INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

ELO Series

TO PREVENT POTENTIAL INJURY OR DAMAGE TO PROPERTY, READ THIS MANUAL CAREFULLY AND COMPLETELY.

PRO-torq electric actuators

IMPORTANT SAFETY INSTRUCTIONS

Basic safety precautions should always be followed, including the following: Failure to follow instructions can cause severe injury and/or death.

⚠ This is the safety-alert symbol. When you see this symbol on your equipment or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

⚠ WARNING warns about hazards that could cause serious personal injury, death or major property damage and if ignored presents a potential hazard.

⚠ CAUTION warns about hazards that will or can cause minor or moderate personal injury and/or property damage and if ignored presents a potential hazard. It can also make consumers aware of actions that are unpredictable and unsafe.

Notice: A notice indicates special instructions that are important but not related to hazards.

⚠ WARNING - Read and follow all instructions in this IOM manual and on the equipment. Failure to follow instructions can cause severe injury and/or death.

⚠ WARNING – **Risk of Electric Shock.** All electrical wiring MUST be in conformance with applicable local codes, regulations, and the National Electric Code (NEC). Hazardous voltage can shock, burn, and cause death or serious property damage. To reduce the risk of electric shock, do NOT use an extension cord to connect unit to electric supply. Provide a properly located electrical receptacle. **Before working on any electrical equipment, turn off power supply to the equipment.**

⚠ WARNING – To reduce the risk of electric shock replace damaged wiring immediately.

⚠ WARNING – Ground all electrical equipment before connecting to electrical power supply. Failure to ground all electrical equipment can cause serious or fatal electrical shock hazard.

⚠ WARNING – Do NOT ground to a gas supply line.

⚠ WARNING – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections.

⚠ WARNING – Failure to bond all electrical equipment to system structure will increase risk for electrocution and could result in injury or death. To reduce the risk of electric shock, see installation instructions and consult a professional electrician on how to bond all electrical equipment. Also, contact a licensed electrician for information on local electrical codes for bonding requirements.

⚠ CAUTION – Potential pinch point. Equipment connected to or driven by this device may start unexpectedly and may cause personal injury or entrapment in linkage systems.

TABLE OF CONTENTS

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ACTUATOR OPERATIONAL CONCEPTS

Single phase actuators range in complexity from simple models with basic operability, to quite complicated models with battery backup and local control capabilities. The various models might seem to be easily adaptable across any site or design intent, but are actually very specific as to how they interface to existing or new installations. It is important to FULLY UNDERSTAND what level of control is required prior to selecting one of these products. While it might make sense to opt for the most feature-laden solution in order to cover all the possibilities in a given application, that selection in fact would NOT function in an application that just required the most basic unit.

Notice: Read the project specifications and understand the application before making an actuator selection. If in doubt, consult with the project engineer to clarify what is actually required for a fully operational installation. We have provided in this document all the tools necessary to determine how the various levels interface to the outside world. If there are any questions, please contact Flo-Tite.

Notice: HRSN3 Series actuators are fully assembled, calibrated and tested prior to leaving our factory. In most cases, after you have mounted the actuator to your device, you should be able to operate the actuator from fully CLOSED (CW) to fully OPEN (CCW) and back again, and find that no adjustments are needed. The assembly can be put into service immediately. However, should it be necessary to make adjustments to the end-of-travel positions to overcome any device related issues (i.e. valve shaft incorrectly timed to the drive stem), the procedures outlined below should be followed to put the assembly into service. Note that there is a maximum adjustment range of +/- 3° at each end of travel.

Pages 8-9 - Travel limits for CW (CLOSED) & CCW (OPEN) positions, HRSN3 Series

Page 10 - Auxiliary switch cams for CW & CCW positions, HRSN3 Series

TECHNICAL INFORMATION

ACTUATOR SPECIFICATIONS		*Elo-NA8*	*Elo-NB9*
Supply	Torque Output (**lbf-in** / Nm)	**880** / 100	**1770** / 200
12VAC - 12VDC	Current Draw (Start / Run / LRA)	7.2A / 5.2A / 17.8A	7.2A / 5.2A / 17.8A
	Speed (90°) DC, seconds	14	28
	Motor - 12vdc Perm Magnet Brush Type	25W	25W
	Duty Cycle (on/off / mod)	75%	75%
	Motor Starts, per hour, Max	1200	1200
	Motor Protection, Temp / Class	135°C / Class F	135°C / Class F
24VAC - 24VDC	Current Draw (Start / Run / LRA)	4.2A / 3.2A / 11A	4.2A / 3.2A / 11A
	Speed (90°) DC, seconds	14	28
	Motor - 24vdc Perm Magnet Brush Type	25W	25W
	Duty Cycle (on/off / mod)	75%	75%
	Motor Starts, per hour, Max	1200	1200
	Motor Protection, Temp / Class	135°C / Class F	135°C / Class F
120V	Current Draw (Start / Run / LRA)	1.16A / 0.93A / 1.47A	1.16A / 0.93A / 1.47A
	Speed (90°) 60Hz / 50Hz, seconds	16 / 19	33 / 39
	Motor - 120vac Split-Phase Cap TENV	40W	40W
	Duty Cycle (on/off / mod)	25% / 75%	25% / 75%
	Motor Starts, per hour, Max	1200	1200
	Motor Protection, Temp / Class	135°C / Class F	135°C / Class F
230V	Current Draw (Start / Run / LRA)	0.54A / 0.42A / 0.66A	0.54A / 0.42A / 0.66A
	Speed (90°) 60Hz / 50Hz, seconds	16 / 19	33 / 39
	Motor - 230vac Split-Phase Cap TENV	40W	40W
	Duty Cycle (on/off / mod)	25% / 75%	25% / 75%
	Motor Starts, per hour, Max	1200	1200
	Motor Protection, Temp / Class	135°C / Class F	135°C / Class F
All	Environmental Rating	NEMA 4/4X/IP67	
	Electrical Entry (2)	3/4" EMT or ABS gland	
	Control	On/Off or Proportional	
	Ambient Operating Range	-22°F to +158°F / -30°C to +70°C	
	Humidity Range	0-95% RH	
	Altitude Limit	9850 ft / 3000 m	

CONVENTIONS USED IN THIS MANUAL

Below are Terms and Definitions used throughout this manual.

1. **XTS/TS** product manufactured without/with Torque Switches.
2. **XFS/FS** product manufactured without/with Fail Safe built-in.
3. **LCS** is an industry acronym for a Local Control Station.

Use this table to efficiently select the actuator and wiring diagram you require.

ACTUATOR OPTIONS

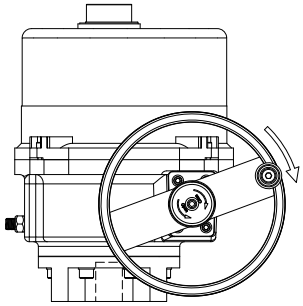
Control	Voltage	Torque Switches	Fail Safe	Local Control Station	IOM	Wiring Diagram Page
On/Off	12VDC/VAC	XTS/TS	XFS	None	This IOM	22
Proportional	12VDC/VAC	XTS/TS	XFS	None	This IOM	23
On/Off	24VDC/VAC	XTS/TS	XFS	None	This IOM	24
Proportional	24VDC/VAC	XTS/TS	XFS	None	This IOM	25
On/Off	120VAC	XTS/TS	XFS	None	This IOM	26
Proportional	120VAC	XTS/TS	XFS	None	This IOM	27
On/Off	230VAC	XTS/TS	XFS	None	This IOM	26
Proportional	230VAC	XTS/TS	XFS	None	This IOM	27
On/Off / Proportional	24VDC/VAC	XTS/TS	FS	None	HRSN3FSIOM	reference correct IOM
On/Off / Proportional	120-230VAC	XTS/TS	FS	None	HRSN3FSIOM	
On/Off / Proportional*	24VDC/VAC	XTS/TS	XFS	LCS	HRCK3IOM	
On/Off / Proportional	120-230VAC	XTS/TS	XFS	LCS	HRCK3IOM	

* No 24VDC/VAC can be equipped with HRCL/CD options

SHIPPING AND HANDLING

1. Position on arrival:
   - A separate actuator arrives in the FULLY CLOSED (CW) position. The red/green position indicator (see illustration) shows RED.
   - A 2 way ball valve assembly arrives in the FULLY OPEN (CCW) position and the position indicator shows GREEN.
   - A 2 way butterfly valve assembly arrives nearly CLOSED (5°) position and the position indicator shows mostly RED.
2. Storage: This unit should not be stored outside unless it is powered up and has proper conduit terminations. When not powered up, it should be stored in a clean, dry environment at all times.
3. This quarter-turn actuator has been factory tested and calibrated to operate between 0° and 90°. Most products will not require recalibration of these settings. If any travel adjustment is necessary, please refer to the Adjusting CW/CCW End of Travel section for instructions.
4. **Notice:** The HRSN3 Series actuators have mechanical stops which limit rotation. Do not attempt to operate with a rotation greater than 95°.
5. **Notice:** Protect the actuator from moisture by installing it with water tight EMT fittings and proper conduit drainage. Supply power to the unit to keep the internal heater warm at the time of installation.

The actuator has a red and green position indicator. RED color in the indicator window means the actuator is fully CW, while GREEN means it is fully CCW.



The manual override handwheel allows a user to position the valve or damper with or without power. Turn the handwheel CW to make the output drive move CW (when viewed from above). Turning the handwheel CCW makes the output drive turn CCW.

WARNING – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections.

INSTALLATION NOTES

CAUTION – Please follow the following guidelines for proper installation.

- These actuators are designed to be used between a horizontal and upright position. Do NOT mount the assembly with the actuator top below a horizontal position (i.e. upside down).
- When installing conduit, use proper techniques for entry into the actuator. Use drip loops to prevent conduit condensate from entering the actuator.
- Mechanical travel stops are factory calibrated for 90 degree operation. These stops are NOT designed to adjust mechanical rotation by more than +/- 3 degrees, they are for positioning the handwheel only.
- Both EMT conduit ports MUST use proper equipment to protect the NEMA 4X integrity of the housing.
- The internal heater is to be used in ALL applications.
- Do NOT install the actuator outdoors or in humid environments unless it is powered up and the heater is functioning.
- Use proper wire size to prevent actuator failure (see Wire Sizing Chart for proper wire sizing).
- All terminals accept 12-18AWG solid/stranded wire.
- **Notice:** Do NOT parallel wire multiple on/off actuators together without utilizing isolation relays. If this is your intention, please contact Flo-Tite for a multiple actuator parallel wiring diagram.

PRODUCT MOUNTING AND SETUP

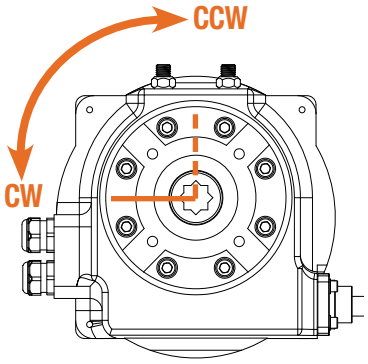
Notice: All HRSN3 Series actuators rotate CW to close the output shaft out the bottom of the actuator **when viewed from above.** On all HRSN3 models, the cam shaft and the indicator rotate CW to close as well.

1. Fully CLOSE the valve or damper to which the actuator is to be mounted.
2. Assemble necessary linkage hardware and attach the actuator to the valve or damper.
3. Center the actuator on the valve or damper drive shaft and tighten all hardware.
4. **Before applying power to the unit**, rotate the manual override handwheel from the fully CW to the fully CCW position to check for unobstructed manual operation of the valve or damper.
5. HRSN3 Series actuators utilize a removable terminal block to simplify field wiring and testing.
   - To remove a terminal block from the PCB receiver, pull straight out in a direction parallel to the PCB.
   - In the photo at right, the RIGHT side of either terminal block (between the PCB mounting screws) is pulled out to the RIGHT.
   - After wiring, reinsert the terminal strip into the receiver. This is a keyed pair and can only be inserted one way.
   - Screw terminals are rated to accept 14AWG down to 18AWG solid or stranded wire. **TERMINAL NUMBERING HAS #1 AT THE BOTTOM.**
6. Refer to your product part number to determine which wiring diagram to follow when wiring up the actuator.
7. Note that although terminals are labeled as 1-8 and A-D, not all terminals are used on all models.

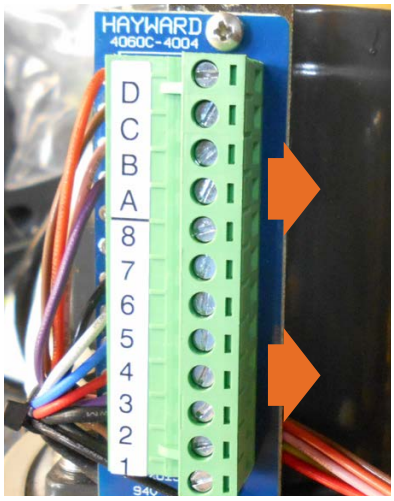
CAUTION – Be sure to make field connections to the proper terminal as identified by the LABEL and not the position!

