FLOWSERVE

USER INSTRUCTIONS

LTQ0x3 – LTQ0x4 Series

Compact Quarter-turn Electric Actuator

Installation
Operation
Maintenance

AIIOM000166-00 EN 20

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

Experience In Motion

Document Version

Initial Release, 04-30-2020

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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

Single phase actuators range in complexity from simple models, with basic operability, to quite complicated models with a battery backup and local control capabilities. The various models are very specific in how they interface to existing or new installations, meaning they are not easily adaptable across any site or design intent. Read the project specifications and understand the application before making an actuator selection. It is important to fully understand what level of control is required prior to selecting one of these products. If in doubt, consult with a project engineer to clarify what is actually required for a fully operational installation. 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.

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.**

Flowserve produces the LTQ0x3-0x4 Series with a manual handwheel on the side of the actuator (LTQ0H3 & LTQ0H4) or an 8mm hex shaft for non handwheel units (LTQ003 & LTQ004).

NOTICE

- All references to the rotation direction of the LTQ0x3 Series actuator(s) are referenced while viewed from above the actuator.
- The cam shaft and the visual indicator rotate opposite the output shaft.

The LTQ0x3 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 fully 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.

Error! Reference source not found. - Actuators shipped with the battery system disconnected until the unit is commissioned after all installation procedures have been completed.

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** This symbol indicates a hazardous situation which, if not avoided, will result in death or severe injury.
	**WARNING** This symbol indicates a hazardous situation which, if not avoided, could result in serious injury.
	**CAUTION** This symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
	**Safety Instruction** This symbol indicates specific safety-related instructions or procedures.
	**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 customer's purchase order change (e.g. pumping fluid, temperature, or duty conditions), 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 LTQ0H3 actuators do not contain mechanical stops. Use caution when operating the manual override. Do not attempt to operate the actuator with a rotation greater than 95°.

LTQxHx actuators are equipped with an override handwheel as shown in Figure 1. To engage the manual override, push in the handwheel and turn. LTQx0x actuators have an 8mm Hex shaft at the base of the actuator for turning.

WARNING - Do not operate the bottom manual override when power is present, and do not use powered tools to turn any manual override. Gear train damage and/or personal injury may occur.

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

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

3.1.1 LTQ008 – LTQ230

The LTQ0x3 – LTQ0x4 Series are quarter-turn, electric industrial service actuators delivering up to 440 in-lb of torque with voltages ranging from 12VAC/DC to 230V single-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, 3A 24V, and a standard clutch-free, manual-override handwheel. Additionally, these units feature two 1/2" 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: local control stations, IP68 submersible, and battery backup.

3.1.2 Control Station LB/LK

Local Control Stations (LCS) provide a means to select Local or Remote control of a valve or damper actuator. The LCS's offered on the 0x3-0x4 sizes are the LB and LK. The LK features an IP65 enclosure with a lock and key for Local and Remote locking. The LB features an IP67 enclosure without the ability to lock the controls knob position.

3.1.3 Shipping and Handling

The actuator arrives in the fully CW (0°) position. The red/green position indicator (see) shows red. The quarter-turn actuator arrives factory-tested and calibrated to operate between 0° and 90°. Most units will not require calibration of these settings; however, if any travel adjustment is necessary, refer to section 7 for instructions.

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

NOTICE - Do not store this unit outside unless it is powered up and has proper conduit terminations. When not powered up, always store the unit in a clean, dry environment.

3.2 Rotation of Components

Output drive rotation:
All LTQ0x3 Series actuators rotate CW to move from 90° to 0°. So, when viewed from above, the output shaft (out the bottom of the actuator) will drive CW to 0° when performing the command.

NOTICE

- For all the LTQ0H3 Series actuators, the camshaft (position indicator and travel cams) rotates opposite from the output shaft.
- **This User Instructions manual details all component rotation descriptions from a viewpoint above the actuator.**

Table 2: Component rotation

Component	CW (0°) Command	CCW (90°) Command
Visual Indicator	Rotates CCW	Rotates CW
Cam 1 – 2 Behavior	Cam 1 engages Switch 1 from the rear	Cam 2 engages Switch 2 from the front
Output Drive	Drive CW (0°)	Drive CCW (90°)

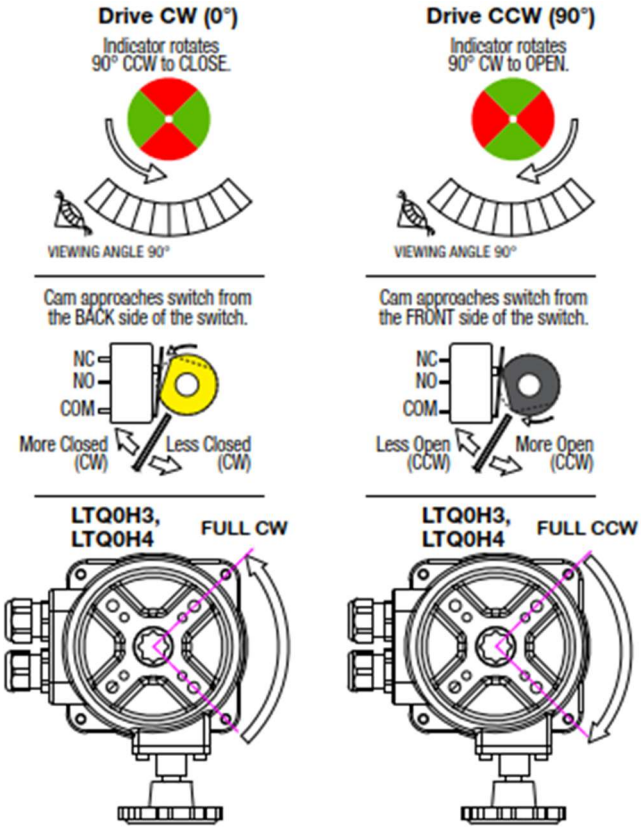


Figure 3: Examples of component rotations

4 Installation

NOTICE - This User Instructions manual references the LTQ0x3-0x4 Series actuator rotation direction while viewed from above the actuator.

⚠CAUTION - Do **NOT** install battery backup units in direct sunlight.

All LTQ0H3 Series actuators rotate CW to drive the output shaft (bottom of the actuator) to the 0° position (Figure). The cam shaft and visual indicator rotate opposite the output shaft.

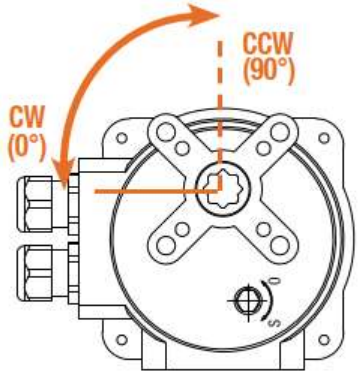


Figure 4: Note that the rotation seen from below is a mirror of the direction viewed from above

4.1 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 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 LTQ0H3 Series actuators utilize a removable terminal block to simplify field wiring and testing.
   - To remove a terminal block from the printed circuit board (PCB) receiver, pull straight out in a direction parallel to the PCB.

- In Figure , the left side of the terminal block (between the PCB mounting screws) is pulled out to the left.
- 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 14 AWG down to 18 AWG, solid or stranded wire.
- Terminal numbering starts from the bottom left at 1 (see Figure).

6. Refer to the product part number to determine which wiring diagram to follow when wiring the actuator (see **Error! Reference source not found.** for more information).
7. Note that although terminals are labeled as 1-8 and A-D, not all terminals are used on all models.

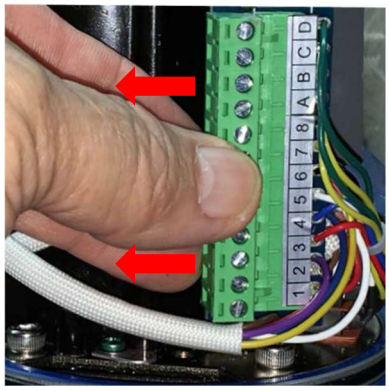


Figure 5: Removable terminal blocks facilitate field wiring and testing.

⚠CAUTION - Be sure to make field connections to the proper terminal as identified by the **label**, 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 A-D on each actuator are for the (adjustable) auxiliary switches. These are dry type (volt free) Form A contacts rated for 24 V @ 3 A max.

4.2 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.
- When installing the conduit, use proper techniques for entry into the actuator. Use drip loops to prevent conduit condensate from entering the actuator.
- 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 Table for proper wire sizing).
- All terminals accept 14 – 18 AWG solid / stranded wire.

NOTICE - Do **not** parallel wire multiple on / off actuators together without utilizing isolation relays. If this is the plan, contact Flowserve for a multiple actuator parallel wiring diagram.

5 Theory of Operation

5.1 NCU On/Off Control

1. Starting with the most basic design are the NCU Series actuators. These models are designed for use with existing single-phase installations where motor control centers are already established.
   a. The remote devices must have volt-free contacts (dry contacts) which will switch the actuator's internal power supply to generate commands to drive CW (0°) or CCW (90°).
   b. **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

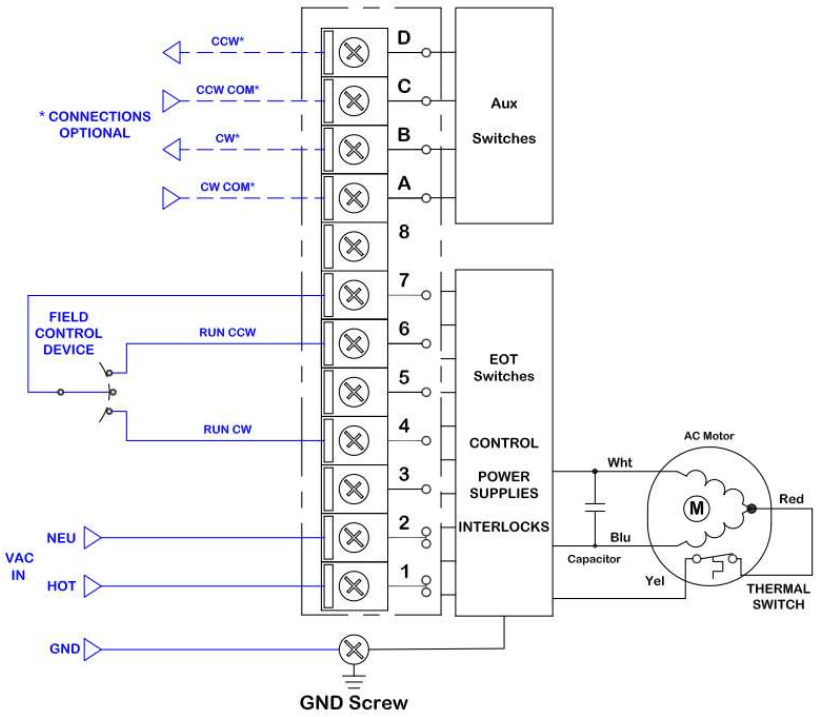


Figure 6: LB 120V wiring diagram shown, others similar

5.2 NCU Proportional Control

1. 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.

   a. **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.

   b. **Proportional Controller.** This analog processing PCB accepts 4 – 20 mA or 2 – 10VDC from the field accordingly.

