FLOWSERVE

Limitorque QX

The Next Generation in Smart Quarter-turn Actuation

Experience In Motion

Flowserve Limitorque Actuation Systems

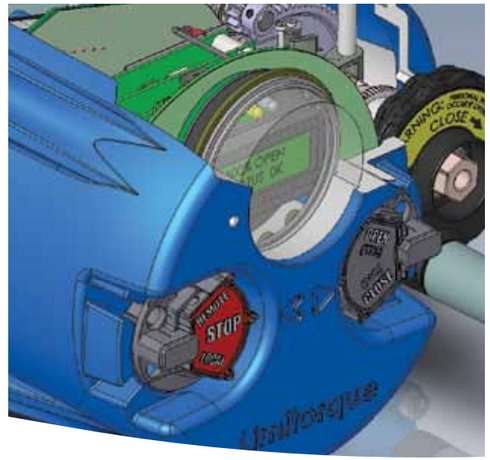
Limitorque is an operating unit of Flowserve, a $4 billion-plus/year company strongly focused on automation and support of the valve industry. Flowserve is the world's premier provider of flow management services.

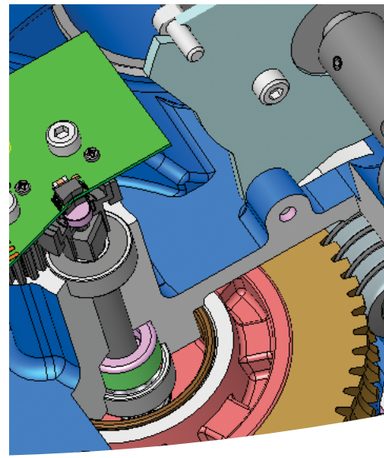
Limitorque has evolved over 80 years since its strategic introduction of a "torque-limiting" design that changed an industry. Flowserve Limitorque offers solutions and automation choices for customers that provide:

- Cost savings from field devices such as electric valve actuators
- Greater operating efficiencies from control-room performance sequencing, interlocking and continuous process optimization
- Competitive advantages derived from increased management visibility of databases and networks

Limitorque is one of the primary reasons Flowserve is "Experience In Motion."

The QX speaks your language, whether it's management, technical, financial, operations or service.



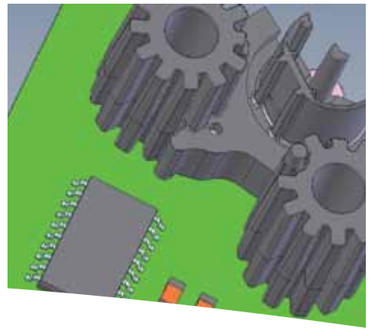


Limitorque QX Smart Valve Actuator

The full measure of safety and reliability in the next-generation smart quarter-turn actuator.

The Flowserve Limitorque QX quarter-turn smart electronic valve actuator continues the legacy of the industry's state-of-the-art, non-intrusive, multi-turn MX actuator by including an absolute encoder for tracking position without the use of troublesome batteries. The QX design provides enhanced safety and reduced downtime through improved diagnostics, built-in self-test (BIST) features and LimiGard™ fault protection.

The QX design builds on more than 10 years of experience with proven Limitorque MX technology—the first-generation double-sealed electronic valve actuator from Flowserve designed to provide control, ease of use and accuracy. The QX includes all the user-preferred features of the MX in a quarter-turn smart actuator package. It is the only non-intrusive, double-sealed quarter-turn actuator to display the Limitorque brand.



QX: The Next Generation in Smart Quarter-turn Actuation

Speed, Precision and Simplicity

The QX control panel features an improved 32-character LCD screen that provides actuator status and diagnostics in an easy-to-use, easy-to-read, graphical format. The industry's first non-intrusive, quarter-turn multilingual actuator is configurable in English, Spanish, German, French, Italian, Portuguese, Mandarin, Russian, Bahasa Indonesia and Katakana as standard configuration languages. In addition, the LCD can be rotated 180° for better field visibility.

User friendliness, precision, simplicity, and intuitive setup are characteristics expected of a smart actuator. Users and valve OEMs demand quick setup and easy-to-understand dialogue in preferred languages. The ability to either upload new software or download diagnostics is also critical to improving a plant's efficiency. The QX provides customers with the essential tools for rapid installation and root-cause diagnostics.

Precision is expected in a smart actuator. The MX was the first such device developed with an absolute encoder that doesn't require troublesome and unpredictable battery backup. Flowserve Limitorque's innovative absolute encoder technology, developed for the MX, is used in the QX. The QX encoder employs system-on-chip technology using a contactless magnet that excites Hall-effect devices to provide redundant, 12-bit resolution over 360 degrees. This redundancy, part of the BIST (built-in self-test) feature, means the device can continue to function reliably until a number of faults have been accumulated.

When a device is designed for BIST, its methodology is such that much of the test functionality is embedded in the device itself. BIST design enables a critical component's ability to communicate its actual state to a CPU for comparison to the expected state. Any deviation from expected values will be reported to the user, with correlation to the failed component or subsystem.

Simplicity is expected in a smart actuator. In fact, one of the reasons for using an electronic actuator is the simplicity of setup, installation on a valve and acquiring diagnostic information. The QX is the simplest and easiest to use electronic quarter-turn actuator.

Long Life and Protection

Long life is expected in a smart actuator. There are more than 1,000,000 Limitorque actuators installed around the globe, in every conceivable environment. Many have been functioning for over 50 years. This legendary Limitorque longevity has been carried over into the QX family of smart actuators. The QX has been developed with the ruggedness and dependability users have come to expect from Limitorque actuators for better than 80 years.

In order to last a long time in severe environments, smart actuators must have unparalleled protection. The QX's IP68 enclosure rating is 20M for 168 hours, regardless of whether the unit is weatherproof or explosion-proof. This is an industry-leading feature. Add other certifications to the list – NEMA 4, 4X, 6 – and the QX is unsurpassed in unit protection.

The QX is double-sealed, which isolates the terminal compartment from the controls environment. Any leakage into the terminal compartment is contained in the compartment.

The QX is powder coated using a polyester resin in Dupont Blue Streak color, not only for aesthetics, but also for protection in severe corrosive environments. The use of powder coating ensures that each QX can withstand saliferous conditions without degradation.

Quality and Certifications

Flowserve Limitorque is a global leader in quality manufacturing. All Limitorque plants are certified to ISO 9001 standards, the recognized benchmark for quality all over the world. The same unexcelled use of certified

materials is found in the QX as in Limitorque's naval and nuclear-qualified electric actuators. The MX has used synthetic gear oils especially optimized for use with worm-gear sets since the first unit was shipped in 1997, and the QX is no exception. All lubrication used in the QX is synthetic, capable of temperature extremes from -60°C to +70°C. The MX was the first non-intrusive actuator to use rolled worms and electronic controls designed and produced using surface-mount technology: the QX uses components manufactured with the same advanced technology. A true globally certified device, the QX meets all pertinent European directives including ATEX, EMC, Machinery and Noise, and displays the CE mark associated with such compliance.

Anatomy of QX Quarter-turn Actuators

Limitorque QX actuators respond to customer needs with advanced features designed for ease of commissioning and use, as well as time- and money-saving operational benefits. What sets the QX apart is the combination of control and reliability enabled by advanced Limitorque technology, plus superior ergonomics and human interfaces for speed, comfort, and ease of use.

Brushless DC Motor
Advanced brushless DC motors eliminate sparks, reduce mechanical and electrical noise, and dissipate heat better than brushed motors. Unique to the industry, brushless motors last longer than conventional motors and allow for more accurate positioning while permitting a global range of voltages (single-phase and three-phase AC and DC) to be used without modification.

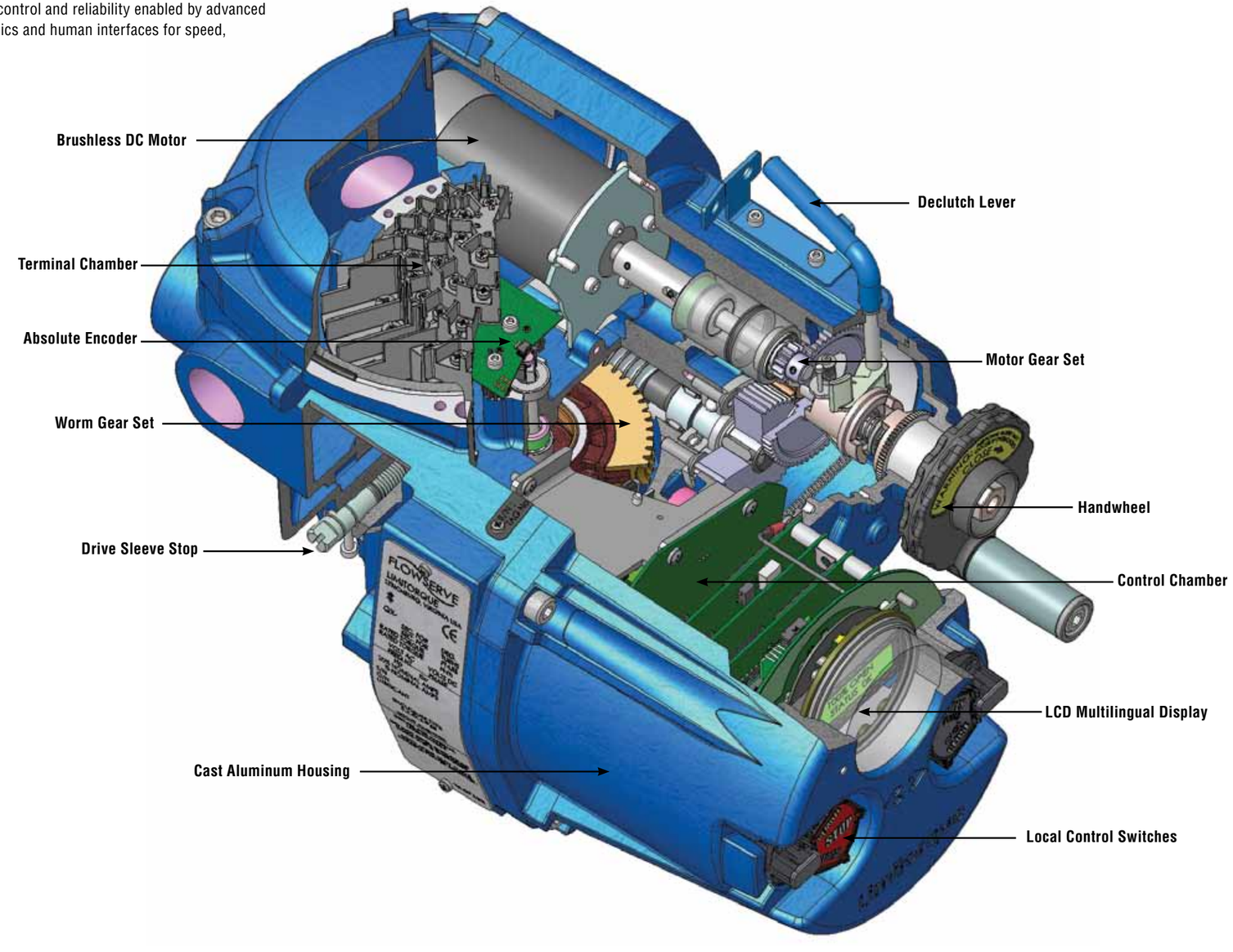
Terminal Chamber
Double-sealed design provides a termination chamber that is separate and sealed from the control chamber. Control components are never exposed to the elements during site wiring or because of a faulty cable connection.

Absolute Encoder
The QX encoder employs system-on-chip technology using a non-contacting magnet to excite Hall effect devices, providing redundant, 12-bit resolution over 360°. This redundancy, part of the BIST feature, means the device can continue to function reliably until a number of faults have been accumulated.

Worm Gear Set and Motor Gear Attachment
Both the motor gear reducers and worm gear sets are designed with Limitorque performance and longevity in mind. Rolled/ ground gears are bearing supported and immersed in an extended life synthetic gear oil specifically designed to improve efficiency and minimize wear.

Drive Sleeve Stop
Drive sleeve stops are supplied for 90° selections and removed for multi-turn applications, up to 20 turns maximum.

Cast Aluminum Housing
The QX housing material is cast 356-T6 grade aluminum. This alloy was selected due to its superior suitability for corrosion resistance in harsh and eroding environments.



Declutch Lever
Declutch lever enables the QX actuator to be placed in manual, handwheel-drive operation. Lever automatically disengages when motor is energized and can be padlocked in the motor position.

Torque Sensing
The QX continues the Flowserve Limitorque commitment to fully electronic smart actuators with advanced torque sensing. This method of torque control uses motor amperage to sense the valve load and has been verified in temperature extremes from -60°C to +70°C.

Handwheel
QX handwheels are manufactured from an engineered resin and are designed to meet most minimum rim pull requirements. Locating the handwheel adjacent to the LCD and controls facilitates local configuration and operation.

Control Chamber
Utilizing the same electronics package as the state-of-the-art MX, the QX has an additional feature - a solid state motor controller. This design permits almost all customer supplied voltages, single or three phase AC or DC, to be connected without modification to the voltage supply.

LCD Multilingual Display
The control panel display delivers instant, up-to-the-minute actuator status and valve position in 10 languages. It also provides simple calibration and diagnostic information, including motor, identification, and hardware data, as well as torque profile and log reports.

Local Control Switches
Local control switches make setup and calibration easy, using "yes" or "no" responses to straightforward questions, plus they provide the ability to open, stop and close the actuator and to select remote or local preferences. These switches are magnetically coupled, solid-state Hall effect devices, which eliminate troublesome and fragile reed switches.

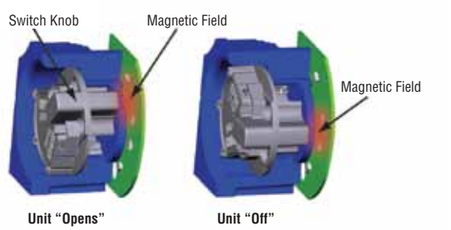
Control and Diagnostics

Control is expected in a smart actuator. The QX simplifies valve automation in three critical methods of control:

- Calibration/setup
- Normal operation
- Diagnostics and troubleshooting

The MX was the first non-intrusive actuator to equip users with LCD dialogue screens in the language of their choice. The QX has the same language options as the MX and uses a graphical dot matrix display that improves the visibility of the display. The use of this type of LCD permits the support of any language. In fact, in addition to English, Spanish, German, French, Italian and Portuguese, the QX also includes four character-based languages – Mandarin, Russian, Bahasa Indonesia and Katakana – with a capacity for even more.

Simple "Yes" and "No" responses to dialogue questions confirm the setup of the QX via solid-state Hall effect devices in both knobs. No special tools or remote devices are required. And the QX is "fit for service", offering the widest range of configuration menus of any non-intrusive smart actuator.



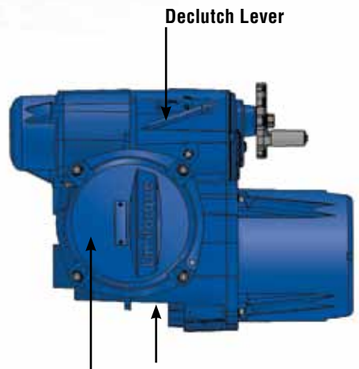
NOTE: Illustration for information only.

Hall effect devices interlocked to prevent operation

Diagnostics should be easy to read and decipher. The QX diagnostic enhancements now offer a BIST (built-in self-test). The BIST feature is also designed into a state-of-the-art controls platform that verifies and validates the integrity of its components. The result is a design that aids the user in meeting the SIL (Safety Integrity Level) requirements of IEC 61508. Placing a smart device into any plant system enhances the ability of a given safety system to achieve its preferred SIL rating. Any device that incorporates fully developed BIST features provides assurance to the user that the device has been designed with plant-wide safety and integrity of operation in mind.

The "View Diagnostics" menu selections now include more definitive routines that can isolate troubleshooting to "root cause" error codes. These root-cause codes can be used in conjunction with BIST. A well-designed BIST-based system can do more than just report failures in the electronic subsystems: it can also determine failures or predict future failures in its associated mechanical system.

The QX also offers Bluetooth technology as an option, up to 10 meters. When used with the Flowserve Limitorque graphical software interface, Dashboard™, diagnostic information can be transferred easily to a PDA with Windows Mobile 5 or greater, laptop computer or smart cell phone. In addition, off-line configuration changes can be uploaded and actuator configurations transferred from one device to any number of subsequent actuators.



Three conduit openings are standard with the option of a fourth.

Terminal Compartment *with O-ring seals that permit a double-sealed compartment, isolating the electronic controls from the environment.*

Nothing Exceeds Limitorque QX Actuators for Ease and Compatibility with Quarter-turn Valves of All Types

Valves

Limitorque QX actuators have been designed to accommodate today's wide variety of valve designs and configurations and meet international standards for valve and actuator interfaces, including ISO 5210 and MSS SP-102.

Direct mounting: The QX can be directly coupled with all quarter-turn valves for position seated or torque-only applications.

Couplings

Standard B4/B4E Base

The standard QX actuator base includes a mounting base for torque-only or position-seated valves. It also includes a steel torque nut, which may be machined to fit a valve or, if necessary, gearbox. A B4E torque nut can be provided and may be installed to allow for extended stem acceptance.

Available QX Flanges

		QX-1	QX-2	QX-3	QX-4	QX-5
Flange 1	ISO 5210	F05/F07	F07	F10	F12	F12
	MSS SP-102	FA05/07	FA07	FA10	FA12	FA12
Flange 2	ISO 5210	F10	F10	F12 F14	F12 F14	F14
	MSS SP-102	FA10 (STD)	FA10 (STD)	FA12 FA14	FA12 FA14	FA14

Integrity and Predictable Performance

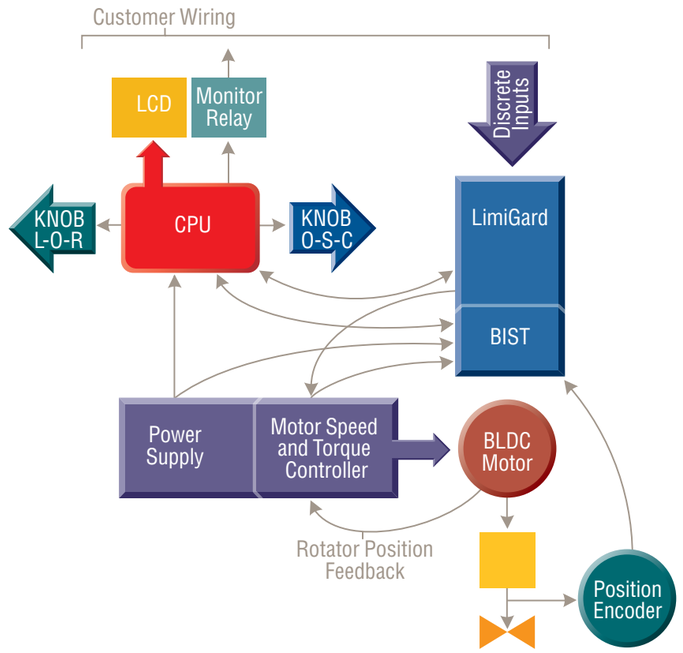
Smart actuators should have enabling technologies that ensure integrity and dependability. The QX offers three.

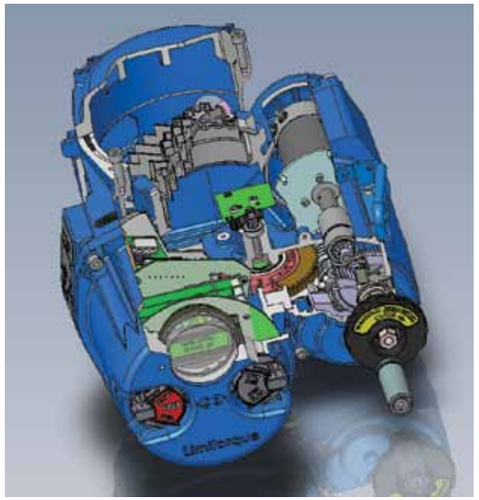
Limigard — now with BIST and FDA

Enhanced reliability for optimal plant operations and reduced troubleshooting costs are the primary benefits of Limitorque's smart actuator monitor, LimiGard.

When LimiGard wiring diagrams are followed, LimiGard continually monitors the motor controller, internal logic circuits and external command signals, comparing them to reference conditions. This virtually eliminates the possibility that an actuator malfunction can occur without prompt detection and alarm communication. In the event of a malfunction, LimiGard takes over and supervises the actuator's response characteristics, maximizing safety and predictability.

A state-of-the-art electronic actuator, such as the QX, includes means for verifying and validating that its components are designed with built-in self-test (BIST) capabilities. Selecting the QX, which incorporates a high level of BIST, can contribute greatly to the integrity and reliability of process applications and enhance the ability of a safety system to achieve its highest possible SIL rating.





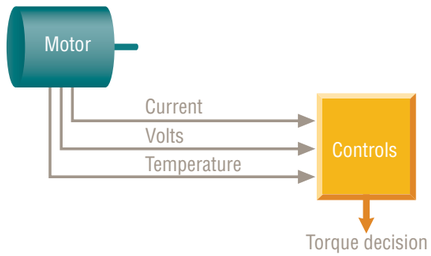
Absolute position encoder

Limitorque was the first to use absolute encoders in smart electronic actuators. An absolute encoder simplifies valve automation from configuration and setup into normal operations, diagnostics and troubleshooting. The QX encoder employs system-on-chip technology using a contactless magnet that excites Hall-effect devices to provide redundant, 12-bit resolution over 360 degrees. This redundancy, part of the BIST features, means the device can continue to function reliably until a number of faults have been accumulated.

As the actuator turns, a mechanical coupling rotates the magnet about an array of several Hall-effect devices. When the magnet passes over a Hall-effect device, it causes a change in the electromagnetic field, and a digital signature (on-off) is developed. This signature is duplicated across the array of Hall-effect devices at specifically timed intervals, resulting in digital values that calculate the position of the valve via the electronic actuator.

Torque sensing

Torque limiting has been a Limitorque feature for better than 75 years. In fact, the name Limitorque was coined to identify the ability of an electric actuator to “limit torque” to a valve. In the past, electromechanical actuators have sensed torque using a complicated system of springs, switches and cams. The QX senses torque electronically for use in valve control, overload protection and torque trending. In conjunction with the Limigard feature, torque is sensed from motor current, with compensation performed for voltage and temperature variations. The result is highly reliable and predictable torque sensing without the need for the extra components associated with electromechanical torque switches. The QX is a true smart actuator.



QX Control, Indication, Protection and Optional Features

Standard features

- Direct-wired remote control – Wiring flexibility includes the following standard alternatives to open-stop-close the actuator:
  - Four-wire – Valve can be opened, closed or stopped.
  - Two-wire switched – Single open or closed contact; valve can be opened or closed but not stopped.
  - Three-wire maintained – Two momentary contacts for self-maintained control. Valve can be opened or closed but not stopped in mid-travel.
  - Three-wire inching – Two “push-to-run” contacts; valve can be opened, closed and stopped in mid-travel.

- Multi-mode Control – Three modes of remote control are permitted when the QX is configured for multi-control: digital (discrete) control, analog control or network (fieldbus) control. The QX will respond to the last command received. However, analog (modutronic) control is initiated by either toggling QX User Input 2 (configured for CSE input) or removing and reapplying the 4-20 mA analog signal. Refer to LMENTB2300 for further information.
- Monitor relay – Provides a N/O and N/C contact representing “Actuator available for remote operation.”
- Emergency Shutdown (ESD) – Up to three remote, external ESD signals may be applied to the actuator to move the valve to a predetermined, user-configured shutdown position, overriding existing control signals.
- User-defined inputs – Three user-defined inputs are supplied.
- Inhibit signals – External signals may be used to inhibit actuator opening, closing or both.
- Control signals – The control signal can be either 24 VDC or optional 110 VAC; it can be sourced from the actuator or customer supply.
- Status contacts (two pairs) – May be set to represent up to 25 actuator conditions.
- Alternate speeds – The QX can be configured to permit differing speeds for Open or Close direction.

Protection features

- Autophase protection and correction – Ensures proper open/close directions and monitors and corrects phasing if connected improperly. Prevents operation if a phase is lost.
- Jammed valve – Automatically initiates a forward/reverse cycle to free jammed valves.
- Instantaneous reversal protection – Incorporates a time delay between the motor reversals to reduce current surges.
- Motor thermal protection – A thermistor, placed within the motor, protects against overheating.
- LimiGard™ circuit protection – QX actuators include LimiGard circuit protection. LimiGard consists of dedicated circuitry that continually monitors the motor controller, control relays, internal logic circuits and external command signals. When the recommended wiring connections are made, it virtually eliminates unexpected, erroneous actuation caused by internal electronic failures and erratic external command signals. Additionally, in the event of malfunction, LimiGard supervises the actuator response, detects the source of the failure and signals an alarm.

Optional features

- Alarm contacts – Up to eight latched contacts may be set to represent up to 25 key actuator conditions.
- Two-speed timer – A two-speed pulsing timer may be incorporated to support variable stroke times as configured by the user.
- Analog Position Transmitter (APT) – The APT is an internally powered, non-contacting valve position transmitter that provides a 4-20 mA signal proportional to valve position.
- Analog Torque Transmitter (ATT) – The ATT is a non-contacting, internally powered transmitter that provides a 4-20 mA signal that is proportional to actuator output torque.
- Modutronic controller – The Modutronic controller positions the valve in response to an external 4-20 mA command signal. It includes automatic pulsing mode to prevent overshoot at the set point. Parameters that may be set easily during configuration include proportional band, dead band, polarity and action on loss of command signal.
- QX Modulating – The QX can be configured for modulating operation that requires greater than 600 starts per hour. It is available for up to 1200 starts per hour.
- Partial stroke and momentary closure ESD – The QX can be supplied with the ability to perform a partial stroke operational parameter. The partial stroke and momentary closure ESD signals are configurable by the user. It can also be supplied with a momentary closure contact initiated ESD signal routine with redundant circuitry.
- Control Station (CSE) – The CSE is a separate control station designed for the operation of inaccessible actuators. It is available with LEDs, Remote/Local and Open/Close selector switches. The CSE may be powered by the actuator's internal supply, provided wire resistance and other external loads do not limit the available signal power presented to the QX.
- Isolation and Load Break Switches – Isolation and Load Break Switches can be supplied for the incoming voltage supply to the actuator. These may be coupled directly to the actuator for weatherproof (WP) applications only or supplied separately for mounting by user. The enclosure is suitable for weatherproof or temporary submersion service. An explosion-proof (XP) isolation switch is also available for user mounting and is suitable for mounting with all QX actuators. Please contact factory for availability.
- Negative Switching – When remote control systems require the negative pole of the circuit supply to be switched to positive earth, a simple software change is made.

- QX Quik – After the actuator has been powered by line power for one hour, it will automatically withstand most power outages while maintaining the correct state of the Status and Alarm (S or R) contacts—even if the user repositions the actuator manually with the handwheel. To maximize its self-power time while the line power is lost, the actuator places itself in its lowest possible power usage mode. The LCD will darken (sleep mode) until it is activated for viewing. The LCD can be activated by moving the black knob to OPEN (YES) or by moving the actuator with the handwheel. After seven to eight seconds of inactivity, the LCD will return to sleep mode.

Bluetooth-capable options

Standard low-power wireless communication path to the actuator enables monitoring and configuration of the unit up to 10m in any direction via a Bluetooth-equipped PC, PDA, smart cell phone, etc. FHSS (Frequency Hopping Spread Spectrum) allows a reliable communication link even in a "noisy" environment and 128-bit data encryption can be enabled to protect the privacy of the link. QX Dashboard configuration/diagnostic tools can use the Bluetooth link as a means for communicating with the actuator. A visible blue LED in the control's LCD window on the face of the actuator signifies an active Bluetooth link to the actuator has been established.

Network Communications

The QX provides a comprehensive network option portfolio to the user. Network solutions are improved with the addition of DeviceNet to complement Modbus, Foundation Fieldbus H1, Profibus DP_V1 and Profibus PA. The QX provides the user with predictable, reliable and safe operation for years to come, in applications that are subject to the most rigorous requirements and environmental extremes.

DDC (Distributed Digital Control) Modbus communication

DDC is Flowserve Limitorque's digital communication control system that provides the ability to control and monitor up to 250 actuators over a single twisted-pair cable. The communication network employs Modbus protocol on an RS-485 network and is redundant. Redundancy ensures that any single break or short in the communication cable will not disable any actuators. Each actuator has included an addressable field unit that communicates over the twisted-pair network and executes open, close, stop, ESD and GO TO position commands. The field unit also communicates all actuator status and alarm diagnostic messages over the same communication network.

DDC Network

- Single-ended loop (consult factory)
- Modbus protocol
- High speed – up to 19.2 k baud

Master Station III

QX units equipped with DDC can be controlled via Flowserve Limitorque's Master Station III. It includes:

- Host interface – Industry standard Modbus Rtu, ASCI, UDP, and TCP/IP protocols and control
- 5.6" TFT touch-screen display for network configuration status
- Configurable polling sequence priority
- Network time protocol for time synchronization of alarms/diagnostics data to host device
- Modular hot-swappable redundant design
- E-mail notifications of alarm conditions
- Data/event logging

FOUNDATION Fieldbus communication with DTM technology

The QX can be fitted with FOUNDATION Fieldbus protocol that complies with the IEC 61158-2 Fieldbus H1 standard. The field unit device is able to support several topologies such as point-to-point, bus with spurs, daisy chain, tree or a combination of these. The FF device has network features that include:

- Link Active Scheduler that controls the system
- High-speed communications up to 31.25 kbits/sec
- Publisher-subscriber communication
- Input and output function blocks
- Device descriptions
- Network communication
- Configurable by user

Link Active Scheduler communication: Fieldbus segments have one active Link Active Scheduler (LAS) at a given time, which is the bus arbiter, and does the following:

  - Recognizes and adds new devices to the link
  - Removes non-responsive devices from the link
  - Schedules control activity in, and communication activity between, devices
  - Regularly polls devices for process data
  - Distributes a priority-driven token to devices for unscheduled transmissions

The Limitorque MX and QX actuators utilize Flowserve ValveSight™ to monitor the status, alarms and health of both the valve and actuator. Embedded predictive diagnostics provide an advanced warning of pending problems, thus minimizing unscheduled plant shutdowns and loss of productivity.

The result is a paradigm shift in valve and actuator maintenance. When you are monitoring for the conditions that would lead to an alarm rather than reacting to alarms and optimizing your process rather than servicing broken actuators, you are putting your maintenance dollars where they deliver the most ROI.

- Reduces commissioning time, maintenance and related operating costs
- Improves productivity by providing a user-friendly graphical interface
- Increases efficiency by enabling network users to communicate in real time with the device and monitor diagnostics information, including alarms
- Interfaces for offline and online parameterization, configuration, reading status and diagnostic data

DTM (Device Type Manager)

The Profibus DP-V1/PA DTM V 1.0 is a software component that contains device-specific application information. The DTM can be integrated into engineering and FDT frame applications, such as stand-alone commissioning tools or asset management systems that are equipped with FDT interfaces. FDT technology is independent from any specific communication protocol, device software or host system, allowing any device to be accessed from any DCS host through any protocol.

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- Interfaces for offline and online parameterization, configuration, reading status and diagnostic data

PROFIBUS DP V1 communication with DTM

The QX can be fitted with Profibus DP_V1 protocol field units that comply with EN50170 Fieldbus Standard for RS-485 communications. The device supports several topologies such as point-to-point, bus with spurs, daisy chain, tree or a combination of these. The PB device has network features that include:

- High-speed communications up to 1.5 Mbps
- Master-to-slave communication
- Standby communication channel
- Analog and digital input and output function blocks
- Device descriptions configurable by user
- High-Speed Data Exchange – Startup Sequence
- Power On/Reset – Power On/Reset of master or slave
- Parameterization – download of parameters into field device (selected during configuration by the user)
- I/O Configuration – download of I/O configuration into the field device (selected during configuration by the user)
- Data Exchange – cyclic data exchange (I/O Data) and field device reports diagnostics
- Redundant Profibus DP with single or multiple – master communications

PROFIBUS PA communication with DTM

A Profibus PA protocol is available and complies with EN50170 Fieldbus Standard and Fieldbus physical layer per IEC 61158-2 for communications. The device supports several topologies such as point-to-point, bus with spurs, daisy chain, tree or a combination of these. The PB device has network features that include:

- High-speed communications up to 31.25 kbits/s with Manchester coding
- Master-to-slave communication
- Bus powered for 9-32 VDC and 15 mA per actuator
- Standby communication channel
- Analog and digital input and output function blocks
- Device descriptions
- Configurable by user

The Profibus DP-V1/PA DTM V 1.0 is a software component that contains device-specific application information. The DTM can be integrated into engineering and FDT frame applications, such as stand-alone commissioning tools or asset management systems that are equipped with FDT interfaces. FDT technology is independent from any specific communication protocol, device software or host system, allowing any device to be accessed from any DCS host through any protocol.

DeviceNet

DeviceNet complies with CAN-based protocol and provides the following features:

- DeviceNet Group 2 Server implementation
- Master-to-slave communication
- Bus-powered network interface allows power alarm information to be communicated when actuator loses main power; the actuator does NOT drop off the network when power is lost
- Standard polled I/O connection
- Standard bit strobed I/O connection
- Standard change of state/cyclic I/O connection
- Standard explicit connections defined as:
  - Various assembly objects and sizes that allow the network user to determine how much data to transfer to accommodate network installation data throughput requirements
  - Automatic baud rate detection
  - Node address configurable via local setup menu or via the remote network user
  - Broadcast or group network originated ESD support

QX Multi-turn

- The industry-leading feature set of the QX has been extended to a multi-turn version, the QXM. The QXM is available for up to 20 turns with increased speed ranges from 2 to 24 rpm. When combined with faster speeds, the torque ranges are consistent with the speed required for limited linear travel. All of the MX and QX features are included in the QXM. In fact, an A1 base can be attached to the QXM for travel up to 70 mm.
- An absolute encoder that simplifies valve automation from configuration and setup into normal operations, diagnostics and troubleshooting. The QXM encoder employs system-on-chip technology using a contactless magnet that excites Hall effect devices to provide redundant, 12-bit resolution over either 6.5 or 20 turns, resulting in resolutions of 0.65 degrees or 2.2 degrees, respectively.
- Available with two distinct motors (“H” version is “high” torque and “L” version is “low” torque) to offer a broad torque and speed range, from 18 ft-lb (24 Nm) to an industry-leading 250 ft-lb (337 Nm). The motors have H class insulation as standard and are rated to 3310IEC 34 as S2_ 15 min_ 40%.
- The QXM is available with all pertinent global explosion and weatherproof certifications – FM, FM Canada, ATEX and IECEx.

Size	Speed (rpm)	Torque		Time to Close (sec)	
		(ft-lb)	(N m)	6.5 Turns	20 Turns
QXM-1	3	100	135	130	400
QXM-2	2	250	337	195	600
QX-1/MH - 6	6	128	172	65	200
QX-1/ML - 6	6	65	87	65	200
QX-1/MH - 12	12	84	113	33	100
QX-1/ML - 12	12	40	54	33	100
QX-1/MH - 18	18	60	81	22	67
QX-1/ML - 18	18	30	40	22	67
QX-1/MH - 24	24	43	58	16	50
QX-1/ML - 24	24	18	24	16	50

QX1 - QX5 Performance Ratings

Description	QX-1	QX-2	QX-3	QX-4	QX-5
Minimum Operating Time (sec*)	5	8	15	30	60
Maximum Operating Time (sec)	20	30	60	120	120
Rated Seating Torque: seating (ft-lb/Nm)	100/136	250/339	400/542	750/1017	1500/2033
Seating Torque Limited by Base	Not Applicable	07 base 200 ft-lb (271 Nm) max	Not Applicable	Not Applicable	12 base 1000 ft-lb (1356 Nm) max
Run Torque: 20% (ft-lb/Nm)	20/27	50/68	80/108	150/203	300/407
Run Torque 50% (ft-lb/Nm)	50/68	125/169	NA	NA	NA
Stall Torque (ft-lb/Nm)	200/271	500/677	800/1083	1500/2031	3000/4063
Motor Seating Rating (in-lb/Nm) 1ph & 3ph	5/.56	12/1.36	5/.56	12/1.36	12/1.36
Motor Run Rating (in-lb/Nm) 1ph & 3ph	1/.11	2.4/.27	1/.11	2.4/.27	2.4/.27
Motor Stall Rating (in-lb/Nm) 1ph & 3ph	6.5/.73	15.6/1.76	6.5/.73	15.6/1.76	15.6/1.76
Gear Ratio Motorized	985	985	3662	3662	7212
Gear Ratio Handwheel	200	200	276	276	276
Handwheel Efficiency	26%	26%	26%	26%	26%
Handwheel Diameter (in/mm)	3/76	3/76	7.5/190	7.5/190	7.5/190
Handwheel turns for 90°	50	50	70	70	70
Handwheel Shaft Octagon Interface to Handwheel (in/mm)	.77/19.5	.77/19.5	.77/19.5	.77/19.5	.77/19.5
Handwheel Shaft Hex Drive (in/mm)	.63/16	.63/16	.63/16	.63/16	.63/16
MSS SP-101 Base FA/ISO 5211 Base F	05, 07, 10	07, 10	10/12/14	12/14	12/14
Max Diameter Bore & Square Key (inches)	05 Base Ø.875, 3/16 sq 07 Base Ø1.1875, 1/4 sq 10 Base Ø1.625, 3/8 sq	07 Base Ø1.1875, 1/4 sq 10 Base Ø1.625, 3/8 sq	10 Base Ø1.625, 3/8 sq 12 & 14 Base Ø2.375, 5/8 sq	12 & 14 Base Ø2.375, 5/8 sq	12 & 14 Base Ø2.375, 5/8 sq
Max Diameter Bore & Rectangular Key (inches)	05 Base Ø.93, 3/16 X 1/8 07 Base Ø1.25, 1/4 X 3/16 10 Base Ø1.75, 3/8 X 1/4	07 Base Ø1.25, 1/4 X 3/16 10 Base Ø1.75, 3/8 X 1/4	10 Base Ø1.875, 1/2 X 3/8 sq 12 & 14 Base Ø2.50, 5/8 X 7/16	12 & 14 Base Ø2.50, 5/8 X 7/16	12 & 14 Base Ø2.50, 5/8 X 7/16
Max Diameter Bore & Key (mm)	05 Base Ø22, 6 sq 07 Base Ø30, 8 X 7 10 Base Ø42, 12 X 8	07 Base Ø30, 8 X 7 10 Base Ø42, 12 X 8	10 Base Ø50, 14 X 9 12 & 14 Base Ø64, 18 X 11	12 & 14 Base Ø64, 18 X 11	12 & 14 Base Ø64, 18 X 11
Max Square Drive	05 Base 0.75 in sq, 19 mm sq 07 Base 1 in sq, 25 mm sq 10 Base 1.41 in sq, 35 mm sq	07 Base 1 in sq, 25 mm sq 10 Base 1.41 in sq, 35 mm sq	10 Base 1.625 in sq, 42 mm sq 12 & 14 Base 1.75 in sq, 45 mm sq	12 & 14 Base 1.75 in sq, 45 mm sq	12 & 14 Base 1.75 in sq, 45 mm sq
Max Double 'D' Diameter (in/mm)	05 Base Ø1.06 in/27 mm 07 Base Ø1.44 in/36 mm 10 Base Ø2.00 in/50 mm	07 Base Ø1.44 in/36 mm 10 Base Ø2.00 in/50 mm	07 Base Ø2.25 in/58 mm 12 & 14 Base Ø2.50 in/64 mm	12 & 14 Base Ø2.50 in/64 mm	12 & 14 Base Ø2.50 in/64 mm
Weight (lb)	40	42	80	80	80
Coatings	Primed using high solids epoxy-ecoat and powder topcoated, royal blue with a DFT of 1–3 mils. The coating is suitable for an ASTM B117 salt spray test of 1500 hours. Standard external fasteners are stainless steel.				

*QX minimum operating times are impacted by temperatures less than -10°C.
QX-1 if set between 5-10 seconds will run slower, requiring 10 seconds for 90 degrees
QX-2 if set between 8-10 seconds will run slower, requiring 10 seconds for 90 degrees
QX-3 if set between 15-30 seconds will run slower, requiring 30 seconds for 90 degrees
QX-4 if set between 30-60 seconds will run slower, requiring 60 seconds for 90 degrees

Information on base torque limits
05 base is limited to 100 ft-lbs/135 Nm max
07 base is limited to 200 ft-lbs/270 Nm max
10 base is limited to 400 ft-lbs/542 Nm max
12 base is limited to 1000 ft-lbs/1350 Nm max

QX Standard Features

The Flowserve Limitorque QX quarter-turn, smart electronic valve actuator is designed for the reliable operation of either ON-OFF or modulating quarter-turn valves. It includes a brushless DCV motor as standard, which can auto-correct to accept any global input voltage, single- or three-phase AC, or DC, an absolute encoder, electronic torque sensing, complete electronic control including a motor control board, state-of-the-art protection, control and monitoring features, mechanical gear reduction including worm gear as final output drive, declutch mechanism and handwheel for manual operation, valve interface bushing, 32-character LCD, local and remote control switches, built-in self-test (BIST) features and LimiGard fault protection. These features are all contained in a non-intrusive enclosure that is double-sealed to NEMA 4, 4X, 6, IP68 to 20M for 168 hours (and explosion-proof as required).

Power transmission and lubrication

All mechanical gearing components are bearing supported, and final drive (output) consists of a hardened alloy steel worm and alloy worm gear. All gears are immersed in an oil-bath lubricated with a synthetic oil designed specifically for extreme pressure worm and worm gear transmission service. Special lubricants are available for operation in temperatures of less than -30°C. Consult factory.

LUBRICATION & TEMPERATURE RANGE	SYNTHETIC BRAND
Standard Lubrication, -30ºC to +70ºC	Petro-Canada SHB 68 or Mobil SHC 626
Optional Food Grade Lubrication, -30ºC to +70ºC	Dow Molykote

Motor

The QX motor is unique to quarter-turn electronic valve actuators. It is a brushless DC motor specifically designed for the QX actuator and complies with IEC 34, S2-50 percent duty cycle at 50 percent of rated torque. The motor is a true bolt-on design with a quick-disconnect plug that can be changed rapidly without sacrificing motor leads. It is equipped with a solid-state motor thermistor to prevent damage due to temperature overloads.

ON-OFF MODULATING
Standard insulation class is F to IEC 34, S2-50% for stated operating times 100-600 starts per hour
600-1200 starts per hour, IEC 34, S4_33%_1200 S/H

The QX motor permits a global range of voltages (single-phase and three-phase ACV and DCV) to be connected without modification. The motor can energize, provided either of the listed voltages are connected:

Phase/Frequency	Application Voltage
VDC	24-48
1ph – 60 Hz	110, 115, 120, 240
1ph – 50 Hz	220-250
3ph - 60 Hz	208, 220, 230, 240, 380, 440, 460, 480, 550, 575, 600
3ph - 50 Hz	220, 380, 400, 415, 440, 525

Electronic control modules

Non-intrusive

The QX is non-intrusive, which means that all calibration/configuration is possible without removing any covers and without the use of any special tools. All calibration is performed in clear text languages; no icons are used. All configuration is performed by answering the “YES” and “NO” questions displayed on the LCD. “YES” is signaled by using the OPEN switch and “NO” by using the CLOSE switch, as indicated adjacent to the switches.

Double-sealed terminal compartment and terminal block

All customer connections are located in a terminal chamber that is separately sealed from all other actuator components. Site wiring doesn’t expose actuator components to the environment. The internal sealing within the terminal chamber is suitable for NEMA 4, 6, and IP68 to 20M for 168 hours. The terminal block includes screw-type terminals; three for power and 54 for control. Customer connections are made via conduits located in the terminal housing.

Three Standard Conduit Openings (NPT threads standard, M optional)
(3) – 1.0” NPT (standard) or M25 (optional)
Optional Fourth Conduit Opening (NPT or M)
(1) – 1.25” NPT or M32

Controls

The controls are all solid state and include power and logic circuit boards and a motor controller that performs as the motor reverser, all mounted to a steel plate and attached in the control compartment with captive screws. All internal wiring is flame resistant, rated 105°C, and UL/CSA listed.

The controls are housed in the ACP (Actuator Control Panel) cover, and the logic module uses solid-state Hall-effect devices for local communication and configuration. A 32-character, graphical LCD is included to display valve position as a percent of open, 0-100% and current actuator status. Red and green LEDs are included to signal ‘Opened’ and ‘Closed,’ and are reversible, and a yellow LED to indicate ‘Valve Moving.’ A blue LED is included when the Bluetooth option is ordered. A padlockable LOCAL-STOP-REMOTE switch and an OPEN-CLOSE switch are included for local valve actuator control

Using the knobs and LCD screen the QX is configurable in 10 languages: English, Spanish, French, German, Portuguese, Italian, Mandarin, Russian, Bahasa Indonesia and Katakana.

S contacts for remote indication

As standard, two pairs of latched status contacts rated 125 VAC, 0.5 A and 30 VDC, 2 A are provided for remote indication of valve position, configured as 1-N/O and 1-N/C for both the open and closed positions. Two contacts may be configured to represent any other actuator status and the other two will be complementary. The contacts may be configured in any of the selections depicted in the “Actuator Status Message”column.

“S” Contact AC	“S” Contact DC
0.5 Amps @ 125 VAC	1A @ 50 VDC, 2A @ 30 VDC (Resistive)

Actuator Status Message	Function
“CLOSED”	– valve closed “(0% OPEN)”
“OPENED”	– valve open “(100% OPEN)”
“CLOSING”	– valve closing
“OPENING”	– valve opening
“STOPPED”	– valve stopped in mid-travel
“VALVE MOVING”	– either direction
“LOCAL SELECTED”	– red selector knob in “LOCAL”
“MOTOR OVERTEMP”	– thermistor range exceeded
“OVERTORQUE”	– torque exceeded in mid-travel
“MANUAL OVERRIDE”	– actuator moved by handwheel
“VALVE JAMMED”	– valve can’t move
“CLOSE TORQUE SW”	– torque switch trip at “CLOSED”
“OPEN TORQUE SW”	– torque switch trip at “OPEN”
“LOCAL STOP/OFF”	– red selector knob at “STOP”
“LOST PHASE”	– one or more of the incoming supply lost
“ESD SIGNAL”	– signal active
“CLOSE INHIBIT”	– close inhibit signal active
“OPEN INHIBIT”	– open inhibit signal active
“ANALOG IP LOST”	– 4-20 mA not present
“REMOTE SELECTED”	– red selector in “REMOTE”
“HARDWARE FAILURE”	– indication
“NETWORK CONTROLLED”	– permits relay control via DDC, FF, or other network driver
“FUNCTION”	– LimiGuard circuit protection activated
“MID-TRAVEL”	– valve position, 1-99% open
“CSE CONTROL”	– CSE station in LOCAL or STOP and controls actuator

Monitor relay for remote indication
A monitor relay is included as standard and trips when the actuator is not available for remote operation. Both N/O and N/C contacts are included, rated 125 VAC, 0.5 A and 30 VDC, 2 A. The monitor relay can be configured for three additional fault indications: lost phase, valve jammed and motor Overtemp. The yellow LED will blink when the monitor relay is active. The user can disable the monitor relay, if necessary.

Monitor Relay AC	Monitor Relay DC
0.5 Amps @ 125 VAC	2A @ 30 VDC (Resistive)

Remote control
Discrete remote control (user supplied) may be configured as two, three or four wires for Open-Stop-Close control. Remote control functions may be powered by external 24 VDC, 110 VAC, or the actuator’s internal 24 VDC supply or optional 110 Vac supply. The internal supplies are protected against over current and short circuit faults and utilize optical isolation to minimize electromagnetic interference. Discrete control provides isolated commons for up to three selections.

Signal Threshold for Voltage Values	Maximum Load
5.0 VAC/VDC maximum ‘OFF’	24 VDC + 2 mA
19.2 VAC/VDC minimum ‘ON’	110 VAC + 10 mA

Speed control
The QX permits operational speeds in either Open and Closed directions to be set independently of each other. The QX also has an industry leading span for the optional two-speed timer.

Speed Minimum (Open to Close)	Speed Maximum (Open to Close)	Two-Speed Timer Span “ON” Pulse	Two-Speed Timer Span “Off” Pulse
QX-1 = 5 seconds	QX-1 = 20 seconds	0.5 to 20 seconds (0.5 sec. increments)	1.0 to 200 seconds (1.0 sec. increments)
QX-2 = 8 seconds	QX-2 = 30 seconds	0.5 to 20 seconds (0.5 sec. increments)	1.0 to 200 seconds (1.0 sec. increments)
QX-3 = 15 seconds	QX-3 = 60 seconds	0.5 to 20 seconds (0.5 sec. increments)	1.0 to 200 seconds (1.0 sec. increments)
QX-4 = 30 seconds	QX-4 = 120 seconds	0.5 to 20 seconds (0.5 sec. increments)	1.0 to 200 seconds (1.0 sec. increments)
QX-5 = 60 seconds	QX-5 = 120 seconds	0.5 to 20 seconds (0.5 sec. increments)	1.0 to 200 seconds (1.0 sec. increments)

Software

Limigard
A dedicated circuit to prevent undesired valve operation in the event of an internal circuit fault or erratic command signal is included as standard on each Limitorque electronic actuator. A single point failure will not result in erratic actuator movement nor will an open or short circuit in the internal circuit board logic energize the motor controller. The command inputs are optically coupled and require a valid signal pulse width from at least 250 ms to 350 ms to either turn on or off. In the event of an internal circuit fault, an alarm is signaled by tripping the monitor relay and through LCD indication. The control module also includes an auto reversal delay to inhibit high-current surges caused by rapid motor reversals.

Phase detection and correction (three phase)
A phase correction circuit is included to correct motor rotation faults caused by incorrect site wiring or phase switching in the event of a power down. The phase correction circuit also detects the loss of a phase and disables operation to prevent motor damage. The monitor relay will trip and an error message is displayed on the LCD screen when loss of phase occurs.

Multi-mode remote control
The QX is capable of being configured for multi-mode remote control, which permits discrete wiring for either two, three or four wires, or network (Fieldbuses) for Open-Stop-Close control and responds to the last signal received. The actuator can also distinguish analog control for modulating applications. The QX and MX products from Limitorque are the only smart actuators with such features.

ESD
An Emergency Shutdown (ESD) provision is included in each actuator, and the QX has up to three configurable inputs for ESD. The ESD signal(s) can be selected to override any existing signal and send the valve to its configured emergency position. Provision for an isolated common is standard.

Inhibits
The QX has as standard provisions for inhibit movement and also contains up to three configurable inputs. Provision for an isolated common is also standard.

Diagnostics
The QX contains similar diagnostic facilities as the MX. The values are included to accumulate and report the performance of the motor, encoder, motor controller, cycle time, handwheel operations, actuator ID, firmware revision and output turns. In addition, a torque profile of the reference baseline valve stroke and the last valve stroke is included. A feature for resetting the diagnostic odometer is also provided. All diagnostic information is displayed on the LCD and can be acquired over a network if Fieldbus options are purchased. The QX actuator has the ability for diagnostics information to be downloaded to a PC or PDA via both IRDA and Bluetooth ports using the Dashboard software.

Valve and actuator position sensing

Valve position is sensed by an absolute encoder, employing system-on-chip technology which uses a contactless magnet that excites Hall-effect devices and provides 12-bit resolution over 360 degrees. Each of the position-sensing circuits contains a B.I.S.T. (built-in self-test) feature and is redundant, permitting up to 50 percent fault tolerance before the position

is incorrectly reported. The BIST feature discerns which failures will signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions are stored in permanent, nonvolatile memory. The encoder measures valve position at all times, including both motor and handwheel operation, with or without power present, and without the use of a battery. The absolute encoder is capable of resolving down to 0.1 percent of output shaft position over 360 degrees.

Valve and actuator torque sensing

The QX and MX are the only electric actuators that sense torque electronically. The QX senses torque electronically from motor current. The torque can be adjusted from 40 to 100 percent of rating in 1 percent increments, and the motor is deenergized if the torque limit is exceeded. A boost function is included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (from 0ºC down to -60ºC). The QX monitors for "jammed valve" as a protection feature and initiates an automatic retry sequence if no movement occurs.

Exterior corrosion protection

The QX actuator is coated with as standard a polymer powder coat suitable for exposure to an ASTM B117 salt spray test of 1,500 hours. External fasteners are 300 series stainless steel. Optional coatings are available by contacting factory.

Manual operation

A handwheel and declutch lever are provided for manual operation. The handwheel is an engineered resin material and changing from motor to manual operation is accomplished by engaging the declutch lever. Energizing the motor returns the QX to motor operation. The lever is padlockable in either motor or manual operation. Optional configurations for handwheels are available by consulting the factory.

Handwheel Ratio	Turns to Close 90º	Handwheel Diameter	Handwheel Efficiency
QX-1/QX-2 = 200:1	50	3"/76 mm	26%
QX-3, QX-4, QX-5= 276:1	70	7.5"/191 mm	26%

Factory testing

Every QX actuator is factory tested to verify rated output torque, output speed, handwheel operation, local control, control power supply, valve jammed function, all customer inputs and outputs, motor current, motor thermistor, LCD and LED operation, direction of rotation, microprocessor checks and position-sensor checks. A report confirming successful completion of testing is included with the actuator. Special testing can also be performed by contacting the factory.

Design life and endurance testing

- Design Life – 10,000 Open-to-Close cycles is considered typical life expectancy under normal operating conditions in approved ambient working environments.
- Endurance – 250,000 collective cycles of two 90-degree turns (0-90° Open, 90-0° Closed) were performed on the QX for proof of design.
- AWWA C540-02 – "Standard for Power Actuating Devices for Valves and Sluice Gates" – 10,000 cycles with confirmation of specified torque and position accuracy.

Options

Lost power buffer and 24 VDC UPS

Terminals are included and can be used to optionally connect the electronic controls package, including display, to a backup 24 VDC power source. Another option is the QX Quik. Once the actuator has been powered by line power for one hour, it can automatically withstand most power outages while maintaining the correct state of the alarm and status contacts, even if the user repositions the actuator manually with the handwheel. To maximize its self-power time while the line power is lost, the actuator will place itself in its lowest possible power usage mode. The LCD will darken (sleep mode) until it is needed to be viewed. The LCD can be activated by moving the black knob to OPEN (YES) or by moving the actuator with the handwheel. After 7-8 seconds of inactivity, the LCD will return to sleep mode. This feature can last up to three hours and automatically recharges once main power is restored.

The use of batteries to perform this function is not required.

Analog Position Transmitter (APT)

A non-contacting, internally powered, electrically isolated position transmitter can be included to provide a 4-20 mA or 0-10 VDC signal that is proportional to valve position.

Analog Torque Transmitter (ATT)

A non-contacting, internally powered, electrically isolated torque transmitter can be included to provide a 4-20 mA or 0-10 VDC signal that is proportional to rated output torque.

Voltages or Currents for APT/ATT	Maximum/Minimum External Load - APT/ATT
4-20 mA	470 ohms - 99.9% accuracy/ 750 ohms for 99% accuracy
0-10 VDC	1000 ohms minimum - 99.9% accuracy/ 2700 ohms minimum - 99% accuracy

Modutronic option

A controller that alters valve position in proportion to a 4-20 mA analog command signal can be ordered. Positioning is accomplished by comparing the command signal to a non-contacting internal position feedback. An automatic pulsing feature to prevent overshoot at the setpoint is included. Proportional bands, deadband, signal polarity, motion inhibits time, and fail are adjustable using either the Local control mode of configuration or MX/QX Dashboard. Deadband is adjustable to 0.5 percent full span.

Voltages or Currents for Modulation	Input Impedance/Capacitance
4-20 mA	150 ohms Impedance
0-10 VDC	0.1 µF +/- 30%

Relays for status and alarms

Up to eight additional latching output contacts rated 250 VAC/30 VDC, 5 A and configurable to represent any actuator status in either N/O or N/C state are available. Please refer to "Status and Alarm Contacts for Remote Indication" for list of settings.

"R" Contact and Monitor Relay AC Ratings	"S" Contact and Monitor Relay DC Ratings
5.0 Amps @ 250 VAC	5A @ 30 VDC (Resistive)

Custom software—Momentary contact ESD and partial stroke ESD

An optional, custom software is available which, when combined with the unique safety features of the QX actuator, permits a unique scope of performance for partial stroke and emergency shutdown installations.

When enabled a user may set up the partial stroke and ESD signals as redundant digital inputs for safety. There are two signal inputs for either selection, and both must be in the active state in order for the specific function to occur.

If the partial stroke enable inputs are not active, in a fault state, or are released by the control logic and a signal is detected on the momentary ESD/PSESD input, then the actuator will perform the configured ESD operation. The momentary ESD/PSESD input will be ignored if there is a signal present for less than 100 msec, and is guaranteed to latch in the ESD/PSESD if the signal is present for greater than 800 msec. ESD is active until the control logic ESD release is given.

Please contact factory for application and purchase.

Global Certifications

Non-hazardous (weatherproof / submersion) certifications
IEC 529 protection code IP68; 20 meters for 168 hours
USA & CSA; NEMA 3, 4, NEMA 4X, NEMA 6

Geographic Locations	Weatherproof/ Submersion	Standard Temperature	Optional Temperature
IEC 60529 Protection Code IP68	20M for 168 hours	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +50ºC (-58ºF to 122ºF)
USA & Canada, NEMA 3, 4, 6	20 ft. for 24 hours	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +50ºC (-58ºF to 122ºF)
USA & Canada, NEMA 4X	1500 hrs. to ASTM 176	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +50ºC (-58ºF to 122ºF)

Standard hazardous global certifications

FM – Class I, Groups B, C & D, Div. 1 and Class II, Groups E, F and G, T6

T6 temperature classification is possible with operational times less than 15 min.

