FLOWSERVE

USER INSTRUCTIONS

Limitorque® MX Series B
Electronic Actuator

Experience In Motion

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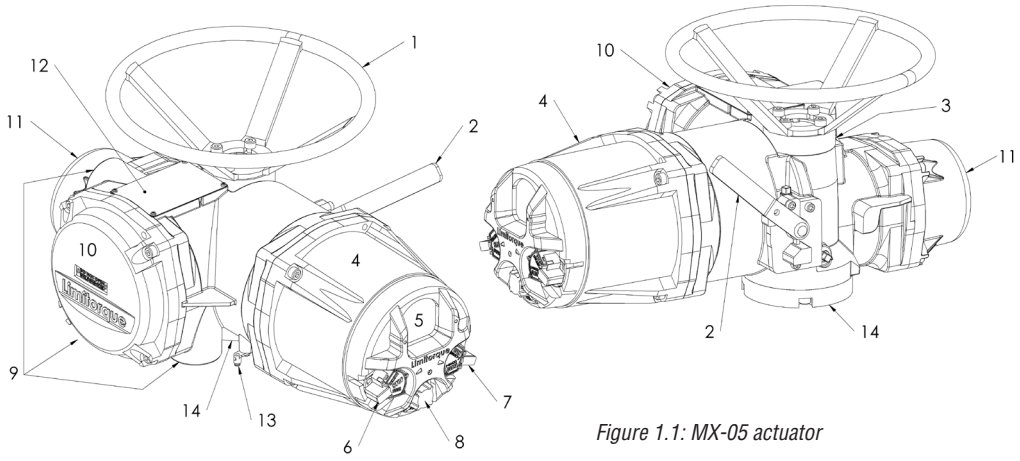

Figure 1.1: MX-05 actuator

Piece	Description
1	Handwheel
2	Declutch lever (MX-05 actuator)
3	Oil fill
4	Controls cover
5	LCD
6	Control knob (red-LSR)
7	Control knob (black-open/close)
8	Menu knob
9	Conduit entry
10	Terminal compartment cover
11	Motor
12	Nameplate
13	Ground lug
14	Torque/Thrust base

1 Important Notes

- Please read this manual in its entirety before attempting to install or operate your MX actuator. A full understanding of the installation and operation options will assist you in installing the actuator in the most effective manner. Flowserve has designed the MX 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 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 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 3.3.3, Sealing cable/conduit entries.

2 Quick Start

Quick Start provides step-by-step instructions for commissioning each MX actuator. This information is also available in Quick Start-Up Instructions.

These instructions are for the following:

- Position limits calibration – can be performed in one of two ways:
  1. Electrically: See Section 2.1.2, Electrical operation.
  2. Manually: See Section 2.1.3, Handwheel operation.
- DDC/Modbus operation: See Section 2.2, DDC/Modbus option.
- See Section 4 for other modes of operation.

After following these instructions, 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; no further calibration should be necessary. If full valve data was not provided when ordering, or if changes are needed for parameters, see Section 4, Customizing the actuator.

2.1 Calibrate – position limits

1. Install the MX 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 selector knob to the "STOP" position.
4. The "POSITION LIMITS NOT SET" warning will be displayed. Use the black control knob to "SELECT" OK.
5. The "LANGUAGE" menu will appear. Use the menu knob to highlight the desired setting, then use the black control knob to "SELECT" it.
6. The "LIMITS" menu will appear.
7. Calibrate end position limits one of two ways:

- Electrically, using the control panel. See Section 2.1.2, Electrical operation and Table 3.10 for LED indication.
- Manually, using the handwheel. See Section 2.1.3, Handwheel operation.

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 (inching) mode 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 "MAIN MENU" and choosing "VIEW QUICK SETUP".

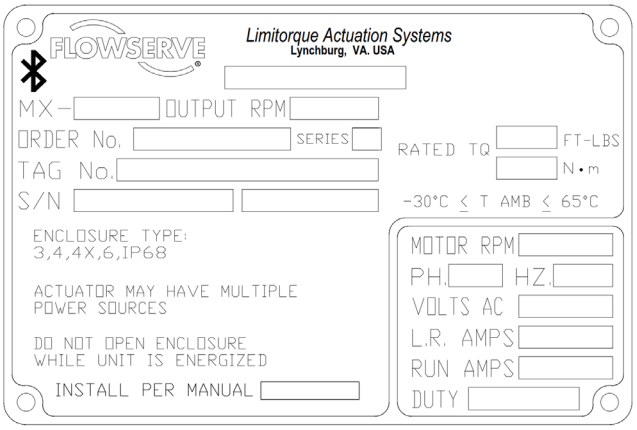

Figure 2.1: MX actuator nameplate

2.1.1 Entering the main menu

1. Place the red selector knob in the "STOP" position.
2. Place the black control knob in the "OPEN" position, then the "CLOSE" position, then again in the "OPEN" position (in quick succession – approximately 1 to 2 seconds).
3. This will bring up the "MAIN MENU". Use the menu knob to cycle through the menu options. Use the black control knob to "SELECT" menu items or navigate "BACK" to the previous menu.

2.1.2 Electrical operation

This feature allows for quick and simple calibration. To set the position limits electrically, enter the "LIMITS" menu via the "QUICK SETUP" menu.

If not already in the "LIMITS" menu:

1. Enter the "MAIN MENU" as detailed in Section 2.1.1, Entering the main menu.
2. Enter the "QUICK SETUP" menu.
3. Enter password if required. See Section 4.1, Password entry.
4. Enter the "LIMITS" menu.

Once in the "LIMITS" menu:

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

9. Inspect for correct operation. If the position limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTE: 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: “WARNING! IDENTICAL POSITION LIMITS SET”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 2.2: Electrical operation

2.1.3 Handwheel operation

To set the position limits manually, enter the “LIMITS” menu via the “QUICK SETUP” menu.

If not already in the “LIMITS” menu:

1. Enter the “MAIN MENU” as detailed in Section 2.1.1, Entering the main menu.
2. Enter the “QUICK SETUP” menu.
3. Enter password if required. See Section 4.1, Password entry.
4. Enter the “LIMITS” menu.

Once in the “LIMITS” menu:

1. Enter the “CLOSE POSITION LIMIT” menu.
2. At the prompt, move the red selector knob to “LOCAL”.
3. 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.
4. If the valve is fully closed, move the handwheel one turn (360 degrees) in the open direction to allow for coasting of the motor.
5. 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.
6. Enter the “OPEN POSITION LIMIT” menu.
7. At the prompt, move the red selector knob to “LOCAL”.
8. 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.
9. 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.
10. Inspect 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.

NOTE: 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: “WARNING! IDENTICAL POSITION LIMITS SET”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

2.2 DDC/Modbus option

The 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.

Figure 2.3: Handwheel operation

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 Flowserve at 434-528-4400.

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 “QUICK SETUP” menu. If not in the “QUICK SETUP” menu, enter the “MAIN MENU” as detailed in Section 2.1.1, Entering the main menu, then use the menu knob to highlight the “QUICK SETUP” menu and “SELECT” it using the black control knob.
2. Enter the “DDC” menu.
3. Use the black control knob to “SELECT” the “ENABLED” option. The LCD will display DDC menu items.
4. Enter the “DDC ADDRESS” menu.
5. Use the menu knob to enter an address from 1 to 250.

▲ **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 torque nut

The MX actuator has two basic base designs:

- Torque-only base, designated by a “B” prefix (e.g., B4/B4E)
- Thrust-only base, designated by an “A” prefix (e.g., A1/A1E)

3.1.1 Type “B” bases: Torque-only applications

3.1.1.1 Standard B4/B4E base

The standard MX actuator base is the B4 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.

NOTE: Some MX actuators are supplied with single-piece drive sleeves that have been bored and keyed. These are typically mounted directly to gearboxes.

NOTE: The MX actuator may be mounted in any position as long as the handwheel is accessible.

Figure 3.1: B4 base

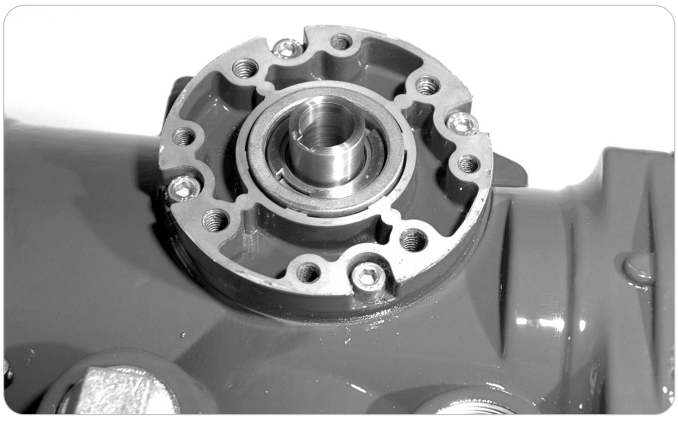

Figure 3.2: B4E base

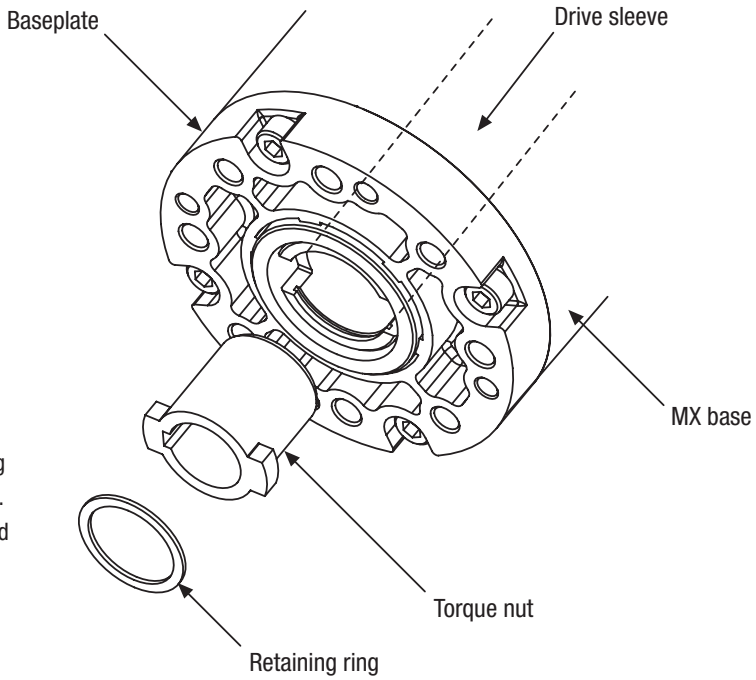

Figure 3.3: Exploded view of B4/B4E base (MX-05 actuator shown)

Disassembly

1. Remove the retaining ring (B4 base) or spiral-wound ring (B4E base) that retains the torque nut in the drive sleeve.
2. Remove the torque nut. If it 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 (see MX actuator performance and dimensions manual for maximum stem capacity). 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 it meshes with the drive lugs.
3. Refit the retaining ring (B4 base) or spiral-wound ring (B4E base).

3.1.1.2 Optional B1 base
(not available for MX-85, MX-140 and MX-150 actuators)

An optional torque base assembly may be added to allow for a greater stem acceptance. This base is supplied with a fixed bore and key, as defined by ISO 5210.

Disassembly/Reassembly

No action is required, since the torque nut has been machined to an international standard. Clean the bore and lightly grease.

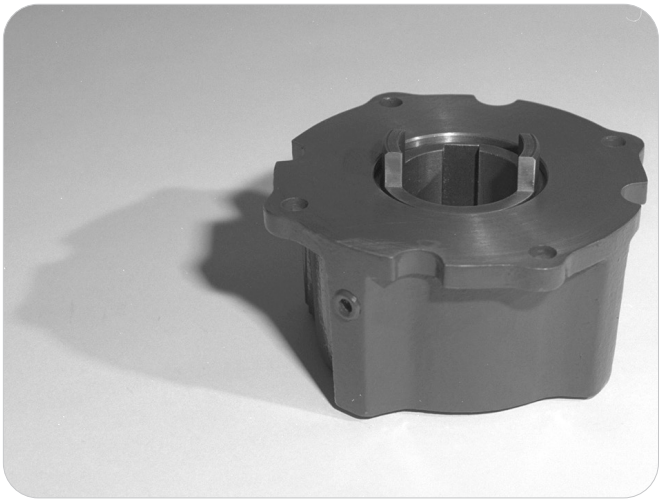

Figure 3.4: B1 base

NOTE: Fill base with a Lithium-based EP0 grease.

3.1.1.3 Type “BL” drive: Splined drive application

Steel alloy splined nuts are provided to a standard involute spline category for rising and rotating stem valves, per customer requirements. Disassembly and reassembly are the same as the B4 base and torque nut. See Section 3.1.1.1, Standard B4/B4E base.

3.1.2 Type “A” bases: Thrust-only applications

3.1.2.1 Standard A1/A1E base

The standard MX actuator thrust base is the A1 and may be bolted directly to the actuator. The thrust base contains a bronze alloy thrust nut that may be machined to suit the valve stem.

An A1E (extended) thrust nut can be provided and may be installed to reach shorter stems.

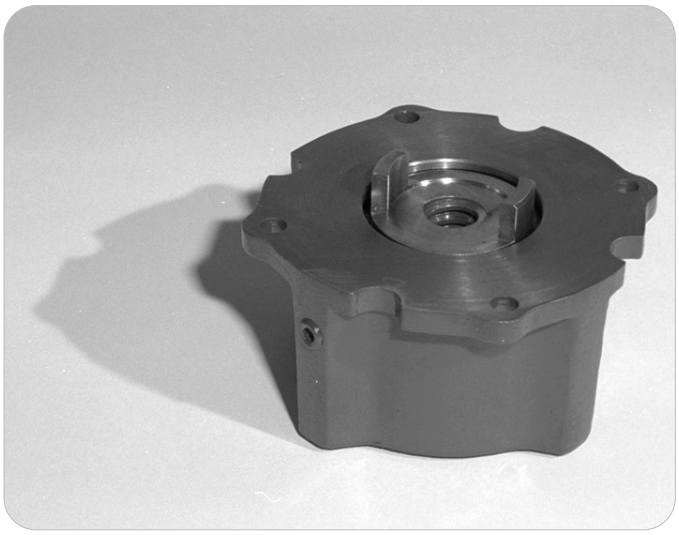

Figure 3.5: A1 base

3.1.2.1.1 MX-05/10/20/40 actuators

Disassembly

Refer to Figure 3.6.

Disassembly of the main housing from the base is recommended to allow the base to remain on the valve if the actuator must be removed for service.

Pilot removal

MX-10 actuator: Remove the screw and washer holding the valve pilot to the thrust base and remove pilot.

MX-05⁄20⁄40 actuators: Turn counter-clockwise and remove.

Thrust bearing and nut removal

1. Remove the first set of thrust washers and bearing.
2. Remove stem nut.

NOTE: The thrust washers, bearing and thrust nut may be removed at the same time. The second set of thrust washers and bearing does not have to be removed.

3. Machine the thrust nut to suit the valve stem. Ensure sufficient clearance to avoid unnecessary wear and heating during operation.

Reassembly

Refer to Figure 3.6.

1. Clean the thrust nut, washers and bearing(s) thoroughly.
2. Slide second set of thrust washers and bearing in place if removed.

NOTE: Order of assembling thrust washers and bearing must be as follows: washer, thrust bearing, washer.

Pilot installation

MX-10 actuator: Slide pilot into thrust base assembly and secure with washer and screw. Tighten fully.

MX-05⁄20⁄40 actuators: Place pilot into thrust base and turn clockwise until pilot is tight.

NOTE: Fill base with Nebula EP 0, Conoco Conolith EP 00, Mobil SHC 632, Dynalife-L-EP0, Triton ELL or Lithium-based EP0 grease.

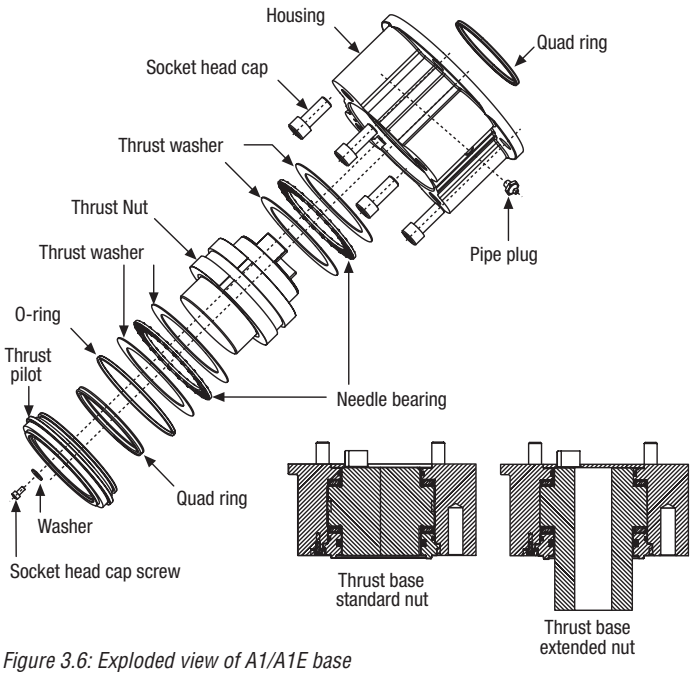

Figure 3.6: Exploded view of A1/A1E base (MX-05/10/20/40 actuators only)

3.1.2.1.2 MX-85 actuator

Disassembly

Refer to Figure 3.7.

Disassembly of the main housing from the base is recommended to allow the base to remain on the valve if the actuator must be removed for service.

Thrust base mounting plate removal

Remove the six socket head cap screws holding the valve mounting plate to the thrust base house and remove mounting plate.

Thrust bearing and nut removal

1. Remove the first set of thrust washers and bearing.
2. Remove stem nut.

NOTE: The thrust washers, bearing and stem nut may be removed at the same time. The second set of thrust washers and bearing does not have to be removed.

3. Machine the stem nut to suit the valve stem. Ensure sufficient clearance to avoid unnecessary wear and heating during operation.

Reassembly

Refer to Figure 3.7.

1. Clean the stem nut, washers and bearing(s) thoroughly.
2. Slide second set of thrust washers and bearing in place if removed.
3. Install stem nut. Lubricate thoroughly.
4. Install first set of thrust washers and bearing.

NOTE: Order of assembling thrust washers and bearing must be as follows: washer, thrust bearing, washer.

NOTE: Fill base with Nebula EP 0, Conoco Conolith EP 00, Dynalife-L-EP0, Mobil SHC 632, Triton ELL or Lithium-based EP0 grease.

Thrust baseplate installation

Mount baseplate to thrust base housing and install the six socket head cap screws to the proper torque per Table 3.1.

Table 3.1: Hardware and torque for thrust base mounting (applies to all bases)

Screw Size	Torque	
	ft-lb	Nm
M8 or 8 mm (5⁄16 in)	12 to 14	16 to 19
M10 or 9 mm (3⁄8 in)	25 to 30	33 to 40
M12 or 13 mm (1⁄2 in)	40 to 50	53 to 67
M16 or 16 mm (5⁄8 in)	90 to 100	122 to 135
M20 or 19 mm (3⁄4 in)	180 to 200	244 to 271

NOTE: Hardware and mounting torque listed in Table 3.1 are used for both:

- Mounting thrust baseplate to thrust base housing (six [6] screws)
- Mounting thrust base assembly to main housing (four [4] screws)

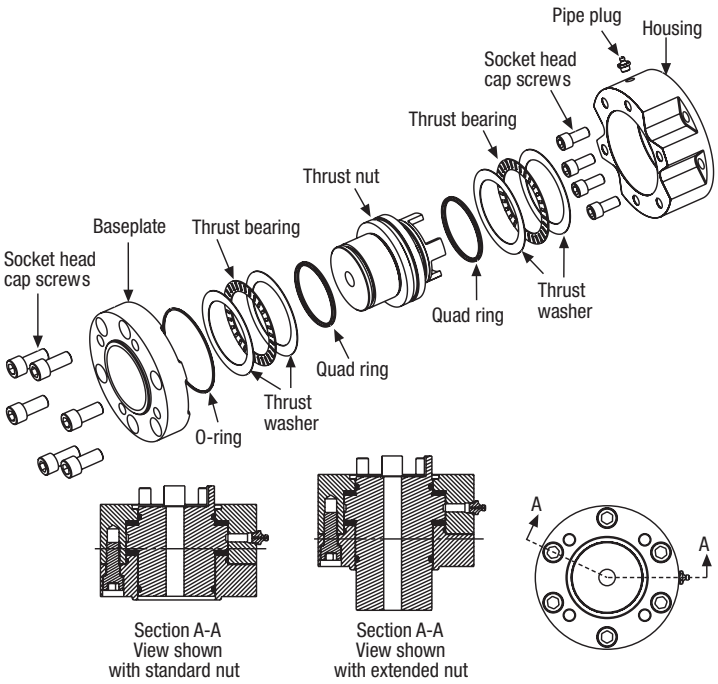

Figure 3.7: Exploded view of thrust base (MX-85 actuator only)

3.1.2.1.3 MX-140/150 actuators

Disassembly

Refer to Figure 3.8.

Disassembly of the main housing from the base is recommended to allow the base to remain on the valve if the actuator must be removed for service.

Pilot removal

Remove the two screws and washers holding the valve pilot to the thrust base and remove pilot.

Thrust bearing and nut removal

1. Remove the first set of thrust washers and bearing.
2. Remove stem nut.

NOTE: The thrust washers, bearing and stem nut may be removed at the same time. The second set of thrust washers and bearing does not have to be removed.

3. Machine the stem nut to suit the valve stem. Ensure sufficient clearance to avoid unnecessary wear and heating during operation.

Reassembly

Refer to Figure 3.8.

1. Clean the stem nut, washers and bearing(s) thoroughly.
2. Remove pipe plug.
3. Slide second set of thrust washers and bearing in place if removed.
4. Install stem nut. Lubricate thoroughly.
5. Install first set of thrust washers and bearing.
6. Install pipe plug.

NOTE: Order of assembling thrust washers and bearing must be as follows: washer, thrust bearing, washer.

NOTE: Fill base with Nebula EP 0, Conoco Conolith EP 00, Dynalife-L-EP0, Mobil SHC 6[32], Triton ELL or Lithium-based EP0 grease.

Pilot installation

Slide pilot into thrust base assembly and secure with the two washers and screws. Tighten fully.

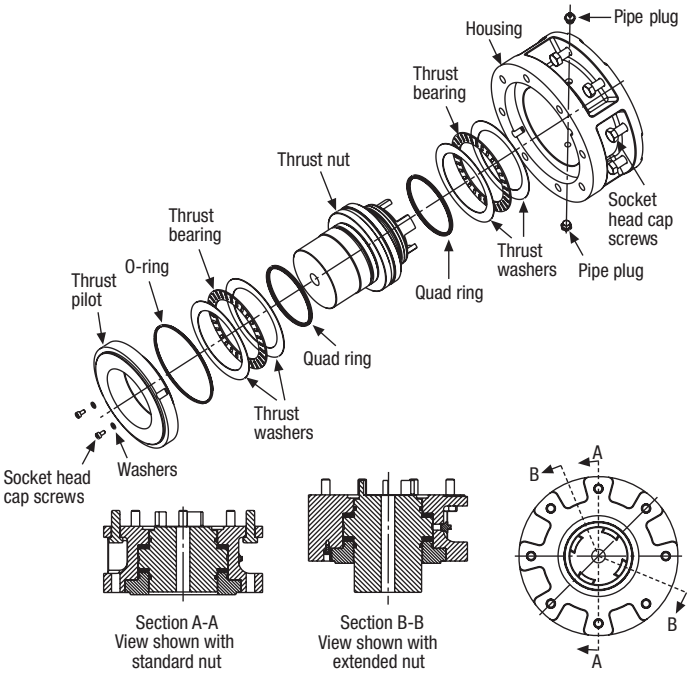

Figure 3.8: Exploded view of thrust base (MX-140/MX-150 actuators only)

3.2 Mechanical installation onto valve or gearbox

NOTE: Refer to MX Actuator Maintenance and Spare Parts bulletin for more detailed instructions.

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 or gearbox input shaft.
- Ensure the stem nut mates with the valve stem or input shaft. For screwed nuts, it is advisable to run the stem nut down the entire length of the stem to check for tightness. 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.
- 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:

  - Socket and hex 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.

3.2.1 Type “B” bases: Torque-only

3.2.1.1 Mounting

Refer to Figures 3.1 through 3.4.

1. Ensure the torque nut is secured inside actuator drive sleeve with the retaining ring.
2. Lower actuator onto the valve or gearbox stem. Align the stem nut key and keyway with valve or gearbox stem key seat.
3. Verify that the actuator and valve mounting adapter flanges mate correctly.
4. Secure the actuator to the valve mounting adapter with mounting bolts.

3.2.1.2 Removal

Refer to Figures 3.1 through 3.4.

1. Remove the bolts that secure the actuator to the valve mounting adapter. If a type B1 base is used in addition to the standard type B4 baseplate, you may leave the B1 base attached to the actuator and remove as a unit.
2. Lift the actuator from the actuator mounting adapter.

3.2.2 Type "A" bases: Thrust-only

3.2.2.1 Mounting

Refer to Figures 3.5 through 3.8.

1. The following are two options for mounting the type "A" base actuator:
   a. If the type "A" thrust base was removed from the valve-mounting adapter, replace the thrust base onto the valve-mounting adapter. Ensure the thrust base stem nut has the lugs positioned upward to engage with the drive sleeve slots when the actuator is reinstalled. Rotate the bronze nut while holding the base steady.

