke to: 1) place control rod compression on a mechanical stop in the closed position and 2) prevent accidental movement from the open position.
4. Switch position status must be indicated locally on the control panel and transmitted via SCADA remotely when in either local/manual or remote/motor operating mode.
5. Single point lifting is to be provided on a powder coated welded stainless steel enclosure with stainless steel hardware and safety handle.
6. A visible air gap must be attainable between the control rod and output shaft of the motor operator in the open position. No adjustments shall be required to re-engage the operator and the control rod. The switch position must be lockable during a clearance.¹
7. It shall not be necessary to disengage the control rod to perform a manual operation of the switch.
8. The manual handle shall require the use of an interlocking device which, when removed for use with the manual handle, shall break the electrical circuit to the motor.¹

Control and SCADA Specifications:

1. The operator shall have a control panel with the following controls and status indications:
 - Switch Open/Close Pushbutton and LED Status Indication
 - Battery Test/Reset Toggle Switch Control
 - Low Battery Motor Lock-out Lamp
 - Power Supply "ON" Lamp
 - Remote/Local Toggle Switch
 - Motor Decoupled Lamp¹
 - Motor Circuit Interlock Pin Removed Lamp
 - Operations Counter
 - Door Sensor
 - Motor Interlock Pin¹
 - Decoupling Handle¹
 - 120 VAC, 6 Amp Convenience Receptacle
 - Lamp Test Push Button
2. The operator electronic controls shall have the following minimum features:
 - 12-pin analog input plug
 - 120 VAC regulated heater
 - Removable battery pack
 - Weather-tight panel separating mechanical output linkage mechanisms.
 - Removable control logic, RTU, and communications module with the following features:
 - Battery monitoring and automatic timed test
 - Low voltage motor lockout
 - Low voltage system disconnect
 - All status and control outputs shall be connected to a test terminal block.
 - DC startup test pushbutton
 - Fused 120 VAC input, and 24 VDC power supply
 - Minimum control points including:
 - Open/Close Switch
 - Battery Test/Reset
 - Minimum digital status outputs including:
 - Switch Open/Closed
 - Low Battery Lock-out
 - Power supply Failure
 - Local/Remote Control
 - Operator Decoupled
 - Interlock Pin Removed
 - Minimum analog outputs including:
 - Six analog outputs shall be provided to interface with line post, or other sensors.
 - Fused 24 VDC and 12 VDC outputs for the radio, RTU or other equipment .

¹: User Safety Point.

Scope: This material description covers the minimum acceptable requirements for 4 kV-138 kV G.O.A.B. reciprocating switch controllers and stored energy operators. The switch controller is to be mounted below the switch assembly. The controller shall be able to accommodate the various applications, including, but not limited to:

- Encrypted, secured and codable 900 MHz handheld remote control.
- External S.C.A.D.A. with, or without current or current/voltage sensors or remote faulted circuit indicators via RTU and radio or other communication media of the customer's choice, through a bulkhead receptacle.

Mechanical and manual operation

- The switch operator must be designed to open and close all the types of manufacturers' reciprocating switches of sufficient force in 0.5 to 0.7 seconds.
- The operating mechanism and enclosure must be G.O.-95 compliant.
- All linkage components are to be of nonferrous anticorrosive materials and be physically and be environmentally isolated from the electronic components by a bulkhead.
- Means shall be provided to enable the motor to be coupled or decoupled from the output linkage in any position without realigning the motor linkage to the output shaft or repositioning the output linkage to its original position prior to manual operation.
- Switch position status is to be indicated when operated either by motor or when operated manually.
- A motor de-energizing interlock, physical linkage stop in a padlockable collar are to be provided for clearance point verification.
- The operator enclosure is to be of welded NEMA 4X construction of 14 gauge, stainless steel with ANSI 71grey powder-coated 3 mil. minimum.
- A thermostatically controlled heater shall be provided to reduce condensation in the operator.
- The operator enclosure shall be a maximum of 16 inches wide for traffic and pedestrian safety.
- All ferrous components and hardware shall be hot-dip galvanized per ASTM A123.

