FLOWSERVE

Limitorque MX

The Next Generation in Smart Multi-turn Actuation

DIAGNOSTICS PORT
BLUETOOTH - OK?

REMOTE
STOP
LOCAL

OPEN
(YES)
(NO)
CLOSE

Limitorque

Experience In Motion

Flowserve Limitorque Actuation Systems

Limitorque is an operating unit of Flowserve, a $5+ billion-a-year company strongly focused on automation and support of the valve industry. Flowserve is the world's premier provider of flow management services.

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

- cost savings from field devices such as electric valve actuators.

- greater operating efficiencies from control room performance sequencing, interlocking, and continuous process optimization.

- competitive advantages derived from increased management visibility of databases and networks.

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

MX – No Batteries Required"

Limitorque MX: smart multi-turn actuator that delivers what you want most — control, ease of use and "no batteries required."

Flowserve Limitorque introduced the MX electronic actuator in 1997 as the first smart actuator that provided uncompromised reliability and performance in a design that was easy to use. The MX innovations which were market firsts – unique absolute encoder that doesn't require battery back-up – Limigard™ technology – easy to use menus in six languages – the use of Hall effect devices to eliminate potentially troublesome reed switches – have been improved. The features Users have come to expect from Flowserve Limitorque are still standard, but the list of improvements and optional equipment permits improved reliability, functional performance and durability. The MX is the smart actuator design that is rigorous and easy to use. It is the only non-intrusive, double-sealed electronic actuator to display the Limitorque brand.
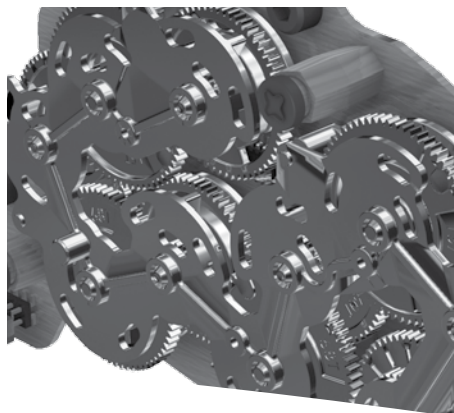
MX: The Next Generation in Smart Actuation

Speed, Precision and Simplicity

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

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

Precision is expected in a smart actuator. The MX was the first such device developed with an innovative absolute encoder that doesn't require troublesome and unpredictable battery back-up. Flowserve Limitorque's innovative absolute encoder now offers to 18-bit resolution over 10,000 drive sleeve rotations and is 100% repeatable. It now has BIST (Built In Self Test) enhancements and redundancy.

When a device is designed for BIST, its methodology is such that much of the test functionality is embedded in the device itself. BIST design facilitates a critical component's ability to communicate its actual state for comparison to the expected state. Any deviation from expected values will be reported to the User either local at the actuator's LCD screen or over a network device.

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

Long Life and Protection

Long life is expected in a smart actuator. There are more than 1,000,000 Limitorque actuators installed around the globe, in every conceivable environment. Many have been functioning for over 50 years. Introduced in 1997, the MX is the Flowserve Limitorque smart actuator that inherits Limitorque's legendary longevity.

In order to last a long time in severe environments smart actuators must have unparalleled protection. The MX's IP68 enclosure rating is 15M for 96 hours, regardless of whether the unit is weatherproof or explosionproof. Add other certifications to the list – NEMA 4, 4X, 6 – and the MX is unsurpassed in unit protection.

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

The MX is powder coated using a polyester resin in Blue Streak color, not only for aesthetics, but also for protection in severe corrosive environments.

Quality and Certifications

Flowserve Limitorque is a global leader in quality manufacturing. All Limitorque plants are certified to ISO 9001 standards, the recognized benchmark for quality all over the world. The same unexcelled use of certified materials is found in the MX as in Limitorque's naval and nuclear qualified electric actuators. The MX has used synthetic gear oils especially optimized for use with worm gear sets since the first unit was shipped in 1997. It was the first non-intrusive actuator to use rolled worms and electronic controls designed and produced using surface mount technology. A true globally certified device, MX meets all pertinent European Directives including ATEX, EMC, Machinery and Noise and displays the CE mark associated with such compliance.