ATEX EExd IIB T6 ATEX II 2 G, CENELEC Norm EN50014 and EN50018

ATEX EExd IIC T6 ATEX II 2 G, CENELEC Norm EN50014 and EN50018

FM Canada – Class I, Groups B, C & D, Div. 1 and Class II, Groups E, F and G, T6

IEC - Exd IIB T6, IIB T6

IEC - Exd IIC T6, IIC T6

Geographic Locations	Explosionproof Classifications	Standard Temperature	Optional Temperature (2)
USA to Factory Mutual (FM)	Class I, Groups B, C, & D, Div. 1, T4 and Class II, Groups E, F, & G, Div. 2, T6	-30ºC to +70ºC (-22ºF to 156ºF)	-60ºC to +40ºC (-76ºF to 104ºF)
Canada to FM Canada	Class I, Groups B, C, & D, Div. 1, T4 and Class II, Groups E, F, & G, Div. 2, T6	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +40ºC (-76ºF to 104ºF)
ATEX II 2 G, CENELEC Norm EN 50014 & 50018	Eex d IIB T6, Eex d IIC T6, and Eex de IIB T6, Eex de IIC T6	-30ºC to +70ºC (-22ºF to 156ºF)	-60ºC to +40ºC (-76ºF to 104ºF) Eexd IIB T6 only
IEC	Eexd IIB T6, Eexd IIC T6, and Eexde IIB T6, Eexde IIC T6	-30ºC to +70ºC (-22ºF to 156ºF)	-60ºC to +70ºC (-76ºF to +156ºF), Eexd IIB T6 only

European directives

All QX actuator designs have been tested to demonstrate compatibility with the following European directives and are marked with the CE label:

- 2006/42/EC - Machinery Directive
- Vibration and seismic capability is in accordance with MILSTD-167, IEEE-344-1975, and IEC68-2-6. Test performed in each of three (3) axes, H1, horizontal – parallel to motor, H2, horizontal – perpendicular to motor, and "V1," vertical.

Vibration Levels (QX functions after event)	Seismic Levels (QX functions after event)
5-100-5 Hz sweeps at 0.75g acceleration in 3 axes	5.0g acceleration from 3.5 – 31 - 3.5 Hz sine dwells in 3 axes
2-35-1 Hz sweeps at 1.0 g acceleration in 3 axes	3.0g acceleration from 35 - 200 Hz sine dwells in 3 axes
1-500-1 Hz sweeps @ 2.0 g acceleration in 3 axes	
25 Hz dwell @ 2.0 g acceleration in 3 axes	

- 2003/10/EC -Airborne Noise to EN 60204-1
  The QX has been tested for noise emissions and at 1 m distance is less than 74 dB per grade A noise requirement of MIL-STD-740 and ANSI/ISA-S82.01-1994 (harmonized std. to IEC 1010-1).
- 2004/108/EC -EMC – Electromagnetic Compatibility and 93/68/EC -Low Voltage; EN 50081-1 & 2 – actuator complies with all pertinent requirements of Class A service categories in the listed table.

Applicable Emissions standards	EN50011:1998	Class A service	
Radiated emissions	EN55011:1998 & FCC Part 15, subpart J	30-130MHz 40dBmV / m 230-1000MHz 47dBmV / m	
Conducted emissions	EN55011:1998 & FCC Part 15, subpart J	0.15 to 0.5MHz 79dBmV (QuasiPeak 66dBmV avg) 0.5 to 30MHz 73dBmV (QuasiPeak 60dBmV avg)	
Applicable immunity standards	IEC EN 61000-6-1:2001		
ESD	IEC61000-4-1:1995	±8kV thru air ±4kV thru contact	
Radiated RF immunity	IEC61000-4-3:1995	80MHz to 2GHz 10Vrms / m	
Fast transients/burst	IEC61000-4-4:1995	EFT AC Power leads: ±2kV Signal leads: ±1kV	
Voltage surges	IEC61000-4-5:2001	AC Power: ±2kV com, ±1kV diff Signal leads: ±0.5V com, ±1kV diff	Perf criterion: B
Conducted RF immunity	IEC61000-4-6:1996	150kHz to 80MHz 10Vrms	Perf criterion: A w/ 80% AM modulation @ 1KHz
Magnetic field immunity	IEC61000-4-8:1993	Power line frequency 30A/m @ 60Hz	Perf criterion: A
Voltage dips and interrupts	IEC6326-1:2005 (IEC61000-4-11:2004)	60Hz 100% dip, 1 cycle duration 40% dip, 10 cycle duration 70% dip, 25 cycle duration 100% interrupt for 5s	Perf criterion: B, C 3 test each @ 10 sec interval 3 test each @ 10 sec interval 3 test each @ 10 sec interval 3 test each @ 10 sec interval

• Di-electric – Motor per NEMA MG1-12.02 and .03 with leakage of less than 10 mA. Control terminals per IEC-1131-2 and CSA C22.2 with check against physical breakdown.

FLOWSERVE

FCD LMENBR3302-02 0611 Printed in USA.

To find your local Flowserve representative:

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Flowserve Corporation
Flow Control

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Plot No 4
Export Promotional Industrial Park
Whitefield, Bangalore 560066
India
Phone: 91-80-40146200
Facsimile: 91-80-28410286

NOTES: (SEE INSTALLATION & OPERATION MANUAL LMENIM 3306 FOR DETAILS)

CIRCUIT SHOWN WITH VALVE IN FULLY CLOSED POSITION AND WITH POWER OFF.

MOTOR

SINGLE PHASE, LOW VOLTAGE
MOTOR CONTROL BOARD
250VAC MAX.

L2=NEUTRAL
L1=LINE

L2
L1 POWER SUPPLY
PE
GROUND

1. REMOTE INPUTS

SIGNAL THRESHOLD – MINIMUM "ON" 19.2V AC/DC
MAXIMUM "OFF" 5.0V AC/DC
MAX LOAD – 10 mA / 110V AC
2 mA / 24V DC

REQUIRED CONTROL SIGNAL DURATION – 350ms MIN.
INPUTS 0,1,2 ARE FIELD CONFIGURABLE FOR
CLOSE/OPEN INHIBIT, USER INPUT, OR ESD.
IN ADDITION, INPUT 2 MAY BE CONFIGURED
FOR CSE REMOTE SELECTION INDICATION.
DEFAULT INPUT CONFIGURATION:
INPUT 0 – ESD,
INPUT 1 – OPEN INHIBIT,
INPUT 2 – CLOSE INHIBIT.

2. REMOTE INPUT JUMPERS

JUMPERS CAN BE USER WIRED TO CONNECT DIG COMMONS #1, 2 & 3 (AS NEEDED). THE 3 REMOTE WIRING GROUPS ARE ELECTRICALLY ISOLATED, INTERNALLY. ONLY A SINGLE POWER SOURCE MAY BE USED TO POWER ANY ONE GROUP BUT DIFFERENT SOURCES MAY POWER DIFFERENT GROUPS. IF DIFFERENT SOURCES ARE USED, ENSURE THAT THE POLARITIES ARE CORRECT.

3. DEFAULT [S] SETTINGS

THE DEFAULT OPERATING CONFIGURATION FOR THE "S" OUTPUTS ARE SHOWN IN THE TABLE BELOW. THE CONTACT STATES SHOWN IN THE SCHEMATIC REPRESENT A FULLY CLOSED VALVE. SEE OPERATION MANUAL FOR ALTERNATE CONFIGURATIONS.

OUTPUT SWITCH CONTACT DEVELOPMENT

OUTPUT SWITCH	VALVE POSITION: FULL CLOSE	VALVE POSITION: FULL OPEN	FUNCTION
S1a	■	– – –	CLOSE LIMIT
S1b	–	■	
S2a	– – –	■	OPEN LIMIT
S2b	■	–	

– – OPEN CONTACT
■ CLOSED CONTACT

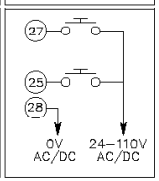
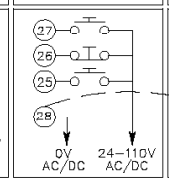
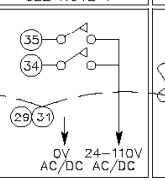
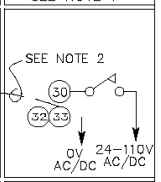
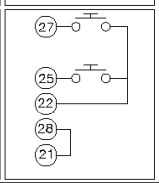
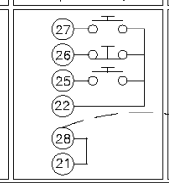
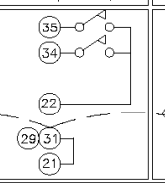
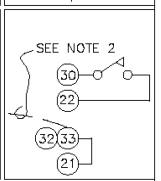
4. MAXIMUM EXTERNAL LOAD

TERMINALS 21 AND 22 (24 VDC)
– 5W MAX. EXT. LOAD

5. CONTACT RATINGS

S1, S2– 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)
MONITOR– 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)

(–) NEGATIVE COMMON

	3–WIRE	4–WIRE	INHIBIT	ESD
	Configurable at SET–UP to give either: –OPEN/CLOSE push–to–run (inching) mode OR –OPEN/CLOSE push–and–release (maintained) mode with mid– travel reversal (Stop before reverse)	OPEN/STOP/CLOSE Push–and–release (maintained) MODE with mid–travel reversal and mid–travel stop	Configurable at SET–UP to give: interlock/inhibit on maintained open or close contacts	Configurable at SET–UP to give following modes of ACTIONS on receipt of a maintained ESD signal: CLOSED/OPEN STOP/IGNORED
	SEE NOTE 1		SEE NOTE 1	
EXTERNAL SUPPLY 24 TO 110 VOLT AC/DC				
INTERNAL SUPPLY 24V DC				

Control Cable:
8-Conductor, 22AWG, Shielded, Drain
General Cable Part No. C0764A

THERMAL SENSOR
TORQUE SENSOR
POSITION SENSOR

(SEE NOTE 4) CONTROL SUPPLY
24V DC +Ve — 22
0V DC — 21

PRIMARY RELAYS
(SEE NOTES 3 & 5)

MONITOR (RM)
54
53
52

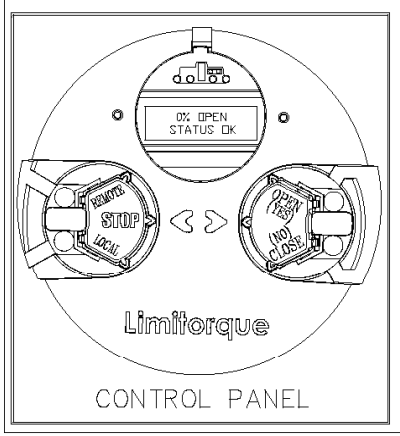
"CLOSE" POSITION (S1)
44 24VDC (RED)
45 CLOSE F/B (GREEN)(CLOSED-CONTACT=VALVE CLOSED)
49
48

"OPEN" POSITION (S2)
46 24VDC (RED)
47 OPEN F/B (WHITE)(CLOSED-CONTACT=VALVE OPEN)
51
50

GROUP 1
CLOSE — 27 CLOSE CMD (BLUE)
STOP — 26
OPEN — 25 OPEN CMD (ORANGE)
DIG COM #1–Ve — 28 0VDC (BLACK)

GROUP 2
INPUT 2 — 35
INPUT 1 — 34
DIG COM #2–Ve — 29
DIG COM #2A — 31
SEE NOTE 2

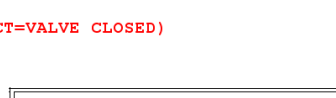
GROUP 3
INPUT 0 — 30
DIG COM #3–Ve — 32
DIG COM #3A — 33



REMOTE WIRING CONNECTIONS

TERMINAL POINT FUNCTION					
CLOSE (27)	+24V DC (22)	0V DC (21)	OPEN INHIBIT (34)	DIG COM #1 (28)	
STOP (26)	+24V DC (22)	0V DC (21)	CLOSE INHIBIT (35)	DIG COM #2(A) (29)(31)	
OPEN (25)	EXTERNAL SUPPLY ↓		ESD (30)	DIG COM #3(A) (32)(33)	

LIMIGARD CONFIG. WIRING



24 VDC TO 120 VAC

DRAWN DATE: RAC 11/10/10	FLOWSERVE Limitorque Actuation Systems 5114 WOODALL ROAD, LYNCHBURG, VIRGINIA 24506-1318		
CHECKED DATE: ZKC 11/12/10	TITLE: QX WIRING DIAGRAM Standard — No CS No Analog Single Phase Low Volt OS, (2) 2A with (1) 2A monitor relay 3Wire_4Wire		
APPROVED DATE: MAD 11/15/10	UNIT TYPE: QX	DWG NO: WD–QX–000000–00000	REV 00H SHEET 1 OF 1

NOTES: (SEE INSTALLATION & OPERATION MANUAL LMENIM 3306 FOR DETAILS)

CIRCUIT SHOWN WITH VALVE IN FULLY CLOSED POSITION AND WITH POWER OFF.

MOTOR

SINGLE PHASE, LOW VOLTAGE
MOTOR CONTROL BOARD
250VAC MAX.

L2=NEUTRAL
L1=LINE

L2
L1
POWER SUPPLY
PE
GROUND

1. REMOTE INPUTS

SIGNAL THRESHOLD – MINIMUM "ON" 19.2V AC/DC
MAXIMUM "OFF" 5.0V AC/DC
MAX LOAD – 10 mA / 110V AC
2 mA / 24V DC

REQUIRED CONTROL SIGNAL DURATION = 350ms MIN.
INPUTS 0,1,2 ARE FIELD CONFIGURABLE FOR CLOSE/OPEN INHIBIT, USER INPUT, OR ESD.
IN ADDITION, INPUT 2 MAY BE CONFIGURED FOR CSE REMOTE SELECTION INDICATION.
DEFAULT INPUT CONFIGURATION:
INPUT 0 – ESD,
INPUT 1 – OPEN INHIBIT,
INPUT 2 – CLOSE INHIBIT.

2. REMOTE INPUT JUMPERS

JUMPERS CAN BE USER WIRED TO CONNECT DIG COMMONS #1, 2 & 3 (AS NEEDED). THE 3 REMOTE WIRING GROUPS ARE ELECTRICALLY ISOLATED, INTERNALLY. ONLY A SINGLE POWER SOURCE MAY BE USED TO POWER ANY ONE GROUP BUT DIFFERENT SOURCES MAY POWER DIFFERENT GROUPS. IF DIFFERENT SOURCES ARE USED, ENSURE THAT THE POLARITIES ARE CORRECT.

3. DEFAULT [S] SETTINGS

THE DEFAULT OPERATING CONFIGURATION FOR THE "S" OUTPUTS ARE SHOWN IN THE TABLE BELOW. THE CONTACT STATES SHOWN IN THE SCHEMATIC REPRESENT A FULLY CLOSED VALVE. SEE OPERATION MANUAL FOR ALTERNATE CONFIGURATIONS.

OUTPUT SWITCH CONTACT DEVELOPMENT

OUTPUT SWITCH	VALVE POSITION: FULL CLOSE	VALVE POSITION: FULL OPEN	FUNCTION
S1a	■	– – – –	CLOSE LIMIT
S1b	–	■	
S2a	– – – –	■	OPEN LIMIT
S2b	■	–	

– – OPEN CONTACT
■ CLOSED CONTACT

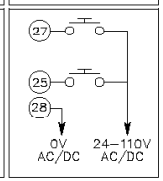
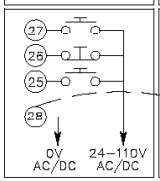
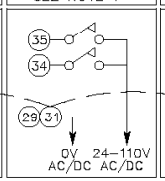
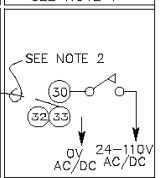
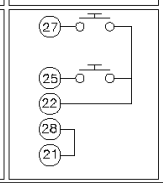
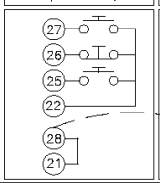
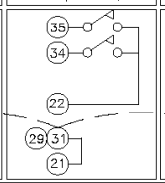
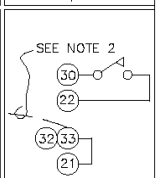
4. MAXIMUM EXTERNAL LOAD

TERMINALS 21 AND 22 (24 VDC)
– 5W MAX. EXT. LOAD

5. CONTACT RATINGS

S1, S2– 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)
MONITOR– 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)

(–) NEGATIVE COMMON

	3–WIRE	4–WIRE	INHIBIT	ESD
	Configurable at SET–UP to give either: –OPEN/CLOSE push–to–run (inching) mode OR –OPEN/CLOSE push–and–release (maintained) mode with mid– travel reversal (Stop before reverse)	OPEN/STOP/CLOSE Push–and–release (maintained) MODE with mid–travel reversal and mid–travel stop	Configurable at SET–UP to give: interlock/inhibit on maintained open or close contacts	Configurable at SET–UP to give following modes of ACTIONS on receipt of a maintained ESD signal: CLOSED/OPEN STOP/IGNORED
	SEE NOTE 1		SEE NOTE 1	
EXTERNAL SUPPLY 24 TO 110 VOLT AC/DC				
INTERNAL SUPPLY 24V DC				

Control Cable:
8-Conductor, 22AWG, Shielded, Drain
General Cable Part No. C0764A

THERMAL SENSOR
TORQUE SENSOR
POSITION SENSOR

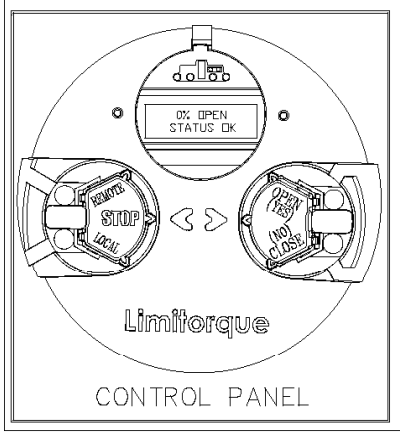
(SEE NOTE 4) CONTROL SUPPLY
24V DC +Ve — 22 — 24VDC (Red)
0V DC — 21 — 0VDC (Black)

PRIMARY RELAYS (SEE NOTES 3 & 5)
MONITOR: RM — 54, 53, 52
"CLOSE" POSITION: a, S1, b — 44 — 24VDC (Red); 45 — Close F/B (Green) (Closed=Valve Closed); 49, 48
"OPEN" POSITION: a, S2, b — 46 — 24VDC (Red); 47 — Open F/B (White) (Closed=Valve Open); 51, 50

GROUP 1
CLOSE — 27 — Close Cmd (Blue)
STOP — 26
OPEN — 25 — Open Cmd (Orange)
DIG COM #1–Ve — 28 — 0VDC (Black)

GROUP 2
INPUT 2 — 35
INPUT 1 — 34
DIG COM #2–Ve — 29
DIG COM #2A — 31
SEE NOTE 2

GROUP 3
INPUT 0 — 30
DIG COM #3–Ve — 32
DIG COM #3A — 33

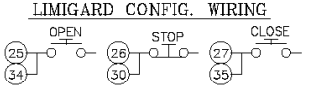


CONTROL PANEL

REMOTE WIRING CONNECTIONS

TERMINAL POINT FUNCTION					
CLOSE (27)	+24V DC (22)	0V DC (21)	OPEN INHIBIT (34)	DIG COM #1 (28)	
STOP (26)	+24V DC (22)	0V DC (21)	CLOSE INHIBIT (35)	DIG COM #2(A) (29)(31)	
OPEN (25)	EXTERNAL SUPPLY ↓		ESD (30)	DIG COM #3(A) (32)(33)	

LIMIGARD CONFIG. WIRING



24 VDC TO 120 VAC

DRAWN DATE: RAC 11/10/10	FLOWSERVE Limitorque Actuation Systems 5114 WOODALL ROAD, LYNCHBURG, VIRGINIA 24506-1318		
CHECKED DATE: ZKC 11/12/10	TITLE: QX WIRING DIAGRAM Standard — No CS No Analog Single Phase Low Volt OS, (2) 2A with (1) 2A monitor relay 3Wire_4Wire		
APPROVED DATE: MAD 11/15/10	UNIT TYPE: QX	DWG NO: WD–QX–000000–00000	REV 00H — SHEET 1 OF 1

Password to Change Settings: 0100

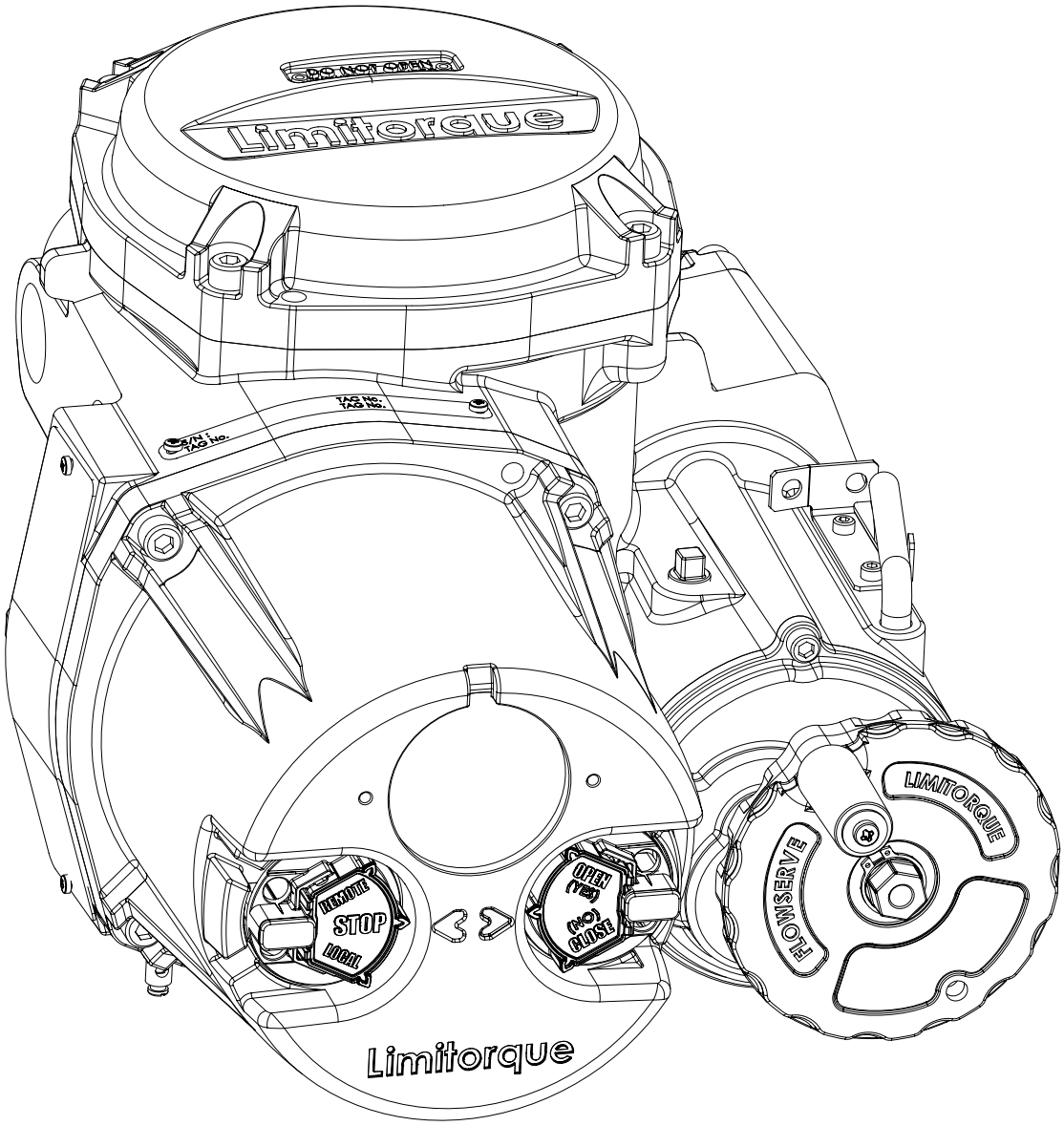
FLOWSERVE

USER INSTRUCTIONS

Limitorque QX Electronic Actuator

FCD LMENIM3306-03 – 11/09

Installation
Operation
Maintenance



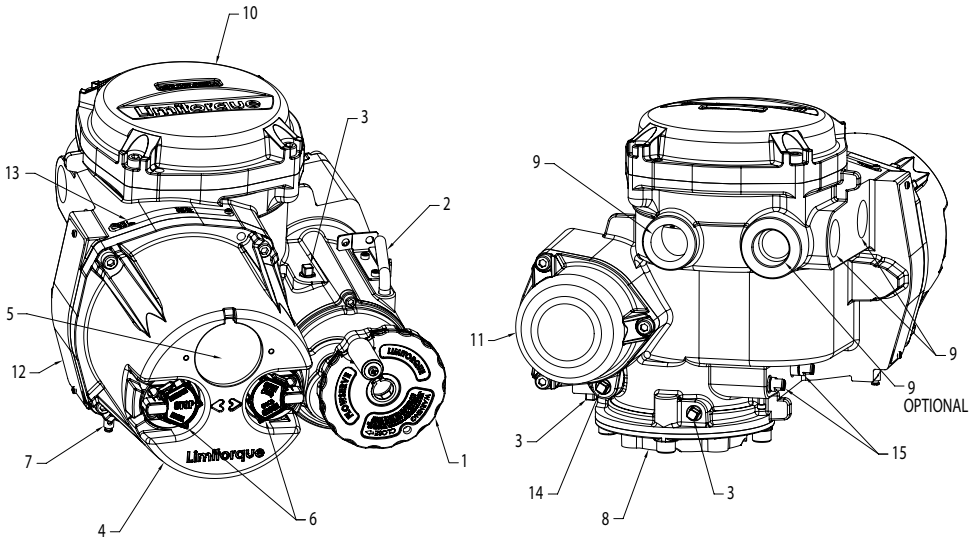
Experience In Motion

Contents

Figures

Tables

Figure 1.1 – QX-05 Actuator



Piece	Description
1	Handwheel
2	Declutch Lever (QX-05)
3	Oil Fill
4	Controls Cover
5	LCD
6	Control Knob
7	Ground Lug
8	Baseplate
9	Conduit Entry
10	Terminal Compartment
11	Motor
12	Certification Nameplate
13	Tag Nameplate
14	Oil Plug
15	Stem Nut Stops

1 Important Notes

- Please read this manual in its entirety before attempting to install or operate your QX actuator. A full understanding of the installation and operation options will assist you in installing the actuator in the most effective manner. Limitorque has designed the QX actuator for long life even in the harshest environments. Flexible control and protection options are provided to ensure the actuator meets your requirements.
- All actuator enclosures are sealed by O-rings, and cable entries are supplied with threaded plugs to protect the terminal compartment until the unit is wired. If the actuator cannot be installed immediately, it is recommended that it be stored in a clean, dry place, preferably in an area that is not subject to large fluctuations in temperature.
- Disconnect all incoming power before opening any cover on the actuator. The user/operator must ensure that safe working practices are employed at all times and are in accordance with local or national standards that are enforced at the particular site.
- To install and commission the actuator, only the terminal compartment cover needs to be removed. See Figure 1.1, Item 10. Settings for commissioning the actuator are done externally; therefore, no other covers need to be removed. The actuator was assembled in ideal dry conditions and the total sealing of the enclosure protects all electrical components against deterioration.

NOTE: Removal of any cover, other than the terminal compartment cover, will invalidate the unit warranty. Exposure of actuator components to an environment that results in deterioration of internal components will also invalidate the unit's warranty.

- During final field installation, ensure that all cable entries are correctly sealed in accordance with National Standards or Regulatory Authorities. All temporary transit plugs must be removed and any unused cable entries closed in an approved manner. See Section 3.4.3, Sealing Cable/Conduit Entries.

2 Quick Start

Quick Start provides step-by-step instructions for commissioning each QX actuator. This information is also available in Bulletin LMENIM3310, Quick Start-Up Instructions. These instructions are for the following:

- Position limits calibration – can be performed one of two ways:
    1. Electrical operation: See Section 2.1.2, Electrical Operation Feature.
    2. Handwheel operation: See Section 2.1.3, Handwheel Operation Feature.
- DDC operation: See Section 2.2, DDC Option.
- FF operation: See Section 4.10, FF Option.
- PB operation: See Section 4.11, PB Option.
- DeviceNet operation: See Section 4.12. DN Option.

When these Quick Start instructions are complete, the position limits will be set and the actuator will be ready for normal operation.

NOTE: The actuator has been configured with all customer-specified parameters and no further calibration should be necessary. If full valve data was not provided when ordering, or if changes are needed for parameters, see Sections 3.4 and 4, Commissioning the Actuator and Customizing the Actuator.

2.1 Calibrate – Position Limits

1. Install the QX actuator on the valve.
2. Refer to the nameplate for the correct main power supply voltage. Switch on the main power to the unit.
3. Turn the red knob to the STOP position. The “SET CLOSE POSITION LIMIT” message will be displayed. When the red knob is in “LOCAL” or “REMOTE,” the liquid crystal display (LCD) screen will read “SET POSITION LIMITS.”
4. Calibrate end position limits one of two ways:
    - Electrically, using the control panel. See Section 2.1.2, Electrical Operation Feature.
    - Manually, using the handwheel. See Section 2.1.3, Handwheel Operation Feature.

Once the position limits have been set, the screen message will indicate the valve position as a percentage of the valve opening.

While setting limit switches, place the red selector knob in the “LOCAL” position to permit the actuator to run open or closed in push-to-run mode (inching) only.

⚠ **CAUTION:** Extreme care must be taken as the valve approaches its end position.

The unit will not function with the red selector knob in the “REMOTE” position until both limit switches are set.

The existing configuration of the actuator/valve parameters may be viewed by entering the “SETUP” mode.

2.1.1 Entering the Setup Mode

1. Place the red selector knob in the “STOP” position.
2. Within 10 seconds, place the black control knob in the “YES” position, then the “NO” position, then again in the “YES” position (in quick succession—approximately one-two seconds).
3. The message “SETUP?” will appear in the LCD display for 10 seconds. If no setup action is taken within 10 seconds, the unit will reset.
4. Use the black control knob to answer “YES” or “NO” to the questions appearing in the display.

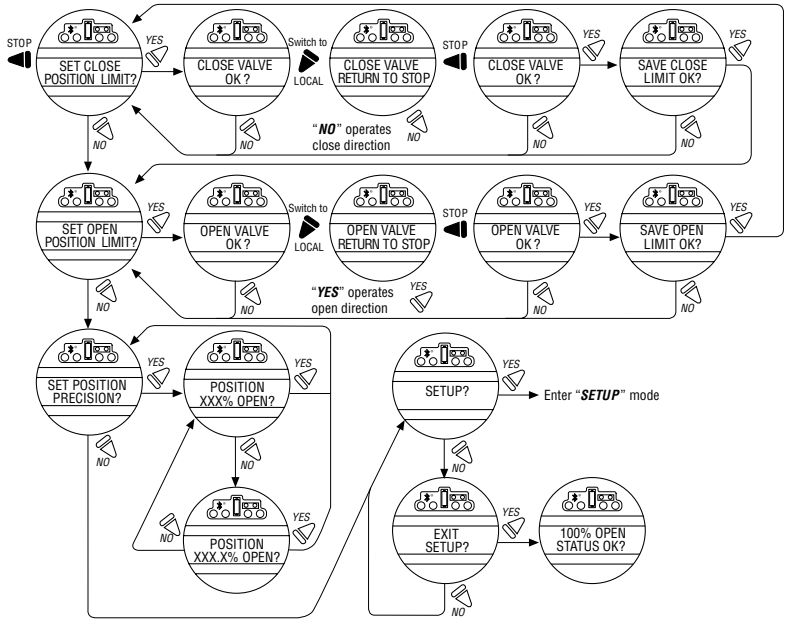
2.1.2 Electrical Operation Feature

This feature allows for quick and simple calibration. To set the position limits electrically, enter the “CHANGE SETTINGS” mode via the “SETUP” mode.

1. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. When screen prompt reads “CHANGE SETTINGS,” select “YES.”
3. The screen will display the “CHANGE SETTINGS” mode menu items. Select “NO” until screen displays “CHANGE POSITION SETUP.” User may select to set close limit first or open limit first.
4. Select “YES.” “CLOSE” or “OPEN VALVE - OK?” is displayed.
5. Place the red selector knob in the “LOCAL” position. Move the black knob in the intended direction. The LCD screens are shown in Figure 2.1.
6. When valve has reached desired position, return the red selector switch to “STOP” and complete calibration.

The position settings are now complete. The actuator will now function as ordered, and may be run electrically to inspect for correct operation.

Figure 2.1 – Electrical operation

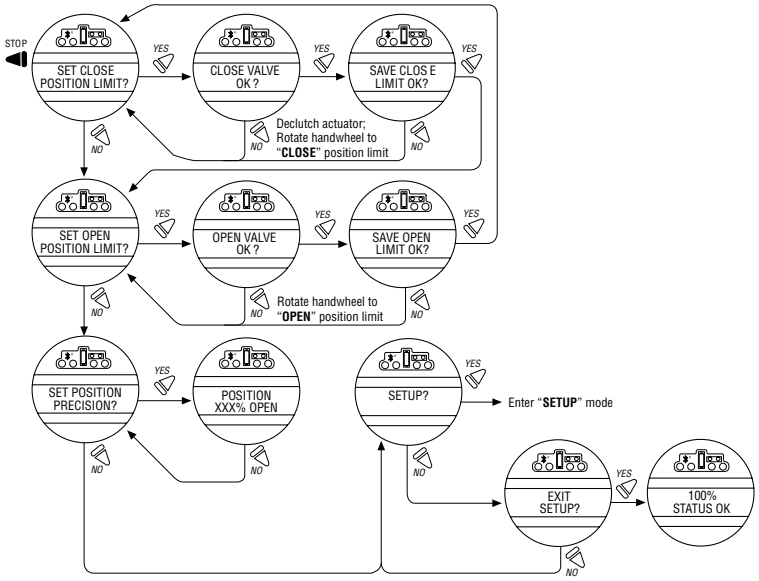


2.1.3 Handwheel Operation Feature

To set the position limits manually, enter the “CHANGE SETTINGS” mode via the “SETUP” mode.

1. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. When LCD reads “CHANGE SETTINGS?”, select “YES.”
3. The LCD will display the “CHANGE SETTINGS” mode menu items. Select “NO” until screen displays “CHANGE POSITION SETUP?”
4. Select “YES.” See Figure 2.2. Manually set position limits:
    a. Close position limit
        1. “SET CLOSE POSITION LIMIT?” is displayed.
        2. Select “YES.” “CLOSE VALVE - OK?” is displayed.
        3. Depress the declutch lever, and at the same time slowly rotate the handwheel until the clutch is fully engaged. Release the lever; the clutch will be retained in the handwheel mode by spring-loaded latches.
        4. Ensure the valve is fully closed, then move the valve in the open direction for one to two handwheel turns to allow for coasting of the motor.
        5. When the valve is in the desired position, select “YES” again. The LCD will read “SAVE CLOSE LIMIT OK?”
        6. Select “YES” if the valve’s close limit position is correct. The close position limit is set.
    b. Open position limit
        1. “SET OPEN POSITION LIMIT?” is displayed.
        2. Select “YES.” “OPEN VALVE - OK?” is displayed.
        3. Depress the declutch lever, and at the same time slowly rotate the handwheel until the clutch is fully engaged. Release the lever; the clutch will be retained in the handwheel mode by spring-loaded latches.
        4. Ensure the valve is fully open, then move the valve in the close direction for one handwheel turn to allow for coasting of the motor.
        5. When the valve is in the desired position, select “YES” again. The LCD will read “SAVE OPEN LIMIT OK?”
        6. Select “YES” if the valve’s open position limit is correct. The open position limit is set.
        7. Move the valve in the close direction. The open lamp should extinguish within one to two turns of the handwheel.
        8. Move the valve back in the open direction and check that the open lamp illuminates just before the full open position is reached (approximately ½ to 1 turn).
        9. If the calibration requires adjustment, select “NO” at the “SET CLOSE POSITION LIMIT?” prompt and repeat the “SET OPEN POSITION LIMIT?” routine.
        10. Select “NO” to exit “POSITION SETUP?” or “YES” to return to “SET CLOSE POSITION LIMIT?”

Figure 2.2 – Handwheel operation



2.2 DDC Option

The following instructions assume that all DDC option parameters are set with the exception of the address.

1. After setting position limits, remain in the "SETUP" mode. If not in the "SETUP" mode, enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. When LCD reads "CHANGE SETTINGS?", select "YES."
3. The LCD will display the "CHANGE SETTINGS" mode menu items. Select "NO" until screen displays "CHANGE DDC?" Select "YES." LCD will display DDC menu items.
4. Select "YES" for each menu item until "DDC ADDRESS OK?" appears. Select "NO."
5. Enter an address from one to 250 by toggling "NO" until the correct address is displayed. User may select to hold the knob in the "NO" direction and the number will automatically increment by one until the preferred address is reached.

⚠ **CAUTION:** The network address must be entered in accordance with the user address assignment sheet. This assignment sheet should correspond to the contract specifications. The same address must not be used anywhere else in the same network.

The DDC address does not have to be set to exit the setup.

2.3 Check the Settings

1. Operate the valve to the fully "CLOSE" position. Verify that the "CLOSE" (default GREEN) LED illuminates just as the travel limit is reached, and the valve position is displayed as "0% OPEN."
2. Operate the valve to the fully "OPEN" position. Verify that the "OPEN" (default RED) LED illuminates just as the travel limit is reached, and the valve position is displayed as "100% OPEN."

3 Installation and Operation

3.1 Preparing the Stem Nut

The QX has two (2) basic base designs:

- Torque-only (90º) operation
- Multi-turn operation (up to 20 multi-turn rotations - 7200º total)

3.1.1 Torque Applications

Standard B4/B4E Base

The standard QX actuator base is the stem nut for torque-only. It includes a mounting plate and steel torque nut, which may be machined to fit a valve or gearbox. A B4E torque nut can be provided and may be installed to allow for extended stem acceptance.

Table 1.1 – Available QX Flanges

		QX-1	QX-2	QX-3	QX-4	QX-5
Flange 1	ISO 5210	F05/F07	F07	F10	N/A	N/A
	MSS SP-102	FA05/07	FA07	FA10	N/A	N/A
Flange 2	ISO 5210	F10	F10	F12 (OPT) F14 (STD)	F12 (OPT) F14 (STD)	F14
	MSS SP-102	FA10 (STD)	FA10 (STD)	FA12 (OPT) FA14 (STD)	FA12 (OPT) FA14 (STD)	FA14 (STD)

Disassembly – Flange 1

1. Remove base plate mounting screws and base plate.
2. Remove the torque nut. If the torque nut is difficult to remove, insert a suitable device into the drive sleeve through bore and gently tap it loose from the handwheel end.
3. Machine the torque nut to suit the valve stem or gearbox input shaft. Ensure sufficient clearance for a smooth, sliding fit.

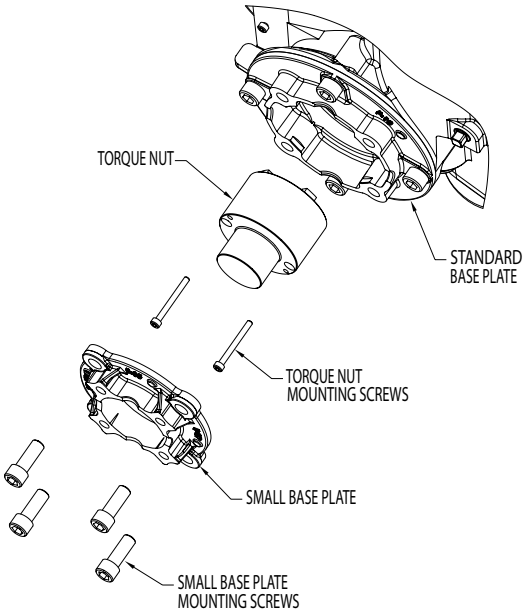
Disassembly – Flange 2

1. Remove the two torque nut screws.
2. Remove the torque nut and screws. If the torque nut is difficult to remove, insert a suitable device into the drive sleeve through bore and gently tap it loose from the handwheel end.
3. Machine the torque nut to suit the valve stem or gearbox input shaft. Ensure sufficient clearance for a smooth, sliding fit.

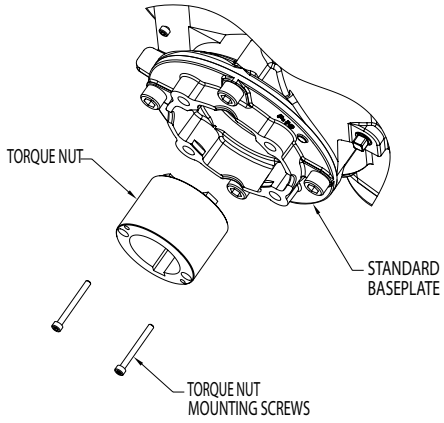
Reassembly

1. Clean the torque nut thoroughly and lightly grease.
2. Replace the torque nut in the drive sleeve. Ensure the torque nut meshes with the drive lugs.
3. Reinstall the torque nut mounting screws.

Figure 3.1 – Exploded view of QX bases



QX-1 F/FA05 & F/FA07, QX-2 F/FA07 Base,
QX-3 F/FA10 Base



QX-1, -2 F/FA10 Base
QX-3, -4, -5 F/FA12 & 14 Base

3.2 Mechanical Installation onto Valve or Gearbox

Before installing the actuator onto a valve or gearbox, check the following to ease installation:

- Verify that mounting flange is suited dimensionally to mate with the actuator base. Ensure that it is perpendicular to the valve stem.
- Ensure the stem nut mates with the valve stem or input shaft. Keyed or splined shafts should exhibit a smooth, sliding fit with the key installed.
- Ensure there is adequate engagement of the stem nut with the valve stem or input shaft when mounted. Generally, the minimum length of engagement is 1.5 times the diameter of the stem.
- Ensure that the valve stem is not too long such that it bottoms out on the QX drive sleeve.
- Verify that mounting studs or bolts are the correct length to suit the thickness of the mounting plate.
- Verify hardware specifications for English style:
  - Socket head cap screw per ASTM A 574 and ANSI 18.3.
  - Hex head cap screw per SAE J429 Grade 5.
  - Verify hardware specifications for metric style: hex and socket head cap screws per Property Class 12.9.
- Clean and lubricate the valve stem or input shaft.
- Ensure adequate lifting facilities and slings are available at the installation site.

NOTE: Do not use the handwheel to lift the actuator.

3.3 Setting the Mechanical Stops on Quarter-turn Valves

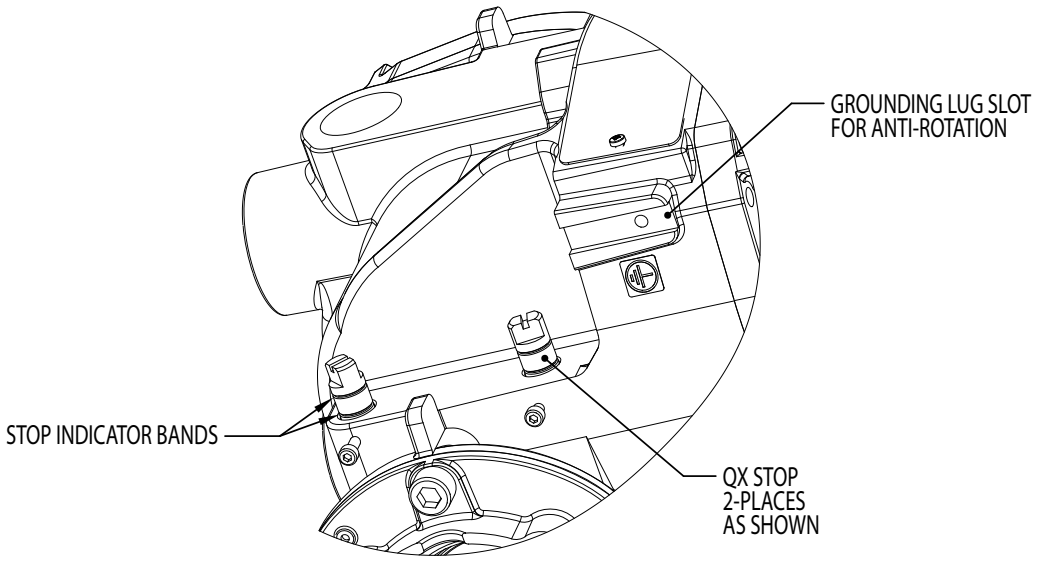
1. Place the actuator at mid position halfway between the two mechanical stops. This can be done by turning the handwheel until one stop is encountered, then turning the handwheel in the opposite direction to reach the other stop while counting the turns required for full stroke. Then turn the handwheel in the opposite direction again half the number of turns to achieve mid position.
2. Place the valve in mid stroke position. Select the QX position based on the lugs on the torque nut and the slot in the drive sleeve. Install the torque nut and place the QX on the valve. Secure the QX to the valve.
3. Using the handwheel, move the QX to the close position. Back out the close stop as needed after loosening the screw securing the stop.
4. Save the close position using the electronic setup procedure.
5. If not already complete, loosen both screws securing the stops. While in the close position, turn the close stop against the drive sleeve, then back the stop off the drive sleeve assuring the stop does not contact the drive sleeve. This is approximately 0.5 to 1.5 turns of the stop.
6. Manually open valve, set the open position and save by using the electronic setup procedure
7. Turn the open stop against the drive sleeve, then back off the stop from the drive sleeve approximately 0.5 to 1.5 turns, assuring the stop does not contact the drive sleeve.
8. Electronically cycle the valve open and closed. While at each respective limit of travel and in the stopped condition, reconfirm that the stop does not contact the drive sleeve. To confirm, rotate the stop freely back and forth, encountering only O-ring drag. If the drive sleeve has not been loaded against the stop, secure the stop with screw to lock it in place. If the stop is loaded by the drive sleeve, the stop must be backed away further from the drive sleeve. The drive sleeve must be backed off the stop before adjusting stops.

NOTE: Do not adjust stops while stop is loaded

Failure to back the stop away from the drive sleeve at the open and close positions will result in the QX being over-loaded during cycling.

9. There are two grooves or indicator bands cut into the stops to evaluate the position of the stops. Align the indicator bands with the edge of the housing to determine the approximate range of position for the stops. If the stops are backed out too far, the O-ring seal will be compromised and the unit will leak oil.

Figure 3.2 – QX travel stops



3.4 Electrical Connections

Verify that the supply voltage details on the nameplate are correct for this installation. Setup is non-intrusive; therefore, remove only the terminal cover to make electrical connections and to commission the actuator.

WARNING: The removal of any other covers without Limitorque's approval will void the warranty. Limitorque will not accept responsibility for any damage or deterioration that may occur as a result of cover removal.

3.4.1 Removing Terminal Cover

Remove the terminal cover as follows:

1. Remove the four cover screws using a 6 mm hexagonal wrench.
2. Remove the cover. XP units have long-spigoted covers and two tapped holes 180° apart. If the XP cover is difficult to remove, fit two of the cover screws into the tapped holes in the cover flange and jack out the cover. Take care to turn the screws by equal increments. Do not lever the cover off with a screwdriver, or similar object, since this may damage the flamepath on an explosionproof unit or the O-ring seal and seating face.

3.4.2 Terminal Compartment Documents

The OEM and user installation kits, wiring diagram, and test report are contained in the terminal compartment or with the actuator. Do not place them in the terminal compartment when the electrical connections have been completed.

NOTE: This instruction does not apply to valve manufacturers or similar installers of the actuator onto a valve prior to shipping to site. It is important that these items are available at the final destination site.

3.4.3 Sealing Cable/Conduit Entries

The sealing of cables and conduit entries should be done in accordance with National Standards or the Regulatory Authorities that have certified the actuators. This is particularly true for units that are certified for use in hazardous areas where the method of sealing must be to an approved standard and cable glands, reducers, plugs, and adapters must be approved and separately certified. All conduit entries should be sealed against the climatic conditions prevailing on-site, especially if temporary submersion is possible. All unused conduit entries should be sealed with threaded metal plugs. Plastic plugs are installed by Limitorque for shipping only and must not be used as permanent seals.

3.4.4 Recommended Terminal Connections

Power Terminals

Ring tongue connectors used on the power terminals should comply with the dimensions shown in Figure 3.3. For Additional information, consult terminal manufacturer.

Figure 3.4 details the allowable voltage and current parameters for the terminal block power terminals. Preload the M5 screws to 1.6-3.2 N m (1.2-2.33 ft-lb).

Control Terminals

Ring tongue connectors used on the control terminals should comply with the dimensions shown in Figure 3.5. For additional information, consult terminal manufacturer. Preload the M3 screws to 0.33-0.66 N m (0.25-0.50 ft-lb).

NOTE: Alternative manufacturers may be substituted only if dimensions are in accordance with Figure 3.5.
NOTE: The use of spade terminals is not recommended for secure electrical connections.

Figure 3.3 – Power terminal connector size limitations

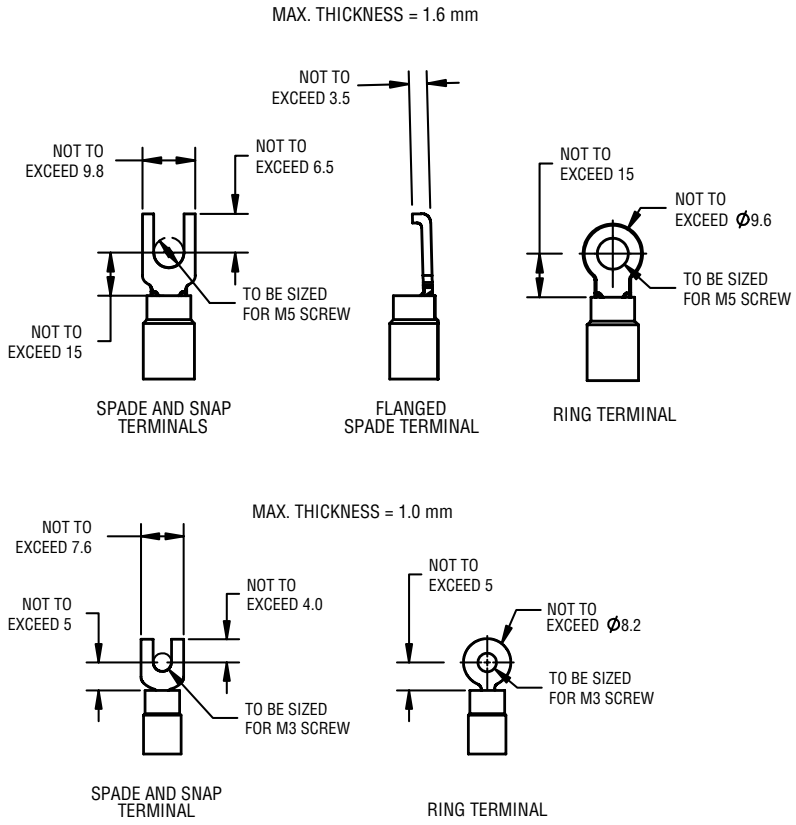


Figure 3.4 – Terminal block rating; power terminals

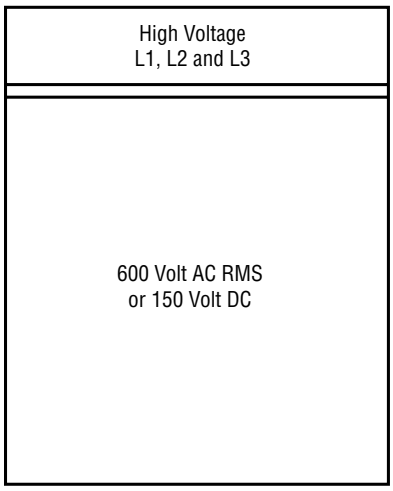
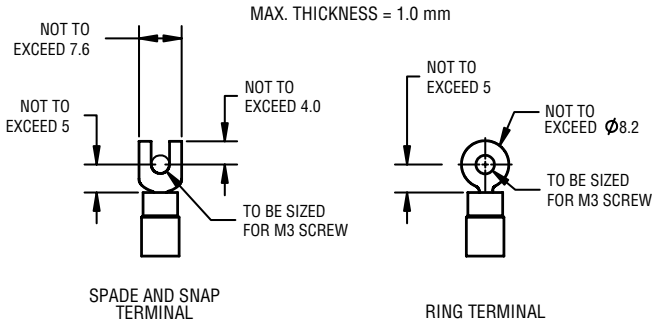


Figure 3.5 – Control terminal connector size limitations



NOTE: Limitorque recommends the use of the following connector for optimum results: Thomas and Betts #RZ22-6.

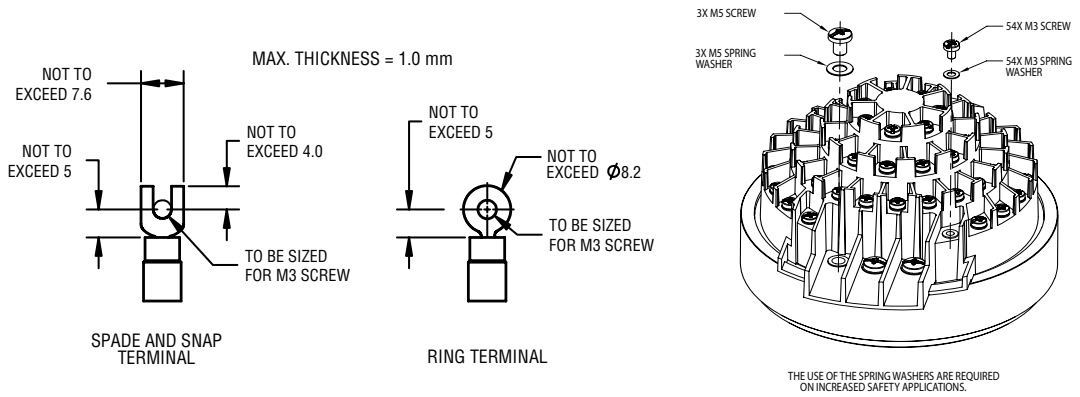
NOTE: Alternative manufacturers may be substituted only if the dimensions are in accordance with Figure 3.5.

Table 3.1 lists the maximum allowable voltage and current parameters for the terminal block control terminals.

Table 3.1 – Terminal block rating; power terminals

Description	L1	L2	L3
STD Rating	30 AMP	20 AMP	15 AMP
	8 Awg/10 mm^2	10 Awg/6 mm^2	14 Awg/2.5 mm^2
	600 VAC	RMS	150 VDC
Increased Safety Rating	27 AMP	18 AMP	13.5 AMP
	8 Awg/10 mm^2	10 Awg/6 mm^2	14 Awg/2.5 mm^2
	500 VAC	RMS	150 VDC

Figure 3.6 – Control terminal connector size limitations



NOTE: Limitorque recommends the use of the following connector for optimum results: Thomas and Betts #RZ22-6.

NOTE: Alternative manufacturers may be substituted only if the dimensions are in accordance with Figure 3.6.

Table 3.2 lists the maximum allowable voltage and current parameters for the terminal block control terminals.

Table 3.2 – Terminal block rating; control terminals

Low Voltage Row	STD Rating	Increased Safety Rating
1 points 1-16, 50 Volt	0.5 AMP AC RMS	0.45 AMP AC RMS
2 points 17-35, 125 Volt	0.5 AMP AC RMS	0.45 AMP AC RMS
3 and 4 points 36-54, 250 Volt	5 AMP AC RMS	4.5 AMP AC RMS

3.4.5 Termination of Cables

All terminations should be made with insulated ring terminals using the appropriate crimping tool. See Figures 3.2 and 3.3 for power terminal connection recommendations. See Figure 3.5 and Table 3.1 and 3.2 for control terminal connection recommendations.

3.4.6 Cable Connections

See Figure 3.6 for connection information.

1. Connect the main power supply cables, including the earth/ground wire using the M5 screws provided.
2. Attach the earth/ground wire to the separate screw on the inside of the terminal compartment.
3. Use the M3 screws installed in the terminal block to connect the control cables in accordance with the wiring diagram and the project specification.
4. Ensure that all connections are tight, including any spare termination screws that have not been used.

NOTE: A “Customer Connection(s) Diagram” sticker is attached to the interior of the terminal compartment cover. This may be removed and user termination numbers inscribed adjacent to Limitorque’s terminal block numbers for field connection reference. The diagram may also be used to assist in locating the terminal block positions. Service and factory contacts are contained on the sticker.

Certification is based on the use of appropriately rated wire for the application. Installation shall be in accordance with the current issue of the applicable national and or local electric code or regulations.

Table 3.3 – Required ratings for external wires

Up to	Use wire rated at least
40°C to 55°C Ambient	60°C
56°C to 70°C Ambient[1]	75°C

Note 1: Refer to unit nameplate.

3.4.7 Network Installations

The Limitorque QX offers a number of network options: DDC-Modbus, Foundation Fieldbus H1, Profibus DP_V1, Profibus PA, and DeviceNet.

Ensure that the network cable type is Belden 3074F, Belden 3105, Belden 9841 or another cable that is within 5% of the following specifications.

- Nominal impedance: 120 ohms @ 1 MHz
- Line to shield capacitance: 23.0 pF/ft (75.5 pF/m)
- Line to line capacitance: 12.8 pF/ft (42.0 pF/m)

Using other cables may result in decrease of internodal distance and/or an increase in communication error.

