

Limatorque® Fail-safe Electric Actuator MXFS and QXFS Series B



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1

Important notes and operational safety

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Figure 1.1: MXb-10 with RSDR-10 fail-safe unit

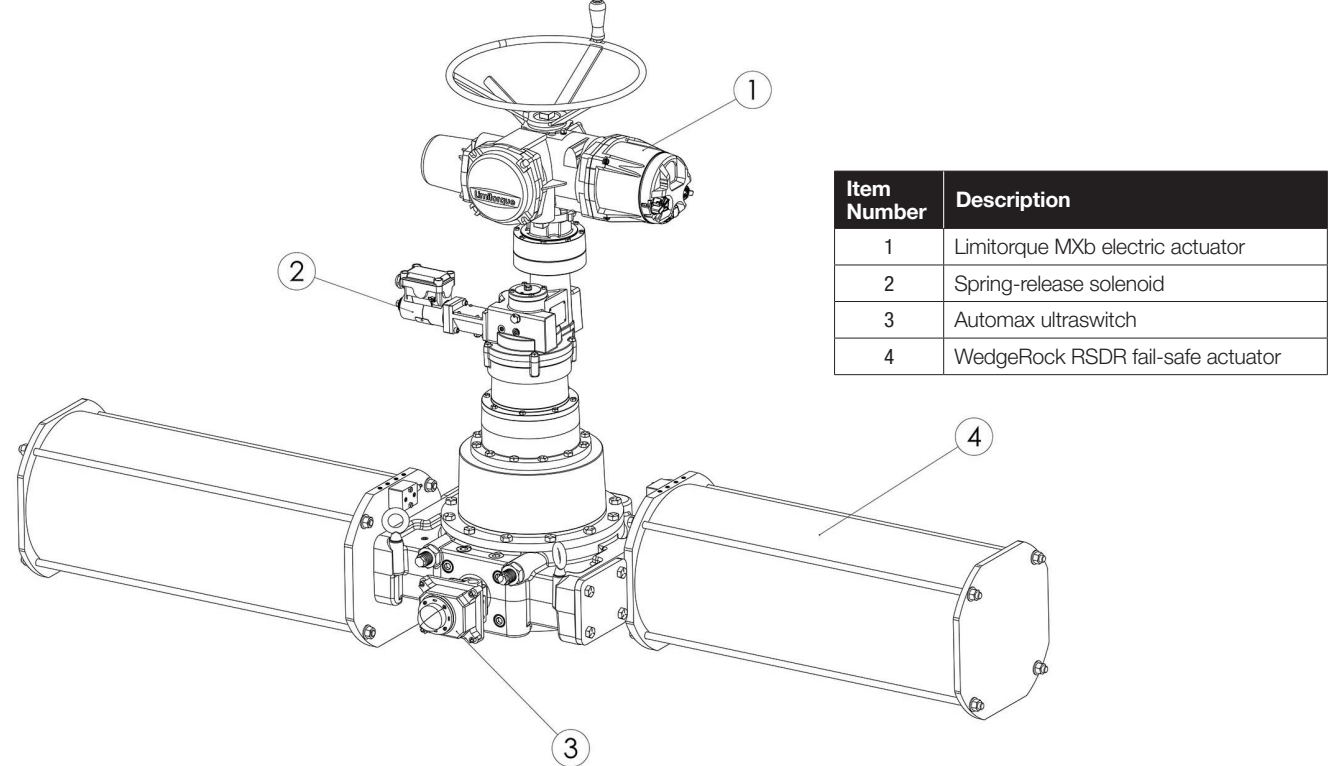
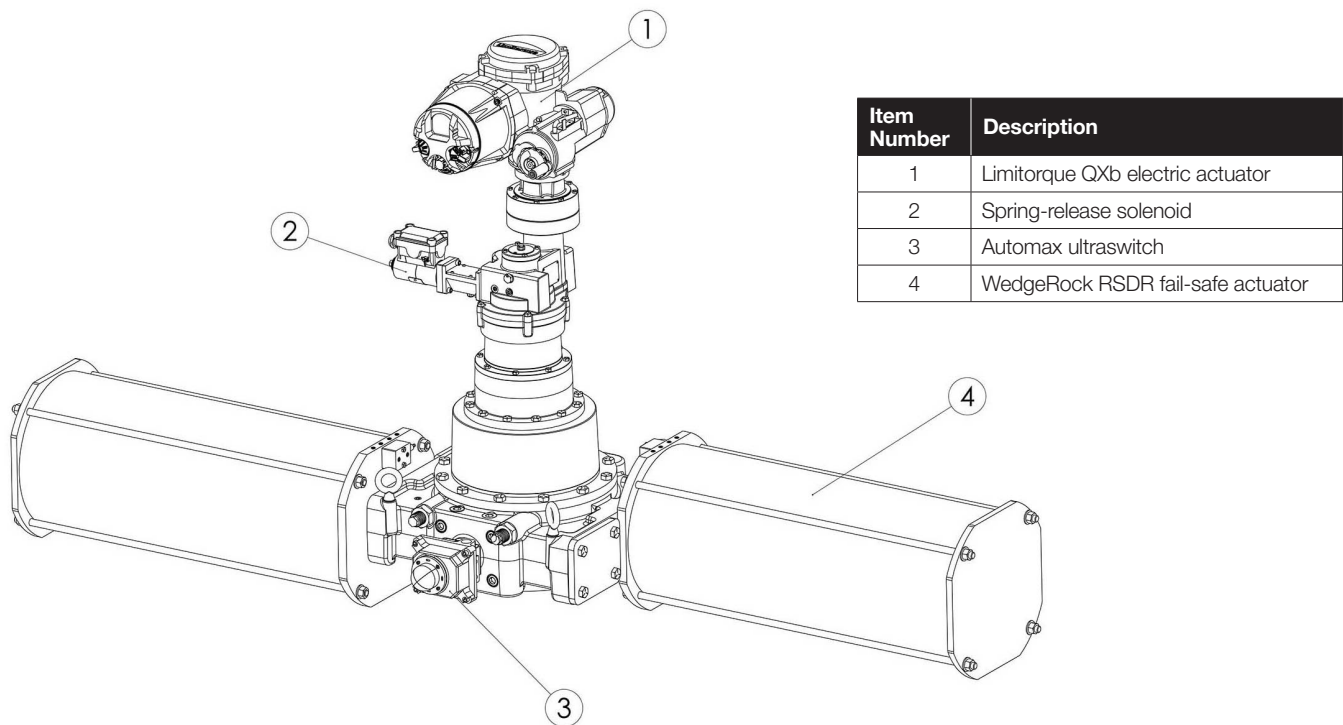


Figure 1.2: QXb-10 with RSDR-10 fail-safe unit



 Read this manual in its entirety before attempting to install or operate your Limitorque fail-safe actuator. A full understanding of the installation and operation options will help you install the actuator in the most effective manner. Failure to observe the instructions contained in the manual could result in personal injury or property damage and may void the warranty. Read this manual carefully before installing and using the product.

1.1 Qualified personnel

The end user or contractor who performs commissioning or repair activities is responsible for securing the work area and implementing protective measures, such as the use of personal protective equipment (PPE), lockout-tagout or barriers. The safety guidelines provided in this document are intended to supplement site/facility work practice and policy.

All activities addressed in this manual must be carried out by suitably qualified personnel having been authorized by the end user or contractor.

1.2 Prerequisite information

The Limitorque fail-safe actuator has a long lifespan, 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 you cannot install the actuator immediately, follow the storage instructions in this manual. See Section 2, Inspection and storage.

Disconnect all incoming power before opening any cover on the actuator. Employ safe working practices at all times and 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. 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.

NOTICE 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 installation, ensure that all cable entries are correctly sealed in accordance with national standards or regulatory authorities. Remove all temporary transit plugs and close any unused cable entries in an approved manner. See Section 3.3.3, Sealing.

Only use replacement parts as approved by Flowserve. Modifications or changes to components can invalidate the warranty, the actuator's certifications, and the actuator's fit for purpose.

1.3 Safety markings

This user instruction contains specific safety markings where non-observance of an instruction would cause a hazard. The specific safety markings are as follows.

Table 1.1: Definition of safety markings

Item Number	Description
 DANGER	This symbol indicates a hazardous situation that, if not avoided, will result in death or serious injury.
 WARNING	This symbol indicates a hazardous situation that, if not avoided, could result in death or serious injury.
 CAUTION	This symbol indicates a hazardous situation that, if not avoided, could result in minor or moderate injury or damage to equipment.
NOTICE	This symbol precedes practices that are not related to physical injury.

Table 1.2: Explanation of safety symbols

Symbol	Description
	Safety Alert This symbol indicates potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.
	Electrical Hazard This symbol indicates electrical safety instructions where non-compliance would affect personal safety and could result in loss of life or damage to equipment.

1.4 Environmental safety

Always keep the work area clean and observe safety regulations regarding waste and emissions. Appropriately dispose of all waste and clean up spills in accordance with local and national safety and environmental procedures. Report all environmental emissions to the appropriate authorities.

▲ **WARNING** If the product has been contaminated in any way, such as from toxic chemicals or nuclear radiation, do NOT send the product to Flowserve unless it has been properly decontaminated.