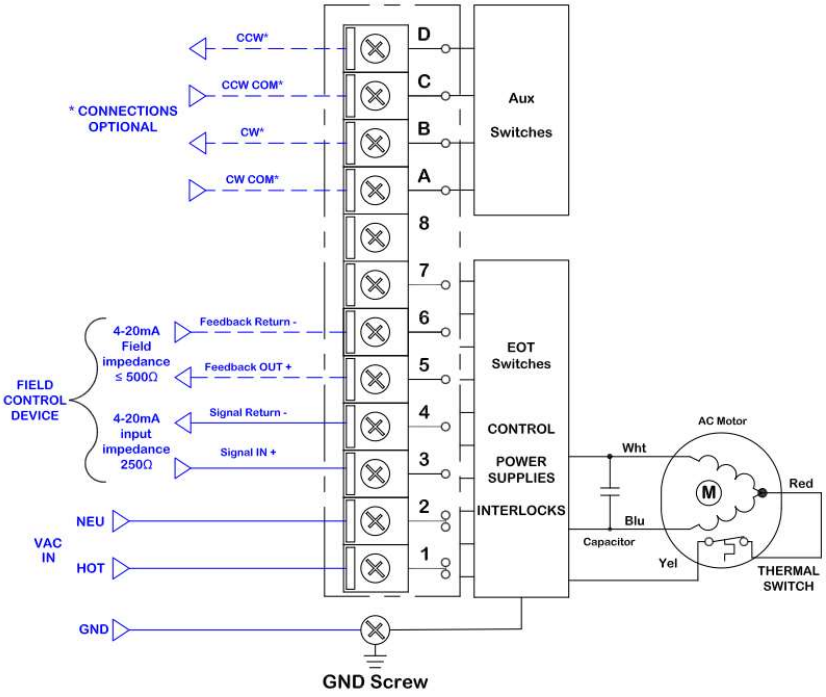


Figure 7: LB 120V wiring diagram shown, others similar

5.3 Control Station On/Off Controls

LTQ advanced stand-alone actuators are designed to be installed in new construction sites or existing sites where there are NO existing local control capabilities. These single phase and low voltage actuators have several versions that continue to add more features and options than the standard actuator range.

Moreover, these units incorporate a Local Control Station (LCS) to facilitate operating the actuator. Having this feature allows operation of the actuator WITHOUT having an existing PLC or BAS based digital controller while also providing operability with existing external controls.

Inside the actuator/LCS package, you will find:

1. Integral Local Control Device. This series is designed to operate in Local mode (control knobs or buttons 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.
   a. While in Remote mode, the Remote devices must have volt-free contacts (dry contacts) which will switch the actuator's internal power supply to generate commands to drive CW (0°) or CCW (90°).
   b. While in Local mode, the actuator responds to the position of the controls located on the face of the integral LCS.

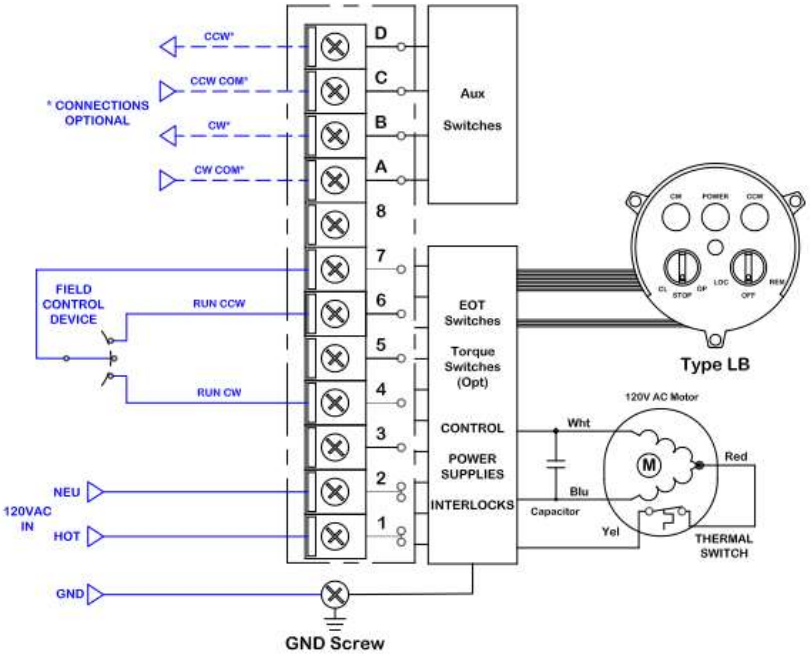


Figure 8: LB 120V wiring diagram shown, others similar

5.4 Control Station Proportional Controls

LTQ LB advanced stand-alone actuators are designed to be installed in new construction sites or existing sites where there are NO existing local control capabilities. These single phase and low voltage actuators have several versions that continue to add more features and options than the standard actuator range.

These units accept analog control signals (4-20mA or 2-10VDC) and 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 and 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 a Local Control Station (LCS) to facilitate operating the actuator locally. Having this feature allows operation of the actuator WITHOUT having an existing PLC or BAS based analog controller while also providing operability with existing external controls.

Inside the actuator/LCS package, you will find:

1. **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.
   a. While in **Local mode**, the actuator responds to the position of the controls located on the face of the integral LCS.
   b. All analog functions are disabled when the actuator is in Local mode.
2. Proportional Controller. When the unit is in Remote mode, this analog processing Printed Circuit Board (PCB) accepts 4-20mA or 2-10VDC from the field and positions the actuator accordingly, utilizing the internal reversing motor controls. A 4-20mA or 2-10VDC feedback signal is internally generated to provide remote reading of the position of the actuator.

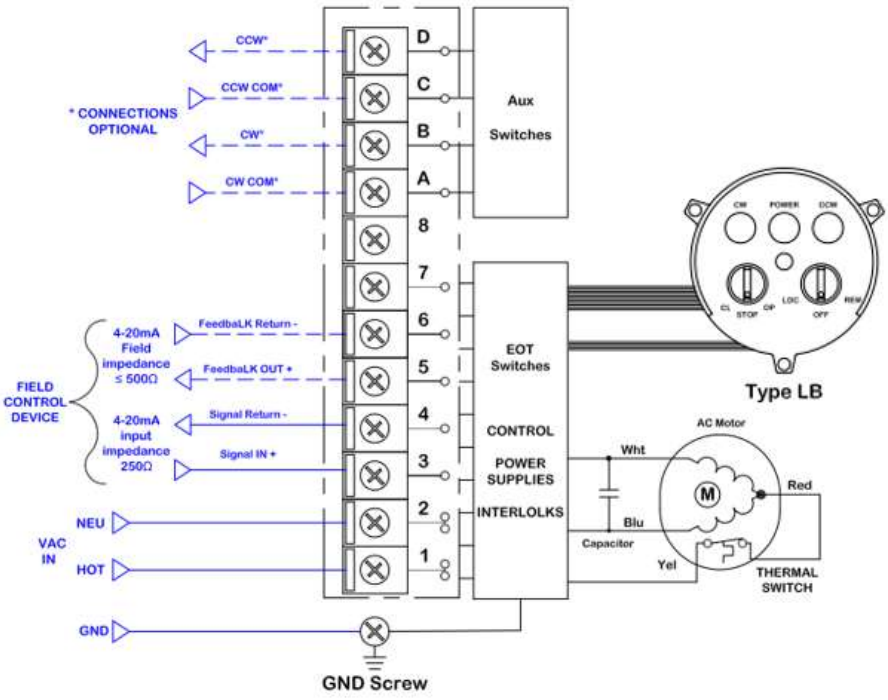


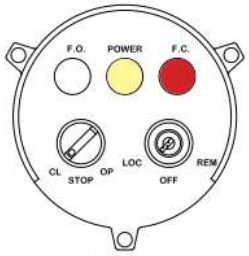
Figure 9: LB 120V wiring diagram shown, others similar

5.5 LK series LCS Operation

This round NEMA 4X & IP65 enclosure houses two rotary control switches that provide the user with the ability to operate the actuator in a normal (REMOTE) mode where the actuator responds to control signals from a building automation system or a PLC or other control device (by others). Or the user can elect to operate the actuator in LOCAL mode where one can control the positioning of the actuator while standing AT the device. This allows opening and closing the actuator (valve) to test for operation, perform maintenance or other function without relying on radio communication to command the automation system to position the actuator.

A Key is provided for lockout and secured access to the MODE control switch of the actuator. With the key removed (from any of the three positions), the MODE switch cannot be changed.

The Position Indicators (top).



Panel shown in the Local Mode

POWER (POWER indicator, all actuators): The Power LED is illuminated whenever power is present at the unit, regardless of MODE position.
The panel also contains two colored LED indicators to provide visual indication of the position and status of the actuator. The green F.O. LED corresponds to the CCW (90°) actuator position. The red F.C. LED corresponds to the CW (0°) actuator position. Both remain steady ON when their respective end of travel is reached.

The MODE switch (right hand side) has three positions.

- **REM** (REMOTE, On/Off actuators): sets the actuator to respond to field generated control signals. In this mode the POSITION KNOB has NO affect on the positioning of the actuator. All actuator movement is controlled by the external signal device. 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 function of that control signal. The indicators are active in this mode.
- **REM** (REMOTE, Proportional Control actuators): The actuator follows the incoming 4-20mA (2-10vdc) control signal, and generates a 4-20mA (2-10vdc) feedback signal OUT which corresponds to the position of the actuator.
- **LOC** (LOCAL, On/Off actuators): sets the actuator to respond to the POSITION KNOB. The indicators are active in this mode.
- **LOC** (LOCAL, Proportional Control actuators): sets the actuator to respond to the POSITION KNOB. The indicators are active in this mode.
- **OFF** (all models) In the OFF position, electronic movement of the actuator is disabled. The actuator will NOT respond to any incoming remote or local signals. The actuator MAY be operated manually using the handwheel and the unit will STAY in its desired position.