Particular care should be taken when terminating twisted-pair shielded cables in a control network. Avoid nicks, cuts, or abrasions in the insulation of data communication cables, since this may result in inadvertent ground connection. Also, excess cable should be cut, not coiled or looped, to prevent noise induction into the network.

Figure 3.7 – View of terminal block

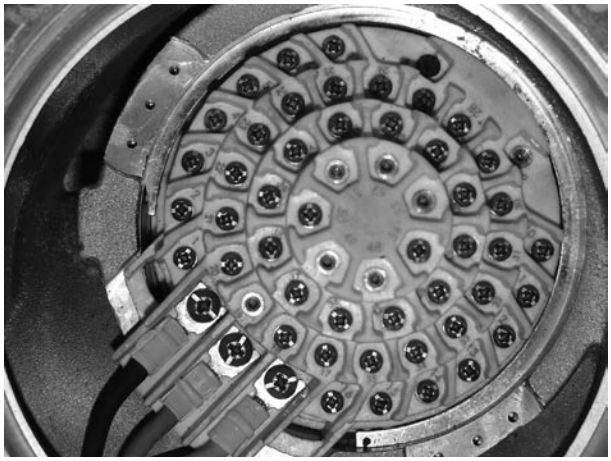
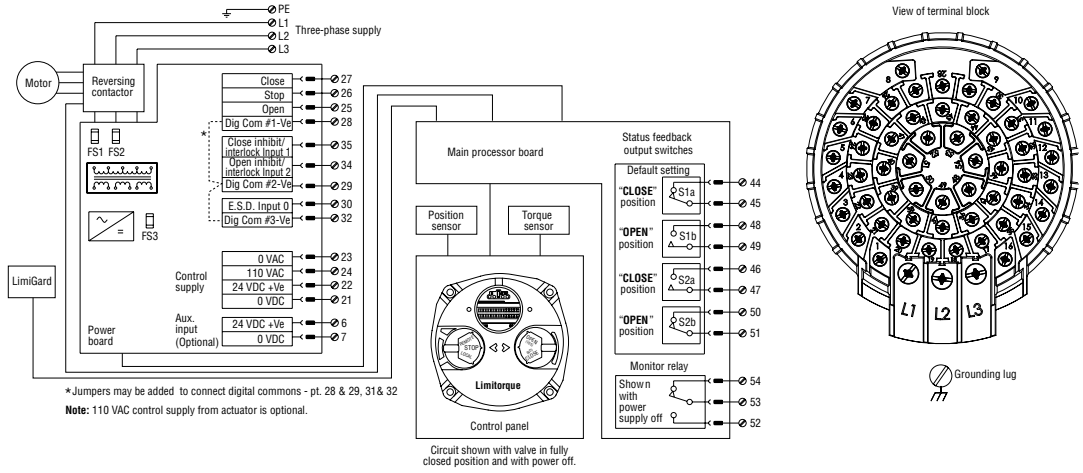


Figure 3.8 – Standard wiring diagram

NOTE: Most current wiring diagram is shipped within the terminal compartment of the QX.



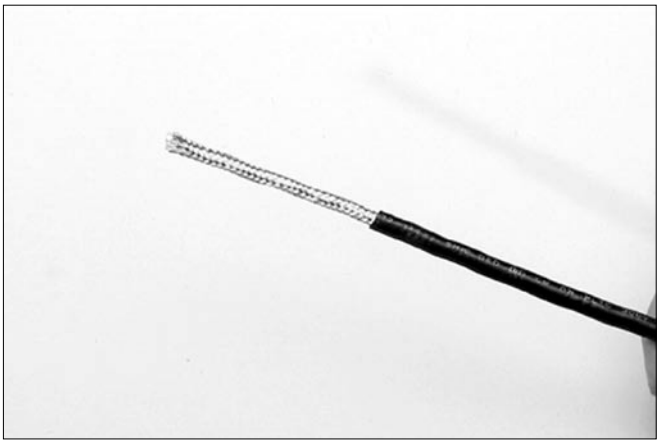
Cable Preparation

Prepare the network cable for connection to the QX actuator terminal block as illustrated in Figures 3.7 through 3.10.

⚠ **CAUTION:** Strip stranded conductors carefully; do not damage the strands. This will weaken the conductor. Do not nick conductors when stripping away the insulation. Nicking stresses the conductor and can cause the conductor to break. This type of damage may not be apparent and failure can occur later without warning.

1. Remove 2 to 3 in. (5 to 8 cm) of the outer plastic jacket as shown in Figure 3.9. Do not cut or nick the drain wire or the insulated conductors.

Figure 3.9 – Removing outer plastic jacket



2. Separate the cable parts. Unbraid the braided shield and peel back the foil shield to the same point where the outer jacket was removed as shown in Figure 3.10.
3. Cut away the braided shield and the foil shield. Strip the insulation from the conductors approximately ½ inch (1 cm) as shown in Figure 3.11.
4. Apply heat shrink tubing to insulate the drain wire and to provide stress relief to the cable.
5. Install ring tongue connectors as shown in Figure 3.12.

⚠ **CAUTION:** Do not melt the insulation.

6. Connect the network cables to the QX actuator terminal block per Table 3.4 and appropriate wiring diagram. Table 3.4 details a connection for the loop topology.

Figure 3.10 – Separating cable parts

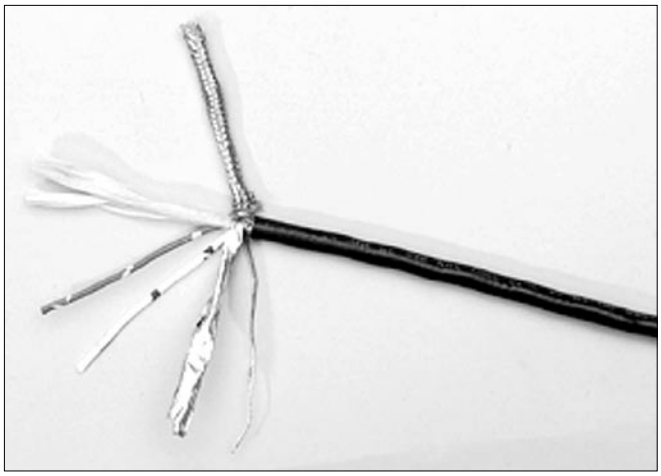


Figure 3.11 – Stripping conductors and applying heat shrink tubing

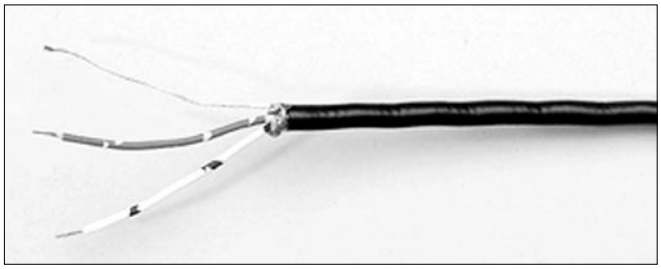


Figure 3.12 – Ring tongue connectors

Table 3.4– Loop topology connections

Terminal Block Number	DDC
4	DATA-A1* (-)
5	DATA-A1 (+)
14	DATA-A2* (-)
13	DATA-A2 (+)
3	Surge Protection

In terms of voltage, DATA is negative with respect to DATA*.

NOTE: Surge protection must be grounded to be effective.

NOTE: Ground each segment of the cabling at only one point to prevent ground loops, which can affect system performance. Verify the actuator is properly grounded.

Limitorque defines an effective local earth ground as the M3 taps on the housing next to the terminal block. See figure 3.15.

NOTE: Safety ground may not be disturbed.

NOTE: Shielding is not sufficient to prevent induction of stray voltages onto signal leads from the power lines.

A network wiring diagram for a loop is shown in Figure 3.14.

After installation is complete and prior to operation, inspect the network cable and its connection to each field unit for the following:

There should not be:

- Nicks in the insulation—this can cause a short to the grounded shield.
- Cut strands in a stranded conductor—this can cause a poor connection and eventually an open circuit.
- Cable armor shorted to the cable shield/drain wire—this may not be at ground potential and could be subject to lightning surges.
- Shield/drain wire grounded at more than one end of each cable segment (the section between each adjacent actuator on the loop). This will avoid ground loop problems.
- Ground/earth connection except at true ground potential and effective at all times.

3.4.8 Foundation Fieldbus Installation

Ensure that the Foundation Fieldbus cable type is Belden 3076F, or another cable that is within 5% of the following specifications.

- Characteristic impedance: 100 ohms @ 31.25 kHz
- Resistance, each wire: 7.32 ohms/1000 ft
- Attenuation: 0.914 dB/1000 ft @ 39 kHz
- Capacitative Unbalance: 3.6 pF/ft

Using other cables may result in decrease of internodal distance and/or an increase in communication error.

Particular care should be taken when terminating twisted-pair shielded cables in a FF control network. Avoid nicks, cuts, or abrasions in the insulation of data communication cables, since this may result in inadvertent ground connection. Also, excess cable should be cut, not coiled or looped, to prevent noise induction into the network.

Cable Preparation

Prepare the network cable for connection to the QX actuator terminal block as follows in Figure 3.9 through 3.12. Table 3.5 details connections for Foundation Fieldbus.

Table 3.5 – Foundation Fieldbus connections

Terminal Block Number	FF Function
4	DATA (-)
5	DATA (+)

The shield must be connected to ground or earth at only one place. The cable shield is generally grounded at the power conditioner.

Reference the Fieldbus Foundation Application Guide 31.25 kbit/s Wiring and Installation guide for more information on network wiring.

⚠ **CAUTION:** Strip stranded conductors carefully; do not damage the strands. This will weaken the conductor. Do not nick conductors when stripping away the insulation. Nicking stresses the conductor and can cause the conductor to break. This type of damage may not be apparent and failure can occur later without warning.

3.4.9 Network Wiring – Profibus DP/PA Installation

Profibus DP is based on RS 485 communication. The standard EN 50170 specifies the cable for use with Profibus DP.

The following specifications need to be fulfilled by the Profibus cable:

Table 3.6 – Profibus cable specifications

Parameter	Type – Profibus DP
Impedance	135 to 165 ohm/3 to 20 MHz
Capacity	< 30 pF/m
Resistance	< 110 ohm/km
Wire gauge	> 0.64 mm
Conductor area	> 0.34 mm^2

The Profibus DP cable is a shielded twisted pair cable.

In general, there are two different types of cables available. The most commonly used cable has solid wire for the Profibus line. When there is a need for more flexiblity (bending) and higher environmental resistance, a cable with stranded wire for the Profibus line and special jackets shall be used. Limitorque recommends the use of:

- Belden 3079A Specifications, 22 AWG, shielded, solid two conductor

Key Specifications

- Capacitance/ft = 8.5 pF
- Nominal Impedance (ohms) – 150.0

Network Wiring - Profibus PA

Please refer to IEC 61158 & ANSI/ISA S.50.02 Part 2-1992 for network wiring guidelines. Refer to Table 3.6 for connections.

3.4.10 Network Wiring – DeviceNet

DeviceNet is a CAN-based protocol that uses five wires including a shield. Two of the conductors are used for 24 VDC power and up to 8 amps (4 amps for NEC Class 2) may be passed along the hi-way from a suitable power source. Two conductors are used for the CAN bus signals, CAN_H and CAN_L, which are usually smaller in diameter. Flowserve recommends Belden 3082A cable for connecting to a DeviceNet network. The specifications for this cable are preferred.

Table 3.7 – DeviceNet cable specifications

Belden Part No.	AWG (Stranding) dia. Inches Nom. DCR	Insulation material (color code)	Nominal O.D.	Nom Impedance (ohms)	Nominal Capacitance	Test Frequency (MHz)	Maximum Attenuation dB/100ft
3082A	2 – 15 AWG (19 x 28) 3.6 ohm/1000 ft 11.8 ohm/km	Power pair (Black/Red)	12.2 mm	120	12.0 pF/ft	0.125 0.5 1	0.13 0.25 1.36
	2 – 18 AWG (19 x 30) 6.9 ohm/1000 ft 22.7 ohm/km	Data pair (Blue/White)					
3084A	2 – 22 AWG (19 x 34) 17.5 ohm/1000 ft 57.4 ohm/km	Power pair (Black/Red)	7.2 mm	120	12.0 pF/ft	0.125 0.5 1	0.29 0.50 1.70
	2 – 18 AWG (19 x 36) 28.0 ohm/1000 ft 91.9 ohm/km	Data pair (Blue/White)					

Please refer to Table 3.2 for connections.

3.4.11 Replacing Terminal Cover

Verify that the O-ring seal and spigot joint are clean and in good condition. Lightly coat these items with mineral-based lubricant before replacing the terminal cover and four retaining screws.

3.4.12 External Earth/Ground Connections

In order to help meet the local electric codes of the installation, one external connection point is provided on the main gear housing for the attachment of earth/ground cables. See Figure 3.15. This is in addition to the ground connection inside the terminal compartment.

3.5 Terminal Block Shield Installation

STEP 1

Remove terminal block cover.

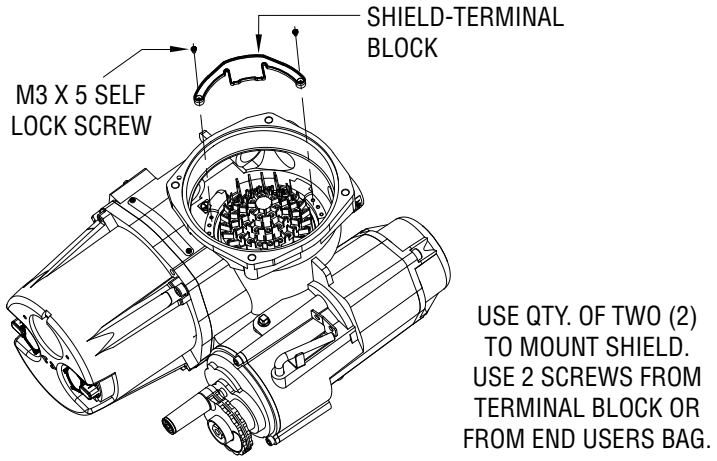
STEP 2

Use Qty of 2 screws from terminal block or from end users bag to attach shield.

STEP 3

Remount terminal block cover.

Figure 3.13 – Terminal Block Shield



3.6 Commissioning the Actuator

Before attempting to commission the actuator, verify that the actuator is installed correctly on the valve and main power is "ON."

After making the initial electrical connections detailed in Section 3.4, Electrical Connections, the QX actuator may be commissioned without removing any covers. No special tools are required. Configuration is accomplished through the use of the LCD and the control knobs mounted on the control panel.

For positioning the actuator:

1. Place the red knob in the "LOCAL" position.
2. Move the black knob to the "OPEN" or "CLOSE" position.

For configuring the actuator:

1. Place the red knob in the "STOP" position.
2. Move the black knob to the "YES" or "NO" position and release to answer questions appearing on the LCD display.

The OPEN and CLOSE position limits must be set after the actuator has been mounted on the valve. See Section 3.6.4, Setting Position Limits. All other actuator parameters are factory-set either in accordance with a Limitorque standard set of default values (see Section 3.6.1, Default Configuration Set) or the requirements specified with the purchase order. Reconfirm these preconfigured settings prior to placing the actuator into service since the requirements of the application may have changed after the manufacture of the actuator. See Section 3.6.2, View the Existing Settings.

3.6.1 Default Configuration Set

Unless otherwise specified, actuators are shipped with the following configuration:

- When Open stopped by position limit; Open seating (position)
- When Close stopped by position limit; Close seating (position)
- Maintained local control; Mode (maintained)
- Clockwise to close; Close direction (CW)
- ESD – User configurable inputs; default is "OFF"
- Inhibits on; Inhibit status (Default = OFF)
- Remote control – three-wire maintained
- Password – 100

Figure 3.14 – User network connection for loop topology/ Typical for all two-wire network protocols

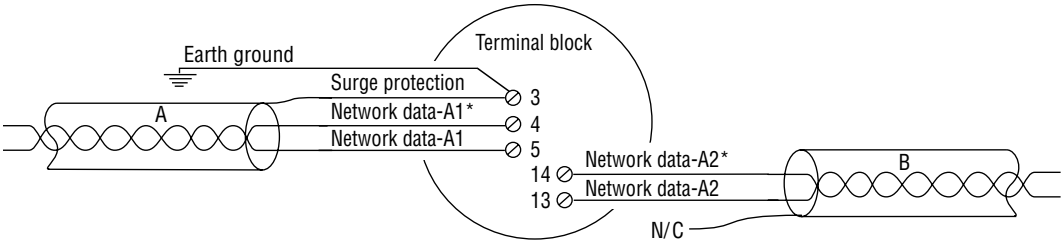


Figure 3.15 – External earth/ground connection – housing

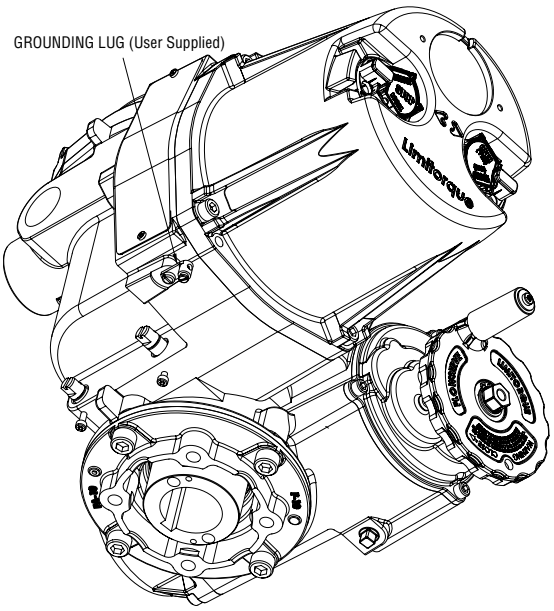


Table 3.8 – Default configurations

Modutronic Option	**Modbus RTU protocol**
Proportional band – 15%	9600 baud
Deadband – 2%	Analog scale = 0-100
Polarity – 20 mA = Open	Proportional band – 15%
Action on loss of signal = Close	Deadband – 2%
FF Option and PB Option	Offset – 0 mA
Analog scale = 0-100	
Proportional band – 15%	
Deadband – 2%	

If the default configuration is acceptable, no further configuring is necessary. If any default setting needs to be changed, see Section 4, Customizing the Actuator.

3.6.2 View the Existing Settings

All the existing setup data may be viewed on the LCD display by following a simple step-by-step dialog that may be selected in the following languages: English (default), Spanish, French, German, Italian, Portuguese, Russian, Malay, Mandarin, and Katakana.

1. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. Select the dialog language. Toggle "NO" to scan the language options. Select "YES" when the desired language appears on the LCD.
3. Scan menu selections on LCD and select "YES" when "VIEW SETTINGS" appears.
4. Scan through the series of displays and answer "YES" or "NO" at the appropriate prompts. Each display shows the state or value of the existing settings. See Figure 3.16.

NOTE: The "VIEW SETTINGS?" mode can be accessed without entering a password, but no changes to the settings can be made in this mode.

3.6.3 Entering the Setup Mode

To customize the actuator, view settings, or view diagnostics, the user must enter the "SETUP" mode. A three-digit password is required to customize the actuator. All actuators are supplied with the same default password (100). See Sections 4.2 and 4.3, Password Entry and New Password for entering and changing password. Main power must be applied to execute the setup procedure. It is recommended that the actuator be mounted to the valve before commissioning the actuator.

Enter the "SETUP" mode as follows:

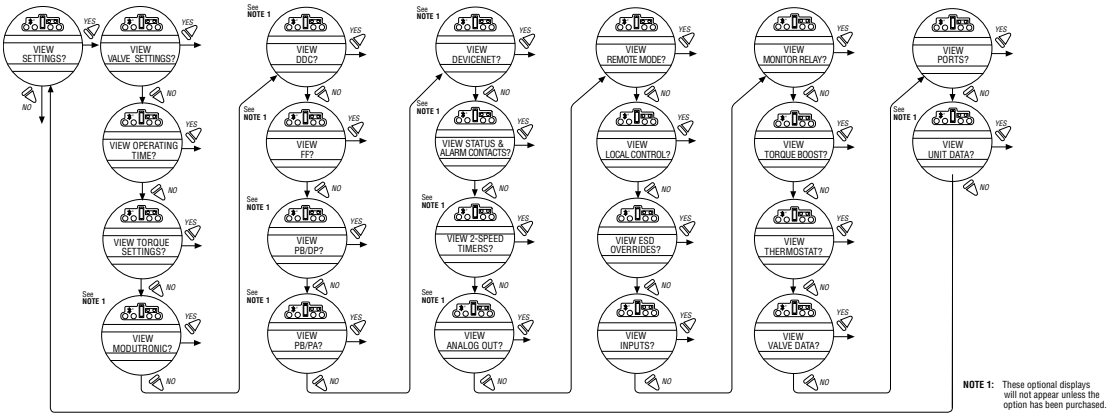
1. Place the red knob in the "STOP" position.
2. Within 10 seconds, place the black control knob in the "YES" position, then the "NO" position, then again in the "YES" position (in quick succession—approximately one-two seconds).
3. The LCD will display "SETUP?" for 10 seconds. If no action is taken within the 10 seconds, the unit will return to "STATUS OK."
4. Using the black knob, answer "YES" or "NO" to the questions appearing on the LCD display.

NOTE: While in the "SETUP" mode, if there is a lapse of 15 minutes from last action, the unit will return to the "SETUP?" display. Any changes that have been made will be stored.

5. When configuration is complete, answer "YES" to "EXIT SETUP?" or move the red knob from "STOP" to "LOCAL" or "REMOTE."

After exiting the "SETUP" mode, all settings will automatically be saved to a non-volatile memory and retained, even when power is removed from the actuator. However, if power is removed from the unit while the unit is in "SETUP" mode, customization changes will be lost.

Figure 3.16 – View settings



3.6.4 Setting Position Limits

This section will advise how to configure end-of-travel limits.

The actuator's position limits may be set by manual operation or electrical operation.

WARNING: If the actuator will not move after setting the limits, the limits have been set incorrectly.

Set Close Position Limit (Handwheel Operation)

1. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. Enter "POSITION SETUP?" routine.
3. From the "SET CLOSE POSITION LIMIT?" display, select "YES." "CLOSE VALVE OK?" will be displayed on the LCD.
4. Engage manual override as detailed in Section 3.7.1, Manual Operation.
5. Ensure that the valve is fully closed.
6. Move the valve in the open direction for one handwheel turn to allow for coasting of the motor.
7. When the valve is positioned correctly, select "YES" again. The LCD will display "SAVE CLOSE LIMIT OK?"
8. Select "YES."

The close position limit is now calibrated. Check the position limit setting as follows:

1. Move the valve in the open direction. The close lamp should extinguish with approximately one turn of the handwheel.
2. Move the valve back in the close direction and check that the close lamp illuminates just before the full close position is reached (approximately ½ to 1 turn).
3. Select "YES" at the "SET OPEN POSITION LIMIT?" prompt.
4. Set Position Precision? The QX permits position to be reported to the User in either default mode of XXX% OPEN, or single precision mode of XXX.X% OPEN. This may be preferred in Modulating or other positioning applications such as network move-to, analog fail move-to, communication loss move-to, or ESD move-to.

If the calibration requires adjustment:

1. Select “NO” at the “SET OPEN POSITION LIMIT?” prompt.
2. Repeat the “SET CLOSE POSITION LIMIT?” routine.

NOTE: The green LED is the default setting for indicating the (CLOSE) position.

Set Open Position Limit (Handwheel Operation)

1. From the “SET OPEN POSITION LIMIT?” display, select “YES.” “OPEN VALVE OK?” will be displayed on the LCD.
2. Engage manual override as detailed in Section 3.7.1, Manual Operation.
3. Ensure that the valve is fully open.
4. Move the valve in the close direction for one handwheel turn to allow for coasting of the motor.
5. When the valve is positioned correctly, select “YES” again. The LCD will display “SAVE OPEN LIMIT OK?”
6. Select “YES.”

The open position limit is now calibrated. Check the open position limit setting as follows:

1. Move the valve in the close direction. The open lamp should extinguish with approximately one turn of the handwheel.
2. Move the valve back in the open direction and check that the open lamp illuminates just before the full close position is reached (approximately ½ to 1 turn).
3. Select “YES” at the “SET OPEN POSITION LIMIT?” prompt or “NO” to exit “POSITION SETUP?” dialog.

If the calibration requires adjustment:

1. Select “NO” at the “SELECT CLOSE POSITION LIMIT?” prompt.
2. Repeat the “SELECT OPEN POSITION LIMIT?” routine.

NOTE: The red LED is the default setting for indicating the (CLOSE) position.

Set Close or Open Position Limit (Electrical Operation)

1. Enter the “SETUP” mode detailed in Section 2.1.1, Entering the Setup Mode.
2. Enter “POSITION SETUP?” routine.
3. During “CLOSE VALVE - OK?” or “OPEN VALVE - OK?,” move the red knob to “LOCAL” and use the “OPEN” and “CLOSE” switch.

Unit will only operate locally and only in the push-to-run configuration (Inching mode). This does not exit the startup routine—moving red selector knob back to “STOP” returns the user to the same message. This permits the valve to be placed at its travel limits and avoids the necessity to use the handwheel. The unit will run while the black knob is engaged with no stop limit when in this mode. Any previously set travel limits will be ignored.

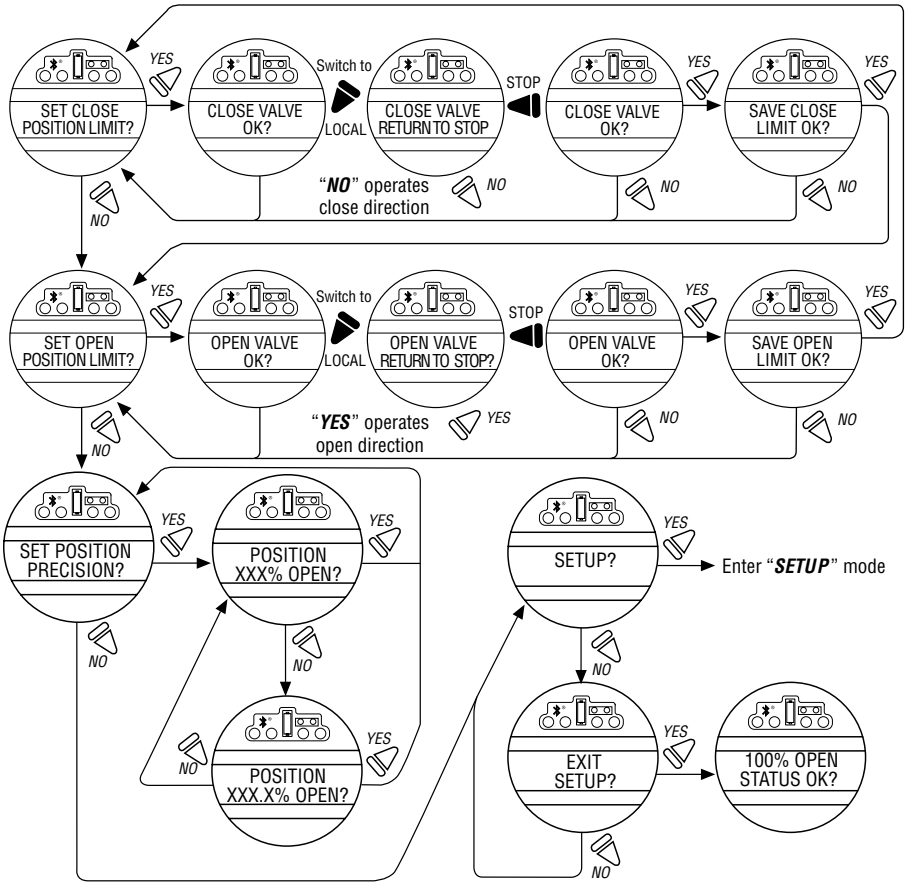
1. Move the red knob to “LOCAL” and move the black knob in the intended direction. LCD display will read:

OR

2. Once the “CLOSE” or “OPEN” valve position limit has been reached, return the red knob to “STOP” and complete setting the “CLOSE” or “OPEN” position limit. See Figure 3.17.

NOTE: Once the travel limits have been set, the actuator may be operated electrically from the remote inputs. Local maintained operation is also permitted. Check the operation of the actuator to ensure that the torque and limit settings are satisfactory. Place the selector switch in “LOCAL” and rotate the “OPEN/CLOSE” switch to operate the actuator in the “MOTOR” mode.

Figure 3.17 – Position setup – electrical operation



Moving the red knob from “STOP” to “LOCAL” or “REMOTE” automatically saves to non-volatile memory all the changes that have been made.

3.7 Operating the QX Actuator

3.7.1 Manual Operation

Operate the actuator with the handwheel as follows:

1. Depress the declutch lever and, at the same time, slowly rotate the handwheel until the clutch is fully engaged.

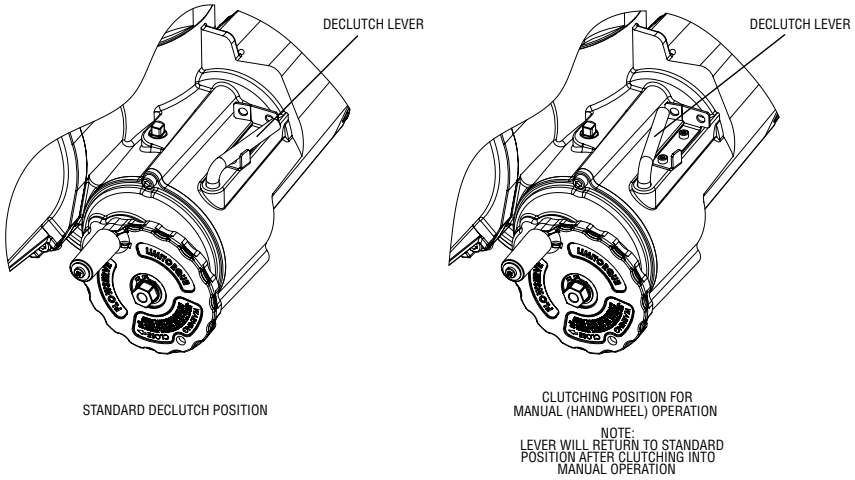
2. Release the lever and it will return to its original position. The clutch will be retained in the handwheel mode by spring-loaded latches.

Manual operation is now possible and the actuator can only be returned to motor operation by energizing the motor. Energizing the motor will trip the spring-loaded latch and allow the clutch to disengage from the handwheel and re-engage with the gear drive. To prevent unauthorized manual operation of the actuator, the declutch lever may be padlocked in "MOTOR" mode. A ½ inch size padlock is recommended.

3.7.2 Electrical Operation

Before applying power to the actuator, check that the supply voltage details on the nameplate are correct for this installation. An incorrect supply connected to the actuator terminals could cause fuses to blow or cause permanent damage to the electrical components in the unit. Phase rotation need not be checked since all units are supplied with an Autophase Correction feature. Apply power to the actuator but do not operate the actuator without first checking that it has been set up and configured correctly for its intended application.

Figure 3.18 – Declutch lever shows direction of engagement (QX-05 shown)



3.7.3 Local Control

Once the position limits have been set (see Section 3.6.4, Setting Position Limits) and the default mode is the maintained mode, the actuator can be controlled locally from the control panel.

1. Place the red selector knob in the "LOCAL" position.

2. Select "OPEN" or "CLOSE" via the black control knob.

If maintained control has been selected, the actuator will continue to run when this control knob is released. The actuator may be stopped at any time by placing the red selector knob in the "STOP" position, or the direction may be reversed or stopped using the black control knob.

If non-maintained control mode (inching) has been selected, the actuator can be inched to any intermediate position by holding the black control knob in the desired position, "OPEN" or "CLOSE," for as long as necessary. The actuator will stop when the knob is released.

3.7.4 Remote Control

Once the position limits have been set, and "REMOTE" mode is enabled:

1. Place the red selector knob in "REMOTE" to permit command control by a remote device. Local "OPEN/CLOSE" mode will be prevented.
2. Rotating the red selector knob to the "STOP" position will automatically stop the actuator regardless of the remote control signal unless ESD override has been selected. See Section 4.18, ESD (Emergency Shutdown) Overrides.

The red selector knob may be locked in or out of any of its three positions, "LOCAL/STOP/REMOTE," using a padlock. A ¼ inch padlock is recommended.

The LCD displays status and valve position. In normal operation mode, the top line displays "XXX % OPEN," while the bottom line displays "STATUS OK." Refer to Section 4.13, Status and Alarm Contacts for a list of "ALARM" or "STATUS MESSAGES." Table 3.9 details the LED indicators' default settings.

3.7.5 Local Indication

Figure 3.19 – Control panel

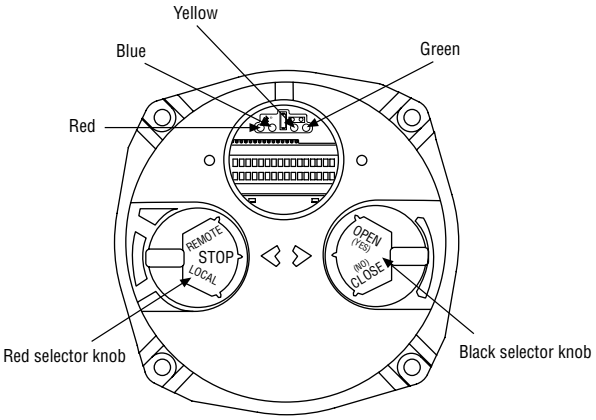


Table 3.9 – LED Indicators – default settings

LED Indicator			Operation Description
Yellow	Red	Green	
OFF	ON	OFF	Valve is fully open (Red knob in "REMOTE")
OFF	OFF	ON	Valve is fully close (Red knob in "REMOTE")
OFF	OFF	Blinking	Valve is closing (Red knob in "REMOTE")
OFF	Blinking	OFF	Valve is opening (Red knob in "REMOTE")
ON	OFF	OFF	Actuator in"REMOTE" and stopped in mid-travel
Blinking	OFF	OFF	Monitor relay alarm or actuator (red knob) in "LOCAL" or "STOP"

Red and green LED indicators can be reversed. See Section 4.17, Local Control.

NOTE: The blue LED indicator is supplied to indicate optional Bluetooth availability in the QX. This LED will light when the Bluetooth feature is recognized by an external Bluetooth enabled device.

4 Customizing the Actuator

The actuator settings can be customized; i.e., the default settings can be changed and the purchased options can be configured.

Language selection can also be customized. At the “SETUP IN ENGLISH?” prompt, select “NO” to move between the following languages: English, Spanish, German, French, Italian, Portuguese, Russian, Malay, Mandarin, and Katakana.

4.1 Changing the Existing Settings

1. Verify main power is ON.
2. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
3. Answer “YES” to “Change Settings.”
4. Enter password if required. See Section 4.2, Password Entry. To change any of the existing settings or to set the end-of-travel limits for the Open and Close positions of the valve, it may be necessary to enter a password.
5. Answer “YES” or “NO” to each of the following groups of setup data. A “YES” allows the selected setup data group menu to be displayed. A “NO” moves the user to the next setup data group. For details of each data group, see Sections 4.2 – 4.18.8, Password Entry through Motor Thermostat.

    - Valve setup
    - Torque setup
    - Position setup
    - Modutronic
    - DDC (distributed digital control)
    - FF (Foundation Fieldbus control)
    - PB (Profibus Control)
    - DN (DeviceNet Control)
    - Status and alarm contacts
    - Two-speed timer
    - Analog Out
    - Remote mode
    - Local control
    - ESD Overrides (emergency shutdown)
    - Inputs
    - Monitor Relay
    - Diagnostic reset
    - TAG
    - LCD contrast
    - Password

- Torque boost
- Thermostat
- Valve Data
- Port
- Restricted Setup (consult factory)

6. Make changes in each setup group as desired. Each display shows the state or value of the existing settings. See Figure 4.3.

7. When configuration is complete, answer "YES" to "EXIT SETUP?" Alternatively, the "SETUP" mode may be terminated at any time by moving the red selector knob from "STOP" to "LOCAL" or "REMOTE." All the changes made so far will automatically be saved.

NOTE: Once you exit this mode and enter either the "VIEW SETTINGS?" mode or "VIEW DIAGNOSTICS?" mode, the password will need to be entered again to gain access to the "CHANGE SETTINGS?" mode in order to make further changes.

Figure 4.1 – Entering the setup mode

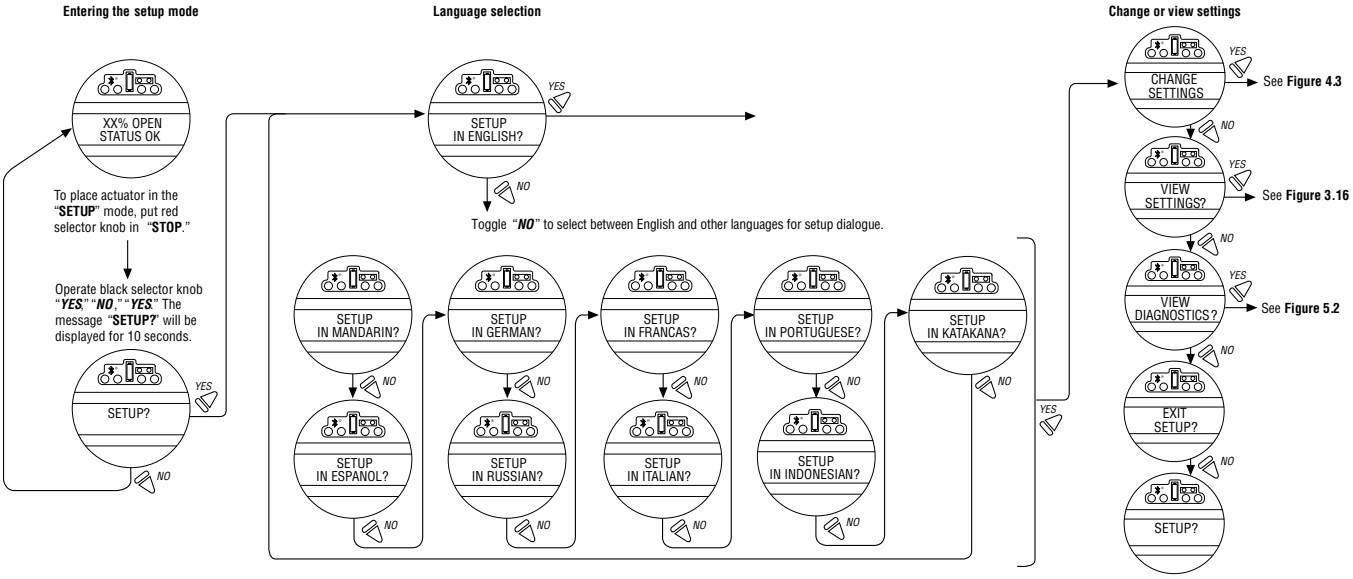


Figure 4.2 – Main menu selections

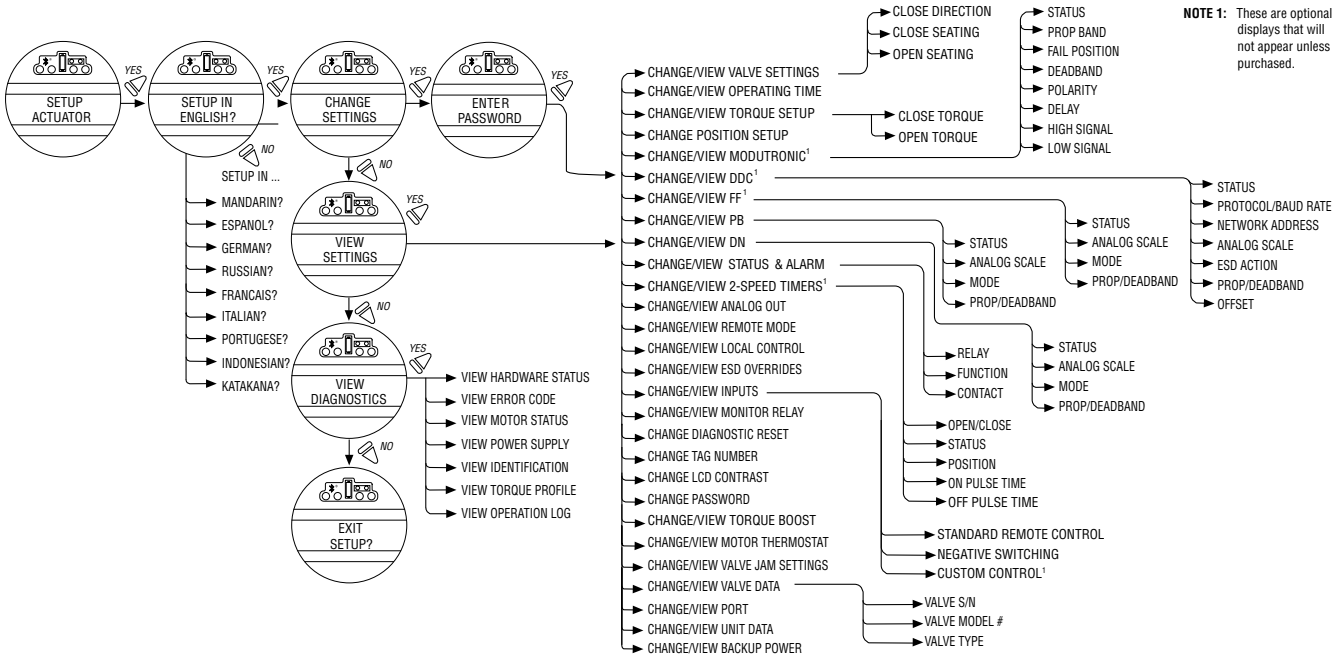


Figure 4.3 – Changing settings

NOTE: See topic list for appropriate page for each setting.

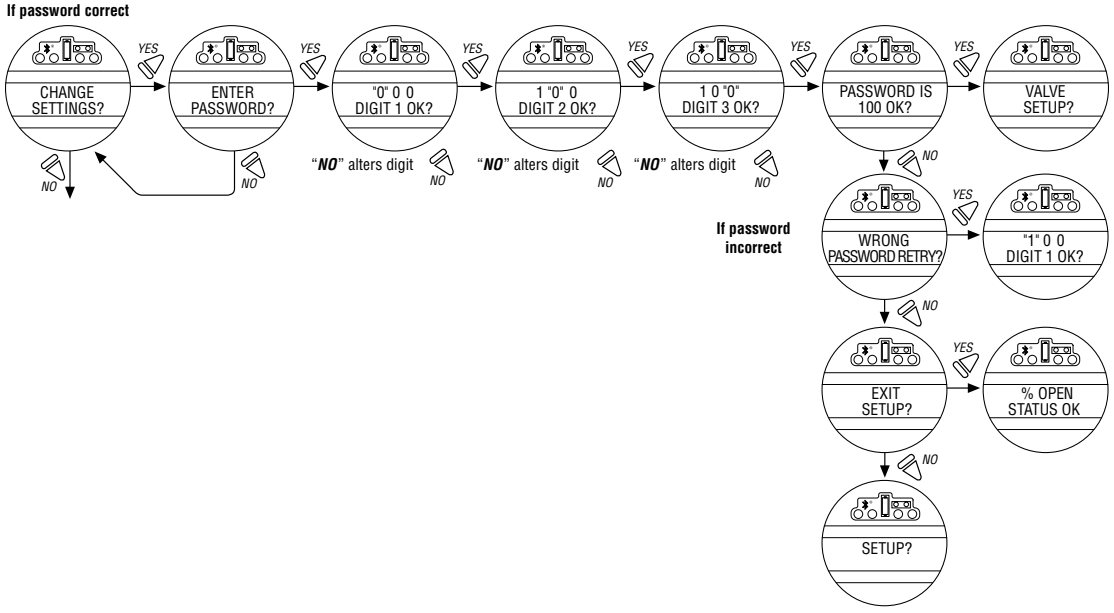
4.2 Password Entry

Default = 100

Unauthorized entry to the “CHANGE SETTINGS?” mode is prevented by a password protection feature. If password protection is not required, the password may be set to “000.” The user will not be prompted to enter a password when the password is set to “000.”

1. Enter the password digit by digit. The password is a three-digit number, ranging from 000-999. The factory default is 100.
2. If the wrong password is entered, re-enter the correct one. After three attempts to enter the correct password, a recovery screen will appear. The screen will display a serial number that can be used for password recovery. A password recovery service is available. Contact Limitorque service coordinator at (434) 528-4400.

Figure 4.4 – Password entry



4.3 New Password

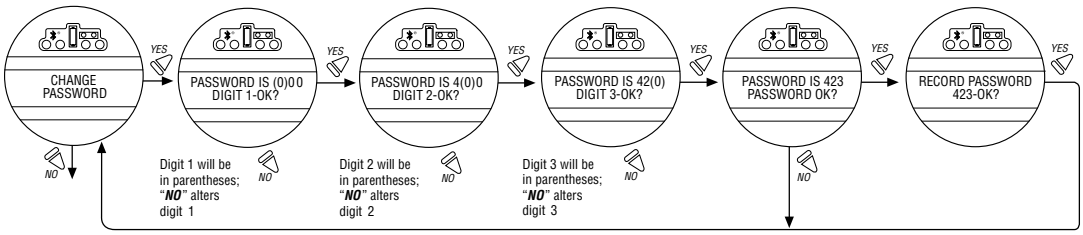
The password may be changed from the default of 100 to a customer-selected value as indicated in Figure 4.5.

The new password becomes effective as soon as the operator answers “YES” to the “RECORD PASSWORD?” display.

NOTE: Take care to record the new password in a secure location to ensure its retrieval in the future, yet prevent unauthorized access to the actuator “SETUP” routine.

If password protection is not required, the password may be set to “000.” The user will not be prompted to enter a password when the password is set to “000.”

Figure 4.5 – New password



4.4 Valve Setup

Valve setup enables the actuator to be changed to suit the type of valve that it is mounted on.

4.4.1 Close Direction

Default = CW to Close

The majority of valves require clockwise (CW) rotation of the actuator drive sleeve when viewed from above the actuator.

1. Engage manual override and check whether the valve closes with CW or CCW rotation of the handwheel.
2. Select “NO” until the required direction is displayed, then “YES.”

NOTE: If in doubt as to valve seating, consult the valve manufacturer.

NOTE: For torque seated valves, ensure that the “POSITION” limit is not set at “TORQUE” seat. It is recommended that the “POSITION” limit be set approximately one handwheel turn (360˚) in the opposite direction from the “TORQUE” seat.

4.4.2 Close Seating

Default = Position Seating

1. Configure the actuator to close on “TORQUE” limit for seating valve types such as wedge gate and globe.
2. Select “POSITION” limit for valve types such as ball, butterfly, plug, sluice gate, parallel slide, knife gate, and through conduit.
3. Select “NO” until the required seating is displayed.
4. Select “YES.”

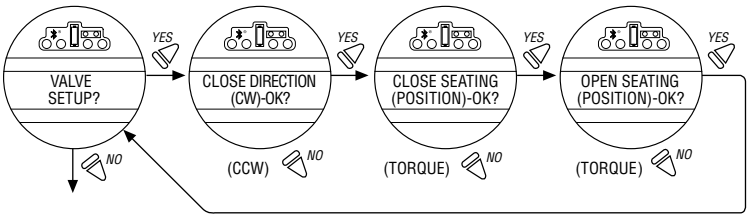
4.4.3 Open Seating

Default = Position Seating

The majority of valves, regardless of their construction, seat on position limit in the open direction. Some valves are “back-seating” and require torque limit in the open direction.

1. Select “NO” until the required seating is displayed.
2. Select “YES” to return to the “VALVE SETUP?” display.

Figure 4.6 – Valve setup



4.5 Operating Time

All QX units are shipped with default operating time values based on unit size. The different sized units each have a specific range of operating times:

- QX-1: 5-20 sec, default 15 sec
- QX-2: 8-30 sec, default 30 sec
- QX-3: 15-60 sec, default 60 sec
- QX-4: 30-120 sec, default 60 sec
- QX-5: 60-120 sec, default 60 sec

These times are based on a 90° open to close span. Consult factory for multi-turn times.

The operating time can be set as desired as follows:

1. From “CHANGE SETTINGS?”, select “YES” to enter the “CHANGE OPERATING TIME?” routine.
2. Select “YES” to change the opening operating time or “NO” to change the closing operating time.
3. When opening and closing operating times are set, select “NO” to return to the “CHANGE OPERATING TIME?” screen and then “NO” to move to the “VIEW TORQUE SETTINGS” screen.

4.6 Torque Setup

The output torque can be changed between 40% and 100% of the rated torque as follows:

1. From “VALVE SETUP?”, select “YES” to enter the “TORQUE SETUP?” routine.
2. Select “YES” to change the settings.

If “NO” is selected, the “POSITION SETUP?” routine will be entered.

4.6.1 Close Torque Valve or Open Torque Valve

The output torque from the actuator to close or open the valve may be configured between 40% and 100% of the rated torque (as stated on the actuator nameplate), in 1% increments (unless limited by the factory).

To Increase the % of Torque Required:

1. Select “NO” until the desired % is indicated.
2. Select “YES” to save the required torque.

Should the user select a maximum torque setting less than 100% due to valve or gearbox limitations, this selection can be password protected.

Figure 4.7 – Operating Time Setup

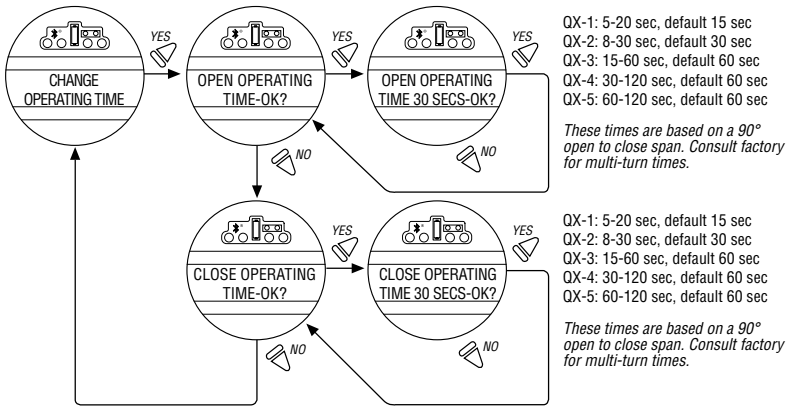


Figure 4.8 – Typical XP nameplate

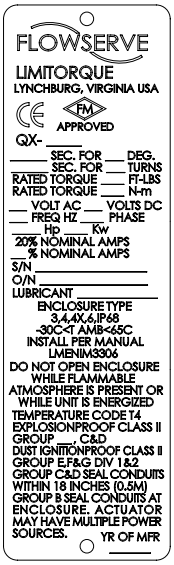
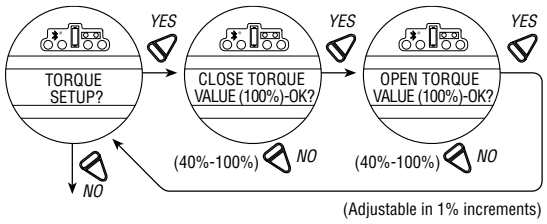


Figure 4.9 – Torque setup



4.7 Position Setup

Change Settings Menu. After successfully entering the password, answer “NO” to the Change Settings menu prompts until you reach the prompt “CHANGE POSITION SETUP?” Answer “YES.”

4.7.1 Set Position Limits for Electrical Operation

1. Set closed valve position. At the “CLOSE VALVE–OK?” prompt, move the red control knob to “LOCAL.” Hold the black control knob in the “CLOSE” position until the valve has reached the desired position. Move the red control knob to “STOP.”
2. Set the open valve position. At the “OPEN VALVE–OK?” prompt, move the red control knob to “LOCAL.” Hold the black control knob in the “OPEN” position until the valve has reached the desired position. Move the red control knob to “STOP.”
3. Inspect for correct operation. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running actuator electrically.

NOTE: For torque seated valves, ensure that the Position limit is not set at torque seat. It is recommended that the Position limit be set approximately one handwheel turn (360˚) in the opposite direction from the torque seat.

4.7.2 Set Position Limits for Manual Operation

1. Set close position. At “SET CLOSE POSITION LIMIT?” answer “YES.” At “CLOSE VALVE-OK?” depress declutch lever and slowly rotate handwheel until clutch is fully engaged. Release declutch lever; the clutch will stay in handwheel mode. If the valve is fully closed, move the handwheel one turn in the open direction to allow for coasting of the motor. When valve is in the desired location, select “YES.” At “SAVE CLOSE LIMIT-OK?” select “YES” to set the close position or “NO” to adjust the setting.
2. Set open position. At “SET OPEN POSITION LIMIT?” select “YES” to get “OPEN VALVE-OK?.” Engage the clutch (see step 1). Valve should be fully opened. Move the handwheel one turn toward the closed position to allow for coasting of the motor. When valve is in the desired location, select “YES” again to set the open position or “NO” to adjust the setting.
3. Checking the settings. Turn the handwheel and verify that the open and close LED’s function correctly (see Checking the Settings). If adjustments are necessary, select “NO” to return to “CHANGE POSITION SETUP?” and repeat from step 1.

Figure 4.10 – Electrical operation

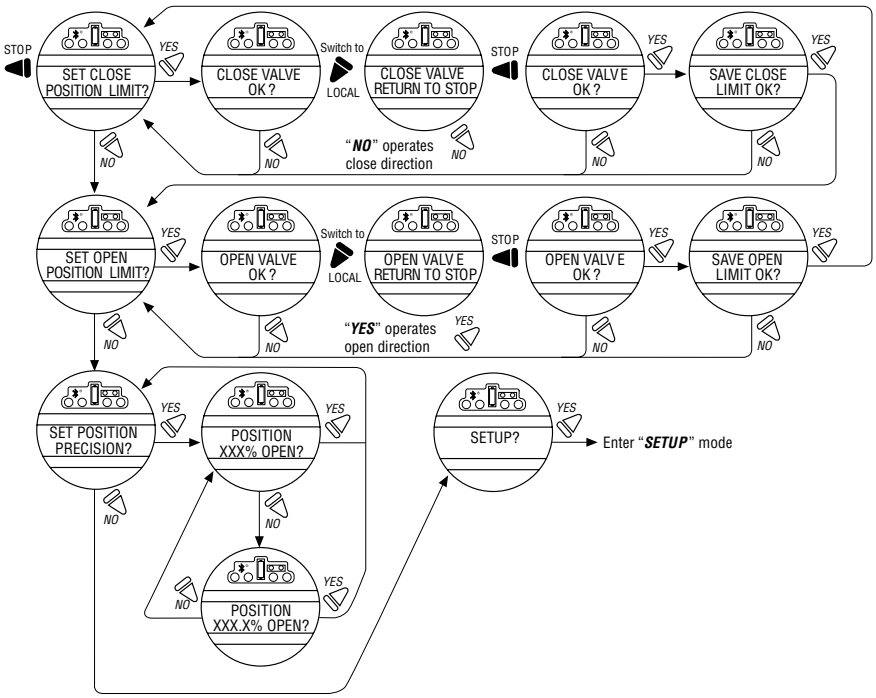
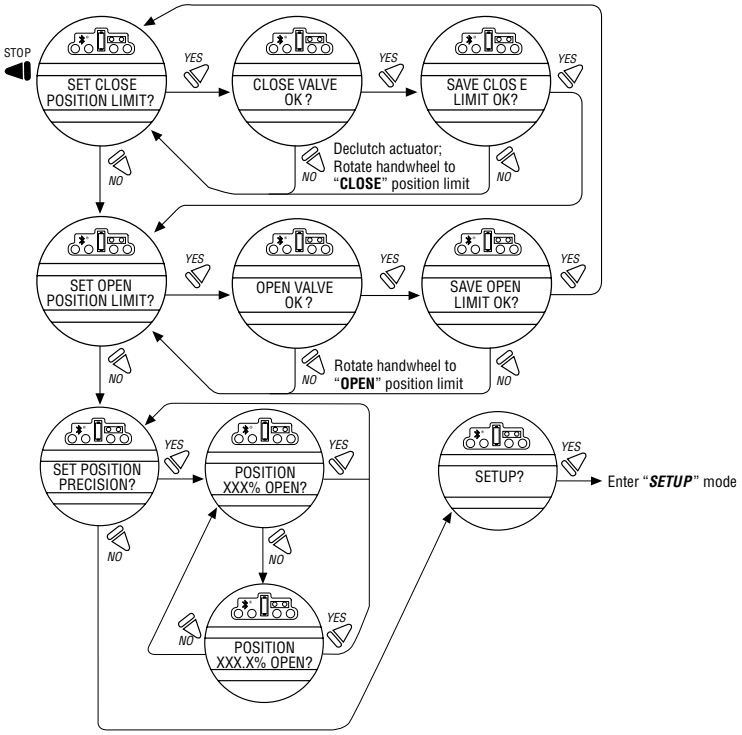


Figure 4.11 – Handwheel operation



4.8 Modutronic Option

The Modutronic option enables the actuator to be controlled via a milliamp input signal.

- If the Modutronic option has been purchased, it is automatically calibrated when position limits are set. No further adjustments are required, unless the defaults do not suit the application.
- If the Modutronic option has not been purchased, the screens for changing Modutronic will not be available. To add the Modutronic option, please consult Limitorque service at (434) 528-4400.

4.8.1 Status

Default = OFF

1. Select “NO” to change Modutronic status to “ON.” If “OFF” is selected, no further menus will be displayed.

4.8.2 Proportional Band

Proportional band is the range of errors between position and demand signal that will produce reduced speed (pulsing).

Default = 15%

To change from the default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

4.8.3 Fail Position

Fail position enables the customer to change the response of the actuator on loss of the milliamp signal.

Default = “CLOSE” Position

Fail position takes effect when the signal level falls below 2 mA or above 20.5 mA.

To Change the Default Position:
Select “NO” to choose whether the valve moves to “CLOSE” or

“OPEN” position, or “STOP” (stops) in its present position at the time of signal failure.