1.5 User safety

1.5.1 Safety equipment

Use safety equipment according to company and manufacturer guidance. The minimum recommended PPE in the work area includes safety glasses, protective shoes, protective gloves and hard hats (as applicable).

1.5.2 Precautions before work

Before you begin work on this unit, take the following series of precautions to ensure the safety of all personnel. Prepare a clear path of retreat and ensure that the product cannot fall in a way that will injure people or damage property. This includes verifying that lifting equipment is in serviceable condition.

Before performing any work on this unit, you need to clear hazardous conditions. Check the explosion risk before you use any electric hand tools. Shut down any potentially dangerous energy sources and disconnect electrical power from the unit to prevent unintended movement. Turn off the signal to the solenoid and ensure that the unit is in the fail-safe position.

▲ **DANGER** Do not disassemble the Limitorque fail-safe actuator if it is malfunctioning, as there is a possibility of releasing potential energy. Contact Flowserve for further instructions.

2

Product description

2.1 General description

Limitorque fail-safe actuators are designed for efficient reliable operation. These are typically used for operating quarter-turn or multi-turn valves. The Limitorque fail-safe actuator can be assembled in a fail-close or fail-open configuration.

A rack and helical spring acts on an output pinion gear that is coupled to a valve stem in the fail position. A helical spring that is housed in a spring can actuates the valve to the fail-safe position when a braking mechanism is released. When a solenoid is energized, a plunger rod is retracted and the locking mechanism is engaged, allowing the Limitorque fail-safe actuator to be operated. When the solenoid is de-energized, a plunger rod extends and releases the locking mechanism, forcing the Limitorque fail-safe actuator to move to the fail-safe position. Stop bolts allow for travel adjustment. Fail-safe actuators are fitted with a position indicator to provide direct valve-stem indication to the operator and the Limitorque electric actuator. A damper adjusts operational time when the actuator is moving in the fail-safe position.

2.2 Nameplate information

Every fail-safe actuator has multiple nameplates that provide information about each major component. Nameplates are located on the actuator, spring return gearbox, switchbox and solenoid.

2.3 Environmental limits

The Limitorque fail-safe actuator has been tested to function within the temperature range of -29°C to 60°C (-20°F to 140°F). Review the expected regional temperatures to ensure that the product will function properly.

3

Inspection, lifting and storage

3.1 Inspection and recording

Upon receipt of the actuator, inspect the condition of the equipment and record the nameplate information:

1. Inspect the package for damaged or missing items upon delivery. Note any damaged or missing items on the receipt and freight bill and file a claim with the shipping company. If you picked up the product from a distributor, make a claim directly to the distributor.
2. Carefully remove actuator from shipping carton or skid. Thoroughly examine the equipment to determine if any parts are damaged or missing.
3. Unfasten the product by removing screws, bolts or straps.
4. Record the actuator nameplate information for future reference; i.e. ordering parts, obtaining further information.

3.2 Lifting and handling

▲ DANGER Dropping, rolling, or tipping units or applying other shock loads can cause property damage, personal injury or death. Likewise, inadequate lifting devices increase risk of damage, injury and death. Ensure that the unit is properly supported and secure during lifting and handling and that lifting devices are rated to a sufficient capacity. Follow all applicable regulations and standards when lifting the Limitorque fail-safe actuator.

The Limitorque fail-safe RS model has threaded holes on the ends of the spring can. Install swivel lifting eyes on these holes for use. Use a choker hitch around the main body and a sling through the swivel lifting eyes, as shown in Figure 3.1.

The Limitorque fail-safe RSDS model comes with lifting eyes to make handling the unit simpler and safer.

▲ WARNING The lifting eyes are not designed to lift both the Limitorque fail-safe actuator and valves or other objects that may be attached.

3.3 Short-term storage

NOTICE The following are our recommended storage procedures to retain maximum product integrity during short-term storage. Failure to comply with recommended procedures will void the warranty. For longer-term storage, contact Flowserve for procedures and recommendations.

Actuators are not weatherproof until properly installed on the valve or prepared for storage.

Store actuators in a clean, dry, protected warehouse away from excessive vibration and rapid temperature changes. If the actuators must be stored outside, they must be stored off the ground, high enough to prevent them from being immersed in water or buried by snow.

1. Position the actuator in storage, with the motor and switch compartment oriented horizontally.
2. Place desiccant in the switch compartment.
3. Replace all plastic caps or plugs with pipe plugs and ensure that all covers are tight.
4. If the actuator is mounted on a valve and the stem protrudes from the unit, provide a suitable stem cover.

Figure 3.1: Using the lifting eyes for the Limitorque fail-safe actuator RS



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Figure 3.2: Using the lifting eyes for the Limitorque fail-safe actuator RSDS



4

Connections, commissioning and installation

4.1 Installing the Limatorque fail-safe actuator to the valve

▲ DANGER The spring-return actuator must be in its fail-safe position when installing in order to avoid the accidental release of the spring. If present, the electric spring-release solenoid must be disconnected from the power supply. If present, the pressure-pilot, spring-release mechanism must be disconnected from any source of pressure. Failure to comply can cause unexpected movement that results in personal injury, death, or damage to equipment.

▲ WARNING Ensure that the shaft that is being driven by the gear actuator is not able to rotate while installing the gear operator. If installing in the field, shut valves, stop the pipeline flow, and lock dampers and gates or place them in a position that won't allow movement. Failure to comply can cause unexpected movement that results in personal injury and damage to equipment.

4.1.1 Installing the Limatorque fail-safe actuator onto a valve

1. Wipe the baseplate underside (mounting surface) and mating flange completely.
2. Verify that both the actuator and valve are in the fail-safe position.
3. Apply a light coat of oil or anti-seize to the valve stem.
4. Install the gear operator.
5. Install the key into the valve stem keyway.
6. Align the valve stem with the actuator and slide them onto the valve flange.
7. Align the actuator and valve-flange mounting holes.
8. Install the mounting bolts and tighten them incrementally in a crossing pattern.
9. Tighten the bolts to the correct torque based on the size and material installed by the end user.

4.1.2 Powering the electric solenoid

The solenoid must receive power as specified per project. Install the cable per local code and properly seal the entering enclosure. The solenoid's design and connection point may vary depending on project requirements; reference the project-specific wiring diagram.

4.2 Electrical connections

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

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

4.2.1 Removing the 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 flame path on an explosion-proof unit or the O-ring seal and seating face.

4.2.2 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.

NOTICE 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.

4.2.3 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.

▲ CAUTION All unused conduit entries should be sealed with threaded metal plugs. Plastic plugs are installed by Limatorque for shipping only and must not be used as permanent seals.

4.2.4 Recommended terminal connections

Power terminals

Ring tongue connectors used on the power terminals should comply with the dimensions shown in Figure 4.1. For additional information, consult terminal manufacturer.

Table 4.1 details the allowable voltage and current parameters for the terminal-block power terminals. Preload the M5 screws to 1.6 to 3.2 Nm (1.2 to 2.33 ft-lb.).

Figure 4.1: Power terminal connector size limitations (dimensions in mm)

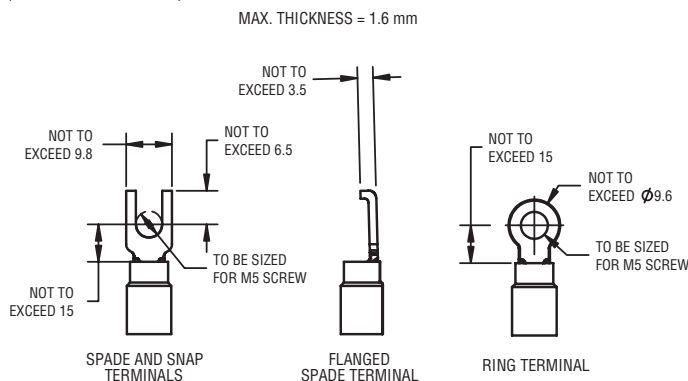


Table 4.1: Terminal block rating – Power terminals

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

Control terminals

Ring tongue connectors used on the control terminals should comply with the dimensions shown in Figure 4.3. For additional information, consult terminal manufacturer. Preload the M3 screws to 0.33 to 0.66 Nm (0.25 to 0.50 ft-lb.).

NOTICE Alternative manufacturers may be substituted only if dimensions are in accordance with Figure 4.3.

NOTICE The use of spade terminals is not recommended for secure electrical connections.