The POSITION switch (left hand side) has three positions.

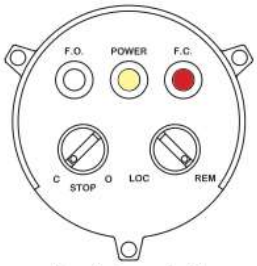
When power is present in the unit, the mode switch is operational.

- **STOP** (center position) removes any ability to reposition the actuator electrically.
- **STOP** with Proportional Control actuators: The actuator generates a 4-20mA (2-10vdc) feedback signal OUT which corresponds to the position of the actuator.
- **OP** (CCW) set the POSITION switch to OP to drive the actuator to the full CCW (90°) position.
- **CL** (CW) set the POSITION switch to CL to drive the actuator to the full CW (0°) position.
- The position switch can be used to "bump" or "jog" the actuator incrementally in either direction as well.

5.6 LB series LCS Operation

This round NEMA 4X & IP67 enclosure houses two rotary control knobs that provide the user with the ability to operate the actuator in a normal (REMOTE) mode where the actuator responds to control signals from a building automation system or a PLC or other control device (by others). Or the user can elect to operate the actuator in LOCAL mode where one can control the positioning of the actuator while standing AT the device. This allows opening and closing the actuator (valve) to test for operation, perform maintenance or other function without relying on radio communication to command the automation system to position the actuator.

The Position Indicators (top).



Panel shown in the Remote Mode

POWER (POWER indicator, all actuators): The Power LED is illuminated whenever power is present at the unit, regardless of MODE position.

The panel also contains two colored LED indicators to provide visual indication of the position and status of the actuator. The green F.O. LED corresponds to the CCW (90°) actuator position. The red F.C. LED corresponds to the CW (0°) actuator position. Both remain steady ON when their respective end of travel is reached.

The MODE switch (right hand side) has three positions.

- **REM** (REMOTE, On/Off actuators): sets the actuator to respond to field generated control signals. In this mode the POSITION KNOB has NO affect on the positioning of the actuator. All actuator movement is controlled by the external signal device. 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 function of that control signal. The indicators are active in this mode.
- **REM** (REMOTE, Proportional Control actuators): The actuator follows the incoming 4-20mA (2-10VDC) control signal, and generates a 4-20mA (2-10VDC) feedback signal OUT which corresponds to the position of the actuator.
- **LOC** (LOCAL, On/Off actuators): sets the actuator to respond to the POSITION KNOB. The indicators are active in this mode.
- **LOC** (LOCAL, Proportional Control actuators): sets the actuator to respond to the POSITION KNOB. The indicators are active in this mode.

The POSITION switch (left hand side) has three positions.

When power is present in the unit, the mode switch is operational.

- **STOP** (center position) removes any ability to reposition the actuator electrically.
- **STOP** with Proportional Control actuators: The actuator generates a 4-20mA (2-10VDC) feedback signal OUT which corresponds to the position of the actuator.
- **OP** (CCW) set the POSITION switch to OP to drive the actuator to the full CCW (90°) position.
- **CL** (CW) set the POSITION switch to CL to drive the actuator to the full CW (0°) position.
- The position switch can be used to "bump" or "jog" the actuator incrementally in either direction as well.

6 Battery Backup

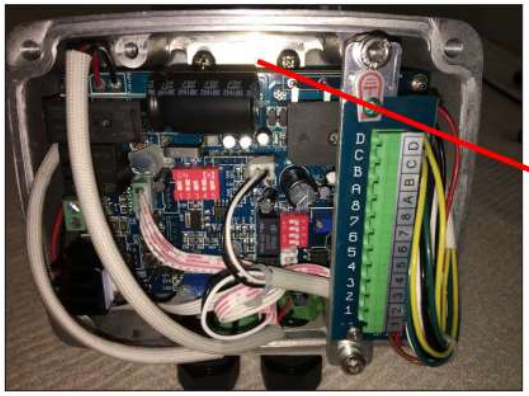
6.1 Battery Identification

The LTQ003-004 Series Battery Backup units are fitted with a battery storage enclosure mounted directly onto the actuator as shown.

All wiring for the battery pack is complete and an internal disconnect for the battery system is provided.

Battery and Controls Enclosure

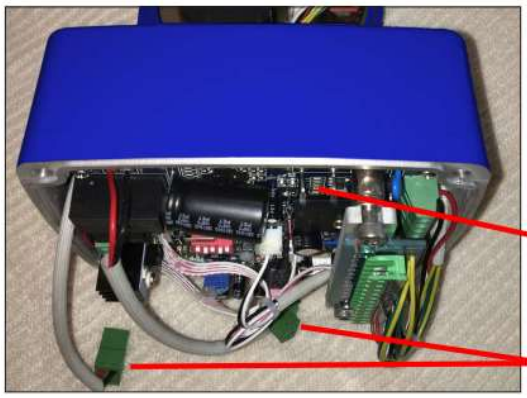
WARNING - Do **NOT** install battery backup units in direct sunlight.



Battery Pack (Behind)
(12 terminal plug removed for clarity)

All field terminations are made inside this enclosure

Error! Reference source not found. - The battery system should remain UNPLUGGED until AFTER the actuator has been mounted and tested for proper travel and end stop calibration.



Control Board

Battery Disconnect
(Male/Female Pair)

6.2 120/230V Transformer Mounting and Setup

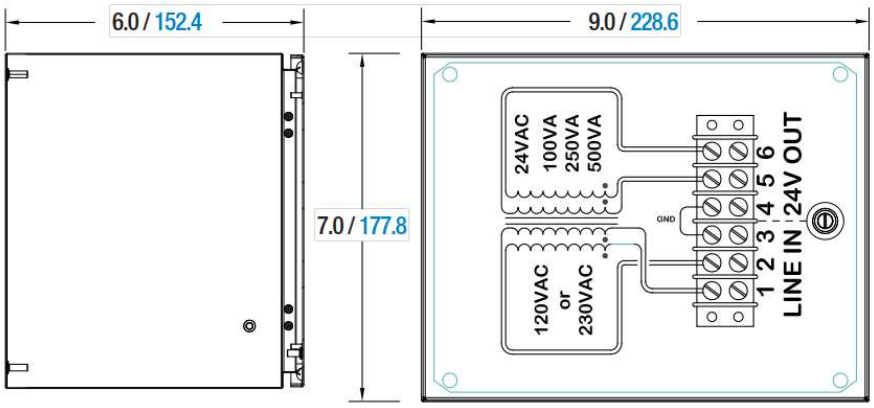
Power Supply:
The LTQ0x3 & 0x4 Series Battery Backup units require a 100VA 24vac / 5A 24vdc power supply directly into the actuator terminal block. To facilitate various site power availability, an optional enclosure is offered which houses an appropriately sized toroidal transformer to supply the 24V power to the actuator. Mounted separately, the enclosure is a NEMA 4X / IP65 9 x 7 x 6 hinged door cabinet. Mounted to a back plane, the transformer primary and secondary are pre-wired to a six position dual terminal block.

Figure 10: LTQ Series Transformer Enclosure (120/230VAC Installations)

Notes:
The enclosure, while NEMA 4X rated, should NOT be installed in direct sunlight. If installed outdoors, it should be installed in the shade under a rain hood using rain-tight conduit fittings and connectors.

The Enclosure is a sealed NEMA 4X type stainless steel type without conduit holes or knock-outs. This allows complete flexibility when mounting. The enclosure can be oriented in any direction, and can be mounted on wall, floor, ceiling, uni-strut or any other fixed surface. Conduit penetrations by others. Interconnect wiring between transformer panel and actuator by others per the supplied wiring diagram.

Figure 11: LTQ Series Transformer (120/230VAC Installations)



Model	Line	Power	Size in / mm	Weight lbs / kg
LTQBBC120-100	120VAC	100VA	9.0 W x 7.0 H x 6.0 D 228.6 W x 177.8 H x 52.4 D	12 / 5.5
LTQBBC120-250	120VAC	250VA		14 / 6.4
LTQBBC120-500	120VAC	500VA		20 / 9.1
LTQBBC230-100	230VAC	100VA		12 / 5.4
LTQBBC230-250	230VAC	250VA		14 / 6.4
LTQBBC230-500	230VAC	500VA		20 / 9.1

Figure 12: LTQ Series Transformer Enclosure Dimensional Data

7 Adjustments

This actuator arrives calibrated and tested by the factory to stop at 0° for the CW position and 90° for the CCW position. 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 7.1.2, Auxiliary Switch Cam Mapping

Error! Reference source not found. below describes how the rotation of the actuator drive shaft activates either auxiliary switch depending on the position – CW or CCW. The auxiliary switches allow a signal current to flow along different paths, ultimately allowing the actuator position to be known by reading the electrical outputs of B or D. Reference the proper wiring diagram for the actuator as needed.

Adjusting End-of-Travel Cams, and 7.1.3, Adjusting Auxiliary Switch Cams. 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 dangerous or fatal electrical shock, **turn off power** to all electrical equipment before working on electrical connections or changing cam positions.

7.1 Auxiliary Switch Cam Mapping

Error! Reference source not found. below describes how the rotation of the actuator drive shaft activates either auxiliary switch depending on the position – CW or CCW. The auxiliary switches allow a signal current to flow along different paths, ultimately allowing the actuator position to be known by reading the electrical outputs of B or D. Reference the proper wiring diagram for the actuator as needed.