Anatomy of MX Multi-turn Actuators

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

The reliable MX motor includes Class F insulation and three phase ACV. It is designed specifically for valve actuator service, with a high starting torque and low inertia to reduce valve position overshoot. Class H is standard for the single phase ACV motors and an option for three phase ACV motors.

Motor gear attachment allows the motor to be removed in one assembly for fast, easy inspection, repair, and maintenance.

MX actuators feature a LimiGard™ circuit monitor that is designed for Fail/No-Action protection. LimiGard consists of dedicated circuitry that continually monitors the motor contactor, control relays, internal logic circuits, and external command signals to detect and alarm malfunctions. It now includes BIST for true predictive maintenance.

Plug-in connectors permit quick and easy replacement of components.

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

External connection block has three power terminals, a ground screw, and 54 control screw-type terminals to simplify commissioning and upgrades.

Long-life gear set consists of hardened alloy steel rolled worm and bronze worm gear immersed in an extended-life synthetic gear oil specifically developed for worm gear operation. It is completely bearing-supported.

Ductile iron thrust base is removable from main actuator housing for easier valve installation and maintenance.

High-strength, bronze alloy stem nut is removable for machining to suit the valve stem.

The control chamber includes an electronic control, monitoring, and protection module mounted on steel plate. Plug-in connectors allow fast, error-free removal and replacement of the module.
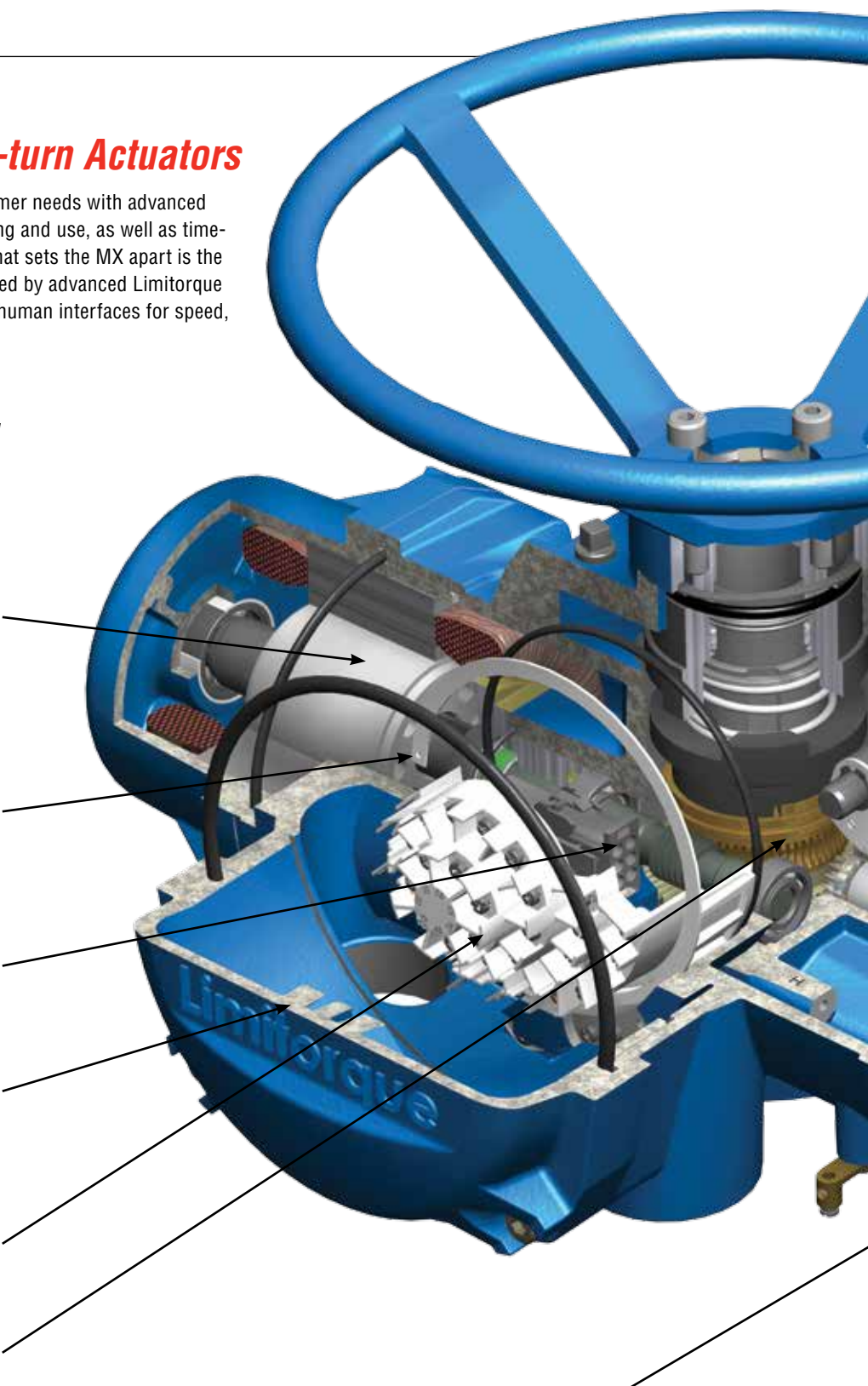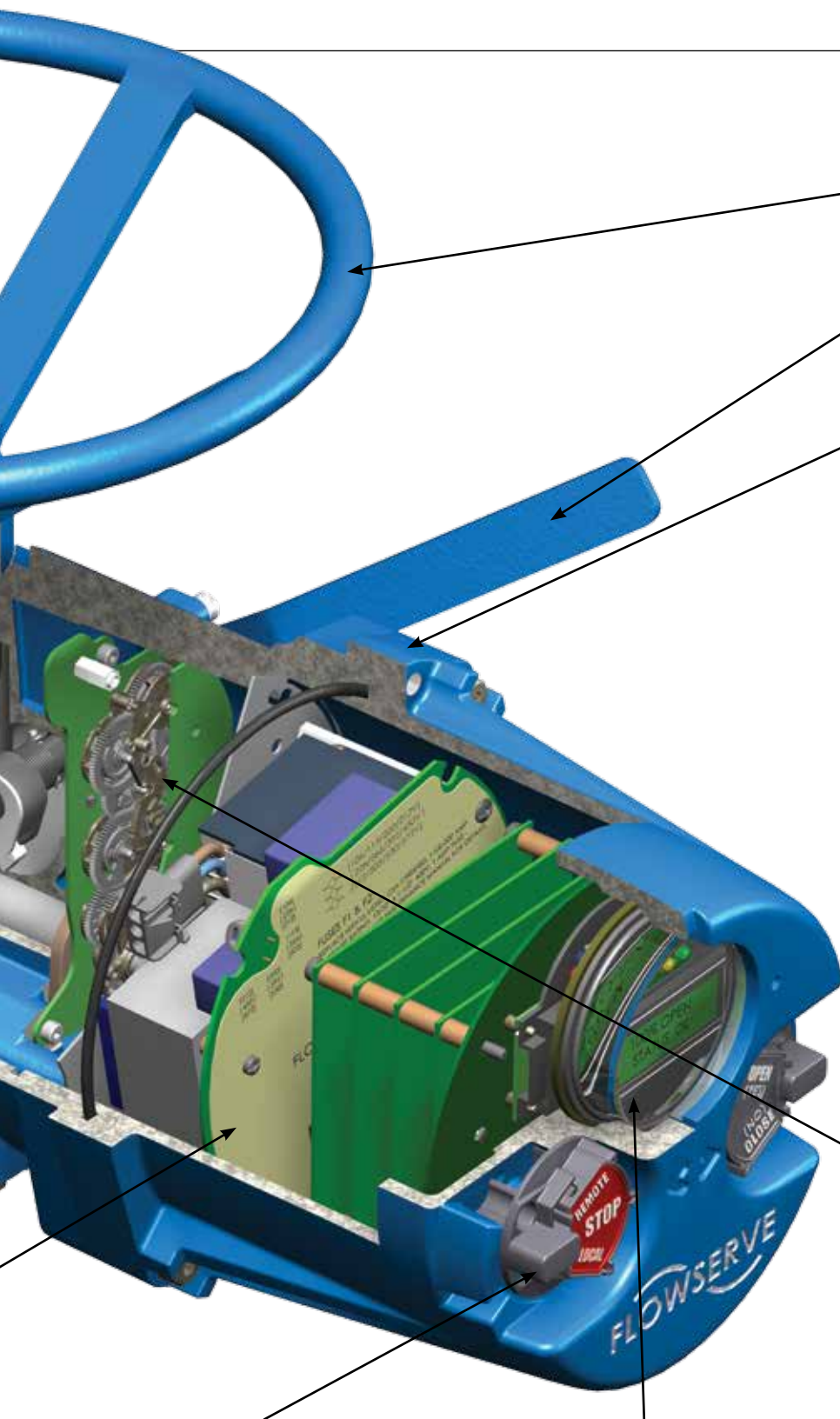
The MX heavy-duty handwheel provides backup for manual operation.