Figure 4.2: Lists the maximum allowable voltage and current parameters for the terminal block control terminals

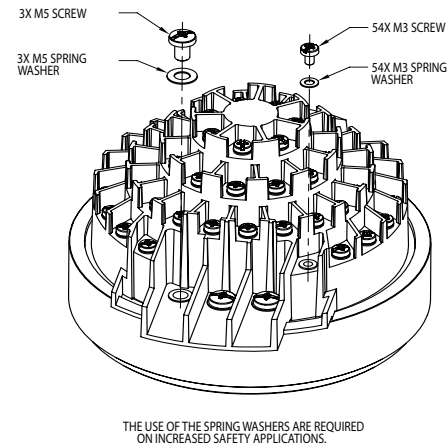
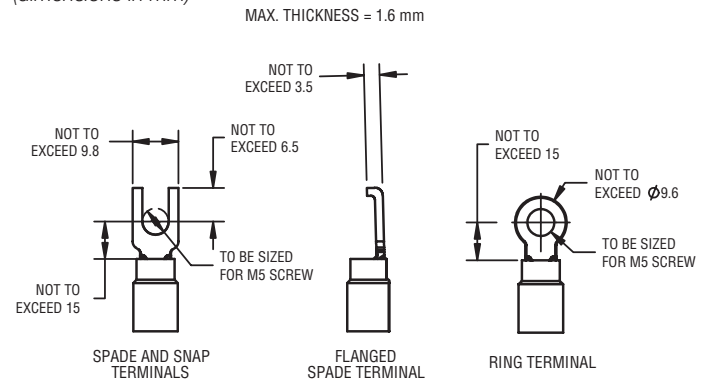


Figure 4.3: Control terminal connector size limitations (dimensions in mm)



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

Table 4.2: Terminal block rating – Control terminals

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

4.2.5 Termination of cables

All terminations should be made with insulated ring terminals using the appropriate crimping tool.

4.2.6 Cable connections

See Figures 3.3 and 3.5 for connection information.

1. Connect the main power supply cables, including the earth/ground wire using the M5 screws provided.

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- 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.

NOTICE 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 4.3: Required ratings for external wires for QX Limitorque fail-safe actuator

Up To	Use Wire Rated at Least
40°C to 55°C (104°F to 131°F) ambient	60°C (140°F)
56°C to 70°C (133°F to 158°F) ambient ¹	75°C (167°F)

Note 1: Refer to unit nameplate.

Table 4.4: Required ratings for external wires for MX Limitorque fail-safe actuator

Up To	Use Wire Rated at Least
40°C (104°F) ambient	75°C (167°F)
55°C (131°F) ambient	90°C (194°F)
60°C, 65°C and 70°C ambient (140°F, 149°F and 158°F)	105°C (221°F)

4.2.7 Network installations

Limiterque MX and QX electric actuators offer a number of network options: DDC-Modbus, Foundation Fieldbus H1, Profibus DP_V1, Profibus PA and DeviceNet.

4.2.7.1 Network wiring – DDC Modbus

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

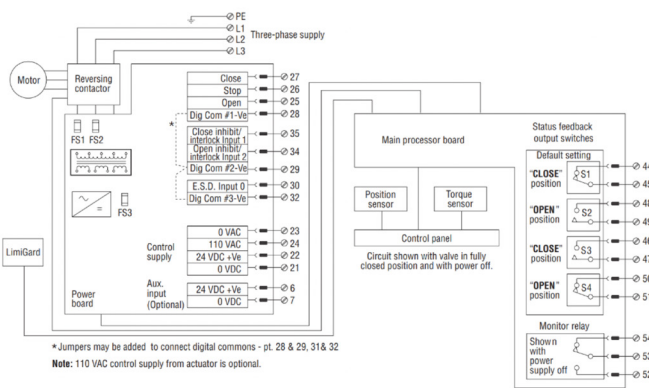
- Nominal impedance: 120 ohms @ 1 MHz
- Line to shield capacitance: 23.0 pF/ft (75.5 pF/m)
- Line to line capacitance: 12.8 pF/ft (42.0 pF/m)

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 these may result in inadvertent ground connection. Also, excess cable should be cut, not coiled or looped, to prevent noise induction into the network.

Flowserve strongly recommends remote communication wiring be routed separately from main line power wiring. Specifically, instrumentation wiring, including communication, analog and discrete signal wiring, should be routed in conduit that is separated from power lines. If this recommendation is not followed, the integrity of instrumentation signals may be compromised. If the signal is compromised, the Limitorque actuator may enter a “safe-state” whereby all motion is prohibited until communication is successfully re-established.

Figure 4.4: Standard wiring diagram illustrating three-phase motor voltage applied



NOTICE The most current wiring diagram is shipped within the terminal compartment of the Limitorque actuator.

Cable preparation

Prepare the network cable for connection to the Limitorque actuator terminal block as illustrated in Figures 4.5 through 4.8.

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 5 to 8 cm (2 to 3 in.) of the outer plastic jacket as shown in Figure 3.7. Do not cut or nick the drain wire or the insulated conductors.

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- 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 4.6.
- 3. Cut away the braided shield and the foil shield. Strip the insulation from the conductors approximately 1 cm (0.4 in.) as shown in Figure 3.9.
- 4. Apply heat-shrink tubing to insulate the drain wire and provide stress relief to the cable.
- 5. Install ring tongue connectors as shown in Figure 4.8.

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

- 6. Connect the network cables to the Limitorque actuator's terminal block per Table 3.3 and appropriate wiring diagram. Table 3.5 details a connection for the loop topology.

Figure 4.5: Removing the outer plastic jacket



Figure 4.6: Separating the cable parts

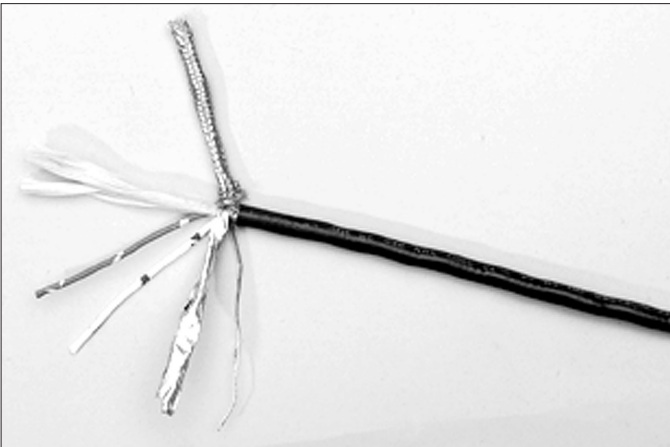


Figure 4.7: Stripping the conductors and applying heat-shrink tubing

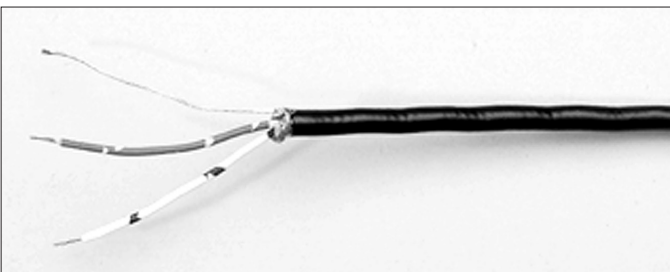


Figure 4.8: Ring-tongue connectors



Table 4.5: Loop topology connections

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

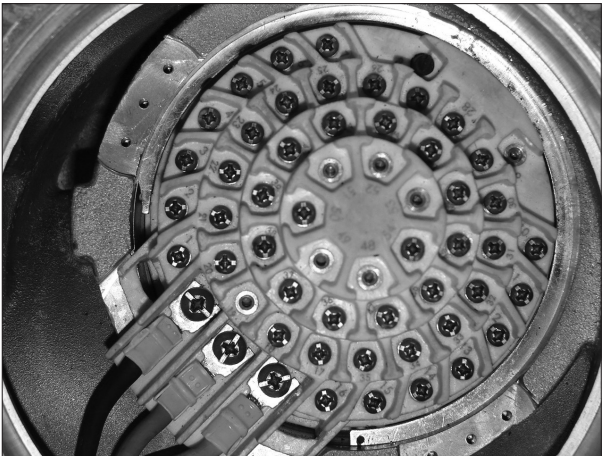
In terms of voltage, DATA is negative with respect to DATA*.

NOTICE Surge protection must be grounded to be effective.

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

Flowserve defines an effective local earth ground as the M3 taps on the housing next to the terminal block.

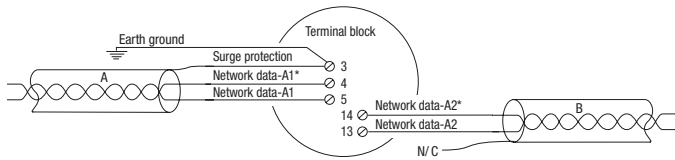
Figure 4.9: View of terminal block



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

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Figure 4.10: User network connection for loop topology



After installation is complete and prior to operation, inspect the network cable and its connection to each field unit for the following traits that should not be present:

- Nicks in the insulation — these can cause a short to the grounded shield.
- Cut strands in a stranded conductor — these 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 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.

Consult the DDC Modbus Network Installation and Operation Manual for correct wiring preparation and installation.

4.2.7.2 Network wiring – Foundation Fieldbus

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/1,000 ft
- Attenuation: 0.914 dB/1,000 ft @ 39 kHz
- Capacitive unbalance: 3.6 pF/ft

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

Particular care should be taken when terminating twisted-pair shielded cables in an FF control network. Avoid nicks, cuts or abrasions in the insulation of data communication cables, since these 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 Limitorque actuator's terminal block, as follows in Figures 3.12 through 3.15. Table 3.6 details connections for Foundation Fieldbus.