Controller:

- The operator controller must be easily replaceable and upgradeable, and provide a terminal block with 24 and 12 VDC power outputs for RTU with status and control points and communication devices.
- The operator controller, RTU and communication equipment are to be enclosed in a modular unit, which can be exchanged with a comparable module. Control module exchange and replacement shall be hot-swap capable, i.e. module can be replaced or removed for upgrade or repair without taking an outage.
- Control module exchange and replacement shall not require rewiring of the controller, analog inputs or the power supply.
- Controller shall be isolated by a separate control panel, to protect the user from inadvertent contact with energized parts. "Open" and "Close" switches shall be covered to prevent inadvertent accidental contact.
- Controller shall have the following points:

Status:	1. Switch open	6. Interlock pin removed (motor circuit disable)
	2. Switch closed	7. Low battery lockout
	3. Local enabled	8. Power supply fail
	4. Remote enabled	9. Door open (optional)
	5. Manual mode (motor decoupled)	10. Local and/or remote operations counter (optional)
Control:	1. Open switch	3. Battery test
	2. Close switch	4. Fault detect reset (optional)

Front Panel User Interface:

- Display/operation panel shall be hinged and latchable, and have the following attributes:
 1. Panel displays:

a) Battery test in progress lamp	e) Operator decoupled lamp
b) Low battery lockout lamp	f) Motor interlock pin removed lamp
c) Power supply lamp	g) Cycle counter for switch operations
d) Open pushbutton (covered & illuminated)	h) Close pushbutton (covered & illuminated)
 2. Provided controls:

a) Lamp test pushbutton	e) Open pushbutton (covered & illuminated)
b) Battery test switch	f) Close pushbutton (covered & illuminated)
c) Battery reset switch	g) Motor decoupler
d) Local/Remote toggle switch	h) Motor interlock

Power Supply:

- The power supply shall have the following minimum characteristics:
 - Input voltage range: 110-240 VAC (50-60 Hz).
 - Output current and voltage: 4.6/4 A, 24/28 VDC temperature compensating.
 - Minimum switching frequency, 20 kHz, 1% peak-to-peak ripple.
 - Inrush surge, EFT/burst, radiated susceptibility tested to: EN61000-4-2,3,4 and 5.
 - Electromagnetic interference, conducted: FCC title 47, class B as applicable.
 - The power supply is to be fused on both the input and output.

Motor and operation:

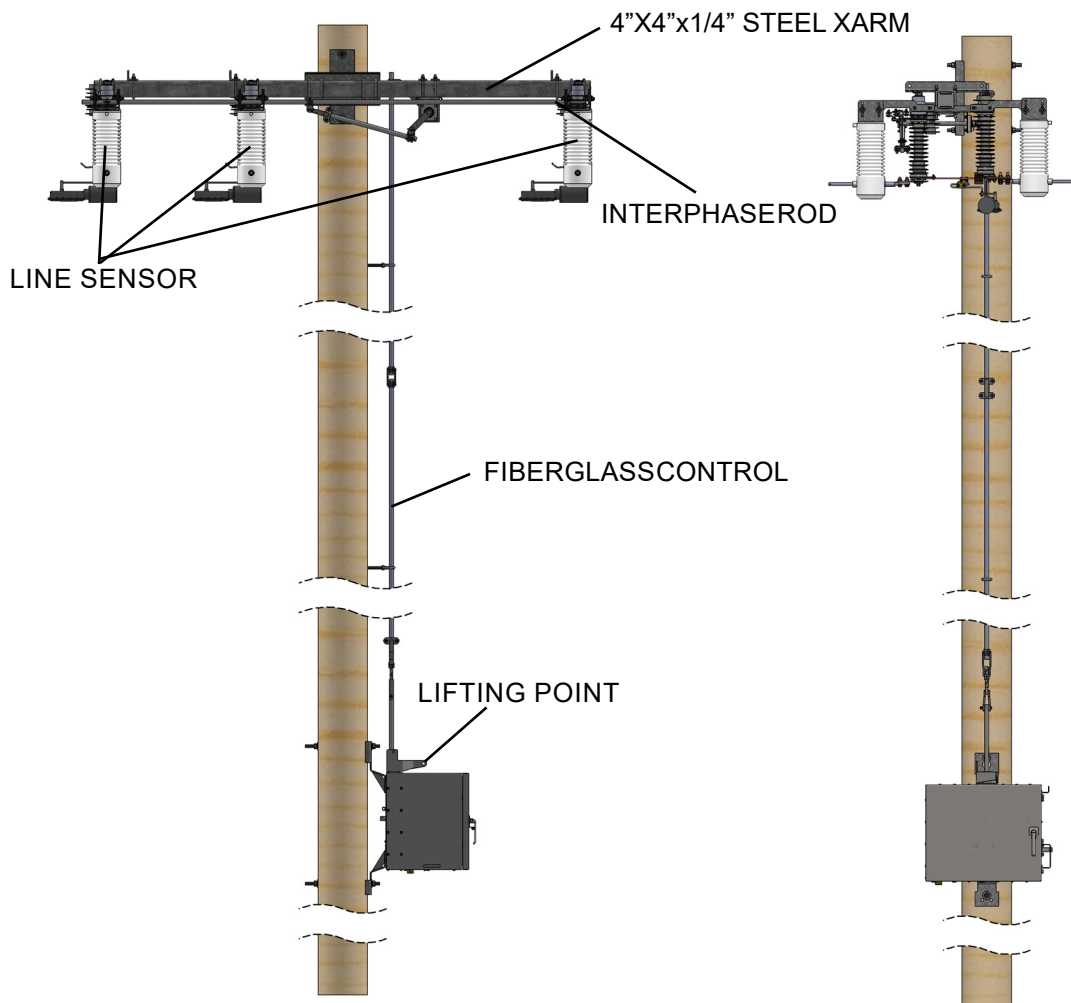
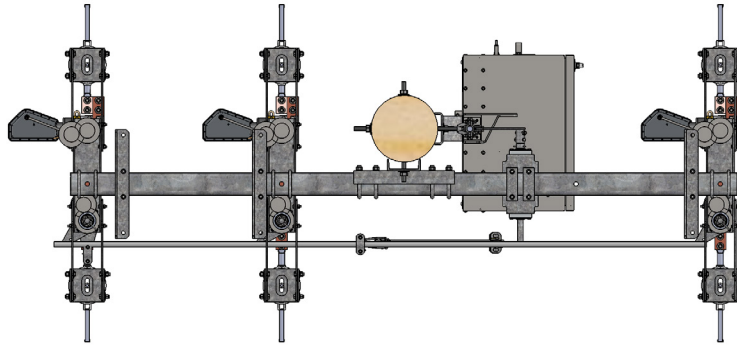
1. A 24 VDC sealed motor shall be powered by an easily replaceable 24 VDC/24 amp-hour maintenance-free, lead acid battery pack capable of sustaining 250 mA communication and RTU equipment for 36 hours, and four motor operations during the first 24 hours upon loss of the AC supply.
2. The motor shall be capable of being exercised via local control without effecting the switch position.
3. The motor is to be protected with thermal trip/reset breakers and overload torque limiting means to sense and reduce damage to iced or locked switches.
4. Motor contactors, relays, timers and battery management electronics shall prevent lazy or partial switch operation.

Documentation:


1. Each operator shall be supplied with an installation and operation manual that includes:
 - Remote and local control and manual operation.
 - RTU and radio installation.
2. Factory acceptance test certificates with associated serial numbers shall also be included.
3. All components shall be warranted the first year for on site repair of all parts and labor, and for an additional two years as returned to the factory. Warranty does not apply to battery replacement. RTUs and radios shall be warranted separately by their respective manufacturer(s).

The foregoing information is provided to help ensure specifying the highest possible quality motorized switch operator. The information provided herein is intended solely as a guideline to create a specification that best suits the end user's application. Some portions may, or may not be applicable to your requirements and environment.