4.8.4 Deadband

Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To Change from the Default:
Select “NO” to adjust the value between 1% and 50%, in 1% increments to suit the application, or 0.1% to 50.0% if the position precision is set to XXX.X%.

4.8.5 Polarity (20 mA)

Polarity allows the user to change the valve position corresponding to the maximum milliamp value.

Default Setting is: 20 mA = Full Open

Select “NO” to select the required position of the valve that is to correspond to the maximum signal level of 20 mA.

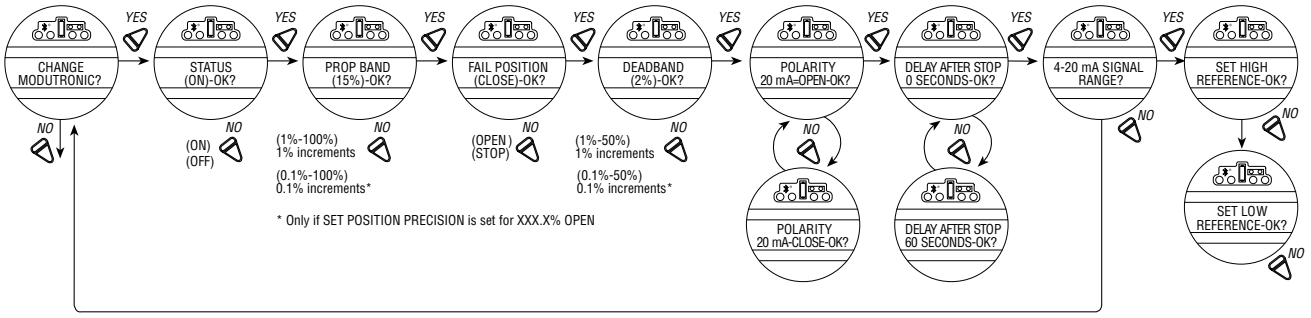
Choose between: 20 mA = Full Close or Full Open.

4.8.6 Delay After Stop

Default setting = 0 seconds

To change from the default setting, select “NO” to adjust the length of delay time after the actuator stops modulating. The delay after stop is adjustable from 0-60 seconds.

Figure 4.12 – Modutronic option



4.8.7 4-20 mA Signal Range

Signal range allows the user to change the signal range from the default range.

Default Setting is for High Reference = 20 mA (High Reference can also be scaled to some older 10-50mA instrumentation systems. A 166.66 Ohm resistor should be placed across the milliamp inputs when scaled from 10-50 mA.)

Default Setting for Low Reference = 4 mA

To change signal range (i.e. 4 mA-12 mA or 12 mA-20 mA or others) answer “YES.” Proceed from “SET HIGH REFERENCE” to “SET HIGH REFERENCE - OK?” A “YES” answer will require the use of a calibrator. If no, change to the signal range is required, answer “NO” and return to “CHANGE MODUTRONIC?” dialog.

4.8.8 Set High Reference

Default = 20 mA

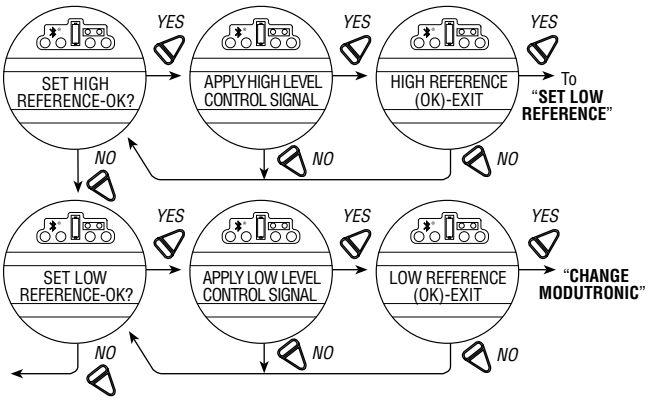
1. Select “NO” to accept pre-existing setting (no change).
2. Select “YES” to enter the display “APPLY HIGH LEVEL CONTROL SIGNAL.”
3. Apply this signal to terminal 28 and 39 indicated on the wiring diagram.
4. Select “YES” again to record this signal as the high reference. See Figure 4.12.

4.8.9 Set Low Reference

Default = 4 mA

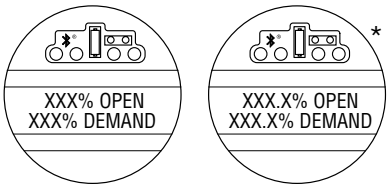
1. Select “NO” to move from “SET HIGH REFERENCE” to “SET LOW REFERENCE.”
2. Select “YES” to enter the display “APPLY LOW LEVEL CONTROL SIGNAL.”
3. Using a calibrator, apply the low signal, and select “YES” to record this signal as the low reference.

Figure 4.13 – Modutronic signals



4.8.10 Modutronic LCD Display

When the Modutronic option has been purchased, is set to "ON," and the red selector switch is in "REMOTE," the normal LCD display will read:



* If SET POSITION PRECISION is set to XXX.X% OPEN

XXX% Demand is the percentage value of the milliamp input signal.

4.9 DDC Option

DDC option enables the actuator to be controlled by an RS-485 serial communication signal. If the DDC option has been purchased, it is automatically enabled. The customer must set the DDC address.

NOTE: If the DDC option has not been purchased, the screens for changing DDC will not be available. To add the DDC option, please consult Limitorque service at (434) 528-4400.

The QX is equipped with the ability to hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, select "Multi-control mode" operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

4.9.1 Status

Default = ON

DDC Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

To Change from the Default Setting:
Select "NO" to switch DDC to "OFF." If "OFF" is selected, no further menus will be displayed.

4.9.2 Network Address

Default = 1

Network address allows user to assign a unique network address to an actuator.

1. The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network.
2. Select "NO" for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 250.

4.9.3 Protocol

Default = Modbus RTU 9600 Baud

Protocol changes the communication language/speed from the default to match the application.

To Change from the Default Language:
Select "NO" to choose between MODBUS, ASCII, or RTU, and the baud rate depending on the design of the DDC system. Refer to the contract documentation.

4.9.4 Analog Scale

Default = 0-100

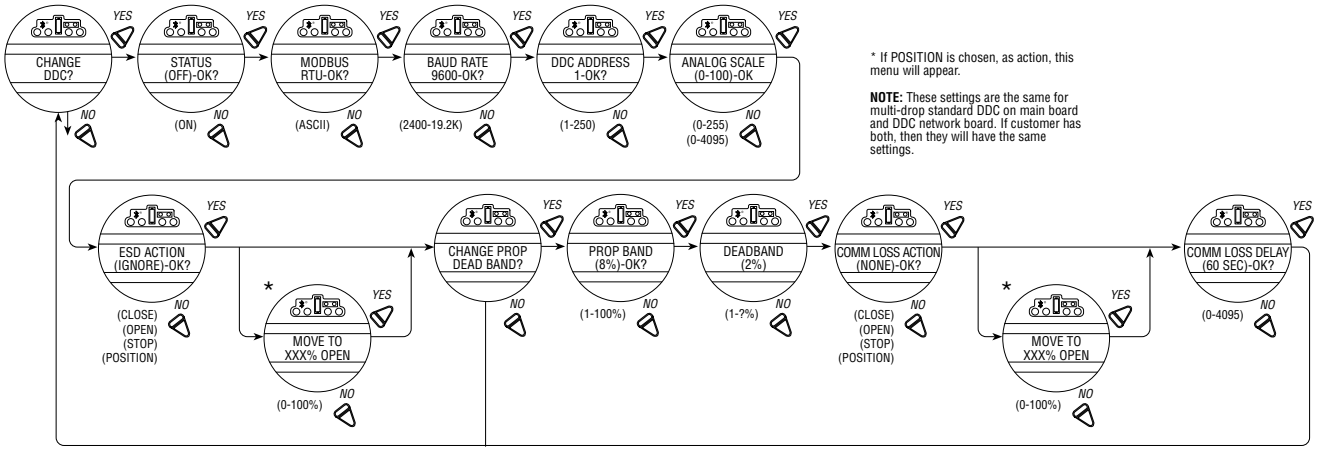
Analog scale allows the user to change the scaling of the analog input from the default.

To Change from the Default Range:
Select "NO" until the required scale is displayed. 0-255 and 0-4095 counts are available.

4.9.5 ESD Action

A network ESD function can be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to either ignore the command; Close, Open, Stop, or Position the actuator.

Figure 4.14 – DDC



4.9.6 Proportional Band

Proportional band is the range of errors between position and demand signal that will produce reduced speed (pulsing).

Default = 15%

To change from the default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

4.9.7 Deadband

Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To Change from the Default Range:
Select “NO” to adjust the value between 0.5% and 50%, in 0.5% increments to suit the application.

4.9.8 Offset

Default = 4 mA/20 mA

No options are available. Select “YES.”

0-10 VDC is available on all units shipped after 6/01/03.

4.9.9 Move To

If positioning is selected as an action, then the Move To dialog will appear. Position is configurable from 0-100%.

4.9.10 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 0-60 seconds.

4.9.11 Comm Loss Action

Default = None

The User may select what action the actuator should take when network communication is interrupted. This action is configurable as Close, Open, Stop, Position.

4.10 FF Option

FF option enables the actuator to be controlled by a Foundation Fieldbus communications signal. If the option has been purchased, it is automatically enabled. A Fieldbus System configuration tool must be used by the customer to set the FF address.

NOTE: If the FF option has not been purchased, the screens for changing FF will not be available. To add the FF option, please consult Limitorque service at (434) 528-4400.

The QX is equipped with the ability to hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, select “Multi-control mode” operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

4.10.1 Status

Default = ON

FF Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

4.10.2 Terminate Bus

Should a user select to make this unique actuator the termination point for the network, select “YES.” If not, then “NO.” Default is “NO.”

4.10.3 Analog Scale

Default = 0-100

Analog scale allows the user to change the scaling of the analog input from the default.

To Change from the Default Range:
Select “NO” until the required scale is displayed. 0-255 and 0-4095 counts are available.

4.10.4 ESD Action

A network ESD function can be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to either ignore the command; Close, Open, Stop, or Position the actuator.

4.10.5 OPEN/CLOSE Mode

Default = YES

To select operation as typically ”OPEN” or “CLOSE,” select “YES.” To select operation as position mode, select “NO.”

4.10.6 Proportional Band

Proportional band is the range of errors between position and demand signal that will product reduced speed (pulsing).

Default = 15%

To change from default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

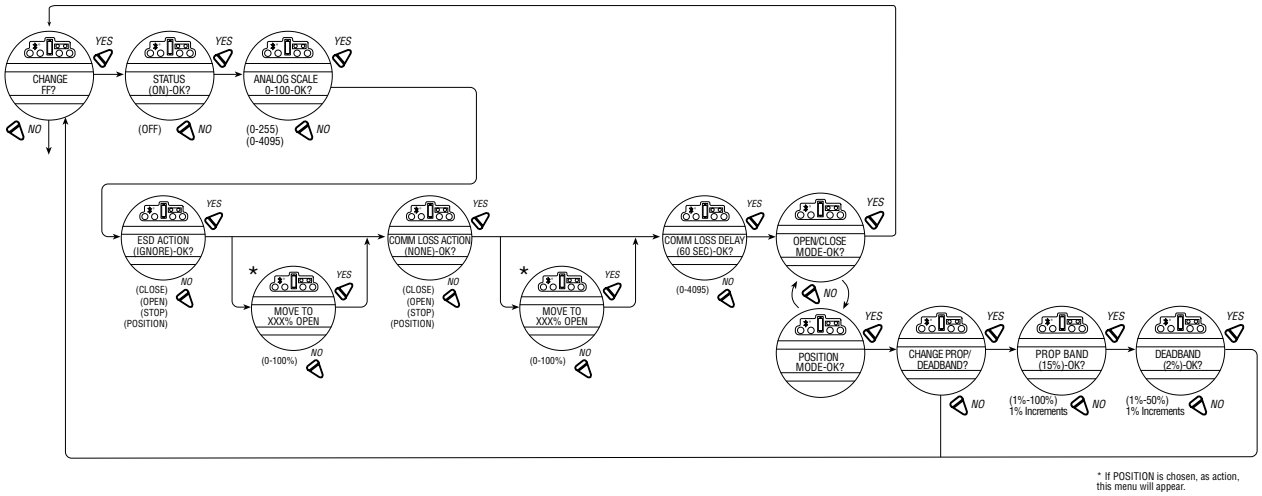
4.10.7 Deadband

Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To change from default, select “NO” to adjust the value between 1% and 50%, in 1% increments to suit the application.

Figure 4.15 – FF



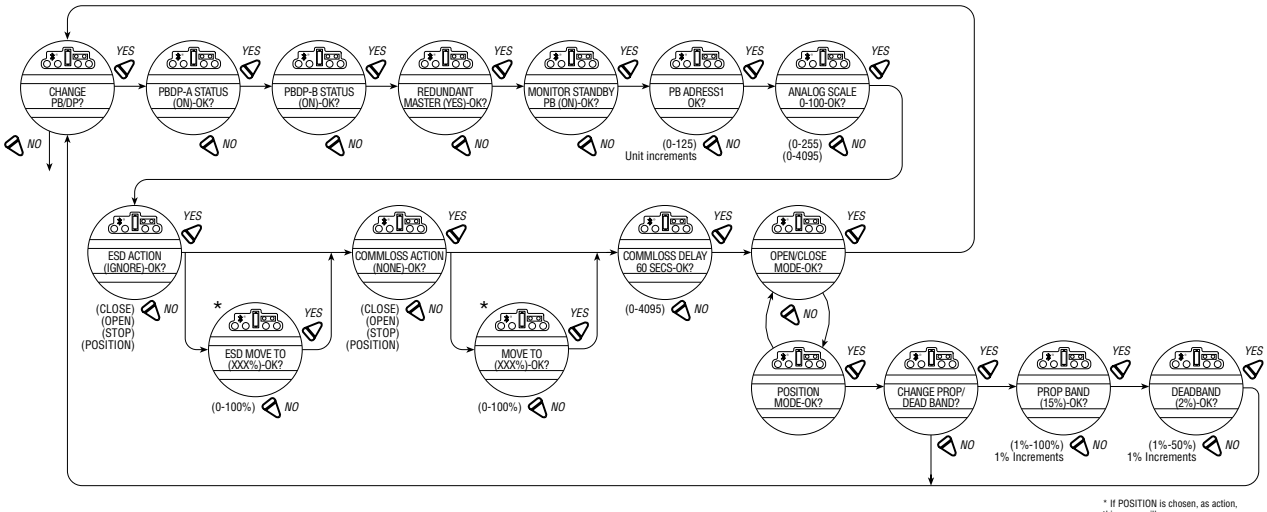
4.11 PB Option

PB option enables the actuator to be controlled by a Profibus communications signal. If the option has been purchased, it is automatically enabled. A Fieldbus System configuration tool must be used by the customer to set the PB address.

NOTE: If the PB option has not been purchased, the screens for changing PB will not be available. To add the PB option, please consult Limitorque service at (434) 528-4400.

The QX is equipped with the ability to either hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, then select “Multi-control mode” operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

Figure 4.16 – Profibus DP



4.11.1 Status

Default = ON

PB Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

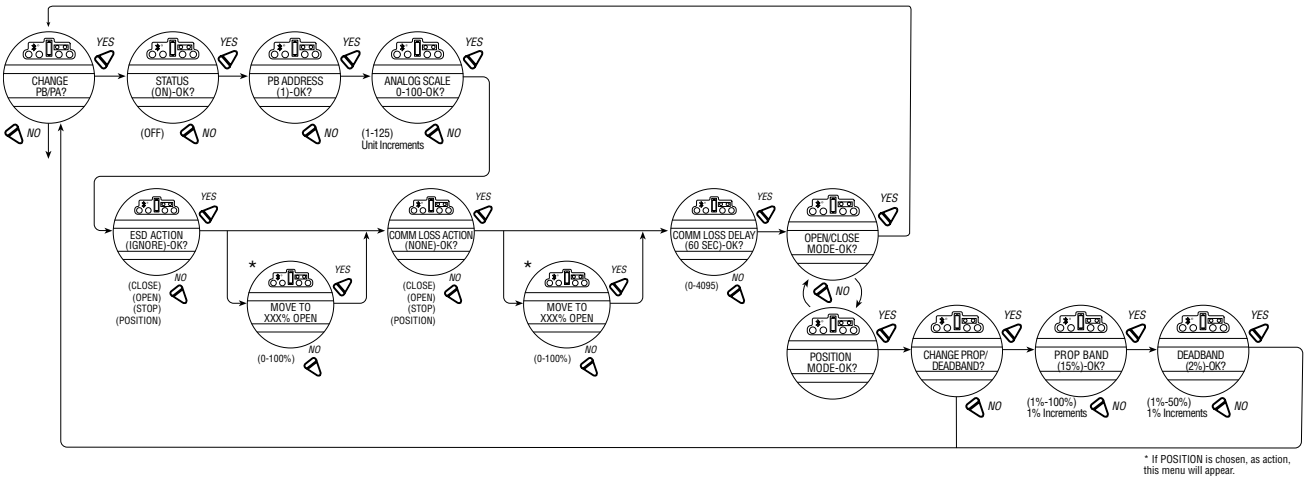
4.11.2 PB DP Operation

Figure 4.16 illustrates the setup sequence for the MX/QX PB DP field unit. For proper operation, either Position Mode or Open/Close Mode must be selected.

Follow these steps to enter and configure the setup mode:

1. Proceed through the Setup to the CHANGE PBDP? display.
2. Select YES to proceed to the PBDP-A STATUS (ON)-OK? display. PBDP-A Status enables the user to change from the default condition to turn on and off the digital control capability of the actuator.
3. Select YES to proceed to the PBDP-B STATUS (ON)-OK? display. PBDP-B Status enables the user to change from the default condition to turn on and off the redundant digital control capability of the actuator, if installed.
4. Select YES to proceed to the REDUNDANT MASTER (YES)-OK? display. Selecting REDUNDANT MASTER will allow for System Redundancy with two independent connections to Profibus masters. REDUNDANT MASTER must be set to NO for Flying Redundancy (single Profibus master connection).
5. If YES is selected, MONITOR STANDBY PB (ON)-OK? is displayed.
6. To allow the standby Profibus master to monitor the health of the actuator's standby PB DP board, select YES.
7. The unit will display PB ADDRESS 1–OK? If OK, select YES. If NO, select different address (1-125).
8. Select YES to proceed to the ANALOG SCALE display.
9. From ANALOG SCALE, if the default value of 0-100 is OK, select YES. If not, select NO.
10. If YES is selected, ESD ACTION (IGNORE) – OK? is displayed.
11. For ignoring ESD ACTION, select YES. For setting ESD ACTION, select NO. If POSITION is chosen as action, ESD MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.
12. If YES is selected, COMM LOSS ACTION (NONE) – OK? is displayed.
13. For no COMM LOSS ACTION, select YES. For setting COMM LOSS ACTION, select NO. If POSITION is chosen, as action, COMM LOSS MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.
14. If YES is selected, COMM LOSS DELAY (60 SEC) – OK? is displayed.
15. For a 60-second delay, select YES. Otherwise, select NO until the required value is displayed.
16. If YES is selected, OPEN/CLOSE MODE-OK? is displayed.
17. For OPEN/CLOSE MODE, select YES. For POSITION MODE, select NO. In position mode, the host device can set the valve position to any desired value; in OPEN/CLOSE MODE the host can only fully open or fully close the valve. The user must locally configure one of these two modes.
18. Proceed to configure the proportional band and deadband as discussed in the next sections.

Figure 4.17 – Profibus PA



4.12 DN Option

DN option enables the actuator to be controlled by a DeviceNet communications signal. If the option has been purchased, it is automatically enabled. A DeviceNet System configuration tool must be used by the customer to set the DN address.

NOTE: If the DN option has not been purchased, the screens for changing DN will not be available. To add the DN option, please consult Limitorque service at (434) 528-4400.

The QX is equipped with the ability to hardwire to digital inputs, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, select “Multi-control mode” operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

4.12.1 Status

Default = ON

DN Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

4.12.2 Baud Rate

Default = 125K Baud

Baud rate changes the communication speed from the default to match the application.

To Change from the Default Speed:
Select “NO” to choose between 125k, 250k, 500k baud rate depending on the design of the DN system. Refer to the contract documentation.

4.12.3 Network Address

Default = 1

Network address allows user to assign a unique network address to an actuator.

1. The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network.
2. Select “NO” for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 63.

4.12.4 Analog Scale

Default = 0-100

Analog scale allows the user to change the scaling of the analog input from the default.

To Change from the Default Range:
Select “NO” until the required scale is displayed. 0-255 and 0-4095 counts are available.

4.12.5 ESD Action

A network ESD function can be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to either “IGNORE” the network command; or Close, Open, Stop, Position the actuator.

4.12.6 Proportional Band

Proportional band is the range of errors between position and demand signal that will produce reduced speed (pulsing).

Default = 15%

To change from the default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

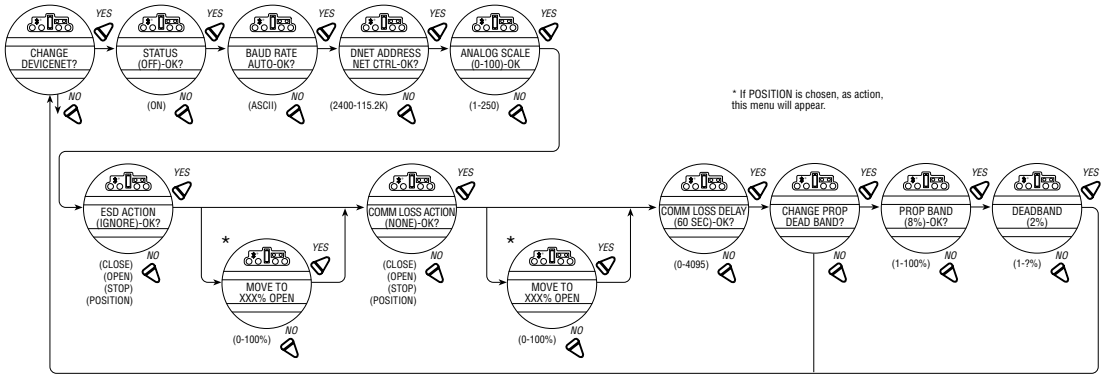
4.12.7 Deadband

Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To Change from the Default Range:
Select “NO” to adjust the value between 1% and 50%, in 1% increments to suit the application.

Figure 4.18 – DN Option



4.13 Status and Alarm Contacts

The status and alarm contacts permit wiring to existing contacts for visibility of operation or fault conditions. (See wiring diagram for contact ratings.)

The status contacts (S) and optional alarm contacts (R) may be configured to have any one of the following functions:

- "CLOSING" – valve closing
- "OPENING" – valve opening
- "STOPPED" – valve stopped in mid-travel
- "VALVE MOVING" – either direction
- "LOCAL SELECTED" – red selector knob in "LOCAL"
- "MOTOR OVERTEMP" – thermistor range exceeded
- "OVERTORQUE" – torque exceeded in mid-travel
- "MANUAL OVERRIDE" – actuator moved by handwheel
- "VALVE JAMMED" – valve can't move
- "CLOSE TORQUE SW" – torque switch trip at "CLOSED"
- "OPEN TORQUE SW" – torque switch trip at "OPEN"
- "LOCAL STOP/OFF" – red selector knob at "STOP"
- "LOST PHASE" – one or more of three phases lost
- "ESD SIGNAL" – signal active
- "CLOSE INHIBIT" – close inhibit signal active
- "OPEN INHIBIT" – open inhibit signal active
- "ANALOG IP LOST" – 4-20 mA not present
- "REMOTE SELECTED" – red selector in "REMOTE"
- "LIMIGARD ACTIVE" – (future—LimiGard™ functionality is not affected)
- "HARDWARE FAILURE" – indication
- "NETWORK CONTROLLED" – permits relay control via DDC, FF, or other network driver
- "CLOSE" – valve closed "(0% OPEN)"
- "OPEN" – valve open "(100% OPEN)"
- "MID-TRAVEL" – valve position, 1-99% open
- "CSE CONTROL" – CSE station in LOCAL or STOP and controls actuator

4.13.1 Status and Alarm Contact Default Settings

All actuators are supplied with the following status or alarm (optional) contact default factory settings:

Status Contacts

S1a – Normally closed contact at valve fully Close

S1b – Normally closed contact at valve fully Open

S2a – Normally open contact at valve fully Close

S2b – Normally open contact at valve fully Open

Alarm Contacts (Optional/requires I/O board)

R1 – Normally closed contact at valve fully Close

R2 – Normally closed contact at valve fully Open

R3 – Normally open contact at valve fully Close

R4 – Normally open contact at valve fully Open

R5 – Motor Overtemp

R6 – Remote Selected

R7 – Overtorque

R8 – Analog I/P (Input)

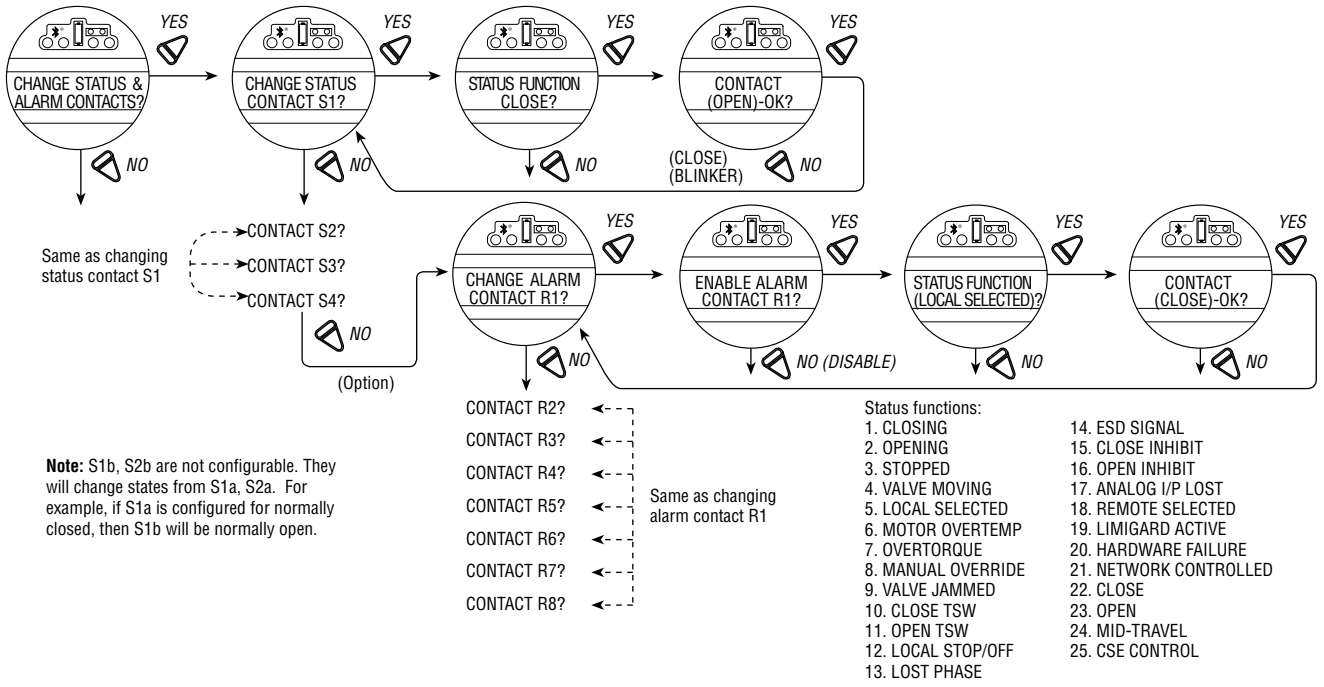
To change any of the default settings:
Select "CHANGE STATUS & ALARM CONTACTS?" from the "SETUP" routine.

Select "YES" to enter the "SETUP" routine for each individual contact. Select "NO" until the particular contact is referenced in the display, then "YES" to make the changes.

4.13.2 Status Function

Toggle "NO" through the range of functions, as listed, until the desired feature is displayed.

Figure 4.19 – Status and alarm contacts (Shown with optional boards added)



4.13.3 Contact

This mode allows the user to select the state of the contact when the function is active. Select "NO" to choose whether the contact is required to be normally closed, normally open, or blinker when the function is active. When "Blinker" has been selected, the contact will switch automatically between open and close (1 second open/1 second close).

4.13.4 Valve Position

This display will appear only if the function "MID-TRAVEL POSITION" has been selected. Toggle "NO" until the display indicates the required value of percentage "OPEN" at which the contact should trip. If the contact has been selected as normally closed, then it will close when the trip point has been reached, with the actuator moving in the open direction.

NOTE: Status contacts (S) and optional alarm (R) contacts are latching type and will remain in their last set position in the event of a main power supply failure.

4.14 Two-speed Timer (Optional)

The optional two-speed timer extends the operating time of the actuator, in the closing and/or the opening direction, by pulsing the motor ON and OFF. Pulsing may be applied to full valve travel or only a part of it. The ON and OFF pulse times are adjustable.

1. Select “CHANGE 2-SPEED TIMERS?”
2. Select “YES” to enter the “CHANGE OPEN TIMER?” routine.
3. If slow opening is required, select “YES;” otherwise select “NO” to move into the “CHANGE CLOSE TIMER?” routine.

4.14.1 Status

Select “NO” to switch the timer ON or OFF. If OFF, no further menus will be displayed.

4.14.2 Start Position

If the Close or Open timer has been switched ON, pulsing will start when the set point is reached in the selected direction and the actuator will continue pulsing until the valve reaches the desired “STOP” position.

Select “NO” until the display indicates the required value of percentage OPEN at which the pulsing should start. Adjustable in 1% increments as listed:

Closing = 0% to 99%. Opening = 1% to 100%.

4.14.3 Stop Position

If the Close or Open timer has been switched ON, pulsing will commence as the valve moves out of its close position and the actuator will continue pulsing until stopped at the set point.

Select “NO” until the display indicates the required value of percentage open at which the pulsing should stop. Adjustable in 1% increments as listed:

Closing = 0% to 99%. Opening = 1% to 100%.

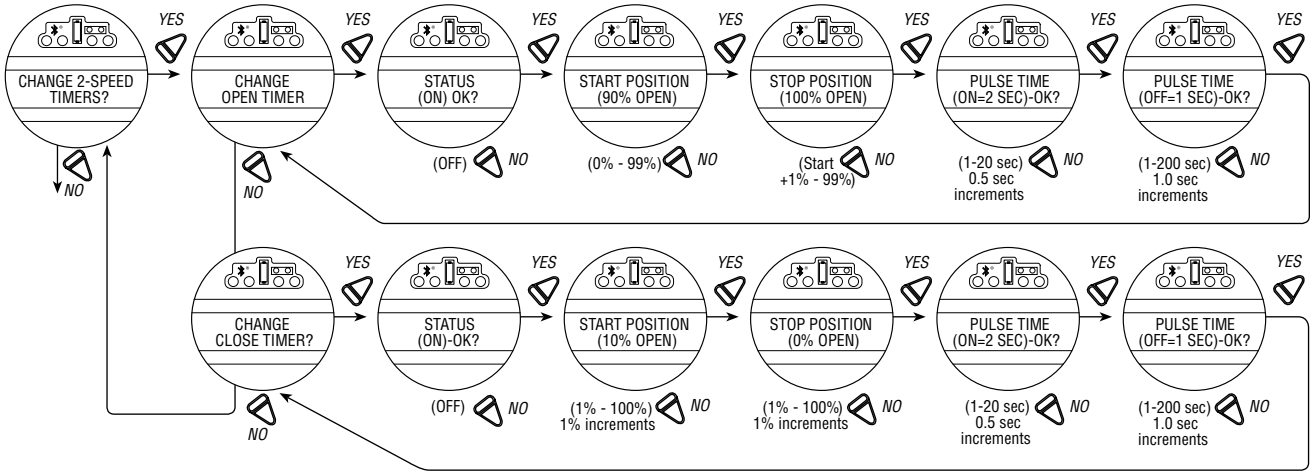
4.14.4 Pulse Time – ON

This mode allows user to change the ON pulse time from the default setting.

Default Setting = 2.0 Second

Select “NO” until the required length of ON pulse is displayed. Adjustable between 1 and 20 seconds, in 0.5 second increments.

Figure 4.20 – Two-speed timers



4.14.5 Pulse Time – OFF

This mode allows user to change the OFF pulse time from the default setting.

Default Setting = 1 Second

Select “NO” until the required length of OFF pulse is displayed. Adjustable between 1 and 200 seconds, in 1.0 second increments.

4.15 Change Analog Out

The QX offers an optional, configurable analog output feedback signal. The User may select between APT (Analog Position Transmitter) or ATT (Analog Torque Transmillter) functionality. Each selection is defined below.

Figure 4.21 – Change Analog Out

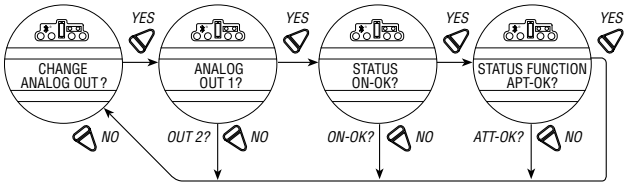


Figure 4.22 – Change Analog Out Voltage – APT

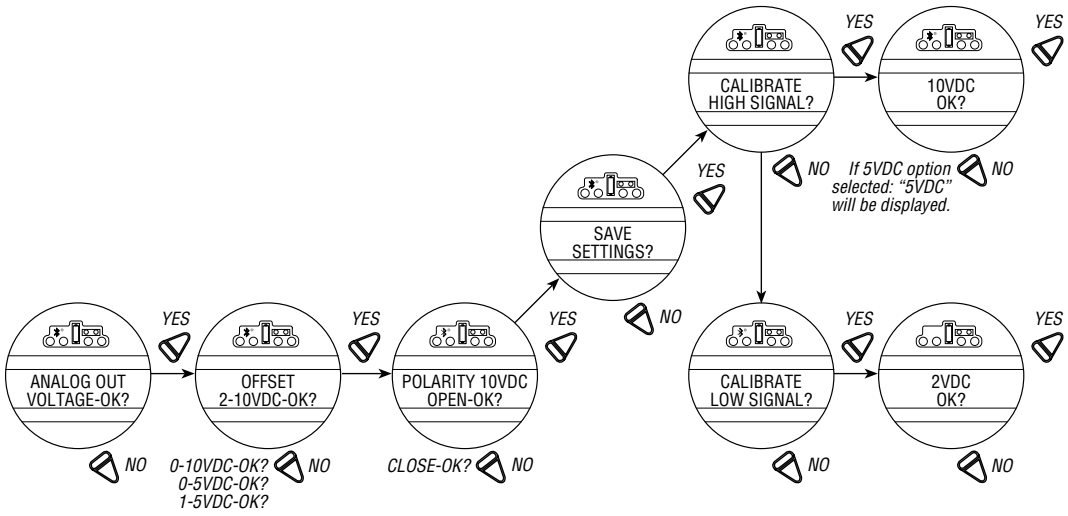


Figure 4.23 – Change Analog Out Current – APT

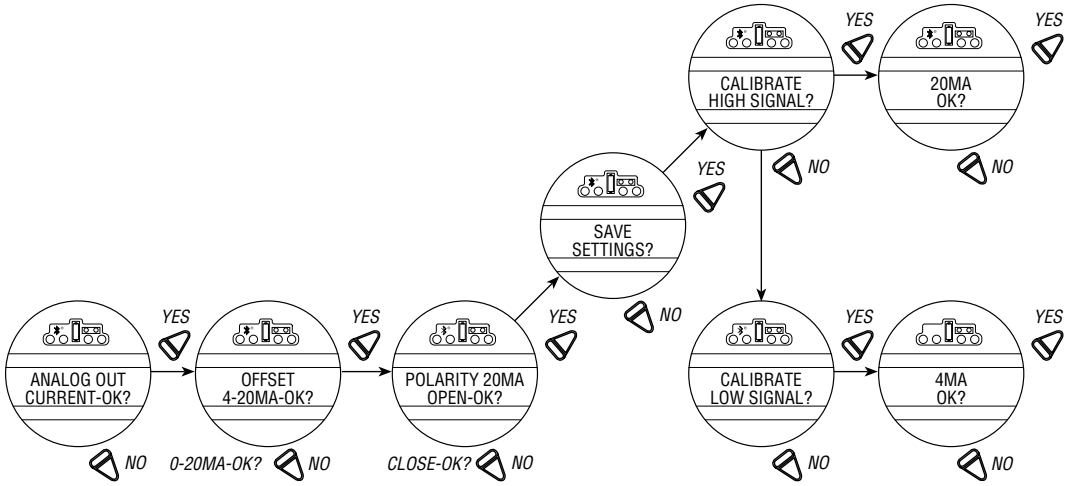


Figure 4.24 – Change Analog Out Voltage – ATT

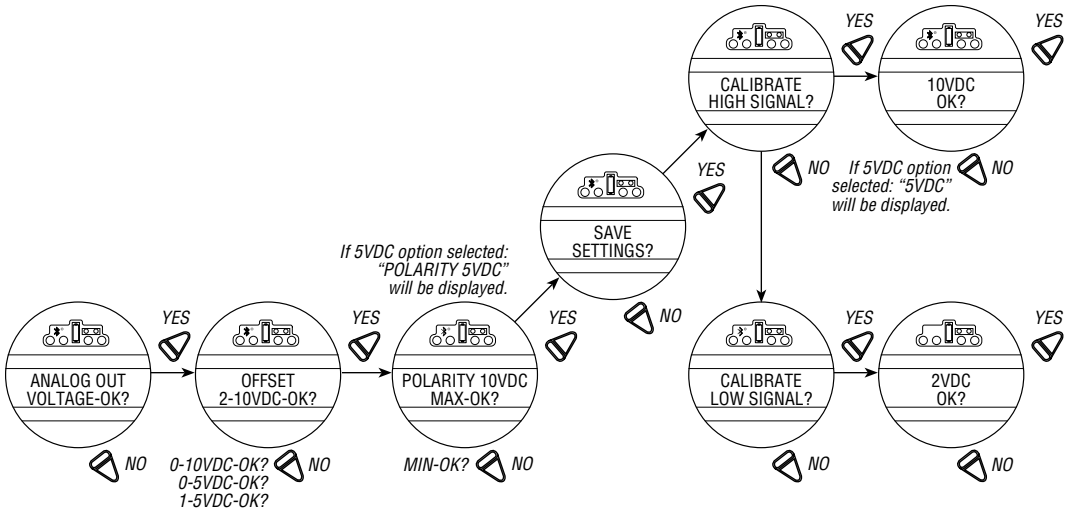
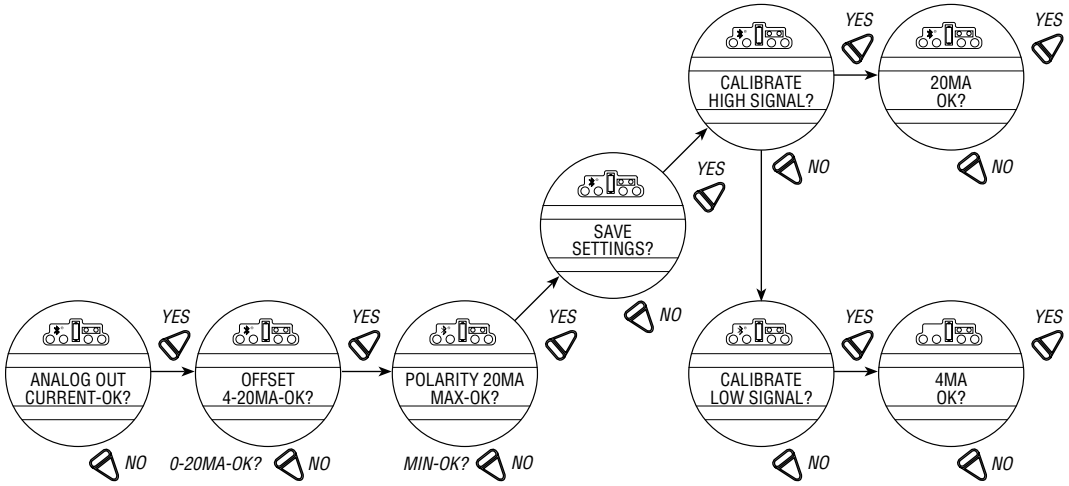


Figure 4.25 – Change Analog Out Current – ATT



4.15.1 APT Polarity Option

The APT option provides a 4-20 mA feedback signal proportional to valve position. APT is connected at terminals 17 and 18 for 4-20 mA output. Consult actuator wiring diagram for details.

NOTE: If the second analog out option is turned ON but this option was not purchased, the display will show a hardware fault. An optional I/O board is required for this option. To purchase, please contact Limitorque service coordinator at (434) 528-4400.

During position limit calibration (see Section 3.6.4, Setting Position Limits) the APT is automatically calibrated to default settings: Default = 20 mA OPEN, 4 mA CLOSE.

To Customize the Settings:

1. Select “CHANGE APT?” from the “SETUP” routine. Select “YES.”
2. Select “NO” to select the status if OFF. If ON, select “YES” to enter the “Status Function APT?” display. Select “NO” to select ATT display.
3. Select “NO” to select 4 ma/0 VDC2. Select “YES” to enter the “POLARITY” display.
4. Select “NO” to choose between:

   20 mA = OPEN

   or

   20 mA = CLOSE

   OR

5. Select “NO” to recalibrate new value (low end 3.4-4.5 mA; high end 19.5-21 mA) as shown on meter. New value will not be shown on display.

4.15.2 ATT Polarity Option

The ATT option provides a 4-20 mA signal proportional to actuator output torque and is for reference only. The signal range is from approximately 40% of rated torque to approximately 100% rated torque. This option is connected at terminals 17 and 18 for 4-20 mA output. Consult the actuator wiring diagram for details.

NOTE: If the second analog out option is turned ON but this option was not purchased, the display will show a hardware fault. An optional I/O board is required for this option. To purchase, please contact Limitorque service coordinator at (434) 528-4400.

To Customize the Settings:

1. Select "CHANGE ATT?" from the "SETUP" routine, then "YES" to select ATT status as "ON" or "OFF."
2. Select "NO" to select the status if OFF. If ON, select "YES" to enter the "Status Function?" display. Select "NO" to select ATT display.
3. Select "NO" to select 4 ma/0 VDC2. Select "YES" to enter the "POLARITY" display.
4. Select "NO" to choose between:

   20 mA = OPEN

   or

   20 mA = CLOSE

   OR

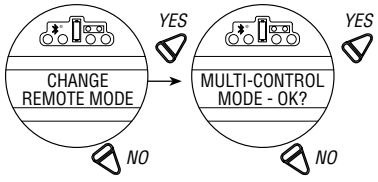
5. Select "NO" to recalibrate new value (low end 3.4-4.5 mA; high end 19.5-21 mA) as shown on meter. New value will not be shown on display.

4.16 Remote Mode

Remote mode permits a User to select from multiple remote control permissions, or isolate remote control to a single control selection:

- Multi Control mode (default): permits up to three discrete remote inputs: There are three modes of remote control for the QX actuator allowed when the remote mode is configured for multi-control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog control operation in initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog signal.
- Digital Control Only: the unit will operate only upon the last digital input command received.
- Network Control Only: the unit will operate only upon the last network command received.
- Analog Control only: the unit will operate only upon the last analog input command received.

Figure 4.26 – Remote Mode



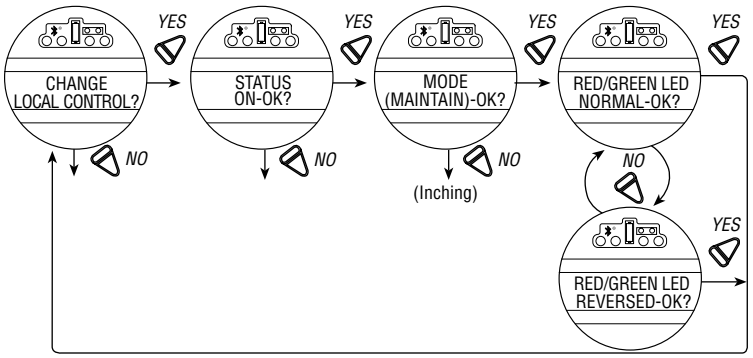
4.17 Local Control

"LOCAL CONTROL" mode changes how the local control switches and display are used from the default settings.

Default = On & Maintain Mode

NOTE: User may select to disable the LOCAL CONTROL, which prohibits the cycling of the QX from OPEN to CLOSE or REVERSE. The LOCAL-STOP-REMOTE knob still functions, which permits the user to re-enter set-up and turn the LOCAL CONTROL back to "ON."

Figure 4.27 – Local control



- Maintain mode: the unit will operate continually in either direction when the black knob is actuated and released, until the position of the black knob is changed or the red knob is changed from "LOCAL" to either "STOP" or "REMOTE."
- Inching mode: the unit will operate only when the black knob is held in the open or close position. If the black knob is released, the unit will stop.

To Customize the Settings:

1. Select "CHANGE LOCAL CONTROL?" from the "SETUP" routine.
2. Select "YES" to enter the mode display.
3. Select "NO" to change from Maintain to Inching control.

4.17.1 LED Customization

This selection allows the customer to reverse the colors of the LED in open and close mode from the default setting.

Default = Red-Open/Green-Close

1. After mode selection, select "YES" to change the colors of the LEDs.
2. Select "NO" to change from the default to Red-Close/Green-Open.

4.18 ESD (Emergency Shutdown) Overrides

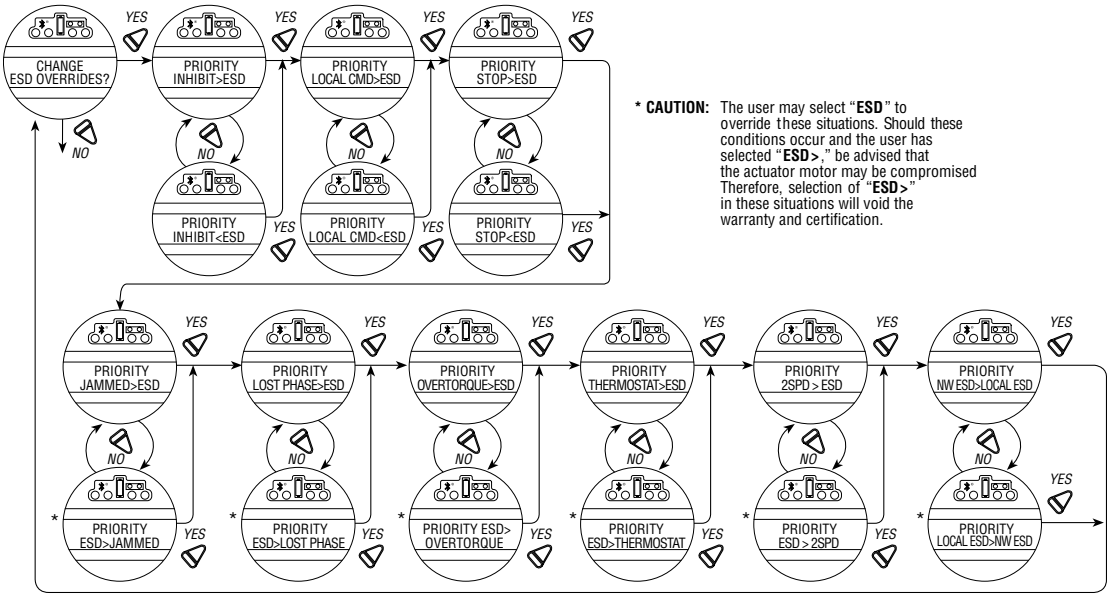
An external contact may be used to place the actuator in emergency shutdown mode. An ESD contact may be connected to the actuator to override existing command signals and send the valve to a predetermined position.

The ESD Action and Signal presence is selected in Section 4.19, Inputs. The default ESD input = Input 0., pt. 30 on wiring diagram.

4.18.1 ESD Override

It may be desirable that ESD override other events. These events are selectable. The ">" symbol after ESD indicates that ESD will override that particular event. Sections 4.18 - 4.24, Inputs through Motor Thermostat list the choices.

Figure 4.28 – ESD Overrides



4.18.2 Inhibit

Default = INHIBIT>ESD

To Customize the Settings:
Select "NO" to choose:

- "ESD>INHIBIT" – ESD overrides active inhibit signal
- "INHIBIT>ESD" – Active inhibit signal will override ESD

NOTE: Removing the wires to these terminals can disable active inhibits.

4.18.3 Local Command

Default = LOCAL>ESD

To Customize the Settings:
Select "NO" to choose:

- "ESD>LOCAL" – ESD overrides local command to operate actuator
- "LOCAL>ESD" – Local command to operate actuator overrides ESD

4.18.4 Stop

Default = STOP>ESD

To Customize the Settings:
Select "NO" to choose:

- "ESD>STOP" – ESD overrides stop command
- "STOP>ESD" – Stop command overrides ESD

4.18.5 Jammed Valve*

Default = JAMMED VALVE>ESD

To Customize the Settings:
Select "NO" to choose:

- "ESD>JAMMED VALVE" – ESD overrides jammed valve indication
- "JAMMED VALVE>ESD" – Jammed valve indication overrides ESD (default)

** See CAUTION on Figure 4.28.*

4.18.6 Lost Phase*

Default = LOST PHASE>ESD

To Customize the Settings:
Select "NO" to choose:

- "ESD>LOST PHASE" – ESD overrides lost phase indication
- "LOST PHASE>ESD" – Lost phase indication overrides ESD

** See CAUTION on Figure 4.28.*

4.18.7 Overtorque*

Default = OVERTORQUE>ESD

To Customize the Settings:
Select "NO" to choose:

- "ESD>OVERTORQUE" – ESD overrides overtorque situation
- "OVERTORQUE>ESD" – Overtorque situation overrides ESD

** See CAUTION on Figure 4.28.*

4.18.8 Motor Thermostat

Default = ENABLED

To Customize the Settings:
Select "NO" to choose:

- "ESD >THERMOSTAT" – ESD overrides Motor Thermostat tripped
- "THERMOSTAT > ESD" – Motor Thermostat tripped overrides ESD

NOTE: Disabling the motor thermostat voids all third party certifications including Factory Mutual, CSA, ANZex, and ATEX. Disabling the motor thermostat removes protection from overheating the motor and may cause unsafe conditions.

4.18.9 Two-Speed Timer

Default = 2 speed timer > ESD

To customize the settings select "NO" to choose:

ESD > 2SPD – ESD overrides two- speed timer

4.18.10 Network ESD

Default = Local ESD > NW ESD

To customize this setting, select “NO” to choose NW ESD > Local ESD.

4.19 Inputs

The User can select up to 3 Inputs (0, 1, 2) and configure them to perform these functions:

- ESD
- Inhibits
- User defined
- CSE

NOTE: Input 0 Default: The default for input 0 will be ESD, signal present, disabled, and ignore.

Input 1 Default: The default for input 1 will be open inhibit, signal present, and disabled.

Input 2: The default for input 2 will be close inhibit, signal present, and disabled.

The inputs will be the same as in previous versions of software. If a firmware upgrade is done from a previous version that did not have configurable inputs, to the later version that does, then the users settings will remain the same.

4.19.1 Input Standard Remote Control

The actuator may be controlled remotely by two, three, or four wires, depending on the connections made in the terminal compartment of the actuator. Configuration is required during actuator setup.

This setting allows the user to change the mode of remote control from the default setting:

Default = Three-wire Maintain Control

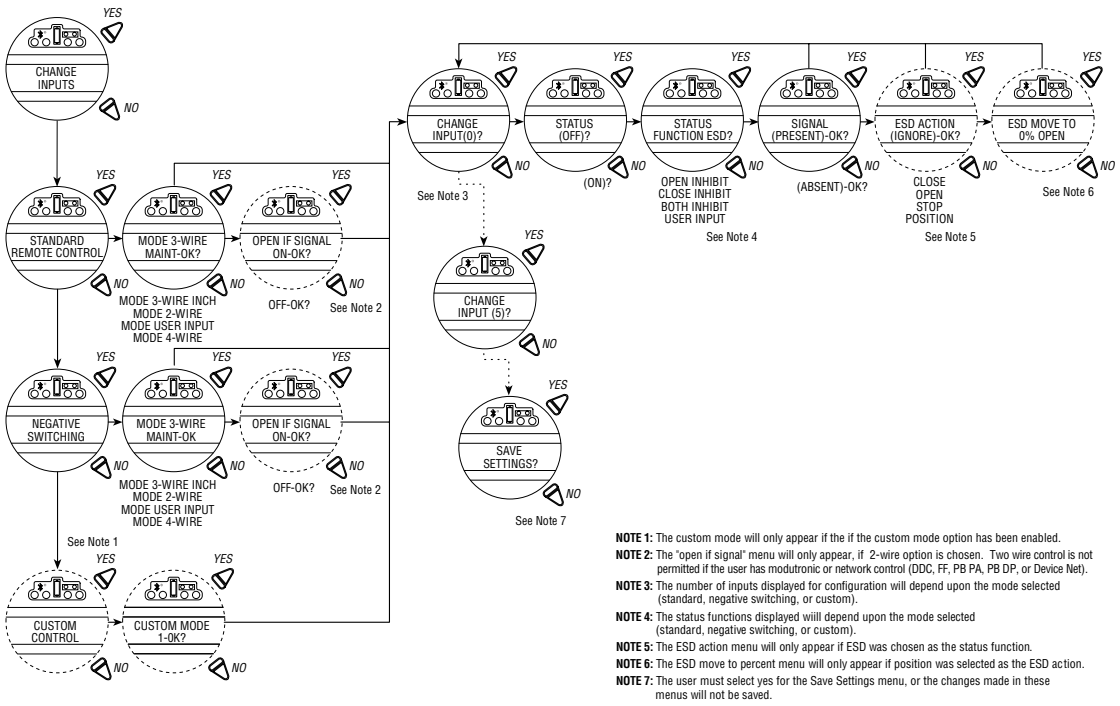
1. Select “CHANGE REMOTE CONTROL?” from the “SETUP” routine.
2. Select “YES” to enter the display that indicates the type of remote control selected.
3. Select “NO” until the required control is displayed. The selections available are:
   - Three-wire Maintain Control (default except Modutronic)
     Requires two maintained contacts for self-maintained control in OPEN or CLOSE direction.
   - Three-wire Inching Control
     Requires two momentary contacts to OPEN or CLOSE the valve, or STOP it in mid-travel.
   - Two-wire Control
     Requires one NO or NC contact. Select “YES” for either.
     Valve OPENS if signal “ON.”
     or
     Valve OPENS if signal “OFF.”
   - Four-wire Control

4.19.2 Status

Default Setting is: OFF

Select “NO” to choose whether the inhibit is “ON” or “OFF.”

Figure 4.29 – Inputs



NOTE 1: The custom mode will only appear if the if the custom mode option has been enabled.
NOTE 2: The “open if signal” menu will only appear, if 2-wire option is chosen. Two wire control is not permitted if the user has modutronic or network control (DDC, FF, PB PA, PB DP, or Device Net).
NOTE 3: The number of inputs displayed for configuration will depend upon the mode selected (standard, negative switching, or custom).
NOTE 4: The status functions displayed will depend upon the mode selected (standard, negative switching, or custom).
NOTE 5: The ESD action menu will only appear if ESD was chosen as the status function.
NOTE 6: The ESD move to percent menu will only appear if position was selected as the ESD action.
NOTE 7: The user must select yes for the Save Settings menu, or the changes made in these menus will not be saved.

4.19.3 Custom Input Mode – Momentary ESD/PSESD (Optional)

Custom software is available for the QX that permits the User to establish certain performance characteristics for partial stroke (PS) testing and momentary contact closure ESD.

Note: these three inputs are normally configurable. However, when this custom mode is enabled, they are set to the predefined configuration and cannot be changed by the customer.

Input 0 (normal default – ESD) terminal 30:

- Set as disabled, user input function, signal present

Input 1 (normal default – Open Inhibit) terminal 34:

- Set as enabled, partial stroke enable function, signal present = active

Input 2 (normal default – Close Inhibit) terminal 35:

- Set as enabled, partial stroke enable function, signal absent = active

The partial stroke enable signals are setup as redundant signals for safety. There are two signal inputs, and BOTH must be in the active state. If the partial stroke enable inputs are in the active state, and an input is detected (>800 ms) on the momentary ESD/PSESD input, then a partial stroke ESD test will be run. If the partial stroke enable inputs are not active or in a fault state, and an input is detected on the momentary ESD/PSESD input, then the ESD will be latched in and the actuator will perform ESD until the ESD Release is given.

NOTE: these three inputs are the normal open-close-stop inputs. When this custom mode is enabled, they are set to the predefined configuration and cannot be changed by the customer. The only change the customer can make is to set the momentary ESD action (if action is position – then also the target value for the ESD) and the partial stroke target value.

