FLOWSERVE

USER INSTRUCTIONS

LTQ008 – LTQ230 Series
3-Phase Products Including LCS Products

Compact Quarter-Turn Electric Actuator

Installation
Operation
Maintenance

AIIOM000165-00 *EN 20*

⚠ ***Read these instructions prior to installing, operating, and maintaining this equipment.***

Experience In Motion

Document Version

Initial Release, 04-30-2020

TABLE OF CONTENTS

1 General Information

1.1 Scope of Manual

⚠ These instructions must be kept close to the product's operating location or directly with the product.

⚠ Read these instructions prior to installing, operating, using, or maintaining the equipment in any region worldwide. Do not put this equipment into service until meeting each of the safe operating conditions noted in the instructions. **Failure to comply with the information provided in this User Instructions manual is considered to be misuse. The Flowserve warranty does not cover personal injury, product damage, delay in operation, or product failure caused by misuse.**

These instructions aim to familiarize the reader with the product and its permitted use. Operating the product in compliance with these instructions is imperative to ensure reliability in service and to avoid risks. These instructions may not account for all local regulations; ensure the observance of such regulations by all, especially those installing the product. Always coordinate repair activities with operations personnel, and follow all plant safety requirements, applicable safety, and health legislation. For more information on a specific product, refer to the IOM for that product.

1.2 Disclaimer

Information in this User Instruction supplement is believed to be complete and reliable. Despite all Flowserve's efforts to provide comprehensive information and instructions, sound engineering and safety practices should always be used. Always consult with a qualified engineer.

Flowserve manufactures products to applicable International Quality Management System Standards as certified and audited by external Quality Assurance organizations. Genuine parts and accessories have been designed, tested, and incorporated into the products to help ensure continued product quality and performance in use. As Flowserve cannot test parts and accessories sourced from other vendors, the incorrect incorporation of such parts and accessories may adversely affect the performance and safety features of the product. Flowserve considers the failure to properly select, install, or use authorized Flowserve parts as misuse. The Flowserve warranty does not cover any damage or failure caused by misuse. Moreover, any modification of Flowserve products, or removal of original components, may impair the safety of these products in use.

1.3 Operational Concepts

The LTQ008-203 Series actuators are fully assembled, calibrated, and tested prior to leaving the factory. In most cases, after mounting the actuator to the desired device, it should be possible to operate the actuator from fully CW (0°) to CCW (90°), and back again, finding that no adjustments are necessary. If so, the assembly is ready for immediate use. However, should it be necessary to adjust the end-of-travel positions to overcome any device related issues (e.g., the valve shaft incorrectly timed to the drive stem), the procedures outlined below in this document should be followed to put the assembly into service.

NOTICE - There is a maximum adjustment range of ± 3° at each end-of-travel.

Three-phase actuators require additional attention to detail as the power coming to the actuator, Phases A, B, and C (or L1, L2, and L3), must be landed in the correct place on the actuator terminals. Landing in incorrect sequences will force the drive motor to rotate in the opposite direction from that intended. For this reason, there are several levels of safety and control offered for the LTQ008 – LTQ230 Series 3-phase actuators.

The range of 3-phase actuators starts with simple models having basic operability to quite complicated models with full featured protection circuitry and local control capabilities. The various levels of these actuators might seem to be easily adaptable across any site or design intent, but they are actually very specific as to how they interface to existing or new installations.

The most basic units (NCU units) have no safeties, meaning the installer is fully responsible for connecting and immediately checking the motor rotation. The installer must correct the rotation if it is reversed, before damage can occur to the actuator, motor, and connecting device. The BIC units have phase correction built-in, meaning that these models will automatically correct phase discrepancies regardless of how the incoming power is landed on the main terminal strip. However, it must be noted that installations with existing motor control centers may only be able to utilize NCU actuators.

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 to cover all the possibilities in a given application, that selection would, in fact, not function in an application that simply required the most basic unit. For this reason, it is imperative to know the application completely before selecting a solution.

Read the project specifications and understand the application before making an actuator selection. If in doubt, consult with a project engineer to clarify what is actually required for a fully operational installation. Despite all of Flowserve's efforts to provide comprehensive information and instructions in this document on how to determine the various actuator levels, questions will arise. **Contact Flowserve for further information before placing orders when unsure of the level of control required.**

2 Safety Information

2.1 Safety symbols and descriptions

This User Instruction contains specific safety markings where non-observance of an instruction would cause a hazard. The specific safety markings are:

Table 1: Definition of safety symbols and markings

Symbol	Description
DANGER	**DANGER** This symbol indicates a hazardous situation which, if not avoided, will result in death or severe injury.
WARNING	**WARNING** This symbol indicates a hazardous situation which, if not avoided, could result in serious injury.
CAUTION	**CAUTION** This symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
SAFETY INSTRUCTIONS	**SAFETY INSTRUCTION** This symbol indicates specific safety-related instructions or procedures.
NOTICE	**NOTICE** This symbol indicates important, special instructions not related to hazards.
	**SAFETY ALERT** This is the safety alert symbol. It warns of potential physical injury hazards. Obey all safety messages that follow this symbol to avoid injury or death.
	**ELECTRICAL HAZARD** This symbol indicates electrical safety instructions where non-compliance would affect personal safety and could result in loss of life.

2.2 Intended use


The product/system must not be operated beyond the parameters specified for the application. If there is any doubt as to the suitability of the product/system for the application intended, contact Flowserve for advice, quoting the serial number.

DANGER - Installing, operating, or maintaining the product/system in any way that is not covered in this User Instruction could cause death, serious personal injury, or damage to the equipment. This includes any modification to the product/system or use of any parts not provided by Flowserve.

- Only operate the product/system when it has successfully passed all inspection acceptance criteria.

- Do not operate the product/system in a partially-assembled condition.
- If the conditions of service on the purchase order change (e.g. pumping fluid, temperature, or duty conditions, etc.), it is imperative that the user seeks written agreement from Flowserve before start-up.
- Observe equipment labels, such as arrows designating the direction of rotation, warning signs, etc., and keep them in a legible condition. Replace any damaged and/or illegible labels immediately.

2.3 General hazard sources

DANGER - 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 - Potential pinch point. Equipment connected to or driven by this device may start unexpectedly, causing personal injury or entrapment in linkage systems.

2.3.1 Mechanical hazards

a) Lifting limits and guidelines

NOTICE - The load values mentioned in this section are Flowserve recommendations only. Perform all lifting in compliance with site safety protocol, local regulations, and related industry standards.

Many precision parts have sharp corners which require appropriate personal protective equipment during handling. Prior to any attempt to lift an item, employees must first determine the approximate weight and stability of the load.

- Always handle large, unstable, or awkward loads with the assistance of additional personnel or appropriate mechanical means.
- Loads more than 23 kg (50 lb) should only be lifted by appropriate mechanical means and in accordance with current local legislation or with the assistance of additional personnel.
- Lifting items less than 23 kg (50 lb) may be prohibited without assistance if the lift is repetitive and/or awkward (i.e., away from the body, above the shoulders, or below the knees) thus placing excessive stress on the personnel.
- Evaluate repetitive lifting, of any kind, as part of a documented end-user safety program.

b) Manual override

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.

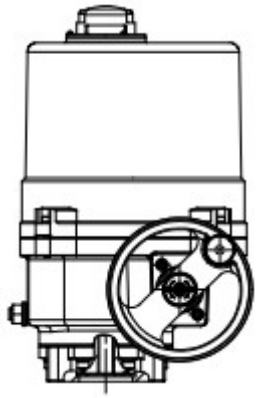


Figure 1: The manual override allows the user to position the valve or damper with or without power.

NOTICE - The LTQ008-230 Series actuators have mechanical stops which limit rotation. Do not attempt to operate the actuator with a rotation greater than 95°.

2.3.2 Electrical Hazards

SAFETY INSTRUCTIONS

DANGER - Risk of Electric Shock.

- Before working on any electrical equipment, turn off power supply to the equipment.
- All electrical wiring must be in conformance with applicable local codes, regulations, and the National Electric Code (NEC). Hazardous voltage can shock, burn, cause death, or serious property damage. To reduce the risk of electric shock, do not use an extension cord to connect the unit to an electric supply. Provide a properly located electrical receptacle.
- To reduce the risk of electric shock, replace damaged wiring immediately.
- Ground all electrical equipment before connecting to an electrical power supply. Failure to ground all electrical equipment can cause serious or fatal electrical shock hazards.
- Do not ground anything to a gas supply line.
- Failure to bond all electrical equipment to a system structure will increase the risk of electrocution and could result in injury or death. Additionally, contact a licensed electrician for information on local electrical codes for bonding requirements.

2.4 Qualified Personnel and Targeted Group

All personnel involved in the operation, installation, and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question does not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to provide applicable training.

Always coordinate repair activities with operation and health and safety personnel. Make sure to follow all plant safety requirements and applicable safety and health laws and regulations.

3 Product Description

3.1 General Product Description

a) LTQ008 – LTQ230

The LTQ008 – LTQ230 Series are quarter-turn, electric industrial service actuators delivering up to 20,350 in-lb of torque with voltages ranging from 230V to 575V 3-phase with on/off or proportional control modes. These NEMA 4X and IP67 compliant units are equipped with two volt-free Form A auxiliary switches rated at, up to, 10A 250VAC, torque switches, and a standard clutch-free, manual-override handwheel. Additionally, these units feature two ¾" EMT entry ports with sealed cable glands and a raised visual position indicator, as standard. Users have the option to customize these units with the following features: motor control centers, local control stations, IP68 submersible, battery backup, and interchangeable ISO5211 flanges and drives. This series is ISO5211 compliant, mounting with double, square female drive inserts.

b) Control Station

Local Control Stations (LCS) provide a means to select Local or Remote control of a valve or damper actuator. The LCS offered on the 008-203 sizes (LL) features unique capabilities, LED feedback, and a human-machine interface.

3.1.1 Type LL (LED type)

This is a NEMA 4/4X and IP67 (optional IP68) type, rectangular enclosure, that is integral to the actuator housing. This type contains two non-intrusive (magnetic) knob switches for mode and position control. This version also employs an LED panel with five, bright LEDs mounted behind the glass with indicators for actuator operations. The two rotary control knobs provide the user with the ability to operate the actuator in a normal (REMOTE) mode where the actuator responds to control signals from a BAS, PLC, or other control device. Or the user can elect to operate the actuator in a LOCAL mode where the user can control the positioning of the actuator while standing at the device. This allows opening and closing of the actuator (valve) to test for operation and to perform maintenance, or other function, without relying on radio communication to command the automation system to position the actuator. The five LEDs provide a visual indication of the position and status of the actuator with indicators for open, close, remote, local, and fault. Open (green) and close (red) flash when the actuator is moving CCW (90°) or CW (0°), respectively, and they remain lit upon reaching the end-of-travel. This version is available on the LTQ008 through the LTQ203 Series for all 3-phase voltage actuators.

3.2 Shipping and Handling

This actuator arrives in the fully CW (0°) position. The red/green position indicator should show all red to denote this. The actuator has a red and green position indicator on the top of the unit. The red color in the indicator window means the actuator is fully CW (0°), while the green color means the actuator is fully CCW (90°). The indicator has graduations for percent of full travel.

Figure 2: Red/green position indicator on top of actuator

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.

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, refer to section 0

Adjustments for instructions.

4 Installation

⚠CAUTION - Follow the guidelines below 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).
- Protect the actuator from moisture by installing it with water-tight, electrical metallic tubing (EMT) fittings and proper conduit drainage. Supply power to the unit to keep the internal heater warm at the time of installation (BIC units only).
- 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° of operation. These stops are not designed to adjust mechanical rotation by more than ± 3°; they are only for positioning the handwheel.
- Use proper equipment on both EMT conduit ports to protect the NEMA 4X integrity of the housing.
- Use the internal heater in all applications.
- Do not install the actuator outdoors, or in humid environments, unless it is powered up and the heater is functioning.
- Use the proper wire size to prevent actuator failure (see XXX for proper wire sizing).
- Terminals 1 – 3 accept 12 – 18 AWG solid / stranded wire. Terminals 4 – N accept 14 – 18 AWG solid / stranded wire.

NOTICE - Do not parallel wire, or interconnect controls, from multiple 3 phase actuators. This can lead to safety bypass, unintentional starting, and potentially damaging operation of the actuator under power.

4.1 Installation

NOTICE - This User Instructions manual references the LTQ008-230 Series actuator rotation direction while viewed from above the actuator.

All LTQ008-203 Series actuators rotate CW to drive the output shaft (bottom of the actuator) to the 0° position. On all LTQ008-230 Series actuators, the cam shaft, and the indicator, rotate CW to 0° as well.