8. Make the electrical connections per the appropriate Wiring Diagram for your actuator.
9. Connect POWER and CONTROL to the correct terminals.
10. Terminals A~D on each actuator are for the (adjustable) auxiliary switches. These are dry type (volt free) Form A contacts rated 250VAC @ 10A Max.
11. Select actuators covered in this manual are equipped with torque switches which protect the actuator motor and gear train. Torque switches protect controlled valves or actuators from damage in the event of a high torque condition. More information can be found throughout this manual.

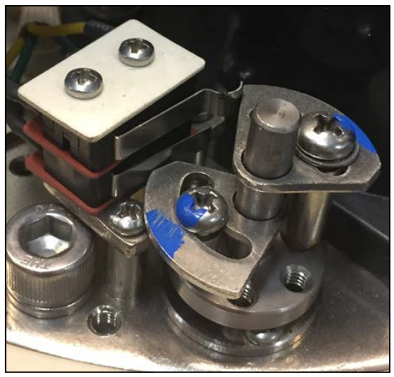
Notice: Torque switches are factory set and are not adjustable.



Note that the rotation seen from below is a mirror of the direction viewed from above.



Removable terminal blocks facilitate ease of field wiring and testing.To remove a terminal block from the PCB receiver, pull straight OUT in a direction parallel to the PCB. Use caution when reinserting block - make sure all pins are aligned before seating.



Torque Switch (TS) equipped products have a secondary set of cams/switches to protect the actuator, equipment and processes.

TORQUE SWITCHES

WARNING – Torque switches are factory set and are NOT ADJUSTABLE. Changing these settings will void the actuator warranty.

Torque Switch Operation

Select HRSN3 units have torque switches to protect the actuator and any attached equipment from possible damage which can occur in a high torque event. In such an event the valve or damper being driven encounters some blockage or impediment to travel. In the case of an actuator without torque switches, the actuator will attempt to drive until it either reaches the end of travel or (likely) the motor overworks and trips on a thermal overload. Units with torque switches will cease supplying power to the motor when a high torque event occurs.

Torque Switch cams and switches are shown in the normal operating position.

Torque Switch (Normal Mode)

1. In normal operating mode, the torque switch and drive cam are in the neutral position shown in the photo.
2. Internal gearing in line with the output drive provide the rotational action for the cams.
3. Upper torque switch protects CW rotation.
4. Lower torque switch protects CCW rotation.

Torque Switch cams shown with the upper cam tripping the upper switch (Actuator was driving CW before this trip)

Torque Event (CW)

1. The photo at left shows a high torque event in the CW direction
2. The torque switch CW drive cam (upper) and switch are in the tripped position.
3. When the torque switch trips, it immediately cuts off power flow to the motor for that direction of travel.

Torque Switch cams shown with the lower cam tripping the lower switch (Actuator was driving CCW before this trip)

Torque Event (CCW)

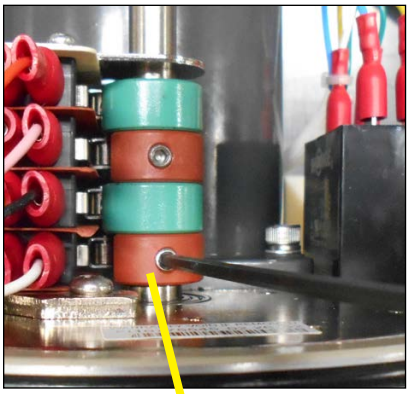
1. The photo at left shows a high torque event in the CCW direction
2. The torque switch CCW drive cam (lower) and switch are in the tripped position.
3. When the torque switch trips, it immediately cuts off power flow to the motor for that direction of travel.

ADJUSTING CW END OF TRAVEL

This actuator has been factory calibrated and tested to stop at 0 degrees for CW position and to stop at 90 degrees for CCW position. Most installations onto valves or dampers will likely not require recalibration of these settings. Please mount the valve or damper and proceed on these pages **only** if adjustments are required. Note that for most actuators these positions are independent - for instance the CW position is accurate while the CCW position might need adjustment.

WARNING – Serious Damage to the actuator will result if the motor is allowed to drive the gear train into the mechanical stop! Remove power from this device BEFORE making any travel adjustments.

CW Mechanical Stop



Cam 1 - CW Cam

CW Mechanical Stop

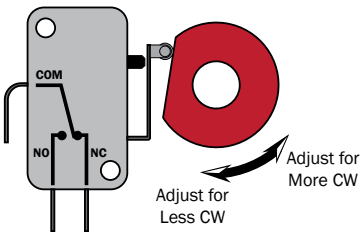
CAUTION! - The mechanical stop screw limits handwheel operation ONLY and is NOT to be used as an electrical travel limiting device.

Reposition Mechanical Stop

1. **Disconnect power.**
2. Loosen the RIGHT SIDE mechanical stop. This is the CW mechanical stop limit adjustment. Using a 17mm wrench and a 5mm hex key, hold the jam nut and turn the stop screw 5-6 turns CCW so it clears the mechanical boss inside the actuator.
   - This will allow you to adjust the cam/switch stop position without running into the mechanical stop screw.
3. Use the manual override handwheel to position the actuator to your required CW position. Keep all changes within +/- 3 degrees of the factory setting.

Adjust CW Cam (Bottom)

4. Cam 1 is the bottom cam (red) and is the end-of-travel adjustment for the actuator CW position. With POWER OFF and the actuator at its required CW position, use a sharp 2.5mm hex key to free up the cam set screw. **Take care not to let the hex key slip at this stage, it can easily strip out.** Once it is free adjust it as described below:
   - Rotate the hex key to the RIGHT 10-15 degrees until you hear a click. This will reset the switch roller arm.
   - Gently tighten (CW) the set screw only until slight pressure is felt. Ideally the set screw rides along the camshaft.
   - Now SLOWLY rotate the hex key to the LEFT, pushing the cam, until you hear the “click” on the bottom switch. The click means correct adjustment has been achieved.
   - Tighten the cam set screw.



CW Limit Switch
Shown in Full CW Position

5. **Apply power** and test for the correct CW position:
   - Drive the actuator CCW at least 15-20 degrees.
   - Drive the actuator CW until the cam stops the electrical travel.
   - Check to be sure this is the correct CW position you require. Repeat the steps of item 4 if further adjustment is needed.

Tighten Mechanical Stop

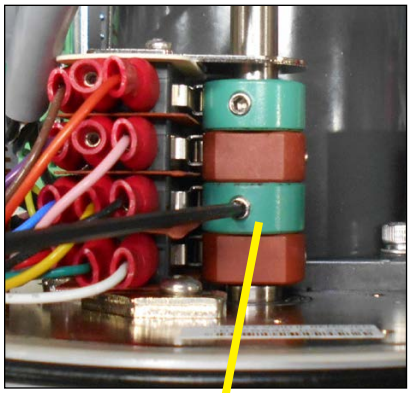
1. With the actuator in the proper position. Hold the 17mm wrench on the RIGHT SIDE jam nut to prevent the jam nut from locking and turn the 5mm hex key CW until the end of the stop screw bottoms out against the internal stop boss.
2. Turn the hex key ONE FULL TURN CCW and lock this position with the jam nut. Now the actuator will reach its end of travel electrically before there is any interference from the mechanical stop.
3. CW position calibration is now complete.

ADJUSTING CCW END OF TRAVEL

This actuator has been factory calibrated and tested to stop at 0 degrees for CW position and to stop at 90 degrees for CCW position. Most installations onto valves or dampers will likely not require recalibration of these settings. Please mount the valve or damper and proceed on these pages **only** if adjustments are required. Note that for most actuators these positions are independent - for instance the CW position is accurate while the CCW position might need adjustment.

WARNING – Serious Damage to the actuator will result if the motor is allowed to drive the gear train into the mechanical stop! Remove power from this device BEFORE making any travel adjustments.

CCW Mechanical Stop



Cam 2 - CCW Cam

CCW Mechanical Stop

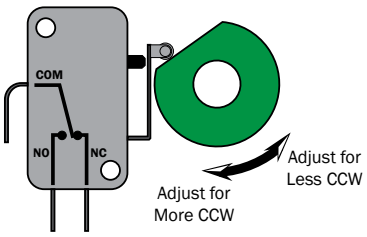
CAUTION! - The mechanical stop screw limits handwheel operation ONLY and is NOT to be used as an electrical travel limiting device.

Reposition Mechanical Stop

1. **Disconnect power.**
2. Loosen the LEFT SIDE mechanical stop. This is the CCW mechanical stop limit adjustment. Using a 17mm wrench and a 5mm hex key, hold the jam nut and turn the stop screw 5-6 turns CCW so it clears the mechanical boss inside the actuator.
   - This will allow you to adjust the cam/switch stop position without running into the mechanical stop screw.
3. Use the manual override handwheel to position the actuator to your required CCW position. Keep all changes within +/- 3 degrees of the factory setting.

Adjust CCW Cam (Second from Bottom)

4. Cam 2 is the second cam up from the bottom (green) and is the end-of-travel adjustment for the actuator CCW position. With POWER OFF and the actuator at its required CCW position, use a sharp 2.5mm hex key to free up the cam set screw. **Take care not to let the hex key slip at this stage, it can easily strip out.** Once it is free adjust it as described below:
   - Rotate the hex key to the LEFT 10-15 degrees until you hear a click. This will reset the switch roller arm.
   - Gently tighten (CW) the set screw only until slight pressure is felt. Ideally the set screw rides along the camshaft.
   - Now SLOWLY rotate the hex key to the RIGHT, pushing the cam, until you hear the “click” on the bottom switch. The click means correct adjustment has been achieved.
   - Tighten the cam set screw.



CCW Limit Switch
Shown in CCW Position

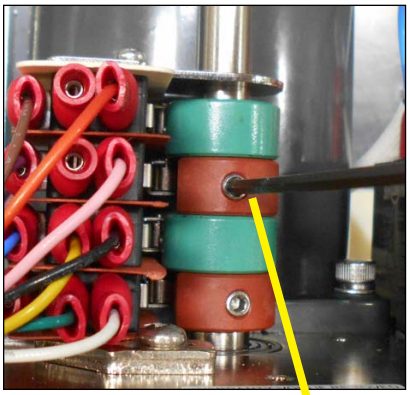
5. **Apply power** and test for the correct CCW position:
   - Drive the actuator CW at least 15-20 degrees.
   - Drive the actuator CCW until the cam stops the electrical travel.
   - Check to be sure this is the correct CCW position you require. Repeat the steps of item 4 if further adjustment is needed.

Tighten Mechanical Stop

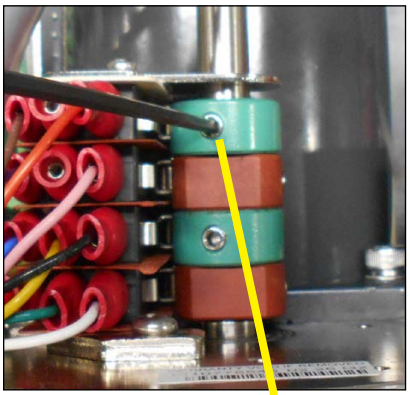
1. With the actuator in the proper position, hold the 17mm wrench on the LEFT SIDE jam nut to prevent the jam nut from locking and turn the 5mm hex key CW until the end of the stop screw bottoms out against the internal stop boss.
2. Turn the hex key ONE FULL TURN CCW and lock this position with the jam nut. Now the actuator will reach its end of travel electrically before there is any interference from the mechanical stop.
3. CCW position calibration is now complete.

ADJUSTING AUXILIARY SWITCHES

This actuator has been factory calibrated and tested to stop at 0 degrees for CW position and to stop at 90 degrees for CCW position. The Auxiliary Switch settings are based on those stops. Ideally the Auxiliary Switches are set a few degrees in advance of the respective stop switches, so if you had adjusted either the CW or CCW you may need to adjust these as well.