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

Cast aluminum housing powder-coated for extreme environments. Optional coatings are available.

Optionally, controls may be powered from an external 24 VDC source as backup for AC power. Controls and display will remain active through loss of AC power.

Torque sensor derives output from motor speed, temperature, and voltage—and shuts off the motor to protect the actuator and valve if the set torque is exceeded. This method of torque sensing indicates Limitorque's commitment to be fully electronic.

Flowserve Limitorque's uncompromising commitment to "no batteries required" is enhanced with the addition of the optional MX Quik uninterrupted power transfer when mains power is lost to the actuator. MX-Quick powers the S/R contacts for updated status to the control room and also provides limited visibility of the LCD screen. It is configurable for "MX Quik time" and, once main power is restored, is available for the next unforeseen power outage.

The absolute encoder, a key that enables MX actuators to achieve 100% repeatable control, provides optical sensing of valve position with 18-bit resolution. The encoder measures valve position in both motor and handwheel operation. No battery or back-up power supply is required. It is redundant (B.I.S.T.), permitting up to a 50% fault tolerance, ensuring reliable performance in the unlikely event of component failure.

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

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

The MX offers Bluetooth technology as optional which connects, receives, and transmits, up to 10 meters. When used with Flowserve Limitorque's Windows based graphical interface Dashboard™, diagnostic information, can be transferred easily to a PDA, laptop computer or tablet.

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Switch Knob

Magnetic Field

Magnetic Field

Unit "Opens"　　　　**Unit "Off"**

NOTE: Illustration for information only.

Hall effect devices interlocked to prevent operation
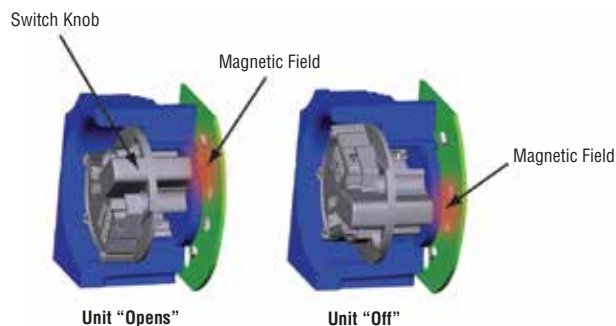
Control & Diagnostics

Control is expected in a smart actuator. The MX is noted for simplifying valve control automation in three critical areas:

- Calibration/set-up
- Normal operation
- Diagnostics & troubleshooting

The MX was the first non-intrusive actuator to equip Users with LCD dialog screens in the language of their choice. MX uses a graphical dot matrix display that improves the visibility of the display. The use of this type of LCD permits the support of any language. In fact, in addition to English, Spanish, German, French, Italian, and Portuguese, the MX now includes five new languages – Mandarin, Russian, Bahasa, Indonesia, Katakana and Turkish – with a capacity for even more. The orientation of the text can be configured to rotate 180° and diagnostic graphs displayed for clearer data collection.