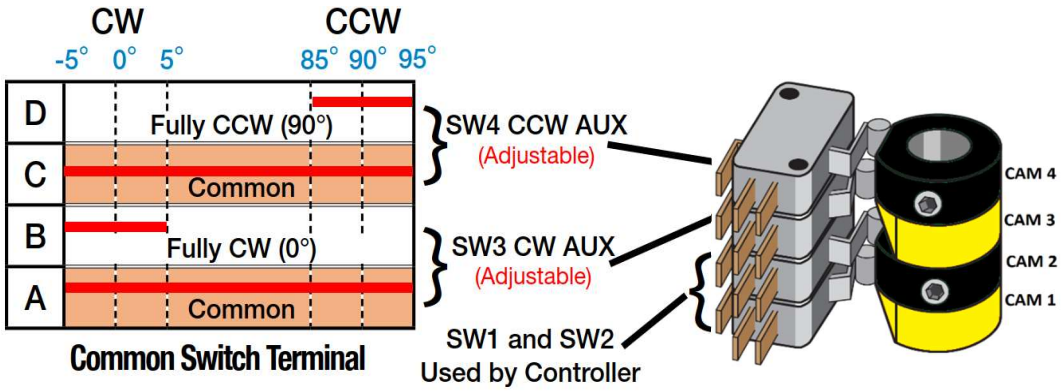


Figure 3: Auxiliary switch cam mapping

7.2 Adjusting End-of-Travel Cams

Figure 14: Cam 1 CW cam

WARNING - **Allowing the motor to drive the gear train beyond its 0 – 90° travel arc will result in severe damage to the actuator!** Remove power from this device **before** making any travel adjustments.

1. Adjust CW End-of-Travel Cam (Cam 1 – Figure)
   a. Cam 1 is the bottom cam and is the end-of-travel adjustment for the actuator CW position. With the **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 the cam 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 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.
   c. Repeat the steps above if further adjustment is needed.

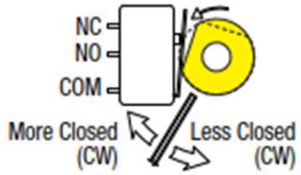


Figure 15: The cam approaches the switch from the back-side of the switch

2. Adjust CCW End-of-Travel Cam (Cam 2 – Figure)
   a. Cam 2 is the second cam up from the bottom and is the end-of-travel adjustment for the actuator CCW position. With the **power off** and the actuator at its required CCW position, use a 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 second 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.
   c. Repeat the steps above if further adjustment is needed.

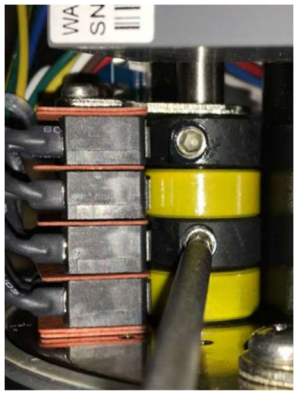


Figure 16: Cam 2 CCW cam

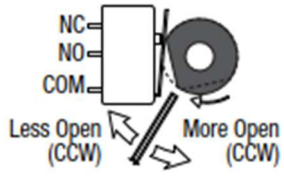


Figure 4: The cam approaches the switch from the front-side of the switch

7.3 Adjusting Auxiliary Switch Cams

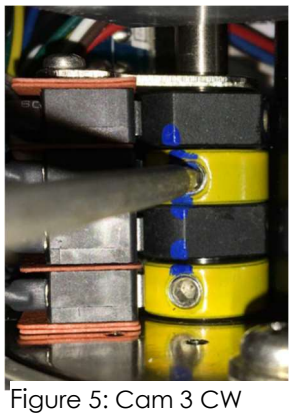


Figure 5: Cam 3 CW auxiliary cam

⚠WARNING - **Allowing the motor to drive the gear train beyond its 0 – 90° travel arc will result in severe damage to the actuator!** Remove power from this device **before** making any travel adjustments.

1. Adjust CW Auxiliary Cam
   a. Cam 3 is the third cam up from the bottom and is the CW auxiliary switch adjustment, an optional switch typically used to indicate the actuator has reached its CW position.
   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 the cam 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 the set screw (only until slight pressure is felt). Ideally, the set crew 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 6° to the right to ensure the auxiliary cam switch changes states before the actuator reaches its end-of-travel electrically.
      v. Tighten the cam set screw.
      vi. To quickly verify the correct CW auxiliary cam setting, compare its set screw location to that of cam 1. The set screw on cam 3 should be approximately one-half the set screw diameter to the right of the set screw on cam 1 (similar to Figure 6).

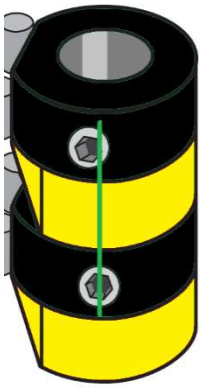


Figure 6: Easy indicator of correct CCW auxiliary cam setting

2. Adjust CCW Auxiliary Cam
   a. Cam 4 is the fourth cam up from the bottom (top cam) and is the CCW auxiliary switch adjustment, an optional switch typically used to indicate the actuator has reached its CCW position.
   b. Drive the actuator to its CCW position. Use a 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 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 from the bottom switch.
      iv. Continue to rotate the cam between 3° and 5° to the left to ensure the auxiliary cam switch changes states before the actuator reaches its end-of-travel electrically.
      v. Tighten the cam set screw.
   c. To quickly verify the correct CCW auxiliary cam setting, compare its set screw location to that of cam 2. The set screw on cam 4 should be approximately one-half the set screw diameter to the left of the set screw on cam 2 (see Figure 6).

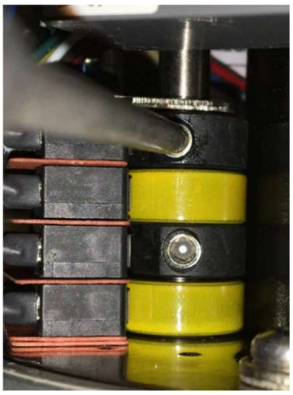


Figure 20: Cam 4 CCW auxiliary cam

7.4 Proportional Control Setup

SAFETY INSTRUCTIONS - During the initial setup, before changing the actuator rotation, ensure that the sector gear set screws (qty 2) are loose enough to allow the sector gear / potentiometer pinion gear to rotate freely by hand. This will prevent damage to the potentiometer if initial settings are incorrect. The two set screws in the sector gear should be **loose**, and the two set screws in the potentiometer pinion gear should be **tight** (see Figure).

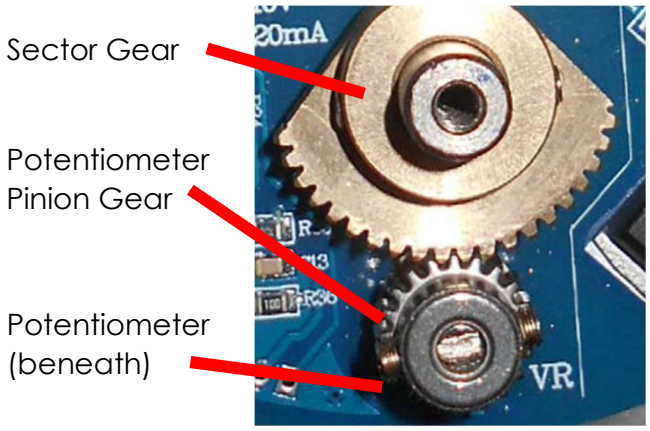


Figure 21: Proportional control sector gear / potentiometer pinion gear for 120 – 230 VAC models

7.4.1 Proper Sector Gear/Potentiometer Pinion Gear Behavior:

- Normal operation: ⚠
  - When viewed from above the actuator, when it is driving to the fully CW (0°) position:
    - The sector gear rotates CCW;
    - The potentiometer pinon gear rotates CW.
  - When viewed from above the actuator, when it is driving to the fully CCW (90°) position:
    - The sector gear will rotate CW;
    - The potentiometer pinon gear rotates CCW until the actuator reaches its fully CCW position.

    NOTICE - If the setting of this procedure is incorrect, the sector gear will overdrive the potentiometer and damage the potentiometer.
- Initial gear mesh setup:
  - Since the potentiometer has a limited angle of rotation and is easily damaged by overdriving its limits, take care during initial setup.

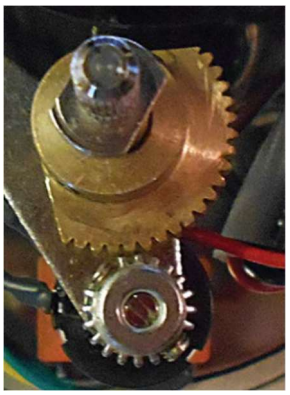


Figure 22: The correct alignment of the sector gear and pinon gear when the actuator is in its fully CW position (CW cam tripped)

- With the sector gear set screws loosened as described, lift the sector gear so it is not meshed with the pinion gear.
- Place the actuator gear train in the fully CW (0°) position.
- Rotate the potentiometer pinion gear to its fully CW direction then back one to two teeth.
- Rotate the sector gear and place it where the second or third tooth from the end meshes with the pre-positioned potentiometer gear.
- Ideally, the sector gear is always meshed with the pinon gear from the CW (0°) position to the CCW (90°) position, never hitting the potentiometer end stops.
- Tighten the two M3 set screws on the sector gear.

NOTICE - During any movements, pull the sector gear onto the camshaft to clear the pinion gear teeth. This will allow proper rotation and alignment of components.

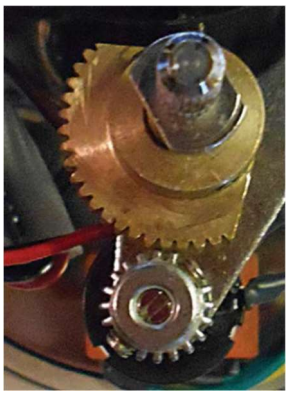


Figure 23: The correct alignment of the sector gear and pinion gear when the actuator is in its fully CCW position (CCW cam tripped)

7.5 Manual Override

The LTQ0H3 and the LTQ0H4 feature a side-mounted, engageable handwheel. Engage the manual override by pressing the handwheel in firmly before rotating it. CW rotation of the handwheel will move the output shaft to 0°, and CCW rotation of the handwheel will move the output shaft to 90°.

Figure24: Engageable handwheel for manual override (LTQ0H3 and LTQ0H4 models) Push to engage.

NOTICE - The handwheel on the LTQ0H3 and LTQ0H4 models is disengaged from the drive system during normal operation. If the actuator is powered up and operating, the handwheel will rotate when pressed into position.

The LTQ0H3 and LTQ0H4 models have limited rotation angles of less than 105°. The gear train contains hard mechanical stops to prevent the manual or automatic operation of the actuator beyond those limitations.

NOTICE - Attempts to use the handwheel system to move the gear train beyond the 105° rotation limits will void the product warranty.

The LTQ003 and LTQ004 feature a bottom mounted hex shaft override. CW rotation of the shaft will CLOSE the actuator and CCW rotation of the shaft will OPEN the actuator.