   OR

   b. If the thrust base is installed on the valve-mounting adapter, proceed to step 2.
2. Lower the actuator along the threaded valve stem and onto the valve-mounting plate. Ensure the thrust base stem nut lugs properly engage and align with the drive sleeve slots.
3. Install the bolts to secure the actuator to the thrust base assembly.

3.2.2.2 Removal

1. Remove the bolts that secure the actuator to the thrust base assembly.
2. Remove the type "A" thrust base by removing the bolts that secure the actuator to the valve mounting adapter.

   OR

   Leave the type "A" thrust base mounted to the valve-mounting adapter until ready to remount the actuator. The thrust base will maintain in the valve position, provided that the valve stem threads are locking.
3. Lift the complete actuator from the thrust base.

3.3 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 commission the actuator.

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

3.3.1 Removing terminal cover

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 degrees 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; this may damage the flame path on an explosion-proof unit or the O-ring seal and seating face.

3.3.2 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.

3.3.3 Sealing cable/conduit entries

The sealing of cables and conduit entries should be done in accordance with national standards or the regulatory authorities who 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.

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

3.3.4 Recommended terminal connections

Power terminals

Ring tongue connectors used on the power terminals should comply with the dimensions shown in Figure 3.9. For additional information, consult terminal manufacturer.

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

Control terminals

Ring tongue connectors used on the control terminals should comply with the dimensions shown in Figure 3.10. For additional information, consult the terminal manufacturer. Preload the M3 screws to 0.33 to 0.55 N m (0.25 to 0.50 ft-lb).

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

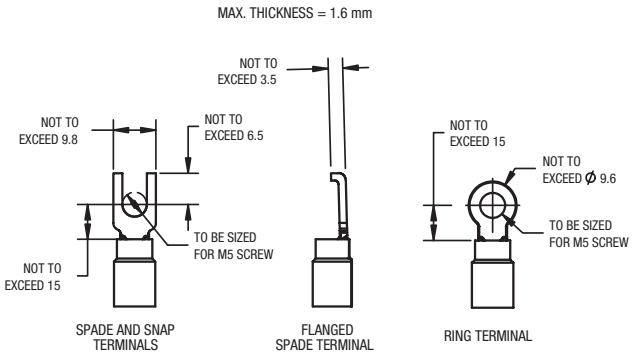

Figure 3.9: Power terminal connector size limitations

Table 3.2: Terminal block rating; power terminals

Description	L1	L2	L3
Standard 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

NOTE: Ratings will be the same for L1, L2 or L3. For example, if 10 Awg is selected, then L1, L2 and L3 will have the same limitations.

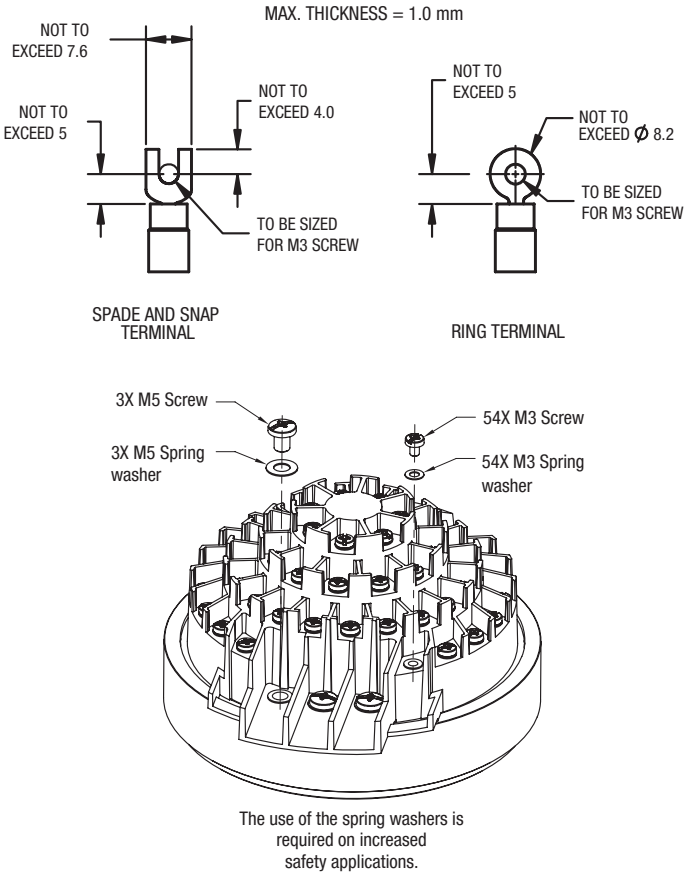

Figure 3.10: Control terminal connector size limitations

NOTE: All dimensions are in mm.

NOTE: Flowserve 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 3.10.

Table 3.3 lists the maximum allowable voltage and current parameters for the terminal block control terminals.

Table 3.3: Terminal block rating; control terminals

Low-Voltage Row	Standard Rating	Increased Safety Rating
Points 1 to 22, 50 Volt	0.5 Amp AC RMS	0.45 Amp AC RMS
Points 23 to 35, 125 Volt	0.5 Amp AC RMS	0.45 Amp AC RMS
Points 36 to 54, 250 Volt	5 Amp AC RMS	4.5 Amp AC RMS

3.3.5 Termination of cables

All terminations should be made with insulated ring terminals using the appropriate crimping tool. See Figure 3.9 and Table 3.2 for power terminal connection recommendations. See Figure 3.10 and Table 3.3 for control terminal connection recommendations.

3.3.6 Cable connections

See Figure 3.10 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 Flowserve'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.

NOTE: Refer to unit nameplate for ambient temperature rating.

Table 3.4: Required ratings for external wires

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)

3.3.7 Network installations

The Limitorque MX actuator offers several network options: DDC-Modbus, Foundation Fieldbus H1, Profibus DP, Profibus PA, DeviceNet and HART.

3.3.7.1 Network wiring – DDC Modbus

Ensure that the network cable type is Belden 3074F, 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 a 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.

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 MX actuator may enter a "safe-state" whereby all motion is prohibited until communication is successfully re-established.

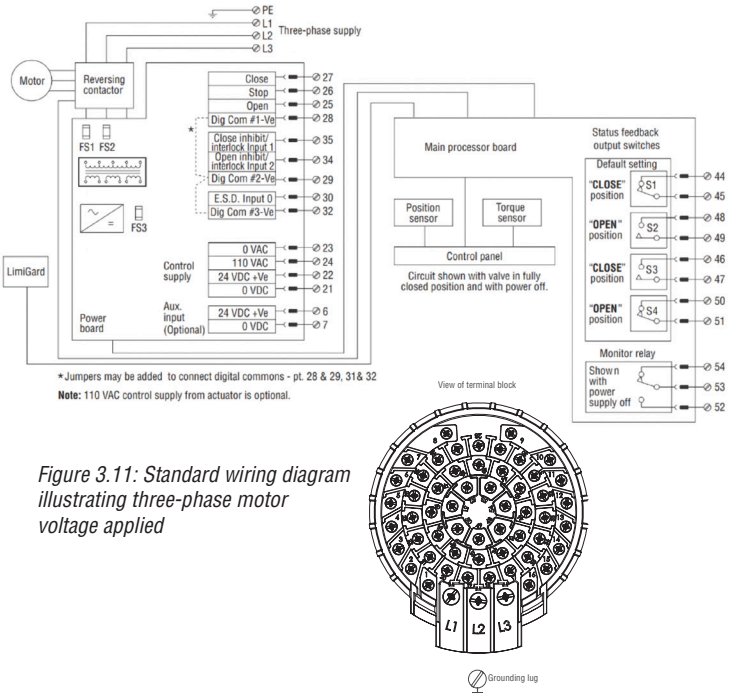

Figure 3.11: Standard wiring diagram illustrating three-phase motor voltage applied

NOTE: The most current wiring diagram is shipped within the terminal compartment of the MX actuator. It can also be retrieved from www.flowserve-wiring.com.

Cable preparation

Prepare the network cable for connection to the MX actuator terminal block, as illustrated in Figures 3.12 through 3.15.

⚠ **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 it 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 3.12. Do not cut or nick the drain wire or the insulated conductors.

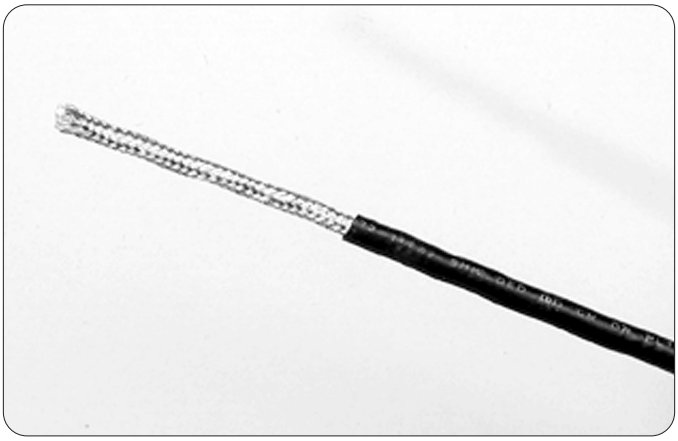

Figure 3.12: Removing outer plastic jacket

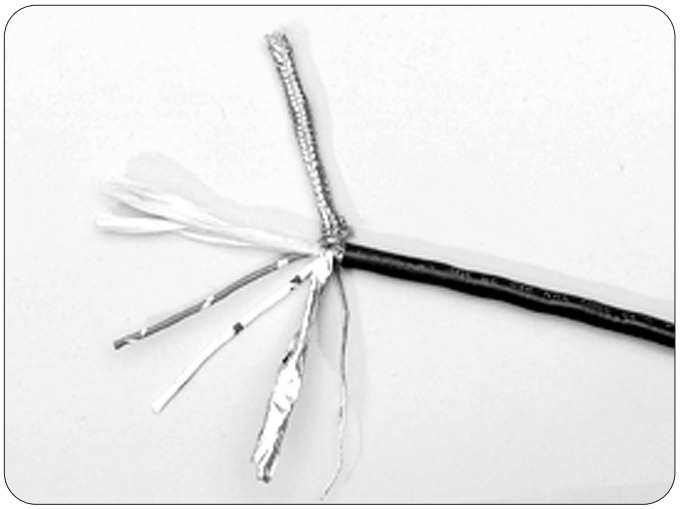

Figure 3.13: Separating cable parts

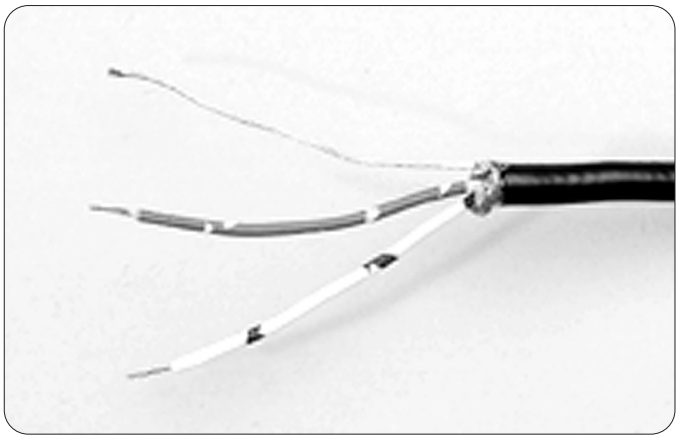

Figure 3.14: Stripping conductors and applying heat shrink tubing

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 3.13.
3. Cut away the braided shield and the foil shield. Strip the insulation from the conductors approximately 1 cm (0.5 in), as shown in Figure 3.14.
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 3.15.

⚠ CAUTION: Do not melt the insulation.

6. Connect the network cables to the MX actuator terminal block per Table 3.5 and appropriate wiring diagram. Table 3.5 details a connection for the loop topology.

Figure 3.15: Ring tongue connectors

Table 3.5: Loop topology connections

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

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.

Flowserve defines an effective local earth ground as the M3 taps on the housing next to the terminal block. See Figure 3.16.

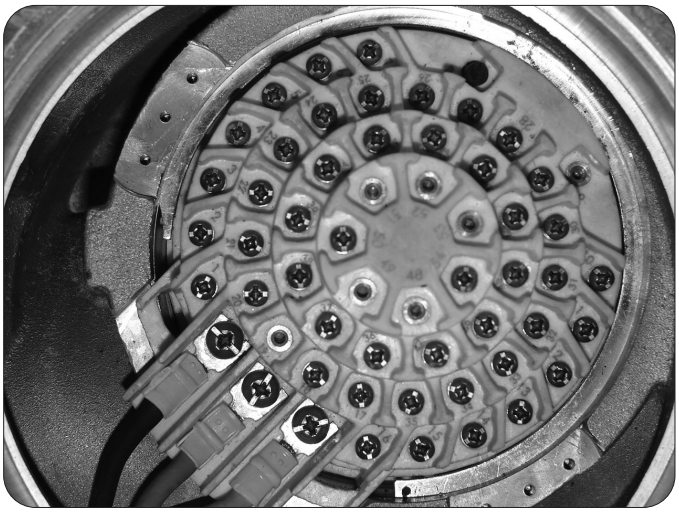

Figure 3.16: View of terminal block

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 3.17.

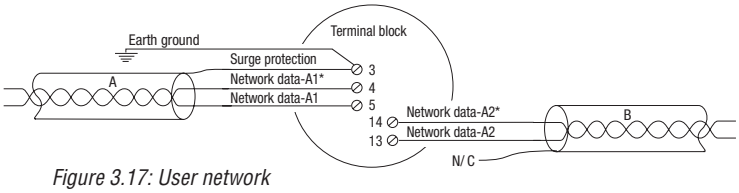

Figure 3.17: User network connection for loop topology

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

There should not be:

- 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.

Please consult DDC Modbus Network Installation and Operation Manual for correct wiring preparation and installation.

3.3.7.2 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 MX actuator terminal block, as follows in Figures 3.12 through 3.15. Table 3.6 details connections for Foundation Fieldbus.

Table 3.6: 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 Foundation Fieldbus Application Guide 31.25 kbit/s Wiring and Installation guide for more information on network wiring.

Please consult Foundation Fieldbus Network Installation and Operation Manual for correct wiring preparation and installation.

⚠ **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 it to break. This type of damage may not be apparent and failure can occur later without warning.

3.3.7.3 Network wiring – Profibus DP

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

Table 3.7: 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 mm²

The following specifications need to be fulfilled by the Profibus cable: 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 flexibility (bending) and higher environmental resistance, a cable with stranded wire for the Profibus line and special jackets shall be used. Flowserve recommends the use of Belden 3079A specifications, 22 AWG, shielded, solid two conductor.

Key specifications

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

Please consult Profibus DP Network Installation and Operation Manual for correct wiring preparation and installation.

3.3.7.4 Network wiring – Profibus PA

Please consult Profibus PA Installation and Operation Manual for correct wiring preparation and installation.

3.3.7.5 Network wiring – DeviceNet

DeviceNet is a CAN-based protocol that uses five wires, including a shield. Two of the conductors are used for [2]4 VDC power, and up to 8 amps (4 amps for NEC Class 2) may be passed along the highway 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.

Please consult DeviceNet Installation and Operation Manual for correct wiring preparation and installation.

Table 3.8: 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 to 15 AWG (19x28) 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 to 18 AWG (19x30) 6.9 ohm/ 1,000 ft 22.7 ohm/km	Data pair (blue/ white)					
3084A	2 to 15 AWG (19x28) 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 to 18 AWG (19x30) 28.0 ohm/ 1,000 ft 91.1 ohm/km	Data pair (blue/ white)					

3.3.7.6 Network wiring – HART

HART, or Highway Addressable Remote Transducer, is a digital signal over analog 4-20 mA communications. Please consult HART Network Installation and Operation Manual for correct wiring preparation and installation.

3.3.8 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.

3.3.9 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. See Figure 3.18. This is in addition to the ground connection inside the terminal compartment.

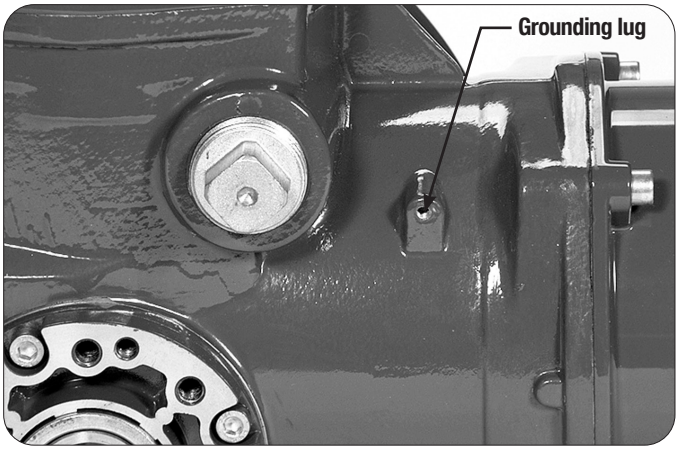

Figure 3.18: External earth/ground connection — housing

NOTE: External ground lug #J2A-L35 supplied. Will take up from 14-8 AWG wire sizes.

3.4 Terminal block shield installation

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

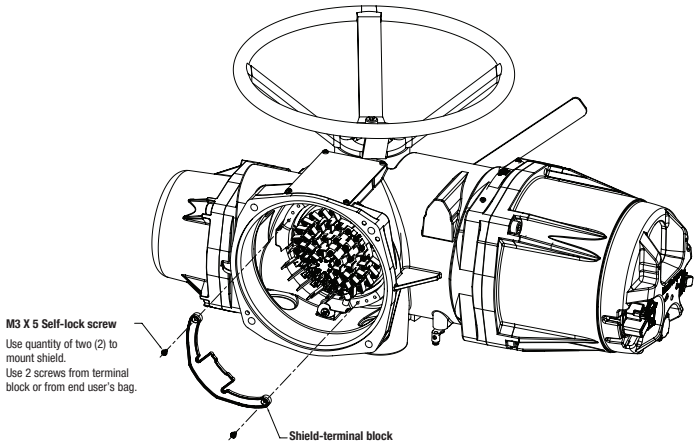

Figure 3.19: Terminal block shield

3.5 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 MX 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 3.5.1, 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 3.5.2, View the existing settings.

3.5.1 Default configuration set

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

- Password = 100
- Close direction = clockwise
- Open seating = position
- Close seating = position
- Local control = maintain
- User-configurable inputs = disabled
- Inhibits = disabled
- Remote control = standard three-wire maintain control

Table 3.9: Default configurations

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

3.5.2 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.

NOTE: 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.

3.5.3 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 Section 4.1, Password entry, for entering the password and Section 5.8, Password, for changing the 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 "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. (See Section 4.1, Password entry.) 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.

NOTE: 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.

NOTE: 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.

3.5.4 Setting position limits

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

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

Set close position limit (electrical 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. Hold the black control knob in the "CLOSE" position until the valve has reached the desired position.
6. Move the red selector knob to "STOP". At the prompt, use the black control knob to "SELECT" OK.

7. Inspect for correct operation. If the position limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Set open position limit (electrical 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 “OPEN POSITION LIMIT” menu.
4. At the prompt, move the red selector knob to “LOCAL”.
5. Hold the black control knob in the “OPEN” position until the valve has reached the desired position.
6. Move the red selector knob to “STOP”. At the prompt, use the black control knob to “SELECT” OK.
7. Inspect for correct operation. If the position limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTE: 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 ([3]60 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting, stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Set close position limit (handwheel operation)

1. Enter the “QUICK SETUP” menu as detailed in Section 3.5.3, Entering the setup mode.

Figure 3.20: Electrical operation

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.
6. If the valve is fully closed, move the handwheel one turn (360 degrees) in the open direction to allow for coasting of the motor.
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. Inspect for correct operation. Turn the handwheel and verify that the open and close LEDs function correctly. See Table 3.10 for LED indication. If adjustments are necessary, use the black control knob to go “BACK” to the prompt and repeat from step 1.

   NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting, stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Set open position limit (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 “OPEN 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.
6. If the valve is fully closed, move the handwheel one turn (360 degrees) in the open direction to allow for coasting of the motor.
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. Inspect for correct operation. Turn the handwheel and verify that the open and close LEDs function correctly. See Table 3.10 for LED indication. If adjustments are necessary, use the black control knob to go “BACK” to the prompt and repeat from step 1.

NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting, stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

3.6 Operating the MX actuator

3.6.1 Manual operation

Operate the actuator with the handwheel as follows:

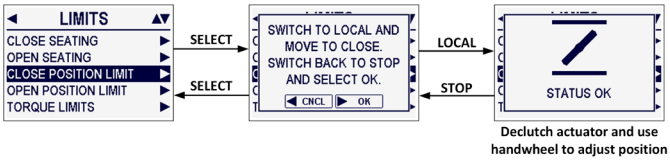

Figure 3.21: Handwheel operation

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; 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.

3.6.2 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 permanent damage to the electrical components in the unit. Phase rotation need not be checked, since all units are supplied with an auto-phase correction feature. Apply power to the actuator, but do not operate it without first checking that it has been set up and configured correctly for its intended application.

3.6.3 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.

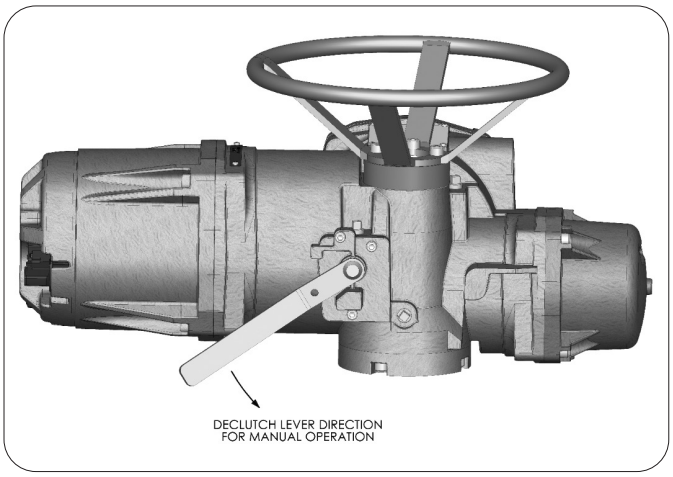

Figure 3.22: Declutch lever shows direction of engagement (MX-05 actuator shown)

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.

3.6.4 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.

3.6.5 Local indication

Red and green LED indicators can be reversed. See Section 5.4.3, R-G LED direction.

NOTE: 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.

NOTE: 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.

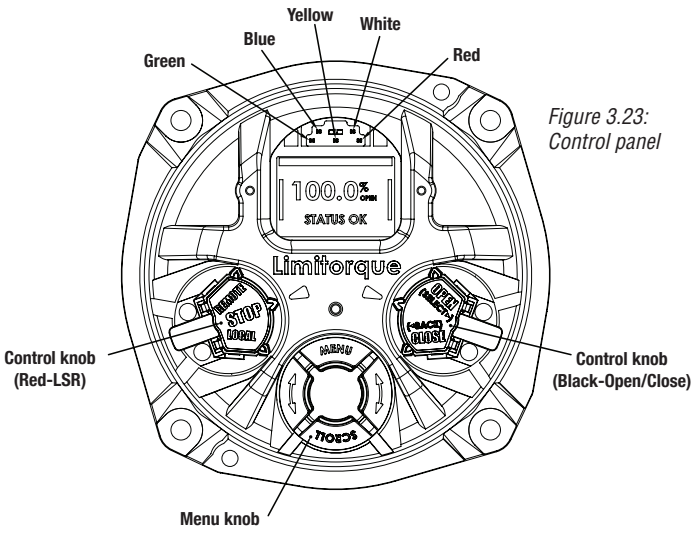

Figure 3.23: Control panel

Table 3.10: 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".

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4 Customizing the Actuator

Many of the actuator's settings can be customized and purchased items can be configured via the "QUICK SETUP" menu. To enter the "QUICK SETUP" menu:

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. (See Section 4.1, Password entry.) 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. Based on the features and option boards purchased, the following menu items may be displayed. To enter a menu, first use the menu knob to highlight a menu item, and then use the black control knob to "SELECT" it.

   - Limits
   - Digital inputs
   - Digital outputs
   - Modutronic
   - Analog outputs
   - DDC
   - FF
   - PB/DP
   - PB/PA
   - DeviceNet
   - HART
   - Monitor relay
   - Real time clock

5. Make changes in each menu as desired. Each display shows the state or value of the existing settings.
6. 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.

NOTE: 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.

4.1 Password entry

The default password for setup is [1]00. This can be changed in the Advanced Setup menu. Unauthorized entry to the "QUICK SETUP" menu is prevented by a password protection feature. The password is a three-digit number, ranging from "000" to "999".

1. Turn the menu knob to change each digit of the password, and then use the black control knob to "SELECT" it.
2. If the wrong password is entered, re-enter the correct one. After four 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 by contacting Flowserve at 434-528-4400.

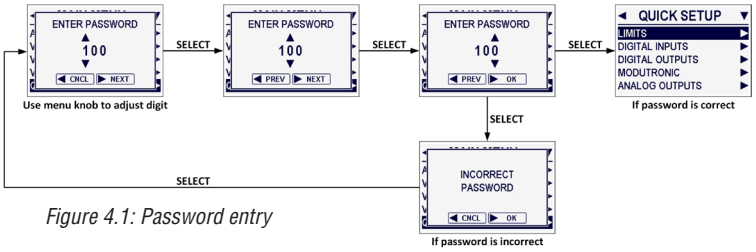


Figure 4.1: Password entry

4.2 Limits

4.2.1 Close direction

Default = CW

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 clockwise or counter-clockwise rotation of the handwheel.
2. Use the menu knob to highlight the appropriate close direction in the menu, then use the black control knob to "SELECT" it.