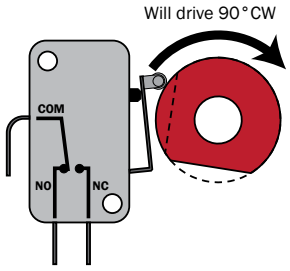


Cam 3 - CW Auxiliary Cam

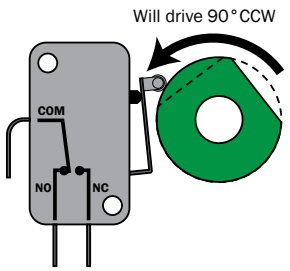


Cam 4 - CCW Auxiliary Cam

CAM BEHAVIOR



CW Limit Switch



CCW Limit Switch
Shown in Full CW Position

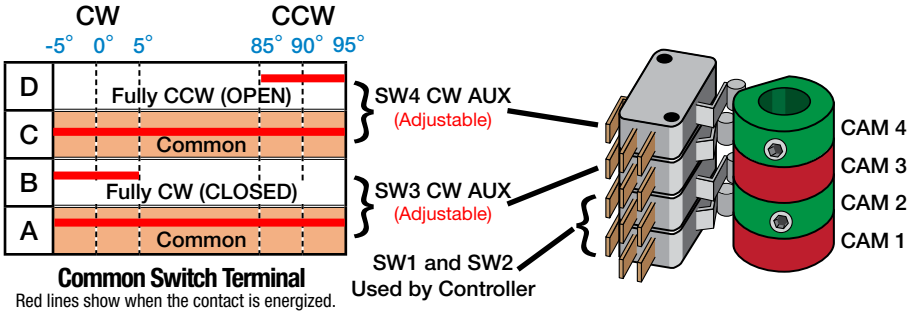
Adjust CW Auxiliary Cam

1. Cam 3 is the third cam up from the bottom (red) and is the CW auxiliary switch adjustment, an optional switch typically used to indicate the actuator reached its CW position.
2. Drive the actuator to its CW position. Use a sharp 2.5mm hex key to free up the cam set screw. **Take care not to let the hex key slip at this stage, it can easily strip out.** Once it is free adjust it as described below:
   - Rotate the hex key to the RIGHT 10-15 degrees until you hear a click. This will reset the switch roller arm.
   - Gently tighten (CW) the set screw only until slight pressure is felt. Ideally the set screw rides along the camshaft.
   - Now SLOWLY rotate the hex key to the LEFT, pushing the cam, until you hear the “click” on the bottom switch.
   - Continue to rotate the cam between 3 and 5 degrees to the LEFT to make sure the auxiliary cam switch changes state before the actuator reaches its end of travel electrically.
   - Tighten the cam set screw.

Adjust CCW Auxiliary Cam

1. Cam 4 is the fourth cam up from the bottom (green) and is the CCW auxiliary switch adjustment, an optional switch typically used to indicate the actuator reached its CCW position.
2. Drive the actuator to its CCW position. Use a sharp 2.5mm hex key to free up the cam set screw. **Take care not to let the hex key slip at this stage, it can easily strip out.** Once it is free adjust it as described below:
   - Rotate the hex key to the LEFT 10-15 degrees until you hear a click. This will reset the switch roller arm.
   - Gently tighten (CW) the set screw only until slight pressure is felt. Ideally the set screw rides along the camshaft.
   - Now SLOWLY rotate the hex key to the RIGHT, pushing the cam, until you hear the “click” on the bottom switch.
   - Continue to rotate the cam between 3 and 5 degrees to the RIGHT to make sure the auxiliary cam switch changes state before the actuator reaches its end of travel electrically.
   - Tighten the cam set screw.

AUXILIARY SWITCH CAM MAPPING



Common Switch Terminal
Red lines show when the contact is energized.

CALIBRATION

The end stop travel (cams) of this actuator have been factory set and tested to respond between 0° and 90° degrees rotation. If NO changes to end stops are required, this unit is ready to be put into service immediately using this procedure. IF changes to the cam positions are required, refer to pages 8 ~ 10 before proceeding.

⚠ *WARNING – Follow these directions carefully and in order. Actuator damage due to improper testing and commissioning will NOT be covered under warranty.*

Calibration Procedure - On/Off Control

1. Apply correct power according to the actuator model, referring to wiring diagrams.
2. Position the actuator to its full CCW (Open) and/or CW (Closed) positions and adjust the cams as necessary.
3. After making cam adjustments on either or both ends of travel, it is advisable to move off cam slightly, and then repeat the drive command to assure the cam settings are correct.
4. Be sure the cam setscrews are snug (overtightening during calibration will make it difficult to make minor incremental adjustments).
5. Unit is now calibrated and is ready to be put into service. No other calibration is necessary.

⚠ *WARNING – Serious Damage to the actuator will result if the motor is allowed to drive the gear train into the mechanical stop! Remove power from this device BEFORE making any travel adjustments.*

COMMISSIONING

Commissioning Procedure - On/Off Control

1. Utilize the handwheel or override shaft to rotate the actuator and damper, valve or other connected device through its full travel from full CW to full CCW and back again to check for any possible interference. Do NOT utilize any mechanical advantage devices to rotate the handwheel (pipes, wrenches, extension bars, etc.).
2. Manually position the actuator to its mid-stroke position.
3. Apply correct power to the unit.
4. Measure correct power and polarity on terminals 1 & 2 AT THE MAIN TERMINAL BLOCK.
5. Command the field device to generate a CCW signal. The actuator rotates in a CCW direction (as viewed from above).
6. Measure terminals 2 and 6 (Run CCW) for correct voltage (matching that measured in step 4).
7. Actuator will stop when it reaches it's full CCW position.
8. With field command signal still present, measure terminals 2 and 5 and read voltage to match that measured in step 4.
9. Read continuity between terminals C & D to show the CCW Aux switch is closed.
10. Command the field device to generate a CW signal. The actuator rotates in a CW direction (as viewed from above).
11. Measure terminals 2 and 4 (Run CW) for correct voltage (matching that measured in step 4).
12. Actuator will stop when it reaches it's full CW position.
13. With field command signal still present, measure terminals 2 and 3 and read voltage to match that measured in step 4.
14. Read continuity between terminals A & B to show the CW Aux switch is closed.
15. Generate a mid-position signal at the field device to move the actuator off its full CW trip position.
16. Return Field control to automatic mode.
17. Actuator is now commissioned and operational.

PROPORTIONAL CALIBRATION

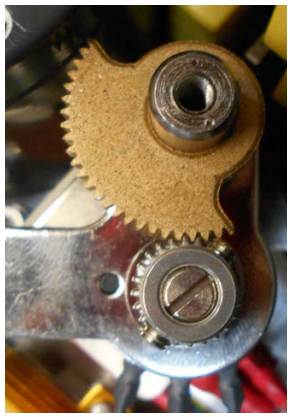
The end stop travel (cams) of this actuator have been factory set and tested to respond between 0° and 90° degrees rotation. If NO changes to end stops are required, this unit is ready to be put into service immediately using this procedure. IF changes to the cam positions are required, refer to pages 8 ~ 10 before proceeding.

⚠ ***WARNING – Follow these directions carefully and in order. Actuator damage due to improper testing and commissioning will NOT be covered under warranty.***

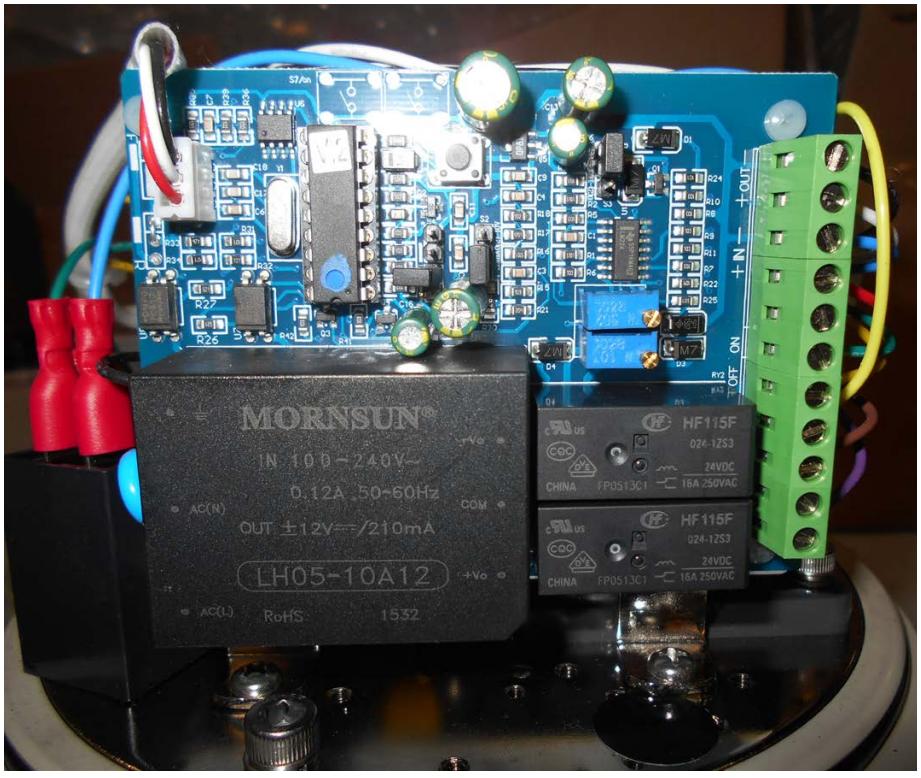
Calibration Procedure - Proportional Control

After completing all mounting and wiring procedures and main power is available, it is now possible to commission the actuator.

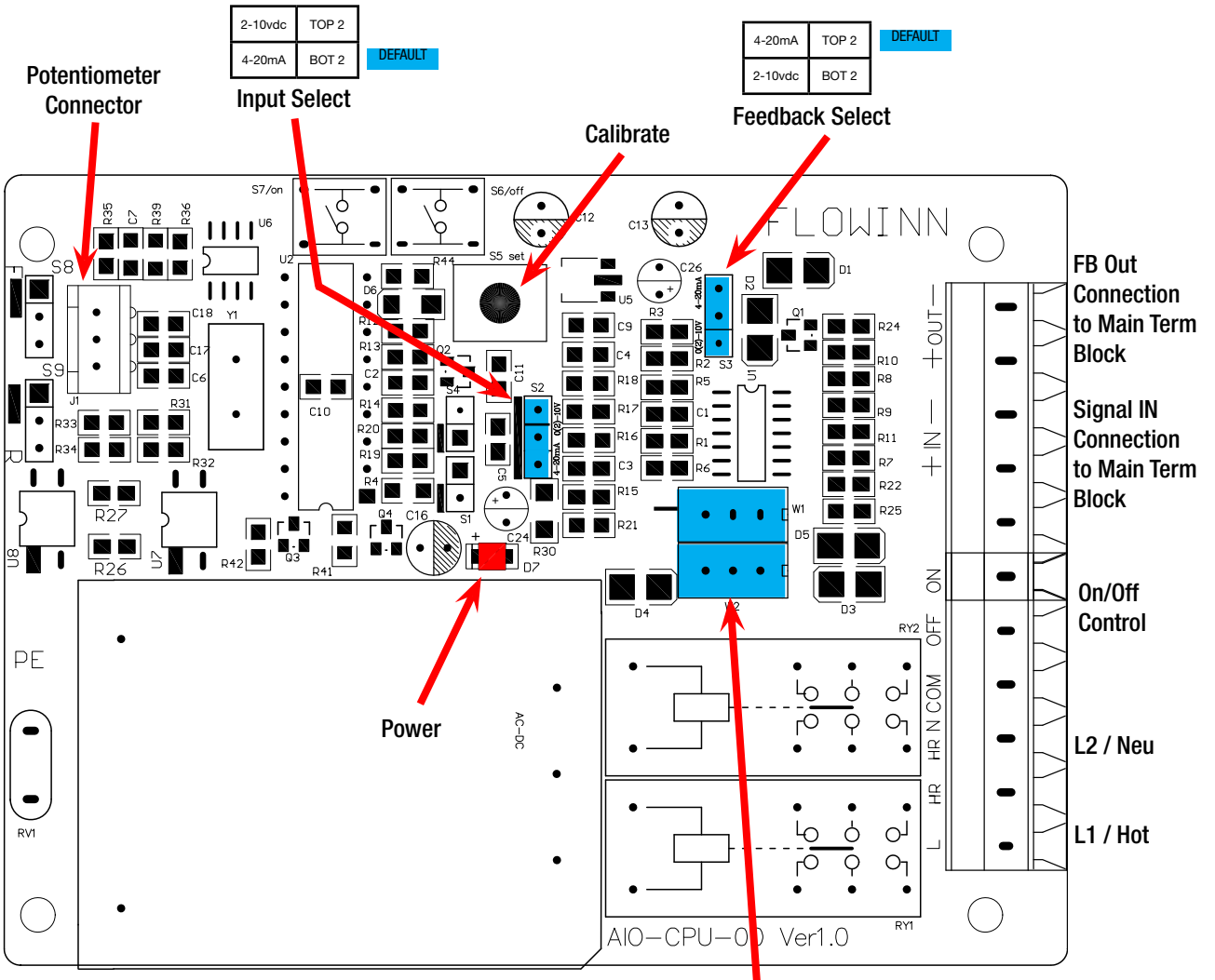
1. Before applying power or making any wiring connections:
2. Set the geartrain in the full CW position.
3. Set the #1 and #3 cams according to the on/off procedure.
4. Set the unit in the full CCW position.
5. Set the #2 and #4 cams according to the on/off procedure.
6. Set the geartrain back to the fully closed (CW) position.
7. Make your field wiring connections for power, control and feedback signals, referring to the correct wiring diagrams for your product.
   A. Connections are made ONLY TO THE MAIN TERMINAL BLOCK.
   B. No connections are made to the proportional control board directly.
8. Set the jumper headers for correct signal IN and OUT. (ref next page)
9. Rotate the potentiometer pinion gear to its full CCW position, then back about 1.5~2 teeth CW before tightening the two M3 setscrews on the sector drive gear.
10. Apply correct power according to the actuator model.
    A. The red PWR LED will turn on.
11. Press the "Calibrate" black pushbutton on the Mod control board and hold it down for about three seconds, then release.
    A. The unit will run to its full CCW position, stop for a few seconds, then run back to its full CW position.
12. After a few seconds, the unit will complete the calibration routine and will return to active operation mode by responding to the incoming 4-20mA control signals being sent to the actuator.
13. Slight adjustments may be made to the 4mA and 20mA trimmers to affect accuracy on the feedback signal as a function of actuator position.
14. Unit is now calibrated and is ready to be put into service. No other calibration is necessary.