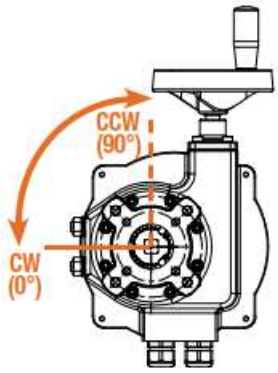


Figure 3: Note that the rotation seen from below is a mirror of the direction viewed from above.

4.2 Mounting

1. Fully close the valve or damper to which the actuator is to be mounted.
2. Assemble the 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 the hardware.
4. **Before applying power to the unit**, rotate the manual override handwheel from the fully CW (0°) to the fully CCW (90°) position to check for unobstructed manual operation of the valve or damper.
5. The LTQ008-203 Series 3-phase actuators utilize a PCB to simply field wiring and testing. This PCB contains one of the terminal blocks.
    a. The green terminal block is for incoming power, and it contains screw terminals 1 – 3. It is rated for up to 575V.

       NOTICE - Terminal numbering starts with 1 at the bottom.

    b. The blue terminal block contains screw terminals 4 – 9 and A – N which are rated to accept 14 AWG down to 18 AWG solid or stranded wire. These are used for interfacing and control wiring.
6. Reference the actuator's product number and **Error! Reference source not found.** to determine which diagram to follow when wiring the actuator.
7. Note that although terminals are labeled as 1 – 9 and A – N, 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 the actuator.
9. Connect power and control to the correct terminals.
10. Terminals E – N on each actuator are for the auxiliary (adjustable) switches, which are dry type (volt free) Form A contacts rated for 24V @ 1A Max.

⚠WARNING - **The torque switches are factory set and are not adjustable.** Torque switches protect controlled valves or actuators from damage in the event of a high torque condition.

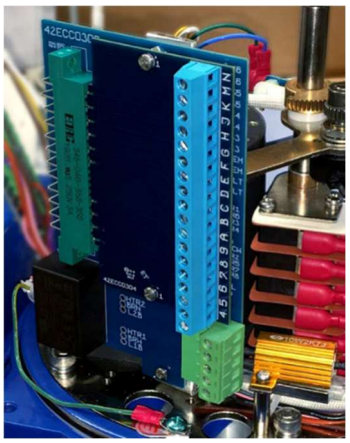


Figure 4: Printed circuit boards (PCB) contain the terminal block. They facilitate simple field wiring and testing.

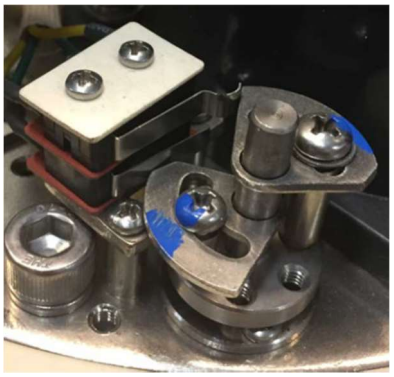


Figure 5: A torque switch (TS) is a secondary set of cams (switches) which further protects the actuator, equipment, and processes.

5 Theory of Operation

Background: Three-phase motors, regardless of size or horsepower, must have a reversing starter / contactor to run in both directions as a result of some process control requirement. On single phase motors, the starter / contact normally starts and run in a fixed direction. Reversing the starting winding causes the motor to run in the opposite direction. In three-phase motors, the direction of rotation is reversed by switching any two of the three phase lines into the motor. This is accomplished most commonly by utilizing a reversing motor starter. The reversing starter can be located inside the actuator, or in a completely separate enclosure remote from the actuator (i.e. switchgear "cabinet"), depending on site requirements and the actuator series chosen.

Flowserve offers several types of three-phase actuators that are designed to fit applications ranging from basic controls to fully-optioned solutions. These various strategies form the levels described below which allow a product to fit functionally and economically into most three-phase applications.

5.1 LTQ008 – LTQ230 NCU (230/3 – 575/3 On/Off Control)

Starting with the most basic design are the NCU Series actuators. These models are designed for use with existing 3-phase installations where motor control centers are already established. A site-furnished 120VAC control power circuit is required for this series.

The inside of the actuator contains:

1. **No Reversing Motor Starter.** This actuator will run in one direction only if the motor leads are not connected to a reversing starter. The required reversing motor starter must be already located in an existing switch gear cabinet.
2. **No Phase Monitor Circuitry.** If phasing is incorrect at the actuator, it will run in the wrong direction at start-up. If phasing is incorrect, limit switches and torque switches are not necessarily in the correct circuit to protect the gear train or actuator from damage. It should also be noted that a three-phase service in a building may be perfectly functional and phased correctly for many years, then a transformer blows, the power company comes to replace it, and it gets connected out of phase. The building still has power, but all three-phases motors now run in the opposite direction. Proper phasing must be verified immediately at initial start-up. Improper phasing may immediately damage the actuator. ***Always perform start-up with the actuator in the mid-stroke position and watch the actuator rotation when powering-up***.
3. **No Local Control Device.** There is no way to operate the actuator locally. Only the existing Motor Control Center (MCC) and the controls already on-site can operate the actuator. Without some type of MCC, there will be no way to drive the actuator in either direction.

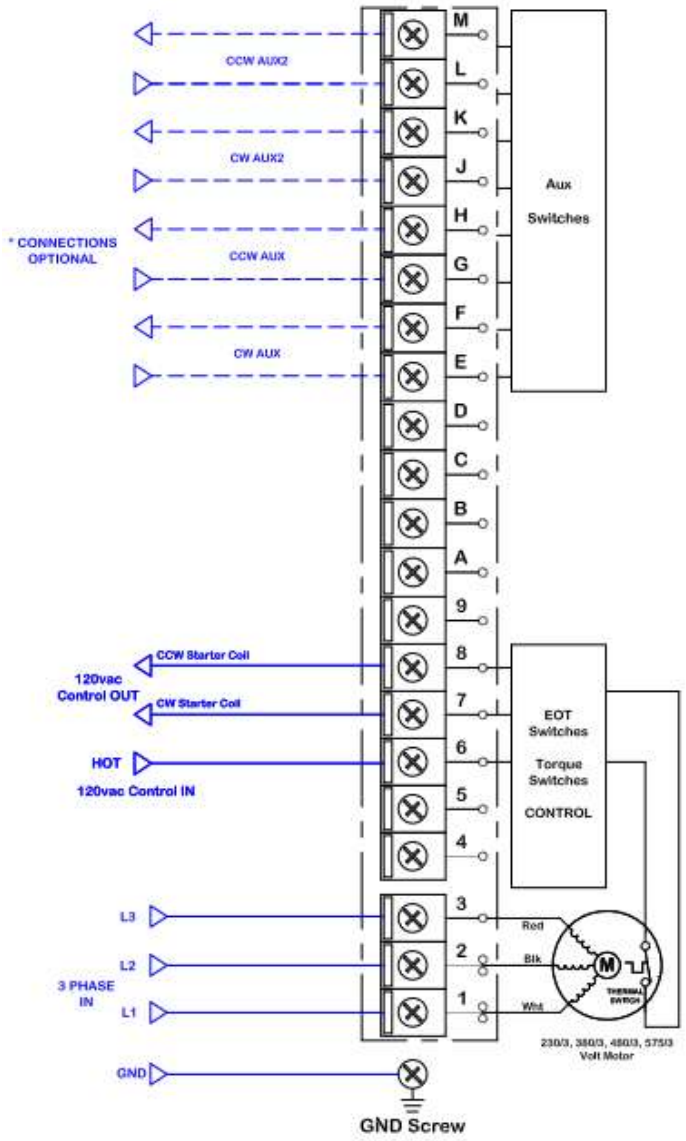


Figure 6: LTQ008 – LTQ230 NCU (230/3 – 575/3 On/Off control) wiring diagram

5.2 LTQ008 – LTQ230 BIC (230/3 – 480/3 On/Off Control)

These models are designed to be used where there are no existing MCCs. Typically, these are used in new facilities, or where additions to existing switch gears have available space limitations or is otherwise just not feasible. The actuator generates a 24V control voltage to be utilized by the field control device, which switches that voltage between CW and CCW commands back to the actuator terminal block.

The inside of the actuator contains:

1. **A Reversing Motor Starter.** This actuator is commanded to run CW (0°) or CCW (90°) as a function of received control signals. The actuator contains the required reversing motor starter on the inside.
2. **Phase Monitor Circuitry.** If phasing is incorrect at the actuator, the protective circuitry will automatically reverse two of the three legs to allow the motor to drive in the correct direction. With this built-in protection device, improper phasing is non-existent. The installer needs neither worry about proper phasing being brought to the actuator, nor possible phase reversal in the future; it is auto-correcting.
3. **No Local Control Device.** There is no way to operate the actuator locally. An external PLC, BAS, or other automation controller is required for operation. These units will require volt-free contacts (dry contacts) in one of the above-mentioned devices, which will switch the actuator's internal 24VAC power supply to generate commands to drive CW or CCW. Without some type of automation interface, there will be no way to command the actuator to move in either direction.

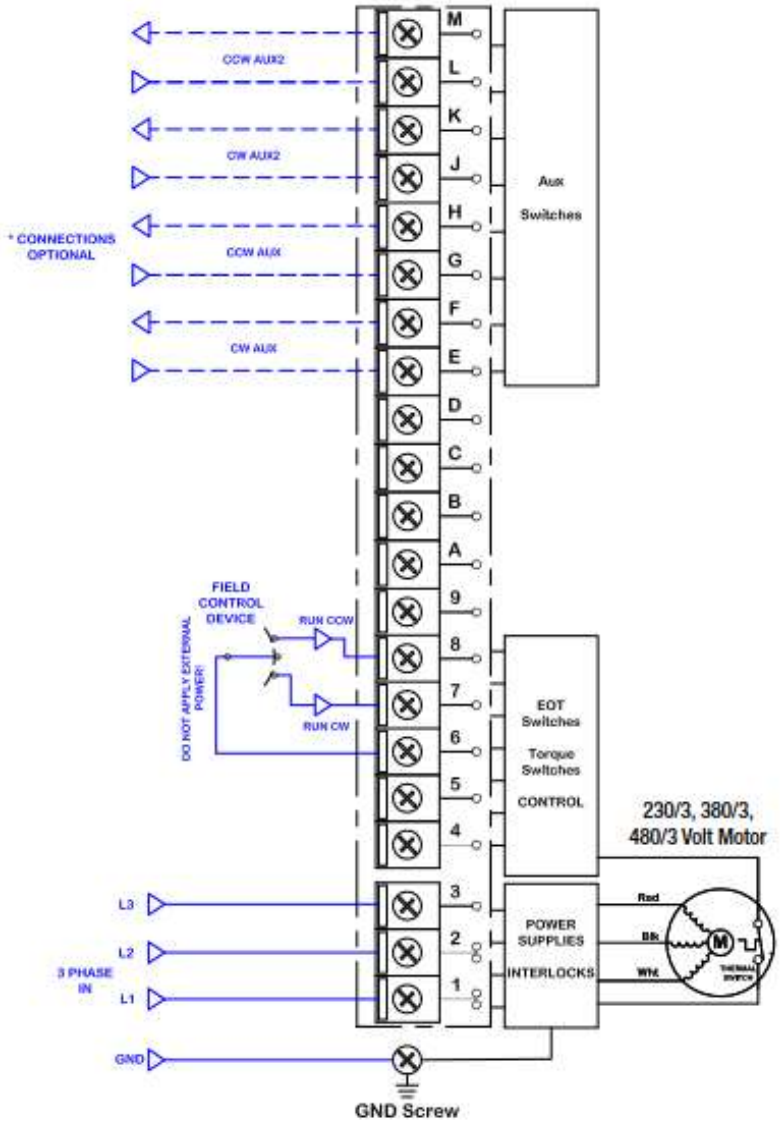


Figure 7: LTQ008 – LTQ230 BIC (230/3 – 480/3 On/Off control) wiring diagram

5.3 LTQ008 – LTQ230 BIC (230/3 – 480/3 Proportional Control)

These models are designed to be used where there are no existing MCCs. Typically, these are used in new facilities, or where additions to existing switch gears have available space limitations or is otherwise just not feasible. The actuator generates a 24V status output that can be used remotely to verify power. These units accept analog control signals (4 – 20 mA or 2 – 10 VDC), and they process the incoming signals to position the actuator as a function of the incoming signal. Additionally, these units generate an analog feedback signal proportional to the position of the actuator, which is not directly related to the incoming signal. This feedback signal is designed to be used by automation devices or displays external to the actuator.