Figure25: Bottom mounted Manual Override

8 Commissioning

Error! Reference source not found. - 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 7 **Error! Reference source not found.**.

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

8.1 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 fully CW (0°) to fully CCW (90°) 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. The actuator will stop when it reaches its fully CCW (90°) position.
8. With a field command signal still present, measure terminals 2 and 5 and
9. Read the 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. The actuator will stop when it reaches its fully CW (0°) position.
13. With a field command signal still present, measure terminals 2 and 3 and read voltage to match that measured in step 4.
14. Read the 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 fully CW (0°) trip position.
16. Return Field control to automatic mode.
17. The actuator is now commissioned and operational.

8.2 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 fully CW (0°) to fully CCW (90°) and back again to check for any possible interference. Do not utilize any mechanical advantage devices to rotate the handwheel (e.g. – 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 20 mA (10 VDC) signal. The actuator output shaft rotates in a CCW direction (as viewed from above) and stops at the fully CCW (90°) position.
6. Measure terminals 5 (+) and 6 (-) to read 20 mA (10 VDC).
7. Read the continuity between terminals C & D to show the CCW Aux switch is closed.
8. Command the field device to generate a 4 mA (2 VDC) signal. The actuator OUPTUT shaft rotates in a CW direction (as viewed from above) and stops at the fully CW (0°) position.
9. Measure terminals 5 (+) and 6 (-) to read 4 mA (2 VDC).
10. Read the continuity between terminals A & B to show the CW Aux switch is closed.
11. Generate a 12 mA (6 VDC) signal at the field device to move the actuator to its mid-travel position.

12. The actuator stops at 50% travel and feedback measures 12 mA (6 VDC) ± tolerance error if any (single decimal).
13. Return Field control to automatic mode.
14. The actuator is now commissioned and operational.

8.3 LK/LB On/Off Controls

1. After the actuator and valve (damper) assembly have been installed with power and control connected, BEFORE applying power, **use the handwheel / manual override to rotate the actuator to a mid-travel position.** This procedure checks LOCAL mode first, then the integrity of REMOTE commands.
2. Place **the LCS Mode switch in the OFF position**, and apply power.
   a. The white Power indicator on the face of the LCS should illuminate.
      i. Note that the MODE switch is NOT a power disconnect.
   b. The actuator should NOT move.
      i. If it does, IMMEDIATELY remove power from the actuator to STOP movement.
      ii. If it does NOT move, proceed to step 3.
      iii. Check control wiring (Reference the Actuator IOM). Correct if necessary, and repeat step 2.
3. Place the LCS Move switch in the STOP position, and place the Mode switch in LOCAL position.
   a. The actuator should NOT move.
4. Place the LCS Move switch in the CLOSE (0°) position, and verify the DIRECTION of rotation of the position indicator is CW.
   a. When the actuator reaches its full CW end of travel position, the F.C. indicator will light up on the face of the LCS.
5. Place the LCS Move switch in the OPEN (90°) position, and verify the DIRECTION of rotation of the position indicator is CCW.
   a. When the actuator reaches its full CCW end of travel position, the F.O. indicator will light up on the face of the LCS.
6. Place the Move switch in the CLOSE (0°) position and drive to approx mid-travel, then STOP.
7. Be sure 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, IMMEDIATELY remove power from the actuator to STOP movement.
      ii. If it does NOT move, proceed to step 8.
      iii. Check control wiring (Reference the Actuator IOM).
         1. Repeat step 7.
8. Generate a remote CW move command and verify the DIRECTION of the position indicator is CW.
   a. If it is NOT, immediately proceed to step 9.
   b. If it is, proceed to step 11.
9. Check Field wiring.
   a. Disconnect power.
      i. Remove field wiring to terminals 4, 6 & 7.
      ii. Place a jumper between terminals 4 & 7. Do NOT apply external power to any of these terminals.
   b. Re-apply power. The actuator will move CW.
   c. After confirmation, remove the jumper and re-connect field wiring between terminal 4 & 7 ONLY.
10. 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, reconnect field wiring to terminal 6 and proceed to step 11.
11. Generate a remote CCW move command and verify the DIRECTION of the position indicator is CCW.
    a. If it is NOT, immediately proceed to step 12.
    b. If it is, proceed to step 14.
12. Check Field wiring.
    a. Disconnect power.
       i. Remove the field wiring on terminal 6.
       ii. Place a jumper between terminals 6 & 7. Do NOT apply external power to any of these terminals.

b. Re-apply power. The actuator will move CCW.
c. After confirmation, remove the jumper and re-connect field wiring to terminal 6.

13. Generate a remote CCW move command and confirm 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 14.
14. 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.
15. Place the LCS in Local or Remote Mode to put the actuator into service.

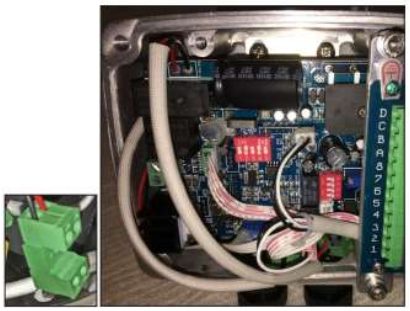
8.4 Battery Backup On/Off Control

8.4.1 Commissioning Procedure

After completing all mounting and wiring procedures and main power is available, it is now possible to commission the actuator. All LTQ003 Series Battery Backup units require a 100VA 24vac / 5A 24vdc power supply directly into the actuator terminal block.

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 12 TERMINAL BLOCK INSIDE THE SIDE MOUNTED ENCLOSURE.
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.

8.4.2 Connecting and Starting the Battery System



After the actuator has been fully installed in the field and wired to power and control systems, the unit is ready to initialize the battery system. The procedure is as follows:

1. Remove the side enclosure cover.
2. Locate the green two-pin connector halves.
   a. Both halves are keyed to connect in only one direction.
   b. Align with each other and plug together.
3. Apply 24V power to the actuator.
4. Replace the side enclosure cover.
5. Battery system must charge for 12 hours after powering up to provide 100% charge capacity.
6. The battery system employs a 22.2V Li Ion pack. The DC motor is driven directly by the battery pack upon loss of power.

9 Calibration Procedures

9.1 Calibration

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. However, if the cam positions require changes, refer to section 7 Adjustments before proceeding.

NOTICE - Identify your actuator and follow these model-specific directions carefully and in order. The Flowserve warranty **does not** cover actuator damage due to improper testing and commissioning.

9.2 On/Off Control

1. Apply correct power according to the actuator model.
2. Position the actuator to its fully CCW (90°) and fully CW (0°) positions and adjust the cams, as necessary.
3. After making cam adjustments on either or both ends of travel, move off the cam slightly then repeat the drive command to assure the cam settings are correct.
4. Verify that the cam set screws are snug but not overtight; overtightening during calibration will make it difficult to make minor, incremental adjustments.
5. The unit is now calibrated and ready for immediate operation. No further calibration is necessary.

9.3 Proportional Control for 120 – 230 VAC Models

After completing all mounting and wiring procedures, and main power is available, it is now possible to calibrate the actuator. Reference Figure and Figure for the following steps. Before applying power or making any wiring connections:

1. Set the gear train in the fully CW (0°) position.
2. Set cam 1 and cam 3 according to the on/off procedure.
3. Set the unit in the fully CCW (90°) position.
4. Set cam 2 and cam 4 according to the on/off procedure.
5. **Set the gear train back to the fully CW (0°) position.**

6. Make the field wiring connections for power, control, and feedback signals, referencing the proper wiring diagrams.
   a. Connections are made **to the main terminal block only.**
   b. No connections are made to the proportional control board directly.
7. Set the select switches for signal "IN" and "OUT" in the correct positions.
8. Verify that the two M3 set screws are tight on the sector drive gear which drives the potentiometer pinion gear.
9. Apply the correct power for the actuator model.
   a. The red LED D18 will turn on, and the blue LED D4 will start to flash.
10. Press the black, push-button on the Mod control board, and hold it down for three seconds then release.
    a. The unit will auto-run through the cam settings set in steps 2 – 5 above.
    b. This procedure reads and saves the potentiometer readings into an Electrically Erasable Programmable Read Only Memory (EEPROM) Microcontroller.
    c. Loss of power does not erase these settings.
    d. During the CCW drive process, the green LED D6 will be on and turns off when the CCW (90°) end-of-travel is reached.
    e. During the CW drive process, the red LED D7 will be on and turns off when the CW (0°) end-of-travel is reached.
11. Upon completion of this procedure, the blue LED D4 will resume flashing, once every four seconds, indicating normal CPU activity.
12. The unit will start responding to the incoming 4 – 20 mA control signal being sent to the actuator.
13. The unit is now calibrated and is ready for immediate operation. No further calibration is necessary.