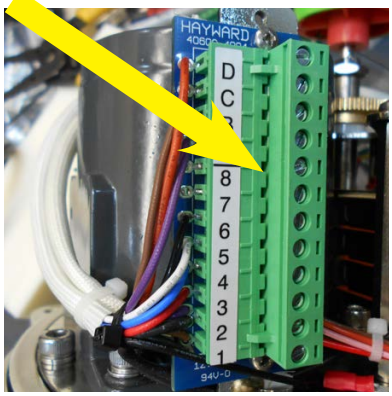
Alignment of the sector and potentiometer gear sets at actuator full CW position. (ref step 9).

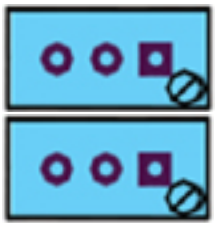


CALIBRATION - CONTINUED



Make all connections to the MAIN terminal block ONLY!





to DECREASE 20mA Feedback Output

to DECREASE 4mA Feedback Output

PROPORTIONAL CALIBRATION

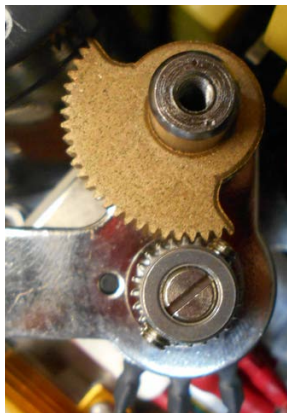
The end stop travel (cams) of this actuator have been factory set and tested to respond between 0° and 90° degrees rotation. If NO changes to end stops are required, this unit is ready to be put into service immediately using this procedure. IF changes to the cam positions are required, refer to pages 8 ~ 10 before proceeding.

⚠ ***WARNING – Follow these directions carefully and in order. Actuator damage due to improper testing and commissioning will NOT be covered under warranty.***

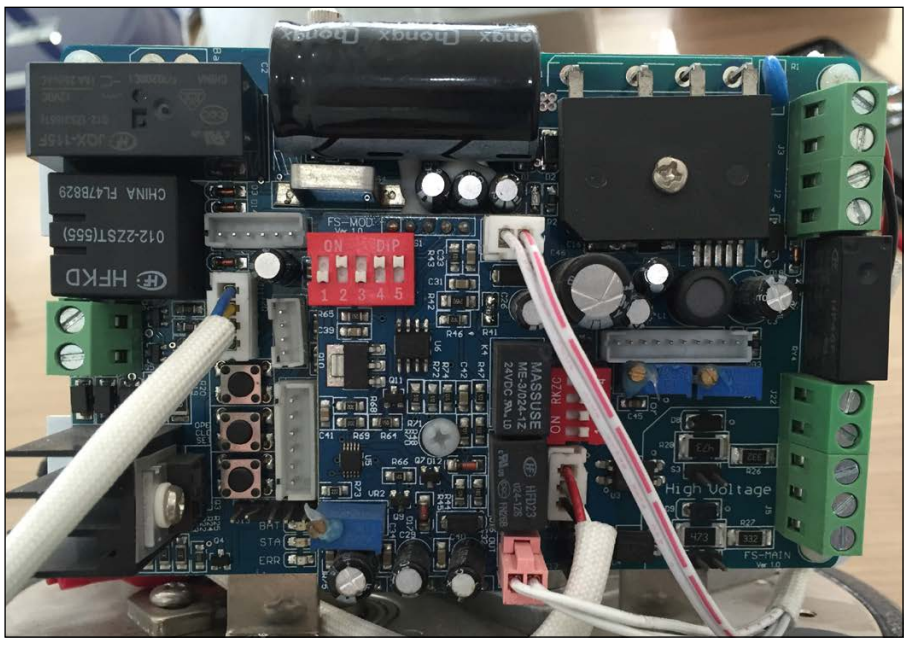
Calibration Procedure - Proportional Control

After completing all mounting and wiring procedures and main power is available, it is now possible to commission the actuator.

1. Before applying power or making any wiring connections:
2. Set the geartrain in the full CW position.
3. Set the #1 and #3 cams according to the on/off procedure.
4. Set the unit in the full CCW position.
5. Set the #2 and #4 cams according to the on/off procedure.
6. Set the geartrain back to the fully closed (CW) position.
7. Make your field wiring connections for power, control and feedback signals, referring to the correct wiring diagrams for your product.
   A. Connections are made ONLY TO THE MAIN TERMINAL BLOCK.
   B. No connections are made to the proportional control board directly.
8. Set the DIP switches for correct signal IN and OUT. (ref next page)
9. Rotate the potentiometer pinion gear to its full CCW position, then back about 1.5~2 teeth CW before tightening the two M3 setscrews on the sector drive gear.
10. Apply correct power according to the actuator model.
    A. The blue LED D1 will turn on, and grn LED STA will turn on.
11. Press the “SET” black pushbutton on the Mod control board and hold it down for about three seconds, then release.
    A. The grn STA LED will turn off and the unit will drive to the full CCW (Open) position and stop when the pre-set cam positions are reached. There are NO LED indicators to advise when the actuator is running.
12. When the actuator stops, press the OP pushbutton ONCE.
    A. The actuator will drive to its full CW (Closed) position and stop when the pre-set cam postions are reached.
13. When the actuator stops, press the CL pushbutton ONCE.
14. The unit will start to respond to the incoming 4-20mA control signal being sent to the actuator.
15. Slight adjustments may be made to trimmer VR2 if necessary to tune the feedback signal.
16. Unit is now calibrated and is ready to be put into service. No other calibration is necessary.



Alignment of the sector and potentiometer gear sets at actuator full CW position. (ref step 9).

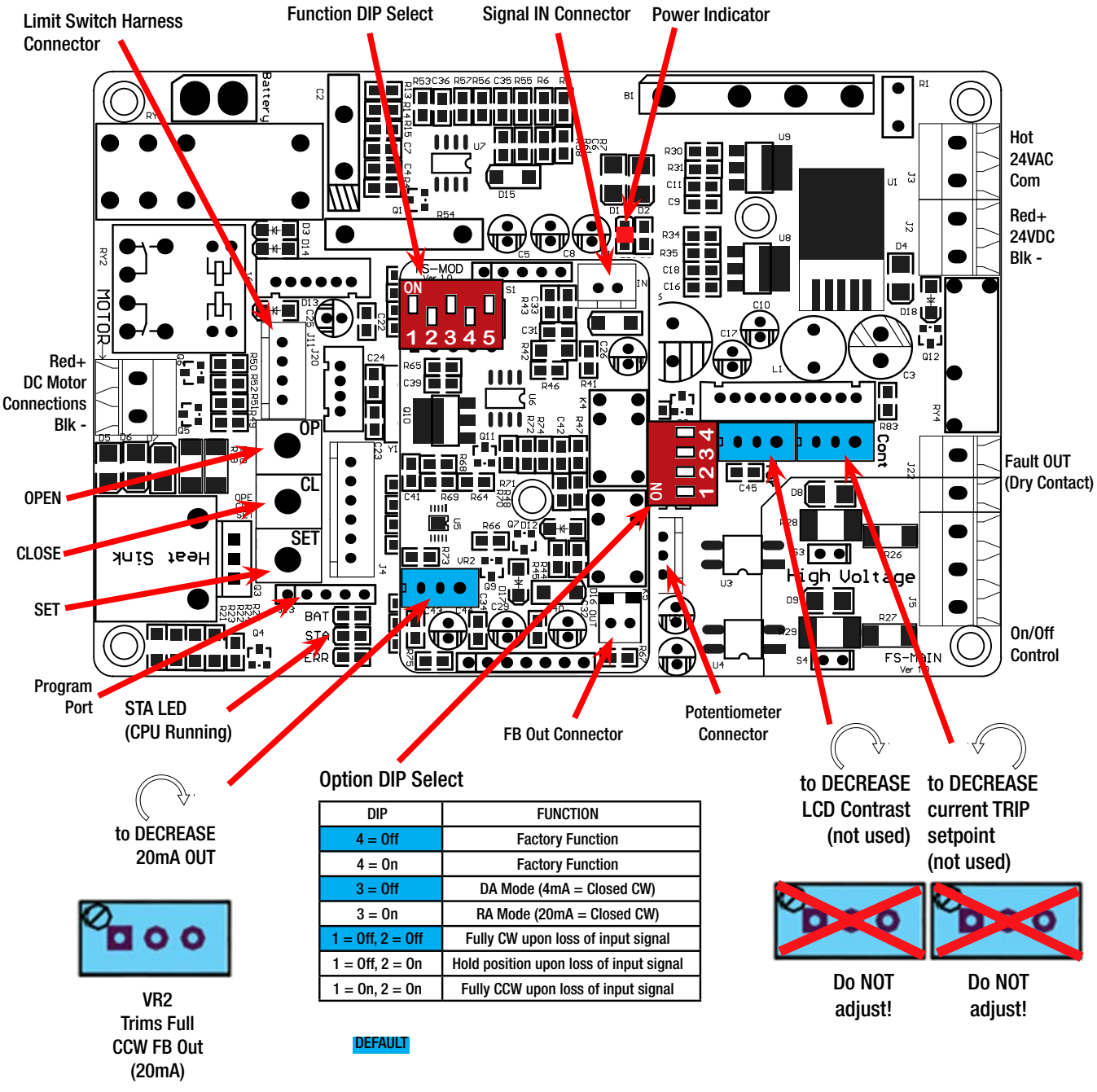


CALIBRATION - CONTINUED

Function DIP Select

DEFAULT

DIP	ON	OFF	FUNCTION
1	4-20mA	0(2)-10V	Input
2	0-10V	2-10V/4-20mA	
3	4-20mA	0(2)-10V	Feedback
4	0-10V	2-10V/4-20mA	
5	Mod	On/Off	Control



Option DIP Select

DIP	FUNCTION
4 = Off	Factory Function
4 = On	Factory Function
3 = Off	DA Mode (4mA = Closed CW)
3 = On	RA Mode (20mA = Closed CW)
1 = Off, 2 = Off	Fully CW upon loss of input signal
1 = Off, 2 = On	Hold position upon loss of input signal
1 = On, 2 = On	Fully CCW upon loss of input signal

DEFAULT

COMMISSIONING

Commissioning Procedure - Proportional Control

After completing all mounting and wiring procedures and main power is available, it is now possible to commission the actuator.

1. Utilize the handwheel or override shaft to rotate the actuator and damper, valve or other connected device through its full travel from full CW to full CCW and back again to check for any possible interference. Do NOT utilize any mechanical advantage devices to rotate the handwheel (pipes, wrenches, extension bars, etc.).
2. Manually position the actuator to its mid-stroke position.
3. Apply correct power to the unit.
4. Measure correct power and polarity on terminals 1 & 2 AT THE MAIN TERMINAL BLOCK.
5. Command the field device to generate a 20mA (10vdc) signal. The actuator OUTPUT shaft rotates in a CCW direction (as viewed from above) and stops at the full CCW (Open) position.
6. Measure terminals 5 (+) and 6 (-) to read 20mA (10vdc).
7. Read continuity between terminals C & D to show the CCW Aux switch is closed.
8. Command the field device to generate a 4mA (2vdc) signal . The actuator OUTPUT shaft rotates in a CW direction (as viewed from above) and stops at the full CW (Closed) position.
9. Measure terminals 5 (+) and 6 (-) to read 4mA (2vdc).
10. Read continuity between terminals A & B to show the CW Aux switch is closed.
11. Generate a 12mA (6vdc) signal at the field device to move the actuator to its mid-travel position.
12. Actuator stops at 50% travel, and feedback measuers 12mA (6vdc) +/- tolerance error if any (single decimal).
13. Return Field control to automatic mode. Actuator is now commissioned and operational.

TROUBLESHOOTING

⚠ ***WARNING – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections. If it is necessary to troubleshoot with live power to the actuator, please use EXTREME CAUTION, and follow your company's safety protocols and procedures at all times.***

After completing all mounting and wiring procedures and main power is available, if the actuator does NOT respond as expected, the following procedure(s) may help in identifying the problem.