The inside of the actuator contains:

1. **A Reversing Motor Starter.** This actuator is commanded to run CW (0°) or CCW (90°) as a function of received control signal compared to the actuator position. The actuator contains the required reversing motor starter on the inside.
2. **Phase Correction Circuitry.** If phasing is incorrect at the actuator, the protective circuitry will automatically reverse two of the three legs to allow the motor to drive in the correct direction. With this built-in protection device, improper phasing is non-existent. The installer needs neither worry about proper phasing being brought to the actuator, nor possible phase reversal in the future; it is auto-correcting.
3. **No Local Control Device.** There is no way to operate the actuator locally. It can only be operated by utilizing an external PLC, BAS, or other automation controller generating 4 – 20 mA or 2 – 10 VDC analog signals to position the actuator between 0° and 90°. Without some type of automation interface, there will be no way to command the actuator to move in either direction.
4. **Proportional Controller.** This analog processing PCB accepts 4 – 20 mA or 2 – 10VDC from the field accordingly, utilizing the reversing motor starter.

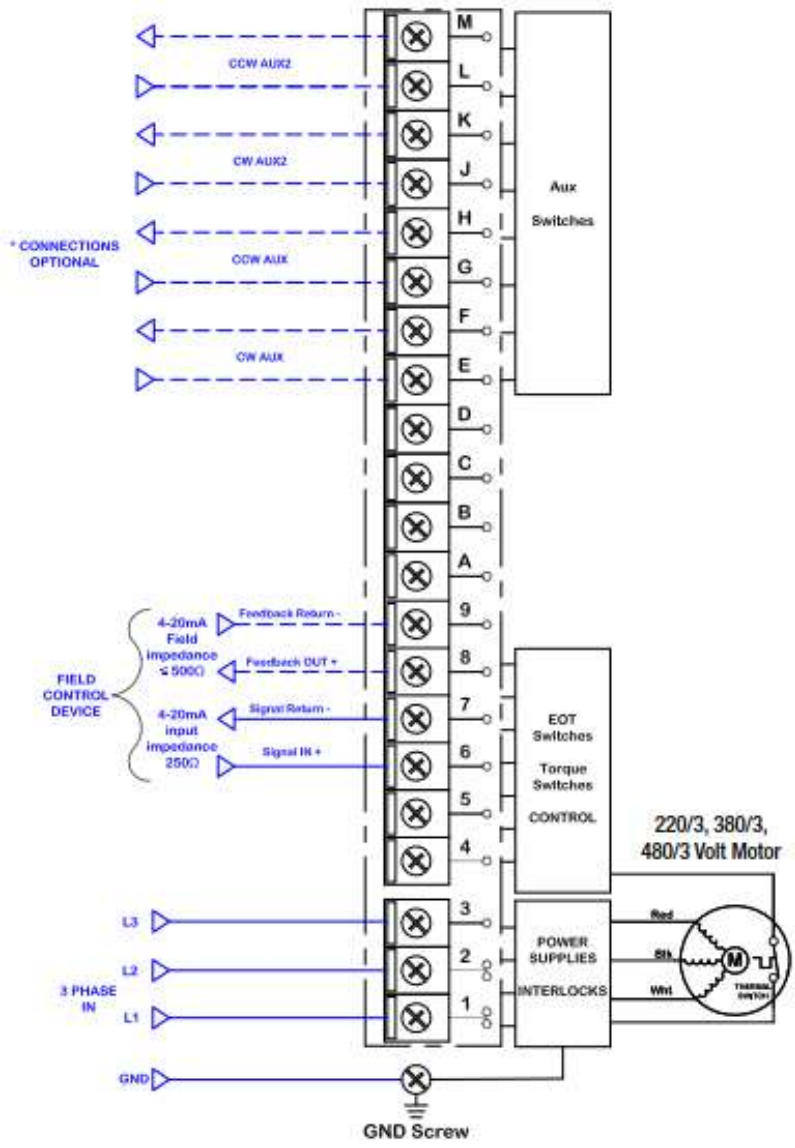


Figure 8: LTQ008 – LTQ230 BIC (230/3 – 480/3 proportional control) wiring diagram

5.4 LTQ008 – LTQ230 BIC + LL (230/3 – 480/3 On/Off Control)

These advanced, stand-alone actuators are designed to be installed in new construction sites, or existing sites, where there are no MCCs. These advanced, three-phase actuators have several versions that continue to add more features and options. These actuators generate a 24 V control output that is connected to a remote PLC or BAS to control the actuator. This 24 V output also serves as a status of the 3-phase connections and actuator operability. Any internal faults will disable the 24 V control output. Moreover, these units incorporate an LCS to facilitate the operation of the actuator locally. Having this feature allows for operation of the actuator without having an existing PLCS or BAS-based analog controller, while also providing operability with existing external controls.

The inside of the actuator contains:

1. **A Reversing Motor Starter.** This actuator is commanded to run CW (0°) or CCW (90°) as a function of control signals from the LCS or the remote control. The required reversing motor starter is already located inside the actuator.
2. **Phase Correction Circuitry.** If phasing is incorrect at the actuator, limit switches and torque switches are not necessarily in the correct circuit to protect the gear train or actuator from damage. Built-in phase protection circuitry will automatically reverse two of the three legs to allow the motor to drive in the correct direction. With this built-in protection device, improper phasing is non-existent. The installer needs neither worry about proper phasing being brought to the actuator, nor possible phase reversal in the future.
3. **Integral Local Control Device.** This series is designed to operate in LOCAL mode (control knobs located on the face of the LCS, which is an integral part of the actuator) or in REMOTE mode, which utilizes commands from a PLC, BAS, or other volt-free contact (dry contact) automation device. While in LOCAL mode, the actuator responds to the position of the controls located on the face of the integral LCS. The mode switch employs a padlockable lever that locks the mode switch in any of its three positions, preventing unauthorized changes in the operating mode (LOCAL, OFF, or REMOTE).

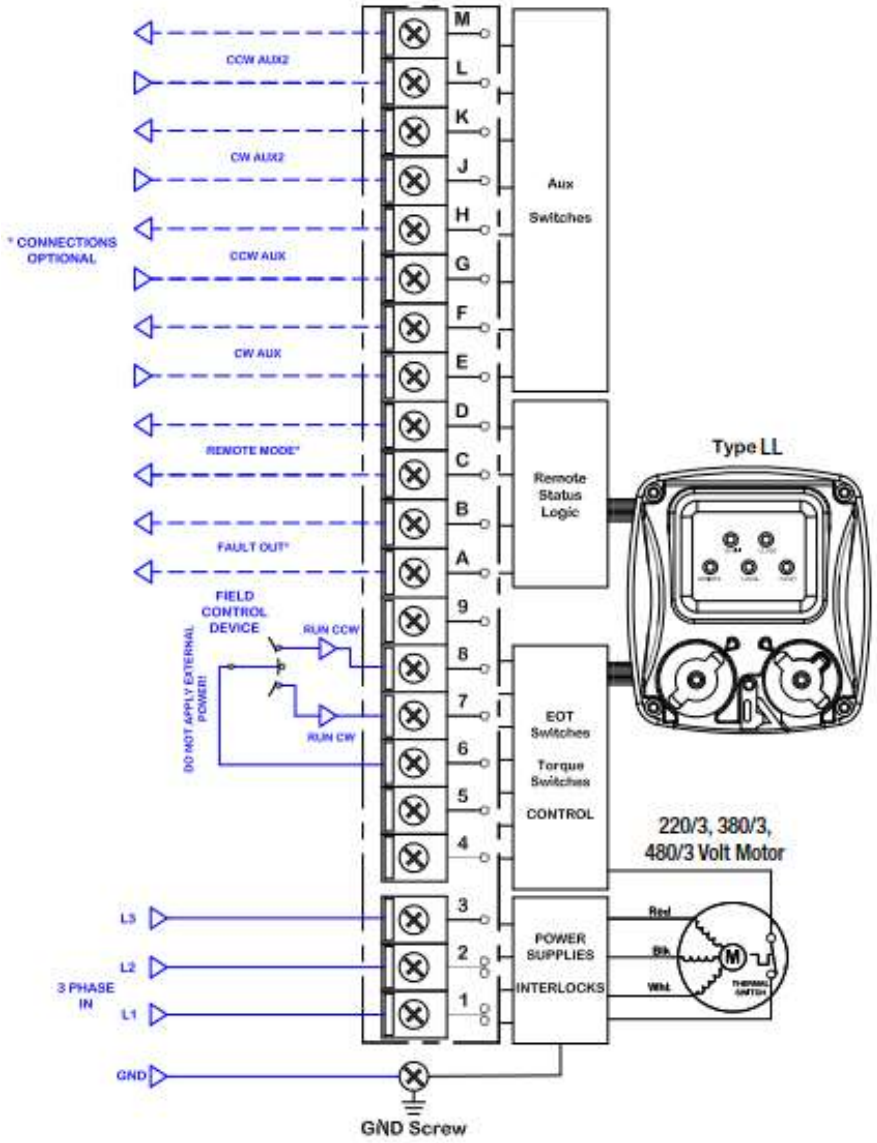


Figure 9: LTQ008 – LTQ230 BIC + LL (230/3 – 480/3 On/Off control) wiring diagram

5.5 LTQ008 – LTQ230 BIC + LL (230/3 – 480/3 Proportional Control)

These advanced stand-alone actuators are designed to be installed in new constructions sites, or existing sites, where there are no existing MCCs. These advanced three-phase actuators have several versions that continue to add more features and options. These units accept analog control signals (4 – 20 mA or 2 – 10 VDC), and they process these incoming signals to position the actuator as a function of the incoming signal. Additionally, these units generate an analog feedback signal proportional to the position of the actuator, which is not directly related to the incoming signal. This feedback signal is designed to be used by automation devices or displays external to the actuator.

Moreover, these units incorporate an LCS to facilitate the operation of the actuator locally. Having this feature allows for the operation of the actuator without having an existing PLC or BAS-based analog controller, while also providing operability with existing external controls.

The inside of the actuator contains:

1. **A Reversing Motor Starter.** This actuator is commanded to run CW (0°) or CCW (90°) as a function of control signals received from the LCS or remote control. The required reversing motor starter is already located inside the actuator.
2. **Phase Correction Circuitry.** If phasing is incorrect at the actuator, limit switches and torque switches are not necessarily in the correct circuit to protect the gear train or actuator from damage. Built-in phase protection circuitry will automatically reverse two of the three legs to allow the motor to drive in the correct direction. With this built-in protection device, improper phasing is non-existent. The installer needs neither worry about improper phasing being brought to the actuator nor possible phase reversal in the future.
3. **Integral Local Control Device.** This series is designed to operate in LOCAL mode (control knobs located on the face of the LCS which is an integral part of the actuator) or in REMOTE mode, which utilizes commands from a PLC, BAS, or other volt-free contact (dry contact) automation device. While in LOCAL mode, the actuator responds to the position of the controls located on the face of the integral LCS. The mode switch employs a padlockable lever that locks the mode switch in any of its three positions, preventing unauthorized changes in the operating mode (LOCAL, OFF, or REMOTE).
4. **Proportional Controller.** When the unit is in REMOTE mode, this analog processing PCB accepts 4 – 20 mA or 2 – 10 VDC from the field and positions the actuator accordingly, utilizing the internal reversing motor starter. A 4 – 20 mA or 2 – 10 VDC feedback signal is internally generated to provide remote reading of the position of the actuator.