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

Diagnostics should be easy to read and decipher. The MX diagnostic enhancements now offer a BIST (Built In Self Test). The BIST feature is also designed into a state-of-the-art controls platform that verifies and validates the integrity of its components. The result is a design which aids the User in meeting the SIL (Safety Integrity Level) requirements of IEC 61508. Electronic actuators are classified as type B, complex devices or devices containing microprocessors, microcontrollers, and ASICs by IEC 61508. Some electronic actuator manufacturers supply separate hardware devices to bypass their internal microprocessors in order to acquire SIL certification. Flowserve Limitorque's MXa is SIL certified without adding unique hardware modules, meaning that another potential point of failure is removed from the safety system. It is SIL 3 capable in "as built" configuration. In fact, when compared to other actuator providers, the MXa's PFD (Probability of Failure on Demand) is the lowest in the industry for a type B, complex device. The PFD can be improved by regularly exercising the actuator. This is achieved by performing a partial stroke test (PST), which
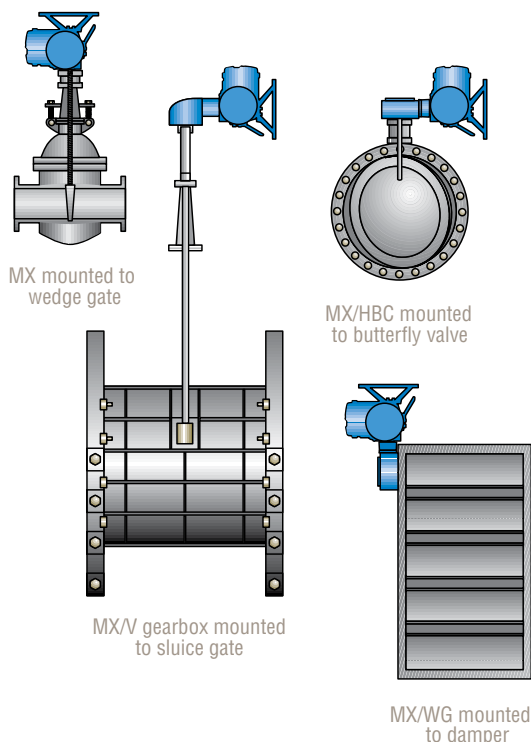
is standard configuration for the MXa. It is highly recommended that a monthly PST be performed to improve the average PFD of the MXa. Please refer to LMENFL2351, MXa SIL Guidance and Certification for additional information.

The MX now offers Bluetooth technology as an option, connecting up to 10 meters. When used with Flowserve Limitorque's Windows based graphical software "interface" Dashboard™, diagnostic information can be transferred easily to a PDA with Windows platform, laptop computer or tablet. In addition, new firmware can be uploaded (IrDA only) and actuator configurations transferred from one device to any number of subsequent actuators.

Conduit entries side and below

Control chamber

Terminal chamber

O-ring seals

Cover
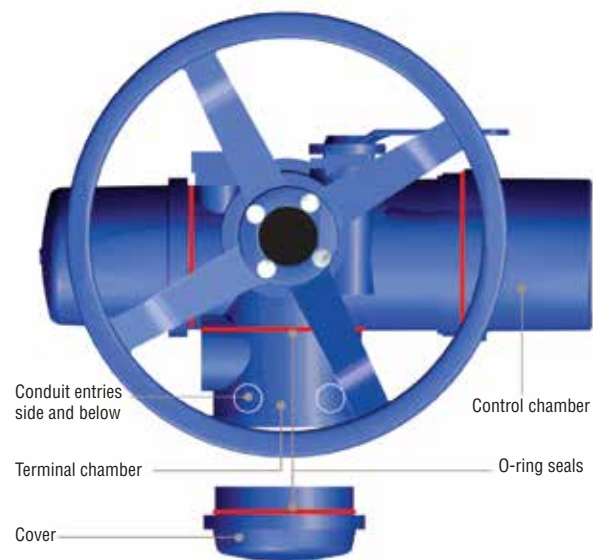
Double-sealed protection from dust and moisture