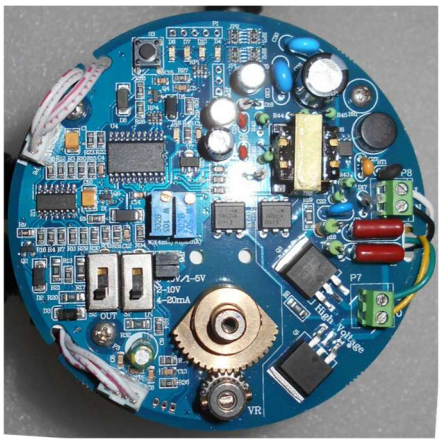


Figure 26: Actual proportional control board for 120 - 230 VAC models

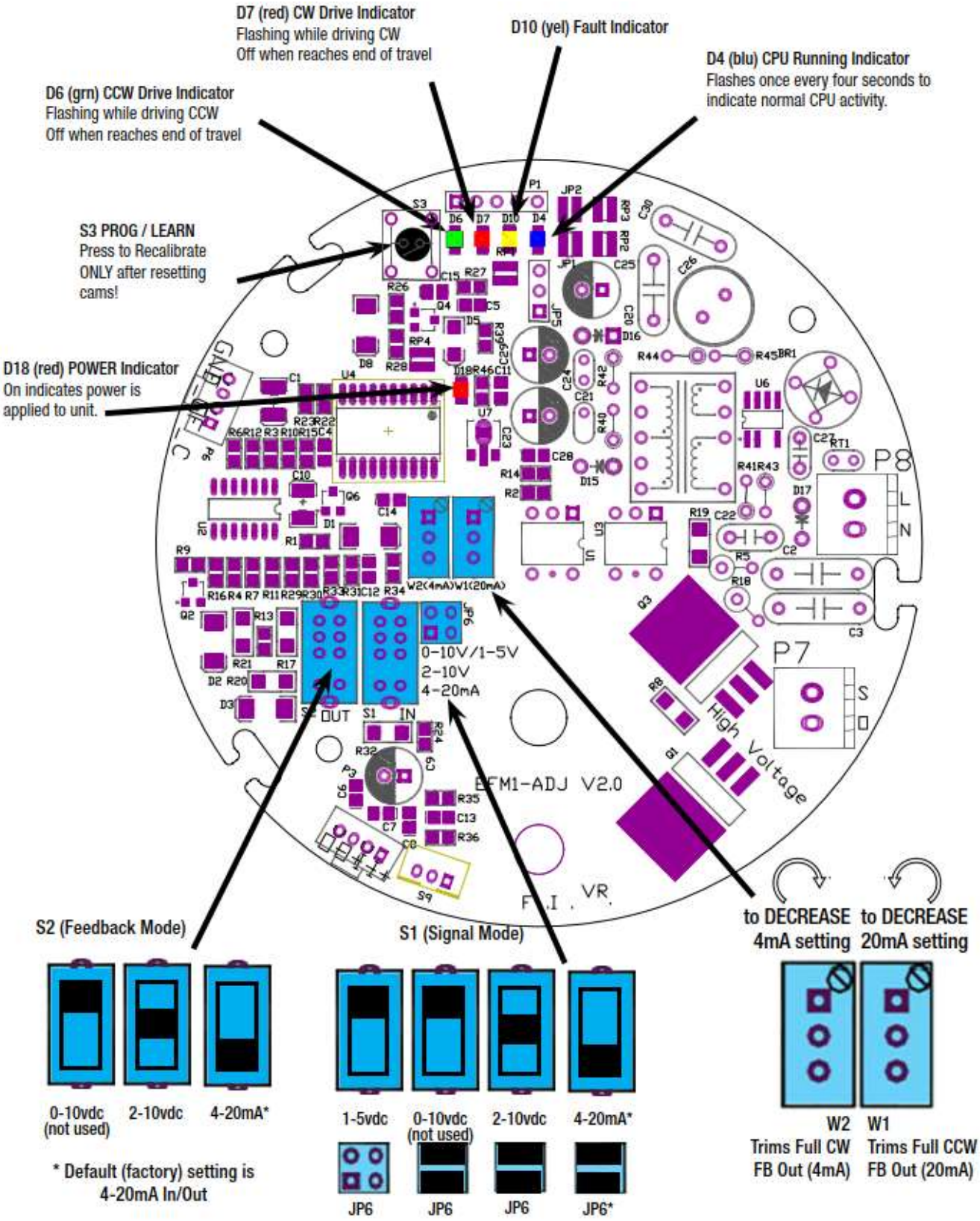


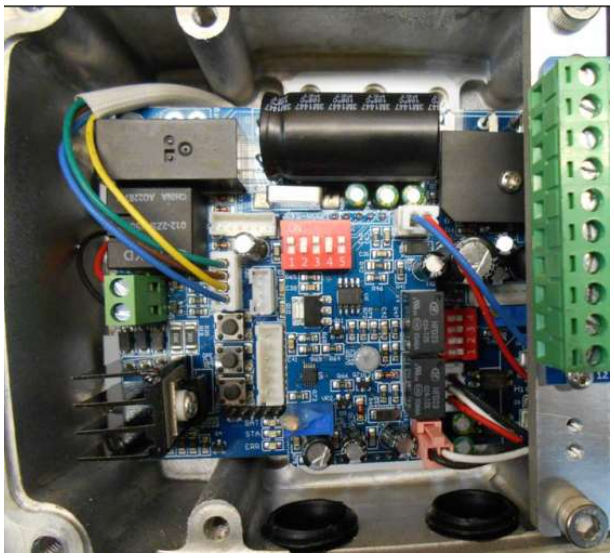
Figure 27: Proportional control board for 120 – 230 VAC models

9.4 Proportional Control for 12 – 24 VAC/VDC Models

After completing all mounting and wiring procedures, and main power is available, it is now possible to calibrate the actuator. Reference Figure for the following steps. Before applying power or making any wiring connections:

Figure28: Correct alignment of sector gear and pinion gear is critical to avoid damage to the position potentiometer (see Proportional Control Setup).

1. Set the gear train in the fully CW (0°) position.
2. Set cam 1 and cam 3 according to the on/off procedure.
3. Set the unit in the fully CCW (90°) position.
4. Set cam 2 and cam 4 according to the on/off procedure.
5. **Set the gear train back to the fully CW (0°) position.**
6. Make the field wiring connections for power, control, and feedback signals, referencing the proper wiring diagrams.
   a. Connections are made **to the main terminal block only.**
   b. No connections are made to the proportional control board directly.
7. Set the DIP switches for correct signal "IN" and "OUT".
8. Confirm the two M3 set screws are tight on the sector drive gear which drives the potentiometer pinon gear.
9. Apply the correct power according to the actuator model.
   a. The blue LED D1 will turn on, and the green LED STA will turn on.
10. Generate a 50% input signal to the actuator and wait for 50% travel position to be reached.
11. Press the "SET" black, push-button on the Mod control board, and hold it down for three seconds then release.
    a. The green STA LED will turn off, and the output shaft will drive to the fully CCW (90°) position and stop when the preset cam positions are reached. There are no LED indicators to indicate when the actuator is running.
12. When the actuator stops, press the "OP" push-button once.
    a. The actuator output shaft will drive to its fully CW (0°) position and stop when the preset cam positions are reached.
13. When the actuator stops, press the "CL" push-button once.
14. The unit will start responding to the incoming 4 – 20 mA control signal being sent to the actuator.
15. The unit is now calibrated and ready for immediate operation. No further calibration is necessary.



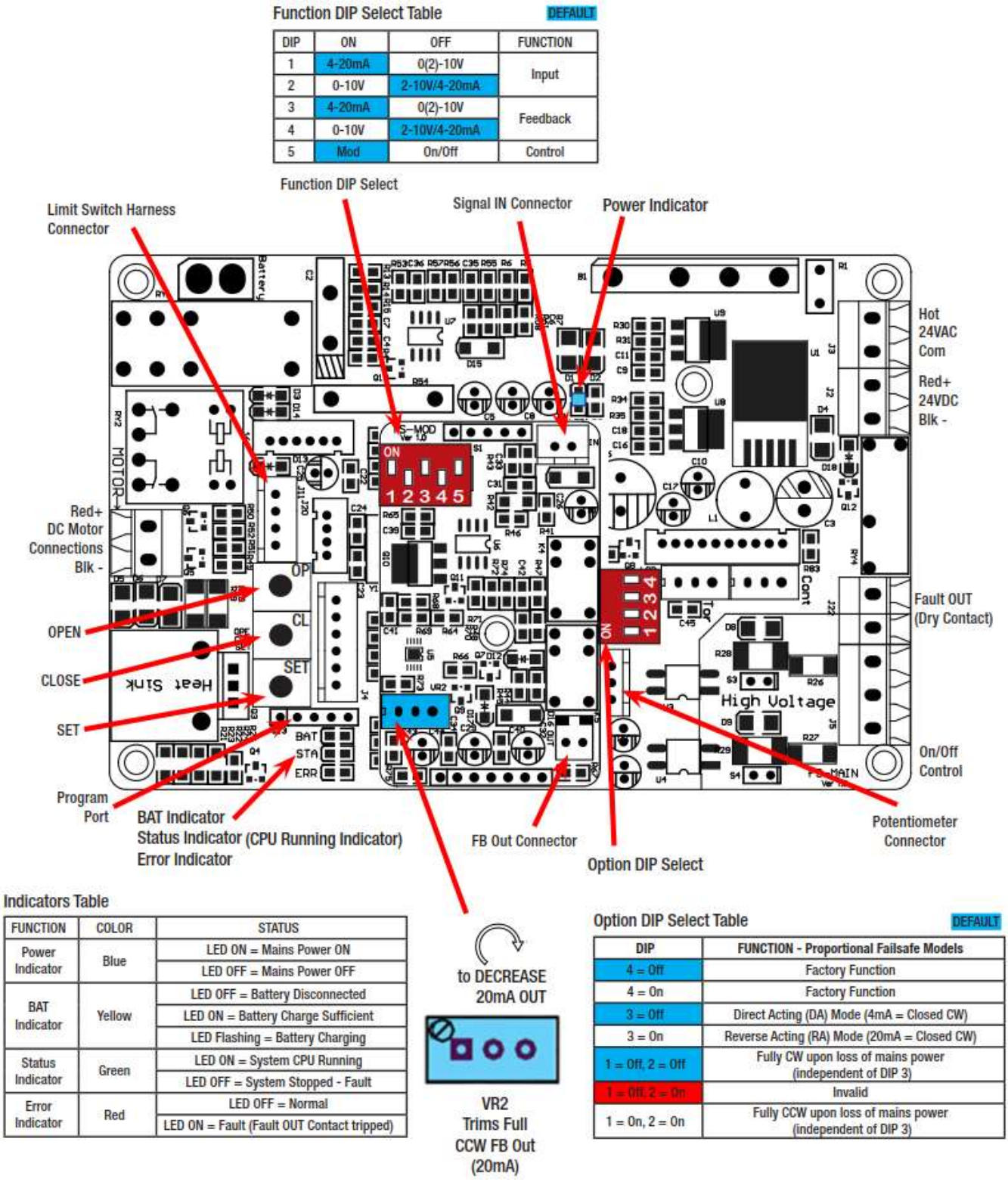


Figure 29: Proportional control board for 12 – 24 VAC/VDC models

9.5 Calibration Procedure for On/Off with Battery Backup

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

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 12 TERMINAL BLOCK INSIDE THE SIDE MOUNTED ENCLOSURE.
   b. No connections are made under the round actuator cover.
8. Apply correct power according to the actuator model.
   a. The blue LED D1 will turn on, and grn LED STA will turn on.
9. Press the "SET" black pushbutton on the 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.
10. 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 positions are reached.
11. When the actuator stops, press the CL pushbutton ONCE.
12. Unit is now calibrated and is ready to be put into service. No other calibration is necessary. Proceed to Commissioning.