4.2.2 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.

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

4.2.3 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 a torque limit in the open direction.

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

4.2.4 Close position limit

4.2.4.1 Set close position limit for electrical operation

1. At the prompt, move the red selector knob to “LOCAL”.
2. Hold the black control knob in the “CLOSE” position until the valve has reached the desired position.
3. Move the red selector knob to “STOP”. At the prompt, use the black control knob to “SELECT” OK.
4. Inspect for correct operation. If the position limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting, stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 4.2: Electrical operation

4.2.4.2 Set close position limit for manual operation

1. At the prompt, move the red selector knob to “LOCAL”.
2. 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.
3. If the valve is fully closed, move the handwheel one turn (360 degrees) in the open direction to allow for coasting of the motor.
4. 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.
5. Inspect for correct operation. Turn the handwheel and verify that the open and close LEDs function correctly. See Table 3.10 for LED indication. If adjustments are necessary, use the black control knob to go “BACK” to the prompt and repeat from step 1.

NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting, stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 4.3: Handwheel operation

4.2.5 Open position limit

4.2.5.1 Set open position limit for electrical operation

1. At the prompt, move the red selector knob to “LOCAL”.
2. Hold the black control knob in the “OPEN” position until the valve has reached the desired position.
3. Move the red selector knob to “STOP”. At the prompt, use the black control knob to “SELECT” OK.
4. Inspect for correct operation. If the position limits are set adjacent to each other, an error message will be displayed: “IDENTICAL LIMITS”. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running the actuator electrically.

NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting, stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

4.2.5.2 Set open position limit for manual operation

1. At the prompt, move the red selector knob to “LOCAL”.
2. 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.
3. If the valve is fully open, move the handwheel one turn (360 degrees) in the close direction to allow for coasting of the motor.
4. 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.
5. Inspect for correct operation. Turn the handwheel and verify that the open and close LEDs function correctly. See Table 3.10 for LED indication. If adjustments are necessary, use the black control knob to go “BACK” to the prompt and repeat from step 1.

NOTE: 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”.

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the user elect to proceed with the setting, an error will be displayed on the screen after rebooting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

4.2.6 Torque limits

The output torque from the actuator to close or open the valve may be configured between 40 and [1]00% of the rated torque (as stated on the actuator nameplate), in [1]% increments (unless limited by the factory).

NOTE: For arctic temperature actuators (-30°C [-22°F] or below), the torque limit ranges from 60 to 100%.

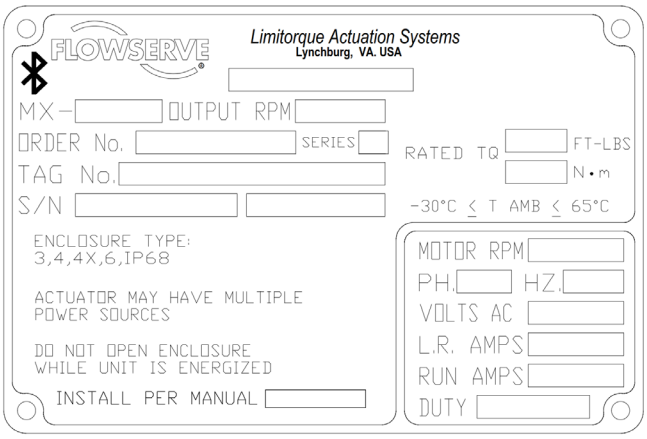


Figure 4.4: MX actuator nameplate

☠ **WARNING:** The MX and QX actuators are factory-tested to establish torque settings of each unit. The customer-set torque is confirmed at EOL (end of line) testing in both open and closed directions and recorded on the EOL test report. This test report is shipped with each actuator and is located in the terminal compartment. If it is not available, please contact the factory at 434-528-4400.

Once the actuator torque has been set, any modification of the torque setup EOL limiter may cause the actuator warranty to be voided.

Do not exceed the setting as displayed on the LCD screen without contacting Flowserve’s Limitorque service department. Warning messages have been added to the LCD screen to alert the user to the potential for damaging the valve or actuator.

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

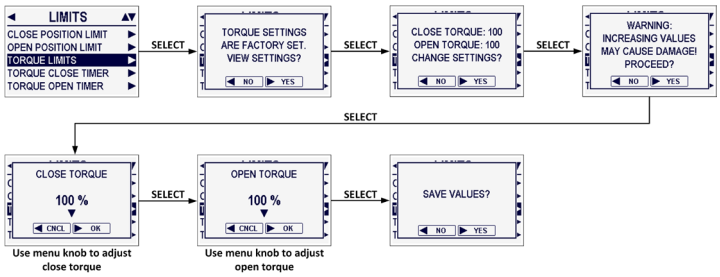


Figure 4.5: Torque limits

4.2.7 Torque close timer

Default = on

The torque close timer permits a user to select a time duration for the torque switch to time out once the actuator determines that it has reached its torque seat. The torque switch timer can be adjusted from 1 second to a maximum of 15 seconds. The default is 5 seconds.

NOTE: The purpose of this feature is to ensure that the torque sensing has shut off the motor after a brief period of time. It is an additional safety feature to prevent the actuator from reaching a stall torque.

If operating in torque seating for either open or close torque seating, a backup timer can be used to halt the actuator to protect the valve in case the actuator does not torque out after it has passed the expected limit.

1. Use the menu knob to highlight the “ON” option, and then use the black control knob to “SELECT” it.
2. At the prompt, use the menu knob to increase or decrease the torque open timer duration. When the appropriate duration is displayed, use the black control knob to “SELECT” it.

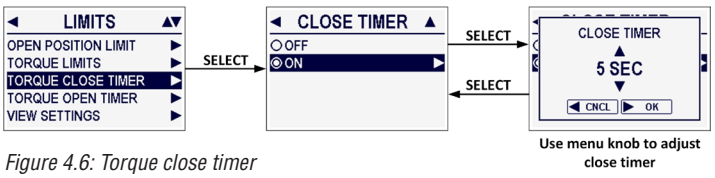


Figure 4.6: Torque close timer

4.2.8 Torque open timer

Default = on

The torque open timer permits a user to select a time duration for the torque switch to time out once the actuator determines that it has reached its torque seat. The torque switch timer can be adjusted from 1 second to a maximum of 15 seconds. The default is 5 seconds.

NOTE: The purpose of this feature is to ensure that the torque sensing has shut off the motor after a brief period of time. It is an additional safety feature to prevent the actuator from reaching a stall torque.

If operating in torque seating for either open or close torque seating, a backup timer can be used to halt the actuator to protect the valve in case the actuator does not torque out after it has passed the expected limit.

1. Use the menu knob to highlight the “ON” option, and then use the black control knob to “SELECT” it.
2. At the prompt, use the menu knob to increase or decrease the torque open timer duration. When the appropriate duration is displayed, use the black control knob to “SELECT” it.

Figure 4.7: Torque open timer

4.3 Digital inputs

Input 0 default = ESD, signal present, disabled, ignore

Input 1 default = open inhibit, signal present, disabled

Input 2 default = close inhibit, signal present, disabled

The user can select up to three inputs (0, 1, 2) and configure them to perform one of the following functions:

- ESD
- Open inhibit
- Close inhibit
- Both inhibit
- User input
- PST (input 1 only)
- CSE (input 2 only)

4.3.1 Wiring scheme

Default = standard three-wire maintain 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. The selections available are:

- Standard four-wire control
- Standard three-wire inching control
  - Requires two momentary contacts to open or close the valve, or stop it in mid-travel
- Standard three-wire maintain control
  - Requires two maintained contacts for self-maintained control in open or close direction
- Standard two-wire open control
  - Requires one normally open or closed contact; valve can open when signal is on or off
- Standard no remote control

Table 4.1: Digital input terminals

Negative Switching (Positive Earth)											
Mode		**Input 0**		**Input 1**		**Input 2**		**Input 3**		**Input 4**	**Input 5**
Two-wire		configurable		open		not used		configurable		not used	not used
Three-wire in		close		open		not used		configurable		not used	not used
Three-wire maint		close		open		not used		configurable		not used	not used
Four-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 Modes											
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
2		stop		close		open		ESD release 2		ESD release 1	MO ESD
3		ESD TDR		configurable		configurable		stop		open	close
(MO = momentary signal)											
4		M1 position		M2 position		configurable		stop		open	close
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 needed. 28 to 29, 31 to 32 and 33 to VDC sources are common.											

LimiGard™ Mode						
Mode	**Input 0**	**Input 1**	**Input 2**	**Input 3**	**Input 4**	**Input 5**
	close	open	stop	stop	open	close

4.3.2 ESD action

Default = ignore

A network ESD function can be enabled after the ESD configuration has been established for the unit. This can be selected to either ignore the command, close, open, stop or position the actuator.

NOTE: This screen is only displayed if the status function is set to “ESD”.

4.3.2.1 ESD move to

Default = 0.0%

“ESD MOVE TO” allows the user to set the position to which the actuator should move on an ESD signal.

The value is adjustable between 0.0 and [1]00.0%.

4.3.2.2 Proportional band

Default = 5.0%

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

The value is adjustable between 5.0 and 100.0%.

4.3.2.3 Deadband

Default = 2.0%

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.

The value is adjustable between 0.5 and 50.0%.

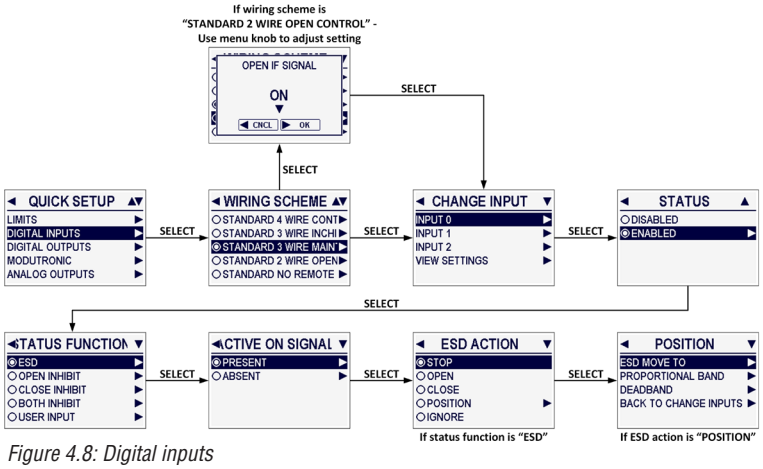


Figure 4.8: Digital inputs

4.4 Digital outputs

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

4.4.1 Status function

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

- CLOSED – valve closed (0% open)
- OPENED – valve open (100% open)
- MID-TRAVEL POSITION – valve position (1 to 99% open)
- CLOSING – valve closing
- OPENING – valve opening
- STOPPED – valve stopped in mid-travel
- VALVE MOVING – valve moving in either direction
- LOCAL SELECTED – red selector knob set to “LOCAL”
- MOTOR OVERTEMP – thermistor range exceeded
- OVERTORQUE – torque exceeded in mid-travel
- MANUAL OVERRIDE – actuator moved by handwheel
- VALVE JAM – 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 set to “STOP”
- LOST PHASE FAULT – one or more of three phases lost
- ESD SIGNAL – ESD signal active
- CLOSE INHIBIT – close inhibit signal active
- OPEN INHIBIT – open inhibit signal active
- ANALOG IN 0 LOST – 4-20mA signal not present
- REMOTE SELECTED – red selector knob set to “REMOTE”
- LIMIGARD ACTIVE – LimiGard signal active
- HARDWARE FAULT – indicates an issue with an option or network board
- CSE CONTROL – CSE station in “LOCAL” or “STOP” and controls actuator
- NETWORK CONTROLLED – permits relay control via DDC, FF, or other network driver
- PST ACTIVE – Partial stroke test active
- PSD PASSED – Partial stroke test passed
- PST FAILED TARGET – Partial stroke test failed target test
- PST FAILED RETURN – Partial stroke test failed return test
- STARTS/HR EXCEEDED – Number of motor starts per hour exceeded
- NETWORK COMM LOSS – Network communication has been interrupted
- LOCAL OPERATION – Unit is being operated locally (red selector knob is in LOCAL and black control knob is in OPEN or CLOSE)
- REMOTE OPERATION – Unit is being operated remotely by digital inputs OPEN or CLOSE
- RUN LOAD HIGH – Exceeded run load maximum warning threshold
- DPTS OPEN – Open torque switch trip (open torque seat or open overtorque)
- DPTS CLOSE – Close torque switch trip (close torque seat or close overtorque)

4.4.2 Status

This setting allows the user to select the state of the contact when the function is active. Choose whether the contact is required to be normally closed, normally opened, or blinker when the function is active. When “BLINKER NO” (normally open) or “BLINKER NC” (normally closed) has been selected, the contact will switch automatically between open and close (1 second open/1 second close).

4.4.3 Digital output default settings

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

Status contacts

- S1 – normally closed contact at valve fully CLOSED
- S2 – normally closed contact at valve fully OPENED
- S3 – normally opened contact at valve fully CLOSED
- S4 – normally opened contact at valve fully OPENED

Alarm contacts (optional; requires I/O board)

- R5 – MOTOR OVERTEMP
- R6 – REMOTE SELECTED
- R7 – OVERTORQUE
- R8 – VALVE JAM

4.4.4 Valve position

This display will appear only if the function “MID-TRAVEL POSITION” has been selected. Use the menu knob to set 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 failure.

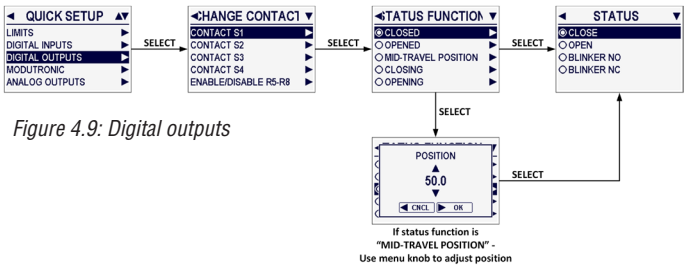


Figure 4.9: Digital outputs

4.5 Modutronic

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 Flowserve at 434-528-4400.

When the Modutronic option has been purchased, is set to “ENABLED”, and the red selector knob is in “REMOTE”, the normal LCD display will show the demand, i.e., the percentage value of the milliamp input signal.

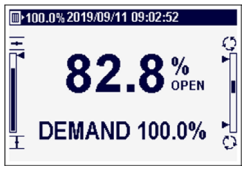


Figure 4.10: Modutronic LCD display

This setting activates or deactivates the Modutronic option on the field unit.

4.5.1 Status

Default = disabled

This setting activates or deactivates the Modutronic option on the field unit.

4.5.2 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.5.3 Deadband

Default = ².0%

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

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.5.4 Polarity

Default = 20 mA open

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

4.5.5 Fail position

Default = close

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

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

4.5.6 Delay after stop

Default = 0 seconds

The delay after stop allows the user to adjust the length of delay time after the actuator stops modulating.

Use the menu knob to adjust the value. The value is adjustable between 0 and 60 seconds.

4.5.7 Filter factor

Default = 20

Filter factor is the strength level of the filter that is applied to ignore noise in the input signal. A lower filter factor makes the actuator more susceptible to noise and thus more sensitive to the signal applied.

Use the menu knob to adjust the valuse. The value is adjustable between 0 and 100.

4.5.8 Calibrate

4.5.8.1 Set low reference

Default = 4 mA

At the prompt, use a calibrator to apply the low signal to terminals 19 and 20 indicated on the wiring diagram, then use the black control knob to “SELECT” OK to record the signal as the low reference.

4.5.8.2 Set high reference

Default = 20 mA

At the prompt, use a calibrator to apply the high signal to terminals 19 and 20 indicated on the wiring diagram, then use the black control knob to “SELECT” OK to record the signal as the high reference.

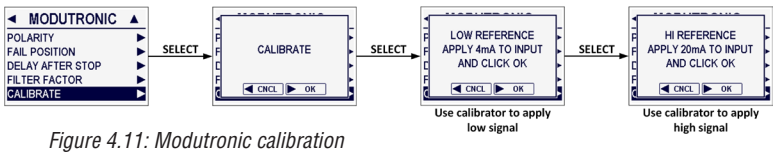


Figure 4.11: Modutronic calibration

4.6 Analog outputs

The MX actuator offers an optional, configurable analog output feedback signal. The user may select between APT (analog position transmitter) or ATT (analog torque transmitter) functionalities.

4.6.1 APT polarity option

Default = 4-20 mA; 20 mA = close

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 "ENABLED" 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 Flowserve at 434-528-4400.

During position limit calibration (see Section 2.1, Calibrate – position limits) the APT is automatically calibrated to default settings.

4.6.2 ATT polarity option

The ATT option provides a 4-20 mA signal proportional to the actuator output torque and is for reference only. The signal range is from approximately 40 to 100% of 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 "ENABLED" 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 Flowserve at 434-528-4400.

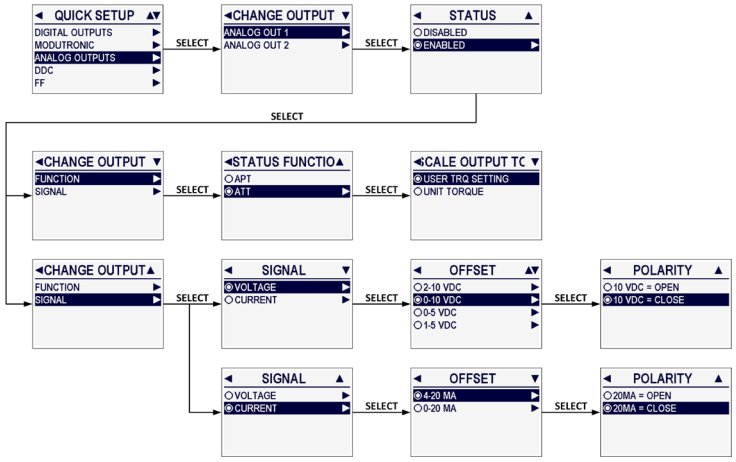


Figure 4.12: Analog outputs

4.7 DDC

The 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 contact Flowserve at 434-528-4400.

The MX actuator is equipped with the ability to either hard-wire 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" located in Section 5.3, 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 are based on the last command received. Analog operation is initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog control signal.

4.7.1 Status

Default = disabled

DDC status allows the user to change from the default condition to turn on and off the Modbus interface capability of the actuator.

4.7.2 Modbus type

Default = RTU

Modbus type allows the user to change the communication language from the default to match the application.

4.7.3 Baud rate

Default = 9,600

Baud rate allows the user to change the communication speed from the default to match the application.

4.7.4 DDC address

Default = 1

The DDC 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.

Use the menu knob to set the desired DDC address. The address may be set at any value between 1 and 250.

4.7.5 Analog scale

Default = 1 to 100

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

4.7.6 ESD action

Default = ignore

The ESD action setting determines the action to be taken in the event that the actuator is commanded to initiate an emergency shutdown.

4.7.7 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.7.8 Deadband

Default = [2].0%

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.

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.7.9 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 none, close, open, stop or position.

4.7.10 Comm loss delay

Default = 60 seconds

The user may select the amount of time delay before communication loss is flagged to the network.

Use the menu knob to adjust the value. The value is adjustable between 5 and 120 seconds.

4.7.11 Topology

Default = repeater

The topology setting selected depends on the system design. Regardless of which topology setting is used, the actuator field wiring is the same. The topology options are:

- Repeater (daisy chain/loop)
  - Field unit connects both Channels A and B to terminal block (dual independent channels)
  - Field unit acts as repeater device
  - Internal bias and termination are enabled
- Multidrop (single bus)
  - Field unit connects only Channel A to terminal block (single shared channel)
  - Field unit does not act as repeater device
  - Internal bias and termination are disabled

4.7.12 Function code

Default = off

Function code allows the user to enable poll by exception (Modbus function code 07) mode. Poll by exception mode detects if a change in status or fault data has occurred within a field unit. This mode of operation requires that the field unit first be configured to use Modbus FC 07.

Once poll by exception mode is enabled, any combination of registers 8, 9, 10, 12 and 13 within the field unit can be monitored for changes. A normal response to the (07) command will indicate whether or not a change within the monitored register range has occurred (00h = No; FFh = Yes). Note that the field unit will continue to report that a change has occurred until the entire range of monitored registers is read using Modbus FC 0[3].

Additionally, when poll by exception mode is enabled, the field unit will not report DDC Comm Loss due to network inactivity. This modification is done in order to further support an event-based mode of operation.

The following Modbus registers can be included (enabled) or excluded (disabled) in poll by exception monitoring:

- Register 8 (position): default = enabled
- Register 9 (status): default = enabled
- Register 10 (fault): default = disabled
- Register 12 (digital input 1): default = disabled
- Register 13 (digital input 2): default = disabled

4.7.13 CMB FLT (combined fault) warnings

Default = disabled

The combined fault warnings setting can be used to expand the set of hardware faults that will trigger combined fault events to include hardware warnings as well.

4.7.14 Parity

Default = none

The parity setting selected depends on the system design. All field units and the host system/Master Station must have the same parity.

4.8 FF (Foundation Fieldbus)

The 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 settings will not be available. To add the FF option, please contact Flowserve at 434-528-4400.

The MX actuator is equipped with the ability to either hard-wire 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" located in Section 5.3, 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 are based on the last command received. Analog operation is initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog control signal.

4.8.1 Status

Default = disabled

FF status allows the user to change from the default condition to turn on and off the Foundation Fieldbus interface capability of the actuator.

4.8.2 Analog scale

Default = 0 to 100

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

4.8.3 ESD action

Default = ignore

The ESD action setting determines the action to be taken in the event that the actuator is commanded to initiate an emergency shutdown.

4.8.4 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 none, close, open, stop or position.

4.8.5 Comm loss delay

Default = 60 seconds

The user may select the amount of time delay before communication loss is flagged to the network.

Use the menu knob to adjust the value. The value is adjustable between 5 and 120 seconds.

4.8.6 Mode

Default = open/close

Mode allows the user to select the mode of operation for the FF option. The choices are open/close mode or position mode.

4.8.7 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.8.8 Deadband

Default = 2.0%

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.

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.9 PB/DP (Profibus decentralized periphery)

The PB/DP option enables the actuator to be controlled by a Profibus communications signal.

NOTE: If the PB/DP option has not been purchased, the screens for changing PB/DP settings will not be available. To add the PB/DP option, please contact Flowserve at (434) 528-4400.

There are two different communication board options for the MX/QX PB/DP actuator field unit: a single channel board for non-redundant deployments and a dual-channel board that supports non-redundant, flying and system redundant deployments. Both support Profibus DP (decentralized periphery) RS-485 physical layer. The single-channel Profibus DP board is identified by part number 64-825-0223 and the dual-channel Profibus DP Redcom (redundant communications) board is identified by part number 64-825-0212.

Profibus DP ensures high-speed data transmission of user data and is designed especially for communication between a master host station and distributed devices at the field level. In flying-redundant systems, the dual-channel board can be configured for single-line or two-line redundancy as well as support for simple or full Redstate diagnostic support. In a single-line configuration, one Profibus network is connected to both channels at the terminal block. A dual-line redundant system takes advantage of two Profibus networks with each network connected to a channel on a Profibus DP Redcom board.

The adjustments to the MX/QX actuator Profibus settings may be made locally at the actuator and over the Profibus network using a DPV[1] network configuration tool.

4.9.1 Status

Default = disabled

PB/DP status allows the user to change from the default condition to turn on and off the Profibus DP interface capability of the actuator.

4.9.2 Redcom mode

Default = no redundancy

The MX/QX PB DP actuator Redcom (redundant communications) version supports two forms of redundancy:

1. Flying redundancy provides slave hardware redundancy in the form of a primary and backup channel installed on the PB DP Redcom board. This form is commonly utilized in applications where a single master is present. Although the basic operation of flying-redundant mode is the same, the way the lines are terminated are different when termination is enabled via the software options. In single-line mode, the software termination settings follow the primary and backup channel determination and will switch, depending on which channel becomes primary. In dual-line (two-line) mode, the software termination settings are applied to channel A and B and do not switch based on which channel becomes primary.
2. System redundancy provides for both slave hardware redundancy, in the form of a primary and backup channel installed in the PB DP Redcom board, and cable redundancy in the form of dual masters connected to the primary and backup channels. Dual network connections are required.

If a dual-channel board is installed, the redundant communication mode for the PB/DP Redcom network board can be set to one of the following:

- No redundancy
- Simple flying, one-line
- Simple flying, two-line
- Full flying, one-line
- Full flying, two-line
- Full system

In full-flying redundant mode, the Profibus DP Redcom board (part number 64-825-0212) fully supports the Redstate diagnostic extensions to the DPV1 protocol. In simple-flying redundant mode, these diagnostic extensions are not included in the communications and allow systems without diagnostic capabilities to operate without producing nuisance errors. Note that system redundancy requires full Redstate diagnostics.

4.9.3 Primary address

Default = 126 (unassigned)

For flying-redundant modes, the address range is 0 through 61 for the primary channel. For system and non-redundant modes, the address range for the primary channel is 0 through 125. The channel address setting for the backup channel is done automatically. In flying-redundant mode, the backup address is the primary address plus 64. For example, if the primary address is 7, the backup address is 71. Note that the address number follows the primary channel and not the physical channel (A or B). In system-redundant mode, the backup channel address is the same as the primary channel address.