Table 4.6: Foundation Fieldbus connections

Terminal Block Number	DDC
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 Foundation Fieldbus Application Guide kbit/s Wiring and Installation Guide for more information on network wiring. Consult the Foundation Fieldbus Network Installation and Operation Manual for correct wiring preparation and installation.

▲ CAUTION Strip stranded conductors carefully, as damaging the strands will weaken the conductor. Do not nick conductors when stripping away the installation, as this will stress the conductor and cause it to break. This type of damage may not be apparent and failure can occur later without warning.

4.2.7.3 Network wiring – Profibus DP/PA

Profibus DP is based on RS485 communication. The standard EN50170 specifies the cable for use with Profibus DP. The Profibus DP cable should be a shielded twisted pair cable.

Table 4.7: Profibus cable specifications

Parameter	Type — Profibus DP
Impedance	135 to 165 ohm or 3 to 20 MHz
Capacity	<30 pF/m
Resistance	<110 ohm/km
Wire Gauge	> 0.64 mm
Conductor Area	> 0.34 mm ²

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 flexibility (bending) and higher environmental resistance, cable with stranded wire for the Profibus line and special jackets shall be used. Flowserve recommends the use of Belden 3079 A specifications, 22AWG, shielded, solid two conductors.

Key specifications:

- Capacitance/ft: 8.5 pF
- Nominal impedance: 150.0 ohms

Consult the Profibus DP Network Installation and Operation Manual and the Profibus PA Network Installation and Operation Manual for correct wiring preparation and installation.

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Table 4.8: DeviceNet cable specifications

Belden Part No.	AWG (Stranding) dia. in. Nom. DCR	Insulation Material (color code)	Nominal O.D.	Nom Impedance (ohms)	Nominal Capacitance	Test Frequency (MHz)	Maximum Attenuation dB/100 ft
3082A	2 – 15 AWG (19 x 28) 3.6 ohm/1,000 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/1,000 ft 22.7 ohm/km	Data pair (Blue/White)					
3084A	2 – 22 AWG (19 x 34) 17.5 ohm/1,000 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/1,000 ft 91.9 ohm/km	Data pair (Blue/White)					

4.2.7.4 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.

Consult the DeviceNet Installation and Operation Manual for correct wiring preparation and installation.

4.2.7.5 Network wiring – HART

HART, or Highway Addressable Remote Transducer, is a digital signal over analog 4–20 mA communications.

Consult the HART Network Installation and Operation Manual for correct wiring preparation and installation.

4.2.8 Replacing the terminal cover

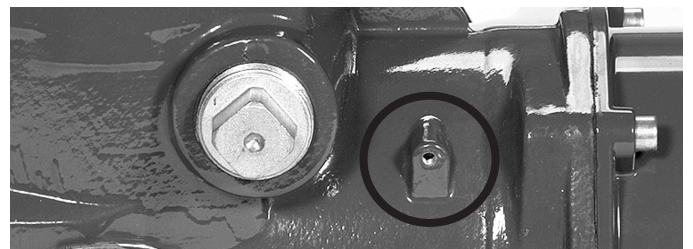
Verify that the O-ring seal and spigot joint are clean and in good condition. Lightly coat these items with mineral-based lubricant before replacing the terminal cover and four retaining screws.

4.2.9 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. This is in addition to the ground connection inside the terminal compartment.

NOTICE External ground lug #J2A-L35 is supplied. The unit will take 14–8 AWG wire sizes.

Figure 4.11: External earth/ground connection



4.3 Terminal block shield installation

1. Remove the terminal block cover.
2. Use two screws from the terminal block or the end user's bag to attach the shield.
3. Remount the terminal block cover.

Figure 4.12: Terminal block shield installation, QX unit

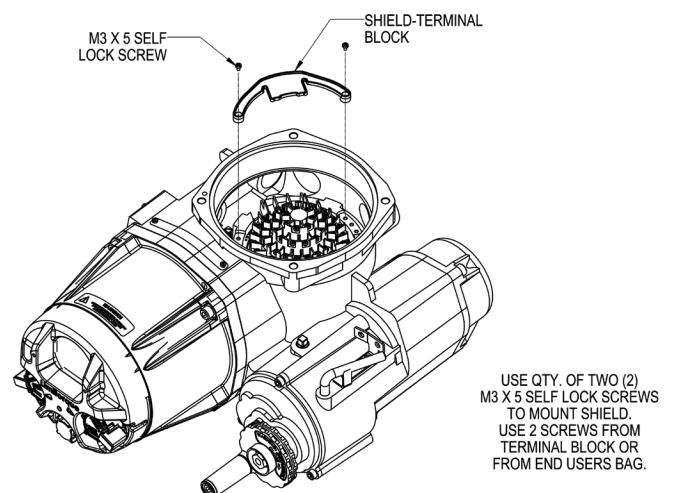
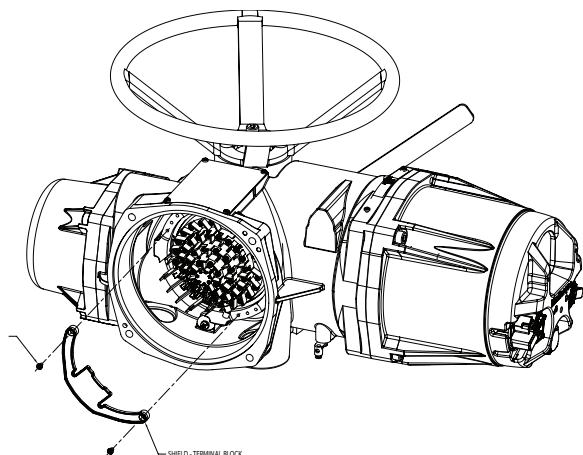


Figure 4.13: Terminal block shield installation, MX unit



4.4 Commissioning the actuator

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

After making the initial electrical connections detailed in Section 3.3, Electrical connections, the Limitorque 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 selector knob in the “LOCAL” position.
2. Use the black control knob to “OPEN” or “CLOSE” the actuator.

For configuring the actuator:

1. Place the red selector knob in the “STOP” position.
2. Use the black control knob to “SELECT” menu items or “CANCEL” menu selections.

The open and close position limits must be set after the actuator has been mounted on the valve. See section 3.5.4, Setting position limits. All other actuator parameters are factory-set, either in accordance with a Flowserve standard set of default values (see section 4.6.1, 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 4.6.2, View the existing settings.

4.4.1 Stop bolt configurations

The open and shut stops prevent the actuator from rotating past the open and shut positions of the valve. Each stop allows for $\pm 5^\circ$ of rotation from the nominal position for a travel range of 80 to 100°.

The stop bolts in the Limitorque fail-safe actuator have two possible configurations: standard and sealed.

In the standard configuration, [1] stop bolts include an [3] O-ring that seals against the stop bolt bore in the housing. This arrangement allows the [1] stop bolt to remain sealed from ingress while being adjusted. See Figure 7 - Standard stop configuration.

[1] Stop bolts are supplied standard as zinc-plated steel. When not suited to the application, a [4] stop bolt cover configuration completely seals the stop bolt from outside elements. See Figure 8 - Sealed stop configuration.

Before adjusting stop bolts, the solenoid should be energized to allow for operation of the fail-safe actuator. The valve can be cycled to set the stops manually with the handwheel or electronically with the local controls.

4.4.1.1 Adjusting the shut-position stop bolt

3. Remove the stop bolt cover and loosen the jam nut (as equipped).
4. Turn the hand wheel so that the valve is in the shut position. The stop bolt may have to be adjusted to allow the valve to move to the correct position.
5. Adjust the shut-position stop bolt until it comes into contact with the stop lug inside the gear operator.
6. Tighten the jam nut to lock the stop bolt in place.
7. If the stop bolt cover is included, verify that the O-rings are correctly installed in their respective grooves. Tighten the stop bolt cover onto the jam nut.

4.4.1.2 Adjusting the open-position stop bolt

1. Remove the stop bolt cover and loosen the jam nut (as equipped).
2. Turn the handwheel so that the valve is in the open position. The stop bolt may have to be adjusted to allow the valve to move to the correct position.
3. Adjust the open-position stop bolt until it comes in contact with the stop lug inside the gear operator.
4. Tighten the jam nut to lock the stop bolt in place.
5. If the stop bolt cover is included, verify that the O-rings are correctly installed in their respective grooves. Tighten the stop bolt cover onto the jam nut.

4.4.2 Adjusting the fail-safe stroke time

The close time is adjusted with a flow-control valve. The valve location is identified in Figures 4.15 and 4.16 as the damper setting. Full clockwise on the setting screw is the fastest speed. As the screw is turned counterclockwise, the fail operation time increases. If two dampers are used, both must be adjusted the same.

▲ WARNING Cycle the Limitorque fail-safe actuator after the final setting to verify the time it takes to stroke to the fail-safe position. The damper adjustment valve may be closed, which will not allow full operation.