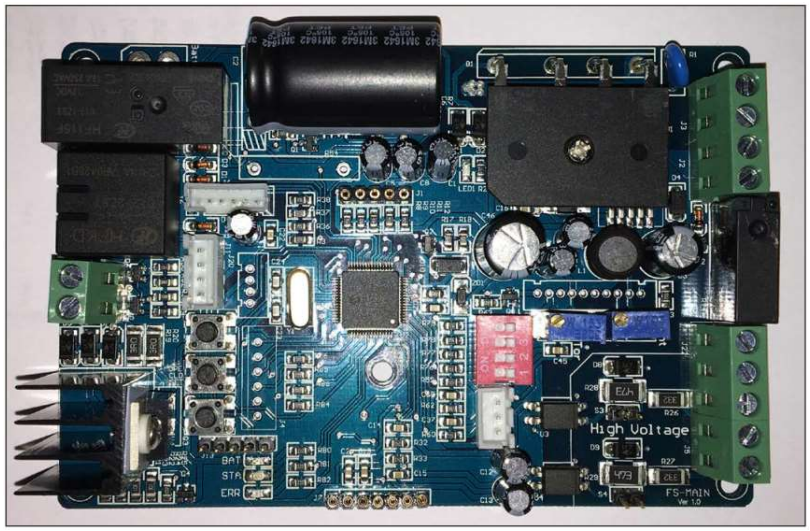
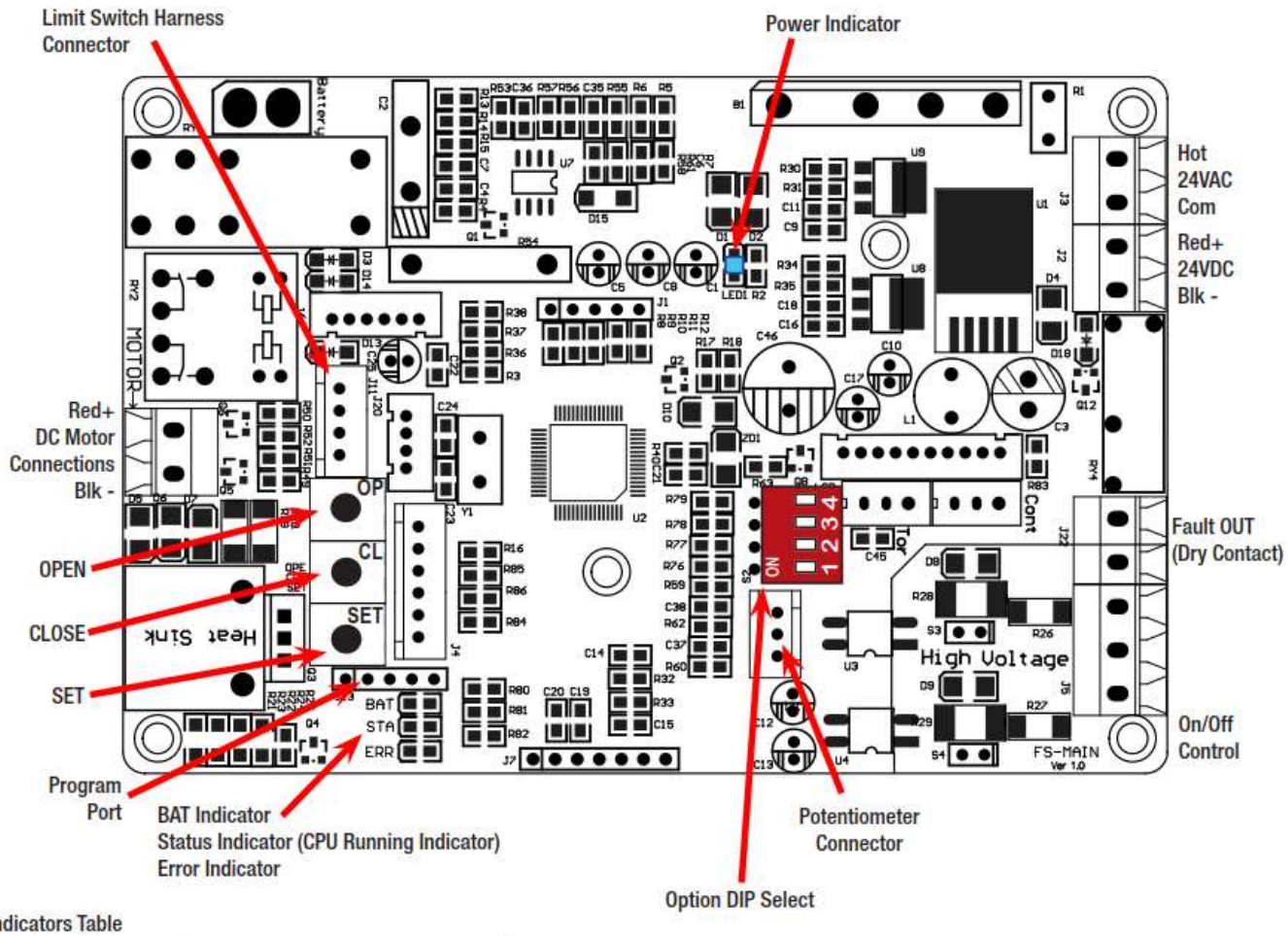


Figure 30: Battery Backup controller board for Open/Close applications



Indicators Table

FUNCTION	COLOR	STATUS
Power Indicator	Blue	LED ON = Mains Power ON
		LED OFF = Mains Power OFF
BAT Indicator	Yellow	LED OFF = Battery Disconnected
		LED ON = Battery Charge Sufficient
		LED Flashing = Battery Charging
Status Indicator	Green	LED ON = System CPU Running
		LED OFF = System Stopped - Fault
Error Indicator	Red	LED OFF = Normal
		LED ON = Fault (Fault OUT Contact tripped)

Option DIP Select Table — DEFAULT

DIP	FUNCTION - On/Off Failsafe Models
4 = Off	Factory Function
4 = On	Factory Function
3 = Off	Direct Acting (DA) Mode (Wiring Terminal #4 = CW)
3 = On	Reverse Acting (RA) Mode (Wiring Terminal #6 = CW)
1 = Off, 2 = Off	Fully CW upon loss of mains power (independent of DIP 3)
1 = Off, 2 = On	Invalid
1 = On, 2 = On	Fully CCW upon loss of mains power (independent of DIP 3)

Figure 31: Battery Backup Open/Close PCB details

10 Troubleshooting

⚠ 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, always 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 3: 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 block. 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 terminals 1 & 2 while commanding the actuator to move. The measured voltage cannot drop more than 10%.
	●			Cams improperly set.	**Remove the power supply**. Check to see if the cams rotate freely on the cam shaft using your finger. Cams must be secure and set according to the procedures in section 7.
		●		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 duty cycle of 25% 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 is out of quadrant.	The manual override system has been employed to rotate the actuator beyond its intended angle of rotation. Use the manual override to rotate the actuator back into its correct quadrant of operation.
			●	Travel cams and/or mechanical stops not positioned correctly.	Reset the end-of-travel cams and/or mechanical stops as detailed in section 7.

Table 4: 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 block. 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. The measured voltage cannot drop more than 10%.
	●			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 7.
		●		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.
			●	Actuator is out of quadrant.	The manual override system has been employed to rotate the actuator beyond its intended angle of rotation. Use the manual override to rotate the actuator back into its correct quadrant of operation.
			●	Travel cams and/or mechanical stops not positioned correctly.	Reset the end-of-travel cams and/or the mechanical stops as detailed in section 7.

Table 5: Fault symptoms for failsafe control models

Actuator does not move to expected Fail-Safe position upon loss of mains power			
⇓	**Actuator does not complete the move to the full end of travel position upon loss of mains**		
	⇓	**Target**	**Action**
●		Stored Energy device not connected	After actuator commissioning, plug the two-pin green connectors together. The BAT status LED must be ON when power is On.
●		Stored Energy device not charged	Unit must charge for at least twelve hours after initial connection is made
●		Fail-Safe direction incorrectly set	Reset 4 position DIP Switch
	●	Stored Energy device not sufficiently charged	Unit must charge for at least twelve hours after initial connection is made. Yellow BAT status indicator must be on or flashing when mains power is ON and stored energy device is plugged into connector.
	●	Fault OUT contact is closed. ERR indicator on PCB is ON	Motor current draw exceeds the capacity of the stored energy device. Check valve torque and charge time.
			Mains power ON time is insufficient between power failures - increase ON time.
			Stored energy demand cycle has depleted the life of the device - replace stored energy pack.
	●	ERR indicator is ON	Stored energy device disconnected - reconnect two-pin plug.
			Stored energy device voltage drops below 18.5VDC.

11 Technical Data

11.1 Nameplate

Figure 32: Example of an LTQ0H3 - LTQ0H4 Series nameplate

11.2 Torque Requirements

Table 2: LTQ0H3 – LTQ0H4 actuator specifications

Actuator			LTQ0x3	LTQ0x4
Supply	Torque Output (in-lb / N m)		310 / 35	440 / 50
12 VAC* - 12 VDC*	Current Draw (Start/Run/LRA)		3.5A / 2.0A / 3.8A	3.5A / 2.0A / 3.8A
	Speed (90°) DC-60Hz / 50Hz, seconds		8 / 8	10 / 10
	Motor – 12V DC Perm Magnet 2 Pole Brush		6W	6W
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2 – 15 min) / **75% (S4 – 75%)**	
		Motor Protection, Temp / Class	All – 130°C / Class B	
		Motor Starts, per hour, Max	All – **600**	
24 VAC - 24 VDC	Current Draw (Start / Run / LRA)		2.1A / 1.2A / 2.3A	2.1A / 1.2A / 2.3A
	Speed (90°) DC-60Hz / 50Hz, seconds		8 / 8	10 / 10
	Motor – 24V DC Perm Magnet 2 Pole Brush		6W	6W
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2 – 15 min) / **75% (S4 – 75%)**	
		Motor Protection, Temp / Class	All – 130°C / Class B	
		Motor Starts, per hour, Max	All – **600**	
120 VAC	Current Draw (Start / Run / LRA)		0.4A / 0.4A / 0.5A	0.4A / 0.4A / 0.5A
	Speed (90°) 60Hz / 50Hz, seconds		9 / 11	13 / 15
	Motor – 120V Capacitor Run TENV		10W	10W
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2-15 min) / **75% (S4-75%)**	
		Motor Protection, Temp / Class	155°C / Class F / **180°C / Class H**	
		Motor Starts, per hour, Max	All – **600**	
230 VAC	Current Draw (Start / Run / LRA)		0.2A / 0.2A / 0.3A	0.2A / 0.2A / 0.3 A
	Speed (90°) 60Hz / 50Hz, seconds		9 / 11	13 / 15
	Motor – 230V Capacitor Run TENV		10W	10W
	On/Off / **Proportional**	Duty Cycle (IEC60034)	25% (S2-15 min) / **75% (S4-75%)**	
		Motor Protection, Temp / Class	155°C / Class F / **180°C / Class H**	
		Motor Starts, per hour, Max	All – **600**	
All	Manual Override		Handwheel or 8mm Hex Shaft	
	Environmental Rating		NEMA 4/4X & IP67	
	Electrical Entry (2)		½" EMT or Polyamide gland	
	Control		On/Off, Proportional, 2 Pos RO, RC & 3 Position	
	Auxiliary Switch – End of Travel		(2) 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	
Battery Specs.	Type		Lithium Ion 22.2v pack	
	Cell Arrangement		Bank of 8 (eight) x 2.8V	
	Service Life - @ Rated Torque Cycle Drain		10,000 cycles @ 5% Stored energy drain per cycle	
	Enclosure		6 x 4 x 4, Aluminum enclosure	