Nothing exceeds Limitorque MX actuators for ease and compatibility with valves of all types

MX mounted to
wedge gate

MX/HBC mounted
to butterfly valve

MX/V gearbox mounted
to sluice gate

MX/WG mounted
to damper

Valves

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

MX actuators are available in a wide variety of configurations to accommodate various applications and valve designs:

Direct mounting The MX can be directly coupled with valves for torque-only applications. For thrust applications, a separate thrust base is used.

MX/HBC/WG The MX can be coupled to a WG or HBC worm gear reducer for operation of part-turn valves, such as butterflies, balls, plugs, and dampers. This combination provides an output torque capacity of up to 136,000 ft-lb/184,280 N m.

MX/B320/MT/V and SR Rising stem valves may be operated by an MX coupled to a variety of bevel gear and spur gear reducers. Thrusts up to 325,000 lb/1,445 kN and torque up to 12,000 ft-lb/16,320 N m can be accommodated.

Couplings

Thrust actuator drive couplings:

• Type A1 – Alloy bronze (thrust)

• Type A1E – Extended bronze nut

• Linear base - Type LB1 (6700 lbs/30 N) and LB2 (24,400 lbs./109N) for control and choke valve applications (see LMENFL2360, MX and QXM Linear Base for further information).

Torque-only actuator drive couplings:

• Type B4 – Standard steel bushing

• Type B4E – Extended steel bushing

• Type B1 – Large fixed-bore keyway steel bushing (ISO 5210)

• Type BL – Splined steel bushing for rising rotating stem valves

Type A1

Type A1E

Type B1

Type B4

Type LB

Type B4E

Type BL
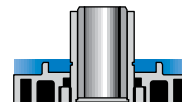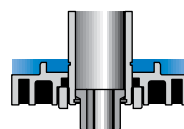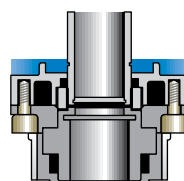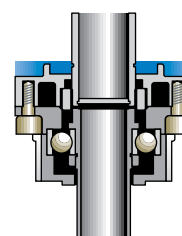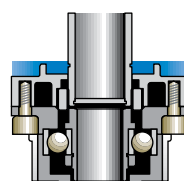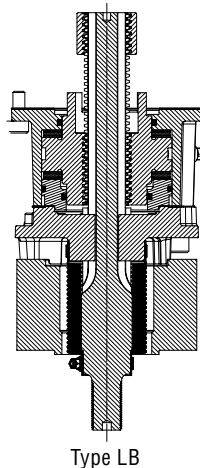
Integrity and Predictable Performance

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

Limigard — now with BIST

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

When LimiGard wiring diagrams are followed, LimiGard continually monitors the control relays, internal logic circuits, and external command signals, comparing them to reference conditions. This virtually eliminates the possibility that an actuator malfunction can occur without prompt detection and alarm communication. In the event of a malfunction, LimiGard takes over and supervises the actuator's response characteristics, maximizing safety and predictability. Fault Insertion Tests confirm this Fail/No-Action philosophy built into every MX actuator.