4.9.4 Analog scale

Default = 0 to 100

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

4.9.5 ESD action

Default = ignore

The ESD action setting determines the action to be taken in the event that the actuator is commanded to initiate an emergency shutdown.

4.9.6 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 none, close, open, stop or position.

4.9.7 Comm loss delay

Default = 60 seconds

The user may select the amount of time delay before communication loss is flagged to the network.

Use the menu knob to adjust the value. The value is adjustable between 5 and 120 seconds.

4.9.8 Termination (A)

Default = disabled

The Profibus DP board has the option to enable/disable the onboard termination feature for the RS-485 communications. This should be enabled when the external wiring does not have termination and the actuator is at the end of the communication network. This option enables/disables the feature for the channel A side of the RS-485 connection.

4.9.9 Termination (B)

Default = disabled

The Profibus DP board has the option to enable/disable the onboard termination feature for the RS-485 communications. This should be enabled when the external wiring does not have termination and the actuator is at the end of the communication network. This option enables/disables the feature for the channel B side of the RS-485 connection.

4.9.10 Mode

Default = open/close

Mode allows the user to select the mode of operation for the PB/DP option.

4.9.11 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.9.12 Deadband

Default = 2.0%

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.

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.10 PB/PA (Profibus process automation)

The PB/PA option enables the actuator to be controlled by a Profibus communications signal.

NOTE: If the PB/PA option has not been purchased, the screens for changing PB/PA settings will not be available. To add the PB/PA option, please contact Flowserve at 434-528-4400.

Profibus PA uses the expanded Profibus DP protocol for data transmission and implements the PA profile that specifies the characteristics of the field device. This transmission technique ensures intrinsic safety and powers the field devices over the bus. Profibus PA is designed for high-speed and reliable communications, with the ability to link sensors and actuators to a common fieldbus line, even in potentially explosive areas.

Profibus PA devices can be integrated into Profibus DP networks using segment couplers.

The adjustments to the MX/QX actuator Profibus settings may be made locally at the actuator and over the Profibus network using a DPV1 network configuration tool.

4.10.1 Status

Default = disabled

PB/PA status allows the user to change from the default condition to turn on and off the Profibus PA interface capability of the actuator.

4.10.2 Primary address

Default = 126 (unassigned)

Primary address allows the user to set the address of the primary PB/PA channel.

Use the menu knob to adjust the value. The address range for PB/PA is 0 through 125.

4.10.3 Analog scale

Default = 0 to 100

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

4.10.4 ESD action

Default = ignore

The ESD action setting determines the action to be taken in the event that the actuator is commanded to initiate an emergency shutdown.

4.10.5 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 none, close, open, stop or position.

4.10.6 Comm loss delay

Default = 60 seconds

The user may select the amount of time delay before communication loss is flagged to the network.

Use the menu knob to adjust the value. The value is adjustable between 5 and 120 seconds.

4.10.7 Mode

Default = open/close

Mode allows the user to select the mode of operation for the PB/PA option.

4.10.8 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.10.9 Deadband

Default = 2.0%

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.

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.11 DeviceNet

The DeviceNet 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 DeviceNet address.

NOTE: If the DeviceNet option has not been purchased, the screens for changing DeviceNet settings will not be available. To add the DeviceNet option, please contact Flowserve at 434-528-4400.

The MX actuator is equipped with the ability to either hard-wire 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" located in Section 5.3, 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 are based on the last command received. Analog operation is initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog control signal.

4.11.1 Status

Default = disabled

DeviceNet status allows the user to change from the default condition to turn on and off the DeviceNet interface capability of the actuator.

4.11.2 Baud rate

Default = 125k

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

4.11.3 Primary address

Default = network control

Primary address allows the 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. Use the menu knob to set the network address. The network address may be set to any value between 0 and 63, or network control.

4.11.4 Analog scale

Default = 0 to 100

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

4.11.5 ESD action

Default = ignore

The ESD action setting determines the action to be taken in the event that the actuator is commanded to initiate an emergency shutdown.

4.11.6 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 none, close, open, stop or position.

4.11.7 Comm loss delay

Default = 60 seconds

The user may select the amount of time delay before communication loss is flagged to the network.

Use the menu knob to adjust the value. The value is adjustable between 5 and 120 seconds.

4.11.8 Mode

Default = open/close

Mode allows the user to select the mode of operation for the DeviceNet option.

4.11.9 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.11.10 Deadband

Default = 2.0%

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.

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.12 HART

The HART option enables the actuator to be controlled by a Highway Addressable Remote Transducer communications signal. If the option is purchased, it is automatically enabled. The device address is fixed for point-to-point connection, but must be set by the customer for multi-drop topology.

NOTE: If the HART option has not been purchased, the screens for changing HART will not be available. To add the HART option, please contact Flowserve at 434-528-4400.

The MX actuator is equipped with the ability to either hard-wire 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" located in Section 5.3, 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 are based on the last command received. Analog operation is initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog control signal.

4.12.1 Status

Default = enabled

HART status allows the user to change from the default condition to turn on and off the HART interface capability of the actuator.

4.12.2 Topology

Default = point to point

This setting allows the user to select the desired HART network topology.

NOTE: Changing the topology also requires that the network be wired correctly for the selected topology.

4.12.2.1 Multidrop

Enabling multidrop topology will allow the user to set the HART polling address of the unit.

Use the menu knob to adjust the value. The value is adjustable from 0 to 63, although multidrop units are typically set from 1 to 63.

4.12.2.2 Point to point

Default = stop

Enabling point to point topology will allow the user to configure the action desired upon loss of the analog input signal.

4.12.3 ESD action

Default = ignore

The ESD action setting determines the action to be taken in the event that the actuator is commanded to initiate an emergency shutdown.

4.12.4 Proportional band

Default = 5.0%

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

Use the menu knob to adjust the value. The value is adjustable between 2.5 and 100.0%.

4.12.5 Deadband

Default = ^{2}.0%

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.

Use the menu knob to adjust the value. The value is adjustable between 0.5 and 50.0%.

4.13 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:

- LOCAL – red selector knob is set to “LOCAL”
- LOCAL STOP – red selector knob is set to “STOP”
- OVERTORQUE – torque range exceeded in mid-travel, thermistor temperature exceeded, or malfunction in thermistor
- INHIBIT SIGNAL – inhibit is on and active
- ESD SIGNAL – ESD is on and active

Each selection is user configurable. To turn a feature on or off, use the menu knob to highlight it and then use the black control knob to “SELECT” it.

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

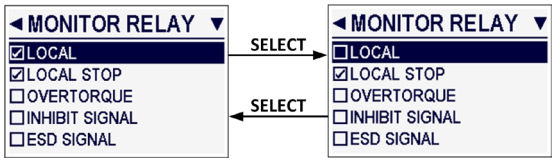


Figure 4.13: Monitor relay configuration

4.14 Real time clock

The “REAL TIME CLOCK” allows the user to set the current date and time.

4.14.1 Set date

The “SET DATE” screen allows the user to set the current date. The date should be in YYYY/MM/DD format.

Use the menu knob to adjust each position, then use the black control knob to “SELECT” it and move to the next position.

Figure 4.14: Set date

4.14.2 Set time

The “SET TIME” screen allows the user to set the current time. The time should be in 24-hour HH:MM format.

Use the menu knob to adjust each position, then use the black control knob to “SELECT” it and move to the next position.

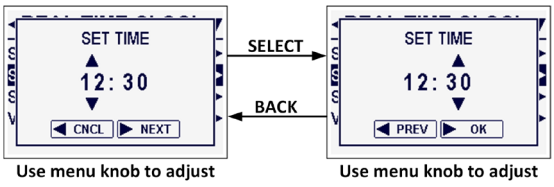


Figure 4.15: Set time

4.14.3 Set timezone offset

The “SET TIMEZONE OFFSET” screen allows the user to set the UTC timezone offset for the location that the actuator will be operated in.

Use the menu knob to adjust the number of hours and minutes of the timezone offset. The hour position ranges from -12 to 14. The minute position ranges from 00 to 45 in 15-minute increments.

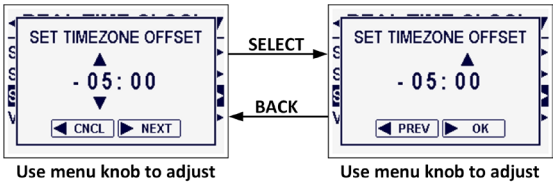


Figure 4.16: Set timezone offset

5 Advanced Setup

The actuator can be further customized through the “ADVANCED SETUP” menu. To enter the “ADVANCED SETUP” menu:

1. Enter the “MAIN MENU” as detailed in Section 2.1.1, Entering the main menu.
2. Use the menu knob to highlight the “ADVANCED SETUP” menu and “SELECT” it with the black control knob.
3. Enter password if required. (See Section 4.1, Password entry.) 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. The following menu items will be displayed. To enter a menu, first use the menu knob to highlight a menu item, and then use the black control knob to “SELECT” it.
   - 2 speed timers
   - ESD overrides
   - Remote mode
   - Local control
   - Diagnostic reset
   - Tag
   - Display options
   - Quick-access function
   - Password
   - Torque boost
   - Motor thermostat
   - Valve data
5. Make changes in each menu as desired. Each display shows the state or value of the existing settings.
6. When 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 “ADVANCED SETUP” mode in order to apply new settings.

NOTE: Once you exit this mode, the password will need to be entered again to gain access to the “ADVANCED SETUP” menu in order to make further changes.

5.1 2 speed timer

The optional “2 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 the full valve travel or only part of it. The on and off pulse times are adjustable. Percentages are the percent open.

5.1.1 Status

Close timer default = disabled

Open timer default = disabled

2 speed timer status allows the user to enable or disable the 2 speed timer functionality.

5.1.2 Start/Stop positions

5.1.2.1 Start position

Close timer default = 10%

Open timer default = 90%

If the close or open timer has been enabled, pulsing will start when the setpoint is reached in the selected direction. The actuator will continue pulsing until the valve reaches the desired stop position. Close start position percent open must be greater than close stop position percent open. Open start position percent open must be less than the open stop position percent open.

Use the menu knob to adjust the value. The close timer start position is adjustable between [1] and [1]00%. The open timer start position is adjustable between 0 and 99%.

5.1.2.2 Stop position

Close timer default = 0%

Open timer default = 100%

If the close or open timer has been enabled, pulsing will commence as the valve moves out of its close position. The actuator will continue pulsing until stopped at the setpoint. Close stop position percent open must be less than close start position percent open. Open stop position percent open must be greater than the open start position percent open.

Use the menu knob to adjust the value. The close timer stop position is adjustable between 0 and 99%. The open timer stop position is adjustable between 1 and 100%.

5.1.3 On/Off pulse time

5.1.3.1 Pulse time on

Close timer default = 2.0 seconds

Open timer default = 2.0 seconds

This setting allows the user to change the “on” pulse time from the default setting.

Use the menu knob to adjust the value. The value is adjustable between 1.0 and ²0.0 seconds.

5.1.3.2 Pulse time off

Close timer default = 1 second

Open timer default = 1 second

This setting allows the user to change the “off” pulse time from the default setting.

Use the menu knob to adjust the value. The value is adjustable between 1 and 200 seconds.

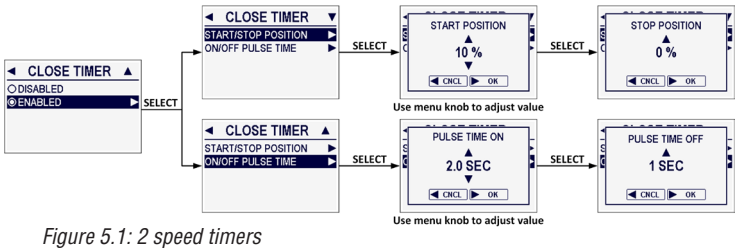


Figure 5.1: 2 speed timers

5.2 ESD 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 are selected in Section 4.3, Digital inputs. The default ESD input is Input 0.

Use the menu knob to highlight an “ESD OVERRIDE” option, then use the black control knob to toggle (“SELECT”) its status. The “>” symbol after each option indicates that particular event will override ESD.

5.2.1 Inhibit

Default = enabled

Disabling this option allows ESD to override an active inhibit signal.

5.2.2 Local command

Default = enabled

Disabling this option allows ESD to override local actuator operation commands.

5.2.3 Stop

Default = enabled

Disabling this option allows ESD to override a local or remote stop command.

5.2.4 Jammed

Default = enabled

Disabling this option allows ESD to override a jammed valve indication.

5.2.5 Lost phase

Default = enabled

Disabling this option allows ESD to override a lost phase indication.

5.2.6 Overtorque

Default = enabled

Disabling this option allows ESD to override an over-torque indication.

5.2.7 Thermostat

Default = enabled

Disabling this option allows ESD to override a motor thermostat-tripped indication.

NOTE: Disabling the motor thermostat voids all third party certifications, including Factory Mutual, CSA, IECEx and ATEX. Disabling the thermostat will void the warranty. Disabling the motor thermostat removes protection from overheating the motor and may cause unsafe conditions, including surface temperatures above the nameplate class.

5.2.8 2 speed timer

Default = disabled

Disabling this option allows ESD to override the ² speed timer functionality.

5.2.9 Network ESD

Default = enabled

Disabling this option allows ESD to override a network ESD indication.

5.2.10 Oil overtemp

Default = enabled

Disabling this option allows ESD to override a high oil temperature indication.

NOTE: This setting is only available for arctic temperature actuators.

5.2.11 Torque timer

Default = enabled

Disabling this option allows ESD to override the torque switch timer.

5.3 Remote mode

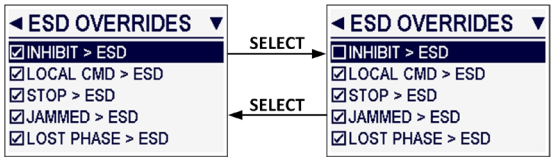


Figure 5.2: ESD overrides

Default = multi-control

"REMOTE MODE" permits a user to select from multiple remote control permissions, or isolate remote control to a single control selection.

- Multi-control: There are three modes of remote control for the MX actuator when the remote mode is configured for multi-control: digital control, analog control and network control. Digital and network control operations are based on the last command received. Analog control operation is initiated by either toggling Input 2 (configured for CSE input) or breaking and reapplying the analog signal.
- Digital control: The unit will operate only upon the last digital input command received.
- Network control: The unit will operate only upon the last network command received.
- Analog control: The unit will operate only upon the last analog input command received.

5.4 Local control

5.4.1 Status

Default = enabled

Local control status allows the user to enable or disable local control mode.

5.4.2 Mode

Default = maintained

Local control mode allows the user to change how the local control switches and display are used from the default settings.

5.4.2.1 Maintained mode

In "MAINTAINED MODE", the unit will operate continually in either direction when the black control knob is actuated and released, until the position of the black control knob is changed or the red selector knob is changed from "LOCAL" to either "STOP" or "REMOTE".

5.4.2.2 Inching mode

In "INCHING MODE", the unit will operate only when the black control knob is held in the open or close position. If the black control knob is released, the unit will stop.

5.4.3 R-G LED direction

Default = normal

This setting allows the user to reverse the colors of the LED in open and close directions.

- Normal: red open/green close
- Reversed: green open/red close

5.4.4 Starts/HR warning

Default = enabled

This setting allows the user to enable or disable the starts per hour warning. If enabled, excessive motor starts per hour will cause a warning message to be displayed. The warning is intended to notify the user of the possibility of the motor overheating. This warning does not prevent operation of the actuator.

5.5 Tag

This menu allows the user to set the valve tag number. Use the menu knob to choose each digit of the tag number, then use the black control knob to "SELECT" it. The tag number can be up to [1]6 digits long.

The alphanumeric display scrolls from a symbol set, numerals, and then A to Z in the following order: ! " # $ % & ' ( ) * + , - . / 0 to 9 A to Z. There is a blank at the end of A to Z to enable a tag number with less than [1]6 digits to be entered clearly.

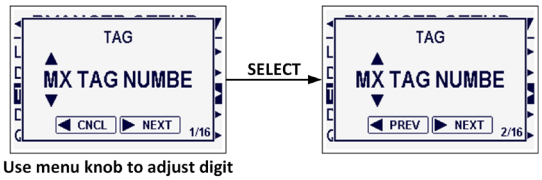


Figure 5.3: Tag number

5.6 Display options

5.6.1 Format

Default = detailed

Format allows the user to specify the amount of detail displayed on the dashboard:

- Simple: Displays percentage open and notification bar
- Standard: Displays percentage open, notification bar, and time and date
- Detailed: Displays percentage open, notification bar, time and date, and graphics indicating current open position and torque limit settings

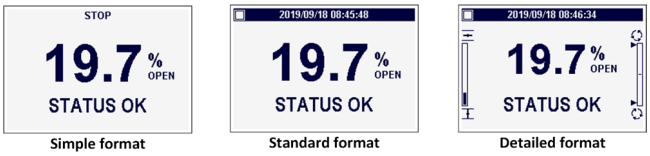


Figure 5.4: Display format

5.6.2 Precision

Default = ###.#

"PRECISION" denotes the presentation of the actuator position on the display. The position can be displayed as percent open as a whole number (###) or with a 10th percent accuracy (###.#). Additionally, a third option is available to show the actuator position graphically with a "butterfly valve" symbol. A vertical line within a pipe graphic denotes closed, a horizontal line within the pipe graphic denotes open, and a slanted line indicates partially open. The line will be animated when the actuator is opening or closing.

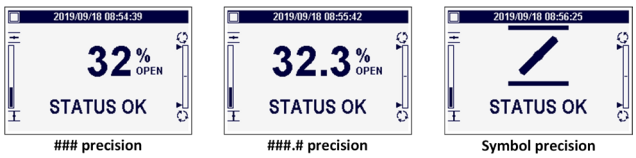


Figure 5.5: Display precision

5.6.3 Contrast

Default = 50

"CONTRAST" allows the user to specify the contrast of the LCD screen.

Use the menu knob to adjust the value. The value is adjustable between 5 and 100 in increments of 5. Alternatively, setting the value to "AUTO" will allow the contrast to adjust itself automatically based on the internal temperature of the actuator.

5.6.4 Backlight

Default = on

"BACKLIGHT" allows the user to specify whether the LCD screen's backlight is always on, always off, or timed, as well as its brightness.

If the "AUTO (TIMED)" option is selected, use the menu knob to adjust the time duration that should pass before the backlight automatically turns off, then use the black control knob to "SELECT" OK. The value is adjustable between 5 and 3,600 seconds (1 hour).

Use the menu knob to adjust the backlight brightness. The value is adjustable between 5 and 100 in increments of 5. Alternatively, setting the value to "AUTO" will allow the brightness to adjust itself automatically based on the amount of ambient light in the environment.

5.6.5 Rotate display

Default = 0 degrees

“ROTATE DISPLAY” allows the user to rotate the orientation of the LCD screen contents by 180 degrees (flip along its horizontal axis).

5.6.6 LED brightness

Default = 50%

“LED BRIGHTNESS” allows the user to specify the brightness of the LED indicator lights.

Use the menu knob to adjust the value. The value is adjustable between 0 and 100%.

5.6.7 LED test

“LED TEST” will repeatedly activate each LED indicator light in a sequence to ensure the user that they are functioning correctly.

Use the black control knob to “SELECT” OK to stop the test.

5.7 Quick-access function

“QUICK-ACCESS FUNCTION” allows the user to specify what occurs when a quick-access action is taken. A quick-access action is turning the menu knob either clockwise or counter-clockwise at the dashboard.

The available options for quick-access functions are:

- No function
- Torque profile chart
- Quick-access menu
- Demo mode

5.7.1 Menu knob CCW

Default = torque profile chart

“MENU KNOB CCW” allows the user to specify the quick-access function when the menu knob is turned counter-clockwise (CCW) at the dashboard.

5.7.2 Menu knob CW

Default = quick-access menu

“MENU KNOB CW” allows the user to specify the quick-access function when the menu knob is turned clockwise (CW) at the dashboard.

5.7.3 Allow in remote

Default = disabled

“ALLOW IN REMOTE” allows the user to enable quick-access functions when the red selector knob is set to “REMOTE”.

5.8 Password

The password may be changed from the default of “100” to a customer-selected value, as indicated in Figure 5.6.

The new password becomes effective as soon as the “PASSWORD ACCEPTED” message is displayed.

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 “QUICK SETUP” menu.

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”.

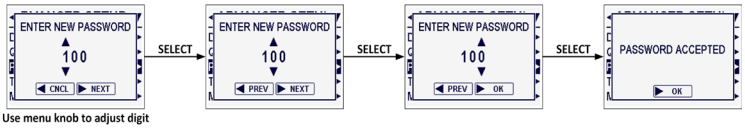


Figure 5.6: New password

5.9 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 actuator will permit more output torque up to the unit’s maximum torque rating when the temperature falls below 0°C (32°F).

NOTE: This setting is only available for arctic temperature actuators.

5.10 Motor thermostat

Default = enabled

If disabled, 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: Disabling the motor thermostat voids all third party certifications, including Factory Mutual, CSA, IECEx and ATEX. Disabling the thermostat will void the warranty. Disabling the motor thermostat removes protection from overheating the motor and may cause unsafe conditions, including surface temperatures above the nameplate class.

5.11 Valve data

"VALVE DATA" allows the user to identify the type of valve the actuator is mounted to. The user is able to specify the valve serial number, model and type.

The valve serial number and model can be up to 16 digits long. Use the menu knob to select each digit of the serial number or model, then use the black control knob to "SELECT" it.

The alphanumeric display scrolls from a symbol set, numerals, and then A to Z in the following order: ! " # $ % & ' ( ) * + , - ./0 to 9 A to Z. There is a blank at the end of A to Z to enable a tag number with less than 16 digits to be entered clearly.

The valve type can be set to one of four options:

- Undefined
- Other
- Linear
- Rotary

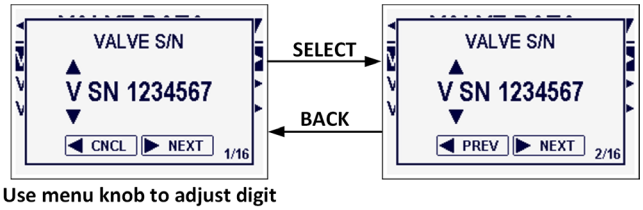


Figure 5.7: Valve serial number

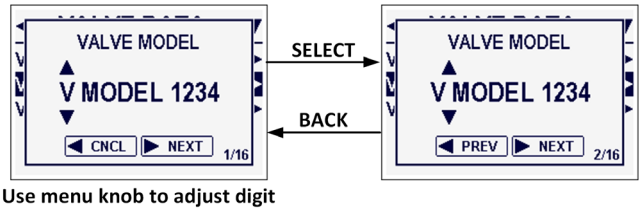


Figure 5.8: Valve model

6 Quick Access

The MX actuator provides quick access to diagnostics and display configuration through a configurable setting of the rotary knob while the actuator is in operation. Configuration of the "QUICK ACCESS FUNCTION" is done in the "ADVANCED SETUP" menu. Spinning of the rotary knob can enter the user into the QUICK ACCESS MENU or to view the LIVE TORQUE GRAPH. No function is also selectable as is the ability to access these menus while in remote. Unit defaults are:

- CCW — LIVE TORQUE GRAPH
- CW — QUICK ACCESS MENU

6.1 Live torque graph

The "LIVE TORQUE" graph shows the most current torque graph live as the unit is running. The graph can be zoomed in and analyzed by moving the black knob to select. The current run graph will disappear, even during the next opposite move direct. To clear the graph, either issue a "BACK" command from the black selector knob or move the rotary knob in the live torque graph configured direction.

6.2 Quick access menu

The "QUICK ACCESS" menu allows the user to view real-time diagnostics along with display-only configuration changes.

6.2.1 Charts/graphs

The "CHARTS/GRAPHS" menu allows the user to view real-time torque, temperature and voltage data. The rotary knob can be used to cycle through the various graph options. Zooming into the graphs can be done by moving the black selector switch to "SELECT" then moving the rotary knob to inspect the data points. Issuing "BACK" on the selector switch exits the zoom and also the charts/graphs menu.

6.2.2 Live data

"LIVE DATA" menu allows the user to view live status information of the unit. Real-time updates to this data can be "frozen" by moving the black selector knob to "SELECT". This will freeze the data to prevent updates. Moving back to "SELECT" will "unfreeze" the data after frozen.

- Actuator — Shows position, demand, torque and internal temp of unit
- Hardware — Shows board status as well as input status of digital inputs
- Motor Status — Shows phase rotation status and motor temp
- Power Supply — Shows max/min/current voltage and frequency settings
- Real Time Clock — Shows current time, date and battery level for RTC

6.2.3 Event log

"EVENT LOG" is the time-stamped event and fault log for the actuator. Event categories can be configured and are outlined in Section 7.4.1. Individual events can be inspected then cycled through by moving the black selector knob to "SELECT" then rotating the rotary knob.

6.2.4 View quick setup

"VIEW QUICK SETUP" menu allows the user to view the configurable menus from the "QUICK SETUP" menus. These viewable configuration menus include limits, inputs, outputs, monitor relay, networks and real time clock.

6.2.5 Display options

Allows for the change to the configurable options pertaining to the "DISPLAY OPTIONS". These options are outlined in Section 5.6, Display options, but include changes to contract, brightness, format, etc.