Figure 4.14: RS damper setting

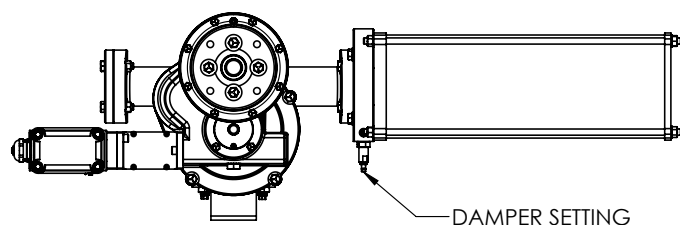
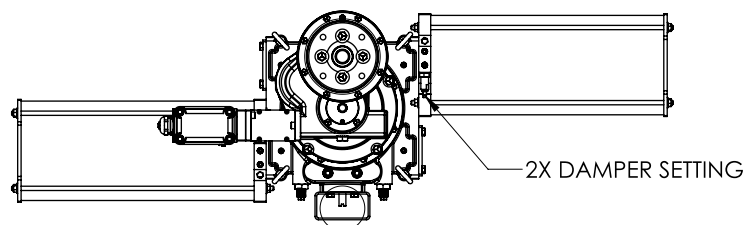


Figure 4.15: RSDR damper setting



4.4.3 Commissioning the pressure relief vent (PRV)

The pressure relief for the stem areas is typically provided to avoid any buildup of pressure due to valve-stem leakage per API 6D. Pressure relief for the gear-actuator housing is not typically provided. It is only used to avoid buildup of pressure due to temperature fluctuation and thermal expansion.

4.4.4 Setting position limits

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

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

4.4.4.1 Set position limits for electrical operation

▲ CAUTION Set the fail-position limits first. When moving in the direction that compresses the spring, the valve drive sleeve will stop moving upon reaching the stop while the input shaft will still be allowed to move. Even if the actuator moves after the valve has stopped, it's acceptable to set the limit because the valve will engage immediately once the actuator is run in reverse. When decompressing the spring, the spring stops will cause an overtorque while setting the limit.

▲ CAUTION The solenoid must be active and engaged while setting actuator limits.

1. Enter the "QUICK SETUP" menu as detailed in Section 3.5.3, Entering the setup mode.
2. Enter the "LIMITS" menu by using the menu dial to highlight it, then using the black control knob to "SELECT" it.
3. Enter the "CLOSE POSITION LIMIT" menu.
4. At the prompt, move the red selector knob to "LOCAL".
5. Hold the black control knob in the "CLOSE" position until the valve has reached the desired position.

NOTICE Do not adjust close stop while stop is loaded.

6. Move the red selector knob to "STOP". At the prompt, use the black control knob to "SELECT" OK.
7. Enter the "OPEN POSITION LIMIT" menu.
8. At the prompt, move the red selector knob to "LOCAL".
9. Hold the black control knob in the "OPEN" position until the valve has reached the desired position.

NOTICE Do not adjust open stop while stop is loaded.

10. Move the red selector knob to "STOP". At the prompt, use the black control knob to "SELECT" OK.
11. Inspect the unit for correct operation.

The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTICE For torque-seated valves, ensure that the position limit is not set at the torque seat. It is recommended that the position limit be set approximately one handwheel turn (360 degrees) in the opposite direction from the torque seat.

CAUTION On some valves, position limits could be set adjacent to each other, so be careful that the close and open limits are set sufficiently apart to permit operation. If the limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The actuator will not move until the error is corrected.

Figure 4.16: Calibrating electrical operation



4.4.4.2 Set position limits for handwheel operation

1. Enter the “QUICK SETUP” menu as detailed in Section 3.5.3, Entering the setup mode.
2. Enter the “LIMITS” menu by using the menu dial to highlight it, then using the black control knob to “SELECT” it.
3. Enter the “CLOSE POSITION LIMIT” menu.
4. At the prompt, move the red selector knob to “LOCAL”.
5. Depress the declutch lever and slowly rotate the handwheel until the clutch is fully engaged. Release the declutch lever; the clutch will stay in handwheel mode.

NOTICE Do not adjust close stop while stop is loaded.

6. If the valve is fully closed, move the handwheel one turn (360 degrees) in the open direction to allow the motor to coast.
7. When the valve is in the desired location, move the red selector knob to “STOP”. At the prompt, use the black control knob to “SELECT” OK.
8. Enter the “OPEN POSITION LIMIT” menu.
9. At the prompt, move the red selector knob to “LOCAL”.
10. Depress the declutch lever and slowly rotate the handwheel until the clutch is fully engaged. Release the declutch lever; the clutch will stay in handwheel mode.

NOTICE Do not adjust open stop while stop is loaded.

11. When the valve is in the desired location, move the red selector knob to “STOP”. At the prompt, use the black control knob to “SELECT” OK.
12. Inspect the unit for correct operation. Turn the handwheel and verify that the open and close LEDs function correctly. If adjustments are necessary, use the black control knob to go “BACK” to the prompt and repeat from step 1.

The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTICE For torque-seated valves, ensure that the position limit is not set at the torque seat. It is recommended that the position limit be set approximately one handwheel turn (360 degrees) in the opposite direction from the torque seat.

CAUTION On some valves, position limits could be set adjacent to each other, so be careful that the close and open limits are set sufficiently apart to permit operation. If the limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The actuator will not move until the error is corrected.

Figure 4.17: Calibrating handwheel operation



4.4.5 Configuring the switch box

4.4.5.1 Adjusting limit switches

Limit switch enclosures feature quick-set cams which are used to trip the limit switches. These cams are easily adjusted without tools.

CAUTION Disconnect power before removing cover when installed in hazardous locations.

Remove cover and set aside. Rotate actuator/valve to full clockwise (CW) position. Adjust cam(s) associated with CW as follows:

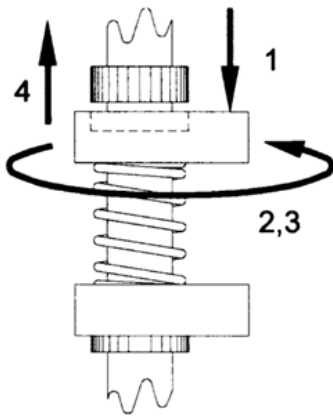
1. Push or pull cam against spring to disengage it from splines.
2. Rotate cam CW, breaking contact with switch (or moving magnet away from switch).
3. Continue rotating cam CW until switch trips.
4. Release cam and re-engage it with splines.
5. Rotate actuator/valve to full counterclockwise (CCW) position. Adjust cam(s) associated with CCW as described in steps 1 through 4, except rotate cam(s) CCW.

NOTICE Factory setting is top switch = CW (closed), second switch = CCW (open), third switch = CW, and fourth switch = CCW.

4.4.5.2 Cam fine adjustment

Some cams have a fine adjustment available. These cams will have a small screw embedded into the side of the cam. Adjusting this screw inward or outward will deform the cam, changing the trip point slightly.

Figure 4.18: Cam adjustment

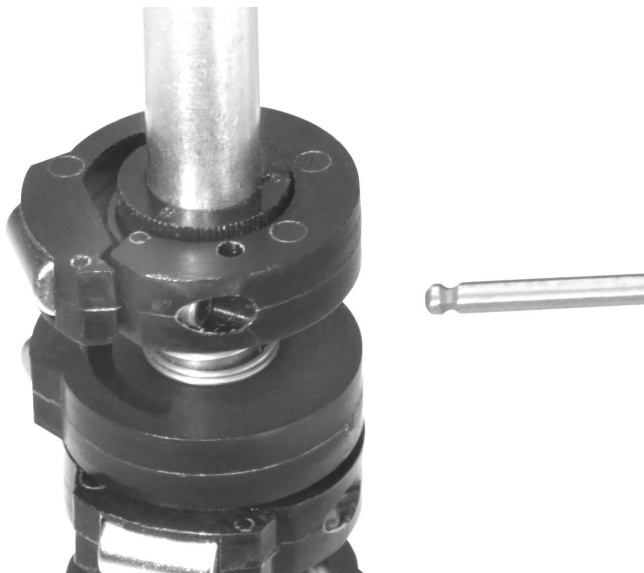


4.4.5.3 Adjusting the dome position indicator

The dome visual indicators are easily adjusted to match the dome's clear windows to the rotor's colored sections. The dome is secured to the limit switch housing with screws mounted through slotted holes. The slotted holes allow approximately 20° adjustment of the dome.

In addition, the dome can be completely removed and reoriented in 45° and 90° increments. The rotor may be reoriented with respect to the shaft by removing the shaft coupler and rotating 90° before reinstalling. This may be necessary to obtain the correct orientation of windows in a multi-way application.

Figure 4.19: Dome adjustment



4.4.5.4 Calibrating 4-20 mA transmitter

Setting direct/reverse action:

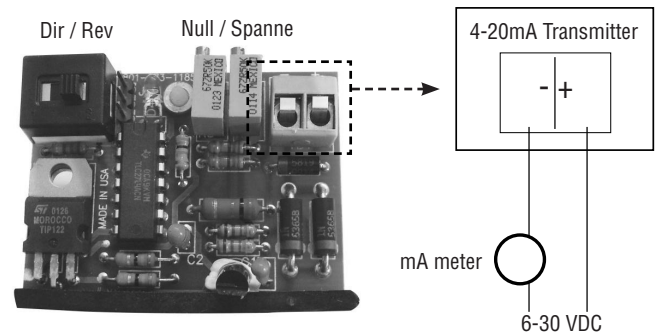
A dip-switch marked Dir/Rev in Figure 4.20 controls the direction of increasing travel. For 4 mA in the full clockwise position, select "D;" for 4 mA in the full counter clockwise position, select "R."