A state-of-the-art electronic actuator such as the MX should include means for verifying and validating that its components are designed with Built-In-Self-Test (BIST) capabilities. Selecting the MX, which incorporates a high level of BIST, can contribute greatly to the integrity and reliability of process applications and enhance the ability of a safety system to achieve its highest possible SIL rating.
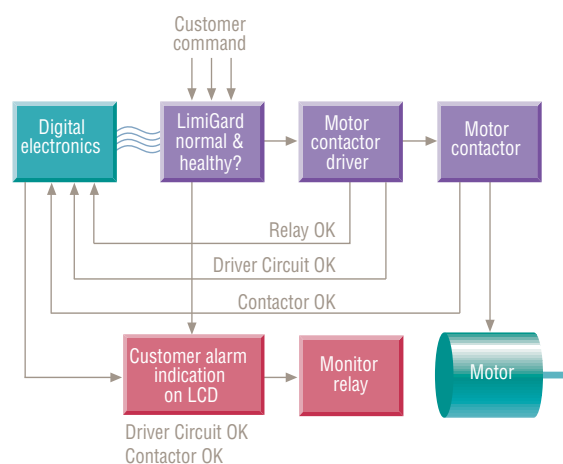
Absolute position encoder

Limitorque was the first electronic actuator supplier to use an absolute encoder which doesn't require battery back-up for positioning. Customers specify absolute encoders for uninterrupted performance and the MX meets customer expectations with an improved, 18-bit optical, 100% repeatable device. Position information is accurate with or without electrical power. The 18 bits also means that the span of the MX encoder is now almost 10x the original – good for ~10,000 drive sleeve rotations. The encoder has redundant circuits ensuring performance even in the event of up to 50% component failure, continuing to provide reliable data while alerting the user to any faults.
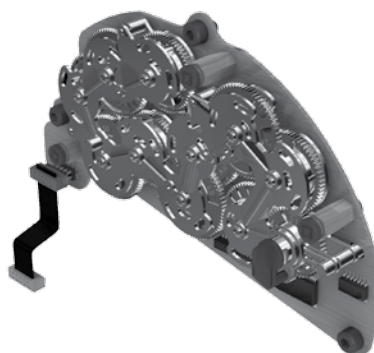
Torque sensing

Torque limiting has been a Limitorque feature for better than 80+ years. In fact, the name Limitorque was coined to identify the ability of an electric actuator to "limit torque" to a valve. In the past, electromechanical actuators have sensed torque using a complicated system of springs, switches and cams. The MX actuator senses torque electronically for use in valve control, overload protection, and torque trending. In conjunction with the Limigard feature, torque is sensed from motor speed, with compensation performed for voltage and temperature variations. The result is highly reliable and predictable torque sensing without the need for the extra components associated with electromechanical torque switches. The MX is a true smart actuator.
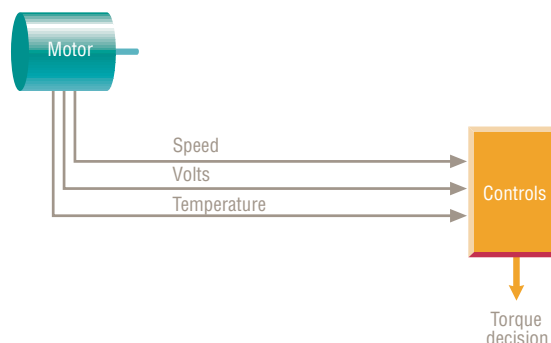
MX Control, Indication, Protection and Optional Features

Standard features

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

- Multi-mode control – Three modes of remote control are permitted when the MX is configured for multi-control: digital (discrete) control, analog control or network (fieldbus) control. The MX will respond to the last command received. However, analog (modutronic) control is initiated by either toggling MX User Input 2 (configured for CSE input) or removing and reapplying the 4-20 mA analog signal. Refer to LMENTB2300 for further information.

- Monitor relay – Provides an N/O and N/C contact representing "Actuator available for remote operation."

- Emergency Shutdown (ESD) – A remote, external ESD signal may be applied to the actuator to move the valve to a predetermined user-configured shutdown position, overriding existing control signals.

- User defined inputs – Three user defined inputs are supplied.

- Inhibit signals – External signals may be used to inhibit actuator opening, closing, or both.

- Control signals – The control signal can be either 24 VDC or optional 125 VAC; it can be sourced from the actuator or customer supply.

- Status contacts (4) – May be set to represent up to 30 actuator conditions.