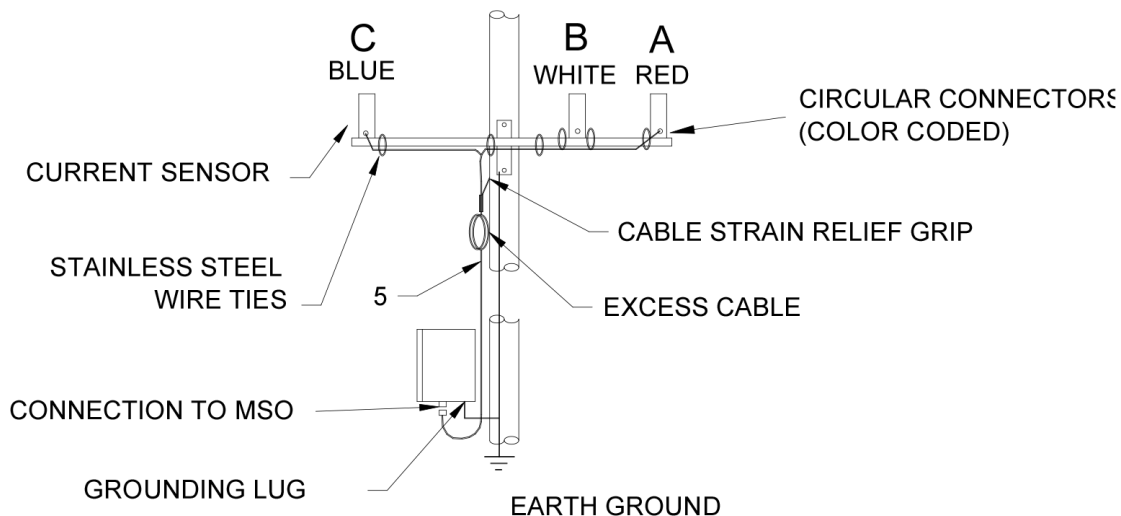
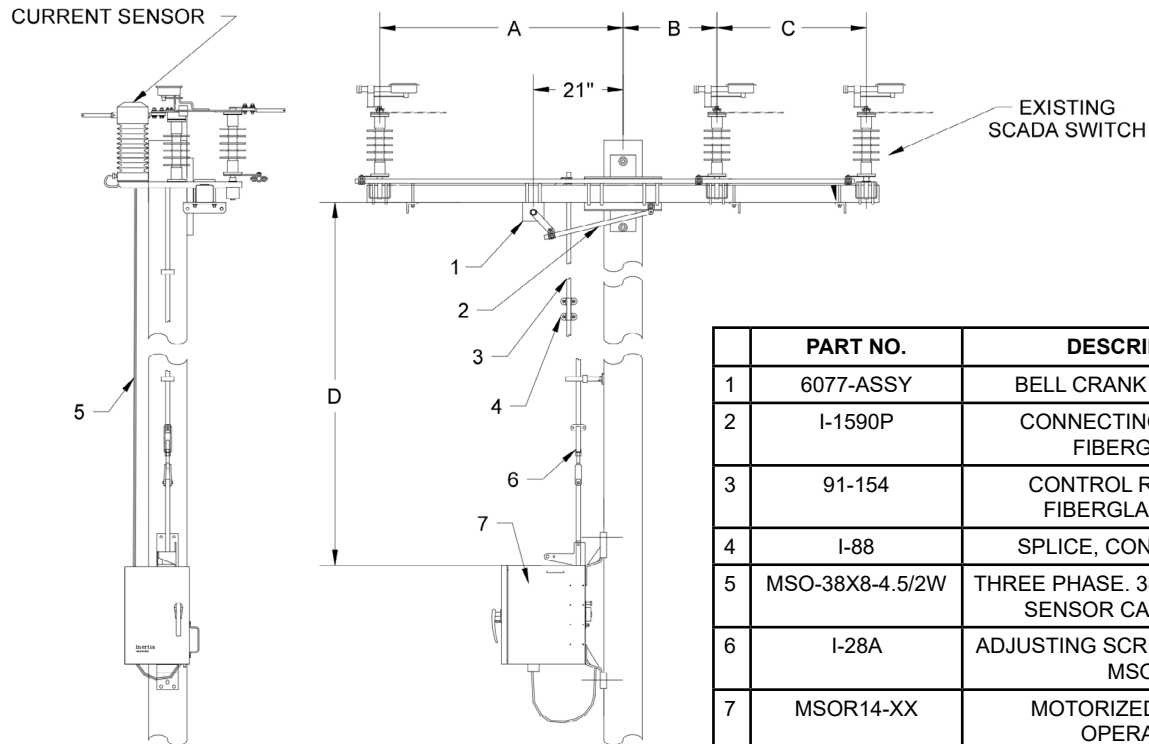
25 kV Horizontal Underarm SCADA Switch



This drawing is for illustrative purposes only and therefore; may, or may not reflect the current revision of this drawing. Please request the current revision from the factory upon quote.


	Materials:	N/A	Description: Horizontal 25 kV Underarm SCADA Switch	
	Finish:	HDG		
	Scale:	NTS		
	Drawn By:	N/A	Drawing No.: 9373-22M	Revision: 00
	Date:	N/A		