6.2.6 Identification

The "IDENTIFICATION" menu can be used by the user to view unit-specific QA data, board firmware versions and Bluetooth-related information.

6.2.7 Unit data

"UNIT DATA" displays all of the original configuration data that was entered to initialize a unit. This data should match and be verified by information printed on the unit nameplate. Improper unit configuration can lead to a unanticipated functioning of the actuator.

6.2.8 Help

The "HELP" menu contains QR codes for quick access to manuals and websites that can help a user in the event it is needed. The user can pull up this IOM, access our wiring diagram website, our network pages, DTM locations, find tech support contacts, etc. all through the use of a phone or tablet capable of reading QR codes.

7 Advanced Diagnostics

7.1 Advanced diagnostics

To access the "ADVANCED DIAGNOSTICS" menus, rotate the red selector knob to the stop position. Then rotate the black control knob in the following sequence: Open – Close – Open. Use the menu knob to navigate through menu options.

NOTE: Some advanced diagnostic charts, graphs, live data and event log information can also be viewed from the "QUICK ACCESS" menu. To access the "QUICK ACCESS" menu, ensure the red selector knob is rotated to the remote or stop position. Then rotate the menu knob in the appropriate direction to access the menu.

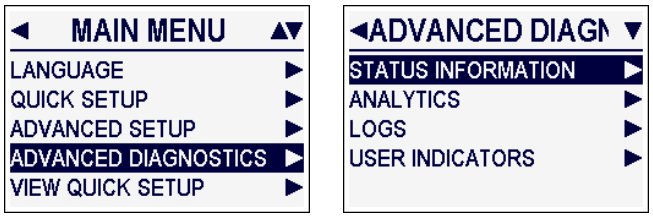


Figure 7.1: Access to the advanced diagnostics menus

7.2 Status information

The advanced diagnostics "STATUS INFORMATION" displays the status of a series of standard alarms, warnings and unit functions. Status information appears as a combination of live process readings and static input criteria. Live status information is also available for review by accessing Quick Access > Live Data. "STATUS INFORMATION" menus are read only.

"STATUS INFORMATION" sub-menus contain detailed information about the following actuator functions:

- Standard alarms
- Standard warnings
- Rated vib exc details
- Actuation
- Open final position
- Close final position
- Operational
- Digital inputs
- Digital outputs
- Partial stroke test
- Real time clock
- Hardware
- Motor status
- Power supply
- Bluetooth
- Identification
- QA data

Additional information about the "STATUS INFORMATION" sub-menus is available in Section 7.7, Diagnostic descriptions.

NOTE: Warnings notify the user of potential unit damage and/or failure. Warnings will not prevent actuator movement; however, if left unresolved, warnings may escalate to activation of alarms. Activated alarms notify the user of immediate issues and failures. Alarms will prevent movement of the actuator.

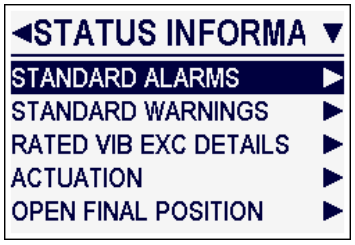


Figure 7.2: Status information menus

7.3 Analytics

The advanced diagnostics "ANALYTICS" displays functional information and visual graphics and charts of function and trend data. Analytics appears as a combination of live process readings and saved historical references. Analytics information can provide an indication of a change in the process conditions, which over time could lead to loss of function or unit failure. Analytics information is primarily read only, with the exception of saving graphed data for future reference.

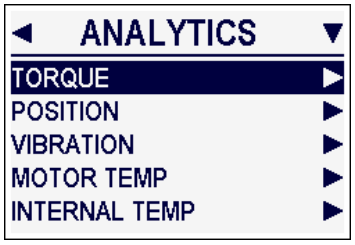


Figure 7.3: Analytics menus

"ANALYTICS" sub-menus contain graphical information about the following actuator functions:

- Torque
- Position
- Vibration
- Motor temp
- Internal temp

NOTE: Specific graphical values can be viewed by activating the graph highlight function. To activate this function, rotate the black control knob to Open/Select, then use the rotary menu knob to view various values on the graph. To exit the function, rotate the black control knob to Close/Back twice.

7.3.1 Torque trends

The "TORQUE TRENDS" menu provides access to information about the open and close torque profiles, the open and close torque profile references and the corresponding torque graphs.

NOTE: A torque profile is a numerical summary of a torque graph.

7.3.1.1 Torque profile

The open and close "TORQUE PROFILE" screens display the date, time and position when the torque value is collected. The motor temperature

is also displayed for the torque start and end points. The torque is collected at the start point, end point, breakout, peak run and ending positions. A sample #, last run torque average and last stop torque are also displayed.

The breakout portion of the actuator stroke represents the first 10% of the full stroke travel. The ending portion of the actuator stroke represents the last 10% of the full travel stroke.

NOTE: Torque values noted with % units indicate a percent of that particular unit's max torque capabilities.

The open and close "TORQUE PROFILE" reference menus display information about the saved reference profile. The information displayed is the same as the information displayed in the "TORQUE PROFILE" menus.

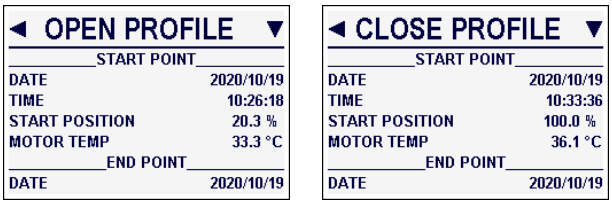


Figure 7.4: Open and close torque profile menus

7.3.1.2 Save reference

The "TORQUE TRENDS" menu also allows the user to save the last torque profile and graph as the reference. The save open and save close reference functions will save the appropriate torque profile and corresponding torque graph simultaneously. The save reference functions can be valuable for saving a profile and graph as a reference after commissioning has been performed on the actuator unit.

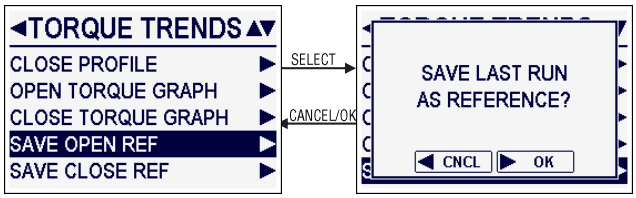


Figure 7.5: Save torque profile and graph as reference

7.3.1.3 Torque graph

The open and close "TORQUE GRAPH" menus provide access to the most recent and reference torque graphs. Max, min, average and long-term average recent and reference torque graphs are available for review.

Graph Type	Description
Max Trq	Displays the maximum torque recorded within each percentage of travel
Min Trq	Displays the minimum torque recorded within each percentage of travel
Avg Trq	Displays the average torque recorded within each percentage of travel
Lta Trq	Displays a re-evaluation of the long-term average with the inclusion of the most current average run.

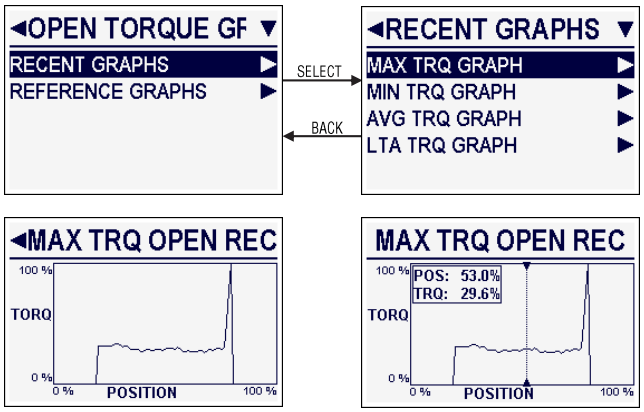


Figure 7.6: Accessing recent open max torque graph and highlighting a specific graphical value. Note: the max torque open graphs shown above illustrate actuator travel that has started and ended mid-stroke. These graphs do not represent full-stroke actuator movement.

Refer to the note in Section 7.3 Analytics for information about how to highlight a specific graphical value.

7.3.2 Position trends

The "POSITION TRENDS" menu provides access to the open and close motor on time histogram charts, the open and close starts/HR histogram charts, and the open and close final position graphs.

NOTE: Each histogram marker bin represents 10% of the stroke. Several motor time readings are measured per bin. These readings are then averaged to obtain the displayed value.

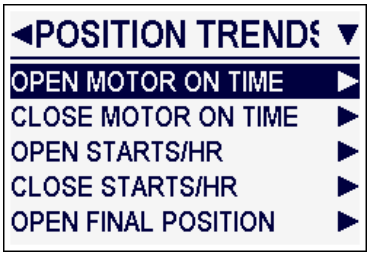


Figure 7.7: Position trends menu

7.3.2.1 Motor on time

The open and close "MOTOR ON TIME" screens display the amount of time the motor is running versus the actuator position.

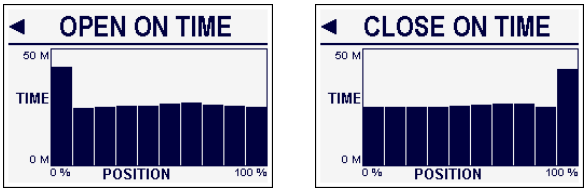


Figure 7.8: Open and close motor on time histograms

To view a bin time value, rotate the black control knob to Open/Select, then use the rotary menu knob to view the time values for different positions.

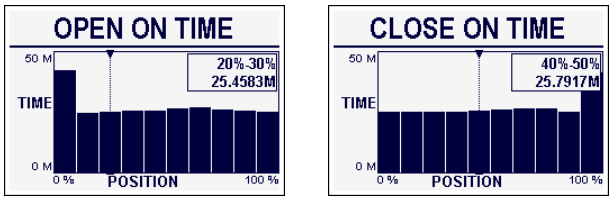


Figure 7.9: Displayed open and close motor on time highlighted value

7.3.2.2 Starts/HR

The open and close "STARTS/HR" screens display the number of motor starts per hour versus the actuator position.

Figure 7.10: Open and close starts/hr histograms. Close starts/hr histogram displays optional bin s/hr and position values.

7.3.2.3 Final position

The open and close "FINAL POSITION" screen provides access to the max, min and average final position graphs, in the open and close direction with respect to the saved position reference user input. The user must save the reference final position to use this data. The final position graphs display the deviation of the final position of the motor (in number of drive sleeve turns) over a user-defined time scale.

The time scale options are 24 hours, 30 days, 12 months or 10 years.

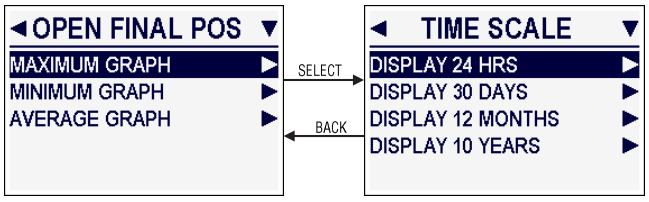


Figure 7.11: Position trends access menus

To highlight a specific time or motor position, rotate the knob to Open/Select then use the rotary menu knob to view the time values for different positions.

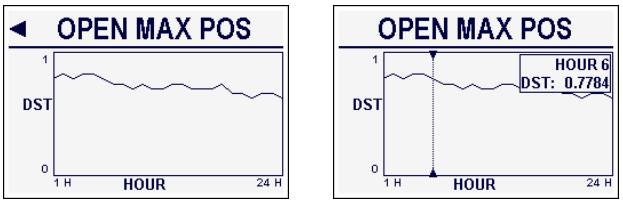


Figure 7.12: Open max position graph. The image on the right displays the highlighted vibration and time details.

7.3.3 Vibration trends

The "VIBRATION TRENDS" menu provides access to graphs of vibration vs. time, position and the amount of time a vibration level is detected. The vibration data displayed in the graphs is always of the acceleration amplitude detected (RMS G's).

NOTE: For histogram-type graphs involving position, each histogram marker bin represents 10% of the actuator stroke. Several vibration readings are measured per bin. These readings are then averaged to obtain the displayed value.

Figure 7.13: Vibration trends menu

7.3.3.1 Vibration vs. time

The "VIBRATION VS. TIME" screen provides access to the max and average vibration vs. time graphs. The time scale is user-defined and available as 24 hours, 30 days, 12 months or 10 years.

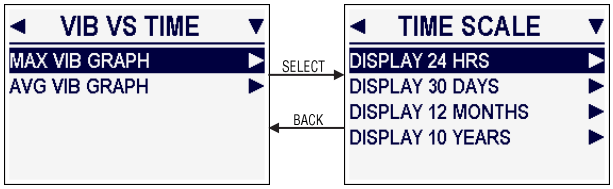


Figure 7.14: Vibration trend access menus

To highlight a specific time or vibration, rotate the knob to Open/Select then use the rotary menu knob to view the time values for different positions.

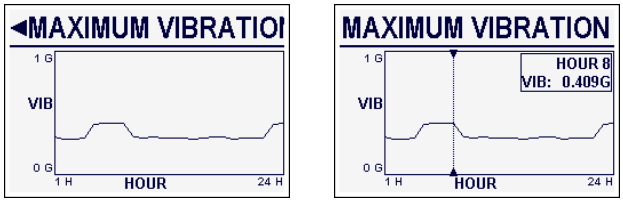


Figure 7.15: Max vibration vs. time. The image on the right displays the highlighted vibration and time details.

7.3.3.2 Vibration vs. position

The "VIBRATION VS. OPEN OR CLOSE POSITION" screens provide access to the max, min and average last run graphs or to the summary run graphs. Summary run graphs are the max, min and average graphs from all runs since the actuator was initiated or reboot.

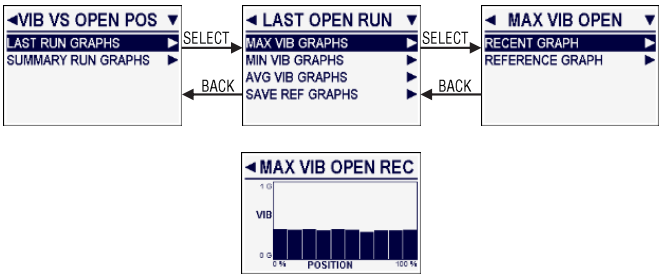


Figure 7.16: Vibration vs. open position graphs

The "VIBRATION VS. POSITION" menus also allow the user to save the last run and summary run graphs as a reference. The save open and close reference functions will save the vibration profile and vibration graph simultaneously. The save reference functions can be valuable for saving a vibration vs. position graph as a reference after commissioning has been performed on the actuator unit. The references are also used as the reference data for the deviation indicators.

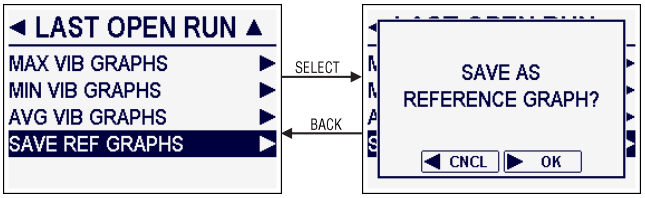


Figure 7.17: Save vibration vs. position graphs as reference

7.3.3.3 Elapsed time vs. vibration

The "ELAPSED TIME VS. VIBRATION" screen displays a histogram of the amount of time a vibration level is detected.

To highlight a specific time or vibration increment, rotate the knob to Open/Select then use the rotary menu knob to view the time values for different positions.

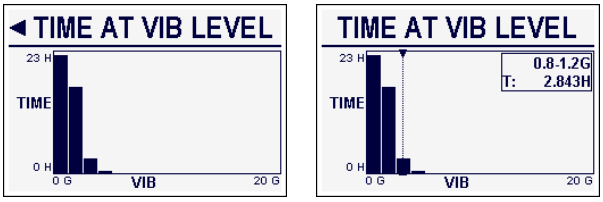


Figure 7.18: Time vs. vibration level. The image on the right displays the highlighted vibration and time details.

NOTE: The vibration histogram marker bin represents vibrational increments of 0.4 G up to the vibrational value of 4.0 G. After 4.0 G, the scale increment increases to 3.2 G. Refer to Figure 7.19, Vibrational scale increment change from 0.4 to 3.2 G for a visual clarification.

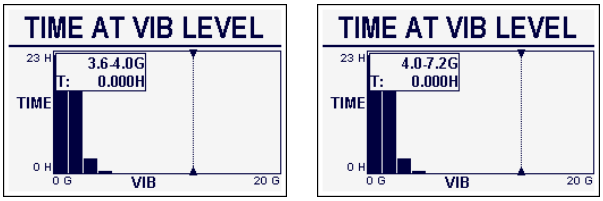


Figure 7.19: Vibrational scale increment change from 0.4 to 3.2 G

7.3.4 Motor temperature

The "MOTOR TEMPERATURE" menu provides access to the max, min and average motor temperature versus time graphs. The time scale is user-defined and available as 24 hours, 30 days, 12 months or 10 years.

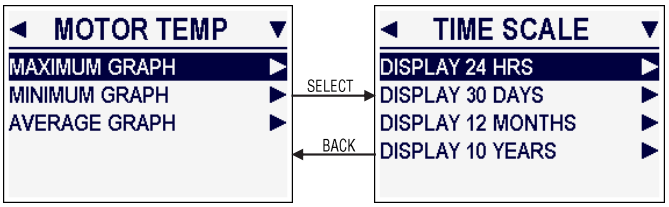


Figure 7.20: Motor temperature graph access menus

To highlight a specific time or motor temperature, rotate the knob to Open/Select then use the rotary menu knob to view the time values for different positions.

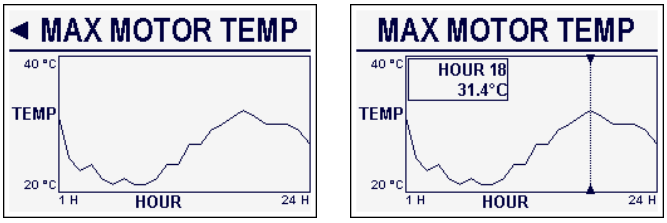


Figure 7.21: Max motor temperature vs. time. The image on the right displays the highlighted motor temperature and hour details.

7.3.5 Internal temp

The "INTERNAL TEMPERATURE" menu provides access to the max, min and average internal temperature versus time graphs. The time scale is user-defined and available as 24 hours, 30 days, 12 months or 10 years.

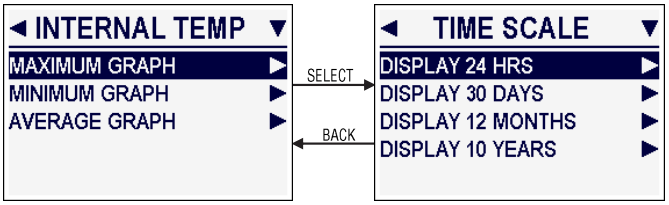


Figure 7.22: Internal temperature graph access menus

To highlight a specific time or motor temperature, rotate the knob to Open/Select then use the rotary menu knob to view the time values for different positions.

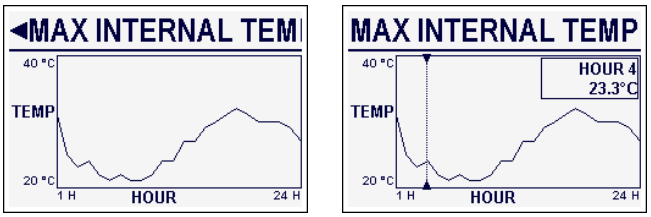


Figure 7.23: Max internal temperature vs. time. The image on the right displays the highlighted internal temperature and hour details.

7.4 Logs

The advanced diagnostics “LOGS” display captured information with a date and time stamp, and statistics for a series of unit functions. Logs information appears as static recorded data.

Logged events can be scrolled through by using the menu rotary knob. Logs can be scrolled through in the list or details format.

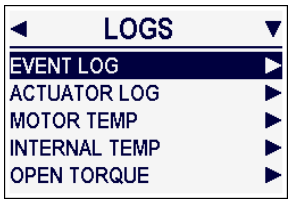


Figure 7.24: Logs menus

“LOG” sub-menus contain captured information about the following actuator functions:

- Event log
- Actuator log
- Motor temp
- Internal temp
- Open torque
- Close torque
- Max starts/HR
- Operation
- Trips
- Power supply
- Service log
- Bluetooth log
- PST log
- Reset counters
- Set real time clock

7.4.1 Event log

The “EVENT LOG” menu provides access to the displayed event logs and the configurable event categories.

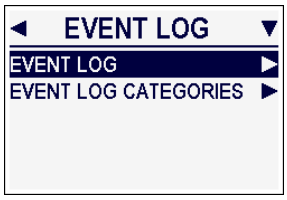


Figure 7.25: Event log menu

Event Log

The event log sub-menu displays a list of date and time-stamped events. A detailed event log screen also displays the logged event ID, date, time, event category and event name.

NOTE: Up to 14,000 events can be logged. Once the allowable number of logs has been exceeded, new events will override the oldest logs.

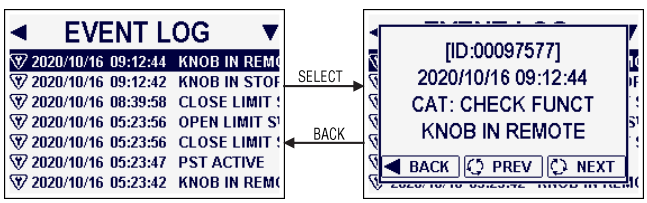


Figure 7.26: Event log list and event log details screen

Event Log Categories

The “EVENT LOG CATEGORIES” menu allows the user to select which events will be logged. Events are separated into the four Namur NE 107 compliant categories:

- Maintenance
- Out of specification
- Check function
- Failure

To configure the event log, select the desired event category, then select the event to log. A check marked event will display in the log. To remove an event from the log, highlight the event, then select the event to remove the check mark status.

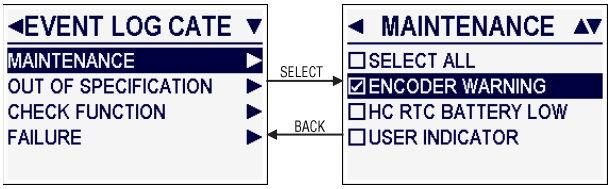


Figure 7.27: Event log categories and maintenance event log category menu

7.4.2 Actuator log

The “ACTUATOR LOG” menu displays a list of date and time logged actuator movement commands, such as mode of command and the reason for stop. The mode of command details how the actuator was commanded to move, e.g., local control, remote network, analog or discrete command. The reason for stop details what caused the actuator to stop moving, e.g., reaching an end limit, position demand reached, command to stop, or trigger of an alarm that caused the actuator to stop prematurely.

A detailed actuator log screen also displays the date, time, mode of command or reason for actuator stop and the actuator command with the % position.

NOTE: Up to 14,000 actuator commands can be logged. Once the allowable number of logs has been exceeded, new commands will override the oldest logs.

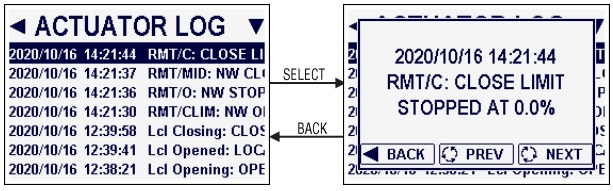


Figure 7.28: Actuator log list and actuator log details screen

7.4.3 Service log

The “SERVICE LOG” menu provides access to the last service date screen and the set last service date function.

Figure 7.29: Service log menu

Last Service Date

The “LAST SERVICE DATE” screen displays the user-defined date and time the unit last received service. It is good practice to log the date and time service was conducted to assist with unit performance tracking and ensure service is performed routinely.

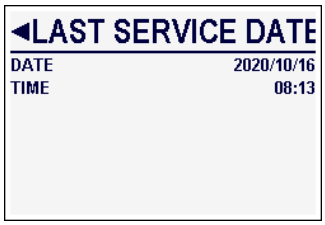


Figure 7.30: Last service date screen

Set Last Service Date

The “SET LAST SERVICE DATE” menu allows the user to configure the year, month, day and time that service was last performed on the actuator unit.

To set the last service date and time, use the menu rotary knob to scroll to the applicable year, month and day, and the open and close to transfer among the year, month and day. Once the date is set, set the time service was conducted. Confirm and save the last service date and time.

Figure 7.31: Set and save the service date and time menus

7.4.4 Partial stroke test log

The “PST LOG” menu provides access to the displayed PST results log and the last PST torque graphs.

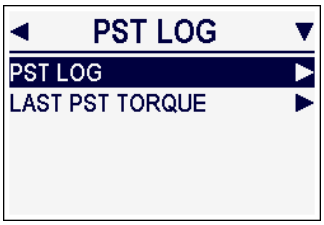


Figure 7.32: PST log menu

PST Log

The “PST LOG” sub-menu displays a list of date and time logged PST results. A detailed PST log screen also displays the logged date, time, and pass or fail result.

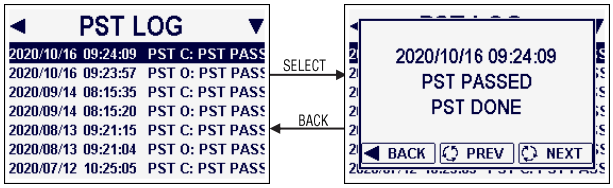


Figure 7.33: PST log list and PST log details screen

Last PST Torque

The “LAST PST TORQUE” menu provides access to graphs of the torque measured during the PST vs. position of the partial stroke. Max, min, average and long-term average torque graphs are available in the actuator open and close direction.