Symptom	Target	Action
Actuator does not move when commanded to do so.	Power Source	Measure incoming power AT the actuator terminal block. Reference the correct wiring diagram.
	Control Problem	Generate move commands by the field device. Measure correct voltage changes between HOT and terminal #6 (CCW) and HOT and terminal #4 (CW).
	Wire Sizing	Check for correct wire size per Wire Sizing Chart.
Supply and controls are measured to be correct, but actuator still does not move.	Overtorque	Remove the actuator from the driven device. If the actuator now moves, the torque required by the mechanical device exceeds that of the actuator. Increase actuator size.
		With the actuator removed from the mechanical equipment, manually rotate the valve or damper through its intended range of travel to check for mechanical problems.
	Insufficient power supply and/or incorrect wire size during installation.	Measure the voltage between terminals 1 & 2 WHILE commanding the actuator to move. The measured voltage cannot drop more than 10%.
	Cams improperly set.	REMOVE POWER. Check to see if cams rotate freely on the cam shaft using your finger. Cams MUST be secure and set according to the procedures in the Adjusting CW/CCW End of Travel section.
Motor is extremely hot to the touch.	Control “noise” or excessive duty cycle	Check for stray voltage fluctuations on the incoming control signals. The on/off line voltage actuators have a maximum 25% duty cycle. While the low voltage models have a 75% duty cycle.
		Check for parallel wiring of multiple on/off actuators. Review the site as-built wiring diagrams to verify.
Actuator does not stop at correct position at either end of travel	Travel cams and/or mechanical stops not positioned correctly	Reset end-of-travel cams and/or mechanical stops as detailed in the Adjusting CW/CCW End of Travel section.

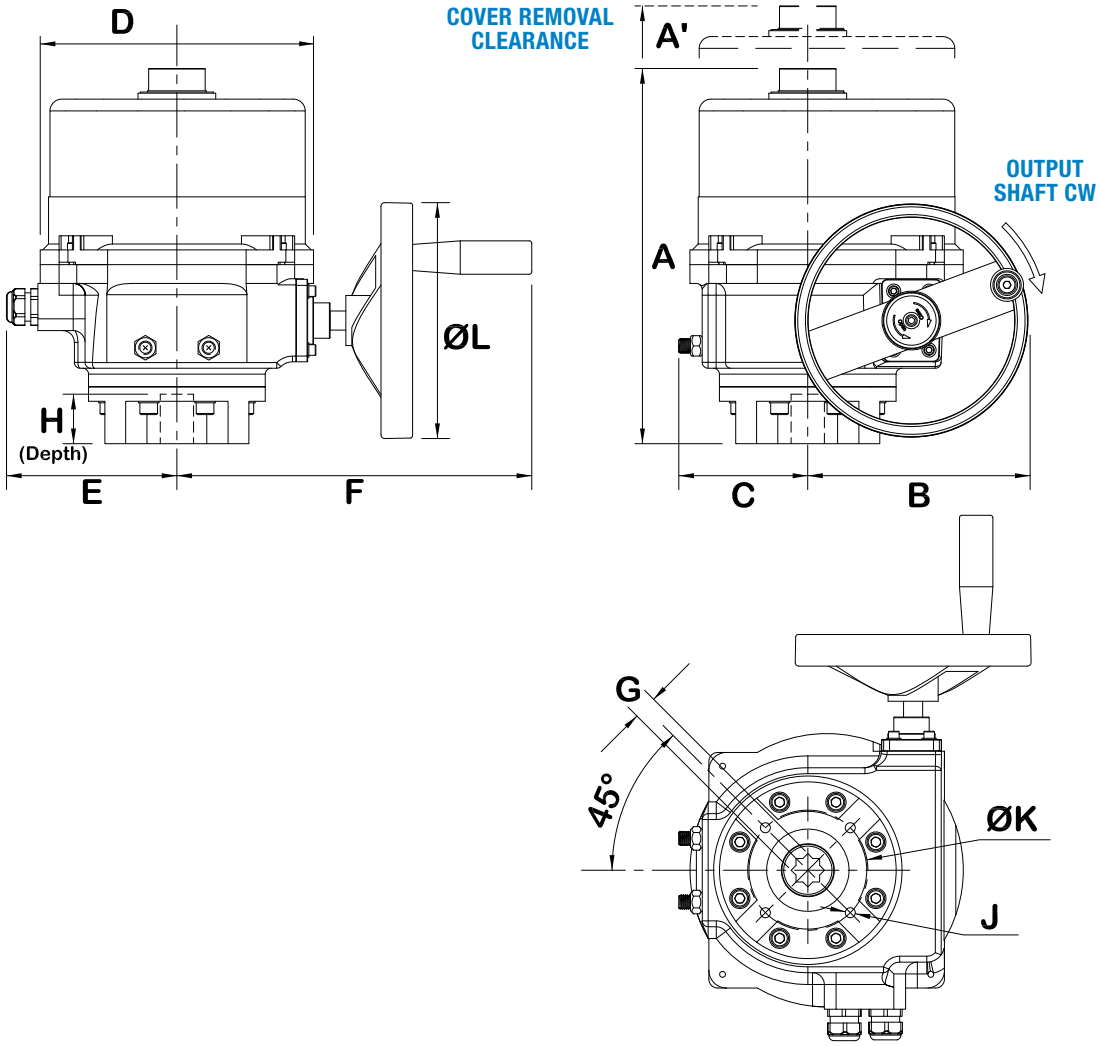
TROUBLESHOOTING

⚠ ***WARNING – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections. If it is necessary to troubleshoot with live power to the actuator, please use EXTREME CAUTION, and follow your company's safety protocols and procedures at all times.***

After completing all mounting and wiring procedures and main power is available, if the actuator does NOT respond as expected, the following procedure(s) may help in identifying the problem.

Symptom	Target	Action
Actuator does not move when commanded to do so.	Power Source	Measure incoming power AT the actuator terminal block. Reference the correct wiring diagram.
	Control Problem	Generate move commands by the field device. For most analog control systems, reversing the polarity will render the control system output as invalid. Check the polarity of the analog control signals as they are connected to the actuator. The actuator will NOT respond to inverted control signals.
	Wire Sizing	Check for correct wire size per Wire Sizing Chart.
Supply and controls are measured to be correct, but actuator still does not move.	Overtorque	Remove the actuator from the driven device. If the actuator now moves, the torque required by the mechanical device exceeds that of the actuator. Increase actuator size.
		With the actuator removed from the mechanical equipment, manually rotate the valve or damper through its intended range of travel to check for mechanical problems.
	Insufficient power supply and/or incorrect wire size during installation.	Measure the voltage between terminals 1 & 2 WHILE commanding the actuator to move. The measured voltage cannot drop more than 10%.
	Cams improperly set.	REMOVE POWER. Check to see if cams rotate freely on the cam shaft using your finger. Cams MUST be secure and set according to the procedures in the Adjusting CW/CCW End of Travel section.
Motor is extremely hot to the touch.	Control “noise” or excessive duty cycle	Check for stray voltage fluctuations on the incoming control signals. Analog control signals are succeptable to “noise” and send unstable control data to the actuator. This results in a never-ending motor drive scenario with the usual result being thermal overload of the drive motor.
		Check for parallel wiring of multiple on/off actuators. Review the site as-built wiring diagrams to verify.
Actuator does not stop at correct position at either end of travel	Travel cams and/or mechanical stops not positioned correctly	Reset end-of-travel cams and/or mechanical stops as detailed in the Adjusting CW/CCW End of Travel section.

MECHANICAL DATA

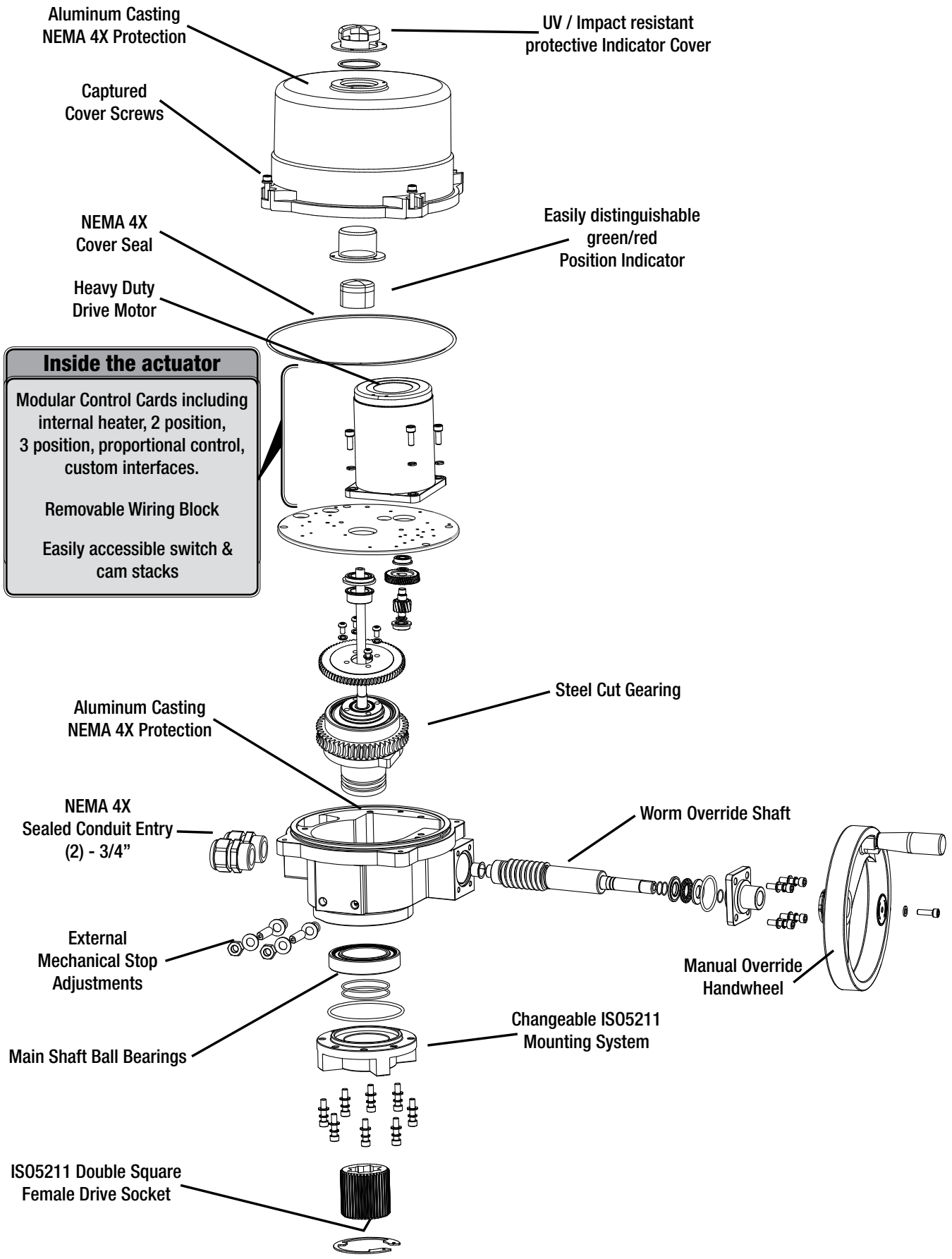


DIMENSIONS

MODEL	A in/mm	A' in/mm	B in/mm	C in/mm	D in/mm	E in/mm	F in/mm	G* in/mm	H in/mm	J* in/mm	K* in/mm	L		WEIGHT lbs/kg
Elo-NA8	10.45/265	6/150	4.85/123	3.11/79	8.50/216	4.73/120	9.45/240	0.669/17	1.38/35	(4) M8-1.25 X 20mm Deep	F07 2.756/70	4.7 / 120	12.5 turns 90°	24.5/11
Elo-NB9	10.45/265	6/150	4.85/123	3.11/79	8.50/216	4.73/120	9.45/240	0.669/17	1.38/35	(4) M8 1.25 X 20mm Deep	F07 2.756/70	4.7 / 120	12.5 turns 90°	24.5/11

*Consult Flo-Tite for optional ISO patterns

EXPLODED VIEW



WIRE SIZING CHART

Wire sizing data is provided in the table below to assist in the selection of the proper wire size for HRSN3 Series actuators using various wire sizes over distance. Be sure to reference the correct voltage and do not exceed the indicated length of the wire run for each model.