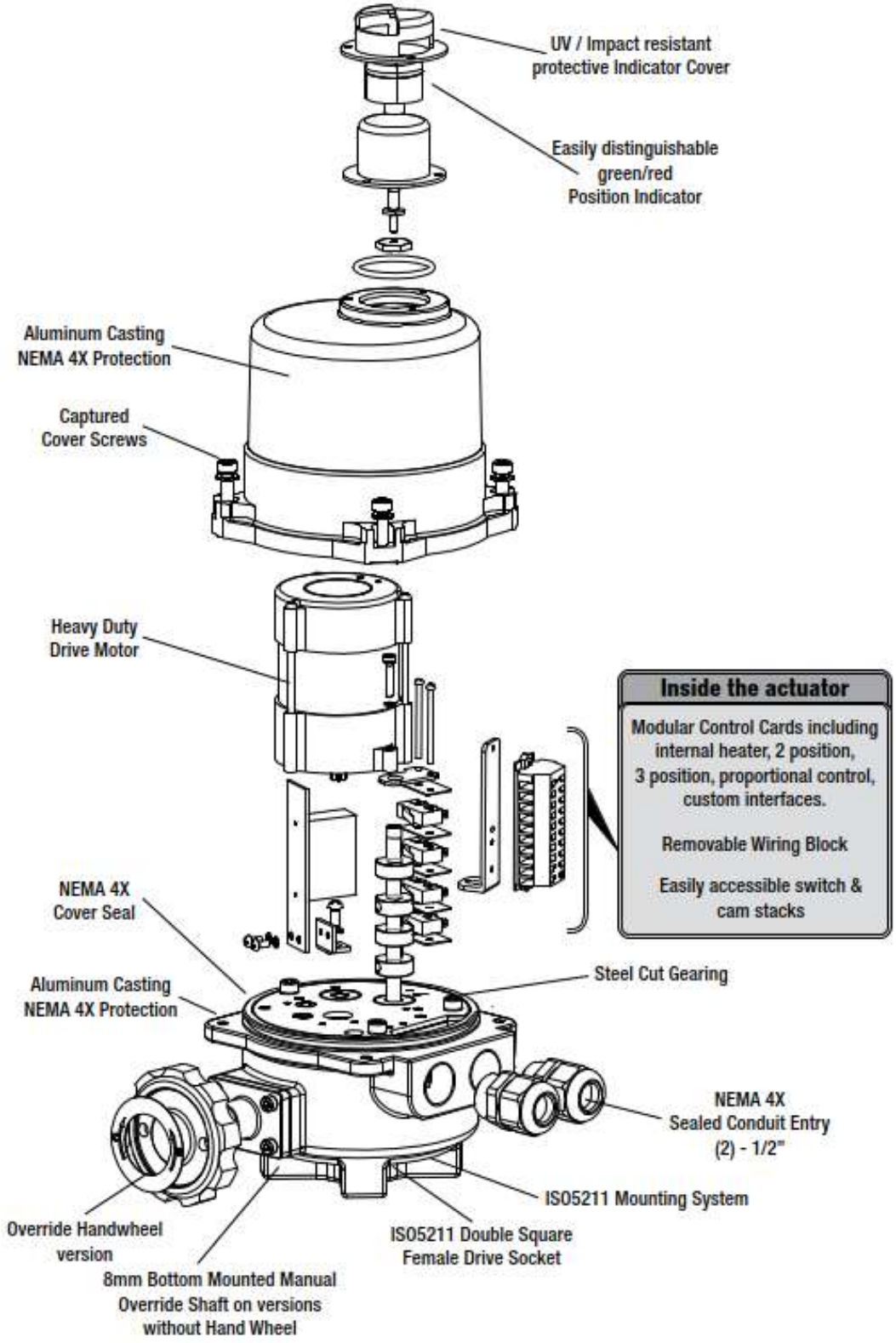
11.3 Wire Sizing

DANGER - To avoid dangerous or fatal electrical shock, turn off the power to all electrical equipment before working on electrical connections.

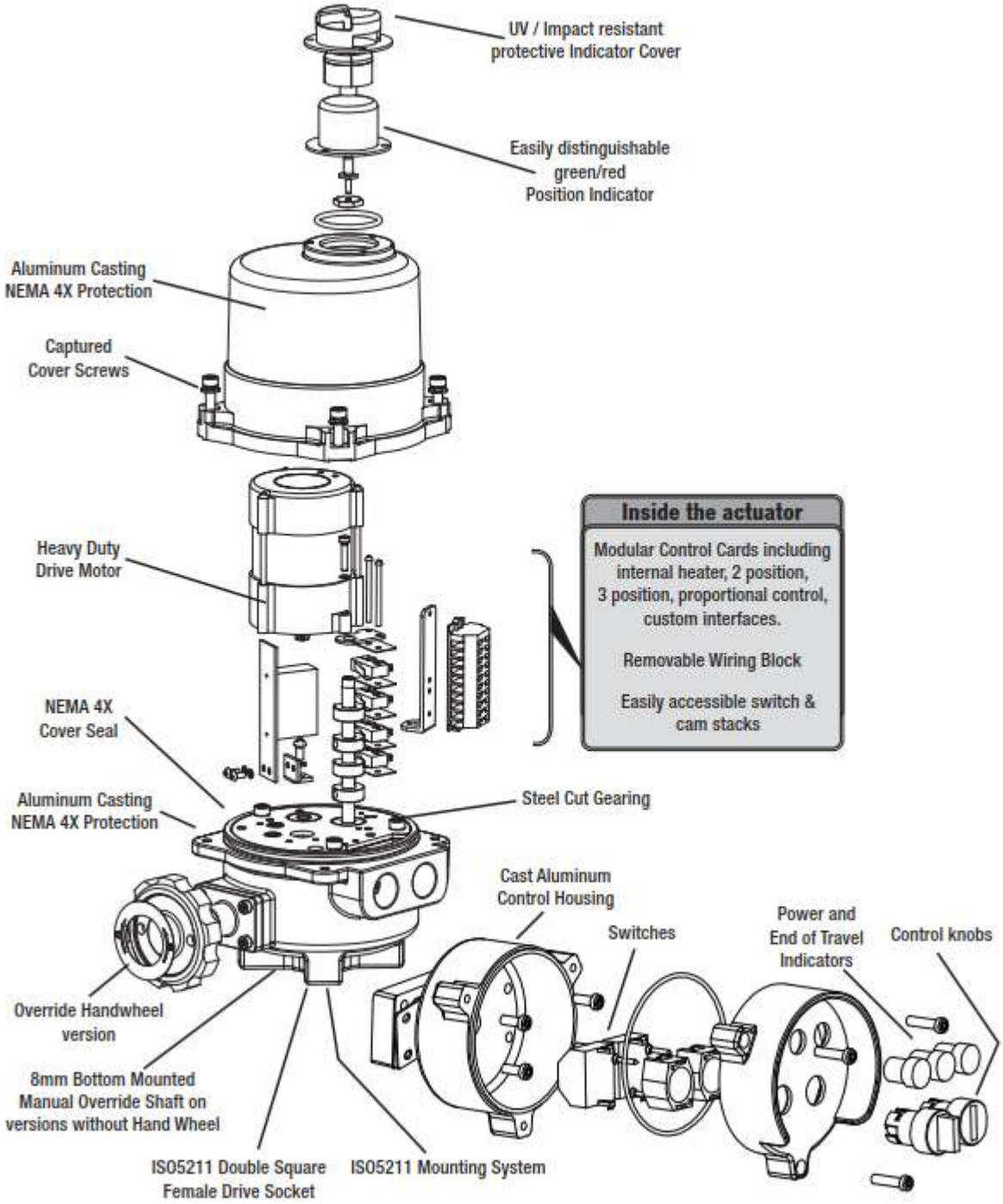
Table 7: Maximum distance between the actuator and the power supply (ft)

Actuator	**LTQ0H3 – LTQ0H4**			
Voltage	12 VAC / VDC	24 VAC / VDC	120 VAC	230 VAC
AWG \ Amps	3.5	2.1	0.4	0.2
18	24	81	2136	8187
16	39	129	3396	13016
14	62	206	5401	20702
12	98	327	8587	32917
10	156	520	13650	52325
8	248	827	21714	83237

11.4 LTQ 0H3/4 Exploded View



11.5 LTQ 0H3/4 LK/LB Exploded View



Annex A: Glossary

Below are terms and definitions used throughout this manual:

1. **XTS** denotes a product manufactured without Torque Switches.
2. **TS** denotes a product manufactured with Torque Switches.
3. **XFS** denotes a product manufactured without Fail Safe built-in.
4. **FS** denotes a product manufactured with Fail Safe built-in.
5. **LCS** is an industry acronym for a Local Control Station.
6. **CW** denotes the Clockwise direction for movement.
7. **CCW** denotes the Counterclockwise direction for movement.
8. **VDC** is an industry acronym for volts direct current.
9. **VAC** is an industry acronym for volts alternating current.
10. PCB
11. EEPROM

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Flowserve factory contacts:

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

United States
Flowserve Corporation
14219 Westfair West Drive
Houston, TX 77027-1137
Phone: 1 281 671 9209
Fax: 1 281 671 9268
Email: vachouston@flowserve.com

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