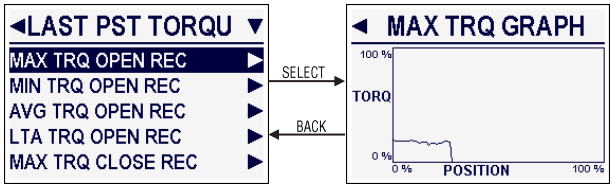


Figure 7.34: Last PST torque menu and max torque graph screen. Note: the max torque open graph shown above illustrates the partial stroke test actuator travel. This graph does not represent full stroke actuator movement.

To highlight a specific torque or position, rotate the knob to Open/Select then use the rotary menu knob to view the torque values for different positions.

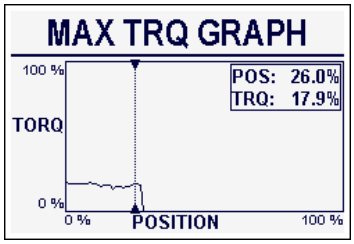


Figure 7.35: Max open torque graph with highlighted torque and position details

7.5 User indicators

The “USER INDICATORS” menus allow the user to enable, view, clear and customize the conditions of the unit indicators. User indicators add greater insight into the specific use application and provide process performance monitoring by warning the operator of potential future failures before they occur. The following indicator types are available for modification:

- Torque
- Vibration
- Final position
- Service indicators

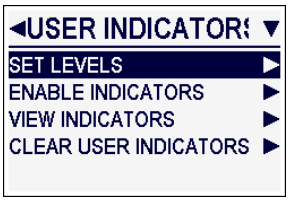


Figure 7.36: User indicators

NOTE: Indicator notifications will remain active until cleared by the user, even if the indicator condition has been resolved. Triggered user indicators must be cleared locally from the actuator. This feature promotes proper diagnoses of the system in the event of a deviation.

NOTE: User indicator notifications will not prevent movement of the actuator.

NOTE: A discrete output (DO) option is available for configuration of the user indicator warning. This DO option can be set to trip in the event any user indicator becomes active.

A status message will display when an enabled and activated indicator is present. The status of the indicators can also be viewed by accessing User Indicators > View Indicators.

7.5.1 Set levels – Customize indicator criteria

The “SET LEVELS” menu allows the user to customize the indicator criteria.

To set or modify the indicator levels, access User Indicators > Set Levels. Then use the black control knob to select the indicator to customize.

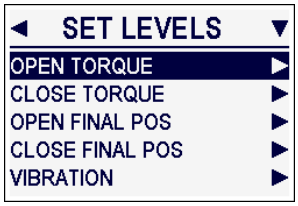


Figure 7.37: Set levels

7.5.1.2 Open and close torque

The “OPEN AND CLOSE TORQUE” indicators provide notification when the torque deviates from the expected average or saved reference torque graphs, or the torque to greater than a configurable value.

To configure the open and close torque indicators, select the desired parameters and use the menu knob to select the indicator value; use the black control knob to select OK to set the value.

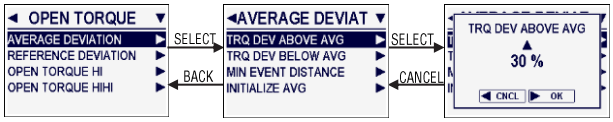


Figure 7.38: Open torque indicator menus

NOTE: The torque deviation % above or below the average is an additive value on top of the current torque percentage at that particular point in the stroke.

Min Event Distance

The “MIN EVENT DISTANCE” is the minimum travel distance in units of [1]% of span necessary to trigger a user indicator.

Initialize Average

The “INITIALIZE AVERAGE” option allows the user to set a new average reference based on the last run, the saved reference or the next run. This function is valuable when the average torque may have changed over an extended period of time.

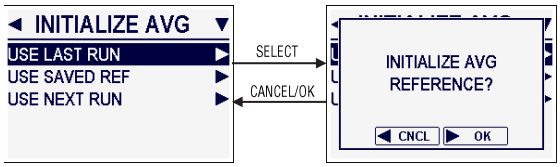


Figure 7.39: Initialize average

Reference Deviation

The “REFERENCE DEVIATION” is allowable amount of deviation above the saved reference graph.

Torque HI/HiHi

The “TORQUE HI AND HIHI” are configurable torque values that must be surpassed to trigger the high torque indicators. One or both can be used for greater protection.

7.5.1.3 Open and close final position

The “OPEN AND CLOSE FINAL POSITION” indicators provide notification when the final seated position deviates from the saved reference position. The position deviation unit of measure is the number of drive sleeve turns.

To configure the open and close final position indicators, select the desired parameters and use the menu knob to select the indicator value; use the black control knob to select OK to set the value.

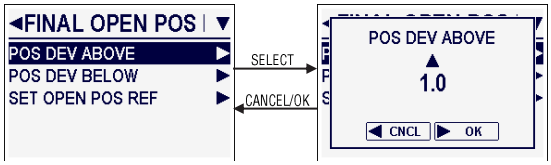


Figure 7.40: Open final position indicator menu

Set Position Reference

The “SET POSITION REFERENCE” allows the user to define the final position reference. Note, the position reference is independent of setting position limits, and must be set through the advanced diagnostics to utilize the position deviation indicator and create position deviation graphs.

To set the final position, move the actuator to the desired position and select set position reference. A pop-up window will ask the user to verify that the actuator is in the final position.

Once the position is verified, select OK to save the current actuator position as the indicator reference.

Figure 7.41: Set final position reference

7.5.1.4 Vibration

The “VIBRATION” indicators provide notification when the vibration deviates from the user-configured value. Vibration indicators can be set for vibration that exceeds a set value, vibration that is above the max reference or vibration that is below the min reference. The vibration unit of measure is mG RMS; the vibration deviation unit of measure is %.

NOTE: The vibration deviation % above or below the reference is the percent deviation from the current vibration reference value.

To configure the vibration indicator, select the desired parameters and use the menu knob to select the indicator value; use the black control knob to select OK to set the value.

Inactive Settle Time

The “INACTIVE SETTLE TIME” is the amount of time that the vibration must remain below the vibration reference to clear the vibration indicator.

Active Settle Time

The “ACTIVE SETTLE TIME” is the amount of time that the vibration must remain above the vibration reference to trigger the vibration indicator.

Vibration Hi

The “VIBRATION HI” is the vibrational value that must be surpassed to trigger the vibration high indicator.

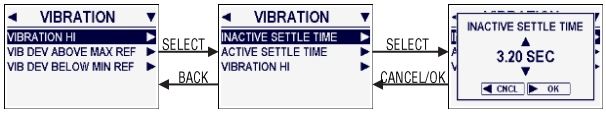


Figure 7.42: Vibration indicator menus

7.5.1.5 Service indicators

The “SERVICE INDICATORS” provide notifications when the actuator function deviates from user-defined criteria. The service indicator sub-menus allow the user to configure the following attributes:

- Motor temp hi
- Starts/hr hi
- Total DS turns
- Total starts open
- Total starts close
- Service interval
- Mod setpoint hunting

Motor Temp High

The motor temperature high indicator notifies the user when the motor temperature reading is higher than a configured temperature value. The temperature unit of measure is °C.

To configure the motor temperature high indicator, select the Motor Temp Hi service indicator option. Then use the menu knob to configure the indicator trigger temperature value; use the black control knob to select OK to set the value.

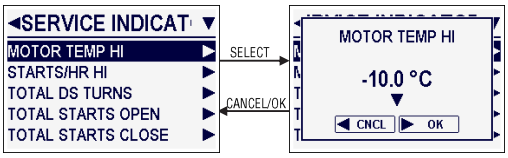


Figure 7.43: Motor temperature high indicator menu

Starts/Hr High

The “STARTS PER HOUR HIGH” exceeded indicator notifies the user when the actuator has started more times per hour than a configured value. The maximum allowable configuration value is five starts/hr below the unit configured rating.

To configure the “STARTS PER HOUR” indicator, select the “STARTS/HR HI” service indicator option. Then use the menu knob to configure the indicator trigger value; select OK to set or cancel to return to the previous menu.

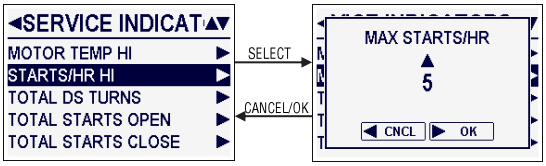


Figure 7.44: Max starts per hour indicator menu

Total Drive Sleeve Turns

The “TOTAL DRIVE SLEEVE TURNS” indicator notifies the user when the drive sleeve has exceeded a configured number of turns.

To configure the allowable “DRIVE SLEEVE TURNS” indicator, select the Total DS Turns service indicator option. Then use the menu knob to configure the indicator trigger value; select OK to set or cancel to return to the previous menu.

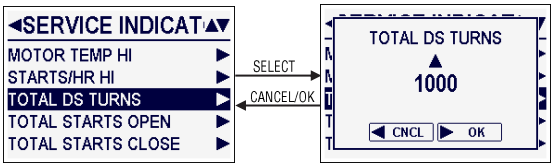


Figure 7.45: Total drive sleeve turns indicator menu

Total Starts Open and Close

The “TOTAL STARTS COUNT EXCEEDED” indicator notifies the user when the total number of starts has exceeded a configured number of starts in the open or close direction.

To configure the “TOTAL STARTS” indicator in the open or close direction, select the “TOTAL STARTS OPEN” or “TOTAL STARTS CLOSE” service indicator option. Then use the menu knob to configure the indicator trigger value; select OK to set or cancel to return to the previous menu.

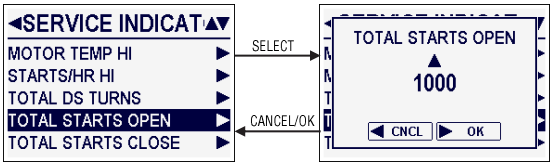


Figure 7.46: Total starts open indicator menu

Service Interval

The “SERVICE INTERVAL” indicator notifies the user when a configured number of hours has passed.

NOTE: Service interval hours are based on active motor on time.

To configure the “SERVICE INTERVAL” indicator, select the “SERVICE INTERVAL” indicator option. Then use the menu knob to configure the indicator trigger value; select OK to set or cancel to return to the previous menu.

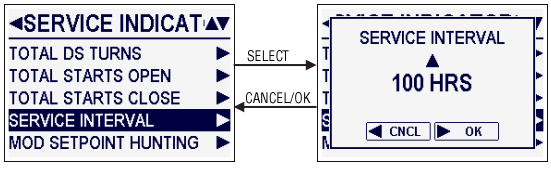


Figure 7.47: Service interval indicator menu

Modulating Setpoint Hunting

The “MODULATING SETPOINT HUNTING” indicator notifies the user when the actuator is unable to achieve a command position within a configured number of position attempts.

To configure the “MODULATING SETPOINT HUNTING” indicator, select the Mod Setpoint Hunting indicator option. Then use the menu knob to configure the indicator trigger value; select OK to set or cancel to return to the previous menu.

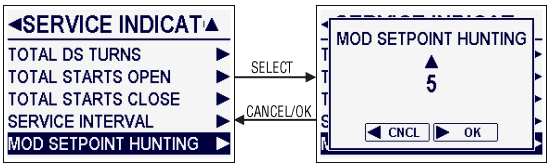


Figure 7.48: Modulating setpoint hunting indicator menu

Enable Indicators

The “ENABLE INDICATORS” menu allows the user to customize which indicators are enabled and disabled.

To enable an indicator, select the box next to the indicator name. A check will appear in the box next to enabled indicators.

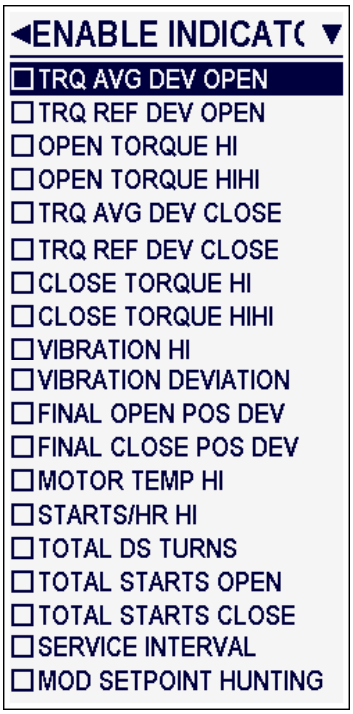


Figure 7.49: Enable indicators menu

7.5.2 View indicators

The “VIEW INDICATORS” menu allows the user to view the status of all set indicators concurrently or the details of individual groups of indicators.

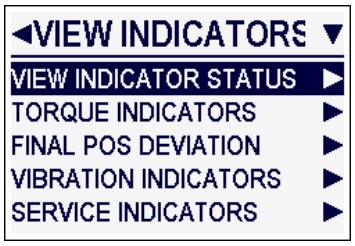


Figure 7.50: View indicators menu

View Indicator Status

The “VIEW INDICATOR STATUS” menu allows the user to view the status all set indicators concurrently.

Figure 7.51: View indicator status menu

Torque Indicators

The “TORQUE INDICATORS” menu provides access to the torque indicator details and the torque deviation details menus.

Torque Indicator Details

The “INDICATOR DETAILS” menu displays the number of times an indicator has occurred, and the date and time the indicator was activated.

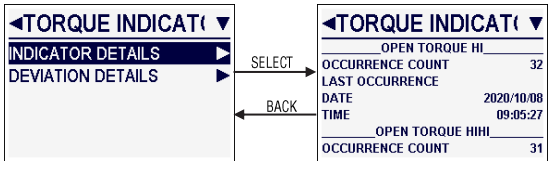


Figure 7.52: Torque indicator details menu

Torque Deviation Details

The “DEVIATION DETAILS” menu provides access to the open and close torque deviation details relative to the reference value or the long-term average torque. The torque deviation details menus display the number of times a deviation occurred, the date and time the deviation occurred, the position at which the deviation occurred, the deviation percent value and a total fail position range.

NOTE: The torque deviation value will appear as a positive percent value if the deviation is above the reference or long-term average value. It will appear as a negative percent value if the deviation is below the reference or long-term average value.

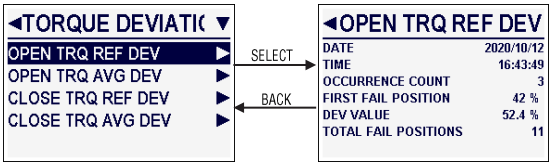


Figure 7.53: Torque deviation from reference details menu

View Final Position Deviation Details

The “FINAL POSITION DEVIATION DETAILS” menu provides access t o the open and close final position deviation details. The final position deviation details menu displays the date and time the deviation occurred, the number of times the deviation occurred and the amount of deviation, displayed in drive sleeve turns.

NOTE: The final position deviation value will appear as a positive value if the deviation is above the set final position value and as a negative value if the deviation is below the set final position value.

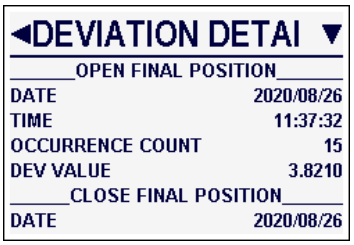


Figure 7.54: Final position deviation details menu

View Vibration Indicators

The “VIBRATION INDICATORS” menu provides the user access to the vibration hi details and the vibration deviation details. The vibration details menus display the date and time when the detected vibration exceeded the allowable range, the date and time when the vibration returned to the allowable range, the number of times the vibration indicator has been triggered, the vibration value recorded when the indictor was triggered and the vibration max allowable setting.

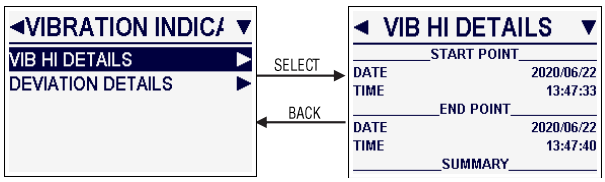


Figure 7.55: Vibration high details menu

View Service Indicators

The “VIEW SERVICE INDICATORS” menu displays the date and time a service indicator was triggered and the number of times an indicator occurred.

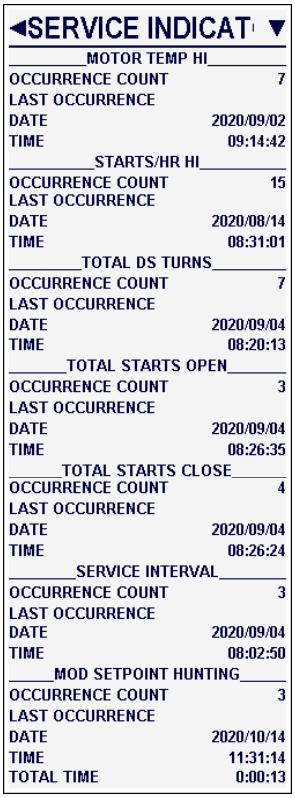


Figure 7.56: Service indicators details menu

7.5.3 Clear user indicators

The “CLEAR USER INDICATORS” function allows the user to clear all of the recorded indicators.

To clear the user indicators, access the User Indicators > Clear User Indicators. Select OK to clear the indicators or cancel to return to the main menu.

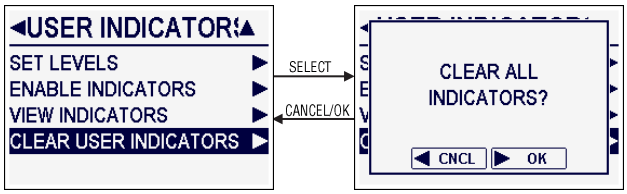
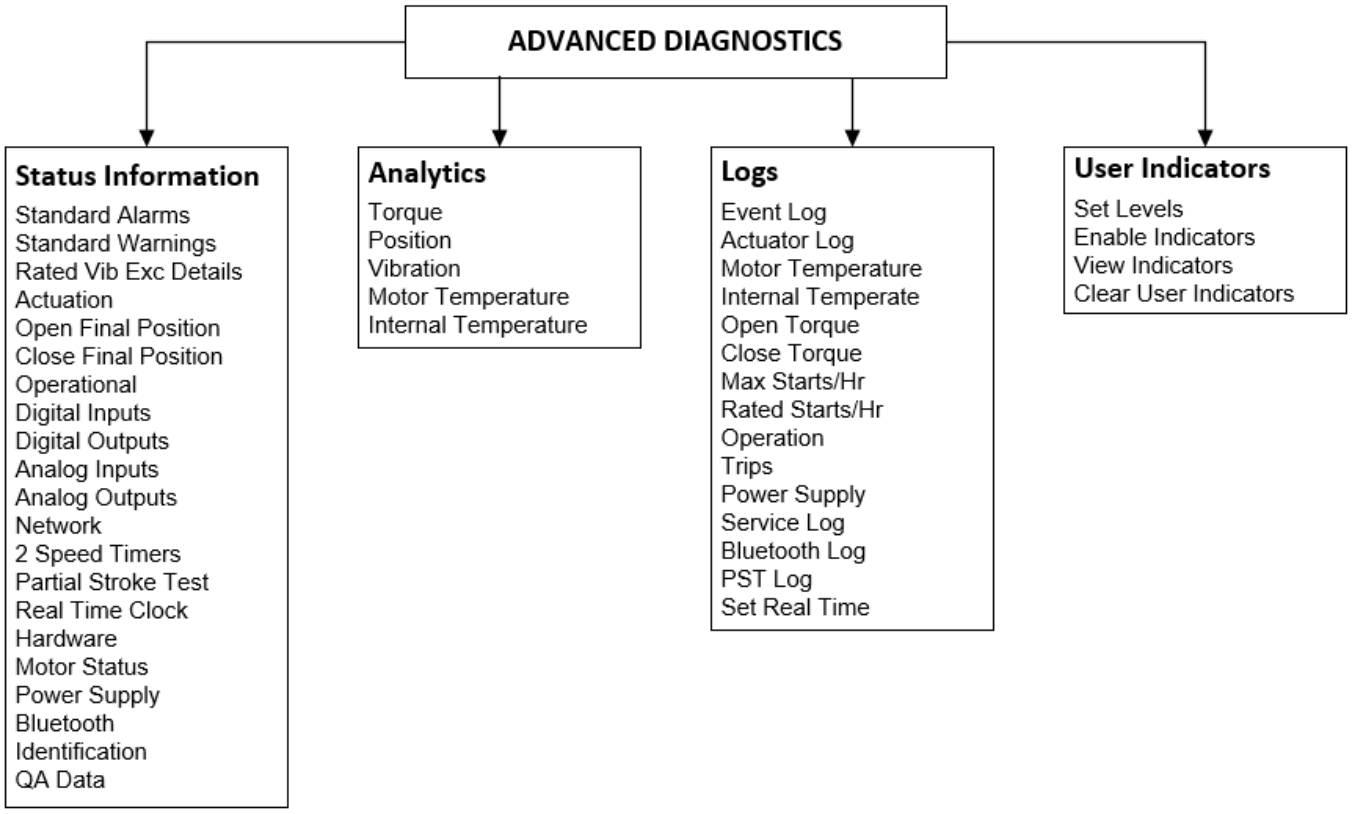


Figure 7.57: Clear user indicators function

7.6 Menu tree


ADVANCED DIAGNOSTICS
Status Information
Standard Alarms
Standard Warnings
Rated Vib Exc Details
Actuation
Open Final Position
Close Final Position
Operational
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Network
2 Speed Timers
Partial Stroke Test
Real Time Clock
Hardware
Motor Status
Power Supply
Bluetooth
Identification
QA Data
Analytics
Torque
Position
Vibration
Motor Temperature
Internal Temperature
Logs
Event Log
Actuator Log
Motor Temperature
Internal Temperate
Open Torque
Close Torque
Max Starts/Hr
Rated Starts/Hr
Operation
Trips
Power Supply
Service Log
Bluetooth Log
PST Log
Set Real Time
User Indicators
Set Levels
Enable Indicators
View Indicators
Clear User Indicators