Adjusting zero/span:

1. Attach a DC mA meter to +/- terminals.
2. Operate valve/switch box to position corresponding to 4 mA.
3. Adjust feedback board zero trim pot to yield 4 mA. (Turning CW increases value; turning CCW decreases value.)
4. Operate valve/switch box to position corresponding to 20 mA feedback.
5. Adjust feedback board span trim pot to yield 20 mA. (Turning CW increases value; turning CCW decreases value.)
6. The zero and span adjustments are interactive. Repeat steps 1 through 5 as necessary.

NOTICE If transmitter adjustment gets difficult (i.e., trim pots do not have desired effect), start over by "centering" the trim pots. This is accomplished by turning in one direction for 20 turns and reversing direction for 10 turns.

Figure 4.20: Setting direct/reverse action



4.4.6 Entering the setup mode

To customize the existing settings on the actuator, the user must enter the "QUICK SETUP" menu. A three-digit password is required to customize the actuator. All actuators are supplied with the same default password (100). See sections 4 and 5 of VAIOM000071 or AIIOM000517 for more information about entering and changing the password.

Limiterque Fail-safe Electric Actuator

Main power must be applied to execute the setup procedure. It's recommended that the actuator be mounted to the valve before commissioning the actuator.

Enter the "QUICK SETUP" menu as follows:

1. Enter the "MAIN MENU" as detailed in Section 2.1.1, Entering the main menu.
2. Use the menu knob to highlight the "QUICK SETUP" menu and "SELECT" it with the black control knob.
3. Enter password if required. To change any of the existing settings or set the end-of-travel limits for the open and close positions of the valve, it may be necessary to enter a password.
4. Make changes in each menu as desired. Each display shows the state or value of the existing settings.
5. When the configuration is complete, use the black control knob to navigate "BACK" out of each menu until the dashboard is displayed. Alternatively, the dashboard can be reached at any time by moving the red selector knob from "STOP" to "LOCAL" or "REMOTE". The system will automatically reboot upon exiting the "QUICK SETUP" mode in order to apply new settings.

NOTICE While in the "QUICK SETUP" menu, if there is a lapse of 5 minutes from last action, the unit will return to the dashboard. Any changes that have been made will be stored.

NOTICE Once you exit this mode, the password will need to be entered again to gain access to the "QUICK SETUP" menu in order to make further changes.

After exiting the "QUICK SETUP" mode, all settings will automatically be saved to 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 "QUICK SETUP" mode, customization changes will be lost.

4.4.7 Configuration settings

Unless otherwise specified, the Limitorque fail-safe actuator is shipped with the following configuration:

- Password = 100
- Close Direction = Clockwise
- Open Seating = Position
- Close Seating = Position
- Local Control = Maintain
- Wiring Scheme = FailSafe Wiring/Standard 3-Wire Maintain Control
- Input 0 = FailSafe Control/Disabled
- Input 1 = Switch Box Limit Switch CLOSE/Enabled
- Input 2 = Switch Box Limit Switch OPEN/Enabled

Relays can be configured in the DIGITAL OUTPUT menus for feedback for Switch Box Limit Switch OPEN/CLOSE as well as FailSafe Active Feedback to alert the end user that the actuator is in fail-safe mode and can be used to notify when it is safe to re-assert the solenoid power.

Table 4.9: Default configurations

Modutronic Option	Modbus RTU Protocol
Proportional band – 5.0%	Baud rate – 9,600
Deadband – 2.0%	Analog scale – 0 to 100
Polarity – 20 mA = open	ESD action – Ignore
Action on loss of signal – close	Proportional band – 5.0%
	Deadband – 2.0%
FF and PB Options	Topology – Repeater
Analog scale – 0 to 100	Parity – None
Proportional band – 5.0%	
Deadband – 2.0%	

If the default configuration is acceptable, no further configuring is necessary. If any default setting needs to be changed, see section 4 of VAIOM000071 or AIOM000517.

4.4.8 View the existing settings

All of the existing setup data may be viewed on the LCD display by following these steps:

1. Enter the "MAIN MENU" as detailed in Section 2.1.1, Entering the main menu.
2. Use the menu knob to highlight the "VIEW QUICK SETUP" or "VIEW ADVANCED SETUP" menu option, then use the black control knob to "SELECT" it.
3. Navigate through the different menu options using the menu knob to change menu selections and the black control knob to "SELECT" them or navigate "BACK" to a previous menu.

NOTICE The "VIEW QUICK SETUP" and "VIEW ADVANCED SETUP" menus can be accessed without entering a password, but no changes to the settings can be made in this mode.

5

Operation

Limitorque Fail-safe Electric Actuator

The Limitorque actuator rotates the input shaft of the fail-safe clockwise or counterclockwise, which in turn results in the output hub rotating. Refer to the general arrangement drawing for output rotational direction with a given input rotation.

5.1 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.

Figure 5.1: Declutch lever shows direction of engagement (QX-05)

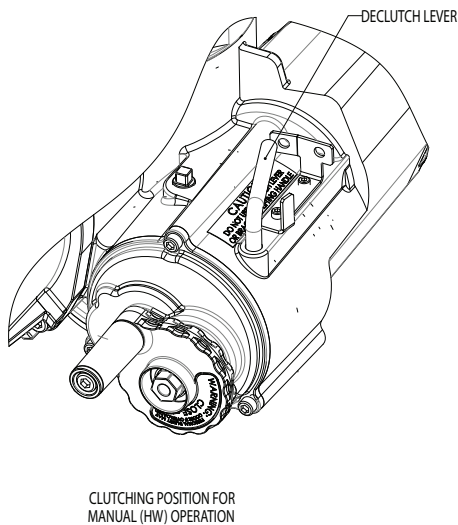
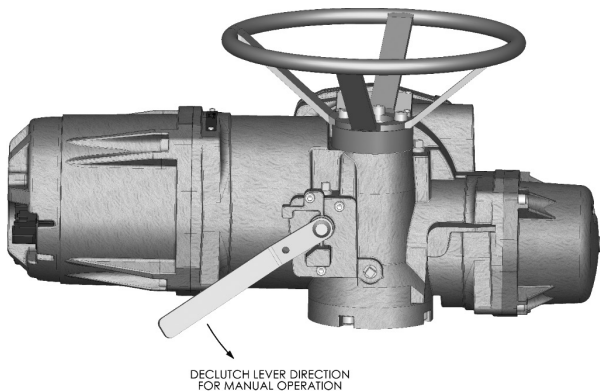


Figure 5.2: Declutch lever shows direction of engagement (MX-05)



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 0.5-in. size padlock is recommended.

5.2 Electrical operation

Before applying power to the actuator, check that the supply voltage details on the actuator nameplate are correct for this installation. An incorrect supply connected to the actuator terminals could cause fuses to blow or 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.

With the solenoid powered and engaged, the input shaft will be allowed to rotate in both directions. One direction will compress the spring until the actuator limit is reached. If operated in the opposite direction, the rotation of the shaft will allow the spring to decompress in a controlled manner.

5.3 Local control

Once the position limits have been set (see Section 3.5.4, Setting position limits) and the default mode is maintained, the actuator can be controlled locally from the control panel.

1. Place the red selector knob in the "LOCAL" position.
2. Use the black control knob to "OPEN" and "CLOSE" the actuator.

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 (inching) control mode 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.

5.4 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” and “CLOSE” commands will be prevented.
- 2. Placing the red selector knob in the “STOP” position will automatically stop the actuator, regardless of the remote control signal, unless ESD override has been selected. See Section 5.2, ESD overrides.

The red selector knob may be locked in or out of any of its three positions using a padlock. A 0.25-in. padlock is recommended.

The LCD displays status and valve position. In normal operation mode, the top line displays “---% OPEN”; bottom line displays “STATUS OK”. Refer to Section 4.4.1, Status function, for a list of alarm or status messages. Table 3.10 details the LED indicators’ default settings.

5.5 Local indication

Red and green LED indicators can be reversed. See Section 5.4.3 of VAIOM000071 or AIOM000517.

NOTICE The white LED indicator is supplied to indicate torque. If solid, it indicates the valve has reached its torque seat. If blinking, it indicates an over-torque occurred during valve travel.

NOTICE The blue LED indicator is supplied to indicate optional Bluetooth® availability in the MX actuator. This LED will light when the Bluetooth feature is recognized by an external Bluetooth-enabled device.

5.6 Fail-safe mode operation

An operational controls mode can be used for fail-safe applications that provides smart automation of the fail-safe unit. If used, when the solenoid power is removed, the actuator will enter a fail-safe mode and enable a relay to indicate to the user that it has entered fail-safe mode. Upon successful completion of the fail-safe movement, the electric actuator will move to realign with the gearbox position. When the actuator realigns with the gearbox, the actuator disables the fail-safe relay to indicate to the user that it’s safe to turn the solenoid back on and there are no issues. Any troubleshooting issues, see section 8.2.7.