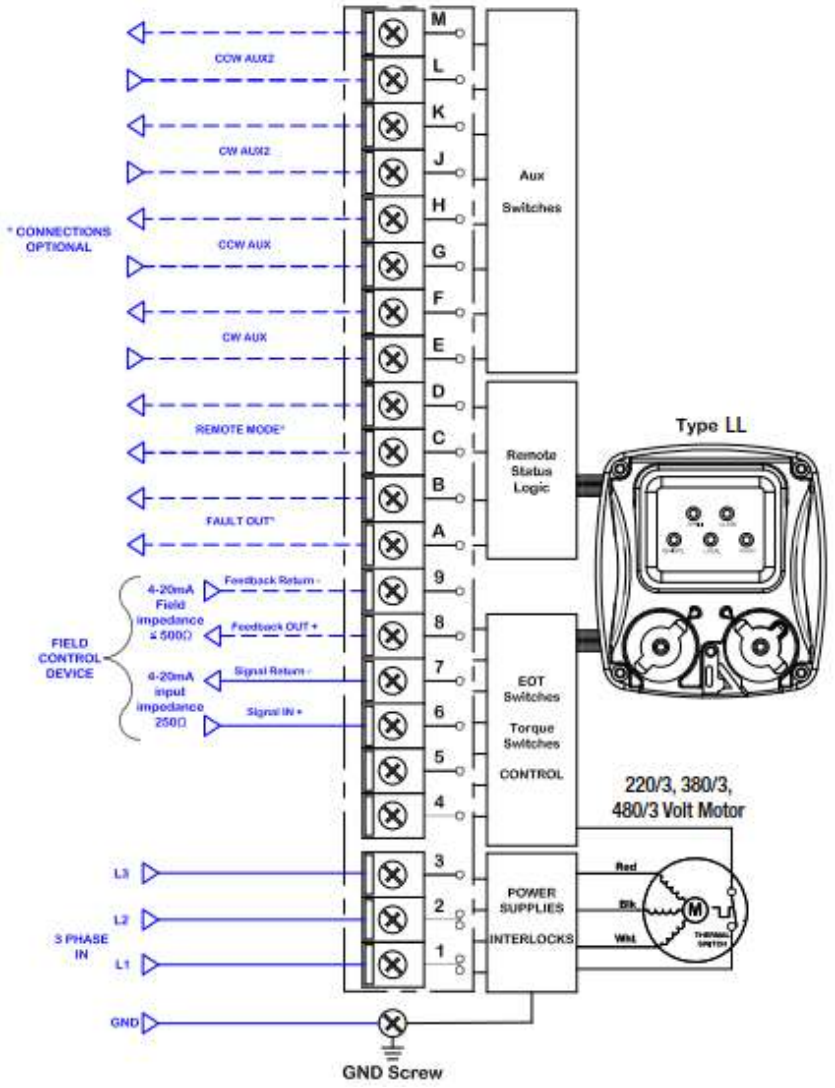


Figure 10: LTQ008 – LTQ230 BIC + LL (230/3 – 480/3 proportional control) wiring diagram

5.6 Torque Switches

⚠WARNING - **Torque switches are factory set and are not adjustable.** Changing these settings will void the actuator warranty.

Torque switch operation

The LTQ 008-230 Series actuators have torque switches to protect the actuator, and any attached equipment, from possible damage that could occur in a high torque event. In such an event, the valve or damper bring 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.

Figure 11: The torque switch cams and switches are shown in the normal operating position.

The upper torque switch and cam for the actuator drive the CW rotation.

The lower torque switch and cam for the actuator drive CCW rotation.

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. The upper torque switch protects CW rotation.
4. The lower torque switch protects CCW rotation.

Figure 12: The upper cam is tripping the upper switch.

The upper cam has rotated CCW from its neutral position, engaging the switch.

Torque Event – CW

1. 12 shows a high torque event in the CW direction.
2. The torque switch CW drive cam (upper) and the 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.

Figure 13: The lower cam is tripping the lower switch.

The lower cam has rotated CW from its neutral position, engaging the switch.

Torque Event – CCW

1. Figure shows a high torque event in the CCW direction.
2. The torque switch CCW drive cam (lower) and the 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.

5.7 LTQ LL Series LCS Operation

Figure 14: Panel shown in the STOP mode

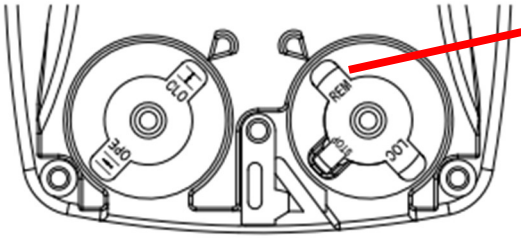


Figure 15: Panel shown in the REM mode

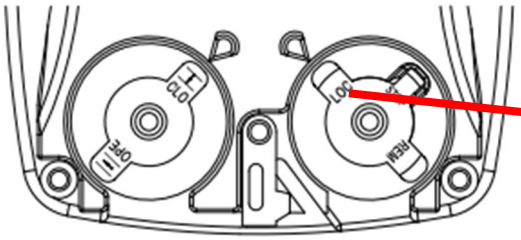


Figure 16: Panel shown in the LOC mode, driving CW

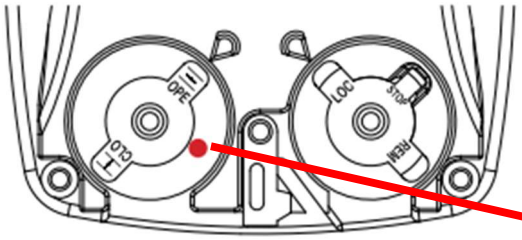


Figure 17: Panel shown in the LOC mode, driving CCW

NOTICE - There is a padlockable lever that engages with the mode knob to lock the operation of the mode switch in position. It provides restricted access in any of the three positions.

Operating the Local Control Station

1. The mode switch (right hand side) has three positions:
   - **i. STOP (center position)**
     On/Off actuators: This position removes any ability to reposition the actuator electrically. Power is still present in the unit, and the open and close LED indicators are operational. When fully CW (0°), the red LED will be steady on. Due to its epicyclic gear train, the manual handwheel can be used to position the actuator. The actuator will remain in the position last determined by the use of the handwheel.
     Proportional control actuators: In this position, the actuator generates a 4 – 20 mA (2 – 10 VDC) feedback signal out, respective of the position of the actuator.
   - **ii. REM (REMOTE)**
     On/Off actuators: This position sets the actuator to respond to field generated control signals. In this mode, the position knob (left side) does not affect the positioning of the actuator. The external signal device controls all actuator movement. The manual handwheel may be used to reposition the actuator while in this mode; however, if an active, external signal is present, the actuator will reposition as a result of that control signal. The LED indicators are active in this mode.
     Proportional control actuators: The actuator follows the incoming 4 – 20 mA (2 – 10 VDC) control signal, generating a 4 – 20 mA (2 – 10 VDC) feedback signal out, respective of the position of the actuator.
   - **iii. LOC (LOCAL)**
     On/Off actuators: This position sets the actuator to respond to the position knob. In this position, the LED indicators are active, and all external field signals are ignored, having no effect on the positioning of the actuator.
     Proportional control actuators: The actuator responds to the function of the position knob, generating a 4 – 20 mA (2 – 10 VDC) feedback signal out, respective of the position of the actuator.
2. The position switch (left hand size) has three positions that the actuator responds to when in the LOC mode:
   i. **OPE** (CCW, all models): The actuator will drive to the fully CCW position.
   ii. **CLO** (CW, all models): The actuator will drive to the fully CW position

NOTICE - There is an unmarked hold position detente in the knob (red dot in **Error! Reference source not found.**) that allows the actuator to maintain position at some point away from the full travel end-stops. In this mode, the manual handwheel may be used to reposition the actuator, and it will remain in this position while the position knob is in the hold position. The LED indicators are active in this mode, and all external field signals are ignored, having no effect on the positioning of the actuator.

5.8 Adjustments

This actuator arrives calibrated and tested by the factory to stop at 0° for the CW position and 90° for the CCW position. The auxiliary switch settings are based on the CW and CCW stops. Ideally, the auxiliary switches are set a few degrees in advance of the respective stop switches. Most installations onto valves or dampers will likely not require recalibration of these settings. Mount the valve or damper. **If the unit requires adjustments**, proceed to sections 5.8.1, Adjusting CW End-of-Travel, and 5.8.2, Adjusting CCW End-of-Travel. Otherwise, proceed without adjusting the cams

NOTICE

- For most actuators, the stop positions are independent of one another – e.g., the CW position is accurate while the CCW position may need adjustment.
- Follow these directions carefully and in order. Actuator damage due to improper testing and commissioning will not be covered under the warranty.

⚠ DANGER

- To avoid the dangerous or fatal electrical shock, **turn off power** to all electrical equipment before working on electrical connections or changing cam positions.
- The mechanical stop screw **only limits** handwheel operation; it is not to be used as an electrical travel limiting device.

5.8.1 Adjusting CW End-of-Travel

1. Reposition Mechanical Stop
   a. **Disconnect power.**
   b. Loosen the right-side mechanical stop. This is the CW mechanical stop limit adjustment. Using a 17 mm wrench and a 5 mm hex key, hold the jam nut and turn the stop screw 5 – 6 turns CCW so it clears the mechanical box inside the actuator.
      i. This will allow the user to adjust the cam/switch stop position without running into the mechanical stop screw.
   c. Use the manual override handwheel to position the actuator to the required CW position. Keep all changes within ± 3° of the factory settings.
2. Adjust CW Cam (Bottom)
   a. Cam 1 is the bottom cam (red) and the end-of-travel adjustment for the actuator CW position. With power off, and the actuator at its required CW position, use a sharp 2.5 mm 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 the screw is free, adjust it as detailed below:
      i. Rotate the hex key to the right 10 – 15° until an audible click is heard. This will reset the switch roller arm.
      ii. Gently tighten (CW) the set screw (only until slight pressure is felt). Ideally, the set screw rides along the camshaft.
      iii. **Slowly** rotate the hex key to the left, pushing the cam, until an audible click is heard on the bottom switch. The click means correct adjustment has been achieved.
      iv. Tighten the cam set screw.
   b. Apply power and test for the correct CW position:
      i. Drive the actuator CCW at least 15 – 20°.
      ii. Drive the actuator CW until the cam stops the electrical travel.
      iii. Verify that the CW position matches the one required.
      iv. Repeat step 2a if further adjustment is needed.
3. Tighten Mechanical Stop
   a. With the actuator in the proper position, hold the 17 mm wrench on the right-side jam nut to prevent the jam nut from locking. Turn the 5 mm hex key CW until the end of the stop screw bottoms out against the internal stop boss.
   b. Turn the hex key **one full turn CCW**, and lock the position with the jam nut. Now, the actuator will reach its end-of-travel electrically before there is any interference from the mechanical stop.
   c. The CW position calibration is now complete.

Figure 6: CW mechanical stop

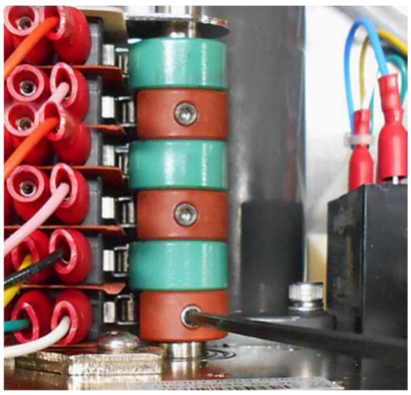


Figure 7: Cam 1 (bottom, CW cam)

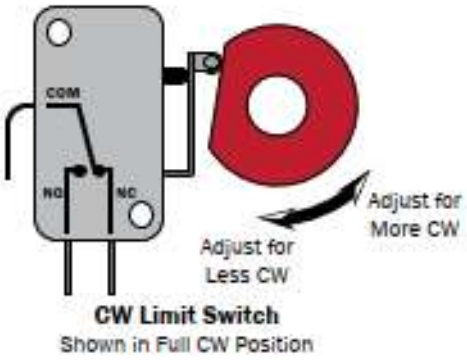


Figure 20: The CW limit switch shown in the fully CW position

5.8.2 Adjusting CCW End-of-Travel

1. Reposition Mechanical Stop
   a. **Disconnect power.**
   b. Loosen the left-side mechanical stop. This is the CCW mechanical stop limit adjustment. Using a 17 mm wrench and a 5 mm hex key, hold the jam nut and turn the stops screws 5 – 6 turns CCW so it clears the mechanical boss inside the actuator.
      i. This will allow the user to adjust the cam/switch stop position without running into the mechanical stop screw.
   c. Use the manual override handwheel to position the actuator to the required CCW position. Keep all changes within ± 3° of the factory settings.
2. Adjust CCW Cam (Second from Bottom)
   a. Cam 2 is the second cam up from the bottom (green) and the end-of-travel adjustment for the actuator CCW position. With power off, and the actuator at its required CCW position, use a sharp 2.5 mm 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 the screw is free, adjust it as detailed below.
      i. Rotate the hex key to the left 10 – 15° until an audible click is heard. This will reset the switch roller arm.
      ii. Gently tighten (CW) the set screw (only until slight pressure is felt). Ideally, the set screw rides along the camshaft.
      iii. **Slowly** rotate the hex key to the right, pushing the cam, until an audible click is heard on the bottom switch. The click means correct adjustment has been achieved.
      iv. Tighten the cam set screw.
   b. Apply power and test for the correct CCW position.
      i. Drive the actuator CW at least 15 – 20°.
      ii. Drive the actuator CCW until the cam stops the electrical travel.
      iii. Verify that the CCW position matches the one required.
      iv. Repeat step 2a if further adjustment is needed.
3. Tighten Mechanical Stop
   a. With the actuator in the proper position, hold the 17 mm wrench on the left-side jam nut to prevent the jam nut from locking. Turn the 5 mm hex key CW until the end of the stop screw bottoms out against the internal stop boss.
   b. Turn the hex key **one full turn CCW**, and lock the position with the jam nut. Now, the actuator will reach its end-of-travel electrically before there is any interference from the mechanical stop.
   c. The CCW position calibration is now complete.