7.7 Diagnostic descriptions

Menu Feature	Description
STATUS INFORMATION The "STATUS INFORMATION" displays the configuration and status of a series of standard alarms, warnings and unit functions.	
Standard Alarms	The "STANDARD ALARMS" menu displays the status of alarms standard to the function of the actuator. The menu is live and not configurable. Standard alarms prohibit movement of the actuator if left unresolved.
Open Overtorque	The "OPEN OVERTORQUE" alarm status indicates if the unit has detected an output torque greater than the configured torque setting while running open in mid-travel.
Close Overtorque	The "CLOSE OVERTORQUE" alarm status indicates if the unit has detected an output torque greater than the configured torque setting while running close in mid-travel.
Motor Overtemp	The "MOTOR OVERTEMP" alarm status indicates the measured motor thermistor temperature has exceeded the safe operating temperature and rating of the motor.
Valve Jammed	The "VALVE JAMMED" alarm status indicates the actuator has not detected any movement of the valve during its last movement command.
Open Torque Timer	The "OPEN TORQUE TIMER" alarm status indicates the unit has exceeded its configured allowable time to torque seat in the open position.
Close Torque Timer	The "CLOSE TORQUE TIMER" alarm status indicates the unit has exceeded its configured allowable time to torque seat in the close position.
Lost Phase Fault	The "LOST PHASE FAULT" alarm status indicates if one of three motor phases has been detected.
Phase Reverse	The "PHASE REVERSE" alarm status indicates if one of the three motor phases has been reversed.
Encoder Fault	The "ENCODER FAULT" alarm status indicates if the encoder has failed.
Contactor Fault	The "CONTACTOR FAULT" alarm status indicates if there is a contactor failure.
Knob Fault	The "KNOB FAULT" alarm status indicates there is a failure with the black control knob and/or the red selector knob. Activation of the knob fault alarm will prohibit actuator movement.
Menu Knob Fault	The "MENU KNOB FAULT" alarm status indicates the center, rotary menu control knob has failed. Activation of the menu knob fault alarm will not prevent actuator movement.
HC Memory Fault	The "HC MEMORY FAULT" alarm status indicates the host controller memory has failed.
UI Memory Fault	The "UI MEMORY FAULT" alarm status indicates the user interface memory has failed.
Analog IN 0 Lost	The "ANALOG IN 0 LOST" alarm status indicates if a 4-20 mA signal is not detected.
Identical Limits	The "IDENTICAL LIMITS" alarm indicates if the position limits are set adjacent to each other. The actuator will not move until the alarm error is corrected.
HC Comm Loss	The "HC COMM LOSS" alarm indicates the user interface board has lost communication with the host controller board.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
Standard Warnings	The “STANDARD WARNINGS” menu displays standard unit warnings. The Standard Warnings is a live menu, displaying actively updated information. Standard warnings will not prevent movement of the actuator unit if left unresolved. However, warnings left unresolved may lead to component failure and unit alarms, which will prevent movement of the actuator unit.
Encoder Warning	The “ENCODER WARNING” notifies the user the encoder has experienced a glitch. If the glitch persists, it could lead to encoder failure.
HC RTC Battery Low	The “HC RTC BATTERY LOW” warning notifies the user of a low real time clock battery.
RTC Not Set	The “RTC NOT SET” warning notifies the user that the real time clock has not been set.
Rated Starts/ HR Exceeded	The “RATED STARTS/HR EXCEEDED” warning notifies the user that the motor has exceeded the number of acceptable starts per hour. The Rated Starts/HR is set per the actuator requirements at the factory but may be reconfigured. Contact Limitorque Customer Service for assistance.
Rated Vibration Exceeded	The “RATED VIBRATION EXCEEDED” warning notifies the user that the unit has experienced vibrations above the actuator rated level. (3g over 3 seconds)
Bluetooth Failed	The “BLUETOOTH FAILED” warning notifies the user that the Bluetooth module has failed.
Rated VIB Exceeded Details	The “RATED VIB EXCEEDED DETAILS” provides the user with information about vibrations above the accepted actuator rated level (3g over 3 seconds). The details include information about the date, time, start and end points, occurrence count, deviation value and the max acceptance level.
Actuation	The “ACTUATION” screen provides the user with live status information about the actuator. The detailed information includes position, analog in 0 status, demand status, percent torque, and the internal and motor temperatures.
Open Final Position	The “OPEN FINAL POSITION” status information page displays the last open seat date, time and deviation from the defined seat reference.
Close Final Position	The “CLOSE FINAL POSITION” status information page displays the last close seat date, time and deviation from the defined seat reference.
Operational	The “OPERATIONAL” menu displays general operational status information. The status will appear as either active or not active.
Opened	The “OPENED” status indicates if the actuator is open.
Closed	The “CLOSED” status indicates if the actuator is closed.
Stopped Midtravel	The “STOPPED MIDTRAVEL” status indicates if the actuator has stopped midtravel.
Manual Operation	The “MANUAL OPERATION” status indicates if the actuator detects movement by the handwheel. This event is cleared through a local or remote movement command.
Open Limit Switch	The “OPEN LIMIT SWITCH” status indicates if the open limit switch has been activated.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
Close Limit Switch	The “CLOSE LIMIT SWITCH” status indicates if the close limit switch has been activated.
Open Torque Switch	The “OPEN TORQUE SWITCH” status indicates if the open torque switch has been activated.
Close Torque Switch	The “CLOSE TORQUE SWITCH” status indicates if the close torque switch has been activated.
Network ESD	The “NETWORK ESD” status indicates if the actuator has received a network emergency shutdown command and entered a shutdown state.
Local ESD	The “LOCAL ESD” status indicates if the actuator has received a local emergency shutdown command and entered a shutdown state.
Open Inhibit	The “OPEN INHIBIT” status indicates if a digital input, open inhibit signal is active.
Close Inhibit	The “CLOSE INHIBIT” status indicates if a digital input, close inhibit signal is active.
Knob Lockout	The “KNOB LOCKOUT” status indicates if the knob lockout function has been activated and the knobs are inaccessible. **Note:** The “KNOB LOCKOUT” option is a custom input option and only available if purchased.
Digital Inputs	The “DIGITAL INPUTS” menu displays the user-defined digital input functions and the live status of the functions as active or not active. The functions of each input can be standard open/stop/close with user-configurable options or custom, depending on configuration. Refer to Limitorque MX Series B Electronic Actuator user instructions for information about wiring and available function options. **Note:** The “ANALOG OUTPUTS” menu is only visible if the user has purchased an analog out board.
Digital Outputs	The “DIGITAL OUTPUTS” menu displays the user defined digital output functions and the live status of the functions as active or not active. Four status (S) contacts and four optional alarm contacts (R) are available for configure. Refer to Limitorque MX Series B Electronic Actuator user instructions for information about wiring and available digital output contact options. **Note:** The “ANALOG INPUTS” menu is only visible if the user has purchased the modulating option.
Analog Input	The “ANALOG INPUT” menu displays live and static data about the status of the 4-20 mA current controlled analog input functions.
Analog In 0	The “ANALOG IN 0” displays the status of the analog input board as enabled or disabled.
Demand	“DEMAND” displays the percent demand as observed and calculated by the analog input circuitry.
Position	The “POSITION” displays the current percent position of the actuator.
Hunting Indicator	The “HUNTING INDICATOR” is a user-configurable alarm that notifies the user when the actuator is hunting and unable to reach a command position.
Proportional Band	“PROPORTIONAL BAND” displays the user-configured percent range where the actuator will begin to pulse or slow toward its demand position. Proportional Band is set by default to 5.0%. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about configuring the actuator proportional band.
Deadband	“DEADBAND” displays the user-configured deadband setting. Deadband is set by default to 2.0%. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about configuring the actuator deadband.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
Analog Outputs	The “ANALOG OUTPUTS” menu displays live and static data about the status of the analog output function options APT polarity and/or ATT polarity. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about configuring the actuator analog outputs.
ANLG# IO BRD	“ANLG# IO BRD” notifies the user if an analog output board is present and enabled or disabled.
AO# Function	“AO# FUNCTION” displays the function assigned by the user to analog output #. The user can assign the analog output APT polarity and provide a 4-20 mA feedback signal proportional to the valve position. Or the user can assign the analog output ATT polarity and provide a 4-20 mA proportional to the actuator output torque.
Analog Out#	“ANALOG OUT#” displays the live data associated with the user-assigned function displayed in AO# Function.
AO# Loss	“AO# LOSS” notifies the user the analog output board driver chip is reporting a fault, resulting in a loss of analog output signal. This fault forces an analog board reset on a continuous cyclic basis until the fault is cleared. **Note:** If two analog output boards are installed, the reset affects both boards.
Network	The “NETWORK” menu displays status information about the applicable communication network such as configuration, board status and communications status. **Note:** The “NETWORK” menu is only visible if the user has purchased a network card.
Two Speed Timers	The “TWO SPEED TIMERS” menu displays live and static information about the Two Speed timer option. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about the Two Speed timer functionality. **Note:** The “TWO SPEED TIMERS” menu is only visible if the user has purchased the option.
Position	The “POSITION” displays the live actuator percent open position.
Close Timer	The “CLOSE TIMER” displays if the user has enabled the 2 speed timer to function in the close direction.
Inside Close Band	The “INSIDE CLOSE BAND” displays if the unit is within the configured close position band.
Start Position	The “START POSITION” displays the user-defined setpoint position at which the actuator motor will begin pulsing. The default close start position is 10%. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the close start position.
Stop Position	The “STOP POSITION” displays the user setpoint position at which the actuator motor will stop pulsing. The default close stop position is 0%. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the close stop position.
Pulse On Time	The “PULSE ON TIME” displays the user set pulse on duration during actuator closing. The default close pulse on time is 2.0 seconds. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the close pulse on time duration.
Pulse Off Time	The “PULSE OFF TIME” displays the user set pulse off duration during actuator closing. The default close pulse off time is 1.0 second. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the close pulse off time duration.
Open Timer	The “OPEN TIMER” displays if the user has enabled the 2 speed timer to function in the open direction.
Inside Open Band	The “INSIDE OPEN BAND” displays if the unit is within the configured open position band.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
Start Position	The “START POSITION” displays the user-defined setpoint position at which the actuator motor will begin pulsing. The default open start position is 90%. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the open start position.
Stop Position	The “STOP POSITION” displays the user setpoint position at which the actuator motor will stop pulsing. The default open stop position is 100%. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the open stop position.
Pulse On Time	The “PULSE ON TIME” displays the user set pulse on duration during actuator opening. The default open pulse on time is 2.0 seconds. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the open pulse on time duration.
Pulse Off Time	The “PULSE OFF TIME” displays the user set pulse off duration during actuator opening. The default open pulse off time is 1.0 second. Refer to Limitorque MX Series B Electronic Actuator user instructions for more information about setting the open pulse off time duration.
Partial Stroke Test	The “PARTIAL STROKE TEST” (PST) menu displays the results of a stroke test.
PST	“PST” displays the state of the stroke test.
PST Results	“PST RESULTS” displays the pass or fail result of the last PST.
Failure Reason	“FAILURE REASON” displays the cause of the PST failure.
PST Target	“PST TARGET” displays the percent open target the actuator needed to meet to pass the PST.
Position	“POSITION” displays the current actuator percent open position.
PST Start Position	“PST START POSITION” displays the user-defined test start position.
Deadband	“DEADBAND” displays the user-defined deadband percent value. The default deadband is 2.0%. Refer to Limitorque MX Series B Electronic Actuator user instructions for information about adjusting the deadband percent value.
Proportional Band	“PROPORTIONAL BAND” displays the user-configured percent range where the actuator will begin to pulse or slow toward its demand position. The default proportional band value is 5.0% The proportional band can be modified by accessing the “DIGITAL INPUTS” menu, “MODUTRONIC” menu, or the “ACTUATORS INSTALLED NETWORK” menu. Refer to Limitorque MX Series B Electronic Actuator user instructions for additional information about adjusting the proportional band percent value.
Real Time Clock	“THE REAL TIME CLOCK” (RTC) menu displays live date, time and battery level information. It also displays time zone offset, the active/deactive low battery alarm status and if the RTC has been set.
Hardware	The “HARDWARE” menu displays the live OK/Fault status of various components and software boards. Components will not display if they have not been incorporated into the unit.
Motor Status	The “MOTOR STATUS” menu displays the live phase rotation status and motor temperature.
Power Supply	The “POWER SUPPLY” menu displays the live minimum and maximum recorded voltage, the current power supply voltage and the power supply frequency.
Bluetooth	The “BLUETOOTH” screen displays details about the Bluetooth connection.
Identification	The “IDENTIFICATION” menu displays information about the actuator unit, firmware and software. Displayed information will be dependent on unit type.
QA Data	The “QA DATA” menu displays the quality assurance test date, time and stamp.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
ANALYTICS	
Torque	The "TORQUE TRENDS" menu provides access to the actuator open and close torque profile information and open and close torque graphs. Trend graphs are useful for tracking changes in operating conditions.
Open Profile	The "OPEN" and "CLOSE PROFILE" screens display the most recent and saved reference information about the actuator torque profile, such as breakout torque, ending torque and peak running torque. The torque profile is helpful for tracking changes in the process conditions.
Close Profile	
Open Torque Graph	The "OPEN" and "CLOSE TORQUE GRAPH" screens display the most recent and saved reference torque graphs, as well as the option to save a graph as a reference. Available torque graphs for view include max torque vs. position, min torque vs. position, average torque vs. position and LTA torque vs. position.
Close Torque Graph	
Save Open Ref	The "SAVE OPEN" and "CLOSE REF" options allow the user to save the latest torque profile and graph as the reference. A newly saved reference will replace an existing reference.
Save Close Ref	
Position	The "POSITION TREND" menu provides access to the actuator open and close motor and position information and graphs. Trend graphs are useful for tracking changes in operating conditions. **Note:** The position reference must be saved to accurately use this data.
Open Motor On Time	The "OPEN" and "CLOSE MOTOR ON TIME" screens display cumulative data of the motor on time vs. position as a histogram chart. Each histogram X axis point equals 10% of stroke.
Close Motor On Time	
Open Starts/Hour	The "OPEN" and "CLOSE STARTS/HOUR" screens display cumulative data of the number of motor starts per hour vs. position as a histogram chart. Each histogram X axis point equals 10% of stroke.
Close Starts/Hour	
Open Final Position	The "OPEN" and "CLOSE FINAL POSITION" screens display the average, maximum or minimum final position vs. time, over a user-defined range of time. Optional time scales include 24 hours, 30 days, 12 months or 10 years.
Close Final Position	
Vibration Trend	The "VIBRATION TREND" menu provides access to vibration data graphs. Trend graphs are useful for tracking changes in operating conditions.
Vibration vs. Time	The "VIBRATION VS. TIME" menu provides access to the max vibration vs. time and average vibration vs. time graphs. Vibration vs. time graphs may be viewed with a time scale of 24 hours, 30 days, 12 months or 10 years.
Vib vs. Open Pos	The "VIB VS. POS" menu provides access to the vibration vs. position last run and summary run graphs. The last run graphs consist of the max, min and average vibration vs. opening position with a time scale of the last run of stroke. The summary run graphs consist of the max, min and average vibration vs. position with a time scale from last system reboot to present. The "VIB VS. POS" menu also provides the ability to save last run and summary graphs as reference graphs. Note, the save reference graph function will save the max, min and average graph for reference.
Vib vs. Close Pos	
Elapsed Time vs. Vib	The "ELAPSED TIME VS. VIB" screen displays cumulative data of the high or low vibration range over time as a histogram chart. The high range vibration data will display as five histogram X-axis points at 3,200 mG each. The low range vibration data will display as 10 histogram X-axis points at 400 mG each.
Motor Temp	The "MOTOR TEMP" screen displays a graph of motor temperature over time. The motor temp vs. time graph may be viewed with a time scale of 24 hours, 30 days, 12 months or 10 years. Trend graphs are useful for tracking changes in operating conditions.
Internal Temp	The "INTERNAL TEMP" screen displays a graph of internal temperature over time. The internal temp vs. time graph may be viewed with a time scale of 24 hours, 30 days, 12 months or 10 years. Trend graphs are useful for tracking changes in operating conditions.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
LOGS	
Event Log	The “EVENT LOG” displays time and date stamped details about maintenance, out of spec, check function and failure events. The events displayed in the log can be configured though the Event Log Categories screen.
Actuator Log	The “ACTUATOR LOG” displays time and date stamped details about actuator commands, position and movement.
Motor Temp	The “MOTOR TEMP” displays time and date stamped details about the average, max and min motor temperatures.
Internal Temp	The “INTERNAL TEMP” displays time and date stamped details about the average, max and min internal temperatures.
Open Torque	The “OPEN TORQUE” displays time and date stamped details about the average, max and high torque indicators experienced while the actuator was opening.
Close Torque	The “CLOSE TORQUE” displays time and date stamped details about the average, max and high torque indicators experienced while the actuator was closing.
Starts/Hr HI	The “STARTS/HR HI” displays time and date stamped details about the number of times the actuator has exceeded the configured motor starts/hr hi setting.
Rated Starts/Hr	The “RATED STARTS/HR” displays time and date stamped details about the number of times the actuator has exceeded the starts/hr unit rating.
Operation	The “OPERATION” displays details about the motor and drive sleeve operation, stroke time and vibration experienced by the unit.
Trips	The “TRIPS” displays time and date stamped information about the actuator seating in the open and closed direction and the torque to seat.
Power Supply	The “POWER SUPPLY” displays time and date stamped information about the max and min voltage and frequency of the power supply.
Service Log	The “SERVICE LOG” displays the last date and time the actuator was serviced. It also provides the user the ability to set the last service date. **Note:** The last service date and time must be set by the user. It is highly recommended to set the last service date for tracking trends and for reference.
Bluetooth Log	The “BLUETOOTH LOG” displays the time and date a Bluetooth-compatible device was connected or disconnected from the actuator.
PST Log	The “PST LOG” displays time and date stamped information about performed partial stroke tests. It also provides access to the graphed max, min, average and long-term average torque recorded during the PST.
Set Real Time Clock	The “SET REAL TIME CLOCK” allows the user to view and set the real time clock details.

7.7 Diagnostic descriptions — Continued

Menu Feature	Description
USER INDICATORS	
Set Levels	The “SET LEVELS” menu allows the user to define indicator notification conditions for open and close torque, open and close final position, open and close speed, vibration and the service indicators.
Open Torque	The “OPEN” and “CLOSE TORQUE” indicator menus allow the user to customize alarms to notify when the torque to open or close the actuator has exceeded an allowed deviation above or below a defined torque value.
Close Torque	
Open Final Pos	The “OPEN” and “CLOSE FINAL POSITION” indicator menus allow the user to customize alarms to notify when the final seat position has deviated from the saved final seat position. Position deviation values are shown in units of drive sleeve turns. The final seat position must also be saved from the open and close final position menus.
Close Final Pos	
Vibration	The “VIBRATION” indicator menus allow the user to customize alarms to notify when a vibration experienced by the actuator has deviated from an accepted value, or when a vibration experienced by the actuator has exceeded an accepted settle time.
Service Indicators	The “SERVICE INDICATORS” menus allow the user to customize alarms to notify when the motor temperature, starts/hr, drive sleeve turns, motor starts in the open and close directions, service interval and modulating setpoint hunting have exceeded an accepted value.
Enable Indicators	The “ENABLE INDICATORS” menu allows the user to select which indicators are active.
View Indicators	The “VIEW INDICATORS” menus allow the user to view time and date stamped details about the active indicators.
Clear User Indicators	The “CLEAR USER INDICATORS” option allows the user to clear all unit-recorded indicators. **Note:** This must be done locally each time there is a user indicator trip in order to ensure the failed condition is properly analyzed and acknowledged.

8 Maintenance

Under normal operating conditions, the MX 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 LMENIM2314, MX Actuator 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 LMENIM2314, MX Actuator Maintenance and Spare Parts.

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

8.1 Lubrication

MX actuators are oil-filled as standard, using Mobil SHC 632. Exxon Teresstic SHP 320 may be used as a direct substitute. These products are synthetic machine oils suitable for ambient temperatures of -30°C to 120°C (-20°F to 250°F). For extreme low-temperature conditions (< -30°C to -60°C; < -22°F to -76°F), an alternative lubricant is available: Petro Canada TRAXON Synthetic 75W-90 with TOS. Consult factory for arctic temperature applications.

8.1.1 Oil capacities

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

- MX-05 actuator – 256 ml (10 oz.)
- MX-10 actuator – 0.6 liters (21 oz.)
- MX-20 actuator – 1.4 liters (48 oz.)
- MX-40 actuator – 1.9 liters (65 oz.)
- MX-85 actuator – 5.7 liters (192 oz.)
- MX-140 actuator– 5.7 liters (192 oz.)
- MX-150 actuator– 5.7 liters (192 oz.)

8.1.2 Checking oil level

To check the level:

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

9 Troubleshooting

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 display 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).

9.1 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

9.2 Troubleshooting problems/ Corrective action

Refer to MX Actuator 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.

1. Switch off the main three-phase power supply and 24VDC backup 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 the main power supply.
5. Measure VAC at 23, 24 — should be 110 VAC if actuator is supplied with optional 110VAC circuit. If no power, check fuses FS1, FS2 and FS3. Replace if necessary. If replacing fuses does not fix the problem, replace damaged board. Contact Flowserve at 434-528-4400.

Fuse Designator	MXb 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 — should be 24 VDC, maximum power of 5 W. If not, replace damaged board. Contact Flowserve at 434-528-4400.
7. Replace the control compartment cover (ACP).

9.2.1 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 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.

9.2.2 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 3.5.4, 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.

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.

9.2.3 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.

9.2.4 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.

9.2.5 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" – 4-20mA 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, R1R4RM IO BOARD" – R1 to R4 board relay check failed
- "---% 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

RAM error

The MX 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 MX 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.

10 Regulatory Information

10.1 Product information

Materials of construction

Terminal and control covers: Aluminum

CS station: Aluminum

Nameplate: Stainless steel

Housing: Aluminum

Window: Fully tempered soda lime float glass

Airborne noise

EN 21680/ISO 1680

Manufacturer's name

Limitorque, a unit of Flowserve USA Inc.

Manufacturer's address

5114 Woodall Road

Lynchburg, VA 24502 USA

Importer's name

Flowserve S.r.l.

Importer's address

Via. Rio Vallone 17

20883 Mezzago (MB) Italy

Type and description of equipment

Valve actuators

Model numbers

MXb-05, -10, -20,-40, -85, -140, -150 actuators

MX actuator series note: Tested with Limitorque products only and with standards applicable at time of tests.

Table 10.1: Electromagnetic compatibility (EMC) and electromagnetic interference (EMI) standards to which the three-phase AC MX actuator complies

Applicable Emissions Standards	EN 301489-1:2017 / EN 301489-17:2016 and EN 61326-1:2013 Class A		
	Method	Level	
Radiated Emissions	EN 55032:2015 / EN 55011:2009, A1:2010 FCC Part 15 (10/2014)	30 to 230 MHz	40 dB µV/m
		230 MHz to 1 GHz	47 dB µV/m
Conducted Emissions	EN 55032:2015 / EN 55011:2009, A1:2010 /FCC Part 15 (10/2014)	0.15 to 0.5 MHz	79 dB µV (quasi-pk) 66 dB µV (average)
		0.5 MHz to 30 MHz	73 dB µV (quasi-pk) 60 dB µV (average)
Electrostatic Discharge	EN 61000-4-2:2009	Contact: Direct	±1 kV, ±2 kV, ±4 kV
		Air	±2 kV, ±4 kV, ±8 kV
		Contact: Indirect	±1 kV, ±2 kV, ±4 kV
Radiated RF Susceptibility	EN 61000-4-3:2006, A2:2010	80 MHz to 1.0 GHz 1.0 to 6.0 GHz	10 Vrms/m @ 80% AM, 1 kHz 3 Vrms/m @ 80% AM, 1 kHz
Electrical Fast Transient/Burst	EN 61000-4-4:2012 / EN 61000-4-4:2004, A1:2010	CDN injection	±2 kV (5/50 ns @ 5 kHz)
		Clamp injection	±1 kV (5/50 ns @ 5 kHz)
Voltage Surge	EN 61000-4-5:2006	Differential mode	±1 kV @ 1.2/50 µs (Line-Line)
		Common mode	±2 kV @ 1.2/50 µs (Line-Ground)
		Common mode	±1 kV @ 1.2/50 µs (Line-Ground)
Conducted RF Immunity Magnetic Immunity	EN 61000-4-6:2009 EN 61000-4-8:2010	150 kHz to 80 MHz Three mounting axes: X, Y, Z; 60-second dwell	3 Vrms @ 80% AM, 1 kHz 30 A/m @ 50 Hz
			30 A/m @ 60 Hz
Voltage Dips and Interrupts	EN 61000-4-11:2004	3x dips @ 10 seconds	100% dip for 1 cycle
			100% dip for 0.5 cycle
			60% dip for 10 cycles (200 ms)
			30% dip for 25 cycles (500 ms)
			100% interrupt for 250 cycles (5 sec)

10.2 EU declaration of conformity

Application of Council Directive(s)

2014/30/EU; EMC Directive
2006/42/EC; Machinery Directive
2014/34/EU; ATEX Directive
2014/35/EU: Low Voltage Directive
2014/53/EU: Radio Equipment Directive

Standards to Which Conformity Is Declared
ATEX Harmonized Standards

EN IEC 60079-0:2018
EN 60079-1:2014
EN 60079-7:2015 + A1:2018
EN 60079-31:2014
EN ISO 80079-36:2016
EN ISO 80079-37:2016
EN 60529:1991+A1:200+A2:2013

IEC Standards

IEC 60079-0:2017
IEC 60079-1:2014
IEC 60079-7:2015 + A1:2017
IEC 60079-31:2013

Machinery Low Voltage Directive

EN 60204-1:2006+A1:2009

EMC - Emissions and Immunity

EN 301489-1:2017
EN 301489-17:2016
EN 61326-1:2013 Class A

Materials of Construction

Terminal and Control Covers - Aluminum Alloy 380 or 383
CS Station - Aluminum Alloy 319
Nameplate - Stainless Steel
Housing - 356-T6 Aluminum
Window - Heat Tempered Soda Lime Glass

Type and Description of Equipment

Electric Valve Actuators

Actuator Models: MX-05, -10, -20, -40, -85, -140, 150 Series 'B'

(Multi-Turn Products)
MX Series Note: Tested with Limitorque products only and with standards applicable at the time of testing.

Equipment Marking for ATEX

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
FM16ATEX0017X
II 2 G Ex db h IIB T4 Gb
Tamb = -60°C to +65°C; IP66, IP68
Note: Actuators marked with Tamb below -20°C require special construction.

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
FM16ATEX0017X
II 2 G Ex db h IIB (or IIC) T4 Gb
Tamb = -30°C to +65°C; IP66, IP68

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
FM16ATEX0017X
II 2 G Ex db eb h IIB (or IIC) T4 Gb
Tamb = -20°C to +65°C; IP66, IP68

Equipment Marking for IECEx

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
FMG10.0023X
Ex db h IIB T4 Gb
Tamb = -60°C to +65°C; IP66, IP68
Note: Actuators marked with Tamb below -20°C require special construction.

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
FMG10.0023X
Ex db h IIB (or IIC) T4 Gb
Tamb = -30°C to +65°C; IP66, IP68

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
FMG10.0023X
Ex db eb h IIB (or IIC) T4 Gb
Tamb = -20°C to +65°C; IP66, IP68

Notified Body

FM Approvals Europe Limited,
One Georges Quay Plaza
Dublin, Ireland D02 E440
Notified Body Number 2809

EU Type Examination Certificate

FM16ATEX0017X

Manufacturer's Name

Limitorque, A Unit of Flowserve Corporation

Manufacturer's Address

5114 Woodall Rd, Lynchburg, VA 24502 USA

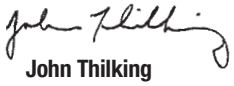
Importer's Name

Flowserve S.r.l.

Importer's Address

Via. Rio Vallone 17, 20883 Mezzago (MB), Italy

I, the undersigned, hereby declare that the equipment specified above conforms to the above standards.