Input 3 (normal default – stop) terminal 26:

- Set as enabled, ESD release function, signal absent = active

Input 4 (normal default – open) terminal 25:

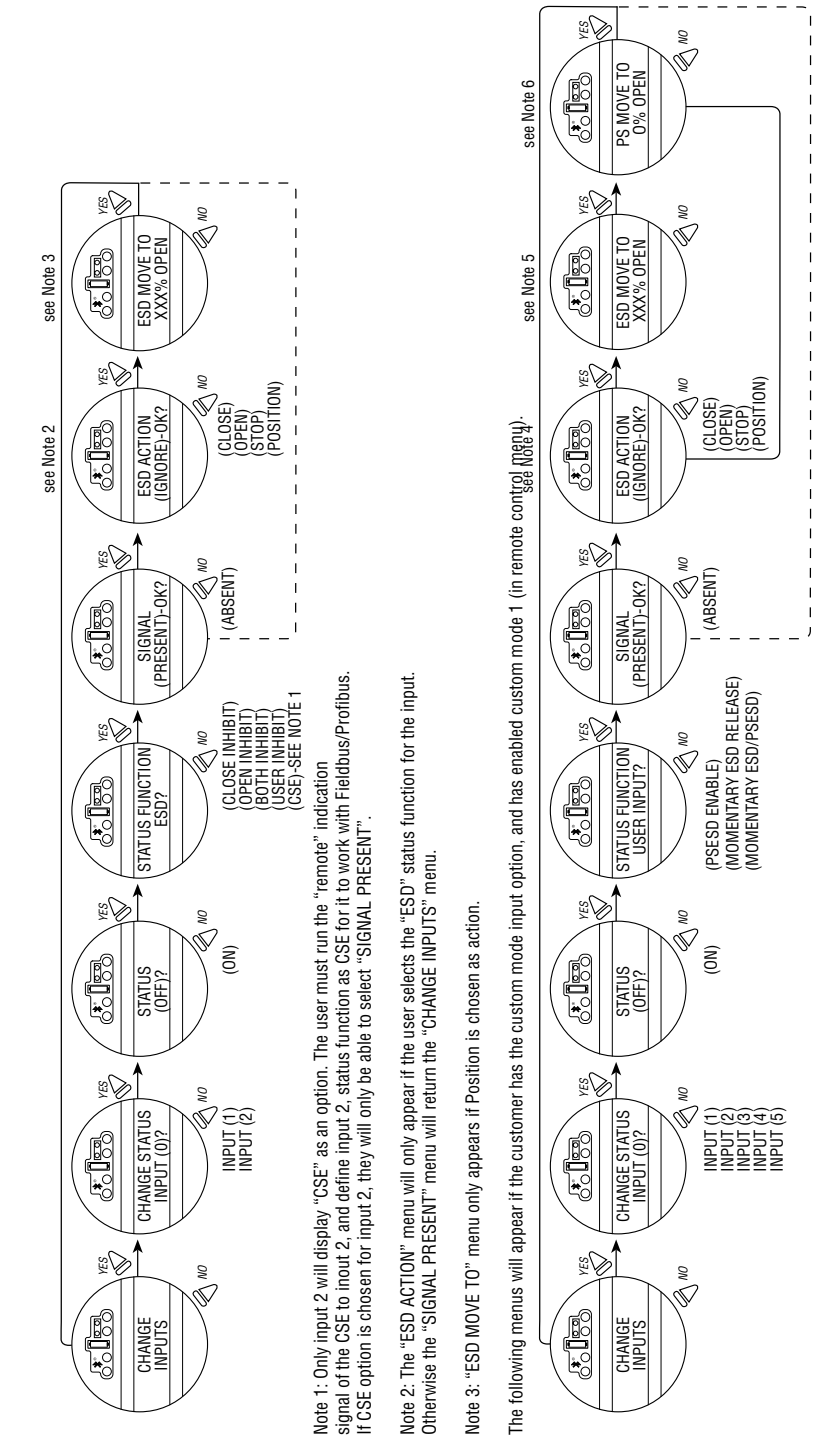
- Set as enabled, ESD Release function, signal present = active

Input 5 (normal default – close) terminal 27:

- Set as enabled, momentary ESD/PSESD function, signal present > 800 ms = active, ESD action = Close, partial stroke target position = 0% open

The ESD release signals are setup as redundant signals for safety. There are two signal inputs, and BOTH must be in the active state. If there is an active ESD and both ESD release inputs are in the active state, the ESD will be unlatched and the unit will return to normal operation. If the ESD release inputs are in a fault state, an active ESD will NOT be released. The ESD release inputs will have no effect on a partial stroke ESD test. The momentary ESD/PSESD input will be ignored if there is a signal present for less than 100 ms, and is guaranteed to latch in the ESD/PSESD if the signal is present for greater than 800 ms. Once the ESD is latched in, the unit will perform the ESD action. In this case the ESD will move the unit to the close limit and remain in ESD mode until the ESD release indication is given using the ESD release inputs.

Figure 4.30 – Custom Input Mode



Note 1: Only input 2 will display "CSE" as an option. The user must run the "remote" indication signal of the CSE to inout 2, and define input 2, status function as CSE for it to work with Fieldbus/Profibus. If CSE option is chosen for input 2, they will only be able to select "SIGNAL PRESENT".

Note 2: The "ESD ACTION" menu will only appear if the user selects the "ESD" status function for the input. Otherwise the "SIGNAL PRESENT" menu will return the "CHANGE INPUTS" menu.

Note 3: "ESD MOVE TO" menu only appears if Position is chosen as action.

The following menus will appear if the customer has the custom mode input option, and has enabled custom mode 1 (in remote control menu).

Note 4: The "ESD ACTION" menu will only appear if the status function for the input is "MOMENTARY ESD/PSESD". Otherwise the "SIGNAL PRESENT" menu will return to the "CHANGE INPUTS" menu.

Note 5: The "ESD MOVE TO" menu only appears if position is chosen as action .

Note 6: "PS MOVE TO" menu only appears if the status function of the input is "MOMENTARY ESD/PSESD".

The user will only be able to change the ESD ACTION (and ESD MOVE TO target if ESD action is position, and the PS MOVE TO settings when in this special custom mode 1. Following are the preconfigured settings for each input.

Input 0: off, user input, signal present
Input 1: off, psesd enable, signal present
Input 3: on, momentary esd release, signal present
Input 4, on, momentary esd release, signal present
Input 5: on, momentary esd/psesd. signal present, esd action close, ps move to target 0%

Table 4.1 – Digital Input Terminals

Standard Control											
Mode	**Input 0**	**Input 1**	**Input 2**	**Input 3**	**Input 4**	**Input 5**
2-wire	configurable	configurable	configurable	not used	open	not used
3-wire inch	configurable	configurable	configurable	not used	open	close
3-wire maint	configurable	configurable	configurable	not used	open	close
4-wire	configurable	configurable	configurable	stop	open	close
User Input	configurable	configurable	configurable	user input	user input	user input
Terminal connections						
Input 0		Input 1		Input 2		Input 3		Input 4		Input 5	
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC
30	32 or 33	34	29 or 31	35	29 or 31	26	28	25	28	27	28
Jumpers can be used to connect the digital commons as need. 28 to 29, 31 to 32, 33 to VDC source common.											

Negative Switching (Positive Earth)											
Mode	**Input 0**	**Input 1**	**Input 2**	**Input 3**	**Input 4**	**Input 5**
2-wire	configurable	open	not used	configurable	not used	not used
3-wire inch	close	open	not used	configurable	not used	not used
3-wire maint	close	open	not used	configurable	not used	not used
4-wire	close	open	not used	stop	not used	not used
User Input	configurable	configurable	not used	configurable	not used	not used
Terminal connections						
Input 0		**Input 1**		**Input 2**		**Input 3**		**Input 4**		**Input 5**	
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC
30	32	34	29	N/A	N/A	26	28	N/A	N/A	N/A	N/A

Custom Mode 1						
Mode	Input 0	Input 1	Input 2	Input 3	Input 4	Input 5
1	not used	PS Enable 1	PS Enable 2	ESD Release 2	ESD Release 1	MO ESD/PSESD
(MO - momentary signal)						
Terminal connections						
Input 0		**Input 1**		**Input 2**		**Input 3**		**Input 4**		**Input 5**	
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC
30	32 or 33	34	29 or 31	35	29 or 31	26	28	25	28	27	28
Jumpers can be used to connect the digital commons as need. 28 to 29, 31 to 32, 33 to VDC source common.											

4.20 Monitor Relay

The monitor relay indicates the actuator is available for remote operation. The monitor relay will de-energize on loss of power or if any of the following functions become active:

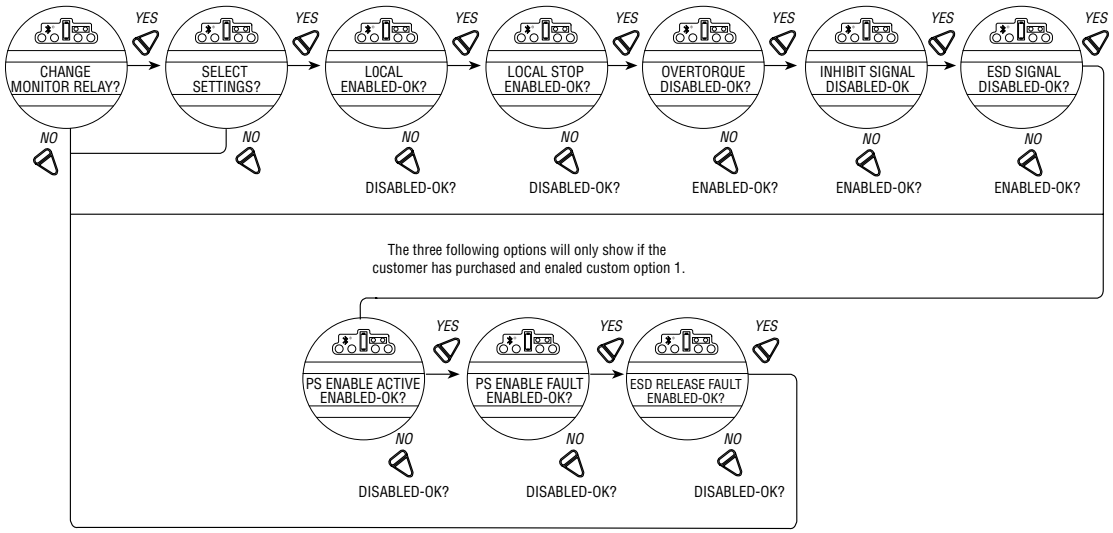
Normal operation

Each selection is User configurable. Select “Enabled” to turn the feature on, and “Disabled” to turn the feature off.

- “LOCAL STOP/OFF” – Red selector knob in “STOP/OFF”
- “LOCAL SELECTED” – Red selector knob in “LOCAL”

The yellow LED will blink when monitor relay is de-energized.

Figure 4.31 – Monitor relay



These functions are monitored continuously and may not be changed, but an additional three functions may be configured individually during setup.

1. Select “CHANGE MONITOR RELAY?” from the “SETUP” routine.
2. Select “YES” to enter the “SELECT SETTINGS?” display. Select “YES” to access each of the following three functions:
   - “OVERTORQUE” – Torque range exceeded in mid-travel, thermistor temperature exceeded, or malfunction in thermistor
   - “INHIBIT SIGNAL” – Inhibit “ON” and active
   - “ESD SIGNAL” – ESD “ON” and active
3. Select “NO” to:
   - “ENABLED” – will trip monitor relay or
   - “DISABLED” – will not trip monitor relay.

4.21 Diagnostic Reset

For diagnostic purposes the following parameters are recorded at certain points in the valve travel on every opening and closing stroke:

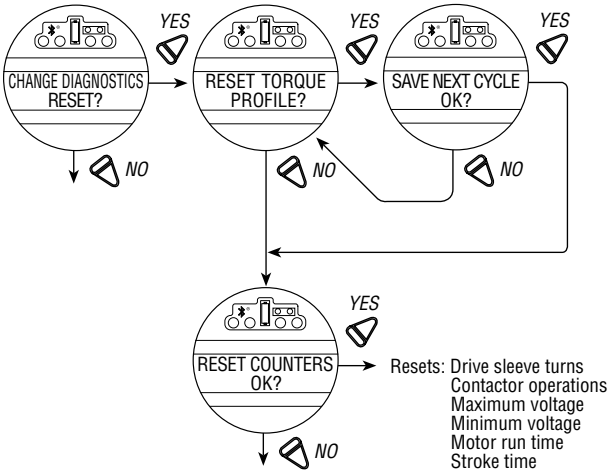
- Proportional measurements of torque
- Drive sleeve turns
- Contactor operations
- Maximum and minimum voltage
- Motor run time
- Stroke time

To enable the new values to be compared with previous measurements, it is essential to record reference values. Limitorque recommends this be done after the valve has been installed, commissioned, and is operating under normal process conditions, and after a plant shutdown or actuator/valve overhaul. The user may select to reset the torque profile at any time.

1. Select “RESET TORQUE PROFILE?” from the “RESET DIAGNOSTICS” routine.
2. Select “YES” to enter the “SAVE NEXT CYCLE?” display.
3. Select “NO” to switch the reset ON or OFF.

   After the next complete cycling of the valve, in both the open and close directions, this reset will automatically be switched OFF.
4. Select “RESET COUNTERS” to reset all the listed parameters to “0.”

Figure 4.32 – Diagnostic reset



4.22 TAG Number

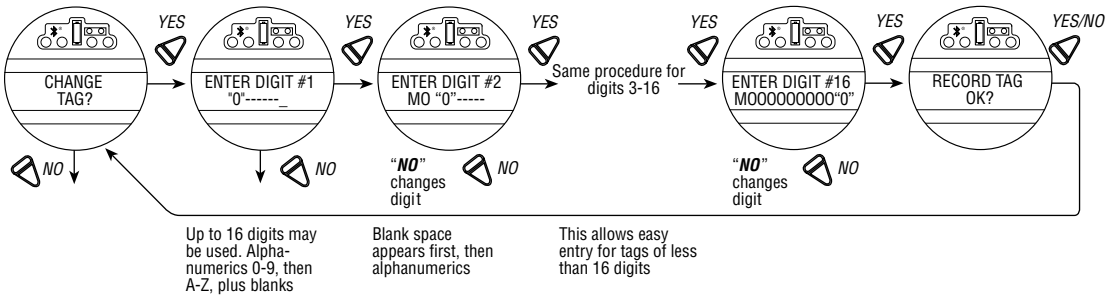
Defaults to blanks.

To Customize the Setting:

1. Select “CHANGE TAG?” from the “SETUP” routine.
2. Select “YES” to enter the “ENTER DIGIT” displays.
3. Select “NO” to choose the required number or letter for each digit of the valve tag number, up to a maximum number of 16 digits.

   The alphanumeric display scrolls from a symbol set, numerals and then A-Z in the following order: ! “ # $ % @ ‘ ( ) * + , - . / 0-9 : ; < = > ? A-Z. There is one blank at each end to enable a tag number with less than 16 digits to be entered clearly. To highlight the digit being entered, a dot appears over the space and the letter above the space disappears.

Figure 4.33 – TAG number

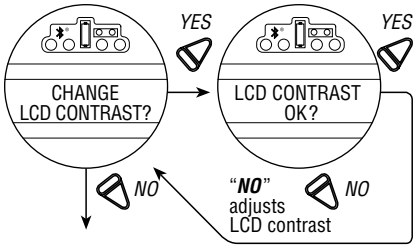


4.23 LCD Contrast

Permits adjustment of the viewing contrast of the LCD.

1. Select “YES” to enter the “LCD CONTRAST” display.
2. Select “NO” to adjust contrast to desired level.

Figure 4.34 – LCD contrast

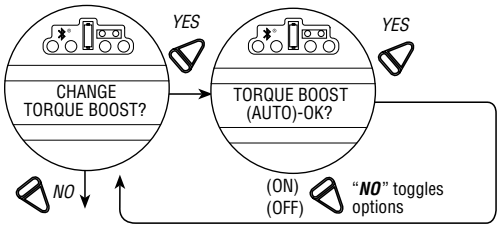


4.24 Torque Boost

Default = “AUTO”

Torque boost increases the capacity to move valves under conditions of low temperature or extreme valve stiffness. In the default setting, the QX will permit more output torque up to the unit’s maximum torque rating when the temperature falls below 32°F (0°C). When configured as ON, torque boost will be present under all conditions regardless of temperature, and when OFF, torque boost will not be present.

Figure 4.35 – Torque boost



4.25 Motor Thermostat

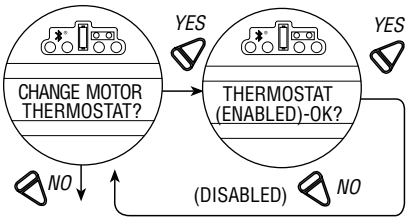
The thermostat setting may be customized:

1. Select “CHANGE MOTOR THERMOSTAT?” from the “SETUP” routine.
2. Select “YES” to enter the “MOTOR THERMOSTAT” display.
3. Select “NO” to choose between “ENABLED” and “DISABLED.”

In the “DISABLED” mode, the motor thermostat is bypassed and detection of an overheated motor does not prevent operation of the actuator. This feature is user-selected when required by the application and may be desirable during critical service.

NOTE: If the motor thermostat is disabled, third party certification including Factory Mutual, FM Canada, IECEx, ATEX and warranty, will be voided.

Figure 4.36 – Motor thermostat

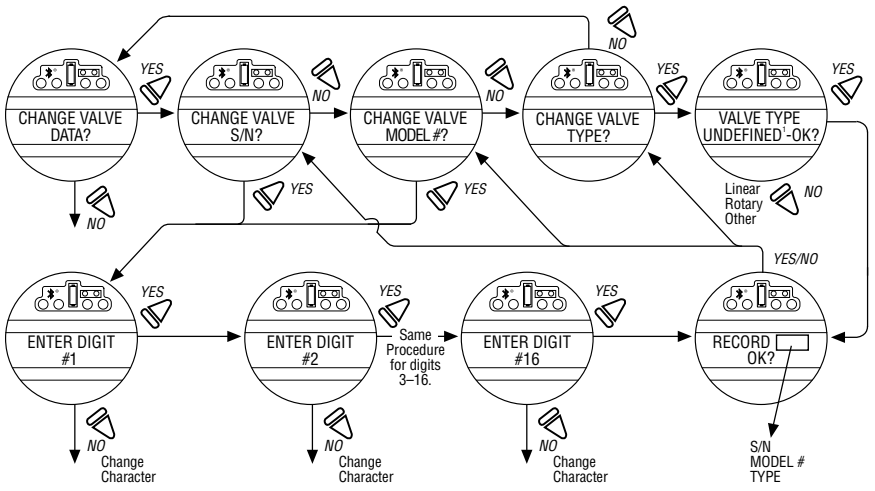


4.26 Change Valve Data

“Change Valve Data” allows the user to identify the type of valve the QX actuator is mounted to.

- Select “YES” to “Change Valve S/N?” Then select “YES” to “ENTER DIGIT” displays.
- Select “NO” to choose the required number or letter for each digit of the valve S/N, up to a maximum of 16 digits.
- Select “YES” when the desired number or letter is displayed. When all digits have been entered select “YES” to “RECORD S/N OK?”
- Follow same sequence for “CHANGE VALVE MODEL #?”, “CHANGE VALVE TYPE?”
- If “YES” to “CHANGE VALVE TYPE?” then “VALVE TYPE UNDEFINED-OK?” is displayed. “VALVE TYPE UNDEFINED-OK?” is only shown until the valve type is chosen. In the rare event that the user would need to “REINITIALIZE” the QX actuator, the screen will reappear. See Figure 5.1.
- The alphanumeric display scrolls from a symbol set, numerals and then A-Z in the following order: ! “ # $ % & ‘ ( ) * + , - . / 0-9 : ; < = > @ A-Z. There is one blank at each end to enable a tag number with less than 16 digits to be entered clearly. To highlight the digit being entered, a dot appears over the space and the letter above the space disappears.

Figure 4.37 – Change valve data



NOTE 1: Valve type "**UNDEFINED**" is only shown until the valve type is chosen. After that, it will not be displayed again unless Reinitialized.

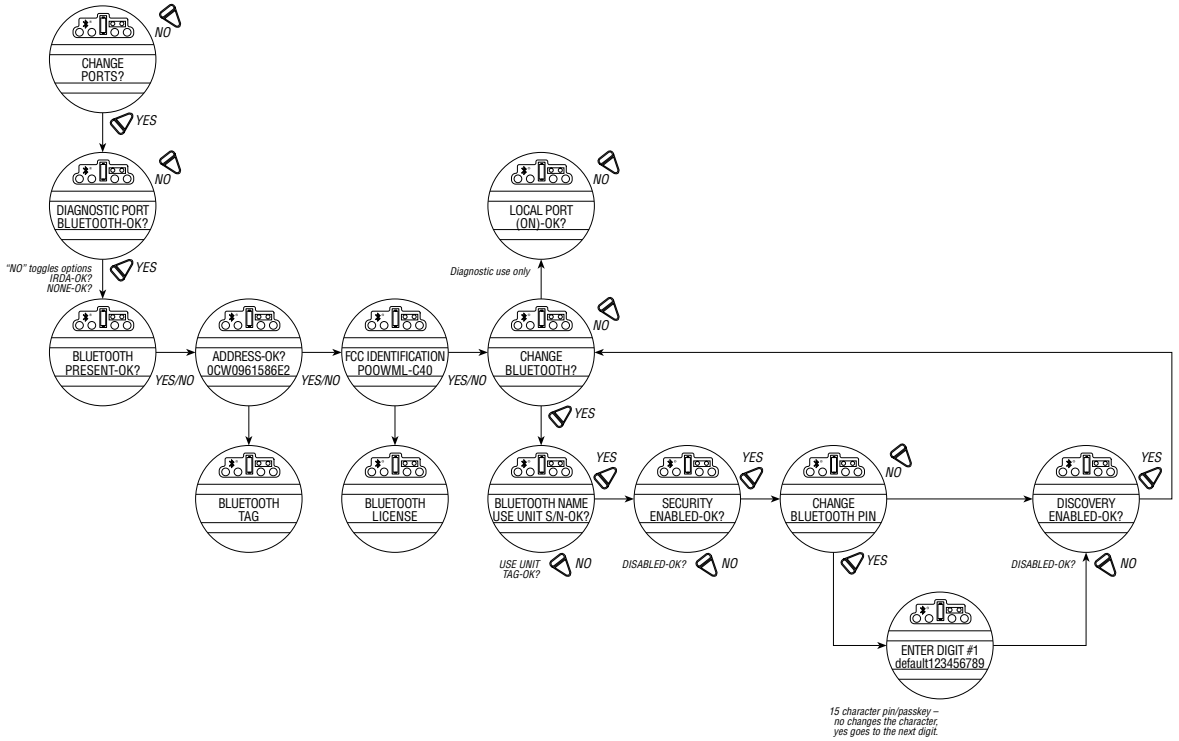
4.27 Change Port

The QX can have new firmware loaded via the local port connections (refer to wiring diagram) or via the IRdA port, located on the LCD board and accessible via the sight glass. If supplied, enable the optional "Bluetooth Port" for remote configuration and access of Diagnostic information.

Both ports cannot be enabled simultaneously as they both share the same serial port on the main board.

Default = Local Port

Figure 4.38 – Change port and Bluetooth settings



5 Troubleshooting

⚠ **WARNING:** This actuator is non-intrusive. Do not open the control compartment on the actuator unless absolutely necessary. It was sealed in dry, clean conditions in the factory and entry to this compartment should not be necessary. Unauthorized entry could void the warranty.

If the actuator will not operate, before attempting to troubleshoot, verify the following:

- LCD display reads "XX% OPEN," "STATUS OK."
- Red selector switch is not in the STOP position.
- All three phases of the main power supply are present at the actuator terminals.
- The supply voltage is the same as that stated on the actuator nameplate.
- Optional 110 VAC is measured at terminals 23 and 24.
- 24 VDC is measured at terminals 22 (+Ve) and 21.
- If 24 VDC power supply is ON, check that the loading does not exceed 5 W across terminals 21 and 22 (remove wires from 21, 22, 23, and 24).
- LCD and LED display on the control panel are illuminated.

If these checks are satisfactory, then attempt to locate the fault using the "VIEW DIAGNOSTICS" routine. It is also recommended that the actuator settings be verified using "VIEW SETTINGS."

5.1 View Diagnostics Routine

1. Enter "VIEW DIAGNOSTICS" as detailed in Section 5.3, View Diagnostics.
2. Review the various displays to try to find the reason the actuator will not operate. The displays that may help to isolate the fault are as follows:
   - View Hardware Status
   - View Motor Status

5.2 Troubleshooting Problems/Corrective Action

(Refer to LMENIM3314, QX Maintenance and Spare Parts and the standard wiring diagram in the Section 3.4, Electrical Connections). We recommend that only Limitorque service personnel perform this operation.

1. Switch off the main power supply and 24 VDC supply at terminals 6 and 7 (if used).
2. Remove control compartment cover (ACP) and protect against the ingress of moisture or dust.
3. Remove any wiring that has been connected to terminals 21, 22, 23 and 24.

4. Switch on main power supply.
5. Measure VAC at 23, 24 – should be 110 VAC if actuator is supplied with optional 110 VAC circuit. If no power, check fuses FS1, FS2 (600 VAC, 1 A, fast acting, 10.3 x 38.1 mm tube) and FS3 (250 VAC, 0.1A, time delay, 5 x 20 mm glass tube) and replace if necessary. If replacing fuses does not fix the problem, replace damaged board. Contact Limitorque Service at (434) 528-4400.
6. Measure VDC at 21, 22 – should be 24 VDC, maximum power of 5 W. If not, replace damaged board.
7. Replace the control compartment cover (ACP).

5.2.1 Actuator Fails to Operate

Actuator Fails to Operate from LOCAL Controls

1. Place the red selector knob in "LOCAL."
2. If motor runs but actuator output does not turn, check that declutch lever has returned to motor operation position.
3. Check LCD display for following alarms:
   - If motor runs but no actuator movement is detected, check if the display says "JAMMED VALVE" and free if necessary.
   - Inhibit signal may be present or absent at the terminals. Check for signal and adjust as necessary. "INHIBIT ACTIVE" appears on display.
   - Thermal overload of the motor may have been detected. Check motor for high temperature. Thermal overload is self-resetting when motor cools. "MOTOR OVERTEMP" appears on the display.
4. Check to see if the position limits are set incorrectly on top of one another. See Section 3.6.4, Setting Position Limits.

Actuator Fails to Operate from REMOTE Controls

1. Check that the actuator will operate from "LOCAL." If not, then carry out the checks described below.
2. Check that the red knob is in "REMOTE."
3. ESD signal may be present or absent at the terminals. Check for signal and adjust as necessary. ("ESD ACTIVE" at display.) If actuator was previously operated in "LOCAL," then the fault is probably in the remote control circuit. Check the integrity of the cabling and that the connections to the terminals are in accordance with the wiring diagram. If motor runs in "LOCAL," but not "REMOTE," adjust ESD to be greater than local ("ESD > LOCAL").
4. Confirm correct monitor relay operation. See Table 3.9.

5.2.2 Jammed Valve Detected

1. Check that position limits have been set correctly. If valve is position-seated, the limits should stop the motor just before the end-of-travel. Recalibrate the position limits if necessary. See Section 3.6.4, Setting Position Limits.
2. Check that torque settings are correct for the valve. Recalibrate if necessary. See Section 4.6, Torque Setup.
3. Check the condition of the valve and lubrication of the valve stem and thrust bearings. The valve may have remained in the same position for a long time and become corroded internally or externally. Engage manual override and employ the handwheel drive to unseat the valve.
4. Verify that the actuator will now operate the valve. Open and close the valve a few times to check for correct operation throughout the travel.

NOTE: To free a jammed valve from the "CLOSE" or "OPEN" position, engage manual override and attempt to unseat it using the handwheel drive. If a rising stem valve is jammed in the close position, loosen the fixing bolts that attach the thrust base to the valve. This will release the compression in the drive components and reduce the effort to unjam the valve. Partly open the valve, then retighten the bolts.

5.2.3 Actuator Operates but Does Not Drive Valve

1. Verify that the declutch lever has returned to motor-operated position.
2. Verify that the stem nut is fitted correctly in the actuator base.
3. Verify that the stem nut has sufficient engagement with the valve stem.
4. Verify that the key is fitted in bore/keyway applications.

5.2.4 Valve Does Not Seat Correctly

1. Verify that position limits are calibrated correctly for the valve travel.
2. Verify that the torque-seating valves have been configured to close on torque, not position.
3. Verify that closing torque value has been set high enough to suit the process conditions.
4. Verify that the valve is not obstructed.

5.2.5 Status Messages

Normal display status is listed in Section 3.7.5, Local Indication. Status or alarm messages are listed below. Once a status or alarm condition occurs, the message will be displayed on the bottom line of the Local Control Station (LCS) screen until the condition is addressed and cleared. If multiple status or alarm conditions are active, the bottom display will cycle through each screen until the condition is addressed and cleared (one message per four seconds).

Status or Alarm Messages (XX = Input # (0, 1, 2))

"---% OPEN, STATUS OK" – Normal display

"---% OPEN, VALVE JAMMED" – Valve cannot start moving

"---% OPEN, LOST PHASE" – One of three phases lost

"---% OPEN, MOTOR OVERTEMP" – Thermistor range exceeded

"---% OPEN, OVERTORQUE" – Torque exceeded in mid-travel

"---% OPEN, HARDWARE FAILURE" – Indication

"---% OPEN, DDC OFF" – DDC enabled, but "OFF"

"---% OPEN, ESD ACTIVE" – ESD signal present

"---% OPEN, INHIBIT ACTIVE" – Inhibit signal present

"---% OPEN, FF OFF" – FF enabled but "OFF"

"---% OPEN, PB OFF" – PB enabled but "OFF"

"---% OPEN, DN OFF" – DN enabled but "OFF"

"---% OPEN, WARMING UP" – Warm up delay active (cold temperature option)

"---% OPEN, NO ANALOG SIGNAL" – 4-20 mA signal absent (Mod enabled, red selector switch in "REMOTE")

"---% OPEN, DDC COM LOST" – DDC enabled, signal absent

"---% OPEN, FF COM LOST" – FF enabled, signal absent

"---% OPEN, PB COM LOST" – PB enabled, signal absent

"---% OPEN, DN COM LOST" – DN enabled, signal absent

"---%OPEN, ESD XX ACTIVE" – Input # set for ESD, is asserted, and has highest priority

"---%OPEN, ESD = XXX.X %" = ESD ACTIVE and its action is "move to" ---.-% position

"---%OPEN, ESD XX INHIBITED" – Active ESD XX has been inhibited by an ESD override.

"---%OPEN, ESD XX CONFLICT" – ESD XX is set for ESD, asserted, and is in conflict with the active ESD.

"---%OPEN, ESD OPEN" – active ESD action is OPEN

"---%OPEN, ESD CLOSED" – active ESD action is CLOSED

"---%OPEN, ESD STOP" – active ESD action is STOP

"---%OPEN, ESD IGNORE" – active ESD action is IGNORE

"---%OPEN, INHIBIT ACTIVE" – INHIBIT signal is asserted

"---%OPEN, INHIBIT CONFLICT" – Conflict with multiple INHIBITs

"SET LIMITS" – Normal display if red selector knob is in "LOCAL" or "REMOTE" and position limits have not been set

"INITIALIZE" – "INITIALIZE" will be displayed if module has no actuator configuration. No operation will be permitted until initialization has been completed. Refer to "ROM ERROR" for routine on next page. See Figure 5.1.

"---% OPEN, THERMISTOR" – There is a failure with the motor thermistor

"---% OPEN, KNOBS" – There is a failure with the local knobs

"---% OPEN, DDC NOT PRESENT" – DDC board expected but not found (missing or not communicating)

"---% OPEN, FF NOT PRESENT" – FF board expected but not found

"---% OPEN, PBDP NOT PRESENT" – Profibus DP board expected but not found

"---% OPEN, PBPA NOT PRESENT" – Profibus PA board expected but not found

"---% OPEN, DN NOT PRESENT" – Device Net board expected but not found

"---% OPEN, ANG1 NOT PRESENT" – Analog 1 board expected but not found

"---% OPEN, ANG2 NOT PRESENT" – Analog 2 board expected but not found

"---% OPEN, CONTACTOR" – Contactor failure

"---% OPEN, ENCODER" – Encoder failure

"---% OPEN, R1R4RM RLY FAILED" – R1-R4 board relay check failed

"---% OPEN, R5R8 RLY FAILED" – R5-R8 board relay check failed

"---% OPEN, DDC FAILED" – Communication with the main board failed, or hardware fault

"---% OPEN, FF FAILED" – Communication with the main board failed, or hardware fault

"---% OPEN, PBDP FAILED" – Communication with the main board failed, or hardware fault

"---% OPEN, PBPA FAILED" – Communication with the main board failed, or hardware fault

"---% OPEN, DN FAILED" – Communication with the main board failed, or hardware fault

"---% OPEN, R1R4RM NOT AVAIL" – R1-R4 board expected but not found

"---% OPEN, R5R8 NOT PRESENT" – R5-R8 board expected but not found

"---% OPEN, ENCODER WARNING" – The encoder has not yet failed, but there was a momentary glitch detected. If the glitch persists, encoder failure will be reported.

RAM Error

The QX processor continually checks RAM for memory corruption errors. If corruption is detected, the processor will force a reset to clear RAM. The LCD will temporarily display the following prior to this reset:

"XXX% OPEN"

"RAM ERROR"

After the reset, the display will read normally. Any momentary commands (DDC command, momentary pushbutton, etc.) that were not completely executed must be reissued.

ROM Error

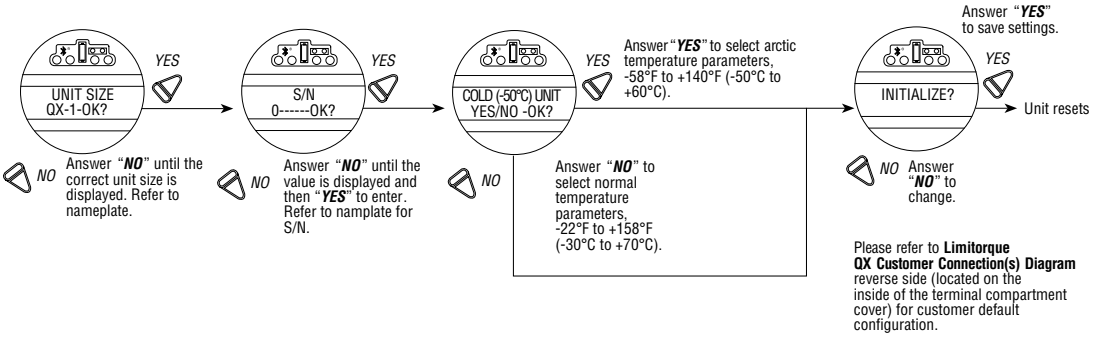
The QX processor continually checks EPROM for memory corruption errors. If corruption is detected, operation is disabled. If the selector switch is in "LOCAL" or "REMOTE," the LCD will display the following:

"XXX% OPEN"

"ROM ERROR"

When the selector is placed in "STOP," the unit will require reinitialization and the LCD will display the following dialog:

Figure 5.1 – Initialize routine



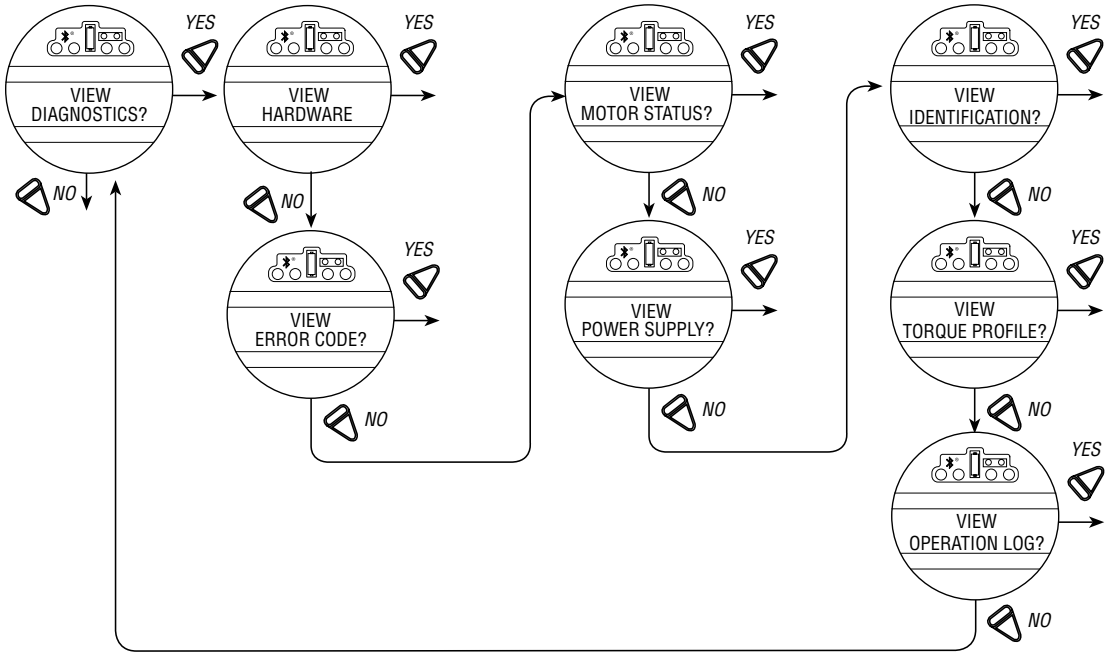
5.3 View Diagnostics

A large amount of historical data is stored in the actuator memory and can be retrieved very easily, without the need for password entry. The data is displayed in dialog format.

1. Enter the "SETUP" mode routine detailed in Section 2.1.1, Entering the Setup Mode.
2. Select "VIEW DIAGNOSTICS?"
3. Select "YES" to access the first display "VIEW HARDWARE?"

NOTE: It is recommended that ALL diagnostics information be recorded prior to contacting an authorized Limitorque service coordinator at (434) 528-4400. This information aids in diagnosing any problem the actuator may experience.

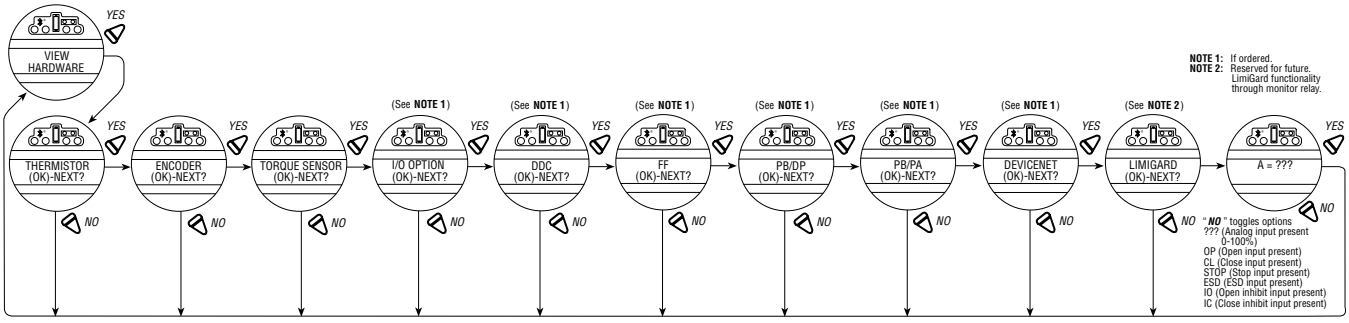
Figure 5.2 – Diagnostic overview



5.4 View Hardware Status

Accessing the "VIEW HARDWARE" routine will enable some of the actuator components to be reviewed for their integrity, as indicated below. These components are continuously being monitored.

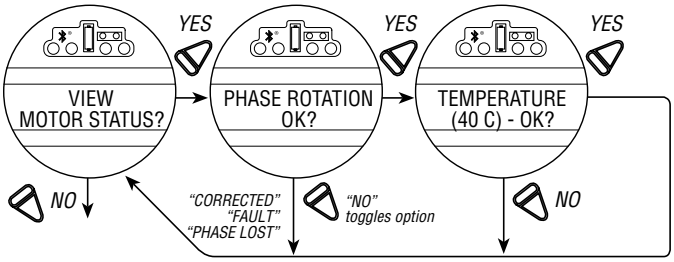
Figure 5.3 – View hardware status



5.5 View Motor Status

Viewing "MOTOR STATUS" will provide information on the temperature of the windings in the motor.

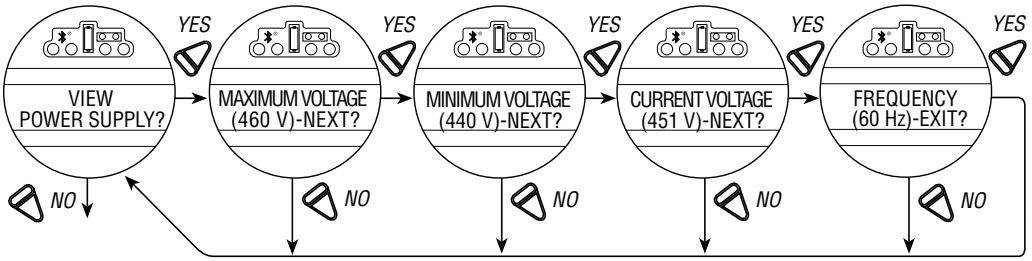
Figure 5.4 – View motor status



5.6 View Power Supply

Viewing "POWER SUPPLY" will provide historical data on the maximum and minimum voltages that have been applied to the actuator, as well as the frequency of the AC supply. These can be reset. See Section 4.21, Diagnostic Reset.

Figure 5.5 – View power supply



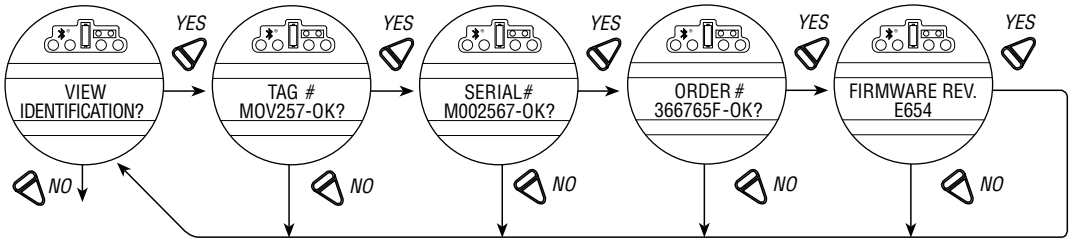
NOTE: Motor temperature and voltage updates every 0.5 seconds.

5.7 View Identification

In this dialog, the identity of the actuator may be reviewed. This dialog provides valuable information for the ordering of spare parts or checking the specification of the actuator.

NOTE: The serial number, order number, and software revision number were entered at the time of manufacture and cannot be changed on screen. The software revision number is necessary when option boards are ordered.

Figure 5.6 – View identification



*Network revisions will only be displayed if the optional network board is installed within the MX.

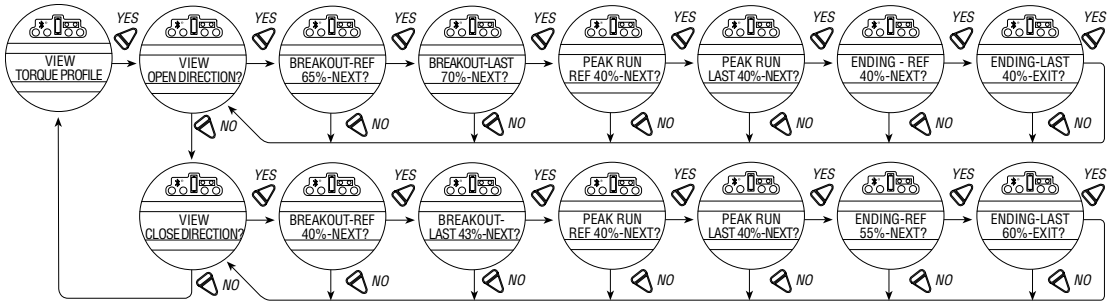
5.8 View Torque Profile

The information contained in the "TORQUE PROFILE" dialog provides indication of the condition of the valve relative to the last time that the "DIAGNOSTIC RESET" reference values were reset. See Section 4.22, TAG Number. It can give an indication of a change in the process conditions, such as an increase in pressure.

Details are given for the REFERENCE and the LAST torque, expressed as a percentage of the rated torque (stated on the nameplate, Figure 4.8) that occurred at BREAKOUT, ENDING, and PEAK RUNNING for both the opening and closing directions. Torque will be expressed proportionally as a reference only from 40% to 100% inclusive. Initial indication may read 0% until torque exceeds 40% minimum.

- "BREAKOUT" – Amount of torque required to unseat the valve.
- "ENDING" – Amount of torque required to seat the valve.
- "PEAK RUNNING" – Maximum torque detected while cycling from BREAKOUT to ENDING. (Maximum mid-travel torque.)

Figure 5.7 – View torque profile



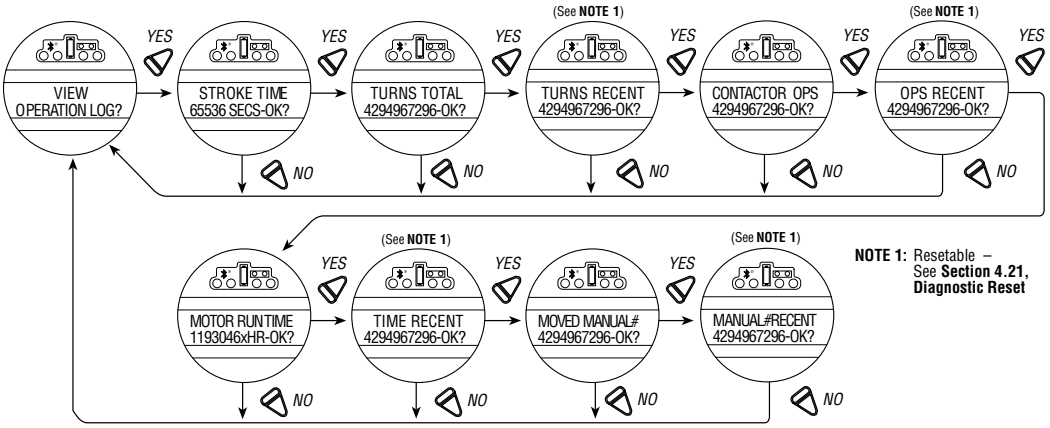
5.9 View Operation Log

The "OPERATION LOG" provides information to assist in the maintenance program for the actuator because it indicates the total number of actuator turns, contactor operations, motor run time, and declutching operations since the actuator was manufactured. These figures may not be reset except in "RESTRICTED SETUP." Contact factory.

The LCD screen definitions are as follows:

- "STROKE TIME" – Length of time of last actuator operation
- "TURNS TOTAL" – Total number of drive sleeve revolutions
- "TURNS RECENT" – Number of drive sleeve revolutions since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
- "CONTACTOR OPS" – Total number of contactor operations
- "OPS RECENT" – Number of contactor operations since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
- "MOTOR RUN TIME" – Total motor operational time
- "TIME RECENT" – Motor operational time since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
- "MOVED MANUAL #" – Total number of times unit has been operated manually
- "MANUAL # RECENT" – Number of times unit has been operated manually since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.

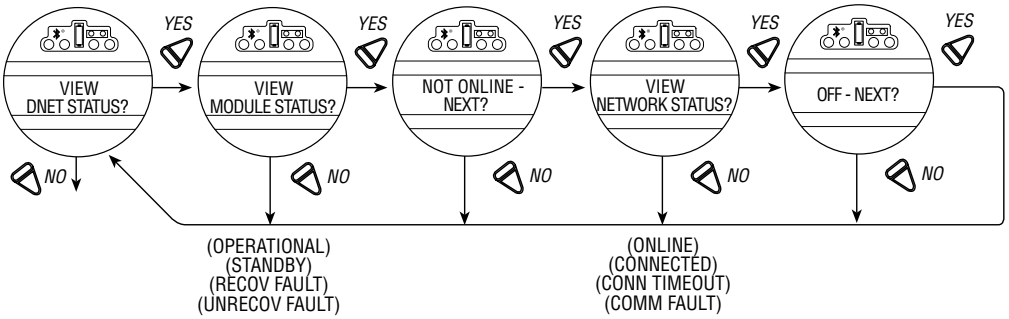
Figure 5.8 – View operation log



5.10 View DNET Status?

This selection permits the User to view pertinent information that summarizes the status of the DeviceNet option board

Figure 5.9 – View DNET status



VIEW MODULE STATUS?

Answer “YES” to determine status of individual DN board within the actuator.

Configuration choices are:

“OFF” = board installed but turned off

“STANDBY” = The device needs commissioning due to configuration missing, incomplete or incorrect.

“RECOVERABLE FAULT” = Conditions that can cause this event are e.g. communication fault, power fault or Limiguard fault of the SMT Main Board. Device may need resetting.

“UNRECOVERABLE FAULT” = Internal Diagnostic Fault detected e.g.

- Receive Queue Overrun
- Transmit Queue Overrun
- CAN Controller Overrun

Device may need replacing.

“SELF TESTING” = The device is in self-test mode.

VIEW NETWORK STATUS?

Answer “YES” to determine status of DN network.

“NOT ON LINE” = Device is not on-line.

- The device has not completed the self-test yet.
- The device may not be powered, look at Module Status Display.

“ONLINE” = Device is on-line but has no connections in the established state.

- The device has passed the SELF test, is on-line, bus has no established connections to other nodes.
- For a Group 2 Only device it means that this device is not allocated to a master.
- For a UCMM capable device it means that the device has no established connections.

“CONNECTED” = The device is on-line and has connections in the established state.

- For a Group 2 Only device it means that the device is allocated o a Master.
- For a UCMM capable device it means that the device has one or more established connections.

“CONN TIMEOUT” = One or more I/O Connections are in the Timed-Out state.

“COMM FAULT” = Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus-off).

“ID COM FLT REQ” = A specific Communication Faulted device. The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request. Long Protocol message.

6 Maintenance

Under normal operating conditions, the QX is a maintenance-free actuator. For ordinary applications, the actuator will require no formal maintenance program. However, if the actuator is used under severe service conditions or operated in a Hazardous Location, the following maintenance procedures are required:

1. Check the oil level every 50 hours of operation at a minimum. Where conditions are severe due to frequent operation or high ambient temperatures, a more regular inspection interval should be maintained.
2. Change the gear oil every 100 hours of operation. See Section 6.1: Lubrication.
3. All ball bearings, oil seals, O-rings and quad-rings are to be replaced after 450 hours of operation. See Bulletin LMENIM3314, QX Maintenance and Spare Parts for disassembly procedures.

Clean and lubricate the valve stem regularly to avoid torque build-up and wear due to silting and corrosion. Infrequent operation can lead to corrosion and contamination of the valve stem thread lubricant. Check any thrust bearings that are fitted to the actuator for proper lubrication at regular intervals. For additional details refer to LMENIM3314, QX Maintenance and Spare Parts.

6.1 Lubrication

QX actuators are oil-filled, as standard, using Petro Canada SHB 68. Mobil SHC 626 may be used as an alternative. These products are synthetic machine oils suitable for ambient temperatures of -20°F to 250°F (-30°C to 120°C). For extreme low temperature conditions (< -30°C to -60°C), an alternative lubricant is available—50% Petro Canada SHB 68 with 50% Soltex PAO 4. Consult factory for arctic temperature applications.

6.1.1 Oil Capacities

To avoid pressurization of the gearcase, the following recommended oil capacities should not be exceeded:

Unit Description	Fluid Ounces	Liters
QX-1/2	26	0.77
QX-3/4/5	80	2.36

6.1.2 Checking Oil Level

To check the level:

1. Remove the uppermost filler plug on the gearcase.
2. Check that the level of oil is within 1 inch (25 mm) of the hole (when actuator is mounted with base horizontal).

7 Regulatory Information

Application of Council Directive(s)

2004/108/EC; EMC Directive

2006/42/EC; Machinery Directive

2003/10/EC; Airborne Noise Directive

94/9/EC; ATEX Directive

Standard(s) to which Conformity is Declared

Machinery; EN 60204-1

EMC - Emissions; EN 50081-1&2, EN 55011, CFR 47

Immunity; EN 50082-1&2, IEC 801-3 & IEC 801-6
ESD; IEC 801-2
EFT/Bursts; IEC 801-4
Surge Immunity; IEC 801-5, ANSI/IEEE C62.41
Mains (power) Harmonics; MIL-STD-462, Method CSO1 & CSO2

Airborne Noise; MIL-STD-740-1, Table 1, and EN 60204

ATEX Harmonized Standards

prEN 60079-0:200X (IEC 60079-0:2007)
EN 60079-1:2007
EN 60079-7:2007
EN 60529:1991 + A1:2000
EN 13463-1: 2009
EN 13463-5: 2003

Materials of Construction Terminal & Control Covers - Aluminum Alloys 380 or 383
CS Station - Aluminum Alloy 319
Nameplate - Stainless Steel
Housing - 356-T6 Aluminum
Window - Heat tempered Soda Lime Glass
Antenna Cover - Polytetrafluoroethylene

EMC - Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI) standards to which this actuator complies:

Applicable Emissions standards	EN50011:1998	Class A service
Radiated emissions	EN55011:1998 & FCC Part 15, subpart J	
		30-130MHz
		40dBmV / m
		230-1000MHz
		47dBmV / m
Conducted emissions	EN55011:1998 & FCC Part 15, subpart J	0.15 to 0.5MHz
		79dBmV (QuasiPeak
		66dBmV avg)
		0.5 to 30MHz
		73dBmV (QuasiPeak
		60dBmV avg)
Applicable immunity standards	IEC EN 61000-6-1:2001	
ESD	IEC61000-4-1:1995	±8kV thru air
		±4kV thru contact
Radiated RF immunity	IEC61000-4-3:1995	80MHz to 1GHz, 10V/m, 1.4GHz-2GHz, 3V/m, 2.0GHz-2.7GHz, 1V/m
Fast transients/burst	IEC61000-4-4:1995	EFT
		AC Power leads: ±2kV
		Signal leads: ±1kV
Voltage surges	IEC61000-4-5:1995	
		AC Power: ±2kV com, ±1kV diff
		AC Power: ±2kV com, ±1kV diff
Conducted RF immunity	IEC61000-4-6:1996	150kHz to 80MHz
		3Vrms
Magnetic field immunity	IEC61000-4-8:1993	Power line frequency
		30A/m @ 60Hz
Voltage dips and interrupts	IEC61000-4-11:1994	60Hz
		30%, 10ms dips
		60%, 100ms dips
		60%, 1s dips

Notified Body

FM Approvals Limited

1 Windsor Dials

Windsor UK

Certification Number

FM09ATEX0058X"

IECEx

IEC 60079-0:2007

IEC 60079-1:2007

IEC 60079-7:2006

IEC 60529:1989 + A1:1999

Manufacturer's Name

Limitorque, a division of Flowserve Corporation

Manufacturer's Address

5114 Woodall Road

Lynchburg, VA 24502

Importer's Name

Limitorque International

Importer's Address

Euro House

Abex Road

Newbury

Berkshire, RG14 5EY

England

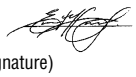
Type & Description of Equipment

Valve Actuators

Model Number

QX Series Note: Tested with Limitorque products only and with standards applicable at time of tests.

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s). List as follows:



(Signature)
Earnest Carey
(Full Name)

Manager, Product Management
(Title)

Flowserve Limitorque
5114 Woodall Rd., Lynchburg VA 24502
(Place)

October, 2009
(Date)

7.1 Specific Conditions for Use — Atex/Cenelec/IECEx Applications

Atex/Cenelec/IECEx certification of the QX product line is described in Certificate of Conformity. This certificate details specific construction requirements that must be met in order to maintain the XP integrity of the actuator. The socket-head cap screws used with the QX electric valve actuators shall conform to the following requirements:

The "X" suffix to the Certificate number relates to the following specific conditions of use.

1. ISO Class 12.9, M8 socket-head cap screws (Yield Stress 1100 MPa) shall be used to replace the terminal, control, or motor compartment fasteners of actuators marked with TAMB < -20°C or for all Group IIC actuators.
2. Stainless steel, A2 or A4, ISO Class 70, M8 socket-head cap screws (Yield Stress 450 MPa) shall be permitted as an alternate to the ISO Class 12.9 socket-head cap screws on the terminal, control, or motor compartments of actuators marked TAMB ≥ -20°C.
3. Consult the manufacturer if dimensional information on the flameproof joints is necessary.

7.2 Statement of Compliance with Applicable European Directives

We, Flowserve Limitorque, 5114 Woodall Road, Lynchburg, VA, USA 24502, as the manufacturer of the equipment listed below:

> QX-1, 2, 3, 4, 5 electronic valve actuator. The QX is a non-intrusive electronic actuator. It is specifically designed for the purpose of being mounted to a quarter turn valve (or other apparatus) in order to move the valve from fully closed to fully open.

Confirm, in accordance with the requirements of clause 1.2.7 of the Essential Health and Safety Requirements of Community Directive 94/9/EC on equipment and protective systems intended for use in potentially explosive atmospheres that the above equipment has been designed and manufactured to:

a) Avoid physical injury or other harm which may be caused by direct or indirect contact;

b) Assure that the surface temperature of accessible parts or radiation which cause a danger, are not produced;

c) Eliminate non-electric dangers which are revealed by experience;

d) Assure that foreseeable conditions of overload shall not give rise to dangerous situations.

And where these risks are wholly or partly covered by other Community Directives, the equipment satisfies the requirements of those specific Directives.

And that literature describing the equipment will not contradict the instructions with regard to safety aspects.