Figure 8: CCW mechanical stop

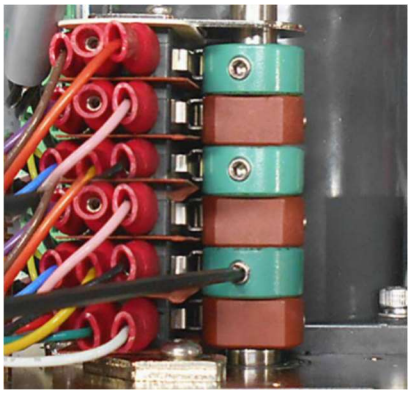


Figure 9: Cam 2 (second from bottom, CCW cam)

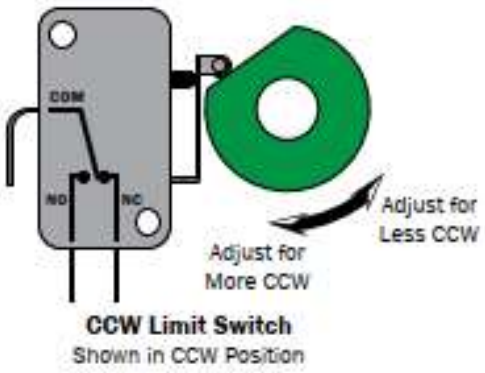


Figure 10: The CCW limit switch shown in the fully CCW position

5.8.3 Adjusting Auxiliary Switches

1. Adjust CW auxiliary cams
   a. Cam 3 (red) and cam 5 (red) control the CW auxiliary switch adjustments. These cams can alert the user to the actuator's position prior to being fully opened or closed – i.e. the user may elect to use these cams to give warnings of when the actuator is nearing the desired position of travel.
   b. Drive the actuator to its CW position. Use a sharp 2.5 mm 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 the screw is free, adjust it as detailed below:
      i. On cam 3, rotate the hex key to the right 10 – 15° until an audible click is heard. This will reset the switch roller arm.
      ii. Gently tighten (CW) the set screw (only until slight pressure is felt). Ideally, the set screw rides along the camshaft.
      iii. **Slowly** rotate the hex key to the left, pushing the cam, until an audible click is heard on the bottom switch.
      iv. Continue to rotate the cam between 3 and 5° to the left to ensure that the auxiliary cam switch changes state before the actuator reaches its end-of-travel electrically.
      v. Tighten the cam set screw.
      vi. Repeat this procedure for cam 5.
2. Adjust CCW auxiliary cams
   a. Cam 4 (green) and cam 6 (green) control the CCW auxiliary switch adjustments. These are optional switches typically used to indicate when the actuator has reached its CCW position.
   b. Drive the actuator to its CCW position. Use a sharp 2.5 mm 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 the screw is free, adjust it as described below:
      i. On cam 4, rotate the hex key to the left 10 – 15° until an audible click is heard. This will reset the switch roller arm.
      ii. Gently tighten (CW) the set screw (only until slight pressure is felt). Ideally, the set screw rides along the camshaft.
      iii. **Slowly** rotate the hex key to the right, pushing the cam, until an audible click is heard on the bottom switch.
      iv. Continue to rotate the cam between 3 and 5° to the right to ensure that the auxiliary cam switch changes state before the actuator reaches its end-of-travel electrically.
      v. Tighten the cam set screw.
      vi. Repeat this procedure for cam 6.

Figure 11: Cam 3 and cam 5 (CW auxiliary switch cams, red)

Figure 12: Cam 4 and cam 6 (CCW auxiliary switch cams, green)

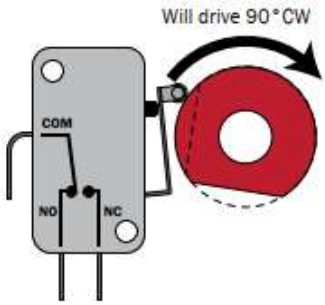


Figure 13: CW limit switch shown in the fully CCW position

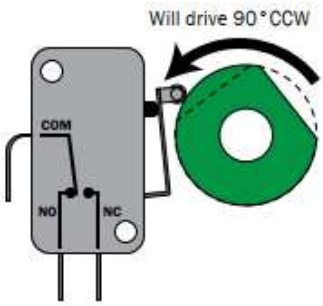


Figure 14: CCW limit switch shown in the fully CW position

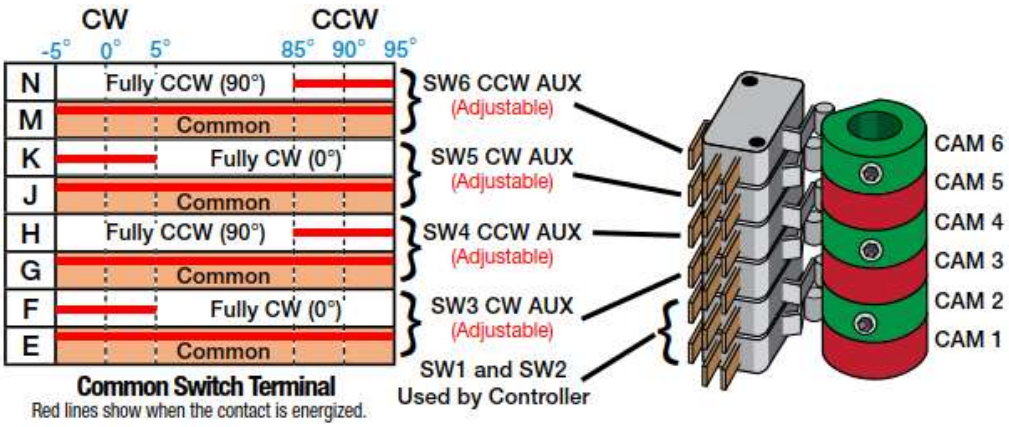


Figure 15: Auxiliary switch cam mapping

6 Commissioning

NOTICE - The factory sets and tests the end-of-travel stops (cams) of this actuator to respond between 0° and 90° of rotation. If the end stops require no changes, this unit is ready for immediate operation using the following procedure. However, if the cam positions require changes, refer to section 0

Adjustments.

SAFETY INSTRUCTIONS - This procedure first establishes correct direction and control as these must be verified to proceed. Regardless of the level of the three-phase actuator, the actuator must drive CW when commanded to do so and stop when the actuator reaches the fully CW travel position. The same applies to the CCW operation.

⚠WARNING - Follow these directions carefully and in order. Actuator damage due to improper testing and commissioning will not be covered under the warranty.

⚠DANGER - This procedure has many sections with the text "**immediately remove power from the actuator to stop movement**". Quick action is necessary to prevent the actuator from possibly driving into the mechanical stops, past the limits of the valve or damper attached, and to simply keep the actuator in a known position for a quick, efficient installation as a result of any unexpected or uncontrolled movement.

6.1 NCU Commissioning - On/Off Control

⚠WARNING - **Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator!** Remove power from this device before making any travel adjustments.

1. After the actuator and valve (damper) assembly have been installed with power and control connected, **before** applying power, **use the handwheel to rotate the actuator to a mid-travel position.**
2. Be sure there are NO movement commands active, and apply 3 phase power.
    a. Actuator should NOT move
        i. If it does move, **IMMEDIATELY remove 3 phase power from the actuator to STOP movement.**
        ii. Check control wiring to terminals 4-N on the actuator. Correct if necessary and repeat step2
3. **Generate a CW move command** and verify that the DIRECTION of the position indicator is CW.
    a. If it is, proceed to step 4.
    b. If it is NOT**, IMMEDIATELY remove 3 phase power from the actuator to STOP movement**.
    c. Check and correct external MCC control wiring if necessary.
    d. With 3 phase power removed, reverse any two of the three connections to terminals L1, L2, or L3 AT THE ACTUATOR.
    e. Reapply 3 phase power and repeat step 3.
    f. During CW travel movement, depress the lever on the UPPER torque switch to interrupt actuator movement as a check of the system.
4. **Generate a CCW move command** and verify the DIRECTION of the position indicator is CCW.
    a. If it is NOT**, IMMEDIATLEY remove 3 phase power from the actuator to STOP movement.**
    b. Check and correct external MCC control wiring if necessary.
    c. During CCW travel movement, depress the lever on the LOWER torque switch to interrupt actuator movement as a check of the system.
5. **If the actuator does NOT stop at the correct positions**, fails to move in the correct directions, or fails to stop movement when the respective torque switch levers are depressed**, IMMEDIATELY STOP the operation of**

the actuator and refer to the Table of Contents for the section to reference for the corrective action needed.

6. **If the actuator stops at the correct positions, the actuator can be put into service and is fully operational.**

6.2 BIC Commissioning - On/Off Control

⚠WARNING - **Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator!** Remove power from this device before making any travel adjustments.

1. After the actuator and valve (damper) assembly have been installed with power and control connected, **before** applying power, **use the handwheel to rotate the actuator to a mid-travel position.**
2. Be sure there are NO movement commands active, and apply 3 phase power.
   a. The actuator should NOT move.
      i. If it does move, **IMMEDIATELY remove 3 phase power from the actuator to STOP movement.**
      ii. Proceed to step 2.
      iii. If it does NOT move, proceed to step 3.
3. Check control wiring to terminals 4~N on the actuator.
   a. Remove field wiring to terminals 6, 7 & 8, then place a jumper between terminals 6 & 7. Do NOT apply external power to any of these terminals.
   b. Re-apply 3 phase power. The actuator will move CW.
   c. After confirmation, remove the jumper between terminals 6 & 7, and place a jumper between terminals 6 & 8.
   d. The actuator will move CCW.
   e. After confirmation, remove the jumper between terminals 6 & 8, and replace the field wiring to terminals 6, 7 & 8.
   f. Repeat step 1.
4. **Generate a remote CW move command** and verify the DIRECTION of the position indicator is CW.
   a. If it is NOT, there is a problem with the field logic or wiring, troubleshoot accordingly.
   b. If it is, proceed to step 4.
5. **Generate a remote CCW move command** and verify the DIRECTION of the position indicator is CCW.
   a. If it is NOT, there is a problem with the field logic or wiring, troubleshoot accordingly.
   b. If it is, proceed to step 5.
6. **If the actuator does NOT stop at the correct positions**, fails to move in the correct directions, or on fails to stop movement when the respective torque switch levers are depressed, **IMMEDIATELY STOP the operation of the actuator** and refer to the Table of Contents for the section to reference for the corrective action needed.

7. Place the LCS in Local or Remote Mode to put the actuator into service.

6.3 BIC Commissioning - Proportional Control

⚠WARNING - **Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator!** Remove power from this device before making any travel adjustments.

1. After the actuator and valve (damper) assembly have been installed with power and control connected, **before** applying power, **use the handwheel to rotate the actuator to a mid-travel position.**
2. Set the control signal selection jumpers, refer to the Proportional PCB detail page.
3. **Generate a mid-travel command (12mA)**, and apply 3 phase power.
   a. The actuator should move only to match the incoming signal, if at all.
      i. If the actuator moves and continues to move **away** from midpoint, **IMMEDIATELY remove 3 phase power from the actuator to STOP movement.**
         1. Place a meter in series with terminal 4 (ref) and the wire coming from the field controller (+), it MUST read +12mA.

a. If it does NOT, check the polarity of the incoming analog signal to make sure it is (+)12mA.
b. Return to step 3.

ii. If the actuator moves momentarily and then STOPS at the mid stroke position, proceed to step 4.
iii. If the actuator does not move at all, rotate the handwheel slightly in either direction to offset the controller.
1. The actuator should move back to the midpoint position and then STOP.
2. Proceed to step 4.

4. **Generate a CW move command** (4mA) and verify the DIRECTION of the position indicator is CW.
   a. The actuator should run CW and run until it reaches its CW end of travel position.
   b. While power is on, an analog feedback signal OUT provides an electronic position of the actuator... i.e. 4mA = full CW and 20mA = full CCW positions (reference actuator terminals #6 and #7).
   c. On LTQ008+ Series units, during CW travel movement, depress the lever on the UPPER torque switch to interrupt actuator movement as a check of the system.
5. **Generate a CCW move command** (20mA) and verify the DIRECTION of the position indicator is CCW.
   a. The actuator should run CCW and run until it reaches its CW end of travel position.
   b. While power is on, an analog feedback signal OUT provides an electronic position of the actuator... i.e. 4mA = full CW and 20mA = full CCW positions.
   c. On LTQ008+ Series units, during CCW travel movement, depress the lever on the LOWER torque switch to interrupt actuator movement as a check of the system.
6. **If the actuator does NOT stop at the correct positions**, fails to move in the correct directions, or fails to stop movement when the respective torque switch levers are depressed, **IMMEDIATELY STOP the operation of the actuator** and refer to the Table of Contents for the section to reference for the corrective action needed.
7. Check the full scale response of the analog signals into and out of the actuator by referring to page 32.
8. **If the actuator stops at the correct positions and generates a feedback signal representative of the position of the actuator, the actuator can be put into service and is fully operational.**

6.4 LCS Commissioning for BIC + LL On/Off Control

⚠WARNING - **Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator!** Remove power from this device before making any travel adjustments.