John Thilking
Principal Engineer - Certifications
ATEX/IEC-Ex Authorized Person
Flowserve Limitorque
Date: February 24, 2025
Flowserve Limitorque
5114 Woodall Rd
Lynchburg, VA 24502

10.3 Specific conditions of use (denoted by X after the certificate number) for ATEX and IECEx applications

1. ISO Class 12.9, M8/M10/M16/M20 socket-head cap screws (Yield Stress 1100 MPa) shall be used to replace the terminal, control or motor compartment fasteners.
2. K-500 Monel®, M8 socket-head cap screws (Yield Stress 700 MPa) shall be permitted as an alternative to the ISO Class 12.9 socket-head cap screws on the terminal or control compartments of Group IIB actuators.
3. K-500 Monel, M8 socket-head cap screws (Yield Stress 700 MPa) shall be permitted as an alternative to the ISO Class 12.9 socket-head cap screws on the motor compartments of Group IIB, MX-05/10/20/40 actuators.
4. Stainless steel, A2 or A4, ISO Class 70, M10 socket-head cap screws (Yield Stress 450 MPa) shall be permitted as an alternative to the ISO Class 12.9 socket-head cap screws on MX-85 actuator motor compartments (frame 56 or 180).
5. Stainless steel, A2 or A4, ISO Class 70, M10/M16/M20 socket-head cap screws (Yield Stress 450 MPa) shall be permitted as an alternative to the ISO Class 12.9 socket-head cap screws on MX-140 actuator (180 frame) or MX-150 actuator motor compartments.
6. Consult the manufacturer if dimensional information on the flame-proof joints is necessary.
7. Single-phase Series MX actuators shall not be applied in an explosive dust atmosphere where high electrostatic charging processes are present that could result in propagating brush discharges. See IEC TS60079-32-1 for additional guidance.

10.4 Statement of compliance to applicable European directives

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

MX-05, 10, 20, 40, 85, 140 and 150 electronic valve actuators. The MX actuator is a non-intrusive electronic actuator. It is specifically designed for the purpose of being mounted to multi-turn valves (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 2014/34/EU 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;

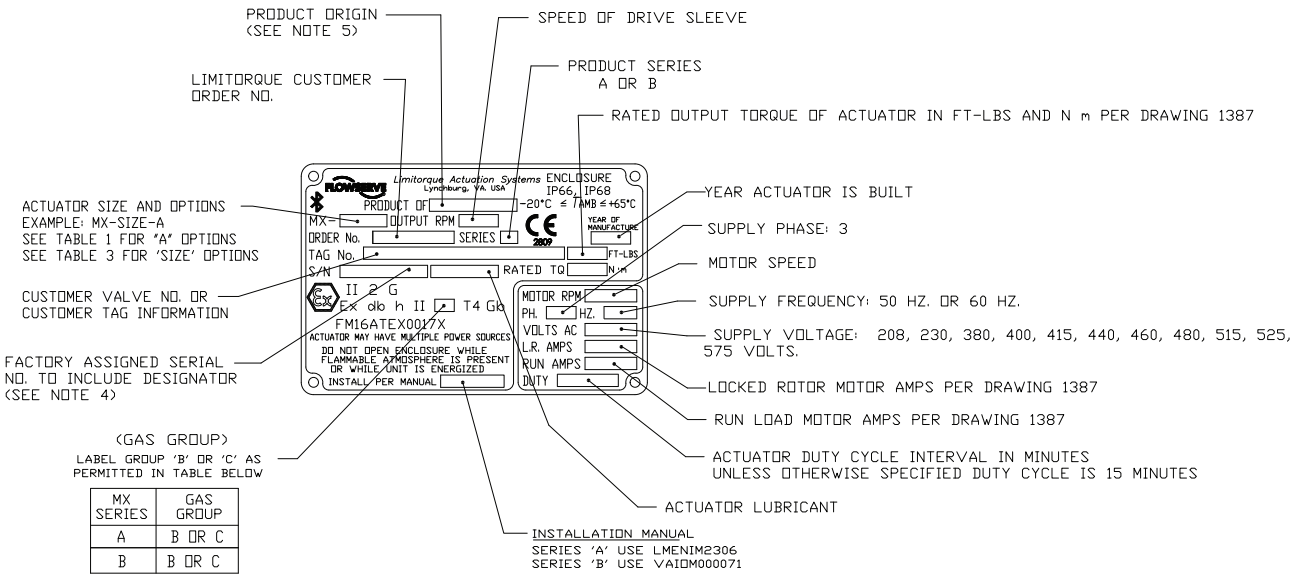
d) Assure that foreseeable conditions of overload shall not give rise to dangerous situations.

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.

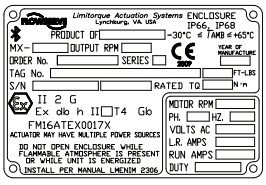
® Monel is a registered trademark of International Nickel Co.

3-Phase MX Series “A” and Series “B” nameplate



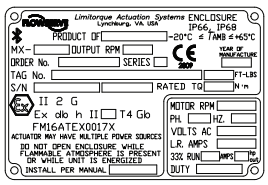
MX SERIES	GAS GROUP
A	B OR C
B	B OR C

DRAWING NUMBER 64-682-0006-56
NOT APPLICABLE FOR INCREASED SAFETY
SERIES A & B



DRAWING NUMBER
64-682-0006-57

-30° IIB OR IIC
NOT APPLICABLE FOR INCREASED SAFETY
SERIES A (IIB ONLY)
& SERIES B (IIB OR IIC)



DRAWING NUMBER
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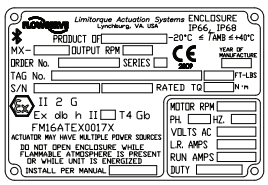
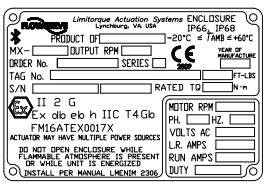
NOT APPLICABLE FOR
INCREASED SAFETY
SERIES A & B



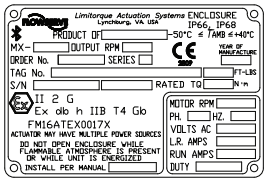
DRAWING NUMBER
64-682-0006-59

SERIES A & B



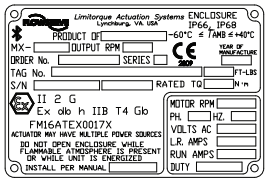
DRAWING NUMBER
64-682-0006-510

INCREASED SAFETY IIC
SERIES A & B



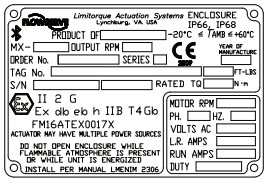
DRAWING NUMBER
64-682-0006-511

-50°C IIB ONLY
SERIES A & B



DRAWING NUMBER
64-682-0006-512

-60°C IIB ONLY
SERIES A & B



DRAWING NUMBER
64-682-0006-513

INCREASED SAFETY IIB
SERIES A & B

TABLE 1

A	DESCRIPTION
5	NO OPTIONS
6	NETWORK BOARD
7	I/O BOARD
8	NETWORK AND I/O BOARD
9	INCREASED SAFETY NO OPTIONAL BOARDS
10	INCREASED SAFETY NETWORK BOARD
11	INCREASED SAFETY I/O BOARD
12	INCREASED SAFETY NETWORK AND I/O BOARD

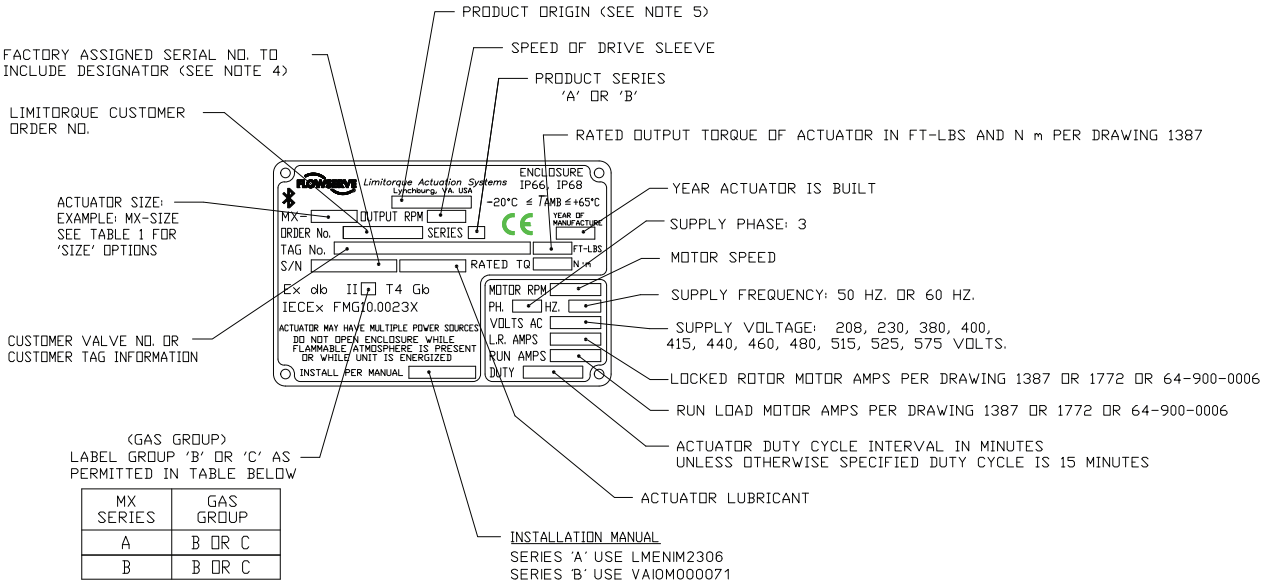
Notes:
1. The transformer design can be determined from the supply voltage.
2. The motor design can be determined from the supply voltage, rated torque and output speed.
3. Routine hydrostatic testing may be required. See EIP 400.
4. Refer to EIP-490 for serial number designator and authorized factories.
5. Country of origin marketing to state “product of” and the country in which the nameplate is applied to the product. For example, for nameplates applied within the U.S.A., country of origin to state “Product of U.S.A.”

TABLE 3

SIZE
05
10
20
40
85
140
150

3-Phase MX Series “A” and Series “B” nameplates

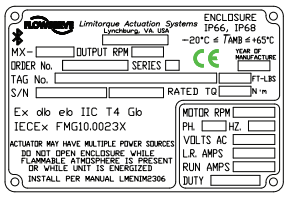
Nameplate, IECEx 3-Phase, M-All



MX SERIES	GAS GROUP
A	B OR C
B	B OR C

DRAWING NUMBER 64-682-0032-01

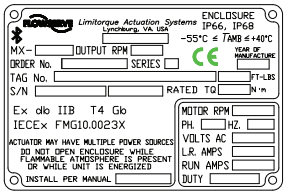
SERIES 'A' AND SERIES 'B'



DRAWING NUMBER 64-682-0032-02

INCREASED SAFETY IIC NAMEPLATE

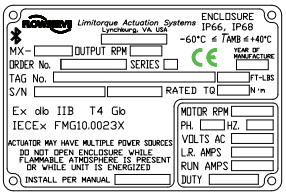
SERIES 'A' AND SERIES 'B'



DRAWING NUMBER 64-682-0032-03

INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE

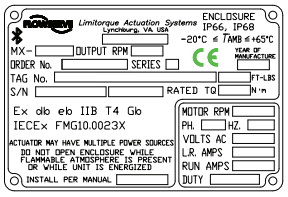
SERIES 'A' AND SERIES 'B'



DRAWING NUMBER 64-682-0032-04

INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE

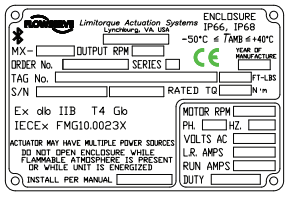
SERIES 'A' AND SERIES 'B'



DRAWING NUMBER 64-682-0032-05

INCREASED SAFETY IIB NAMEPLATE

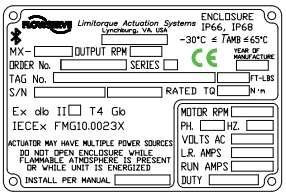
SERIES 'A' AND SERIES 'B'



DRAWING NUMBER 64-682-0032-06

INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE

SERIES 'A' AND SERIES 'B'



DRAWING NUMBER 64-682-0032-07

INCREASED SAFETY NOT APPLICABLE FOR THIS NAMEPLATE

SERIES 'A' (IIB ONLY) AND SERIES 'B' (IIB OR IIC)

REVISION STATUS CHART			
SHEET	1	2	3
REVISION	B	-	-
REVISION	C	C	-
REVISION	D	D	-
REVISION	E	E	-
REVISION	F	F	-
REVISION	G	G	-
REVISION	H	H	-
REVISION	J	H	-
REVISION	K	K	-
REVISION	L	L	-
REVISION	M	M	-
REVISION	N	N	-
REVISION	P	P	P
REVISION	R	R	R

TABLE 1

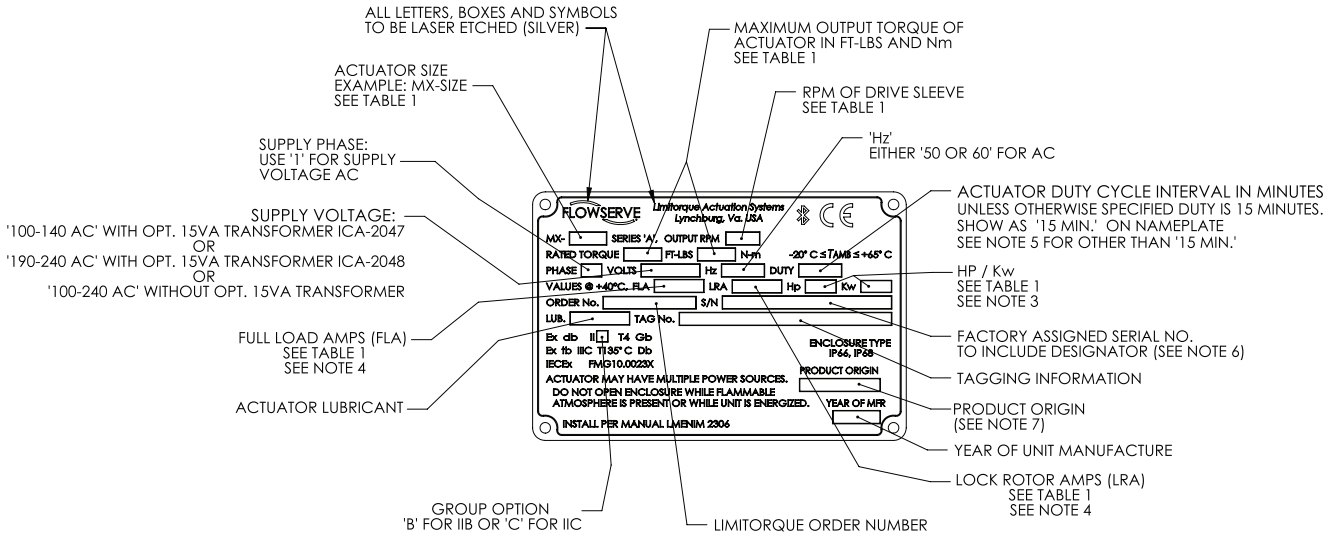
SIZE
05
10
20
40
85
140
150

Notes:

1. The transformer design can be determined from the supply voltage.
2. The motor design can be determined from the supply voltage, rated torque and output speed.
3. Routine hydrostatic testing may be required. See drawing 01-602-1170, 01-602-1171 and 01-602-1172.
4. Refer to EIP-490 for serial number designator and authorized factories.
5. Country of origin marketing to state “product of” and the country in which the nameplate is applied to the product. For example, for nameplates applied within the U.S.A., country of origin to state “Product of U.S.A.”

Nameplate, IECEx gas groups

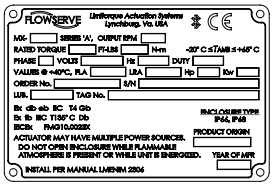
MX Series A, single-phase
Dwg. no: 64-682-0032, Rev. R



DRAWING NUMBER 64-682-0032-11

IECEx -20°C TO +65°C
GROUPS IIB (OR IIC) / IIIC

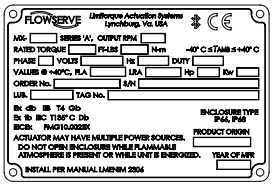
INCREASED SAFETY NOT APPLICABLE FOR THIS NAMEPLATE



DRAWING NUMBER 64-682-0032-12

IECEx -20°C TO +65°C
GROUPS IIC / IIIC

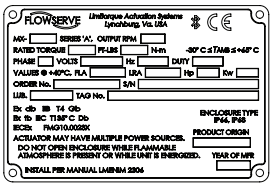
INCREASED SAFETY



DRAWING NUMBER 64-682-0032-13

IECEx -40°C TO +40°C
GROUPS IIB / IIIC

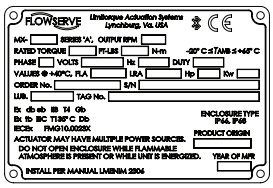
INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE



DRAWING NUMBER 64-682-0032-14

IECEx -30°C TO +65°C
GROUPS IIB / IIIC

INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE



DRAWING NUMBER 64-682-0032-15

IECEx -20°C TO +65°C
GROUPS IIB / IIIC

INCREASED SAFETY

Notes:
1. Nameplate per this sheet is required on all MXa XP IECEx single-phase products per 01-602-1170 or 01-602-1171.
2. Alternate nameplate material is 316 or 304 SS with a brushed or satin surface finish. Lettering is laser-etched silver.
3. kW and HP is output at motor.
4. Nameplate labeling for full load amps must be labeled as shown in Table 1.

Examples:
4-1 For an MX-05, 60 Hz, 40 rpm, 100-140 AC unit, full load amps = 5
4-2 For an MX-05, 60 Hz, 40 rpm, 190-240 AC unit, full load amps = 2.8
4-3 For an MX-05, 60 Hz, 40 rpm, 100-240 AC unit, full load amps = 5 - 2.8

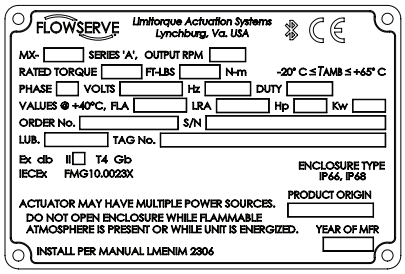
TABLE 1

UNIT SIZE	RPM		RATED FT-LBS (NOMINAL)	RATED N-m (NOMINAL)	FULL LOAD AMPS (FLA) @ +40°C			LOCK ROTOR AMPS (LRA)			HP / Kw @ +40°C
	50 Hz	60 Hz			100-140 VAC	190-240 VAC	100-240 VAC	100-140 VAC	190-240 VAC	100-240 VAC	
05	15	18	55	75	2.8	1.8	2.8 - 1.8	11.8	6.4	11.8 - 6.4	.16 / .12
05	22	26	55	75	3.6	2.1	3.6 - 2.1	15.1	7.9	15.1 - 7.9	.23 / .17
05	33	40	55	75	5	2.8	5 - 2.8	19.6	10.2	19.6 - 10.2	.33 / .25
05	43	52	55	75	6.3	3.4	6.3 - 3.4	23.8	12.5	23.8 - 12.5	.43 / .32
05	65	77	48	65	7.8	4.2	7.8 - 4.2	19.8	11.2	19.8 - 11.2	.56 / .42
05	84	100	39	53	7.7	4.0	7.7 - 4.0	24.3	12.3	24.3 - 12.3	.54 / .40
05	127	155	41	56	11	6	11 - 6	30	17	30 - 17	.86 / .64
05	165	200	34	46	11.3	6	11.3 - 6	28	19	28 - 19	.84 / .63
10	15	18	125	169	5	2.9	5 - 2.9	16	9	16 - 9	.35/ .26
10	22	26	125	169	6.6	3.7	6.6 - 3.7	20.5	11.2	20.5 - 11.2	.47 / .35
10	33	40	125	169	9.5	5.3	9.5 - 5.3	29	16	29 - 16	.68 / .52
10	43	52	125	169	12	6.7	12 - 6.7	30	20	30 - 20	.92 / .69
10	65	77	107	145	13.2	7.5	13.2 - 7.5	30	21	30 - 21	1.1 / .82
10	84	100	89	121	13.1	7.3	13.1 - 7.3	30	19	30 - 19	1.1 / .80
10	127	155	89	121	18	11	18 - 11	30	29	30 - 29	1.6 / 1.23
10	165	200	73	99	19	11	19 - 11	30	30	30 - 30	1.6 / 1.23

5. See MX single-phase sizing chart for other duty cycles.
6. Refer to EIP-490 for serial designator and authorized factories.
7. Country of origin marketing to state “product of” and the country in which the nameplate is applied to the product. For example, for nameplates applied within the U.S.A., country of origin to state “Product of U.S.A.”

Nameplate, IECEx gas groups

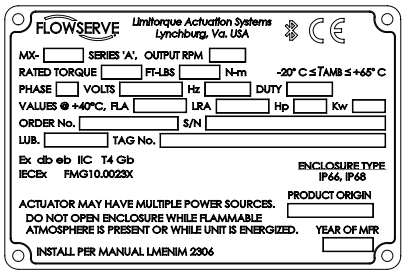
MX Series A, single-phase
Dwg. no: 64-682-0032, Rev. R



DRAWING NUMBER 64-682-0032-21

IECEx -20°C TO +65°C
GROUP IIB (OR IIC)

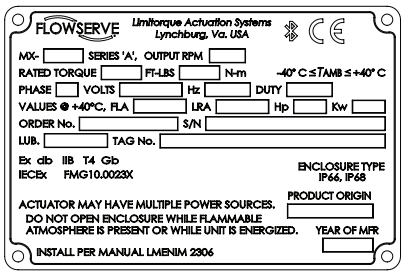
INCREASED SAFETY NOT APPLICABLE FOR THIS NAMEPLATE



DRAWING NUMBER 64-682-0032-22

IECEx -20°C TO +65°C
GROUP IIC

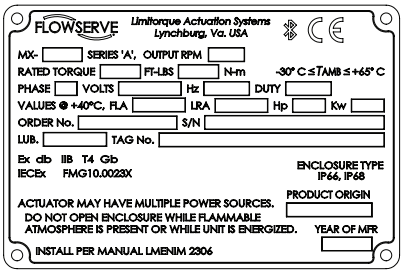
INCREASED SAFETY



DRAWING NUMBER 64-682-0032-23

IECEx -40°C TO +40°C
GROUP IIB

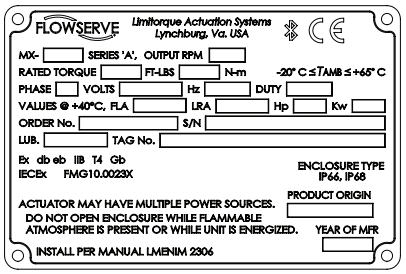
INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE



DRAWING NUMBER 64-682-0032-24

IECEx -30°C TO +65°C
GROUP IIB

INCREASED SAFETY AND IIC NOT APPLICABLE FOR THIS NAMEPLATE



DRAWING NUMBER 64-682-0032-25

IECEx -20°C TO +65°C
GROUP IIB

INCREASED SAFETY

10.5 UKCA declaration of conformity

Application of UK Regulation(s)

UKSI 2016:1107 (as amended)

Standards to Which Conformity Is Declared

EMC - Emissions:

EN 61000-6-3:2007+A1:2011
EN 61000-6-4:2007+A1:2011
EN 55011:2009+A1:2010
EN 61326-1:2013

EMC - Immunity:

EN 61000-6-2:2005
EN 61000-6-1:2007

Airborne Noise:

MIL-740-1
EN ISO 1680: 2013 (Ref)

Machinery Low Voltage Directive:

EN 60204-1 2006+A1:2009

Ingress Protection (IP):

EN ISO 60529:1991+A1:2000+A2:2013

EN Standards

EN IEC 60079-0:2018
EN 60079-1:2014
EN 60079-7:2015+A1:2018
EN 60079-31:2014
EN ISO 80079-36:2016
EN ISO 80078-37:2016

Materials of Construction

Terminal and Control Covers- Aluminum Alloy 380 or 383
CS Station- Aluminum Alloy 319
Nameplate- Stainless Steel
Housing- 356-T6 Aluminum
Window- Heat Tempered Soda Lime Glass
Antenna Cover- Polytetraflouroethylene

Type and Description of Equipment

Valve Actuators

Model Numbers

MX-05, -10, -20, -40, -85, -140, 150 (Multi-Turn Products)
MX Series Note: Tested with Limitorque products only and with standards applicable at the time of testing.

Equipment Marking

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
Ex db h IIB T4 Gb
Tamb = -60°C to +65°C; IP66, IP68
Note: Actuators marked with Tamb below -20°C require special construction.

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40
Ex db h IIC T4 Gb
Tamb = -30°C to +65°C; IP66, IP68
Note: Actuators marked with Tamb below -20°C require special construction.

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
Ex db h IIB (or IIC) T4 Gb
Tamb = -20°C to +65°C; IP66, IP68

MX-a Series 'B' (3 Phase) where 'a' = 05, 10, 20, 40, 85, 140, or 150
Ex db eb h IIB (or IIC) T4 Gb
Tamb = -20°C to +65°C; IP66, IP68

Approved Body

FM Approvals Ltd
Voyager Place
Maidenhead
Berkshire, SL6 2PJ
United Kingdom
Approved Body Number 1725

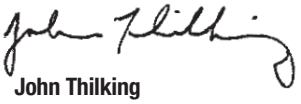
Examination Certificate

FM22UKEX0124X

Manufacturer's Name

Limitorque, A Unit of Flowserve Corporation
Manufacturer's Address
5114 Woodall Rd, Lynchburg, VA 24502 USA

I, the undersigned, hereby declare that the equipment specified above conforms to the above standards.



John Thilking
Senior Engineer - Certification Specialist

ATEX/IEC-Ex Authorized Person
Flowserve Limitorque
Date: December 5, 2022
Flowserve Limitorque
5114 Woodall Rd
Lynchburg, VA 24502

Abbreviations

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

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
Telephone: +1 937 890 5839

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