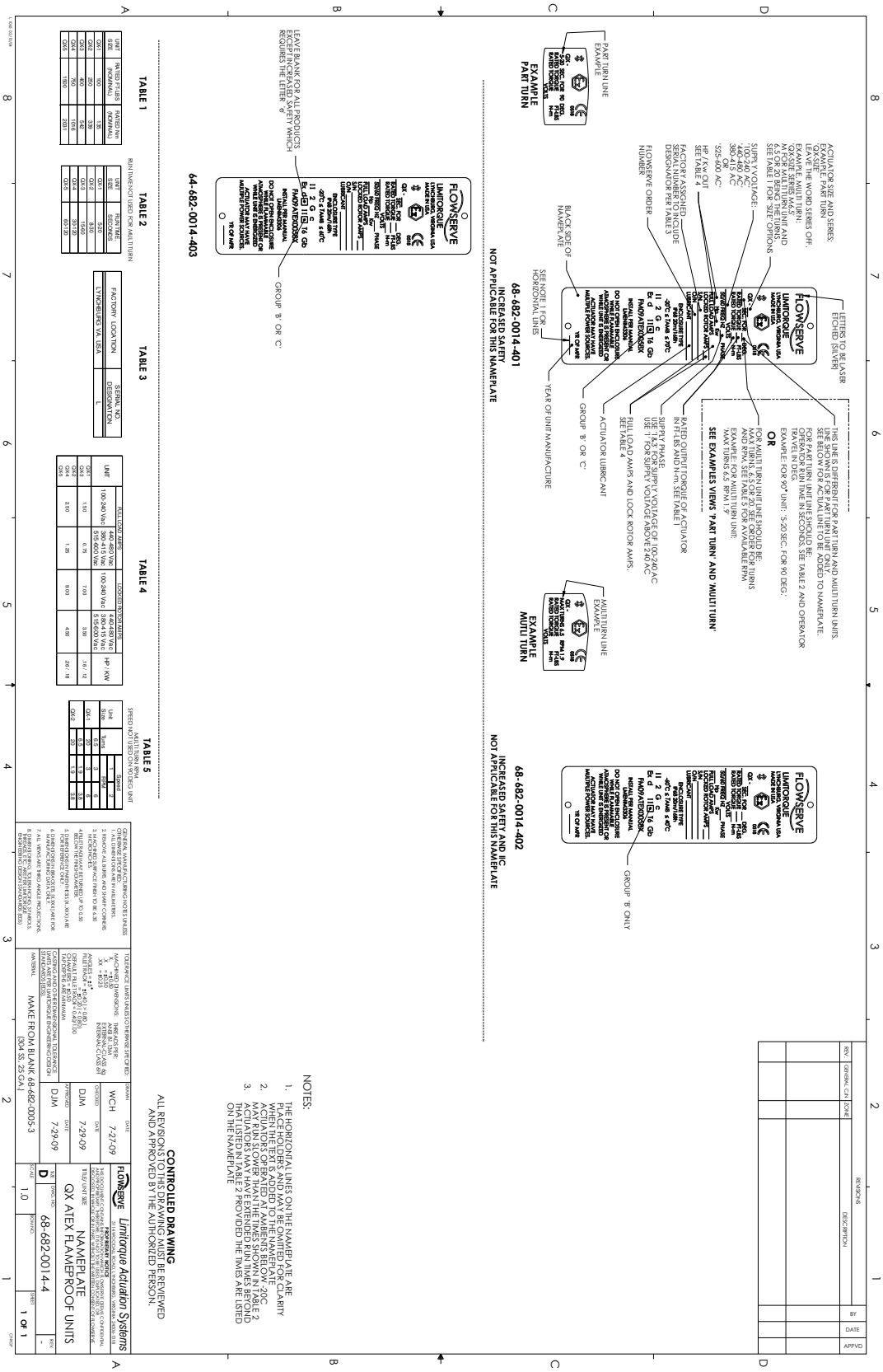
Issued on: 16 September 2009

Authorized by: 

Name: Earnest G. Carey, Jr.

Position: Manager Product Management and Marketing

Figure 7.1 – Typical ATEX nameplate



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FLOWSERVE

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To find your local Flowserve representative, visit www.flowserve.com, www.limitorque.com or call USA 1 800 225 6989

FCD LMENIM3306-03 Printed in USA.

FLOWSERVE

Limitorque QX

Electronic Actuator

FCD LMENIM3314-00 - 5/11

Maintenance and Spare Parts

Experience In Motion

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1 Introduction

1.1 Premise

The Flowserve Limitorque QX actuator components are separated into subassembly groupings. This manual covers the removal and remounting procedures for each subassembly group. Use these instructions when disassembly is required for service, maintenance or parts replacement.

1.2 Procedure Emphasis

Please refer to the following methods used to emphasize text throughout this manual. Safety Warnings, Cautions and Notes present material that is important to user safety. Be sure to read any safety notices you see as they could prevent equipment damage, personal injury or even death to you or a co-worker.

Safety notices are presented in this manual in three forms:

☠ **WARNING:** Refers to personal safety. Alerts the user to potential danger. Failure to follow warning notices could result in personal injury or death.

⚠ **CAUTION:** Directs the user's attention to general precautions that, if not followed, could result in personal injury and/or equipment damage.

NOTE: Highlights information critical to the user's understanding of the procedure.

Bold text stresses attention to the details of the procedure.

1.3 Important Notes and Warning Statements

Please read this Maintenance and Spare Parts Manual carefully and completely before attempting to store or perform maintenance on your QX valve actuator. Further installation, setup and operation instructions are available in the Installation and Operation manual (LMENIM3306) attached to the actuator declutch lever bracket at shipment.

☠ **WARNING:** Be aware of electrical hazards within the actuator and high-pressure hazards of the attached valve or other actuated device when installing or performing maintenance on your QX actuator. Failure to observe these precautions could result in serious bodily injury, damage to the equipment or operational difficulty.

☠ **WARNING:** Do not manually operate actuator with devices other than installed handwheel and declutch lever. Using additive force devices (cheater bars, wheel wrenches, pipe wrenches or other devices of this nature) on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator or valve.

1.4 Reference Documents

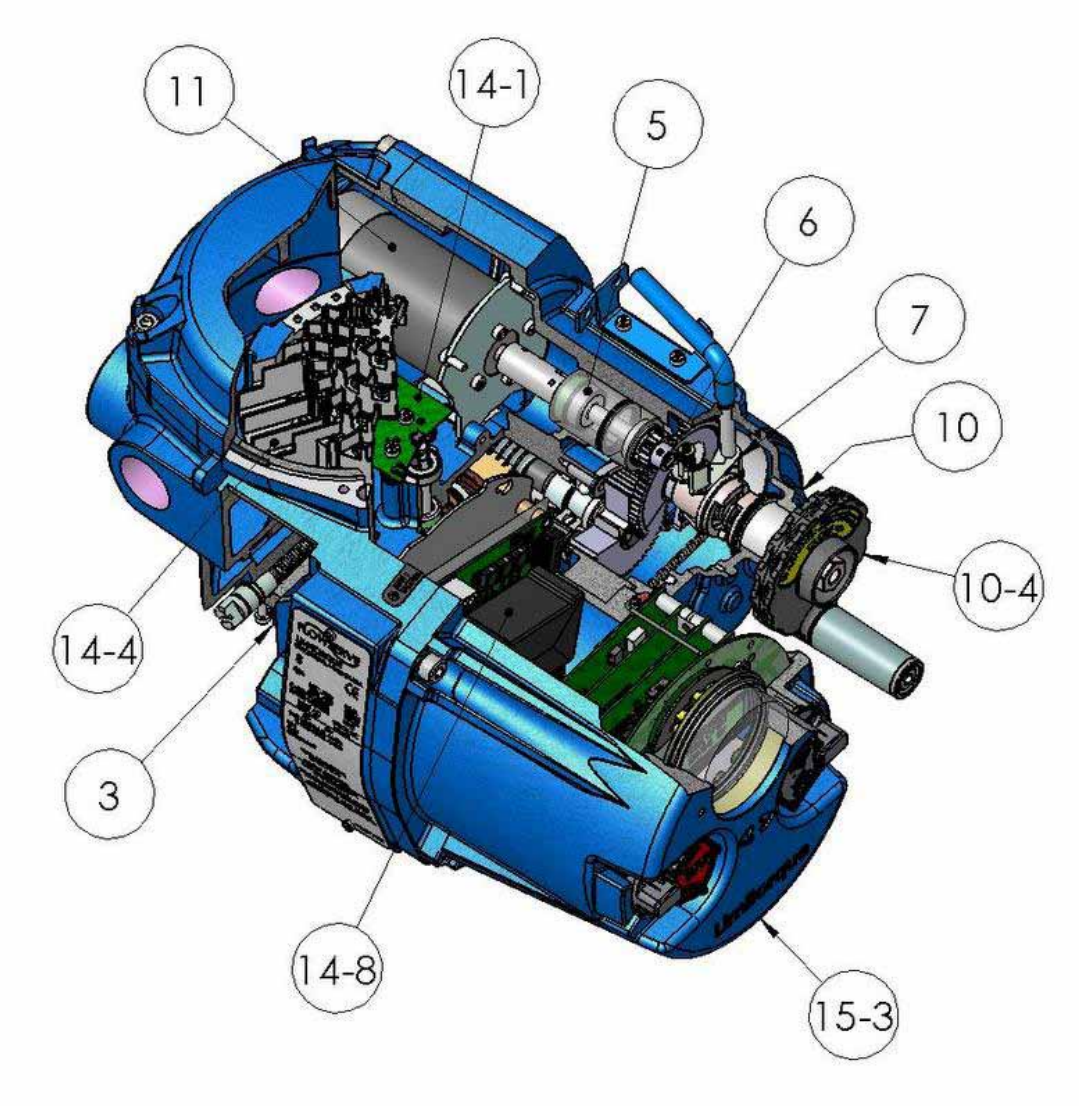
- Protection, Control and Monitoring features of MX/QX Electric Actuators (Bulletin LMENTB2300)
- QX Control, Performance and Value in Quarter-turn Electric Valve Actuators (Bulletin LMENBR3302)
- QX Installation Manual (Bulletin LMENIM3306)
- QX Quick Mount and Start (Bulletin LMENIM3313)

1.5 This document applies to both QX – 90 degree actuators and all QXM-multi-turn actuators.

The latest revisions to these documents are available on-line from Flowserve Limitorque's website, www.flowserve.com or at www.limitorque.com

2 QX Actuator Subassembly

Figure 2.1 - Typical QX Actuator



NOTE: QX-1 and 2 90° unit shown.

2.1 QX Actuator Subassembly Components

Table 2.1 - Typical QX Actuator Subassembly

Item Number	Description
3	Baseplate
5	Motor cartridge
6	Clutch shaft
7	Clutch fork
10	Handwheel cover
10-4	Handwheel
11	Motor
14-1	Encoder
14-4	Terminal block
14-8	Power controls
15-3	Controls cover

2.1.1 Product Description

Your QX actuator controls the opening and closing travel of valves and other actuated devices. OPEN and CLOSED limits are protected by an absolute encoder that provides optical sensing of valve position and measures valve position in both motor and handwheel operation. No battery or backup power supply is required. Output torque is derived from current, voltage and temperature. If the preset torque is exceeded, the motor shuts off. As a result of this reliable and advanced protection technology, all valve and other actuated devices are protected from potential damage from overload, improper seating and foreign obstructions.

A range of control and network options is available which can be easily added to the control capabilities already available on a standard actuator. Contact your local Limitorque distributor or Limitorque sales office for further information.

2.1.2 Storage

Storage Recommendations

Your QX actuator is double-sealed and weather-proof as shipped, even for explosion-proof applications, providing all compartment covers and cable entry plugs are left intact. Actuators should be stored in a clean, dry, protected warehouse until ready for installation. If actuators must be stored outdoors, they should be stored off the ground and high enough to prevent being immersed in water or buried in snow.

Preferred Storage Orientation

Your QX actuator should be stored with terminal compartment in the vertical position and the drive base down to obtain optimum service life.

2.1.3 Unit Weights

Table 2.2 - QX Unit Weights

Unit	lb.	kg
QX-1	40	18
QX-2	42	19
QX-3	80	36
QX-4	80	36
QX-5	80	36

NOTE: Weights include B4 stem nut and lubricant.

2.2 Product Identification

2.2.1 Initial Inspection and Recording Suggestions

Upon receipt of the actuator, several steps should be initially followed to ensure condition of equipment and to establish proper record keeping.

1. After removing the actuator from the shipping carton or skid, thoroughly examine it for any physical damage which may have occurred during shipment. If you note any damage, immediately report the damage to the transport company and call Limitorque for further assistance.
2. A nameplate with important information is attached to each actuator. Record the following information for use when you need to contact Limitorque with any questions about your actuator:
   - Unit type/size
   - Flowserve Limitorque order number
   - Serial number

Figure 2.2 - QX Nameplate

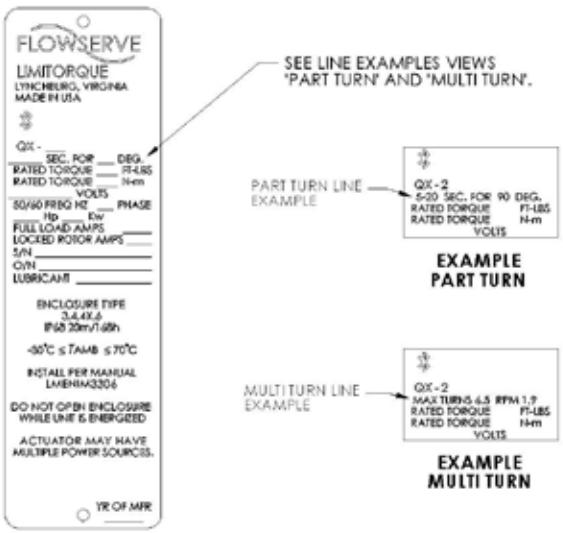


Figure 2.3 - QX Nameplate

2.3 Maintenance

2.3.1 Recommended Maintenance

Under normal operating conditions, the QX is a maintenance-free actuator. Therefore, for normal applications, the actuator will require no formal maintenance program. However, if the actuator is used under severe service conditions or operated in a Hazardous Location, the following maintenance procedures are required:

1. Check the oil level every 50 hours of operation at a minimum. Where conditions are severe due to frequent operation or high ambient temperatures, a more regular inspection interval should be maintained.
2. Change the gear oil every 100 hours of operation. See section 2.3.2 Unit Lubrication.
3. All ball bearings, oil seals, O-rings and quad-rings are to be replaced after 450 hours of operation. See sections 2-3-2 thru 2-3-3.

Clean and lubricate the valve stem regularly to avoid torque build-up and wear due to silting and corrosion. Infrequent operation can lead to corrosion and contamination of the valve stem thread lubricant. Check any thrust bearings that are fitted to the actuator for proper lubrication at regular intervals.

2.3.2 Unit Lubrication

Change oil every 100 hours of operation or if water or other foreign material is found during oil inspection.

Oil Level Inspection and Fill Criteria

To avoid pressurization of the gearcase, the following recommended oil capacities should not be exceeded: (Reference Table 2.3 for oil capacities when mounted in varying positions)

- Actuator viewed in upright position (terminal compartment up / base down) Oil level should be approximately 1 inch (25.4 mm) below the outer surface of the housing at the oil fill port.
- Actuators mounted in other orientations than the upright position should have their oil capacities maintained.

Fill through the highest oil fill port until the oil is at a level that will contact the bottom of the plug when installed in the oil fill port.

NOTE: Do not overfill! Oil will expand during actuator operation. Actuators are shipped with an oil volume suitable for any mounting position. When checking the factory-supplied oil level, excess oil may drain from the highest oil fill port due to the various mounting orientations of each application.

Table 2.3 QX-1 thru 5 Oil Capacities

Unit Description	Fluid Ounces	Litres
QX 1/2	26	0.77
QX-3/4/5	80	2.36

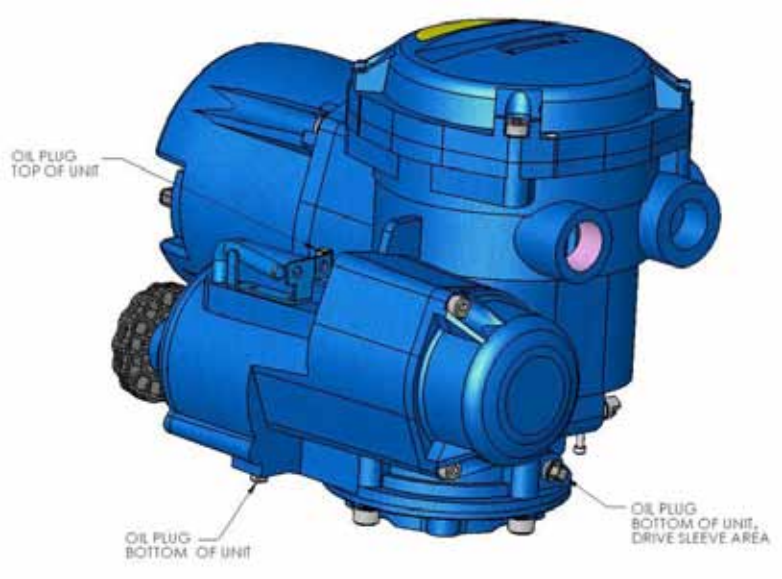
Lubrication Data

Oil Specification – all models

-30°C to +70°C (-22o to + 158o F) units require oil per Petro-Canada SHB-68 or Mobil SHC626

-60°C to +40°C (-76o to + 104o F) units require oil that is 50% Petro Canada SHB-68 with 50% Soltex PAO4

Figure 2.4 - QX Oil fill /Plug Locations (QX-1 thru 5)



2.3.3 O-Ring and Lubrication

O-rings and seals should be replaced any time an actuator is disassembled. Lubricate with a substance that is compatible with Buna N seals.

2.4 Subassembly Removal and Remounting Procedures

This manual divides each QX actuator subassembly into a Removal and Remounting procedure. Use the following procedures to remove subassemblies for inspection, repair or replacement. Some subassemblies require prior subassembly removal before allowing the desired subassembly removal. Note the First Remove instructions at the beginning of each subassembly removal procedure. Remove these subassemblies first, and then remove the desired subassembly according to the instructions. Once removed, evaluate subassembly components to determine requirement for a new subassembly. If a new subassembly is required, see Section 2.5. Once components have been identified and replaced, remount following the appropriate Remounting procedures.

2.5 How to Order Replacement Subassemblies

2.5.1 Replacement Parts

Replacement parts are sold in modular subassemblies; therefore, when part replacement is required, order parts at the subassembly levels as shown in this manual. Parts may be ordered from your local Limitorque representative (www.flowserve.com) or direct from the factory:

Telephone: 1-434-528-4400

Fax: 1-434-845-9736

Please have the following information, found on the actuator nameplate, available to help us facilitate your order:

- Unit type/size
- Limitorque order number
- Serial number

2.5.2 Return Procedure

When parts are identified for warranty or other component replacement, a Return Material Authorization (RMA) must be obtained from Flowserve. Contact factory for a RMA number (see contact information in section 2.5.1). All returned parts must be accompanied by documentation with the following information to obtain credit for returned goods:

- Return Material Authorization (RMA)
- Unit type/size
- Flowserve Limitorque order number
- Serial number

Return parts to the address listed below:

Limitorque Actuation Systems
5114 Woodall Road
Lynchburg, VA 24502

2.5 Screw Preload (Torque)

Torque applied to each size screw used in the QX:

Table 2.4 - Screw Preload Torque

Screw	Screw Preload
M10	10-12 ft-lbs
M10 used on Base Plate QX-3 / 4 / 5	17-20 ft-lbs
M8	6-8 ft-lbs
M6	24-36 inch lbs
M5	15-20 inch lbs
M4	8-12 inch lbs
M3	60-70 inch ounces
M2	18-22 inch ounces

3 Remove Actuator from Mounting Adapter

3.1 Actuator Removal with Type B4/B4E Base (Torque)

3.1.1 Removal (Type B4/B4E Base)

Step 1

WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing actuator from mounting plate. Power sources may include main power or control power. If necessary, disconnect incoming power leads L1, L2, L3, and control wiring from the terminal block.

Figure 3.1 - Torque Nut, F/FA-10, QX-1 & 2 and F/FA-12 and -14, QX-1 thru 5

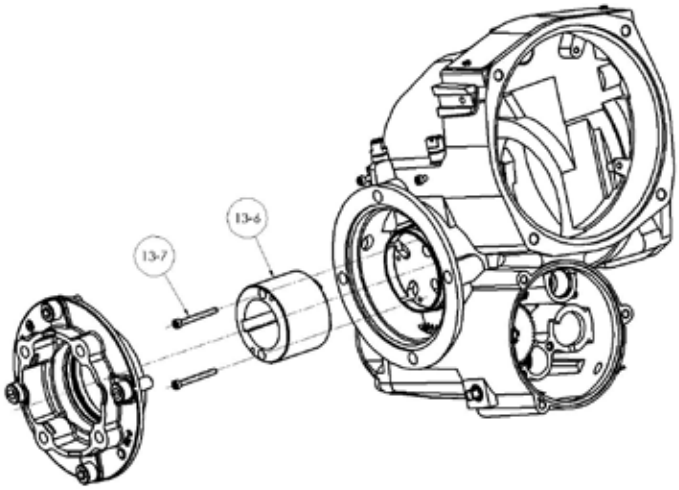
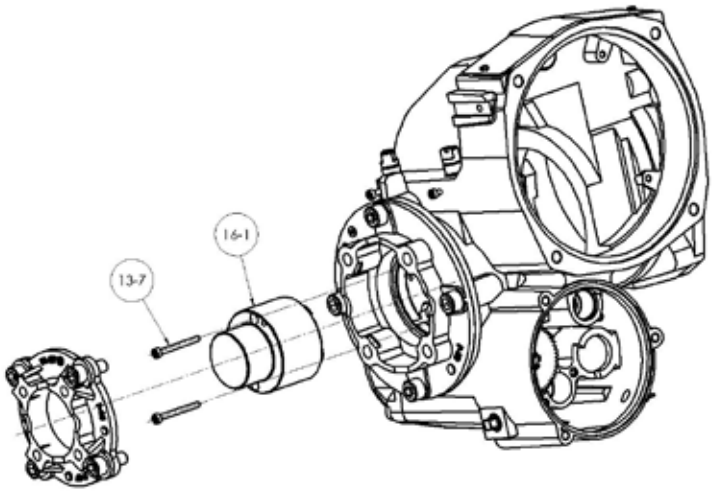


Table 3.1 Torque Nut, F/FA-05 and -07, QX-1 & 2 and F/FA-10, QX-1 thru 5

ITEM NUMBER	DESCRIPTION	QTY.
13-7	SCOKET HEAD CAP SCREW	1
16-7	TORQUE NUT	1

Figure 3.2 - Torque Nut, F/FA-05 and -07, QX-1& 2 and F/FA-10, QX-1 thru 5



Remove the bolts that secure the actuator to the mounting adapter. If type B4 or B4E base is used in addition to the standard type B4 or B4E baseplate, you may leave the B4 base attached to the mounting adapter and remove the actuator only. Or if required, you may remove the bolts that mount type B4 base to mounting adapter. This will allow actuator removal along with optional B4 base.

Step 2

☠ **WARNING:** Potential high-pressure vessel! Before disassembling your actuator, ensure that the valve or other actuated device is isolated and is not under pressure.

Lift the actuator from mounting adapter.

3.1.2 Remounting (Type B4/B4E Base)

Step 3

Ensure stem nut (#1-22) is secured inside actuator drive sleeve with retaining ring (#1-23). Lower the actuator onto the mating component, making sure to align stem nut key and keyway with mating component.

Step 4

Ensure that the actuator and mounting adapter flange mating holes are aligned correctly.

Sept 5

☠ **WARNING:** Hazardous Voltage! Turn off all power sources before rewiring incoming power leads L1, L2, L3, and control wiring in the terminal block.

Secure the actuator to the mounting adapter with mounting bolts.

Step 6

Reconnect incoming power leads L1, L2, L3, and control wiring to the terminal block. Restore power source when ready for operation.

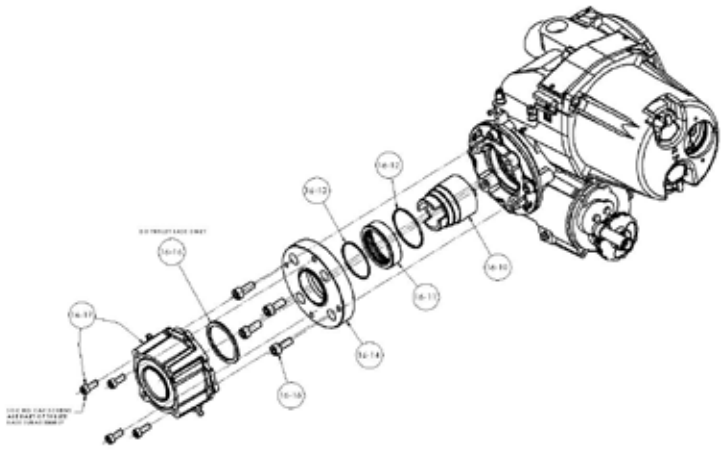
3.2 Actuator Removal with Type A1/A1E Base (Thrust) – QXM only

3.2.1 Optional Thrust Base Assembly QX-1 & 2

Table 3.2 - Optional Thrust Base Assembly

ITEM NUMBER	DESCRIPTION	QTY.
16-10	TORQUE NUT	1
16-11	BUSHING	1
16-12	O'-RING	1
16-13	O'-RING	1
16-14	ADAPTER PLATE	1
16-15	SOCKET HEAD CAP SCREWS	4
16-16	SPACER, PILOT, ISO ONLY	1
16-17	THRUST BASE ASSEMBLY	1

Figure 3.3 - Optional Thrust Base Assembly



3.2.2 Optional thrust base assembly removal.

Step 1

Remove the four (4) screws (#) and remove the thrust base subassembly (#16-17) by sliding the base down. If base is ISO remove the spacer (pilot) (#16-16).

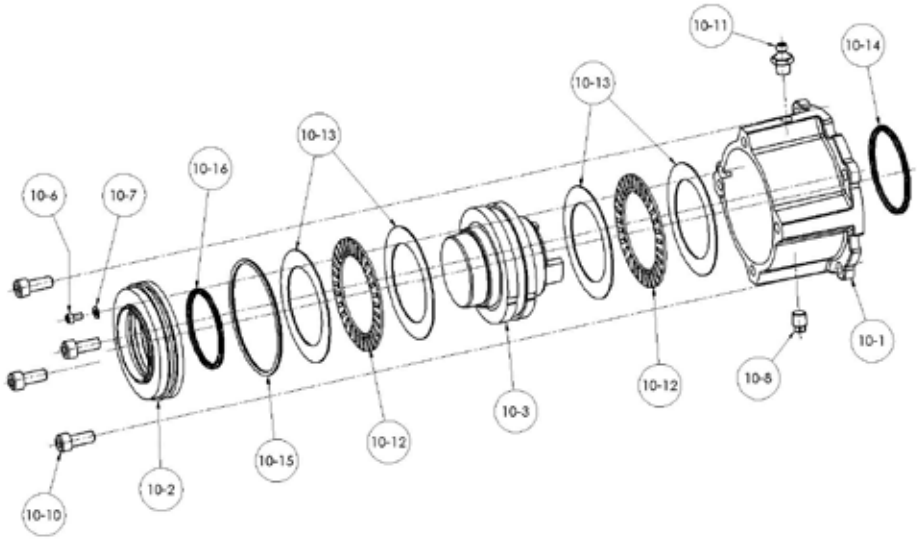
Step 2

Remove the four (4) screws (# 16-15) and remove the adapter plate (#16-14) and torque nut (#16-10). Item (#16-11) bushing is pressed into adapter plate and cannot be removed. The torque nut is held in place by the unit drive sleeve and the bushing (#16-11).

Table 3.3 - Optional Thrust Base Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
10-1	HOUSING, THRUST BASE	1
10-2	PILOT, THRUST BASE	1
10-3	THRUST NUT	1
10-6	SOCKET HEAD CAP SCREWS	1
10-7	FLAT WASHER	1
10-8	RELIEF FITTING	1
10-10	SOCKET HEAD CAP SCREWS	4
10-11	GREASE FITTING	1
10-12	NEEDLE BEARING	2
10-13	THRUST RACE	2
10-14	QUAD RING	1
10-15	O'-RING	1
10-16	QUAD RING	1

Figure 3.4 - Optional Thrust Base Subassembly



3.2.3 Thrust base remounting

Step 1

Place QX torque nut (#16-10) into unit drive sleeve (#1-11) aligning nut lugs to drive sleeve slots.

Step 2

Lightly lubricate 'O'-rings (#16-12) and (#16-13) and insert into bushing (#16-11) that is pressed into adapter plate

(#16-14). Slide adapter plate and bushing over end of torque nut and aligning to unit baseplate. Insert screws (#16-15) into adapter plate holes and tighten.

Step 3

Align thrust base subassembly nut lugs (#10-3) with QX torque nut (#16-10) slots and slide thrust base on to QX unit baseplate aligning pilots. Note; For ISO thrust base pilot spacer (#16-16) must be used to align thrust base to QX baseplate. Insert screws (#10-10) into thrust base holes and tighten

NOTE: Two procedure options are available for removing the actuator and the thrust base:

1. Remove actuator from the thrust base, leaving the base mounted to the mounting flange or removing the thrust base separately
2. Remove actuator and thrust base as a unit from the mounting flange.

3.2.4 Removal (Type A1/A1E Base) Actuator Removal Separate from Thrust Base

STEP 1

☠ **WARNING:** Hazardous Voltage! Turn off all power sources to actuator before removing actuator from mounting plate. Power sources may include main power or control power. If necessary, disconnect incoming power leads L1, L2, L3, and control wiring from the terminal block.

Remove the bolts (#10-10) that secure the actuator to the thrust base assembly (#10).

STEP 2

☠ **WARNING:** Potential high-pressure vessel! Before disassembling your actuator, ensure that the valve or other actuated device is isolated and is not under pressure.

Lift actuator from thrust base assembly (#10).

STEP 3

☠ **WARNING:** Potential for actuated device to change position! The thrust base will maintain position only if non-backdriving thread lead is used. Ensure proper thread lead is used in your application before allowing thrust base to be used for main- taining position when actuator is removed.

Thrust base removal (if required)

The valve position will be maintained if a locking thread lead is used on the valve stem. If thrust base removal is required, use the following removal procedure.

Remove the bolts that secure the thrust base to the mounting adapter.

STEP 4

Rotate the thrust base (#10) until it feeds off the threaded stem.

3.2.5 Remounting (Type A1/A1E Base) Actuator Remounting Separate from Thrust Base

STEP 5

Thrust base remounting (if required)

Ensure the thrust base stem nut has the two lugs positioned upward to engage with the drive sleeve slots when actuator is reinstalled onto thrust base. Thread thrust base back onto mounting adapter.

STEP 6

Secure thrust base to mounting adapter with mounting bolts.

STEP 7

Actuator remounting

Lower the actuator onto the thrust base, making sure thrust nut lugs align and properly engage with drive sleeve slots.

STEP 8

Install bolts (#10-10) to secure the actuator to the thrust base assembly (#10).

STEP 9

☠ **WARNING:** Hazardous Voltage! Turn off all power sources before rewiring incoming power leads L1, L2, L3, and control wiring in the terminal block.

Reconnect incoming power leads L1, L2, L3, and control wiring to the terminal block. Restore power source when ready for operation.

3.2.6 Removal (Type A1/A1E Base) Actuator and Thrust Base as a Unit

STEP 1

☠ **WARNING:** Hazardous Voltage! Turn off all power sources to actuator before removing actuator from mounting plate. Power sources may include main power or control power. If necessary, disconnect incoming power leads L1, L2, L3, and control wiring from the terminal block.

Actuator and thrust base removal

Remove the bolts that secure the actuator and thrust base (#10) to the mounting adapter.

STEP 2

☠ **WARNING:** Potential high-pressure vessel! Before disassembling your actuator, ensure that the valve or other actuated device is isolated and is not under pressure.

Declutch the actuator to manual mode.

STEP 3

Rotate the handwheel until the actuator lifts off the threaded stem.

3.2.7 Remounting (Type A1/A1E Base) Actuator and Thrust Base as a Unit

STEP 4

Actuator and thrust base remounting

Declutch the actuator to manual mode. Lift actuator up to the threaded stem and carefully align threads with thrust base threaded stem nut.

STEP 5

Rotate the handwheel to lower the actuator along the threaded stem and onto the mounting adapter plate.

STEP 6

Install the mounting bolts to secure the actuator and thrust base (#10) to the mounting adapter.

STEP 7

☠ **WARNING:** Hazardous Voltage! Turn off all power sources before rewiring incoming power leads L1, L2, L3, and control wiring in the terminal block.

Reconnect incoming power leads L1, L2, L3, and control wiring to the terminal block. Restore power source when ready for operation.

4 Mechanical Assemblies

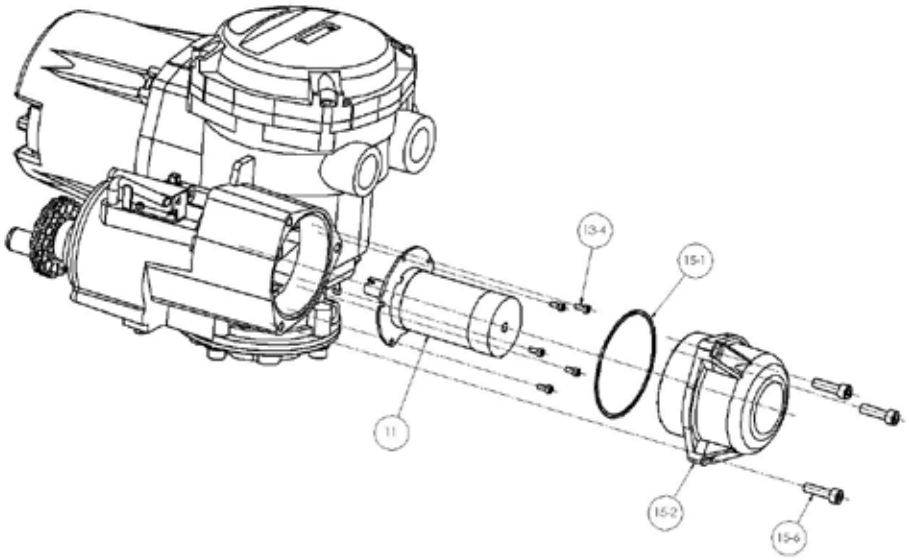
4.1 Motor subassembly. QX-1 thru 5.

NOTE: Proper motor testing is required when replacing motor. Consult your Limitorque representative or the Limitorque factory to replace with correct motor.

Table 4.1 - Motor Parts List

ITEM NUMBER	DESCRIPTION	QTY.
11	MOTOR	1
13-4	SOCKET HEAD CAP SCREWS	5
15-1	'O'-RING	1
15-2	COVER, MOTOR	1
15-6	SOCKET HEAD CAP SCREWS	3

Figure 4.1 - Motor Cover and Motor Subassembly Removal



4.1.1 Motor subassembly Removal. QX-1 thru 5.

Step 1

WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing motor assembly. Power sources may include main power or control power.

Using a M6 hex key, remove the three M8 screws (#15-6) that mount the motor cover and remove cover (#15-2) and 'O'-ring (#15-1) from unit assembly.

NOTE: The controls cover must also be removed to disconnect the motor cable from the motor controller if the motor is to be completely removed. See Section 6.2 for controls cover removal, Section 7.1 for motor connector placement.

Step 2

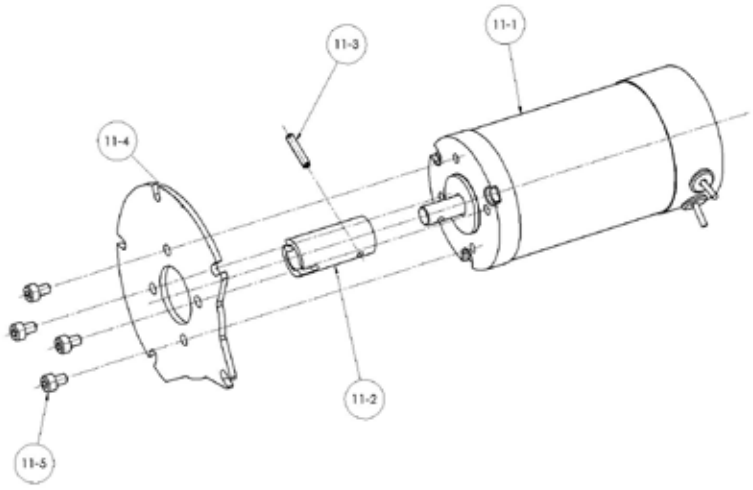
CAUTION: The rotor is not connected to the motor housing; when removing the motor, ensure the rotor is carefully removed and not dropped from the motor housing.

Using a M3 hex key, remove the five M4 screws (#13-4) that mount the motor assembly. Remove the motor assembly (#11) from unit by sliding motor out of the unit and if needed disconnect motor connector from motor control board and slide wiring out of unit.

Table 4.2 Motor Subassembly, Item 11

ITEM NUMBER	DESCRIPTION	QTY.
11-1	MOTOR	1
11-2	COUPLING	1
11-3	SPIRAL PIN	1
11-4	PLATE, MOTOR MOUNTING	1
11-5	SOCKET HEAD CAP SCREWS	1

Figure 4.2 - Motor Subassembly, Item11



4.1.2 Motor subassembly Remounting. QX-1 thru 5.

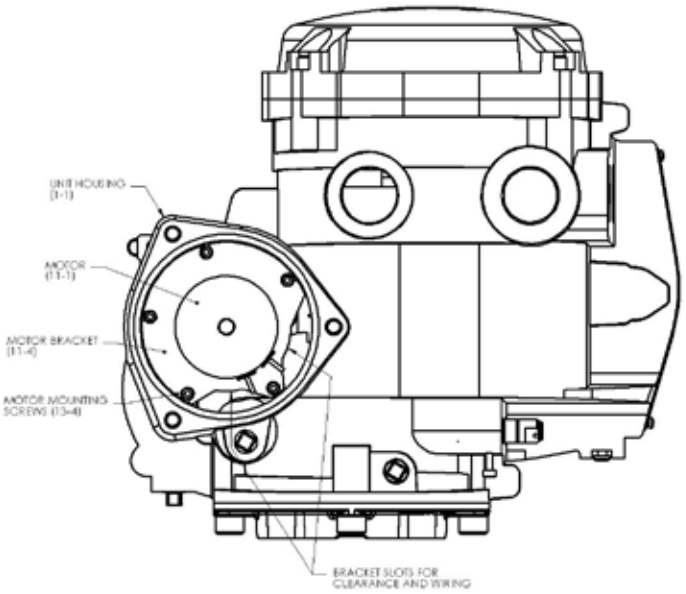
Step 1

WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing motor assembly. Power sources may include main power or control power.

If motor wiring was removed reroute wiring thru housing over to the motor control board. Do not connect motor wiring connector until motor is mounted in unit. Rotate motor coupling slot to correct position on motor to match motor cartridge pin orientation noting motor bracket position to unit housing per Figure 4.3 and slide motor assembly into housing aligning the motor coupling bore and slot to the motor cartridge shaft and pin and the motor bracket to the unit housing.

(See Figure 4.3 listed for motor bracket orientation to unit housing).

Figure 4.3 - Motor Bracket Orientation View



Step 2

Reconnect motor wiring connector to motor control board. Install the five M4 screws (#13-4) and tighten.

(See section 7 for motor wiring connection).

Step 3

Lightly lubricate 'O'-ring (#15-1) and install around motor cover spigot/pilot (#15-2). Slide motor cover spigot/pilot into the unit housing.

Step 4

Fit the 3 screws (#15-6) into motor cover mounting holes and tighten to torque in section 2.

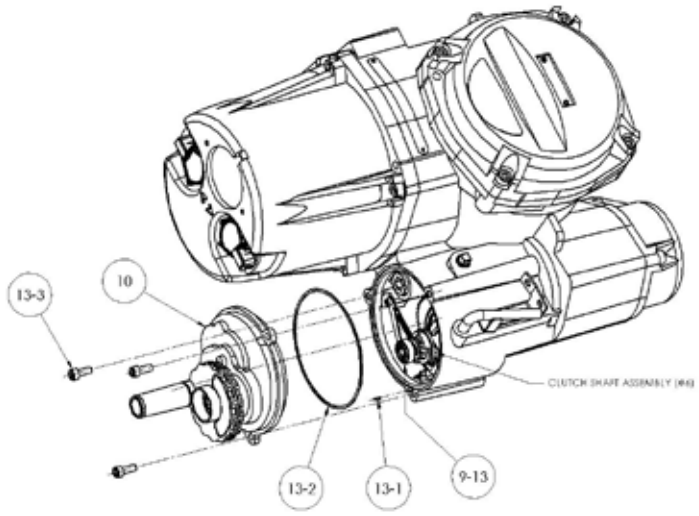
4.2 Handwheel cover subassembly, QX-1 thru 5.

NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained.

Table 4.3 - Handwheel Cover Assembly

ITEM NUMBER	DESCRIPTION	QTY.
10	HANDWHEEL COVER ASSY	1
13-1	DOWEL PIN	1
13-2	'O'-RING	1
13-3	SOCKET HEAD CAP SCREW	3

Figure 4.4 - Handwheel Cover Assembly



WARNING: Do not manually operate the actuator with devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

4.2.1 – Handwheel cover subassembly Removal, QX-1 thru 5

Step 1

WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing top-mounted handwheel assembly. Power sources may include main power or control power.

Using a M5 hex key, remove the three M6 screws (#13-3) that mount the handwheel cover and remove the handwheel cover assembly (#10) and 'O'-ring (#13-2) from unit assembly. Dowel pin (#13-1) is pressed into the unit housing.

Note: QX-1 thru 5 Ball bearing (#9-13) may also come out with the handwheel assembly, QX-3,4 and 5 Ball bearing (#9-3) may also come out with the handwheel assembly.

Table 4.4 - Handwheel Cover Subassembly Item 10. QX -1 & 2

ITEM NUMBER	DESCRIPTION	QTY.
10-1	COVER, HANDWHEEL	1
10-2	'O'-RING	1
10-3	SHAFT, HANDWHEEL	1
10-4	HANDWHEEL SUBASSEMBLY	1
10-5	RETAINING RING	1

Figure 4.5 - Handwheel Cover Subassembly, Item 10. QX-1 & 2

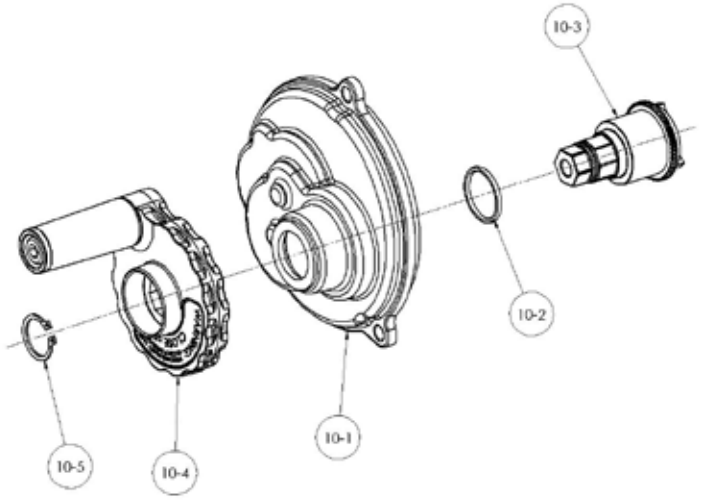


Table 4.5 - Handwheel Cover Subassembly, Item 10. QX-3 thru 5

ITEM NUMBER	DESCRIPTION	QTY.
10-1	COVER, HANDWHEEL	1
10-2	'O'-RING	1
10-3	SHAFT, HANDWHEEL	1
10-4	HANDWHEEL SUBASSEMBLY	1
10-5	WASHER	2
10-6	HEX NUT	1

Figure 4.6 - Handwheel Cover Subassembly, Item 10. QX-3 thru 5

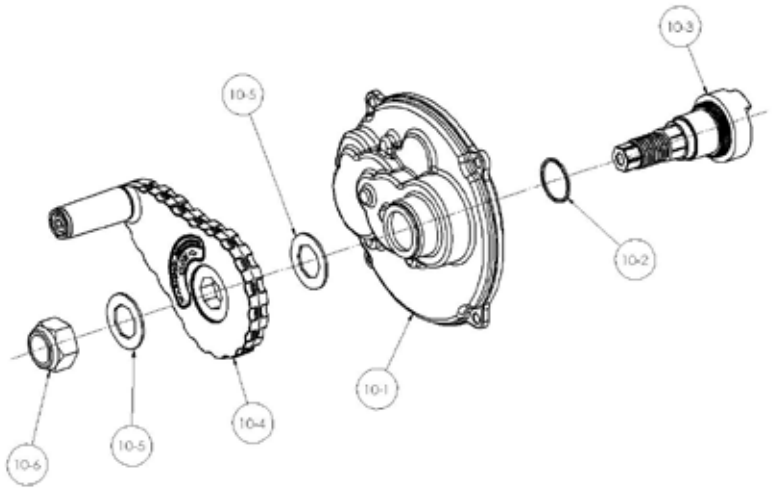
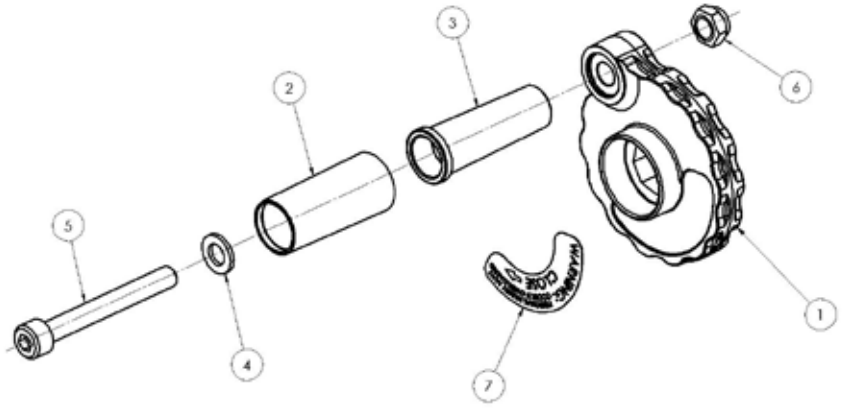


Table 4.6 - Handwheel Subassembly, Item 10-4

ITEM NUMBER	DESCRIPTION	QTY.
1	HANDWHEEL	1
2	SPINNER	1
3	SPINNER ROD	1
4	FLAT WASHER	1
5	SOCKET HEAD CAP SCREW	1
6	HEX NUT	1
7	HANDWHEEL LABEL	1

Figure 4.7 - Handwheel Subassembly, Item 10-4. QX-1 & 2 shown.



4.2.2 Handwheel Cover Assembly Remounting

Step 1

Lightly lubricate 'O'-ring (#15-2) and install around handwheel cover subassembly pilot (#10). Slide ball bearing (#9-13) back on end of clutch assembly if bearing was removed. Slide handwheel cover assembly pilot (#10) into the unit housing assuring the ball bearing aligns in handwheel shaft bore and dowel pin (13-1) aligns with the pin hole in cover.

NOTE: for QX-3,4 and 5 Handwheel assembly must also align with Ball bearing (#9-3) and the idle shaft assembly, see Figure 4.10 for view of idle shaft assembly location.

Step 2

Fit the 3 screws (#13-3) into handwheel cover mounting holes and tighten.

Check to make sure handwheel rotates freely.

4.3 Motor Cartridge Subassembly, QX-1 thru 5.

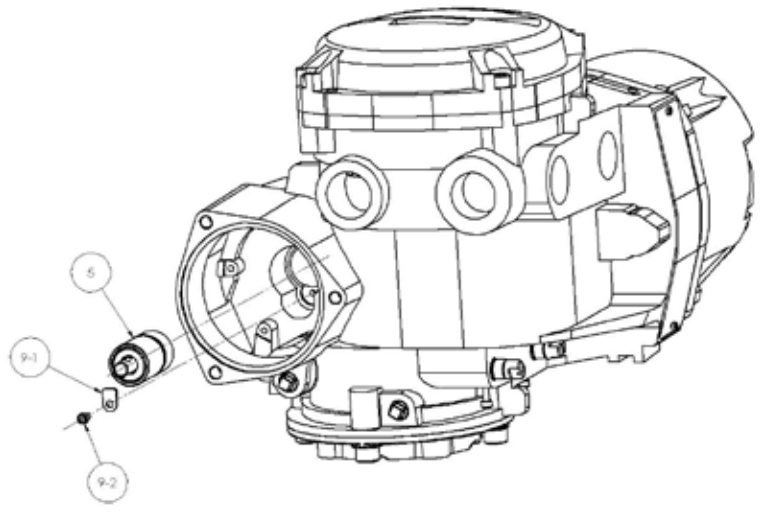
NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained.

4.3.1 Motor Cartridge Subassembly Removal, QX-1 thru 5.

Table 4.7 Motor Cartridge Assembly Removal

ITEM NUMBER	DESCRIPTION	QTY.
5	MOTOR CARTRIDGE	1
9-1	TAB, BRACKET	1
9-2	SOCKET HEAD CAP SCREW	1

Figure 4.8 - Motor Cartridge Assembly Removal



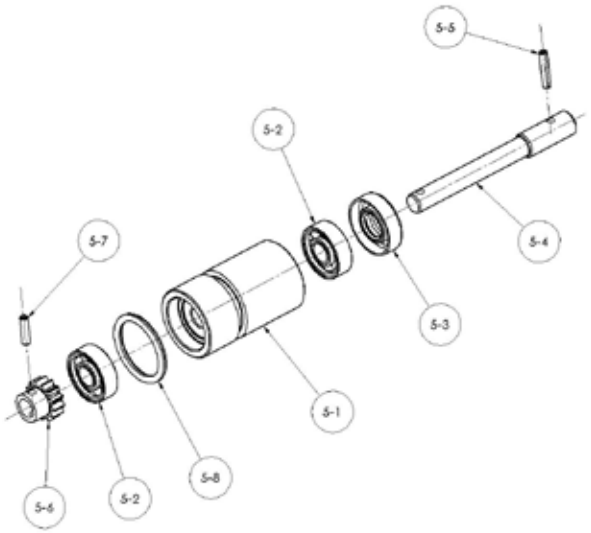
Step 1

Using a M3 hex key, remove the M4 screw (#9-2) and bracket (#9-1). Grab end of motor cartridge shaft and pull out cartridge subassembly.

Table 4.8 - Motor Cartridge Subassembly, Item 5

ITEM NUMBER	DESCRIPTION	QTY.
5-1	BUSHING	1
5-2	BALL BEARING	2
5-3	OIL SEAL	1
5-4	SHAFT	1
5-5	SPIRAL PIN	1
5-6	PINION, MOTOR	1
5-7	SPIRAL PIN	1
5-8	'O'-RING	1

Figure 4.9 - Motor Cartridge Subassembly, Item 5



4.3.2 Motor Cartridge Assembly Remounting.

Step 1

Lightly lubricate 'O'-ring (#5-8). Push cartridge subassembly into housing bore assuring motor pinion (#5-6) aligns with motor gear on handwheel side of housing. Cartridge face should be even or below the counter bore face in the unit housing. Place bracket (#9-1) and screw (#9-2) in countered bored area with M4 tap and tighten screw. Note: The bracket must sit flat on cartridge bushing and on the housing counter bore face.

4.4 Gearing and Clutching.

NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained.

Table 4.9 - Gearing and clutching, QX-1 & 2

ITEM NUMBER	DESCRIPTION	QTY.
6	CLUTCH SHAFT SUBASSEMBLY	1
7	CLUTCH FORK SUBASSEMBLY	1
9-4	PLATE, GEAR	1
9-5	SOCKET HEAD FLAT SCREW	2
9-6	BRACKET, DECLUTCH	1
9-7	SOCKET HEAD FLAT SCREW	2
9-8	'O'-RING	1
9-9	DECLUTCH LEVER	1
9-10	SOCKET HEAD CAP SCREW	1
9-11	EXTENSION SPRING	1
9-12	BRACKET	1
9-13	BALL BEARING	1
9-14	SOCKET HEAD CAP SCREW	1
9-15	SPACER, DECLUTCH SPRING	1

Figure 4.10 - Gearing and clutching, QX-1 & 2

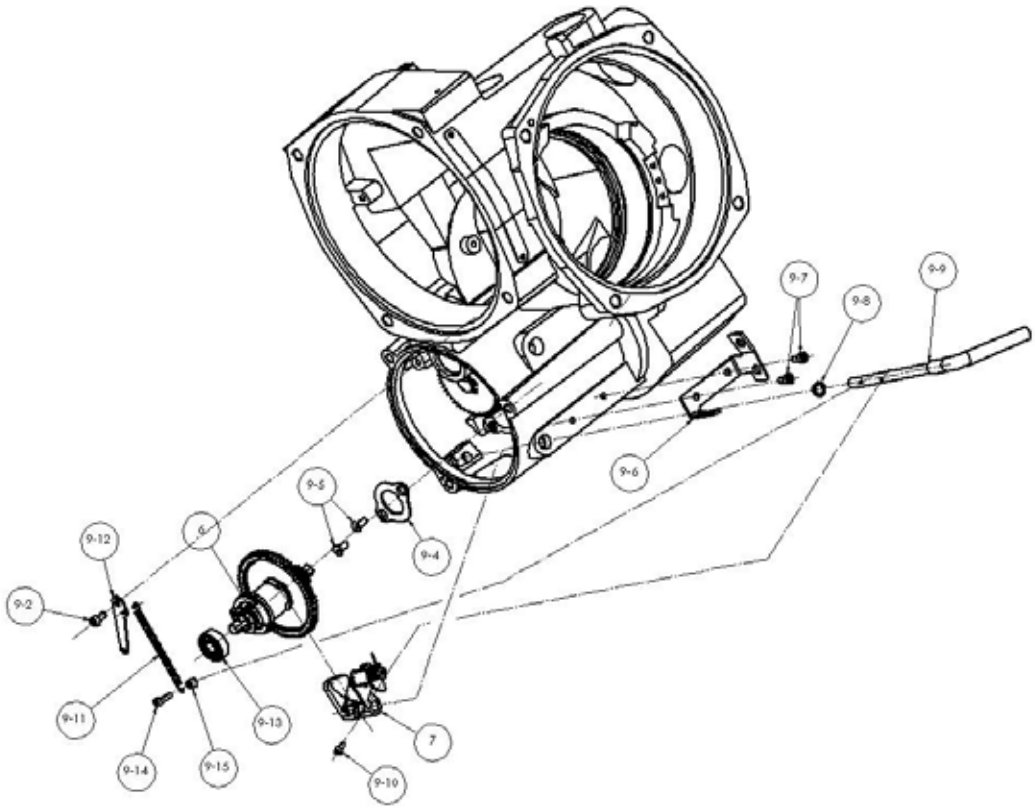
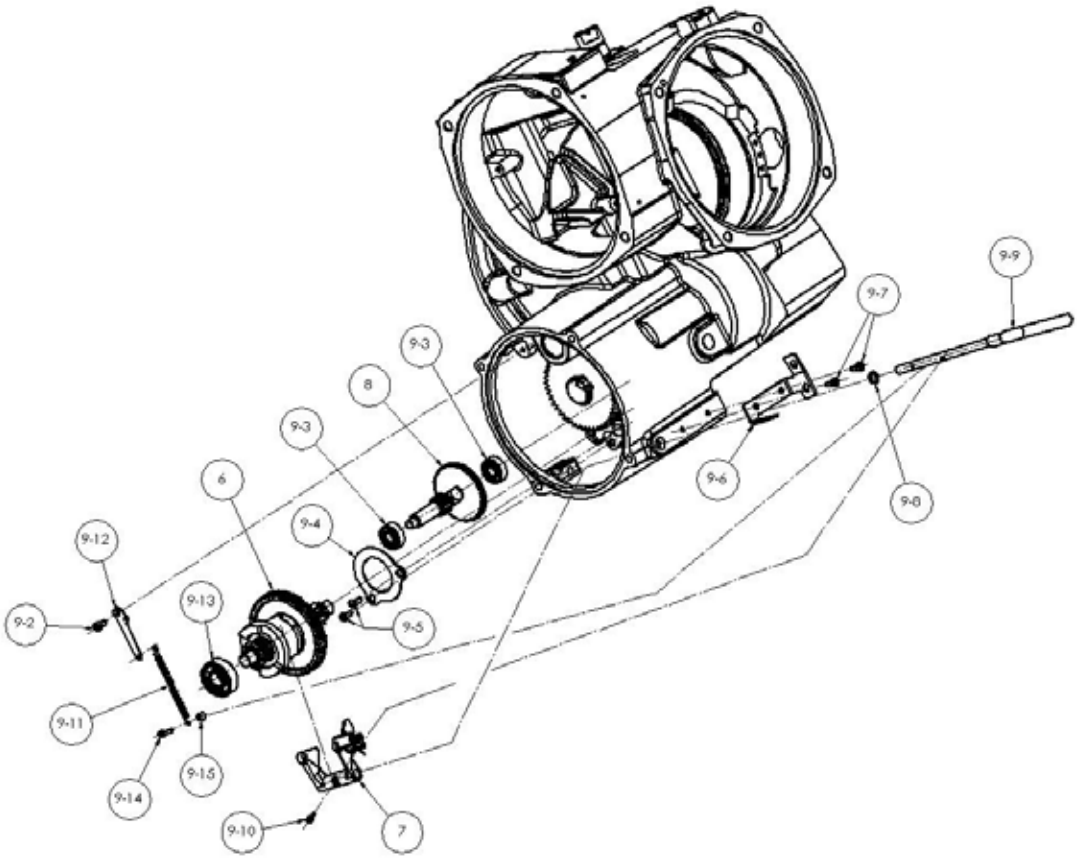


Table 4.10 - Gearing and clutching, QX-3 thru 5

ITEM NUMBER	DESCRIPTION	QTY.
6	CLUTCH SHAFT SUBASSEMBLY	1
7	CLUTCH FORK SUBASSEMBLY	1
8	SPUR IDLER SUBASSEMBLY	1
9-4	PLATE, GEAR	1
9-5	SOCKET HEAD FLAT SCREW	2
9-6	BRACKET, DECLUTCH	1
9-7	SOCKET HEAD FLAT SCREW	2
9-8	'O'-RING	1
9-9	DECLUTCH LEVER	1
9-10	SOCKET HEAD CAP SCREW	1
9-11	EXTENSION SPRING	1
9-12	BRACKET	1
9-13	BALL BEARING	1
9-14	SOCKET HEAD CAP SCREW	1
9-15	SPACER, DECLUTCH SPRING	1

Figure 4.11 - Gearing and clutching, QX-3 thru 5



4.4.1 Gearing and Clutching Removal.

WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing top-mounted handwheel assembly. Power sources may include main power or control power.