1. After the actuator and valve (damper) assembly have been installed with power and control connected, **before** applying power, **use the handwheel to rotate the actuator to a mid-travel position.**
2. **Place the LCS mode switch in the OFF position,** and apply 3-phase power.
   a. The actuator should not move.
      i. If it does move, **immediately remove power from the actuator to stop movement**.
      ii. If it does not move, proceed to step 3.
      iii. Check the control wiring on terminals 4 – N on the actuator, correct if necessary, and repeat step 2.
3. Place the LCS move switch in the STOP position, and place the mode switch in the LOCAL position.
   a. The actuator should not move.
4. Place the LCS move switch in the CW (0°) position, and verify that the direction of the position indicator is CW.
   a. On LTQ008 Series units, during CW travel movement, depress the lever on the upper torque switch to interrupt the movement of the actuator, as a check of the system.
   b. While traveling to the fully CW (0°) position, the CLOSE LED will be flashing.
   c. When the actuator reaches its fully CW (0°) end-of-travel position, the CLOSE LED indicator will stay illuminated on the face of the LCS.
   d. Place the LCS move switch in the CCW (90°) position, and verify that the direction of the position indicator is CCW.
   e. On LTQ008 Series units, during CCW travel movement, depress the lever on the lower torque switch to interrupt the movement of the actuator, as a check of the system.
   f. While traveling to the fully CCW (90°) position, the OPEN LED will be flashing.

g. When the actuator reaches its fully CCW (90°) end-of-travel position, the OPEN LED indicator will stay illuminated on the face of the LCS.

5. Place the move switch in the CW (0°) position, and drive to approximately mid-travel, then stop.
6. Ensure that there are no remote movement commands active, and place the LCS mode switch in the REMOTE position.
   a. The actuator should not move.
      i. If it does move, **immediately remove power from the actuator to stop movement**.
      ii. Check the control wiring on terminals 4 – N on the actuator, correct if necessary and repeat step 6.
7. Generate a remote CW move command, and verify the direction of the position indicator is CW.
   a. If it is, proceed to step 9.
8. Check the field wiring:
   a. Disconnect power.
      i. Remove the field wiring to terminals 6, 7, and 8.
      ii. Place a jumper between terminals 6 and 7. Do not apply external power to any of these terminals.
   b. Reapply 3-phase power. The actuator will move CW.
   c. After confirmation, remove the jumper and reconnect the field wiring between terminal 6 and 7 only.
   d. Generate a remote CW move command, and verify that the direction of the position indicator is CW.
   e. Reconnect the field wiring to terminal 8.
9. Generate a remote CCW move command, and verify that the direction of the position indicator is CCW.
   a. If it is CCW, proceed to step 11.
10. Check the field wiring:
    a. Disconnect power.
       i. Remove the field wiring to terminals 6 and 8.
       ii. Place a jumper between terminals 6 and 8. Do not apply external power to any of these terminals.
    b. Reapply 3-phase power. The actuator will move CCW.
    c. After confirmation, remove the jumper and reconnect the field wiring to terminals 6 and 8.
    d. Generate a remote CCW move command, and verify that the direction of the position indicator is CCW.
11. If the actuator does not stop at the correct position(s), fails to move in the correct direction(s), or fails to stop moving when the respective torque switch levers are depressed, **immediately stop the operation of the actuator**, and refer to the Table of Contents for the section to reference for the corrective action needed.
12. Place the LCS in LOCAL or REMOTE mode to put the actuator into service.

6.5 LCS Commissioning for BIC + LL Proportional Control

⚠WARNING - **Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator!** Remove power from this device before making any travel adjustments.

1. After the actuator and valve (damper) assembly have been installed with power and control connected, **before** applying power, **use the handwheel to rotate the actuator to a mid-travel position.**
2. Set the control signal selection jumpers (refer to Figure).
3. Place the LCS mode switch in the OFF position, and apply 3-phase power.
   a. The actuator should not move.
      i. If it does move, **immediately remove power from the actuator to stop movement**.
      ii. If it does not move, proceed to step 4.
      iii. Check the control wiring on terminals 4 – N on the actuator, correct if necessary, and repeat step 3.
4. Place the LCS move switch in the STOP position, and place the mode switch in the LOCAL position.
   a. The actuator should not move.
5. Place the LCS move switch in the CW (0°) position, and verify that the direction of the position indicator is CW.
   a. On LTQ008 Series units, during CW travel movement, depress the lever on the upper torque switch to interrupt the movement of the actuator, as a check of the system.
      i. When depressing the torque switch lever, the FAULT LED will illuminate on the face of the LCS.
   b. While traveling to the fully CW (0°) position, the CLOSE LED will be flashing.

c. When the actuator reaches its fully CW (0°) end-of-travel position, the CLOSE LED indicator will stay illuminated on the face of the LCS.

6. Place the LCS move switch in the CCW (90°) position, and verify that the direction of the position indicator is CCW.
   a. On LTQ008 Series units, during CCW travel movement, depress the lever on the lower torque switch to interrupt the movement of the actuator, as a check of the system.
      i. When depressing the torque switch lever, the FAULT LED will illuminate on the face of the LCS.
   b. While traveling to the fully CCW (90°) position, the OPEN LED will be flashing.
   c. When the actuator reaches its fully CCW (90°) end-of-travel position, the OPEN LED indicator will stay illuminated on the face of the LCS.
7. Place the move switch in the CW (0°) position and drive to approximately mid-travel, then stop.
8. Generate a mid-travel command (12 mA), then place the LCS mode switch in the REMOTE position.
   a. The REMOTE LED will illuminate on the face of the LCS.
   b. The actuator should move only to match the incoming signal, if at all.
      i. If the actuator moves, and continues to move away from the midpoint, **immediately remove power from the actuator to stop movement**.
         1. Manually position the actuator back to a mid-travel position.
         2. Place a meter in series with terminal 4 (signal IN) and the wire coming from the field controller (+), ensuring a reading of +12 mA.
            a. If it does not read +12 mA, check the polarity of the incoming analog signal to ensure a reading of +12 mA. Repeat step 8.
      ii. If the actuator moves momentarily and stops at the mid-stroke position, proceed to step 9.
      iii. If the actuator does not move at all, rotate the handwheel slightly in either direction to offset the controller.
         1. The actuator should move back to the midpoint position and stop. Proceed to step 9.
9. Generate a CW move command (4 mA), and verify that the direction of the position indicator is CW.
   a. The actuator should run CW until it reaches its CW end-of-travel position.
   b. The CLOSE LED indicator on the front of the panel should illuminate.
   c. While power is on, an analog feedback signal out provides an electronic position of the actuator (i.e., 4 mA is fully CW and 20 mA is fully CCW - reference terminals 6 and 7).
10. Generate CCW move command (20 mA), and verify that the direction of the position indicator is CCW.
    a. The actuator should run CCW until it reaches its CCW (90°) end-of-travel position.
    b. The OPEN LED indictor on the front of the panel should illuminate.
    c. While power is on, an analog feedback signal out provides an electronic position of the actuator (i.e., 4 mA is fully CW and 20 mA is fully CCW).
11. If the actuator does not stop at the correct position(s), fails to move in the correct direction(s), or fails to stop movement when the respective torque switch levers are depressed, **immediately stop the operation of the actuator**, and refer to the Table of Contents for the section to reference for the corrective action needed.
12. Place the LCS in LOCAL or REMOTE mode to put the actuator into service.

7 Calibration

7.1 Calibration Procedure for BIC On/Off Control

⚠WARNING - Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator! Remove power from this device before making any travel adjustments.

1. After the actuator and valve (damper) assembly have been installed with power and control connected, **before** applying power, **use the handwheel to rotate the actuator to the mid-travel position.**
2. Ensure there are no movement commands active, and apply 3-phase power.
   a. The actuator should not move.
      i. If it does move, **immediately remove power from the actuator to stop movement**.
      ii. Check the control wiring to terminals 4 – N on the actuator. Correct if necessary and repeat step 2.
      iii. If it does not move, proceed to step 7.
3. To establish correct actuator response to incoming control signals, remove any wires connected to terminals 6, 7, and 8, and reapply 3-phase power. The actuator should not move as there are no external control signals to command the actuator to move. Verify that there is zero movement in this mode.
4. Place a jumper between terminals 6 and 7. Do not apply external power to any of these terminals. The actuator will move CW. After confirmation, remove the jumper.
5. Place a jumper between terminals 6 and 8. Do not apply external power to any of these terminals. The actuator will move CCW. After confirmation, remove the jumper.
6. Reconnect field wiring to terminals 6, 7, and 8.
7. Generate a CW move command, and verify the direction of the position indicator is moving CW.
   a. If it is not, **immediately remove power from the actuator to stop movement and correct field wiring errors.**
   b. On LTQ008 Series units, during CW travel movement, depress the lever on the upper torque switch to interrupt the movement of the actuator, as a check of the system.
8. Generate a CCW move command, and verify that the direction of the position indicator is CCW.
   a. If it is not, **immediately remove power from the actuator to stop movement and correct field wiring errors.**
   b. On LTQ008 Series units, during CCW travel movement, depress the lever on the lower torque switch to interrupt the movement of the actuator, as a check of the system.
9. If the actuator does not stop at the correct position(s), fails to move in the correct direction(s), or fails to stop movement when the respective torque switch lever is depressed, **immediately stop the operation of the actuator,** and refer to the Table of Contents for the section to reference for the corrective action needed.
10. If the actuator stops at the correct positions, the actuator is fully operational and ready for immediate use.

7.2 Calibration Procedure for BIC Proportional Control

⚠WARNING - Allowing the motor to drive the gear train into the mechanical stop will result in severe damage to the actuator! Remove power from this device before making any travel adjustments.

After completing all mounting and wiring procedures, and main power is available, it is now possible to commission the actuator. Before applying power or making any wiring connections:

1. Remove 3 phase power.
2. Set the DIP switches for correct signal IN and OUT. (ref 5 pos DIP)
3. Set the DIP switches for correct signal response and loss of signal action. (ref 4 pos DIP)
4. Apply correct power according to the actuator model.
5. The blue LED D1 (ref POWER LED) will turn on, and green LED STA will turn on. (ref CPU RUNNING)
6. Press the "SET" black pushbutton on the Mod control board and hold it down for about three seconds, then release
   a. The green STA LED will turn off and the unit will drive to the fully CW position and stop when the pre-set cam positions are reached.
   b. There are NO LED indicators to advise when the actuator is running. – 2 teeth CW before tightening the two M3 set screws on the sector drive gear.
7. When the actuator stops, press the CLO pushbutton ONCE.
   a. The actuator will drive to its full CCW (Open) position and stop when the pre-set cam positions are reached.
8. When the actuator stops, press the OP pushbutton ONCE.
9. The unit will start to respond to the incoming analog control signals being sent to the actuator.
10. Slight adjustments may be made to trimmer VR2 if necessary, to tune the feedback signal (20mA end of scale only).
11. Unit is now calibrated and is ready to be put into service. No other calibration is necessary.

Figure 29: Alignment of the sector and potentiometer gear sets at the fully CW position (see step 8).