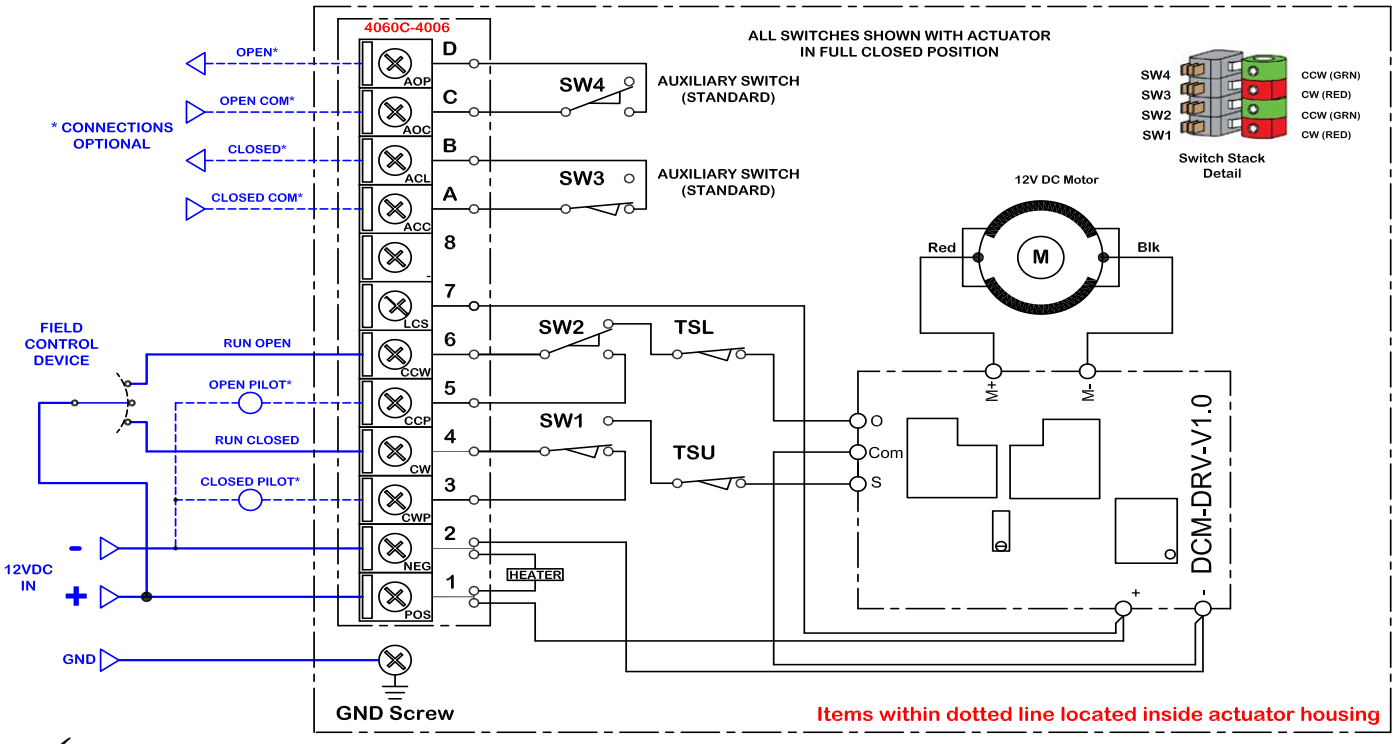
> ***WARNING – To avoid dangerous or fatal electrical shock, turn OFF power to all electrical equipment before working on electrical connections.***

Maximum distance between Actuator and Power Supply (ft)

ACTUATOR	Elo-NA8C	Elo-NB9C	Elo-NA8F	Elo-NB9F	Elo-NA8K	Elo-NB9K	Elo-NA8L	Elo-NB9L
Voltage	**12VAC/VDC**	**12VAC/VDC**	**24VAC/VDC**	**24VAC/VDC**	**120VAC**	**120VAC**	**230VAC**	**230VAC**
AWG \ Amps	7.2	7.2	4.2	4.2	1.16	1.16	0.54	0.54
18	-	-	39	39	712	712	2933	2933
16	18	18	62	62	1120	1120	4610	4610
14	29	29	100	100	1809	1809	7446	7446
12	45	45	153	153	2766	2766	11388	11388
10	76	76	260	260	4702	4702	19360	19360
8	133	133	388	388	7018	7018	28896	28896

WIRING DIAGRAMS

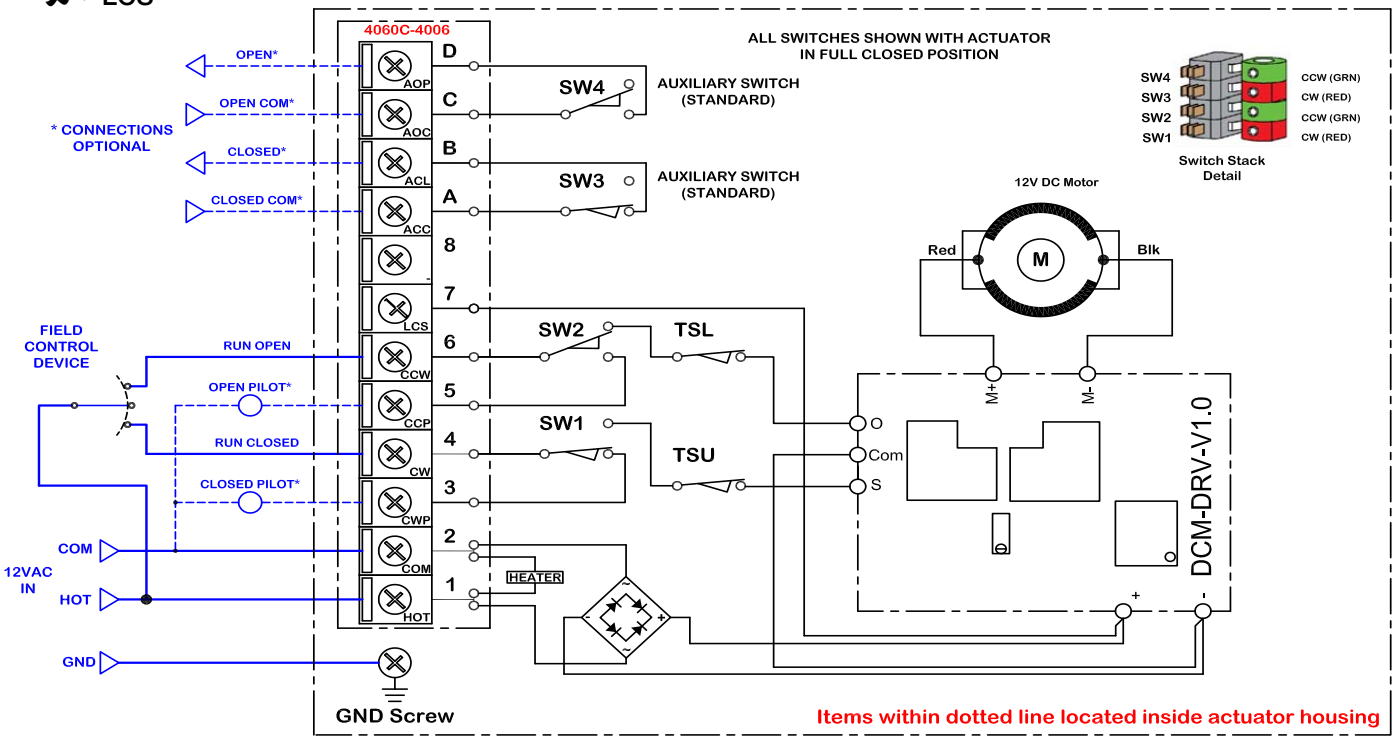
Elo-NA8C/Elo-NB9 12vdc On/Off



- ✓ • On/Off Control
- ✓ ✘ • Torque Switches
- ✘ • Battery Backup
- ✘ • LCS

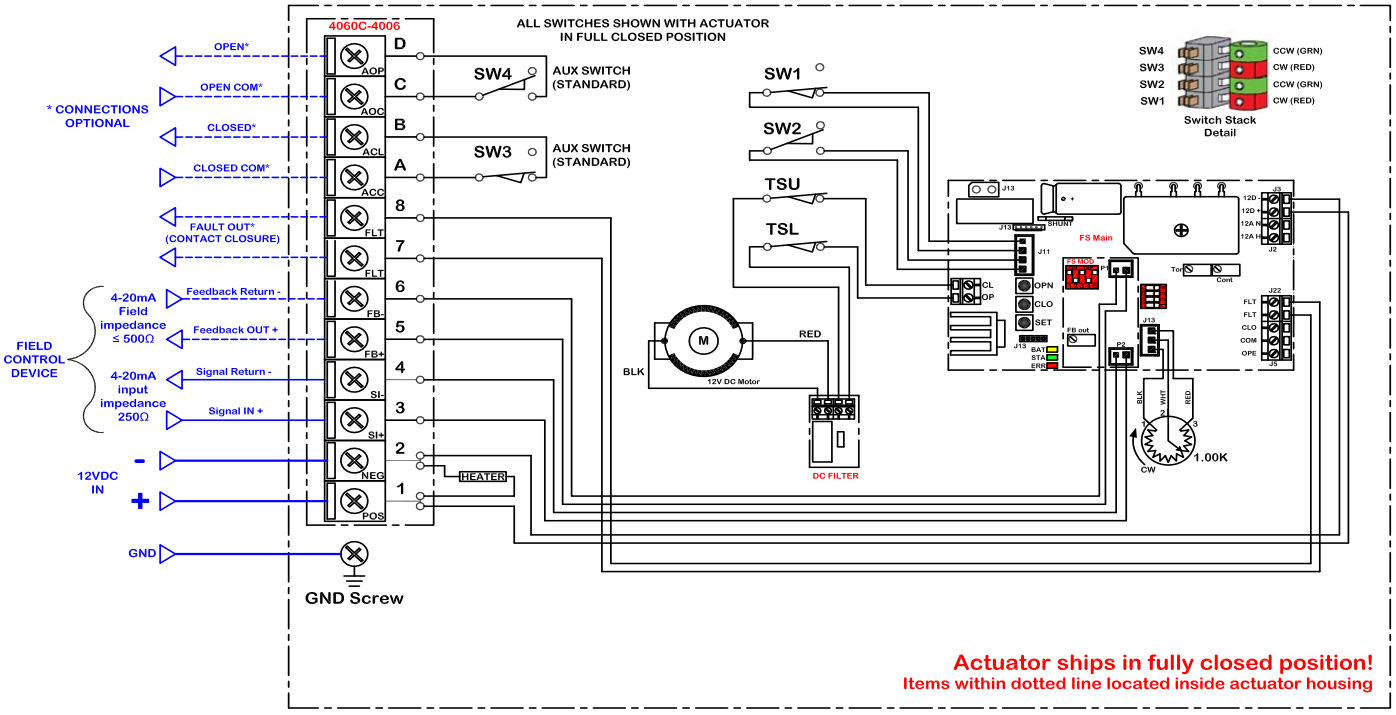
Wiring diagrams are shown with torque switches. Models without torque switches have those switches bypassed in the diagrams.

Elo-NA8B/Elo-NB9 12vac On/Off



WIRING DIAGRAMS

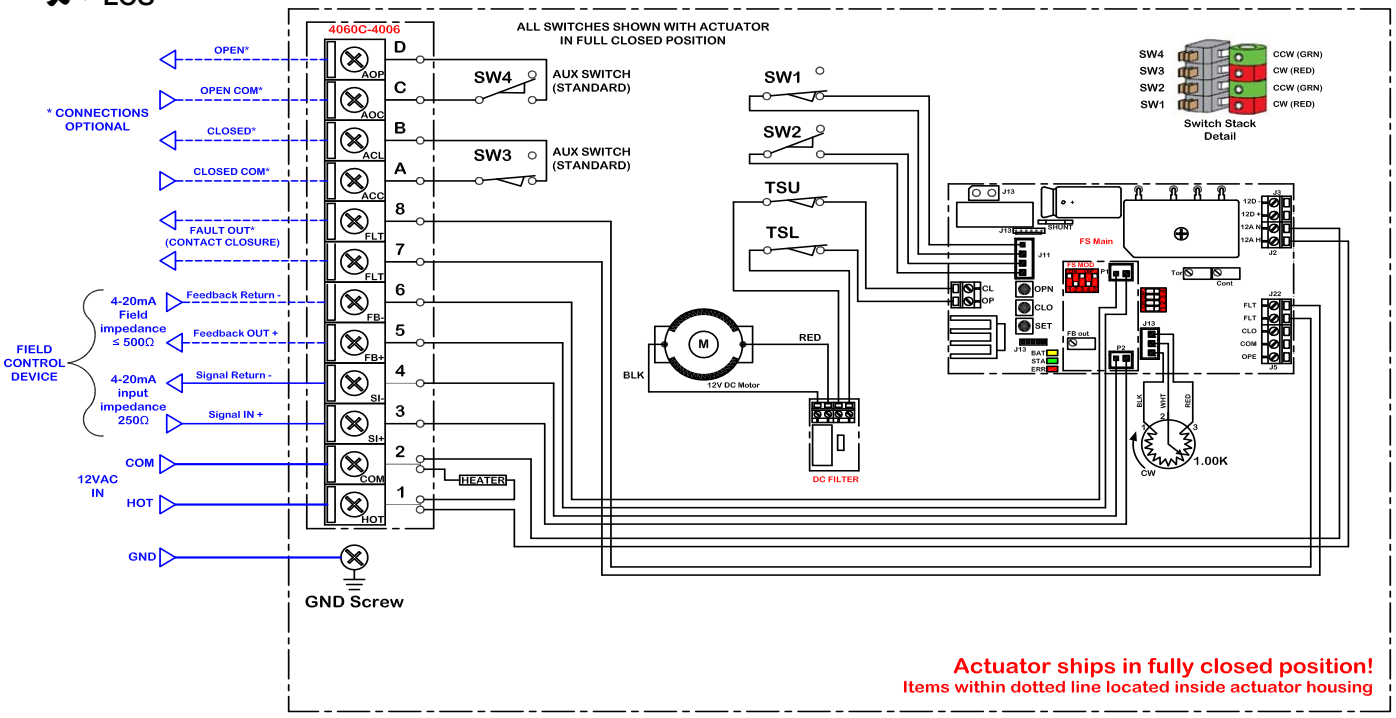
Elo-NA8C8/Elo-NB0 12vdc Proportional



- ✓ • Proportional Control
- ✓ ✗ • Torque Switches
- ✗ • Battery Backup
- ✗ • LCS