Step 1, Declutch lever spring return assembly.

Using a M3 hex key, remove the M4 screw (#9-2) and remove bracket (#9-12). Note that spring may be removed from bracket before removing screw (#9-2) using needle nose pliers. Using a M2.5 hex key remove M3 screw (#9-14), spring (#9-2) and spacer (9-15) from declutch shaft.

Step 2, Declutch lever, Clutch fork and clutch shaft subassembly.

Using a M2.5 hex key remove M3 screw (#9-10) holding clutch fork (#7) subassembly and declutch lever (#9-9) in place. Remove declutch lever (#9-9) and 'O'-ring (#9-8) by sliding lever up and out of housing. Gently pull out the clutch shaft subassembly (#6) and clutch fork subassembly (#7) out of unit thru the handwheel cover bore.

Step 3, Spur idler subassembly. QX-3/4/5 only.

Gently pull out spur idler subassembly (#8) out thru handwheel cover bore.

Step 4, Gear plate.

Using a M3 hex key, remove the two M4 screws (#9-5) holding in gear plate (#9-4) and remove.

Step 5, Declutch bracket.

Using a M3 hex key, remove the two M4 screws (#9-7) holding declutch bracket (#9-6) in place and remove.

Table 4.11 - Clutch Shaft Subassembly, Item 6. QX-1 & 2

ITEM NUMBER	DESCRIPTION	QTY.
6-1	CLUTCH SHAFT	1
6-2	MOTOR CLUTCH GEAR	1
6-3	PINION	1
6-4	RETAINING RING	1
6-5	CLUTCH	1
6-6	COMPRESSION SPRING	1
6-7	WASHER	1
6-8	RETAINING RING	1

Figure 4.12 - Clutch Shaft Subassembly, Item 6. QX-1 & 2

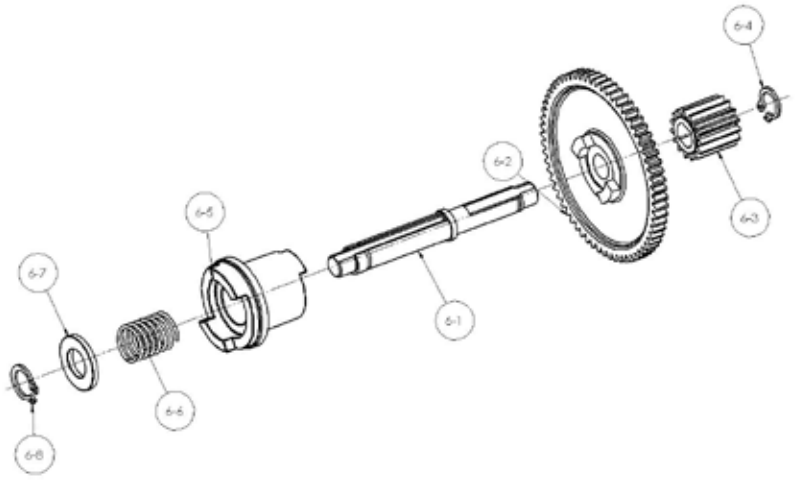


Table 4.12 - Clutch Shaft Subassembly Item 6. QX-3 Thru 5

ITEM NUMBER	DESCRIPTION	QTY.
6-1	CLUTCH SHAFT	1
6-2	MOTOR CLUTCH GEAR	1
6-5	CLUTCH	1
6-6	COMPRESSION SPRING	1
6-7	WASHER	2
6-8	RETAINING RING	2

Figure 4.13 - Clutch Shaft Subassembly, Item 6. QX-3 thru 5

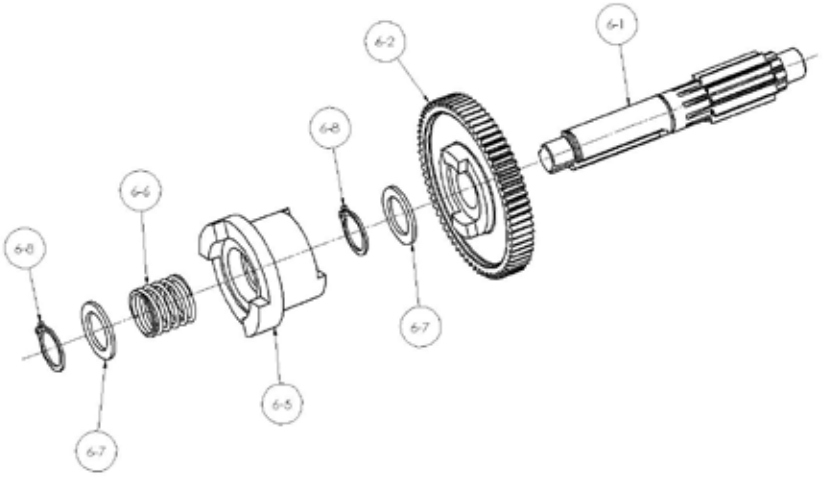
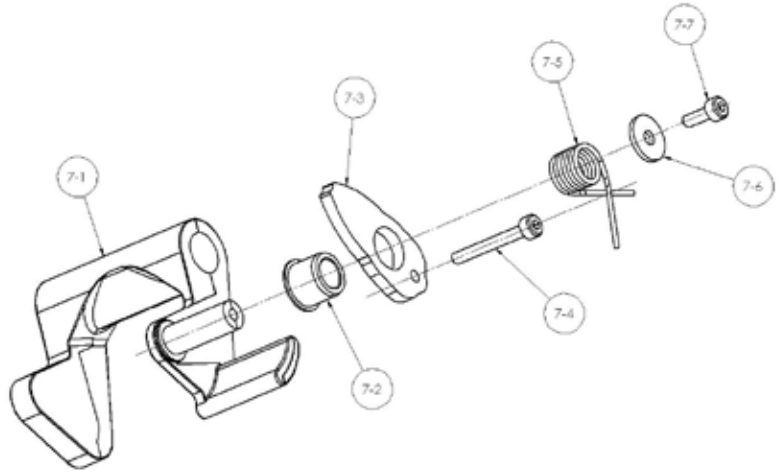


Table 4.13 - Clutch Shaft Subassembly Item 7

ITEM NUMBER	DESCRIPTION	QTY.
7-1	CLUTCH FORK	1
7-2	BUSHING	1
7-3	LATCH	1
7-4	SOCKET HEAD CAP SCREW	1
7-5	TORSION SPRING	1
7-6	WASHER	1
7-7	SOCKET HEAD CAP SCREW	1

Figure 4.14 - Clutch Shaft Subassembly, Item 7



4.4.2 Gearing and Clutching Remounting.

Step 1, Declutch bracket.

Place declutch bracket (#9-6) on to housing and secure with two M4 screws (#9-7) using a M3 hex key.

Step 2, Gear plate.

Before placing plate be sure that ball bearing item (#2-8) is in place (See Figure 4.18). The ball bearing will not slide thru place with gear plate mounted in housing. Place plate in housing on pad with the two M4 taps and with the plate counter sunk holes facing toward the handwheel cover aligning the plate big hole with the ball bearing (#2-8) bore. Note that the two counter sunk holes is for the two flat head screws (#9-5). Fit the two M4 flat head screws (#9-5) and tighten with a M2.5 hex key.

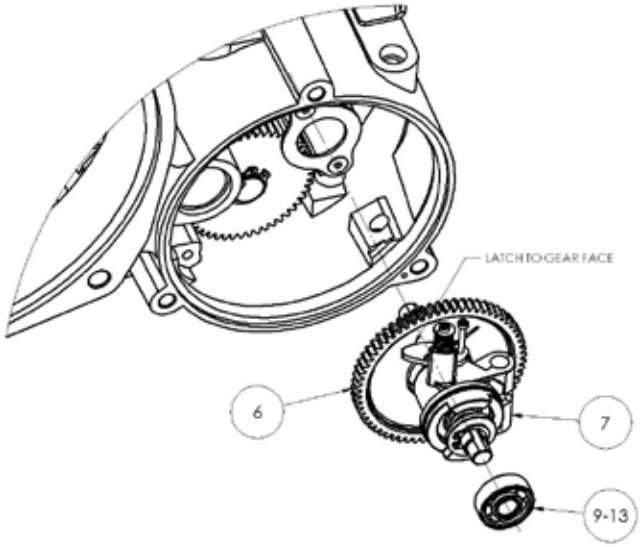
Step 3, Spur idler subassembly, QX-3 Thru 5 only.

Place ball bearing (#9-3) in housing bore, the bore without the bearing plate. Slide in the spur idler subassembly (#8) into bearing (#9-3) with the big gear end of the idler shaft first and engage with bearing (#9-3).

Step 4, Clutch fork and clutch shaft subassembly.

Slide the clutch fork subassembly (#7) over the clutch on the clutch shaft subassembly with the latch (#7-3) side pushed against the big gear face. Fit both clutch shaft and clutch fork subassemblies together into housing with the small pinion on clutch shaft fitting thru the gear plate (#9-4) and engaging shaft into ball bearing (#2-8). Note also that the clutch fork must be orientated with the latch up towards the declutch plate and the clutch fork bore in line with the declutch shaft.

Figure 4.15 - Clutch Fork Shaft Remounting



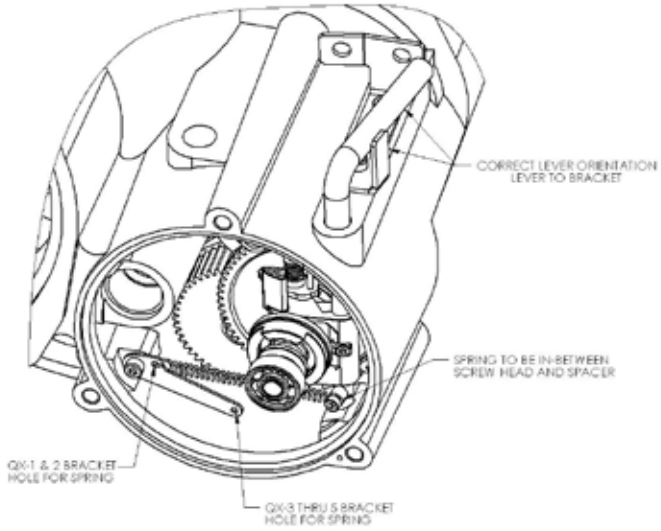
Step 5, Declutch lever and spring return assembly.

Lightly lubricate 'O'-ring (#9-8) and slide over declutch lever (#9-9). Slide declutch lever and 'O'-ring thru housing bore and down thru clutch fork bore and into the housing bore on other side ensuring that lever handle is installed properly with declutch bracket (#9-6), lever should not swing outwards. Secure fork with M3 screw (9-10) by inserting screw thru fork slot and into tap in lever and Tighten.

⚠ **CAUTION:** Do not lift unit by declutch lever.

Slide spring end (#9-14) on M3 screw (#9-14), then slide spacer (#915) on to M3 screw and secure assembly to bottom tap in declutch lever. The spacer should be in-between the spring and declutch lever. Place M4 screw (#9-2) into spring bracket (#9-12). Hook the spring bracket on to the declutch return spring (#9-14) that has already been installed on to the lever, (See Figure 4.16) for correct hole for spring to hook into. Carefully stretch the spring and position the M4 screw in place on housing and tighten.

Figure 4.16 - Declutch Spring Assembly View. QX-1 & 2 shown



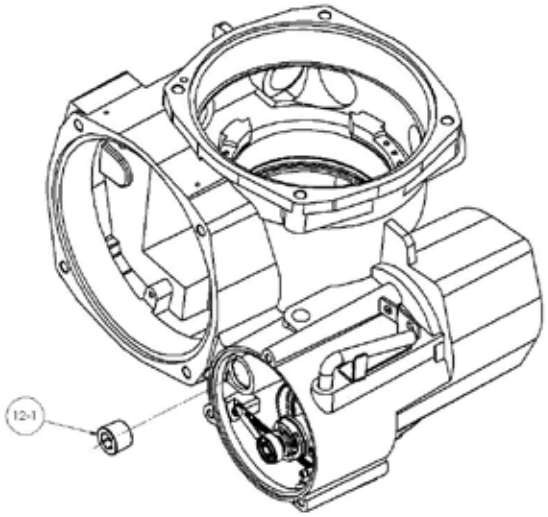
4.5 Pipe Plug

NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained.

Table 4.14 - Pipe Plug

ITEM NUMBER	DESCRIPTION	QTY.
12-1	PIPE PLUG	1

Figure 4.17 Pipe Plug



NOTE: If the pipe plug was removed, pipe sealant or tape must be applied to plug threads before remounting.

4.6 Baseplate

4.6.1 Baseplate Removal

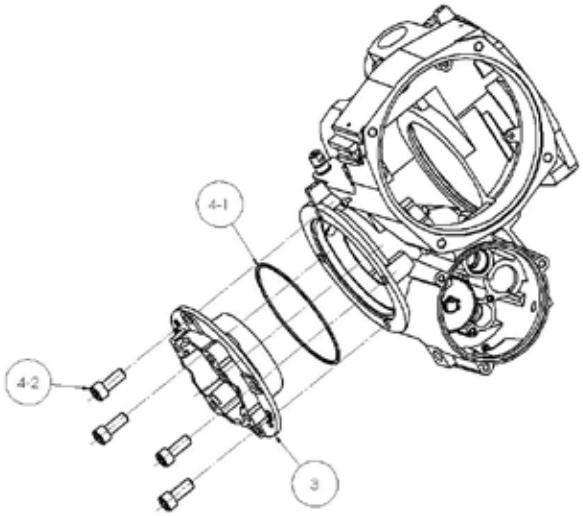
NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained.

NOTE: If unit has a F/FA-05 or 07 QX-1 & 2, F/FA-10 QX-3 thru 5 base or Thrust base attached, these bases must be removed before removing the standard baseplate. See section 4-9 thru 4-10.

Table 4.15 Baseplate F/FA-10 QX-1 & 2, F/FA-12 & 14 QX-3 thru 5

ITEM NUMBER	DESCRIPTION	QTY.
3	BASEPLATE ASSEMBLY	1
4-1	'O'-RING	1
4-2	SOCKET HEAD CAP SCREWS	4

Figure 4.18 - Baseplate, F/FA-10 QX-1 & 2, F/FA-12 & 14, QX-3 thru 5



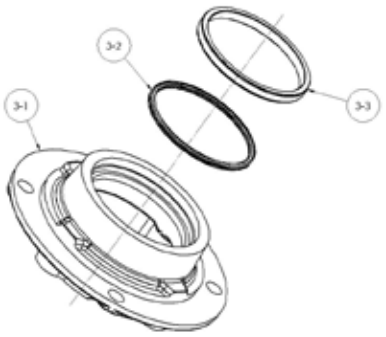
Step 1

Using a M8 hex key, remove the M10 screws (#4-2) and remove baseplate (#3).

Table 4.16 - Baseplate subassembly Item 3

ITEM NUMBER	DESCRIPTION	QTY.
3-1	BASEPLATE	1
3-2	QUAD RING	1
3-3	BUSHING	1

Figure 4.19 - F/FA-10 QX-1 & 2, F/FA-12 & 14, QX-3 thru 5 Baseplate Subassembly, Item 3



QX-1 & 2 Baseplate shown

4.6.2 Baseplate Remounting.

Step 1

Lightly lubricate 'Q'-ring (#3-2) and install in baseplate subassembly groove. Lightly lubricate 'O'-ring (#4-1) and install around baseplate subassembly pilot (#3). Slide baseplate subassembly into housing and over drive sleeve (#1-1). Fit the screws (#4-2) (Qty of 4 for QX-1 & 2) and (Qty of 8 for QX-3 thru 5) into baseplate mounting holes and tighten.

NOTES: Base Mounting Orientation.

1. QX-1 & 2 baseplate mounts with 4 screws and orientation will always be the same with the 4 mounting taps straddling centerline.
2. QX-3 thru 5 baseplate mounts with 8 screws and orientation depends on add on base options.
   A. If not adding on any base options the 4 mounting taps in base should be straddling centerline.
   B. If adding smaller F/FA-10 base the 4 mount taps should be on centerline.

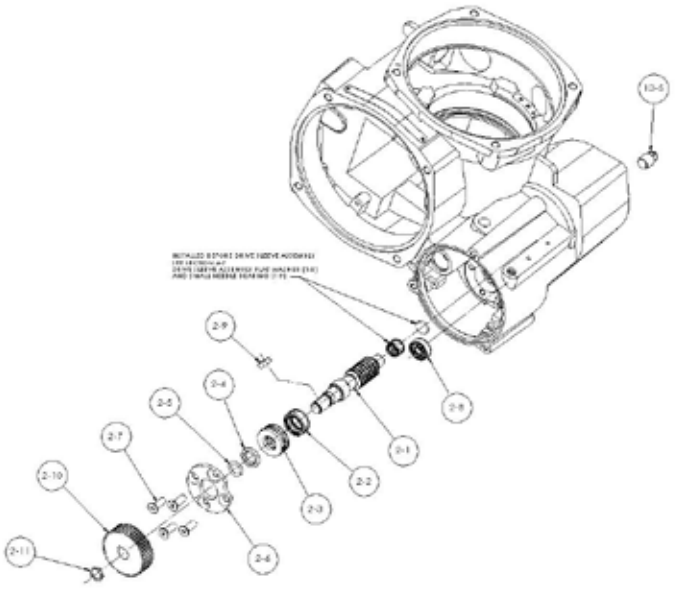
4.7 Worm Shaft Assembly

NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained.

Table 4.17 Worm Shaft Parts List

ITEM NUMBER	DESCRIPTION	QTY.
2-1	WORM SHAFT	1
2-2	NEEDLE BEARING	1
2-3	THRUST BEARING	1
2-4	WASHER	1
2-5	RETAINING RING (ROUND)	1
2-6	PLATE, WORM SHAFT	1
2-7	FLAT HEAD MACHINE SCREW	5
2-8	BALL BEARING	1
2-9	KEY	1
2-10	GEAR	1
2-11	RETAINING RING	1

Figure 4.20 - Worm Shaft



4.7.1 Worm Shaft Assembly Removal.

Step 1

WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing top-mounted handwheel assembly. Power sources may include main power or control power.

Using retaining ring pliers remove retaining ring (#2-11) and then remove gear (#2-10) and key (#2-9). Using M4 hex key (QX-1 & 2) or M6 hex key (QX-3 thru 5) remove M6 or M10 screws (#2-7) and remove plate (#2-6).

Step 2

Remove pipe plug (#13-5) from back of housing and worm shaft underneath motor. Remove base plate (#3) so drive sleeve and stops are visible (See section 4-6-1). Rotate worm shaft so the drive sleeve is in mid position. Being careful not to hit the threads of the pipe tap, hammer out the worm shaft hitting the flat washer (#1-8) that is in back of the worm shaft.

NOTE: The drive sleeve will rotate when knocking out worm shaft. Be sure that the drive sleeve is off of stops or damage to drive sleeve, stops and/or housing could accrue.

Step 3

If replacing bearings but not worm shaft remove round retaining ring (#2-5) to remove thrust bearing (#2-3) and needle bearing (#2-2) from worm shaft.

If replacing worm shaft, thrust bearing and needle bearing this step is not needed.

4.7.2 Worm Shaft Assembly Replacement.

CAUTION: Flowserve Limitorque recommends that the factory be contacted at 434-528-4400 to arrange replacement of a QX worm shaft at an authorized service center. Special tools are required for replacement.

Step 1

(Special tools required, contact factory for ordering information)

NOTE: Drive sleeve assembly must be removed before inserting washer (#1-8) and small needle bearing (#1-9).

See section 4-8-1 step 1 for drive sleeve removal and section 4-8-2 step 3 for remounting of flat washer and needle bearing.

Step 2

NOTE: Before inserting worm shaft the drive sleeve assembly must be assembled per section 4-8-2.

Insert worm shaft into housing meshing with drive sleeve and bottoming out in needle bearing installed in step 1. Note worm shaft should rotate freely with the drive sleeve and needle bearing.

Step 3

(Special tools required, contact factory for ordering information)

NOTE: Before pressing in needle bearing (#2-2) rotate worm so the drive is in mid position and off of the stops. If the drive sleeve touches stops when pressing in needle bearing damage to drive sleeve, stops and/or housing could accrue.

Lubricate needle bearing (#2-2) and place in housing and around worm shaft.

Using special tools from Flowserve lightly press needle bearing into housing until tool bottoms out. Needle bearing should be even with housing counter bore. Check that the worm shaft rotates freely and has freedom to be moved in and out.

Step 4

(Special tools required, contact factory for ordering information)

Lubricate thrust bearing (#2-3) and slide on end of worm shaft with the bigger ID bearing washer going on first. Place washer (#2-4) over end of worm shaft making sure that the chamfer on washer is facing out (Away from thrust bearing).

Using special tools from Flowserve slip on round retaining ring (#2-5). Retaining ring must engage in worm shaft round groove and fit inside the chamfer on washer (#2-4).

Step 5

Place ball bearing (#2-8) in housing bore for clutch shaft assembly. Place plate (#2-6) over end of worm shaft and align cut out notch with housing bore with bearing (#2-8). Fit the screws (#2-7) in plate holes and tighten. Place gear (#2-10) on worm shaft end and insert key (#2-9). Using retaining ring pliers secure gear and key with retaining ring (#2-11).

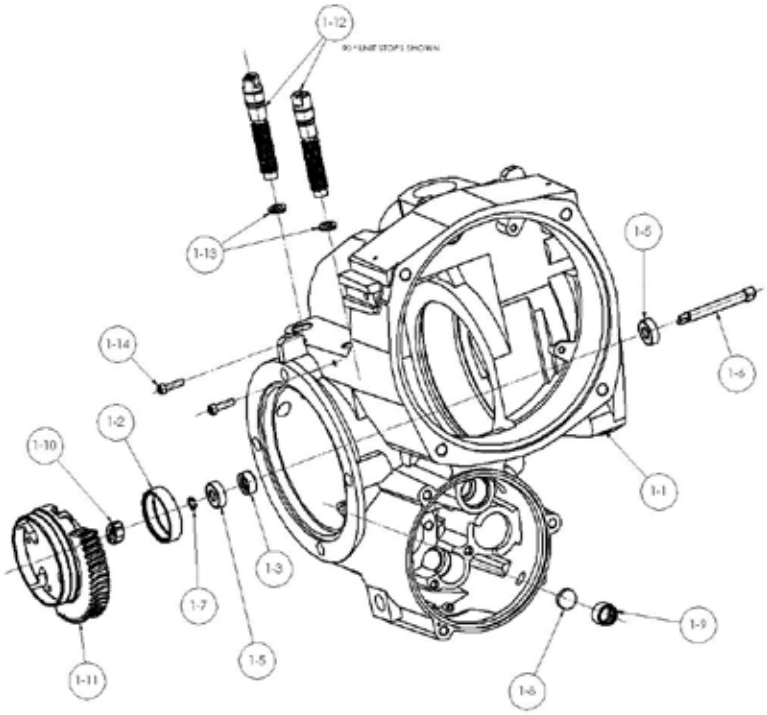
4.8 Drive Sleeve, Stops and Encoder Shaft Assemblies

NOTE: Sections 4.2 – 4.8 require the actuator to be removed from the mounting plate and the oil drained

Table 4.18 - Drive Sleeve, Stops, and Encoder Shaft Assembly

ITEM NUMBER	DESCRIPTION	QTY.
1-1	HOUSHING	1
1-2	BUSHING	1
1-3	OIL SEAL	1
1-5	BALL BEARING (SEALED)	2
1-6	SHAFT, ENCODER	1
1-7	RETAINING RING	1
1-8	DISC	1
1-9	NEEDLE BEARING	1
1-10	INSERT	1
1-11	DRIVE SLEEVE	1
1-12	STOPS	2
1-13	O-RING	2
1-14	SOCKET HEAD CAP SCREW	2

Figure 4.21 - Drive Sleeve, Stops, and Encoder Shaft Assembly



4.8.1 Drive Sleeve, Mechanical Stops, Encoder Shaft Removal.

NOTE: Baseplate (#3) must be removed to remove drive sleeve, see step 4-6-1. Washer ((#1-8) and needle bearing (#1-9) removed in section 4-7-1 step 2 when removing worm shaft.

Step 1, Drive sleeve removal.

☠ **WARNING:** Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing drive sleeve assembly. Power sources may include main power or control power.

Grab drive sleeve and while rotating back and forth pull out drive sleeve (#1-11). If needed remove insert (#1-10) by using inserting a screw driver down the center of the insert and prying out the insert.

Step 2, Stop removal.

Loosing screws (#1-14) using a M3 hex key. Using a flat head screw driver rotate the mechanical stops CCW to remove.

Step 3, Encoder shaft removal.

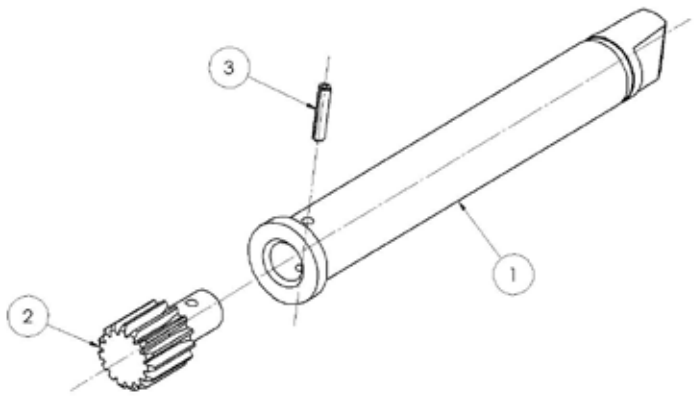
NOTE: The encoder must be removed before this step. (See Section 5 - Encoder Assemblies)

Using retaining ring pliers remove retaining ring (#1-7). Grab the encoder shaft (#1-6) from the terminal block side of the housing and pull out. Remove ball bearings (#1-5).

Table 4.19 - Multi-turn Encoder Shaft Subassembly (Item 1-6)

ITEM NUMBER	DESCRIPTION	QTY.
1	ENCODER SHAFT	1
2	PINION	1
3	ROLL PIN	1

Figure 4.22 - Multi-turn Encoder Shaft Subassembly (Item 1-6)



Step 4 – Encoder shaft seal.

If replacing encoder shaft seal (#1-3) the seal must be pried out using small screw driver.

NOTE: Be careful not to damage the seal bore of the unit housing (#1-1). Seal will not seal correctly if housing seal bore is damaged.

NOTE: Bushing (#1-2) is pressed on to housing. If bushing and/or housing is damaged a subassembly of the housing with the bushing will have to be ordered from the factory.

4.8.2 Drive Sleeve, Mechanical Stops and Encoder Shaft Assembly Remounting.

Step 1, Encoder shaft seal.

(Special tool required, contact factory for ordering information)

Using tool from factory press oil seal (#1-3) into housing making sure that the open end of the seal is towards the base of the unit. If some of the seal is torn, remove the excess.

Step 2, Encoder shaft assembly.

Insert the two ball bearings (#1-5), one on the encoder side and one on the unit base side. Slide the encoder shaft (#1-6) through from the encoder side and using retaining ring pliers place retaining ring (#1-7) on base side of encoder shaft. Ensure retaining ring is seated correctly in encoder shaft groove.

Step 3, Flat washer and small needle bearing.

(Special tools required, contact factory for ordering information)

NOTE: drive sleeve assembly must be removed before inserting washer (#1-8) and small needle bearing (#1-9).

Place flat washer (#1-8) in bottom of housing worm shaft bore making sure the washer is flat in bottom of housing bore. Note that this washer is needed if worm shaft is to be removed at any time in the future.

Lubricate needle bearing (#1-9) and using special tools from Flowserve lightly press or hammer needle bearing into housing until seated.

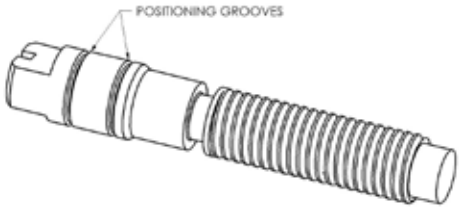
Step 4, Mechanical Stop assembly.

If needed replace 'O'-ring (#1-13) on stop (#1-12). (Special tool can be order from factory for installing 'O'-ring, contact factory for ordering information).

Insert stops into housing and using a flat head screw driver turning in stop CW to about midpoint of the two grooves on the stop.

NOTE: The two grooves on the stop is approximate min and max positions of stop travel by aligning grooves with housing face. If stop is positioned out too far oil could leak by the mechanical stop 'O'-ring. Stop positions will have to be reset after mounting unit to valve.

Figure 4.23 - Stop Groove View



Step 5, Drive sleeve remounting.

If removed place new encoder insert (#1-10) into drive sleeve (#1-11) slot. Place drive sleeve in to housing aligning drive sleeve with bushing (#1-2) and the insert with the encoder shaft flats. Rotate drive sleeve to each end of travel to make sure that it turns smoothly. Leave loose for installing the worm shaft.

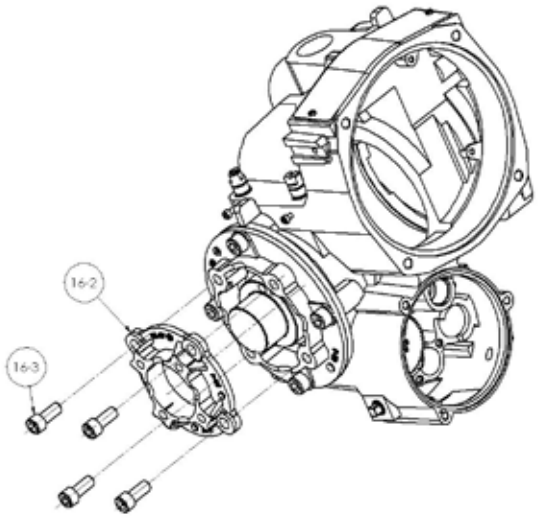
4.9 Optional Baseplate Assembly, F/FA-05 & -07 QX-1 & 2, F/FA-10 QX-3 thru 5.

4.9.1– Optional Baseplate Removal.

Table 4.20 - Optional Baseplate Removal

ITEM NUMBER	DESCRIPTION	QTY.
16-2	BASEPLATE	1
16-3	SOCKET HEAD CAP SCREWS	4

Figure 4.24 - F/FA-05 / 07, QX-1 & 2 or F/FA-10, QX-3 thru 5 Optional Baseplate



Step 1

QX-1 & 2, MSS FA-05 or -07 baseplate. Using a 5/6" hex key For MSS baseplate, remove the 3/8-16 screws (#4-2) and remove baseplate (#3).

QX-1 & 2, ISO F-05 or -07 baseplate. Using a M8 hex key For ISO baseplate, remove the M10 screws (#4-2) and remove baseplate (#3).

QX-3, 4 & 5, MSS FA-10 baseplate. Using a ½" hex key For MSS baseplate, remove the 5/8-11 screws (#4-2) and remove baseplate (#3).

QX-3, 4 & 5, ISO F-10 baseplate. Using a M14 hex key For ISO baseplate, remove the M16 screws (#4-2) and remove baseplate (#3).

4.9.2 – Optional Baseplate Remounting.

NOTE: For small baseplate the torque nut must be mounted to drive sleeve before mounting baseplate. See section 4-11-1.

Place small baseplate on large baseplate aligning pilot. Place screws in baseplate holes and tighten.

4.10 Torque Nut.

Table 4.21 - Torque nut, F/FA-10, QX-1 & 2 and F/FA-12 and -14, QX-1 thru 5

ITEM NUMBER	DESCRIPTION	QTY.
13-6	TORQUE NUT	1
13-7	SCO HEAD CAP SCREW	1

Figure 4.25 - Torque nut, F/FA-10, QX-1 & 2 and F/FA-12 and -14, QX-1 thru 5

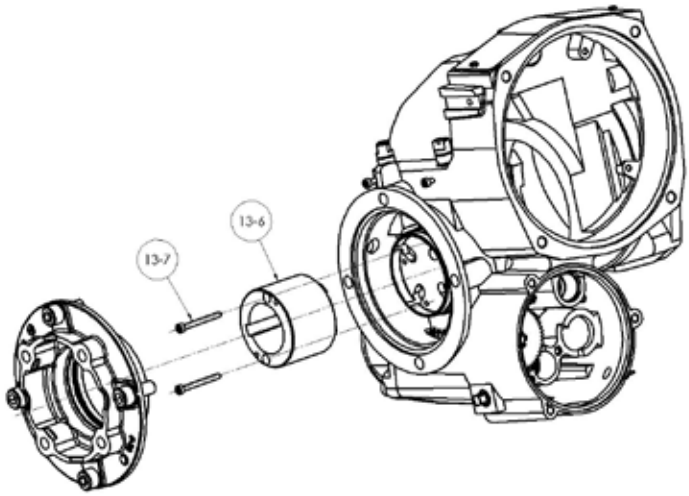
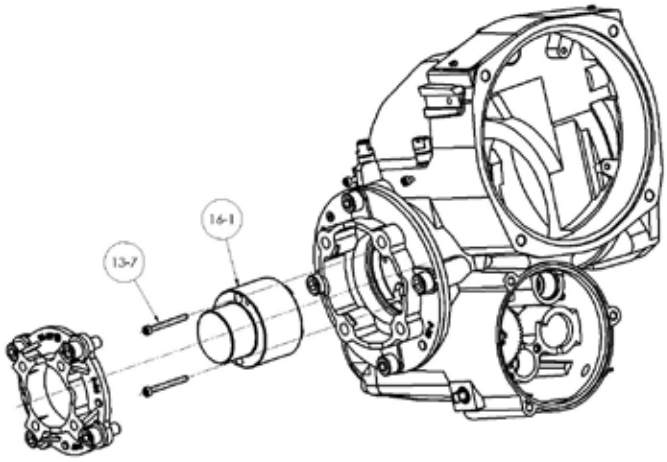


Table 4.22 - Torque nut F/FA-05 and -07 QX-1 & 2 and F/FA-10, QX-1 thru 5

ITEM NUMBER	DESCRIPTION	QTY.
13-7	SOCKET HEAD CAP SCREW	1
16-7	TORQUE NUT	1

Figure 4.26 - Torque nut, F/FA-05 and -07, QX-1 & 2 and F/FA-10, QX-1 thru 5



4.10.1 Optional Small Baseplate Removal.

Step 1

QX-1 & 2, F/FA-10 and QX-3 thru 5 F/FA-12 and -14. Using a M3 hex key forQX-1 & 2 or M5 hex key for QX-3, 4 & 5, remove the M4 or M6 screws (#13-7) and remove torque nut (#13-6).

QX-1 & 2, F/FA-05 or -07, QX-3 thru 5 F/FA-10.

Remove small baseplate per Section 4-6-4. Using a M3 hex key, QX-1 & 2 or M5 hex key for QX-3, 4 & 5, remove the M4 or M6 screws (#13-7) and remove torque nut (#16-7).

4.10.2 Optional Small Baseplate Remounting.

Step 1

NOTE: Torque nut may be mounted in 1 of 4 positions (every 90°) on QX-1 & 2 and 1 of 8 positions (every 45°) on the QX-3 thru 5. Make sure the torque nut is in the position needed.

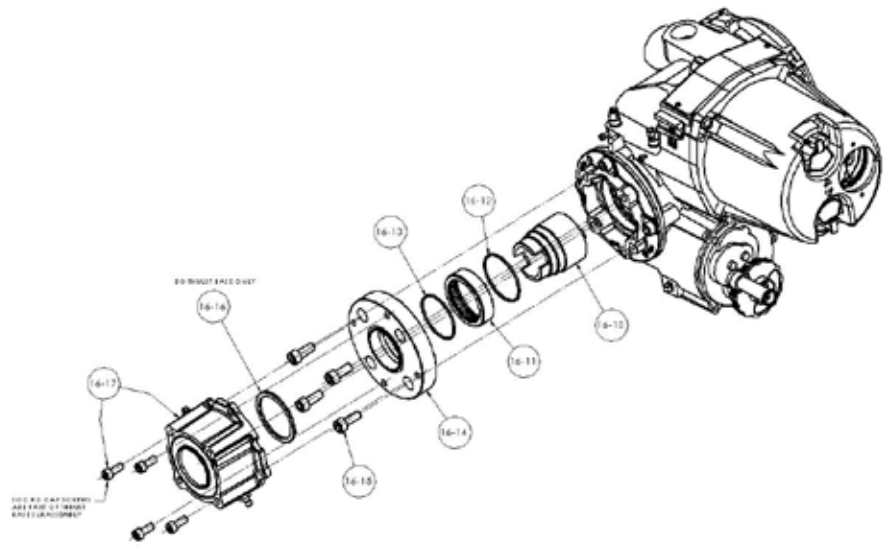
Slide torque into drive sleeve aligning pilot and lugs, Place screws in torque nut holes and tighten. Remount baseplate.

4.11 Optional Thrust Base Assembly QX-1 & 2.

Table 4.23 - Optional Thrust Base Assembly

ITEM NUMBER	DESCRIPTION	QTY.
16-10	TORQUE NUT	1
16-11	BUSHING	1
16-12	O'-RING	1
16-13	O'-RING	1
16-14	ADAPTER PLATE	1
16-15	SOCKET HEAD CAP SCREWS	4
16-16	SPACER, PILOT, ISO ONLY	1
16-17	THRUST BASE ASSEMBLY	1

Figure 4.27 - Optional Thrust Base Assembly QXM Only



4.11.1 Optional Thrust Base Assembly Removal.

Step 1

Remove the four (4) screws (#) and remove the thrust base subassembly (#16-17) by sliding the base down. If base is ISO remove the spacer (pilot) (#16-16).

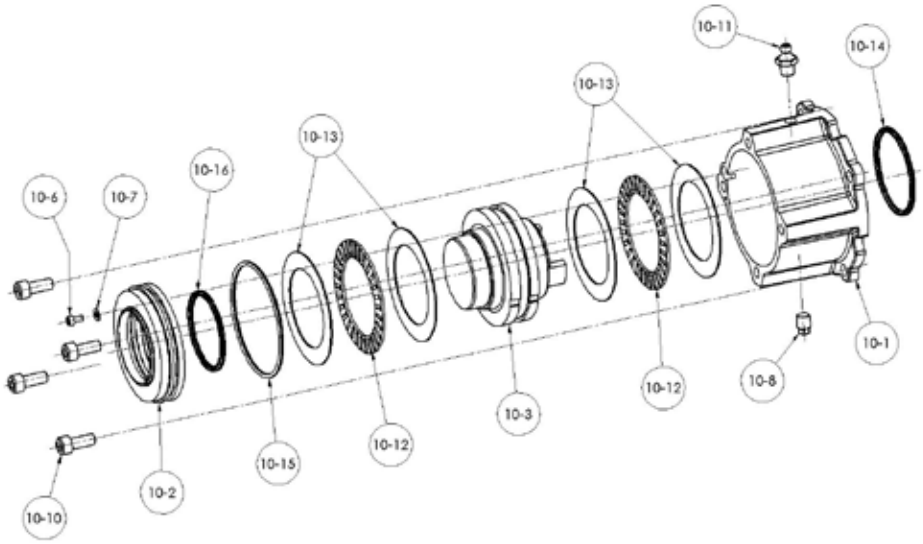
Step 2

Remove the four (4) screws (# 16-15) and remove the adapter plate (#16-14) and torque nut (#16-10). Item (#16-11) bushing is pressed into adapter plate and cannot be removed. The torque nut is held in place by the unit drive sleeve and the bushing (#16-11).

Table 4.24 Optional Thrust Base Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
10-1	HOUSING, THRUST BASE	1
10-2	PILOT, THRUST BASE	1
10-3	THRUST NUT	1
10-6	SOCKET HEAD CAP SCREWS	1
10-7	FLAT WASHER	1
10-8	RELIEF FITTING	1
10-10	SOCKET HEAD CAP SCREWS	4
10-11	GREASE FITTING	1
10-12	NEEDLE BEARING	2
10-13	THRUST RACE	2
10-14	QUAD RING	1
10-15	O'-RING	1
10-16	QUAD RING	1

Figure 4.28 - Optional Thrust Base Subassembly



4.11.2 Thrust Base Remounting.

Step 1

Place QX torque nut (#16-10) into unit drive sleeve (#1-11) aligning nut lugs to drive sleeve slots.

Step 2

Lightly lubricate 'O'-rings (#16-12) and (#16-13) and insert into bushing (#16-11) that is pressed into adapter plate

(#16-14). Slide adapter plate and bushing over end of torque nut and aligning to unit baseplate. Insert screws (#16-15) into adapter plate holes and tighten.

Step 3

Align thrust base subassembly nut lugs (#10-3) with QX torque nut (#16-10) slots and slide thrust base on to QX unit baseplate aligning pilots. Note; For ISO thrust base pilot spacer (#16-16) must be used to align thrust base to QX baseplate. Insert screws (#10-10) into thrust base holes and tighten.

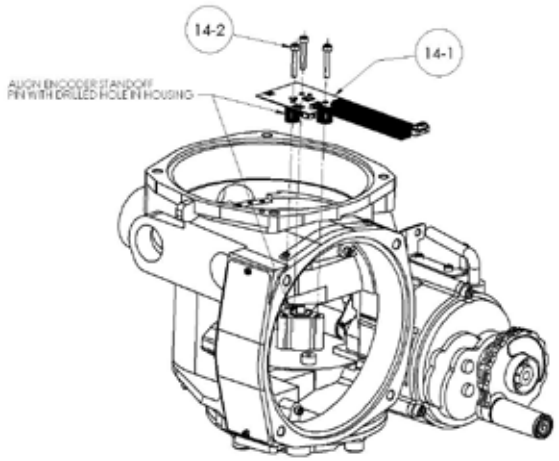
5 Encoder Assemblies

5.1 Encoder 90 Degree Unit Removal. QX-1 thru 5

Table 5.1 - 90º Encoder Assembly

ITEM NUMBER	DESCRIPTION	QTY.
14-1	ENCODER ASSEMBLY	1
14-2	SOCKET HEAD CAP SCREWS	3

Figure 5.1 90º Encoder Assembly



5.1.1 – 90 Degree Encoder Removal.

Step 1

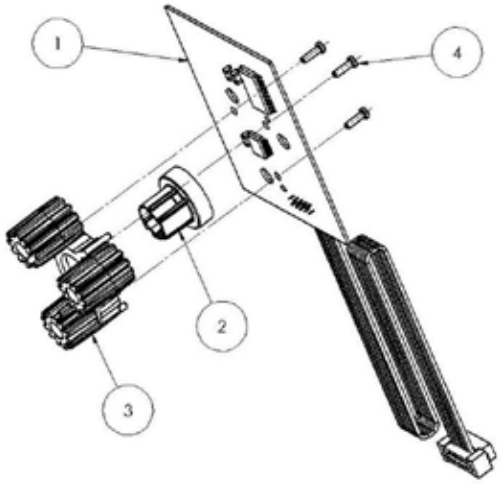
NOTE: The terminal block must be removed before removing the encoder. See section 6.4 for terminal block removal.

Disconnect the encoder ribbon cable connector from the Motor controller board, See Section 7.1 for connector placement. Using M3 Hex key remove the three screws (#14-2) that mount the encoder. Gently pull the encoder up and out of the housing thru the terminal block bore.

Table 5.2 - Encoder Subassembly, Item 14-1

ITEM NUMBER	DESCRIPTION	QTY.
1	ENCODER BOARD	1
2	ROTOR	1
3	STANDOFF	1
4	SELF TAP OVAL HEAD SCREWS	4

Figure 5.2 - Encoder To Subassembly, Item 14-1



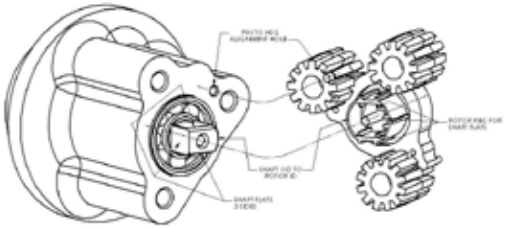
5.1.2 90 Degree Encoder Remounting

Step 1

Slide the encoder assembly into housing and down over encoder shaft (#1-6) aligning the rotor (#2) of the encoder to the encoder shaft OD, flats, encoder standoff ID to encoder top ball bearing (#1-5) and encoder standoff pin to housing alignment hole (See Figure 5.3 - Encoder To Unit Assembly View).

NOTE: The encoder rotor can only be mated to the encoder shaft in one position. The encoder shaft has 3 flats that must align correctly to the encoder rotor ID and ribs.

Figure 5.3 - Encoder To Unit Assembly View



Step 2

Install the three M4 screws thru encoder and standoff assembly (#14-2) and tighten. Take note not to over tighten.

Step 3

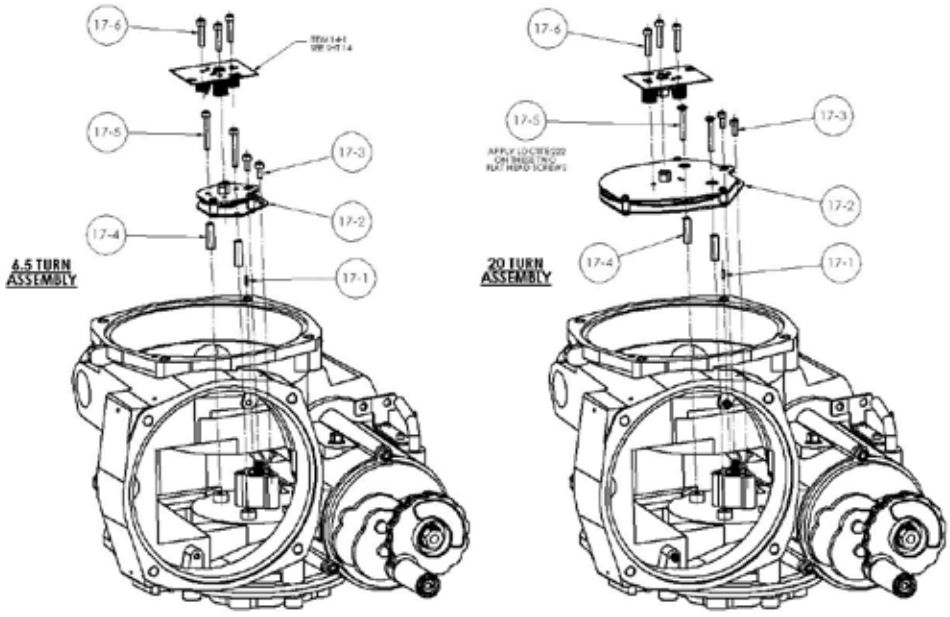
Reconnect encoder ribbon cable to motor controller board. (See Section 7.1 for connector position on motor control board)

5.2 Multi Turn Encoder. QXM-1 thru 5, all RPMs

Table - 5.3 Multi-Turn Encoder Assembly

ITEM NUMBER	DESCRIPTION (6.5 TURN)	DESCRIPTION (20 TURN)	QTY. (QX-1 &2)	QTY. (QX-3 THRU 5)
17-1	DOWEL PIN	DOWEL PIN	1	1
17-2	6.5 TURN SPUR GEAR ASSY	SPUR GEAR ASSY	1	1
17-3	SOC HEAD CAP SCREW	SOC HEAD CAP SCREW	2	2
17-4	SPACER	SPACER	2	NA
17-5	SOCKET HEAD CAP SCREWS	SOCKET HEAD CAP SCREWS	2	2
17-6	SOCKET HEAD CAP SCREWS	SOCKET HEAD CAP SCREWS	3	3

Figure 5.4 - Multi-turn Encoder Assembly



5.2.1 Multi Turn Encoder Removal

Step 1

NOTE: The terminal block and power controls must be removed before removing the encoder. See section 6.4 for terminal block and controls removal.

Disconnect the encoder ribbon cable connector from the Motor controller board, See section 6 for connector placement. Using M3 Hex key remove the three screws (#17-6) that mount the encoder. Gently pull the encoder up and out of the housing thru the terminal block bore.

Step 2

Using M3 Hex key (QX-1 & 2) or M2.5 Hex key (QX-3 thru 5) remove the two screws (#17-5) that mount the encoder spur gear subassembly to the two housing pads.

NOTE: For the 20 turn encoder assembly the slots in the big gear must be aligned with the top and bottom plate to access screws (#17-5). To do this the encoder shaft and/or drive sleeve must be rotated to the correct position aligning slots. See Figure 5.4 for orientation view.

Using M3 Hex key remove the two screws (#17-3) that mount the encoder spur gear subassembly to the housing encoder pad. Gently pull the spur gear subassembly up and over encoder shaft and pinion and out the controls area bore in housing.

QX-1 and 2 remove the two spacers (#17-4) (not used in QX-3 thru 5). The dowel pin (#17-1) is press into the housing.

Table 5.4 - 6.5-Turn Spur Gear Subassembly I(tem 17-2)

ITEM NUMBER	DESCRIPTION	QTY.
1	TOP PLATE	1
2	SHAFT, ENCODER	1
3	GEAR	1
4	ROLL PIN	1
5	BOTTOM PLATE	1
6	STANDOFF	3
7	COMBO HEAD SCREW	6

Figure 5.5 - 6.5-Turn Spur Gear Subassembly (Item 17-2)

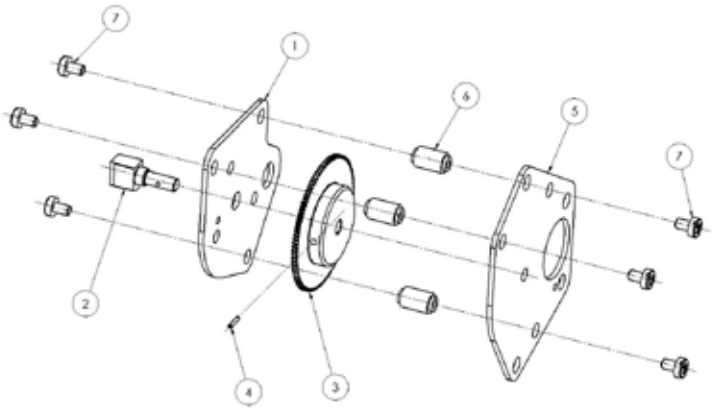
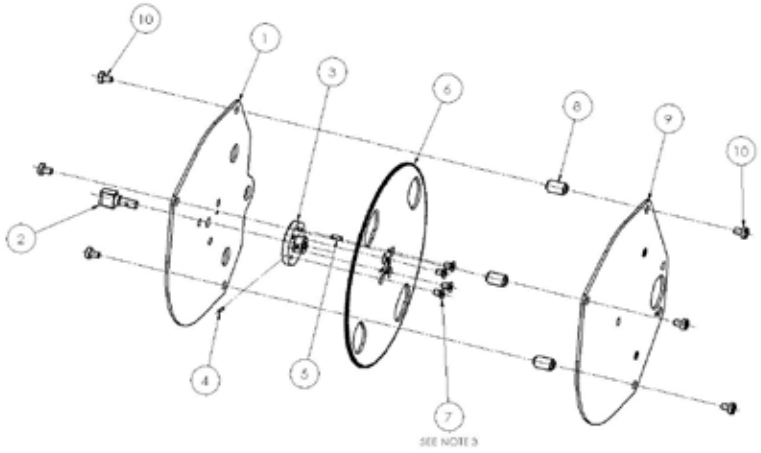


Table 5.5 - 20-Turn Spur Gear Subassembly (Item 17-2.)

Pc NUMBER	DESCRIPTION	QTY.
1	TOP PLATE	1
2	SHAFT, ENCODER	1
3	HUB, GEAR	1
4	ROLL PIN	1
5	DOWEL PIN	1
6	GEAR	1
7	FLAT HEAD SCREW	4
8	STANDOFF	3
9	BOTTOM PLATE	1
10	COMBO HEAD SCREW	6

Figure 5.6 - 20-Turn Spur Gear Subassembly (Item 17-2)



5.2.2 Multi Turn Encoder Remounting

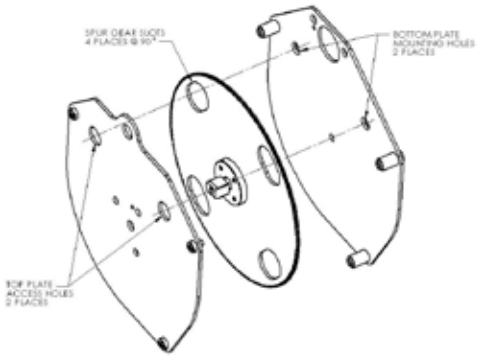
Step 1

Slide the encoder spur assembly (#17-2) into housing thru housing controls area bore and down over the multi turn encoder shaft pinion. Align spur assembly bottom plate to top encoder ball bearing (#1-5), the dowel pin (#17-1) while also aligning the spur assembly big gear to the encoder shaft pinion.

NOTE: for the 20 turn assembly the big spur gear slots must be aligned with the holes in the top and bottom plates to insert the two (#17-3) screws. Figure 5.7 for orientation view.

Insert the two screws (#17-3) and tighten.

Firgure 5.7 - 20-Turn Gear Slot Orientation View



Step 2

Place spacers (#17-4) (QX-1 &2 only) in place in-between the spur assembly bottom plate and the housing lower pads, Note that this step can be done before step 1. Insert screws (#17-5) and tighten.

Step 3

Slide the encoder assembly into housing and down over encoder shaft (#2) on multi turn spur assembly aligning the rotor (#2) of the encoder to the encoder shaft OD, flats and encoder standoff pin to the top spur assembly alignment hole (See Figure 5.3) for reference.

Note: The encoder rotor can only be mated to the encoder shaft in one position. The encoder shaft has 3 flats that must align correctly to the encoder rotor ID and ribs. See Figure 5.3 for reference.

Step 4

Install the three M4 screws thru encoder and standoff assembly (#17-6) and tighten. Take note not to over tighten.

Step 5

Reconnect encoder ribbon cable to motor controller board. (See section 6 for connector position on motor control board).

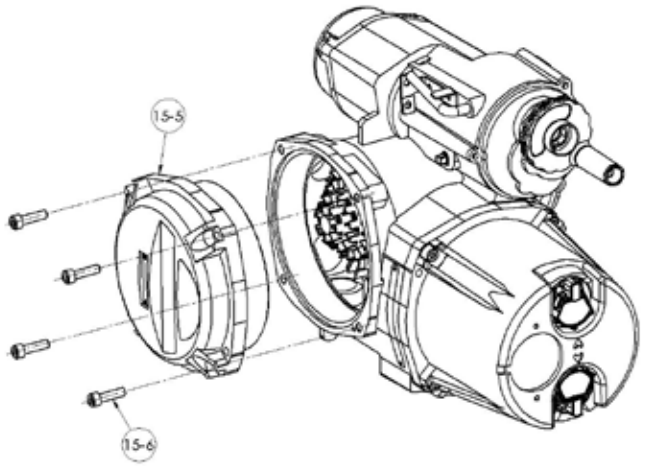
6 Electronic Assemblies

6.1 Terminal Cover

Table 6.1 - Terminal Cover Assembly

ITEM NUMBER	DESCRIPTION	QTY.
15-5	TERMINAL COVER SUBASSEMBLY	1
15-6	SOCKET HEAD CAP SCREWS	3

Figure 6.1 - Terminal Cover Assembly



6.1.1 Terminal Cover Removal

WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing control module assembly. Power sources may include main power or control power.

CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

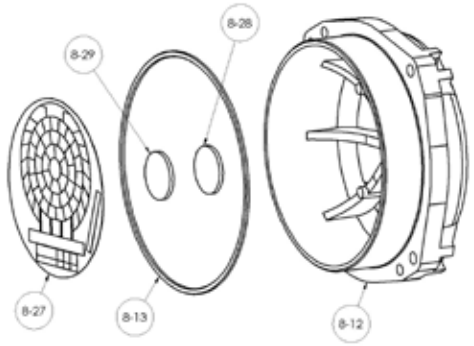
Step 1

Using a M6 hex key, remove the four M8 screws (#15-6) that mount the Terminal cover subassembly and remove cover (#15-5).

Table 6.2 - Terminal Cover Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
8-12	TERMINAL COVER	1
8-13	O'-RING	1
8-27	LABEL, TERMINAL BLOCK	1
8-28	HOOK	1
8-29	LOOP	1

Figure 6.2 - Terminal Cover Subassembly



6.1.2 Terminal Cover Remounting

Step 1

Lightly lubricate 'O'-ring (#8-13) and install around terminal cover spigot/pilot (#8-12). Slide terminal cover spigot/pilot into the unit housing.

Step 2

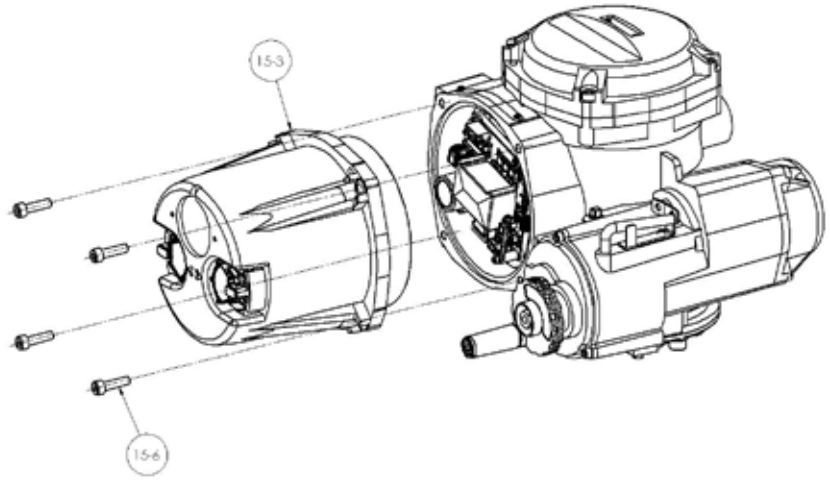
Fit the 4 screws (#15-6) into terminal cover subassembly mounting holes and tighten to torque in section 2.