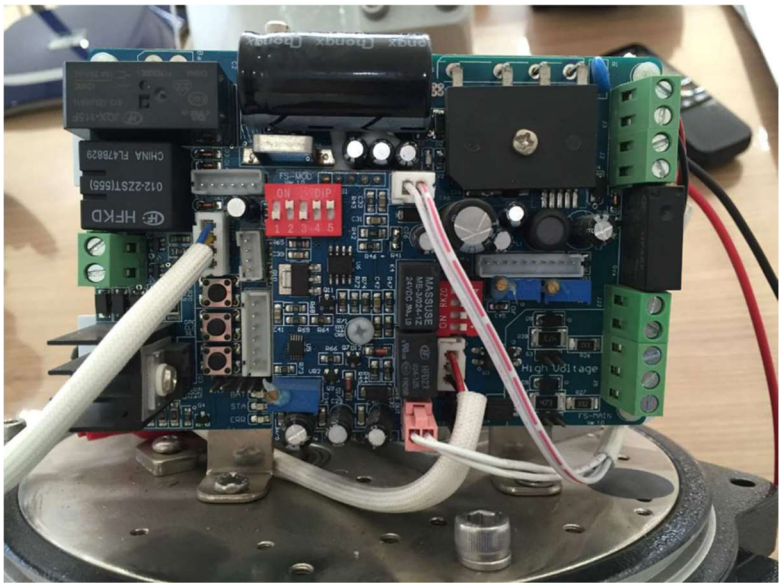


Figure 30: Proportional PCB 3-phase (24 V controller)

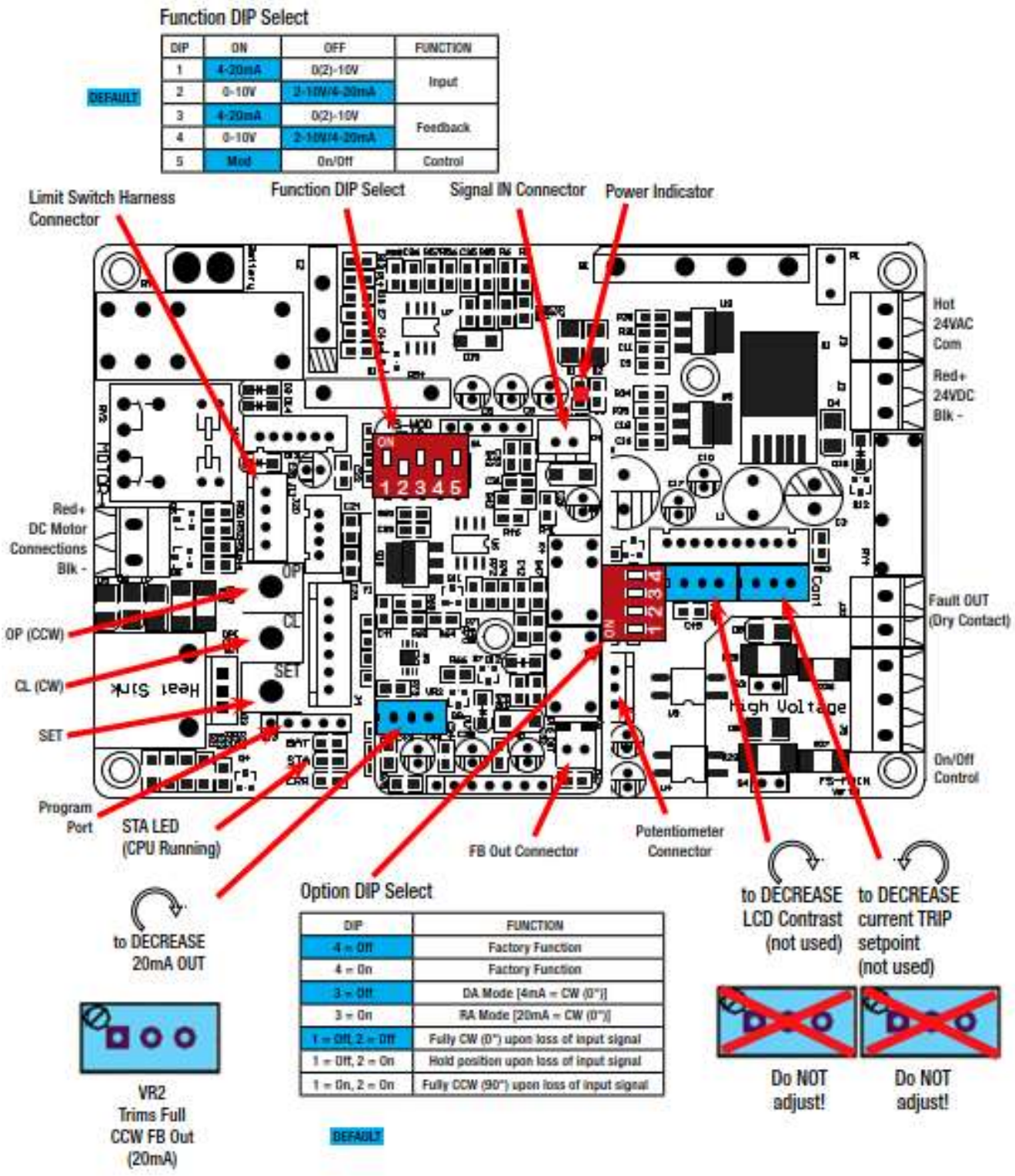


Figure 31: Proportional PCB 3 -phase details (24 V controller)

7.3 Calibration Procedure for BIC + LL Control Station Proportional Control

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

1. Position the actuator to a mid-stroke position.
2. Apply correct power according to the actuator model.
3. Press the S1 button on the control board for 5 seconds, the blue light (D18) turnsthe red light (D3) turns off. The system then enters the stroke setting mode.
4. First, set the full CW stroke position.
    a. Under the full CW setting mode, press S3 button for the actuator to move CW.
    b. Press S3 to move CW until the actuator reaches full CW position and then release the button.
    c. Press S1 button for 5 seconds, the blue light (D18) and red light (D3) both turn on.
    d. The MCU will record the CW (0%) position, and then enters the full CCW setting mode.
5. Set the full CCW stroke position.
    a. Press S2 button for the actuator to move CCW.
    b. Continue to pressing S2 towards 100% until the actuator reaches full CCW position and then release the button to stop.
    c. Press S1 button for 5 seconds, blue light (D3) turns off and the red light (D3) turns on.
    d. The MCU will record the CCW (100%) position.
6. Setting is done.
7. Note: The actuator has a blocked protection function. When stroke block occurs for over 10 seconds, the system goes into lock mode and stops the stroke movement. If it happens during the stroke setting, move the stroke towards the opposite direction to unlock. For example if it happens at 0% position, direct the stroke towards 100% to release the block protection.
8. On/Off Control stops here, Calibration is complete.

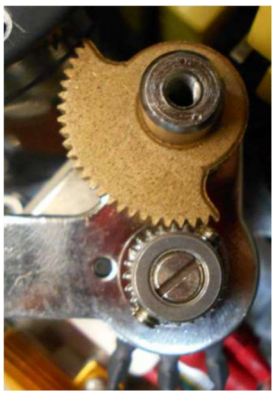
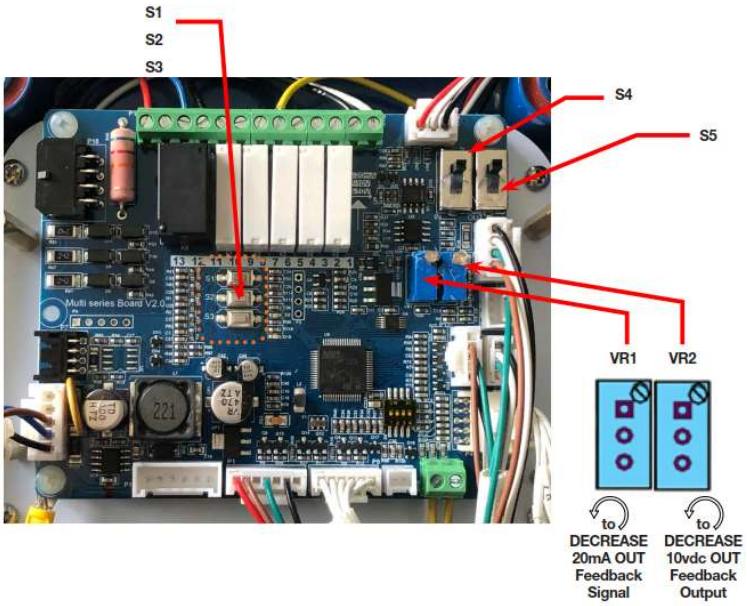


Figure 32: Alignment of the sector and potentiometer gear sets at the fully CW position (ref. only).



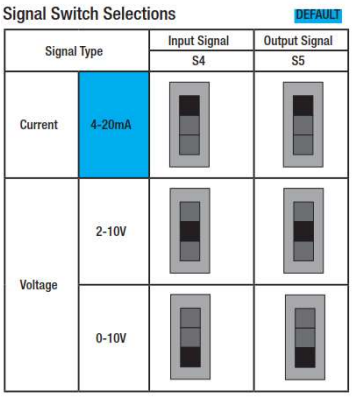


Figure 33: Proportional LL 3-phase (24 V controller)

8 Troubleshooting Guide

DANGER - 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, use **extreme caution**, and follow all relevant company safety protocols and procedures.

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. If problems still exist after consulting Table and Table , contact Flowserve for additional support.

Table 2: Fault symptoms for on/off control models

The actuator does not move when commanded to do so.					
⇓	**The supply and controls are measured to be correct, but the actuator still does not move.**				
	⇓	**The motor is extremely hot to the touch.**			
		⇓	**The actuator does not stop at the correct position at either end-of-travel.**		
			⇓	**Target**	**Action**
●				Power source	Measure incoming power at the actuator terminal blocks. Reference the correct wiring diagram (**Error! Reference source not found.**).
●				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 the correct wire size per Table .
	●			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 the size of the actuator.
	●				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 hot and terminal 2 while commanding the actuator to move. Also measure the voltage between terminals L1, L2, and L3. The measured voltage cannot drop more than 10% from the rated voltage.
	●			Cams improperly set.	**Remove the power supply**. Check to see if the cams rotate freely on the cam shaft using your finger. The cams must be secure and set according to the procedures in section 5.8.
		●		Control “noise” or excessive duty cycle.	Check for stray voltage fluctuations on the incoming control signals. The on/off high voltage actuators have a maximum duty cycle of 25%.
		●			Check for parallel wiring of multiple on/off actuators. Review the site as-built wiring diagrams to verify.
			●	Travel cams and/or mechanical stops not positioned correctly.	Reset the end-of-travel cams and/or mechanical stops as detailed in section 5.8.

Table 3: Fault symptoms for proportional control models

The actuator does not move when commanded to do so.				
⇓ **The supply and controls are measured to be correct, but the actuator still does not move.**				
	⇓ **The motor is extremely hot to the touch.**			
		⇓ **The actuator does not stop at the correct position at either end-of-travel.**		
			⇓ **Target**	**Action**
●				Power source	Measure incoming power at the actuator terminal blocks. Reference the correct wiring diagram (**Error! Reference source not found.**).
●				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 the correct wire size per Table .
	●			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 the size of the actuator.
	●				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. Also measure the voltage between terminals L1, L2, and L3. The measured voltage cannot drop more than 10% from the rated voltage.
	●			Cams improperly set.	**Remove power.** Check to see if the cams rotate freely on the cam shaft using your finger. The cams must be secure and set according to the procedures in section 5.8.
		●		Control "noise" or excessive duty cycle.	Check for stray voltage fluctuations on the incoming control signals. Analog control signals are susceptible 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.
			●	Travel cams and/or mechanical stops not positioned correctly.	Reset the end-of-travel cams and/or the mechanical stops as detailed in section 5.8.