Figure 5.3: Control panel

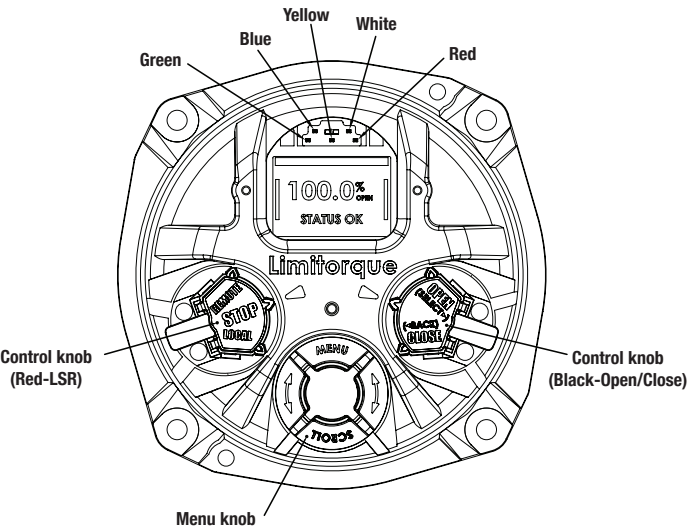


Table 5.1: LED indicators (default settings)

LED Indicator			Operation Description
Green	Yellow	Red	
Off	Off	On	Valve is fully open. (red selector knob in “REMOTE”)
On	Off	Off	Valve is fully closed. (red selector knob in “REMOTE”)
Blinking	Off	Off	Valve is closing. (red selector knob in “REMOTE”)
Off	Off	Blinking	Valve is opening. (red selector knob in “REMOTE”)
Off	On	Off	Valve stopped in mid-travel. (red selector knob in “REMOTE”)
On/Off	Blinking	On/Off	Monitor relay alarm or red selector knob in “LOCAL” or “STOP”.

6

Disassembly and reassembly

- ▲** Ensure that the device being operated is secure and the shaft being driven by the fail-safe actuator will not rotate uncontrollably after removal. Do not remove the actuator if the valve is blocked and not in the fail-safe position. Failure to conduct a comprehensive risk assessment of gear removal can lead to personal injury and damage to equipment

6.1 Removing the Limitorque fail-safe actuator from the valve

1. Disconnect power supply.
2. Disconnect signal and control lines from the fail-safe.
3. Verify that the Limitorque fail-safe actuator is in the fail-safe position.
4. Attach lifting slings as shown in Section 3.2.
5. Remove mounting bolts.
6. Remove gear actuator from valve.

6.2 Removing the Limitorque actuator from the fail-safe

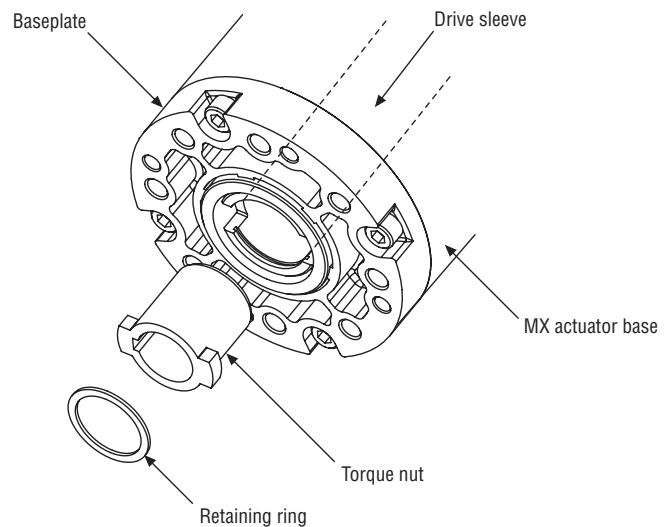
▲ WARNING In some configurations, the electric actuator may be relied on for its self-locking features to keep the input shaft from spinning uncontrollably. It's good practice to verify that the fail-safe actuator is completely in its fail-safe position with all potential energy removed before removing the electric actuator. Failure to do so may cause the electric actuator to rotate out of control once bolts are removed.

1. Slowly loosen the bolts that are holding the electric actuator to the motor flange.
2. With the bolts loosened, verify that the actuator housing is free to rotate on the flange and is not under any amount of built-up torque.
3. Follow the disassembly steps for the QX or the MX version of the Limitorque fail-safe actuator.

6.2.1 MX disassembly

1. Remove the retaining ring that holds the torque nut in the drive sleeve.
2. Remove the torque nut. If it's difficult to remove, insert a suitable device into the drive-sleeve through the bore and gently tap it loose from the handwheel end.

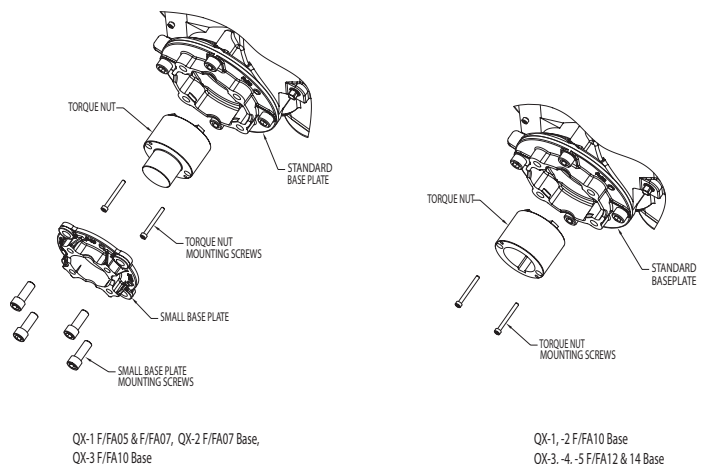
Figure 6.1: Exploded view of MX actuator base



6.2.2 QX disassembly

3. Remove the baseplate mounting screws and small baseplate.
4. Remove the two torque-nut mounting screws and remove the torque nut.

Figure 6.2: Exploded view of QX actuator base



6.2.3 Reassembly

1. Clean the torque nut thoroughly and lightly grease it.
2. Replace the torque nut in the drive sleeve. Ensure that the torque nut meshes with the drive lugs.
3. Reinstall the torque nut mounting screws.
4. For MX units, refit the retaining ring.

7

Maintenance

7.1 General maintenance

Under normal operating conditions, the Limatorque fail-safe actuator is maintenance-free. For ordinary applications, it 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 motor 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 motor operation. See Section 8.1, Lubrication.
3. All ball bearings, oil seals, O-rings and quad-rings are to be replaced after 450 hours of motor operation. See Bulletin LMENIM3314, QX Maintenance and Spare Parts.

NOTICE Operational indicators may be set up to notify operators when service is required. Please refer to Section 7.5.1.5 for instructions.

7.2 Lubrication

Limatorque actuators are oil-filled, using Petro Canada SHB 68 for QX units and Mobil SHC 632 (with Teresstic SHP 320 as a substitute) for MX units. These products are synthetic machine oils that are suitable for ambient temperatures of -30°C to 120°C (-20°F to 250°F).

7.2.1 Oil capacities

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

Table 7.1 Oil capacities

Unit Description	Fluid Ounces	Liters
QX-1 /2	26	0.77
QX-3 /4/5	80	2.36
MX-05	10	0.256
MX-10	21	0.6
MX-20	48	1.4
MX-40	65	1.9
MX-85/14/150	192	5.7

7.2.2 Checking the oil level

To check the level:

1. Remove the uppermost filler plug on the gear case.

7.3 Spare parts

In typical applications, spare parts are not necessary for the service life of the Limatorque fail-safe actuator. However, if spare parts are required, contact your Flowserve sales representative.

7.4 Service

Flowserve has service personnel available to install, maintain and repair all of their respective projects. For more information, contact your Flowserve sales representative or visit www.flowserve.com.

7.5 Decommissioning

When decommissioning the Limatorque fail-safe actuator, follow removal instructions. The main spring must be fully decompressed to avoid accidental release of potential energy. Contact Flowserve for proper removal instructions.

8

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

If these checks are satisfactory, then attempt to locate the fault using the “Advanced Diagnostics” menu (see Section 7 of VA10M000071 or A110M000517).

8.1 View advanced diagnostics

1. Enter the “ADVANCED DIAGNOSTICS” menu as detailed in Section 7.
2. Review the various menus to try to find the reason the actuator will not operate. The menus that may help to isolate the fault are as follows:
 - Status Information — configuration settings and status
 - Analytics — graphs, histograms and profiles
 - Logs — event, actuator commands, PST, time-stamped records
 - User Indicators — user-configurable deviations and service intervals

8.2 Troubleshooting problems and corrective action

Refer to LMENIM3314, QX Maintenance and Spare Parts and the standard wiring diagram in Section 3.3, Electrical connections. We recommend that only Flowserve service personnel perform this operation.

8.2.1 Incorrect actuator-controls power

1. Switch off the main three-phase power supply and 24VDC backup supply at terminals 6 and 7 (if used).
2. Remove the terminal cover 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 the main power supply.
5. Measure VAC at 23, 24 — it should be 110 VAC if the actuator is supplied with optional 110VAC circuit. If there is no power, check fuses FS1, FS2 and FS3. Replace the fuses if necessary. If replacing fuses does not fix the problem, replace the damaged board. Contact Flowserve at LimitorqueService@flowserve.com or by calling 434-528-4400.