6.2 Controls Cover

Table 6.3 - Controls Cover Assembly

ITEM NUMBER	DESCRIPTION	QTY.
15-3	CONTROLS COVER SUBASSEMBLY	1
15-6	SOCKET HEAD CAP SCREWS	3

Figure 6.3 - Controls Cover Assembly



6.2.1 Controls Cover Removal

Step 1

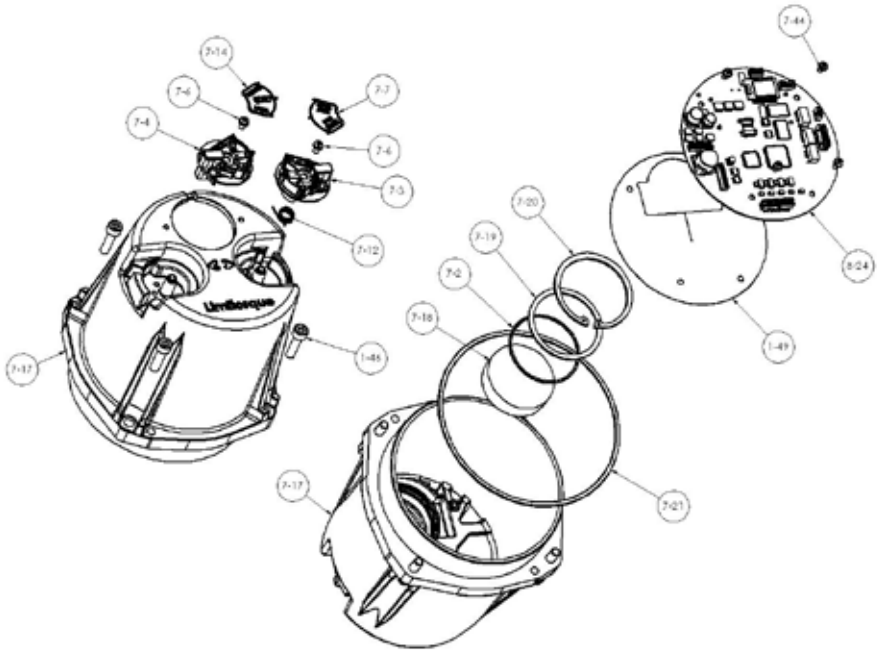
Using a M6 hex key, remove the four M8 screws (#15-6) that mount the Controls cover subassembly and remove cover (#15-3).

NOTE: When removing cover take care not to pull on cables that connect to the controls cover main board.

Table 6.4 - Controls Cover Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
1-49	SHIELD, MAIN BOARD	1
7-2	O'-RING	1
7-3	BLACK KNOB	1
7-4	RED KNOB	1
7-6	SELF TAPPING SCREW	2
7-7	BLACK KNOB CAP	1
7-12	TORSION SPRING	1
7-14	RED KNOB CAP	1
7-17	CONTROLS COVER	1
7-18	WINDOW	1
7-19	O'-RING RETAINER	1
7-20	RETAINING RING	1
7-21	O'-RING	1
7-44	PAN HEAD MACHINE SCREW	4
8-24	PC BOARD, MAIN	1

Figure 6.4 - Controls Cover Subassembly



6.2.2 Controls Cover Subassembly Remounting

Step 1

Lightly lubricate 'O'-ring (#7-21) and install around controls cover spigot/pilot (#7-17). Connect all wiring (See section 7 for wiring connection locations). Slide controls cover spigot/pilot into the unit housing insuring not to pinch wiring.

Step 2

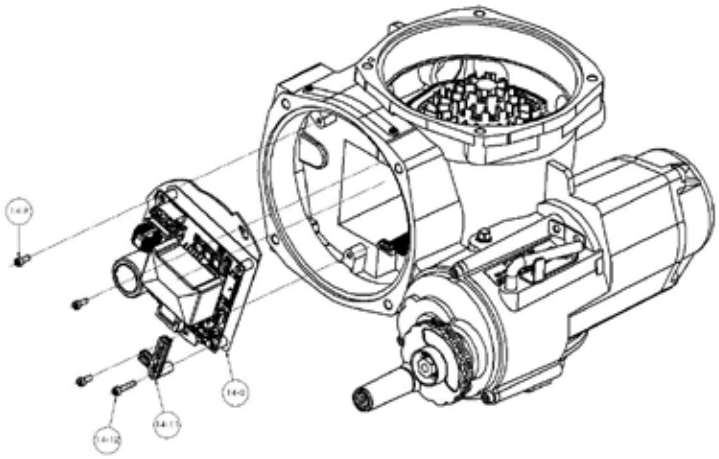
Fit the 4 screws (#15-6) into controls cover mounting holes and tighten to torque in section 2.

6.3 Control Modules

Table 6.5 - Control Module Assembly

ITEM NUMBER	DESCRIPTION	QTY.
14-8	CONTROLS SUBASSEMBLY	1
14-9	SOCKET HEAD CAP SCREWS	3
14-11	BRACKET, CONNECTOR RETAINER	1
14-12	SOCKET HEAD CAP SCREWS	1

Figure 6.5 - Control Module Assembly



6.3.1 Control Module Removal

Step 1

Using a M3 hex key remove screw (# 14-12) and retainer (#14-11). Disconnect all wiring harnesses.

Step 2

Using a M3 hex key, loosen the three M4 mounting screws (#14-9) that mount the Control module subassembly. Slightly rotate the complete control module subassembly in a counterclockwise (CCW) direction until the keyholes slots in the control module chassis plate (#1-1) allow the head of the screws to pass thru and remove controls subassembly.

6.3.2 Control Module Subassemblies

Table 6.6 - Low Voltage (Less than 250 VAC) Control Module Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
1-1	CHASSIS PLATE	1
1-2	MOTOR CONTROLLER BOARD	1
1-7	SHIELD	1
1-8	PAN HEAD CAP SCREW	4
1-9	COVER, IRAM	1
1-10	RIBBON CABLE	1

Figure 6.6 - Low Voltage (Less than 250 VAC) Control Module Subassembly

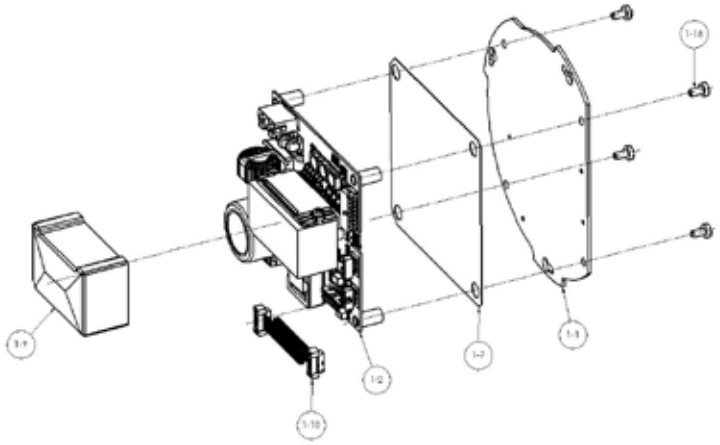


Table 6.7 - High Voltage (Greater than 250 VAC) Control Module Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
1	CHASSIS PLATE	1
2	RUBBER PAD, TOROID	2
3	TRANSFORMER, TOROID	1
4	MOUNTING PLATE, TOROID	1
5	FLAT WASHER	2
6	HEX HEAD CAP SCREW	1
7	HEX NUT	1
8	MOTOR CONTROLLER BOARD	1
13	SPACER	4
14	SHIELD	1
15	PAN HEAD CAP SCREW	4
16	COVER, IRAM	1
17	RIBBON CABLE	1

Figure 6.7 - High Voltage (Greater than 250 VAC) Control Module Subassembly

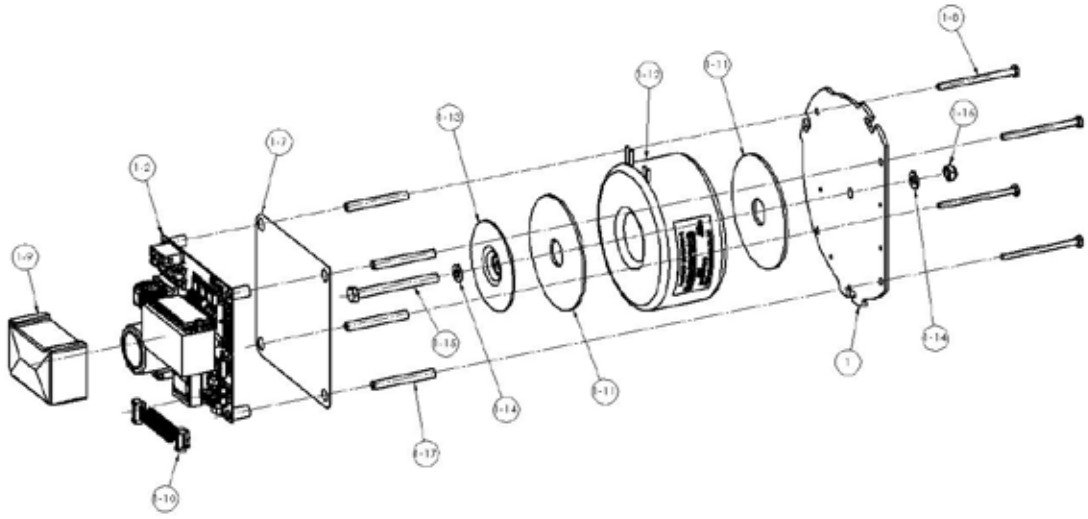
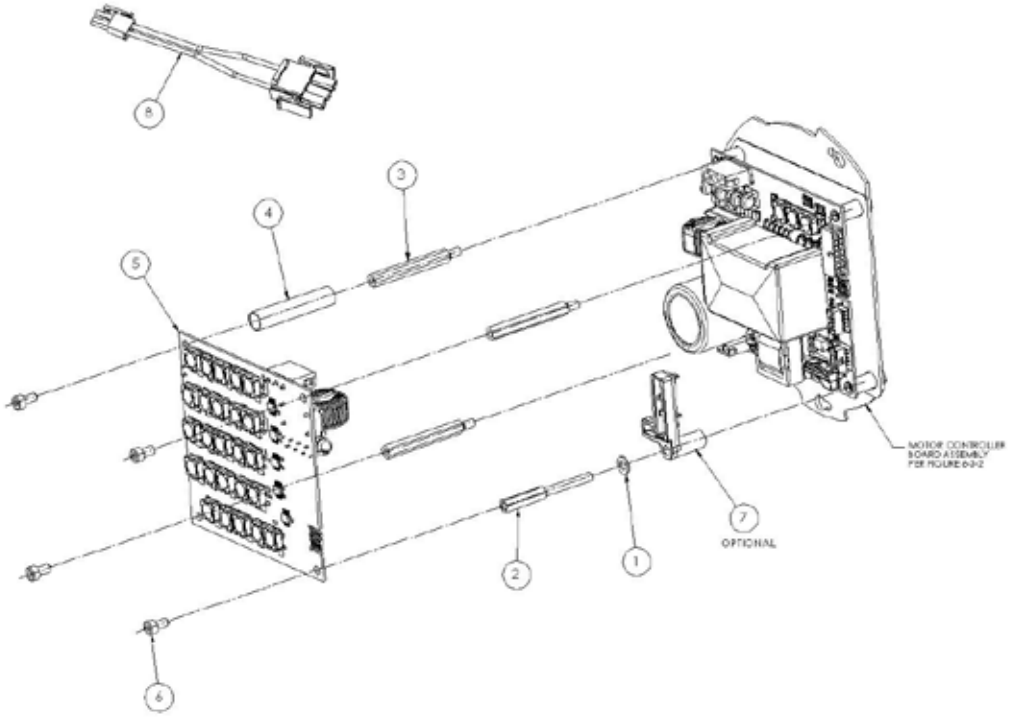


Table 6.8 - DCV Control Module Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
1	FLAT WASHER	1
2	HEX STANDOFF, SHORT	1
3	HEX STANDOFF, LONG	3
4	PVC TUBE	1
5	DC BOARD	1
6	SOCKET HD CAP SCREWS	1
7	BRACKET, CONNECTOR RETAINER (OPTIONAL)	1
8	WIRING HARNESS	1

Figure 6.8 - DCV Control Module Subassembly



NOTE: If optional bracket (Item 7) is not used the flat washer (Item 1) and short standoff (Item 2) will be replaced with the long spacer (Item 3).

6.3.3 Control Module Remounting

Step 1

Position the controls module subassembly over the three mounting screw heads (#14-9). Rotate the subassembly in a clockwise (CW) direction until all three screws are seated in the keyhole slots.

(The keyhole slots in the chassis plate (#1 or 1-1) are spaced in such a way that the control module subassembly will mount in only one position).

Step 2

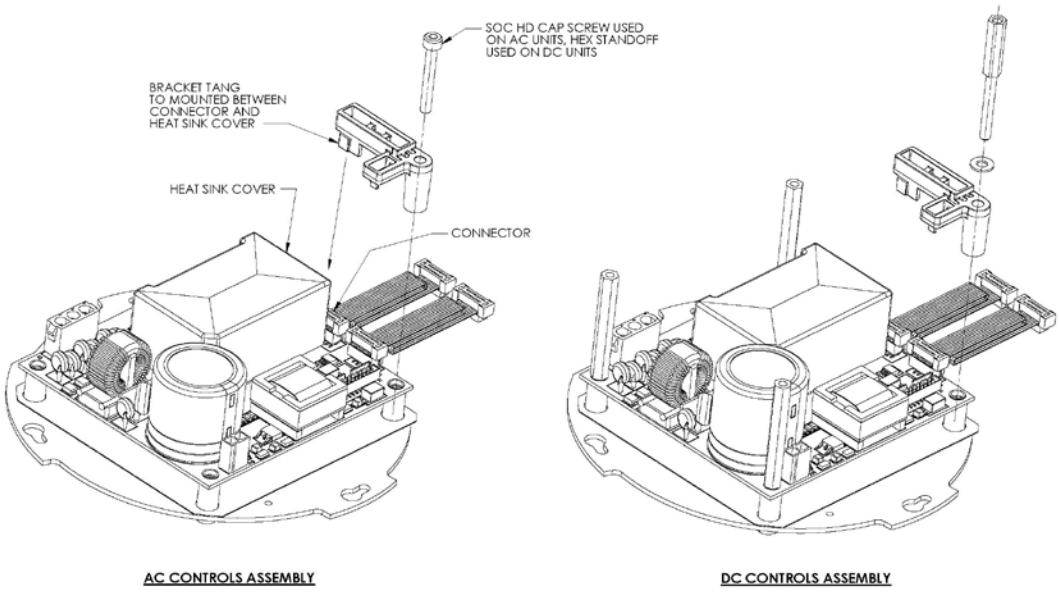
Tighten the three screws (#14-9) with a 3mm hex key.

Step 3

Connect wiring (See section 7 for wiring connection). Place retainer (#14-11 or 7) (Optional) on control module ensuring the long tang sits in-between the Iram heat sink cover (#1-9 or 16) and connector on control module

For AC controls Insert screw (#14-12) in to retainer hole (#14-11) and tighten. For DC controls Insert flat washer (#1) and standoff (#2) in to retainer hole (#14-11) and tighten. . (See Figure 6.9).

Figure 6.9 - Bracket Connector Retainer Assembly

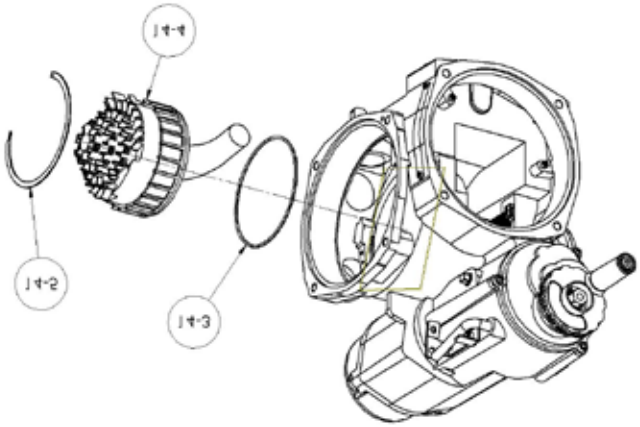


6.4 Terminal Block

Table 6.9 Terminal Block Assembly

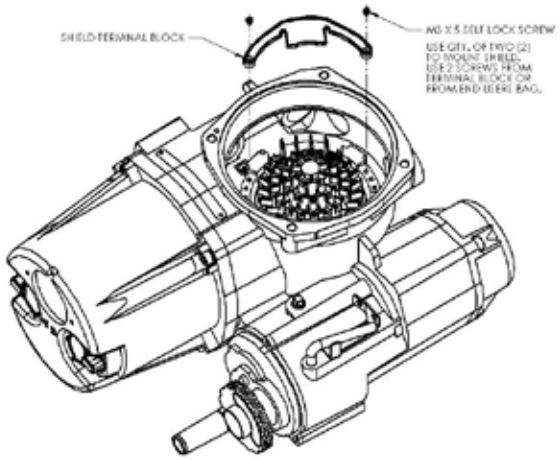
ITEM NUMBER	DESCRIPTION	QTY.
14-3	O'-RING	1
14-4	TERMINAL BLOCK SUBASSEMBLY	1
14-5	RETAINING RING	1

Figure 6.10 - Terminal Blockm Assembly



6.4.1 Terminal Block Shield

Figure 6.11 - Terminal Block Shield



6.4.2 Terminal Block Removal

Step 1

Remove terminal block cover.

Step 2

Use Qty of 2 screws from terminal block or from end users bag to attach shield.

Step 3

Remount terminal block cover.

6-5 Mounting of Standard and Optional Controls

6.5.1 Installation

NOTE: RESTRICTIONS ON OPTION BOARD COMBINATIONS: Only one of the following can be on any unit: Modbus - DDC, Profibus PA, Profibus DP, FOUNDATION Fieldbus, DeviceNet.

A shield must be installed on the last board fitting between the last option board and the power board. See Figure 6.14 for illustration.

A maximum of four option boards can be used per unit, barring other restrictions. A four option board stack requires four (4) M4x70 pan head screws.

A single option board stack requires four (4) M4x25 pan head screws.

STEP 1 – Standard 2A, (4) "OS" contacts (LCS/Main Board)

Connect to the control cover using (4) M4x8 pan head screws.

From the terminal block, connect 12-pin plug (Cable J1) to socket J5 on the main board.

STEP 2 – Option "OA", 4-5A "R" contacts and (1) 5A MR (monitor relay); Digital Output board connection

Connect to the control cover using four (4) M4x25 pan head screws.

Ensure that jumper on the DO board is located in the 1-2 position. Connect 12-to-22 pin adapter to Cable J1 (12-pin plug). Connect to the 22-pin socket J3 on DigOut board

NOTE: This will disable the digital relays on the main board. A keycode must be entered to restore them. Please contact factory at 434-528-4400 for the keycode.

A shield is required to be installed between the digital output board and any adjacent boards.

STEP 3 - Option "OB", 4-5A "R" contacts and (1) 2A MR (monitor relay); Digital Output board connection and 2 – 2A "S" contacts

Connect to the control cover using four (4) M4x25 pan head screws.

Ensure that the jumper is located in the 3-4 position. Connect Cable J1 (12-pin) to socket J5 (12-pin) on the main board. Connect cable J5 (22-pin) to socket J3 on DigOut board.

STEP 4 - Option "OC", 8-5A "R" contacts and (1) 5A MR (monitor relay); 2 Digital Output boards connection

Connect to the control cover using four (4) M4x40 pan head screws.

Ensure that the jumper on DigOut board 1 is in the 1-2 position and the jumper on DigOut board 2 is in the 3-4 position. Connect the 12-22 pin adapter to Cable J1 (12-pin), then connect it to socket J3 (22-pin) of board 1. Connect cable J5 to socket J3 of board 2.

STEP 5 – ANALOG OPTION BOARD CONNECTION (option)

Connect to the control cover using four (4) M4x25 pan head screws if one analog board is installed. Connect to the control cover using four (4) M4x40 pan head screws if two analog boards are installed.

Ensure that jumpers 1 and 2 are in the same position. If there is only one board, both should be in the

1-2 position (Board 1). If there are two boards, the second board should have the jumpers in

2-3 position. Connect J8 (3-pin) cable to J3 of board 1. Connect J3 (4-pin) cable to J1 of board 2.

STEP 6 – MODBUS – DDC NETWORk BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one DDC board is installed. Ensure that Jumpers 1 and 2 are both in the "A" position. Connect the J7 6-pin cable from the terminal block to socket J2.

STEP 7 – PROFIBUS-DP NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one Profibus-DP board is installed. Ensure that both jumpers are in the "A" position. Connect the J7 6-pin cable from the terminal block to socket J8.

For Redundant Profibus-DP Network Board Connection:

Connect to the control cover using four (4) M4x40pan head screws. Ensure that primary board jumper (board "A") is in the "A" position and redundant board jumper (board "B") is in the "B" position. Connect the J7 6-pin cable from the terminal block to socket J8 on the "A" board and J3 4-pin connector for the redundant board "B".

STEP 8 – PROFIBUS-PA NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one Profibus-PA board is installed. Ensure that both jumpers are in the "A" position. Connect the J7 6-pin cable from the terminal block to socket J8.

STEP 9 – FOUNDATION FIELDBUS NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one FOUNDATION Fieldbus board is installed. Ensure that both jumpers are in the "A" position. Connect the J7 6-pin cable from the terminal block to socket J8.

STEP 10 - DEVICENET NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one DeviceNet board is installed. Ensure that both jumpers are in the "A" position. Connect the 6-pin cable from the terminal block to socket J8. Set aside yellow ground wire to be fastened to top of option board stack per Figure 6.14. Above the shield, the wire must make contact with the screw.

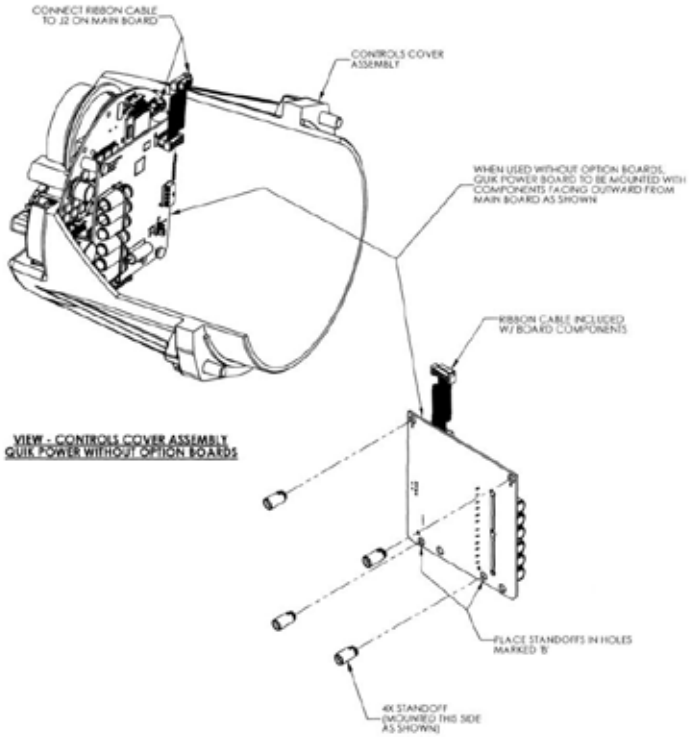
STEP 11 – QX Quik (auxiliary) power board

⚠ **CAUTION:** Use proper tools and only apply light pressure when installing standoffs to avoid damage to circuit board.

Installation without option boards:

1. Move JP1 jumper to the 'NORM' position
2. Insert PCB standoffs on unpopulated side of board in holes marked 'B' as shown in Figure 6.13
3. Plug ribbon cable into the J2 receptacle on main board as shown

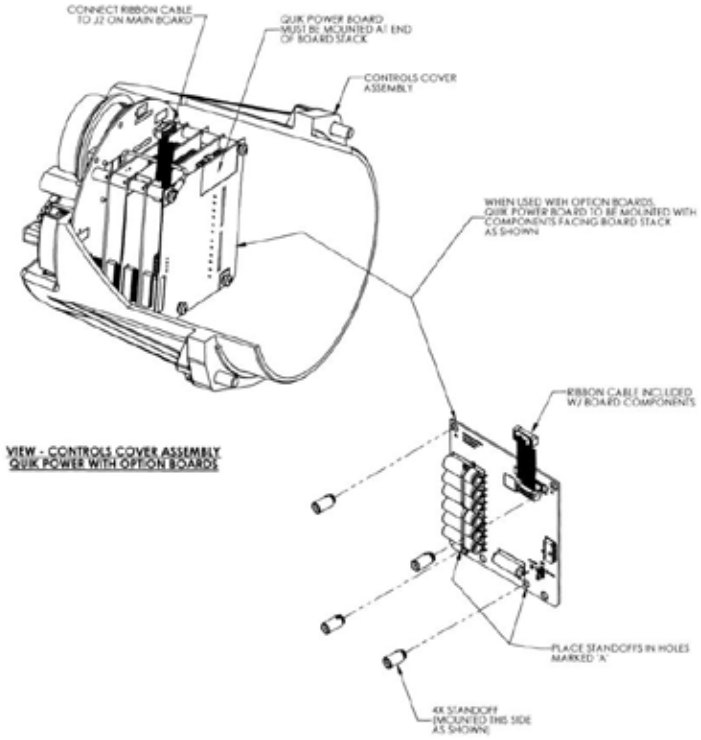
Figure 6.12 Quik Power Without Option Boards



Installation with option boards:

1. Move JP1 jumper to the 'NORM' position
2. Insert PCB standoffs on populated side of board in holes marked 'A' as shown in Figure 6.13.
3. Mount board at end of board stack, plugging ribbon cable into the J2 receptacle on main board as shown

Figure 6.13 - Quik Power With Option Boards



Work on electronics if Quik Board is installed

1. Cycle through CHANGE SETTINGS menu until you reach CHANGE BACKUP POWER.
2. Select YES
3. Select BACKUP POWER DISABLED – OK?
4. Select YES
5. Exit CHANGE SETTINGS MENU
6. Turn power off to actuator, LCD and LEDS should still operate once power is removed. This is due to the quik board still supplying power. Wait for unit to shut off.
7. Carefully remove electronics and Quik Board.
8. Locate JP1 (jumper) on JP1 of Quik Board and move to FAST DISCHARGE PINS.

STEP 12 – ALIGNMENT OF OPTION BOARDS INTO LCS/MAIN BOARD

Line up screw sockets and stack the boards so that J7 (option board pins and sockets) fits in with the main board or any boards that are installed previously. Place shield so sockets match up with cuts in shield. If DeviceNet board (61-825-0058-4) is used, position grounding wire on top of shield before fastening screws. Fasten four screws, then align in cover and install to main housing. Please refer to Table 6.10 for the connector numbers.

Table 6.10 - Control Board Connectors

Control Board	Connector Number
DeviceNet	X1
Foundation Fieldbus	X1
Profibus PA	X1
PBDP	X1
Digital Out	J2
Modbus/DDC	X1
Analog	J2

Figure 6.14 - Option Board Assembly

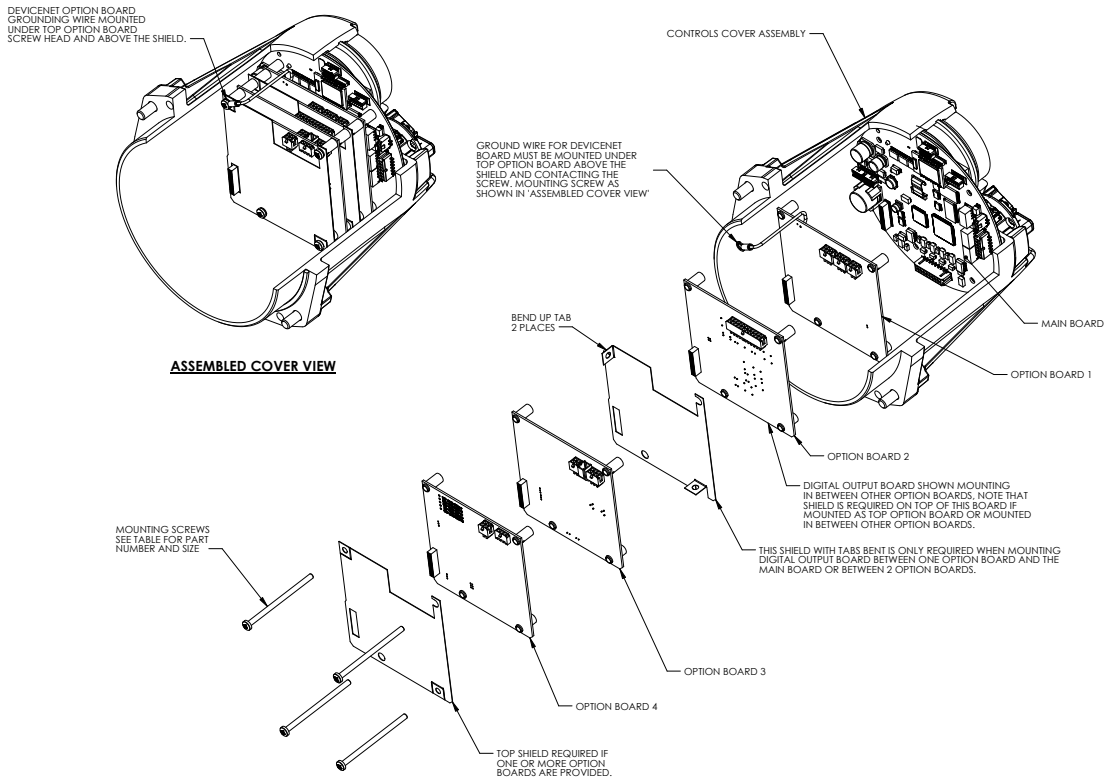


Table 6.11 - Screw Part Numbers

BOARD DESCRIPTION	SCREW PART NUMBER	DESCRIPTION	QTY.
MAIN WITH NO OPTION BOARDS	64-818-0001-35	M4X8	4
MAIN WITH 1 OPTION BOARD	64-818-0001-32	M4X25	4
MAIN WITH 2 OPTION BOARDS	64-818-0001-36	M4X40	4
MAIN WITH 3 OPTION BOARDS	64-818-0004-3	M4X55	4
MAIN WITH 4 OPTION BOARDS	64-818-0005-3	M4X70	4

⚠ **CAUTION:** Potential to pinch cables. When remounting ACP cover, take special care no to pinch ribbon cables.

Dress the cables being careful to position wires so that they pass perpendicularly over the housing flange.

NOTE: The face of the ACP may be installed in any one of four 90° incremental positions. When changing ACP position, avoid over-twisting the ribbon cable(s).

Rotate the ACP until the display orientation of the front face is correct for normal viewing, and then slide the ACP assembly into the actuator housing.

6.5.2 Removal

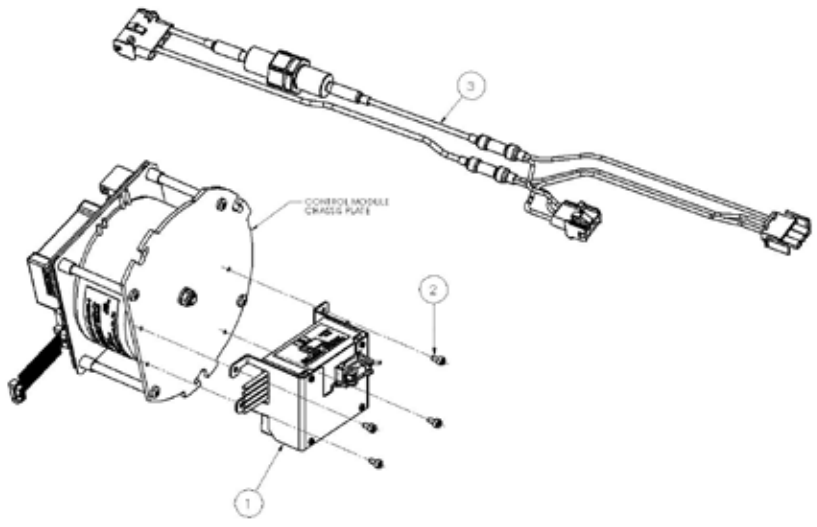
For removal, follow installation instructions in reverse.

6.6 Optional Transformer

Table 6.12 - Optional Transformer Assembly

ITEM NUMBER	DESCRIPTION	QTY.
1	OPTIONAL TRANSFORMER SUBASSEMBLY	1
2	SOCKET HEAD CAP SCREWS	4
3	WIRING HARNESS	1

Figure 6.15 - Optional Transformer Assembly



6.6.1 Optional Transformer Removal

☠ **WARNING:** Hazardous Voltage! Turn off all power sources to actuator before removing control module assembly. Power sources may include main power or control power.

⚠ **CAUTION:** Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

Step 1

Remove controls cover per section 6-2.

Step 2

Remove control module per section 6-3.

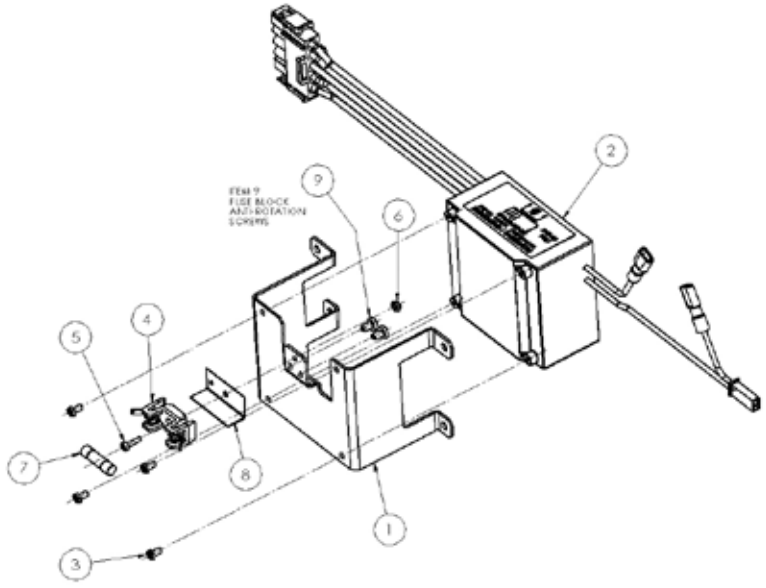
Step 3

Using a M2.5 hex key, remove the four M3 screws (#2) holding the optional transformer assembly (#1) in place and remove from back of control module. If require unplug wiring harness (#3).

Table 6.13 - Optional Transformer Subassembly

ITEM NUMBER	DESCRIPTION	QTY.
1	BRACKET	1
2	OPTIONAL TRANSFORMER	1
3	SOVAL HEAD SCREW	4
4	FUSE BLOCK	1
5	SOCKET HEAD CAP SCREWS	1
6	HEX NUT	1
7	FUSE	1
8	SHIELD, FUSE BLOCK	1
9	SELF TAP SCREW	2

Figure 6.16 Optional Transformer Subassembly



6.6.2 Optional Transformer Remounting

Step 1

Position optional transformer assembly (#1) to the 4 M3 taps on the back of the control module chassis plate, see Figure 6.16 for orientation. Fit the four M3 screws (#2) thru bracket holes aligning with the taps in on the control module and using a M2.5 hex key tighten the four M3 screws.

Step 2

Connect wiring (See section 7 for wiring connections). Note that the optional transformer wiring harness (#3) must have the correct wire to connector position per voltage supply (See Table 7.1).

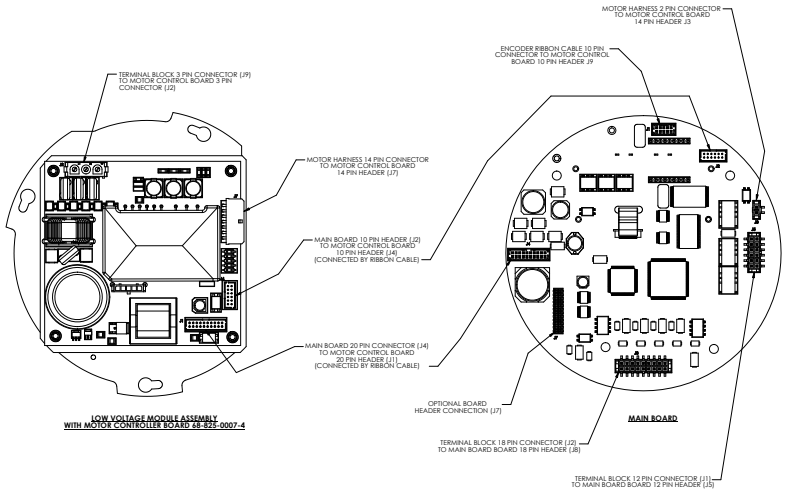
7 Electronic Wiring (Cabling)

7.1 AC Low Voltage Wiring (Cabling) Quick Reference Guide for Control Module and Main Board. (Less than 250 VAC)

7.1.1 AC Low Voltage Module (Version 1).

Figure 7.1 is a diagram that shows wiring locations for a low voltage QX unit with version 1 motor controller board. Motor controller board part number 68-825-0007-4.

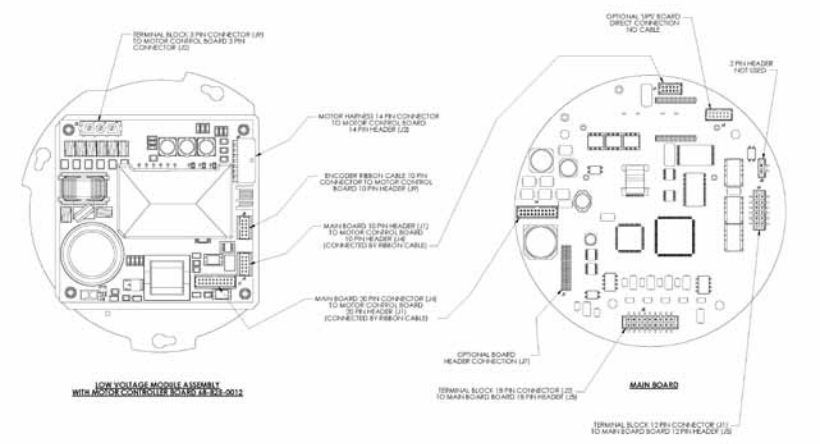
Figure 7.1 - Low Voltage QX Unit Wiring Connections



7.1.2 AC Low Voltage Module (Version 2).

Figure 7.2 is a diagram that shows wiring locations for a low voltage QX unit with version 2 motor controller board. Motor controller board part number 68-825-0012.

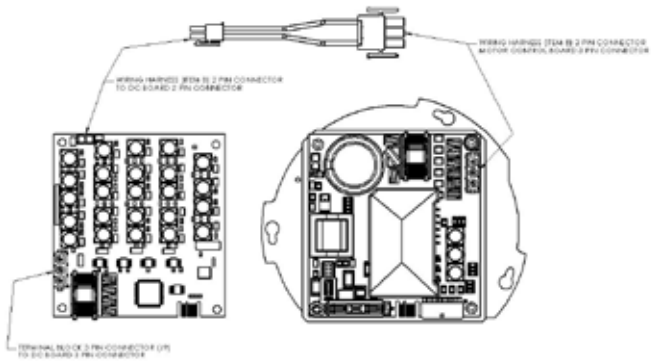
Figure 7.2 - Low Voltage QX Unit Wiring Connections (Version 2)



7.1.3 DC Board Wiring (24 – 48 VDC)

Figure 7.3 shows wiring locations for the DC QX unit. All other wiring is the same as the low voltage wiring.

Figure 7.3 - DC QX Unit Wiring Connections

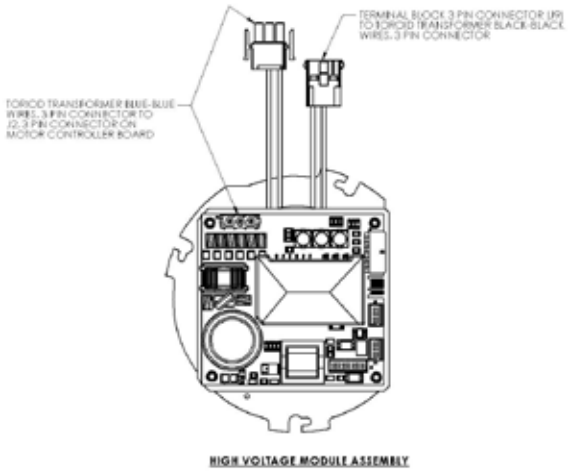


7.2 High Voltage Wiring (Cabling) Quick Reference Guide. (Greater than 250 VAC)

7.2.1 High Voltage Module

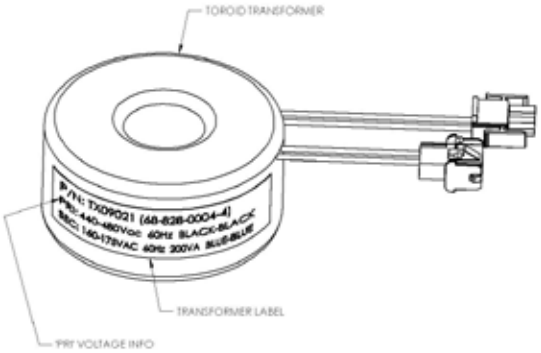
Figure 7.4 is a diagram that shows wiring connections for QX unit with a high voltage module with toroid transformer. Control supply (power in) from L1, L2 and L3 from terminal block connector (J9) now connects to the toroid transformer and the toroid transformer connects to the motor controller board (J2). All other wiring is the same as the low voltage wiring.

Figure 7.4 - High Voltage QX Unit Wiring



NOTE: Check to make sure the toroid transformer has the correct 'PRI' voltage values for the application. See Figure 7.5 for typical labeling of toroid transformer.

Figure 7.5 Typical Toroid Transformer Label



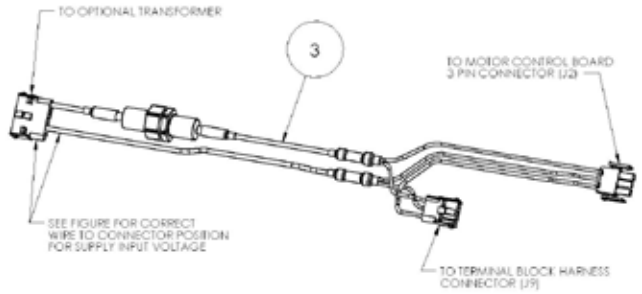
7.3 Optional Transformer Wiring (Cabling) Quick Reference Guide

The optional transformer uses a separate wiring harness to connect the controls supply (power in from L1, L2 and L3) terminal block connector (J9) to the control module and optional transformer. See below for wiring configurations. All other wiring is the same as the low or high voltage connections.

NOTE: See Figure 7.9 for wiring harness configurations per supply input voltage.

7.3.1 Optional Transformer Harness Wiring Used With Low Voltage Control Module

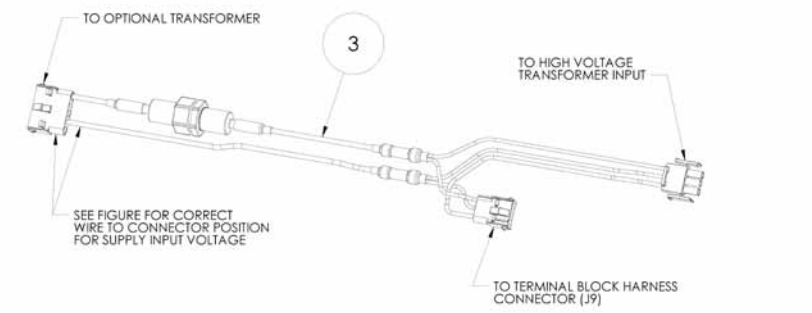
Figure 7.6 - Optional Low Voltage Transformer Harness Wiring



7.3.2 Optional Transformer Harness Wiring Used With High Voltage Control Module

NOTE: See Figure 7.8 for harness routing around toroid transformer assembly.

Figure 7.7 - Optional High Voltage Transformer Harness Wiring



7.3.3 Optional Transformer Harness Routing Used With High Voltage Control Module

The wiring harness (#3) when used with the high voltage toroid transformer assembly should be routed as show below in Figure 7.8.

Figure 7.8 - High Voltage Optional Transformer Harness Assembly Routing

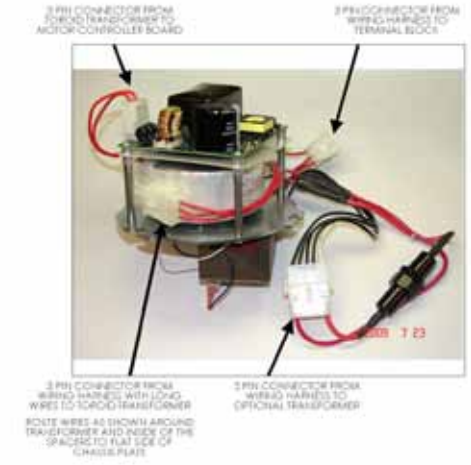
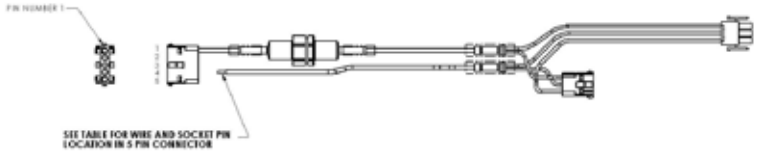


Figure 7.9 - Optional Transformer Harness Connector to Wire Position per Supply Voltage



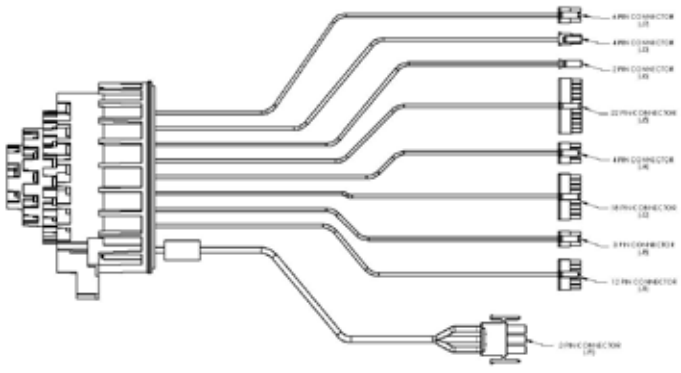
WIRE AND PIN LOCATION IN 5 PIN CONNECTOR	VAC POWER SUPPLY		
	OPTIONAL TRANSFORMER DWG. 64-828-0004-3	OPTIONAL TRANSFORMER DWG. 64-828-0005-3	OPTIONAL TRANSFORMER DWG. 64-828-0006-3
PIN NUMBER 2	90-104vac	210-240vac	NA
PIN NUMBER 3	105-128vac	342-390vac	496-560vac
PIN NUMBER 4	187-209vac	391-420vac	NA
PIN NUMBER 5	NA	421-495vac	561-600vac

Table 7.1 Connector to Wire Position per Supply Voltage

Wire and Pin Location in 5 Pin Connector	VAC Power Supply		
	Optional Transformer	Optional Transformer	Optional Transformer
	DWG. 64-828-0004-3	DWG. 64-828-0005-3	DWG. 64-828-0006-3
PIN NUMBER 2	90-104vac	210-240vac	N/A
PIN NUMBER 3	105-128vac	342-390vac	496-560vac
PIN NUMBER 4	187-209vac	391-420vac	N/A
PIN NUMBER 5	N/A	421-495vac	561-600vac

7.4 Terminal Block Wiring Harness Numbers

Figure 7.10 - Terminal Block Wiring Harness And Connector Numbers



8 Spares and Replacement Parts

8.1 Guidelines for Recommended Spare Parts

Since every Flowserve Limitorque actuator is designed to meet a specific application, the recommended spare parts needed to support the actuator will vary for every project. The following guidelines are provided to assist in determining the specific spare parts requirements for your QX actuators.

8.1.1 Wear Components

The following components will eventually wear under normal use and should therefore be planned as spares. The expected lifetime of these parts will vary from application to application. They are listed in order of most frequent to least frequent replacement. Flowserve recommends stock levels of between 5% and 10% of the total population of each part with a minimum of one of each in order to support the product for life.

1. Stem nut
2. Worm shaft subassembly
3. Drive sleeve subassembly

8.1.2 Bearings, O-rings, and Seals

All bearings should be replaced any time an actuator is refurbished. Therefore, all bearings should be planned for stock for any scheduled refurbishment. In addition, any O-ring or seals should be replaced any time an actuator is disassembled. Complete actuator seal kits are available for the QX-1, 2, 3, 4, and 5.

Flowserve recommends stock levels for seal kits of 10% of the total population of each actuator model and size. Also, an adequate supply of Flowserve approved oil (See Section 2.3.2) should be maintained in stock to support any necessary maintenance or refurbishment.

8.1.3 Critical Components

The following parts are not subject to wear but are still recommended for stock due to their critical nature. Flowserve recommends stock levels of between 5% and 10% of the total population of each part with a minimum of one of each in order to support the product for life.

1. Motor
2. Encoder
3. Control module

8.2 Recommended Spare Parts for QX Actuators

8.2.1 Commissioning and Startup

No additional spare parts are required. All necessary spares are included in the end-user bag.

8.2.2 Short-Term Duty

This is defined as up to 5000 seats or up to 1 million drive sleeve operations, whichever occurs first. There are no spare parts required for the actuator during short-term duty.

8.2.3 Long-Term Duty

This is defined as service beyond short-term duty but less than 10,000 seats and less than 1.5 million drive sleeve operations. The spares suggested for long-term duty are as follows:

- Quad rings at the top and bottom of the drive sleeve
- Drive sleeve assembly, which includes the worm gear
- Wormshaft assembly
- Encoder cartridge assembly
- Motor assembly
- Fuse (Controls, quantity 1)
- Fuses (Power, quantity 2)
- Encoder assembly
- Motor controller board
- Control module (includes PCB-power, main, CP, and optional DDC and I/O boards)
- Bronze stem nut for thrust base (multi-turn QXs only)

NOTE: Oil should be changed every 10,000 seats or sooner if the oil has been contaminated with water or other foreign material.

8.2.4 Severe Duty

This is defined as open/close service when run loads exceed 50% of the unit rating. This also includes all modulating applications.

NOTE: Oil should be changed every 5000 seats for open/close service, or sooner if the oil has been contaminated.

The spares suggested for severe duty are identical to the long-term duty spares.

8.3 Other Concerns

There are other unique application requirements that may result in additional parts being added to the list of recommended spares. Some additional issues or requirements that should be considered when determining required spare parts include (but are not limited to):

1. Maintenance program
2. Frequency of operation
3. Modulating duty
4. Frequent operation by handwheel
5. Regular testing
8. Stall/overload condition

Flowserve strongly recommends using OEM parts to support and maintain your QX actuator. Installing parts other than genuine Flowserve Limitorque parts could cause premature failure of your actuator and voids any remaining warranty.

The above guidelines are provided to assist you in determining your unique spare parts needs. Please contact your local Limitorque Sales Office or local Authorized Stocking Distributor for additional help in evaluating your needs.

9 Regulatory Information

9.1 Declaration of Conformity

Application of Council Directive(s)

2004/108/EC; EMC Directive
2006/42/EC; Machinery Directive
2003/10/EC; Airborne Noise Directive
94/9/EC; ATEX Directive

Standard(s) to which Conformity is Declared

Machinery; EN 60204-1

EMC - Emissions; EN 50081-1&2, EN 55011, CFR 47
Immunity; EN 50082-1&2, IEC 801-3 & IEC 801-6
ESD; IEC 801-2
EFT/Bursts; IEC 801-4
Surge Immunity; IEC 801-5, ANSI/IEEE C62.41
Mains (power) Harmonics; MIL-STD-462, Method CSO1 & CSO2

Airborne Noise; MIL-STD-740-1, Table 1, and EN 60204

ATEX Harmonized Standards
prEN 60079-0:200X (IEC 60079-0:2007)
EN 60079-1:2007
EN 60079-7:2007
EN 60529:1991 + A1:2000
EN 13463-1: 2009
EN 13463-5: 2003
Materials of Construction Terminal & Control Covers - Aluminum Alloys 380 or 383
CS Station - Aluminum Alloy 319
Nameplate - Stainless Steel
Housing - 356-T6 Aluminum
Window - Heat tempered Soda Lime Glass
Antenna Cover - Polytetrafluoroethylene

EMC - Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI) standards to which this actuator complies:

APPLICABLE EMISSIONS STANDARDS	EN50011:1998	CLASS A SERVICE	
Radiated emissions	EN55011:1998 & FCC Part 15, subpart J	30-130MHz 40dBmV / m 230-1000MHz 47dBmV / m	
Conducted emissions	EN55011:1998 & FCC Part 15, subpart J	0.15 to 0.5MHz 79dBmV (QuasiPeak 66dBmV avg) 0.5 to 30MHz 73dBmV (QuasiPeak 66dBmV avg)	
Applicable immunity standards	IEC EN 6100-6-1:2001		
ESD	IEC6100-4-1:1995	±8kV thru air ±4kV thru contact	
Radiated RF immunity	IEC6100-4-3:1995	80MHz to 2GHz 10Vrms / m	
Fast tansients/burst	IEC6100-4-4:1995	EFT AC Power leads ±2kV Signal leads: ±1kV	
Voltage surges	IEC6100-4-5:2001	AC Power: ±2kV com, ±1kV diff Signal leads: ±0.5kV com, ±1kV diff	Perf criterion: B
Conducted RF immunity	IEC6100-4-6:1996	150kHz to 80MHz 10Vrms	Perf criterion: A w/80% AM modulation @1KHz
Magnetic field immunity	IEC6100-4-8:1993	Power line frequency 30A/m @60Hz	Perf criterion: A
Voltage dips and interrupts	IEC6326-1:2005 (IEC61000-4-11:2004)	60Hz 100% dip, 1 cycle duration 40% dip, 10 cycle duration 70% dip, 25 cycle duration 100% dip, 1 cycle duration	Perf criterion: B, C 3 test each @ 10 sec interval 3 test each @ 10 sec interval 3 test each @ 10 sec interval 3 test each @ 10 sec interval

Notified Body

FM Approvals Limited
1 Windsor Dials
Windsor UK
Certification Number
FM09ATEX0058X"

IECEx
IEC 60079-0:2007
IEC 60079-1:2007
IEC 60079-7:2006
IEC 60529:1989 + A1:1999

Manufacturer's Name
Limitorque, a division of Flowserve Corporation
Manufacturer's Address
5114 Woodall Road
Lynchburg, VA 24502

Importer's Name
Limitorque International
Importer's Address

Euro House
Abex Road
Newbury
Berkshire, RG14 5EY
England

Type & Description of Equipment

Valve Actuators

Model Number

QX Series Note: Tested with Limitorque products only and with standards applicable at time of tests.

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s). List as follows:

(Signature)
Earnest Carey
(Full Name)

Principal Product Portfolio Manager and Marketing Manager
(Title)

Flowserve Limitorque
5114 Woodall Rd., Lynchburg VA 24502

(Place)
February 2011
(Date)

9.2 Specific Conditions for Use — Atex/Cenelec/IECEx Applications

Atex/Cenelec/IECEx certification of the QX product line is described in Certificate of Conformity. This certificate details specific construction requirements that must be met in order to maintain the XP integrity of the actuator. The sockethead cap screws used with the QX electric valve actuators shall conform to the following requirements:

The “X” suffix to the Certificate number relates to the following specific conditions of use.

1. ISO Class 12.9, M8 socket-head cap screws (Yield Stress 1100 MPa) shall be used to replace the terminal, control, or motor compartment fasteners of actuators marked with TAMB < -20°C or for all Group IIC actuators.
2. Stainless steel, A2 or A4, ISO Class 70, M8 socket-head cap screws (Yield Stress 450 MPa) shall be permitted as an alternate to the ISO Class 12.9 socket-head cap screws on the terminal, control, or motor compartments of actuators marked TAMB ≥ -20°C.
3. Consult the manufacturer if dimensional information on the flameproof joints is necessary.

9.3 Statement of Compliance with Applicable European Directives

We, Flowserve Limitorque, 5114 Woodall Road, Lynchburg, VA, USA 24502, as the manufacturer of the equipment listed below:

QX-1, 2, 3, 4, 5 electronic valve actuator. The QX is a non-intrusive electronic actuator. It

is specifically designed for the purpose of being mounted to a quarter turn valve (or other

apparatus) in order to move the valve from fully closed to fully open.

Confirm, in accordance with the requirements of clause 1.2.7 of the Essential Health and Safety Requirements of Community Directive 94/9/EC on equipment and protective systems intended for use in potentially explosive atmospheres that the above equipment has been designed and manufactured to:

a) Avoid physical injury or other harm which may be caused by direct or indirect contact;

b) Assure that the surface temperature of accessible parts or radiation which cause a danger, are not produced;

c) Eliminate non-electric dangers which are revealed by experience;

d) Assure that foreseeable conditions of overload shall not give rise to dangerous situations.

And where these risks are wholly or partly covered by other Community Directives, the equipment satisfies the requirements of those specific Directives. And that literature describing the equipment will not contradict the instructions with regard to safety aspects.

Issued on: February 2011
Authorized by:
Name: Earnest G. Carey, Jr.
Position: Principal Product Portfolio Manager and Marketing Manager
(Authorized EU Representative)

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