9 Technical Data

9.1 Nameplate

Figure 34: Example of an LTQ0H3 - LTQ0H4 Series nameplate

9.2Torque Requirements

Table 4: Actuator specifications for 3-phase models

Actuator			**LTQ008**	**LTQ017**	**LTQ034**	**LTQ053**	**LTQ070**	**LTQ088**	**LTQ150**	**LTQ203**
Supply	Torque Output (in-lb / N m)		880 / 100	1770 / 200	3540 / 400	5310 / 600	7080 / 800	8850 / 1000	15040 / 1700	20350 / 2300
230/3PH	Current Draw (Start / Run / LRA)		0.7A/0.6A/1.0A		1.8A/1.1A/2.4A				3.6A/1.9A/4.5A	
	Speed (90°) DC – 60Hz / 50Hz (sec)		16/19	33/39	24/29	33/39	33/39	39/47	28/34	39/47
	Motor - 220V Polyphase TENV		40W		90W				200W	
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2 – 15min) / **75% (S4 – 75%)**						25% (S2-15 min) / **50% (S4-50%)**	
		Motor Protection, Temp / Class	155°C (311°F) / Class F / 180°C (356°F) / Class H						155°C / Class F / **180°C / Class H**	
		Motor Starts, per hour, Max	All – 600							
380/3PH	Current Draw (Start / Run / LRA)		0.4A/0.3A/0.6A		1.1A/0.6A/1.4A			1.6A/0.8A/1.9A	2.1A/1.1A/2.6A	
	Speed (90°) DC – 60Hz / 50Hz (sec)		16/19	33/39	24/29	33/39	39/47		28/34	39/47
	Motor - 380V Polyphase TENV		40W		90W				200W	
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2 – 15min) / **75% (S4 – 75%)**						25% (S2-15 min) / **50% (S4-50%)**	
		Motor Protection, Temp / Class	155°C (311°F) / Class F / 180°C (356°F) / Class H						155°C / Class F / **180°C / Class H**	
		Motor Starts, per hour, Max	All – 600							
480/3PH	Current Draw (Start / Run / LRA)		0.2A/0.2A/0.4A		0.7A/0.4A/1.0A			0.9A/0.5A/1.1A	1.2A/0.9A/2.1A	
	Speed (90°) – 60Hz / 50Hz (sec)		16 / 19	33 / 39	24 / 29	33 / 39	39 / 47		28 / 34	39 / 47
	Motor - 480V Polyphase TENV		40W		90W			120w	200W	
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2 – 15 min) / **75% (S4 – 75%)**						25% (S2 – 15 min) / **50% (S4 – 50%)**	
		Motor Protection, Temp / Class	155°C (311°F) / Class F / 180°C (356°F) / Class H							
		Motor Starts, per hour, Max	All – 600							
575/3PH	Current Draw (Start / Run / LRA)		0.2A/0.2A/0.3A		0.4A/0.3A/0.8A			0.8A/0.4A/0.9A	1.0A/0.7A/1.9A	
	Speed (90°) – 60Hz / 50Hz (sec)		16 / 19	33 / 39	24 / 29	33/ 39	39 / 47		28 / 34	39 / 47
	Motor - 575V Polyphase TENV		40W		90W			120W	200W	
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2 – 15 min) / **75% (S4 – 75%)**						25% (S2 – 15 min) / **50% (S4 – 50%)**	
		Motor Protection, Temp / Class	155°C (311°F) / Class F							
		Motor Starts, per hour, Max	All – 600							
All	Environmental Rating		NEMA 4/4X and IP67							
	Electrical Entry (2)		3/4" EMT or polyamide gland							
	Control		On/Off, Proportional, in Five Levels of Control and Protection (some limited applications)							
	Auxiliary Switch – End-of-Travel		(4) Form A Volt-Free, Rated 1A @ 24V							
	Ambient Operating Range		-22°F to +158°F (-30°C to +70°C)							
	Humidity Range		0 – 95% RH							
	Altitude Limit		9850 ft / 3000 m							

9.3 LTQ NCU and BIC Units

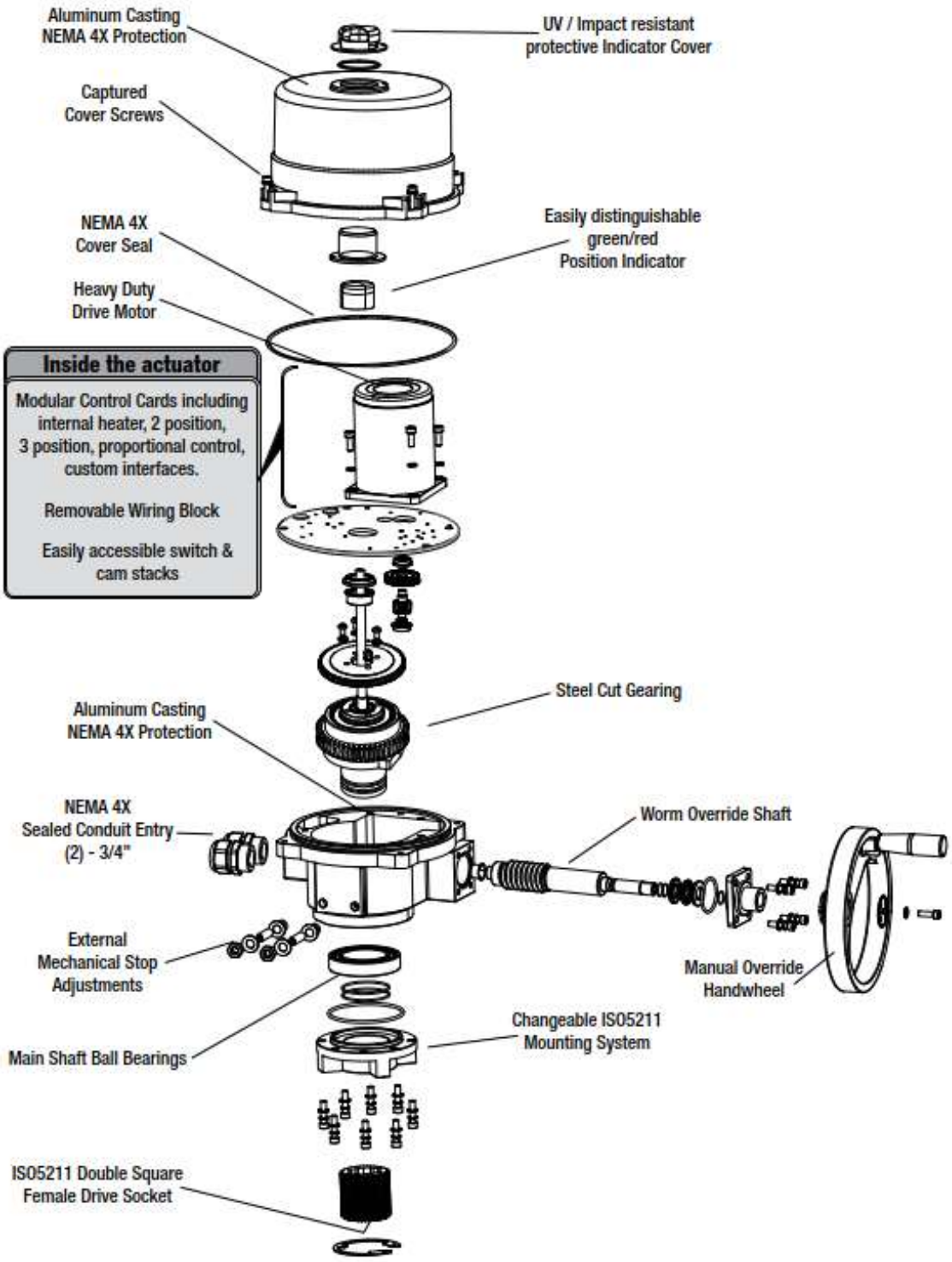


Figure 35: Exploded view of the NCU and BIC units

9.4 LTQ BIC + LED Units

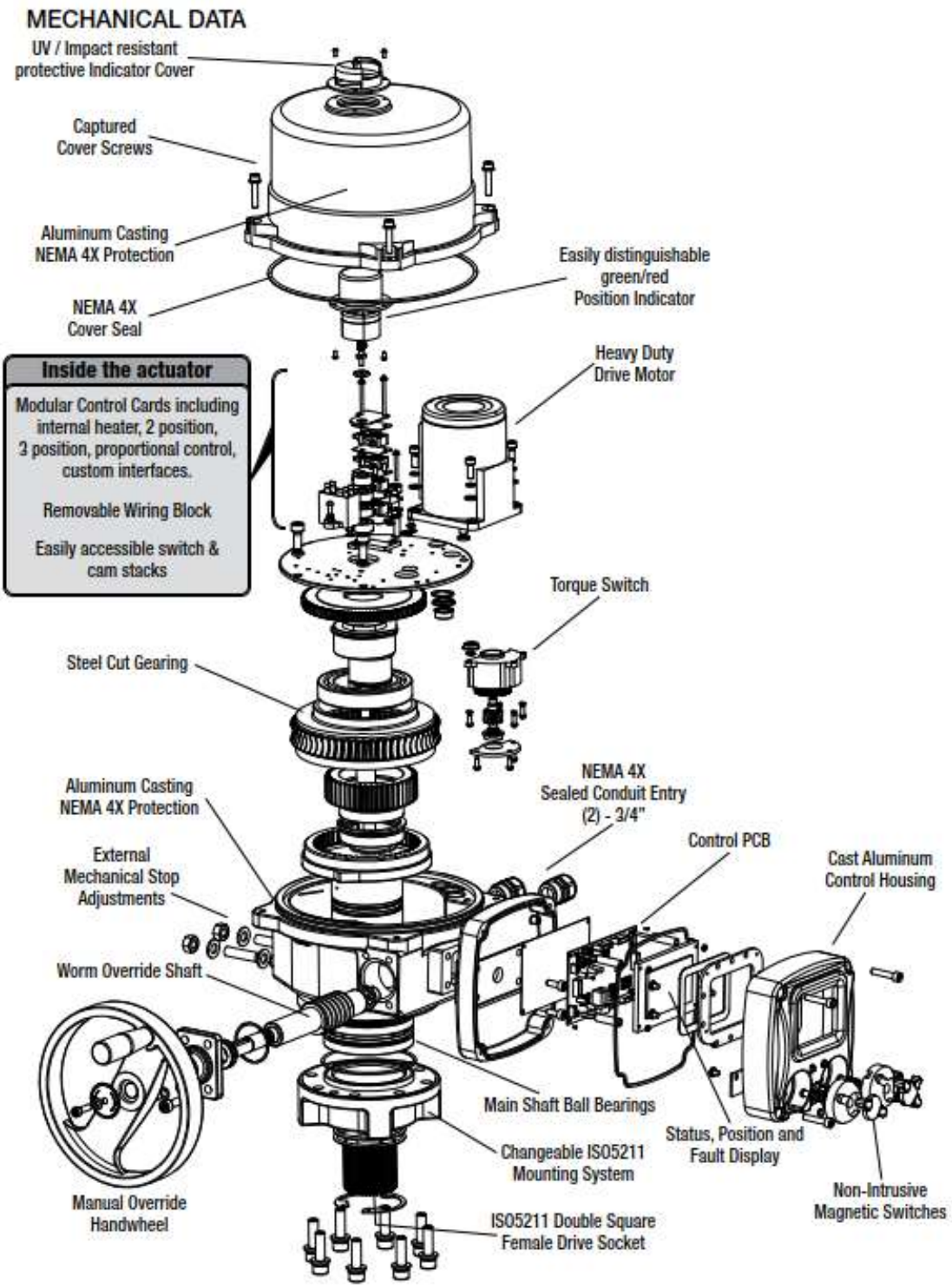


Figure 36: Exploded view of BIC + LED units

9.5 Wire Sizing

Wire sizing data is provided in Table below to assist in the selection of the proper wire size for LTQ008 Series actuators using various wire sizes over distance. Always reference the correct voltage, and do not exceed the indicated length of the wire run for each model.

Table 5: Maximum distance between actuator and power supply

LTQ008-LTQ017 ACTUATOR	**Voltage**			
	230 / 3	380 / 3	480 / 3	575 / 3
	Amps			
	0.7	0.4	0.2	0.2
AWG	**Maximum Distance – Actuator to Power Supply (ft)**			
16	1665	10752	25636	33559
14	2649	17102	40774	53375
12	4212	27193	64833	84869
10	6695	43225	103058	134908
8	10650	68761	163940	214606

Annex A: Glossary

Below are terms and definitions used throughout this manual:

1. **BAS** is an industry acronym for a building automation system.
2. **BIC** is an industry acronym for Basic Integral Controls.
3. **CCW** denotes the Counterclockwise direction for movement.
4. **CW** denotes the Clockwise direction for movement.
5. **F.C.** denotes the operational status of the actuator when fully closed.
6. **F.O.** denotes the operational status of the actuator when fully opened.
7. **FS** denotes a product manufactured with Fail Safe built-in.
8. **LCS** is an industry acronym for a Local Control Station.
9. **MCC** is an industry acronym for a Motor Control Center.
10. **NCU** is an industry acronym for No Controls Units.
11. **PC** denotes a product manufactured with Phase Correction circuity built-in.
12. **PCB** is an industry acronym for printed circuit board.
13. **PLC** is an industry acronym for a programmable logic controller.
14. **PP** denotes a product manufactured with Phase Protection circuitry built-in.
15. **REV** denotes a product manufactured with Reversing Motor Starters built-in.
16. **TS** denotes a product manufactured with Torque Switches.
17. **VAC** is an industry acronym for volts alternating current.
18. **VDC** is an industry acronym for volts direct current.
19. **XFS** denotes a product manufactured without Fail Safe built-in.
20. **XLCS** denotes a product manufactured without a Local Control Station.
21. **XPP** denotes a product manufactured without Phase Protection circuitry built-in.
22. **XREV** denotes a product manufactured without Reversing Motor Starters built-in.
23. **XTS** denotes a product manufactured without Torque Switches.

Flowserve factory contacts:

United States
Flowserve Corporation
5114 Woodall Rd
Lynchburg, VA 24502-2248
Phone: 1 434 528 4400
Fax: 1 434 845 9736

United States
Flowserve Corporation
14219 Westfair West Dr
Houston, TX 77041-1137
Phone: 1 281 671 9209
Fax: 1 281 671 9268
Email: vachouston@flowserve.com

FLOWSERVE REGIONAL SALES OFFICES:

Local Flowserve representative:

To find your local Flowserve representative use the Sales Support Locator System found at www.flowserve.com.