MSO SENSOR UPGRADE PACKAGE

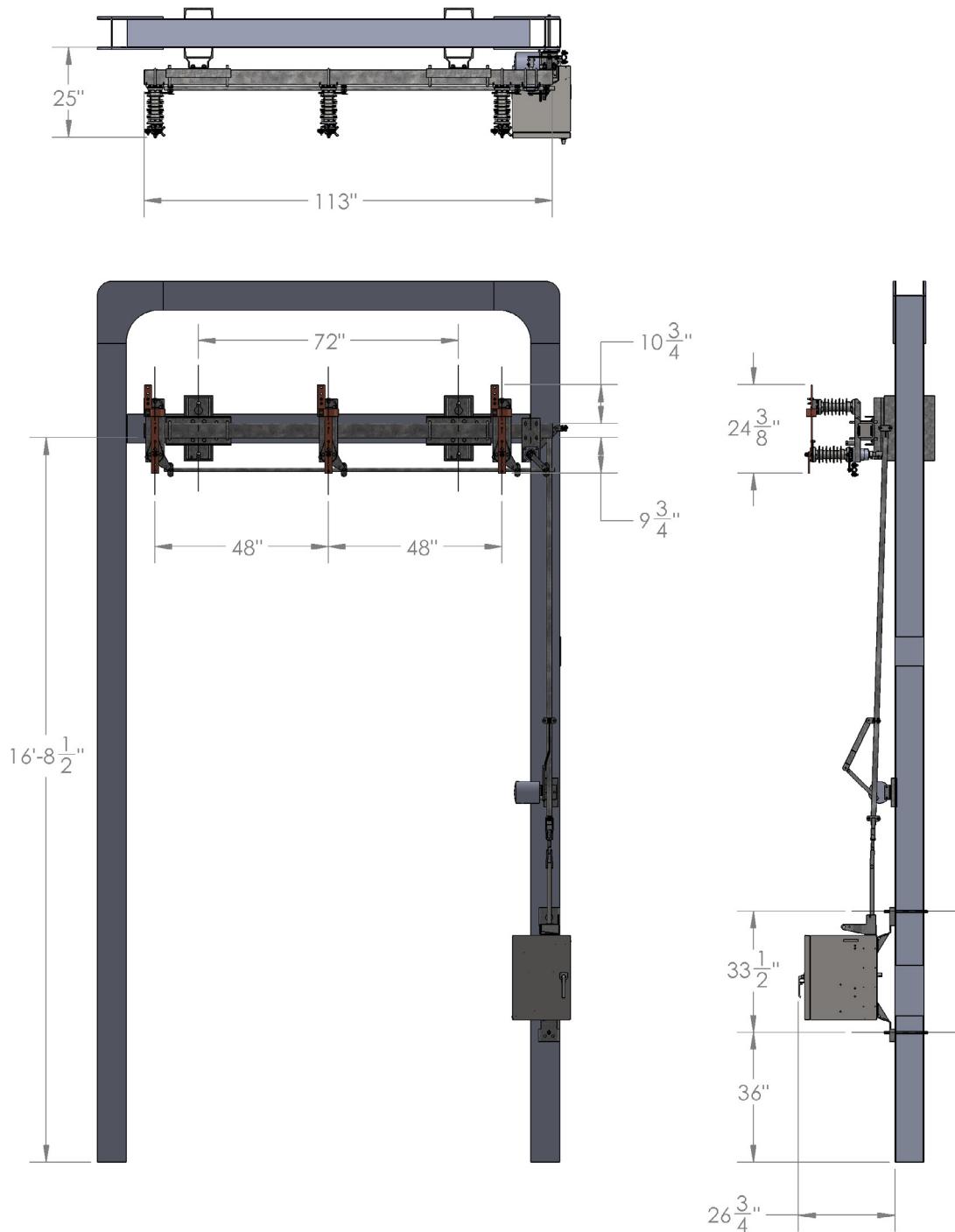


SENSOR CONNECTIONS TO SWITCH, MSO AND GROUND


This drawing is for illustrative purposes only and therefore; may, or may not reflect the current revision of this drawing. Please request the current revision from the factory upon quote.

	Materials:	N/A	Description: MSO SENSOR UPGRADE PACKAGE	
	Finish:	N/A		
	Scale:	NTS		
	Drawn By:	DS	Drawing No.: 9333-1M	Revision: 00
	Date:	11/22/02		

15 kV Riser H-Frame SCADA Switch Dimensions



This drawing is for illustrative purposes only and therefore; may, or may not reflect the current revision of this drawing. Please request the current revision from the factory upon quote.

	Materials:	N/A	Description: 15 kV RISER, H-Frame, SCADA Switch Dimensions	
	Finish:	HDG		
	Scale:	NTS		
	Drawn By:	N/A	Drawing No.: 9661-32MM	
	Date:	N/A		
			Revision:	00