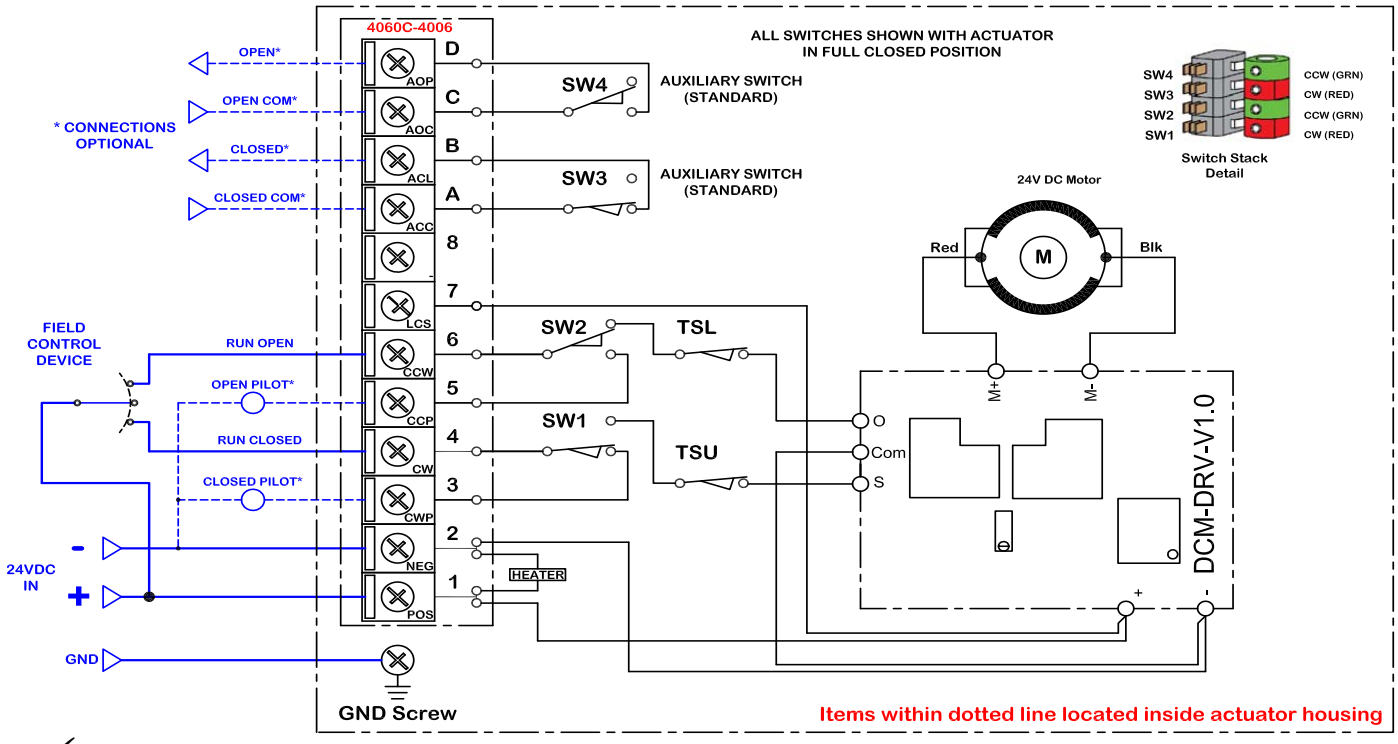
Wiring diagrams are shown with torque switches. Models without torque switches have those switches bypassed in the diagrams.

Elo-NA8B8/Elo-NB9 12vac Proportional



WIRING DIAGRAMS

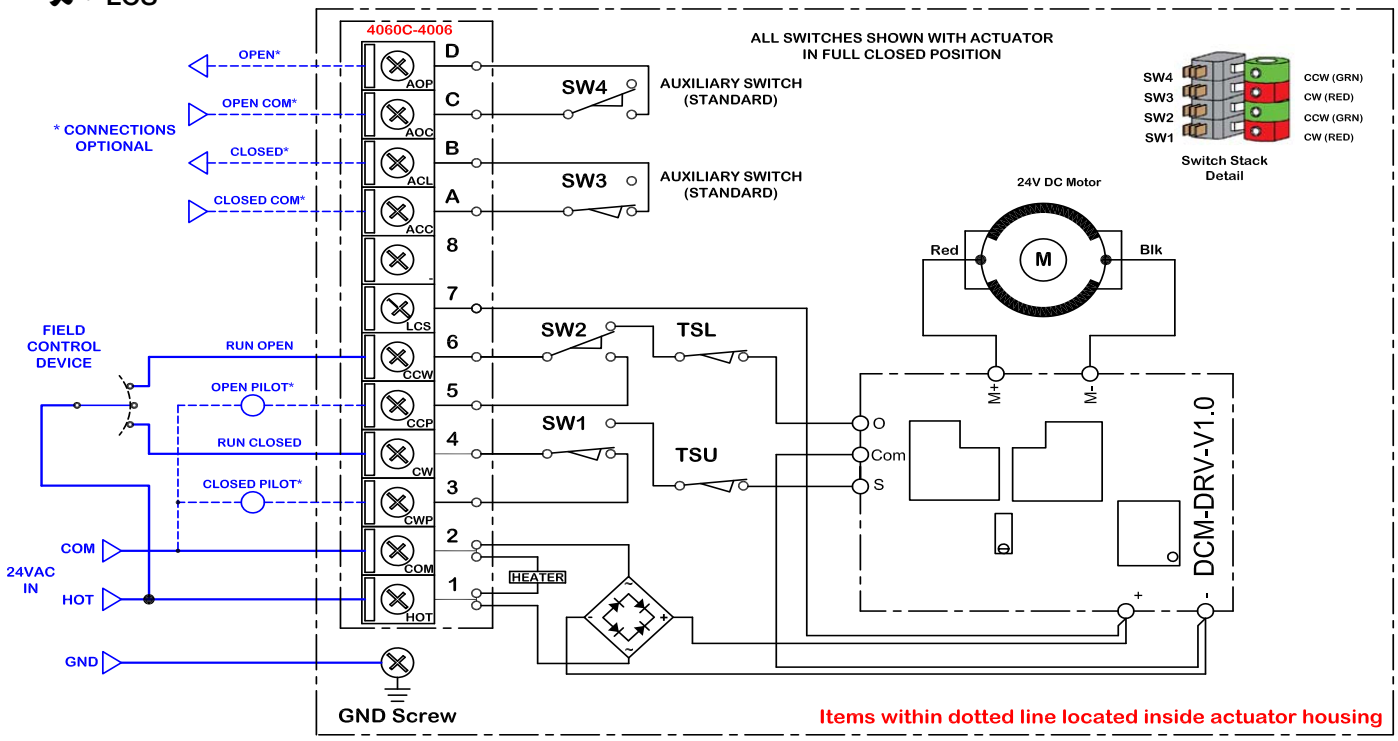
Elo-NA8D/Elo-NB5 24vdc On/Off



- ✓ • On/Off Control
- ✓ ✘ • Torque Switches
- ✘ • Battery Backup
- ✘ • LCS

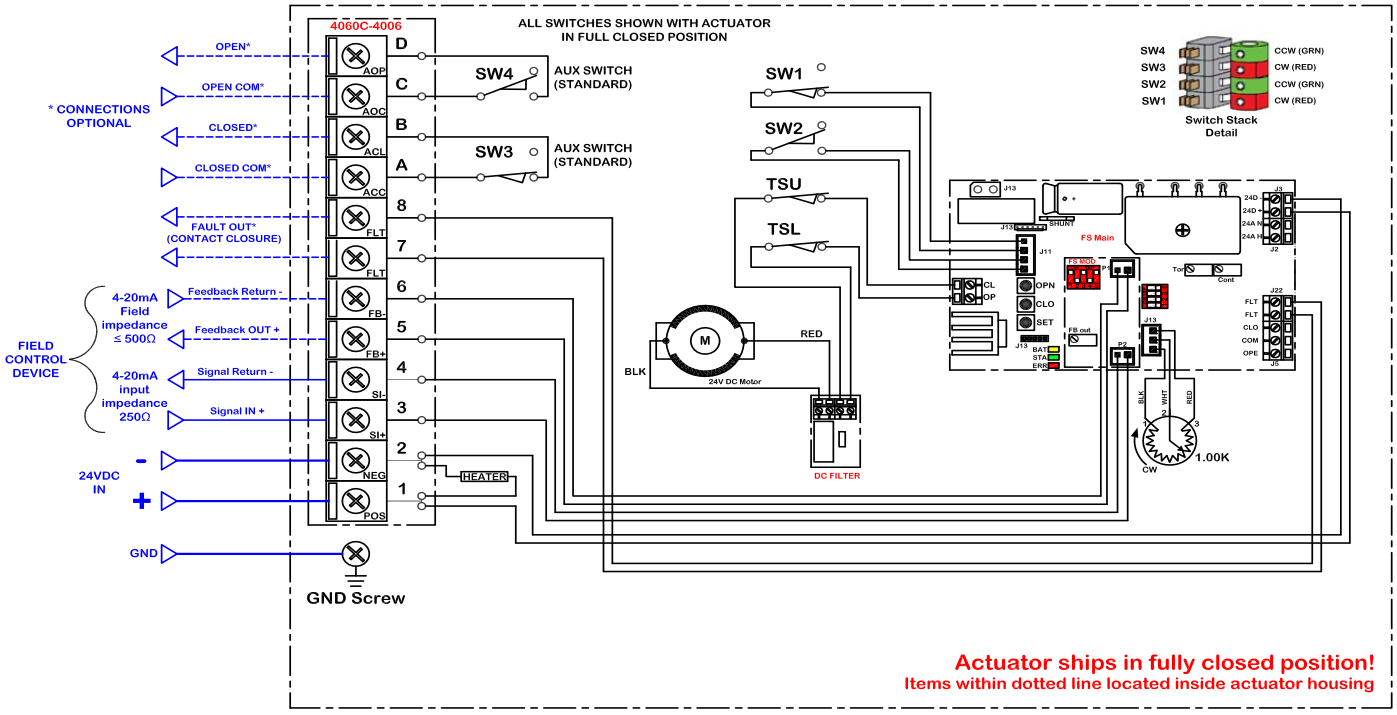
Wiring diagrams are shown with torque switches. Models without torque switches have those switches bypassed in the diagrams.

Elo-NA8E/Elo-NB9 24vac On/Off



WIRING DIAGRAMS

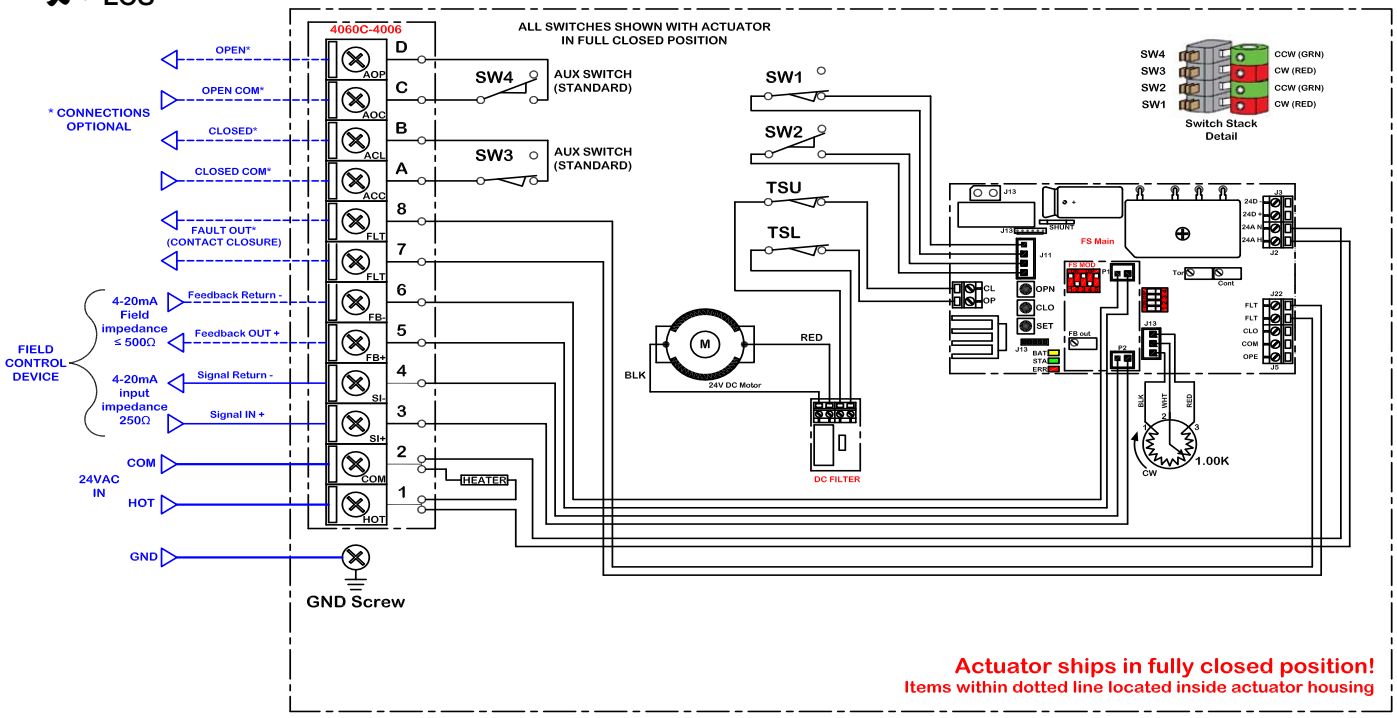
Elo-NA8F8/Elo-NB9 24vdc Proportional



- ✓ • Proportional Control
- ✓ ✘ • Torque Switches
- ✘ • Battery Backup
- ✘ • LCS