Table 8.1: Optional transformer fuse

Fuse Designator	MXb/QXb Actuator Three-Phase
FS1, FS2	600 VAC, 1 A, fast-acting, 10.3 x 38.1 mm
FS3	250 VAC, 0.2 A, time delay, 5 x 20 mm

6. Measure VDC at 21, 22 — it should be 24 VDC, maximum power of 5 W. If it's not, replace the damaged board. Contact Flowserve at LimitorqueService@flowserve.com or by calling 434-528-4400.
7. Replace the control compartment cover (ACP).

8.2.2 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 the 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 3.5.4, 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 above.
2. Check that the red selector knob is in “REMOTE.”
3. ESD signal may be present or absent at the terminals. Check for signal and adjust as necessary. “ESD ACTIVE” appears on 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 override local (“ESD > “LOCAL”, see Section 5.2, ESD overrides).
4. Confirm correct monitor relay operation.

8.2.3 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 3.5.4, Setting position limits.
2. Check that torque settings are correct for the valve. Recalibrate if necessary. See Section 4.2.6, Torque limits.
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 travel.

NOTICE 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.

8.2.4 Actuator operates but does not drive valve

1. With the unit in the fail-safe position, verify that the solenoid engages and disengages the unit by observing whether the solenoid plunger moves while energizing or de-energizing the solenoid.
2. Verify that the declutch lever has returned to motor-operated position.
3. Verify that the stem nut is fitted correctly in the actuator base.

4. Verify that the stem nut has sufficient engagement with the valve stem.
5. Verify that the key is fitted in bore/keyway applications.

8.2.5 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.

8.2.6 Status messages

Normal display status is listed in Section 3.6.5, 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.

Status or alarm messages

- “---% OPEN, STATUS OK” – normal display
- “---% OPEN, VALVE JAMMED” – valve cannot start moving
- “---% OPEN, LOST PHASE FAULT” – one of three phases lost
- “---% OPEN, MOTOR OVERTEMP” – thermistor range exceeded
- “---% OPEN, OVERTORQUE” – torque exceeded in mid-travel
- “---% OPEN, HARDWARE FAILURE” – general indication
- “---% OPEN, DDC OFF” – DDC enabled, but off
- “---% OPEN, FF OFF” – FF enabled, but off
- “---% OPEN, PBDP OFF” – PB/DB enabled, but off
- “---% OPEN, PBPA OFF” – PB/PA enabled, but off
- “---% OPEN, DN OFF” – DeviceNet enabled, but off
- “---% OPEN, NO ANALOG SIGNAL” – 4–20 mA signal absent (Modutronic enabled, red selector knob in “REMOTE”)
- “---% OPEN, DDC COMM LOSS” – DDC enabled, signal absent
- “---% OPEN, FF COMM LOSS” – Foundation Fieldbus enabled, signal absent
- “---% OPEN, PROFIBUS COMM LOSS” – Profibus DP enabled, signal absent

- “---% OPEN, PBPA COMM LOSS” – Profibus PA enabled, signal absent
- “---% OPEN, DN COMM LOSS” – DeviceNet enabled, signal absent
- “---% OPEN, PLC OFFLINE” – the PLC has stopped communicating with the actuator
- “---% OPEN, THERMISTOR FAULT” – there is a failure with the motor thermistor
- “---% OPEN, KNOBS” – there is a failure with the local knobs
- “---% OPEN, LEFT KNOB FAIL” – there is a failure with the red selector knob
- “---% OPEN, RIGHT KNOB FAIL” – there is a failure with the black control knob
- “---% OPEN, CENTER KNOB FAIL” – there is a failure with the menu knob
- “---% OPEN, CONTACTOR FAULT” – contactor failure
- “---% OPEN, ENCODER FAULT” – encoder failure
- “---% OPEN, R5R8 IO BOARD” – R5 to R8 board relay check failed
- “---% OPEN, DDC BOARD” – DDC board communication with the host controller failed, or hardware fault
- “---% OPEN, FF BOARD” – Foundation Fieldbus board communication with the host controller failed, or hardware fault
- “---% OPEN, PB DP BOARD” – Profibus DP board communication with the host controller failed, or hardware fault
- “---% OPEN, PB PA BOARD” – Profibus PA board communication with the host controller failed, or hardware fault
- “---% OPEN, DN BOARD” – DeviceNet board communication with the host controller failed, or hardware fault
- “---% OPEN, HART1 BOARD” – HART board 1 communication with the host controller failed, or hardware fault
- “---% OPEN, HART2 BOARD” – HART board 2 communication with the host controller failed, or hardware fault
- “---% 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
- “---% OPEN, ESD XX ACTIVE” – input XX is set for ESD, is asserted, and has highest priority
- “---% OPEN, ESD CONFLICT” – input is set for ESD, is asserted, and is in conflict with the active ESD
- “---% OPEN, INHIBIT ACTIVE” – inhibit signal is asserted
- “---% OPEN, INH CONFLICT” – conflict with multiple inhibits
- “---% OPEN, IDENTICAL LIMITS” – position limits identical, preventing operation
- “---% OPEN, TORQUE TIMEOUT” – the torque switch timed out after the actuator determined that it has reached its torque seat
- “ANALOG OUT 1 LOSS” – analog board output driver chip is reporting a fault and cannot be reset, resulting in loss of analog out signal
- “ANALOG OUT 2 LOSS” – analog board output driver chip is reporting a fault and cannot be reset, resulting in loss of analog out signal
- “---%, OIL OVER TEMP” – arctic unit oil temperature too high
- “---%, HIGH LINE VOLTAGE” – QX line voltage too high to run safely
- “---%, MC COMM LOSS” – QX communication loss with motor controller board
- “---%, MC BOARD FAULT” – QX motor controller board fault
- “---%, MOTOR FAULT” – QX motor fault
- “---%, LOW LINE VOLTAGE” – QX line voltage too low to run safely

RAM error

The QX actuator 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:

- “---% OPEN, RAM ERROR”

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

ROM error

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

- “---% OPEN, ROM ERROR”

When the red selector knob is placed in “STOP”, the unit will require reinitialization.

8.2.7 Fail-safe active relay indication

When operating correctly, the fail-safe active relay will be ACTIVE to indicate to the user that the actuator is in fail-safe mode and will DEACTIVATE when the actuator is safe to re-engage the solenoid.

If the fail-safe active relay remains ACTIVE for longer than the anticipated stroke time of the electric actuator, then the connections between the switch box and actuator should be examined.

Actuator Fully Open Condition: Check the OPEN limit switch connection and switch position, as this may be an indication that the actuator thinks the gearbox is not fully OPEN. Failure of the solenoid could also contribute to this condition as well.

Actuator Fully Close Condition: Check the CLOSE limit switch connection and switch position, as this may be an indication that the actuator thinks the gearbox is not fully CLOSED.

NOTICE Fail-safe ACTIVE status does not latch and will clear once the fault condition is cleared. Intermittent faults will cause intermittent status changes.

Abbreviations

ANLG	Analog	MM	Two-digit Month
APT	Analog Position Transmitter	MOD	Modulating
ATT	Analog Torque Transmitter	OLIM	Open Limit
AVG	Average	OPS	Operation
BRD	Board	POS	Position
CL	Close	PREV	Previous
CMD	Command	PS	Partial Stroke
CNCL	Cancel	PST	Partial Stroke Test
CNT	Count	PWRON	Power On
COMM	Communication	QA	Quality Assurance
CONT	Continuous	REC	Recent (last run)
DEV	Deviation	REF	Reference
DS	Drive Sleeve	RMT	Remote
ESD	Emergency Shutdown	RTC	Real Time Clock
EXC	Exceeded	SEC	Seconds
HC	Host Controller	TEMP	Temperature
HH:MM	Two-digit Hour: Two-digit Minute (time represented in 24-hour increments)	TRQ	Torque
HI	High	UI	User Interface
HR	Hour	VIB	Vibration
ID	Identification	YYYY	Four-digit Year
LTA	Long-term Average		
MAC	Media Access Control		
MAX	Maximum		
MID	Mid-travel		
MIN	Minimum		

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United States
Limitorque, a unit of
Flowserve USA Inc.
5114 Woodall Road
P.O. Box 11318
Lynchburg, VA 24506-1318

Italy
Flowserve Limitorque
via Rio Vallone 17
20883 Mezzago (MB), Italy

Singapore
Limitorque Asia
Pte., Ltd. 12, Tuas Avenue 20
Singapore 638824

China
Limitorque Beijing
Pte., Ltd. RM A1/A2
22/F, East Area
Hanwei Plaza No. 7
Guanghua Road
Chaoyang District
Beijing 100004
Peoples Republic of China

India
Flowserve Limitorque
Office A, 7th Floor
Plot Nos. 32A & B Ambit IT Park
Ambit IT Park Road Ambattur
Industrial Estate
Chennai – 600058

Headquarters
Flowserve Corporation
5215 North O'Connor Blvd.
Suite 700
Irving, Texas 75039-5421 USA

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