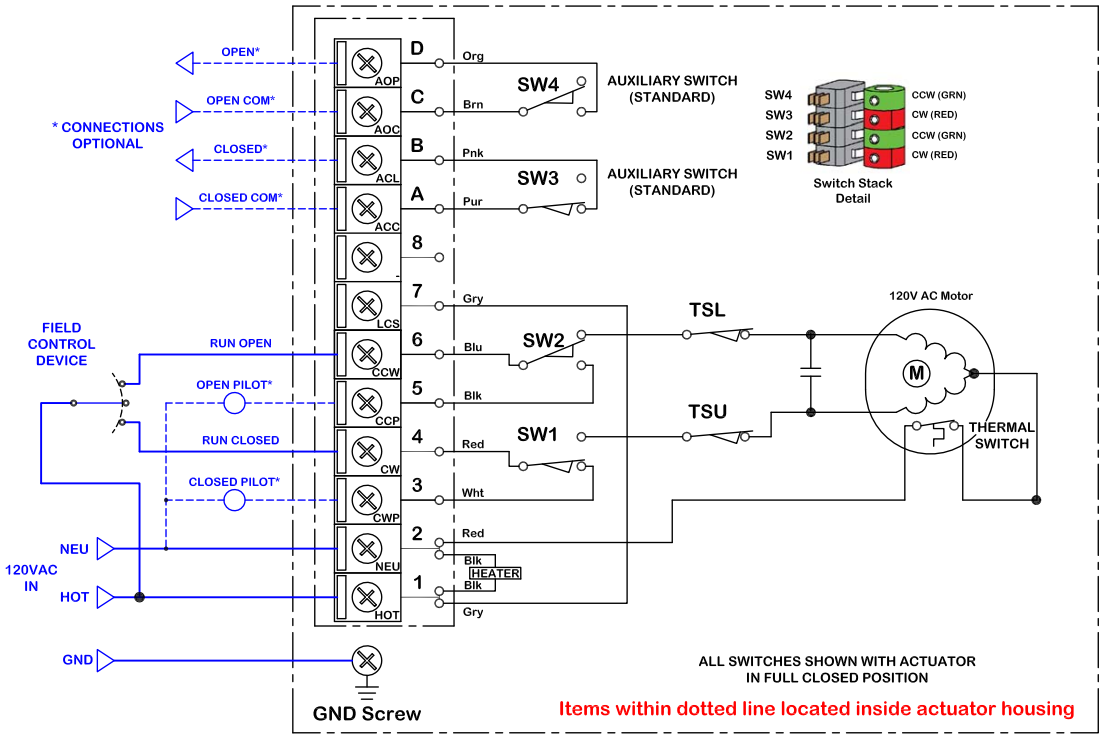
Wiring diagrams are shown with torque switches. Models without torque switches have those switches bypassed in the diagrams.

EloNA8E8/Elo-NB9 24vac Proportional



WIRING DIAGRAMS

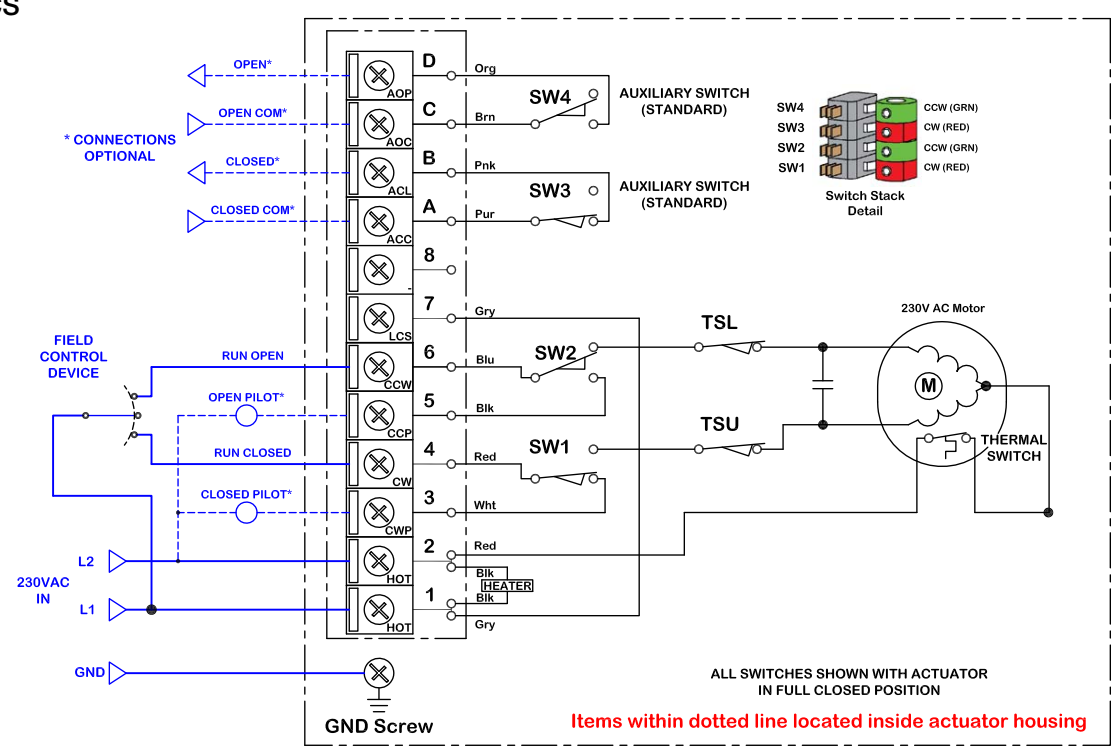
Elo-NA8K0/Elo-NB9 120vac On/Off



- ✓ • On/Off Control
- ✓ ✘ • Torque Switches
- ✘ • Battery Backup
- ✘ • LCS

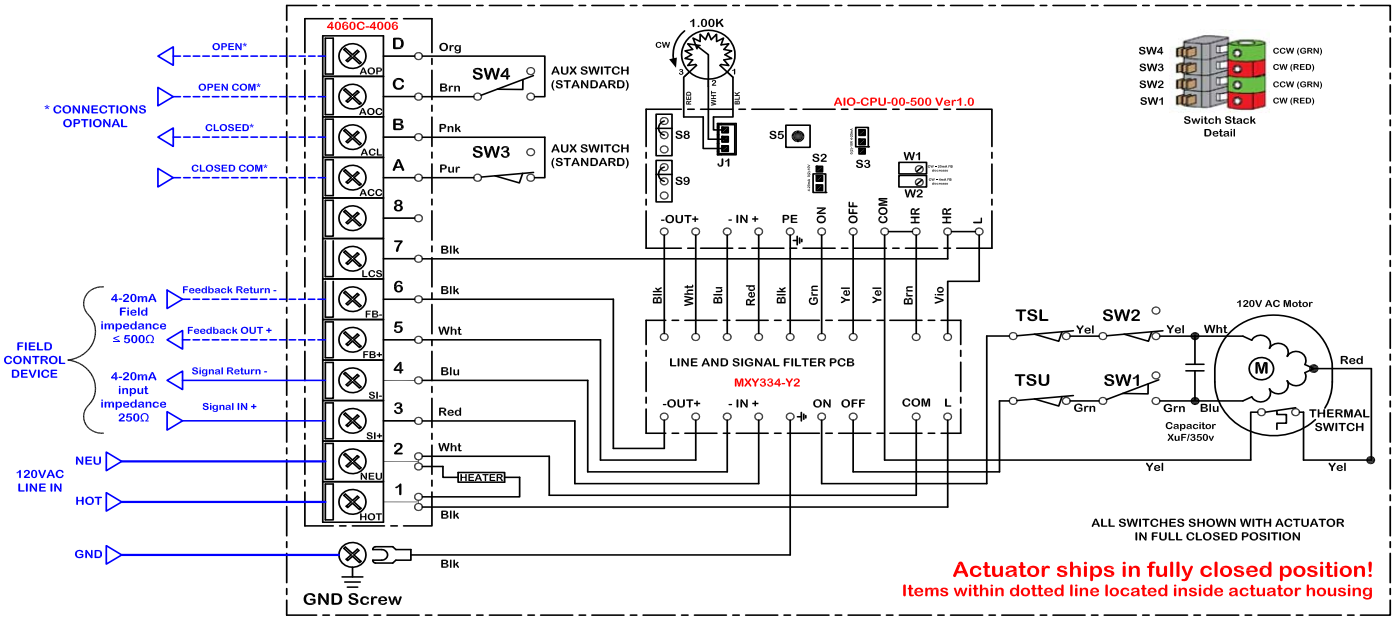
Wiring diagrams are shown with torque switches. Models without torque switches have those switches bypassed in the diagrams.

Elo-NA8L0/Elo-NB9 230vac On/Off



WIRING DIAGRAMS

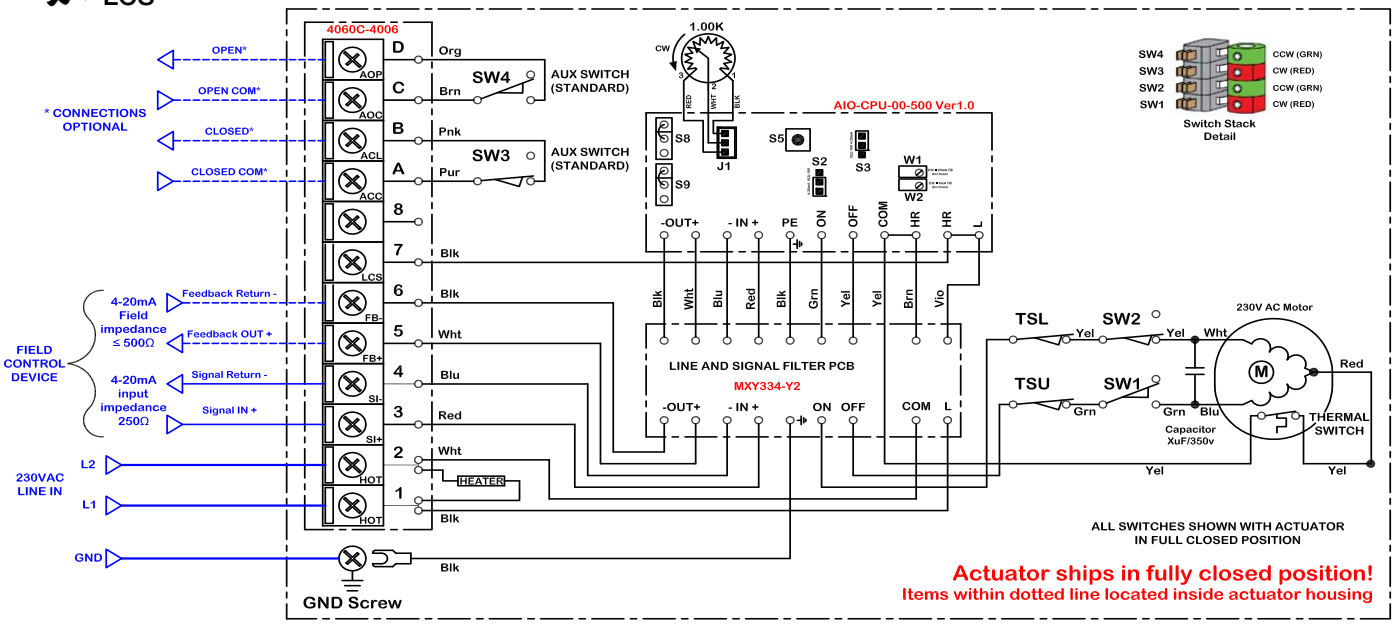
Elo-NA8K8 120vac Proportional



- ✓ • Proportional Control
- ✓ ✘ • Torque Switches
- ✘ • Battery Backup
- ✘ • LCS

Wiring diagrams are shown with torque switches. Models without torque switches have those switches bypassed in the diagrams.

Elo-NA8L8/Elo-NB9 230vac Proportional



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