Protection features

- Autophase protection and correction – Assures proper open/close directions and monitors and corrects phasing if connected improperly. Prevents operation if a phase is lost.

- Jammed valve – Automatically initiates a forward/reverse cycle to free jammed valves.

- Instantaneous reversal protection – Incorporates the proper time delay between the motor reversals to reduce current surges and extend contactor life.

- Motor thermal protection – A thermistor, placed within the motor, protects against overheating.

- LimiGard™ circuit protection – LimiGard consists of dedicated circuitry that continually monitors the motor controller, control relays, internal logic circuits and external command signals. When the recommended wiring connections are made, it virtually eliminates unexpected, erroneous actuation caused by internal electronic failures and erratic external command signals. Additionally, in the event of malfunction, LimiGard supervises the actuator response, detects the source of the failure and signals an alarm.

Optional features

- Alarm contacts – Up to eight latched contacts may be set to represent up to 30 key actuator conditions.

- Two-speed timer – A two-speed pulsing timer may be incorporated to support variable stroke times as configured by the user.

- Analog Position Transmitter (APT) – The APT is an internally powered, non-contacting valve position transmitter that provides a 4-20 mA signal proportional to valve position.

- Analog Torque Transmitter (ATT) – The ATT is a non-contacting, internally powered transmitter that provides a 4-20 mA signal that is proportional to actuator output torque.

- Modutronic controller – The Modutronic controller positions the valve in response to an external 4-20 mA command signal. It includes automatic pulsing mode to prevent overshoot at the set point. Parameters that may be set easily during configuration include proportional band, dead band, polarity, and action on loss of command signal.

- Solid State Motor Reverser (SSMR) – An SSMR is available when severe modulating operating conditions demand continuous operation.

- Partial stroke and momentary closure ESD – The partial stroke and momentary closure ESD signals are configurable by the user. It can also be supplied with a momentary closure contact initiated ESD signal routine with redundant circuitry.

- Arctic temperature – The MX is suitable for installation and operation in severely cold climates to -60°C (-76°F). There is no need for external heat sources to supplement the internal power—the MX is predictable and reliable even in the most rugged applications.

- Control Station (CSE) – The CSE is a separate control station designed for the operation of inaccessible actuators. It is available with LEDs, Remote/Local and Open/Close selector switches. The CSE may be powered by the actuator internal supply, provided wire resistance and other external loads do not limit the available signal power presented to the MX.

- Isolation and Load Break Switches – Isolation and Load Break Switches can be supplied for the incoming three-phase supply to the actuator. These may be coupled directly to the actuator for weatherproof (WP) applications only or supplied separately for mounting by user. The enclosure is suitable for weatherproof or temporary submersion service. An explosion-proof (XP) isolation switch is also available for user mounting and is suitable for mounting with all MX actuators. Please contact factory for availability.

- Negative Switching – When remote control systems require the negative pole of the circuit supply to be switched to positive earth, a simple software change is made.

- MX Quik – After the actuator has been powered by line power for one hour, it will automatically withstand most power outages while maintaining the correct state of the S or R status contacts—even if the user repositions the actuator manually with the handwheel. To maximize its self-power time while the line power is lost, the actuator places itself in its lowest possible power usage mode. The LCD will darken

(sleep mode) until it is activated for viewing. The LCD can be activated by moving the black knob to OPEN (YES) or by moving the actuator with the handwheel. After 10 seconds of inactivity, the LCD will return to sleep mode.

Bluetooth capable options

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

Network Communications

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

DDC Modbus (Distributed Digital Control) Communication

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

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

Master Station III

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

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

Foundation Fieldbus communication with Device Type Manager (DTM) technology

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

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

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

   – Recognizes and adds new devices to the link
   – Removes non-responsive devices from the link
   – Schedules control activity in, and communication activity between, devices
   – Regularly polls devices for process data
   – Distributes a priority-driven token to devices for unscheduled transmissions
   - DTM technology includes PID (proportional integral derivative) and partial stroke (PS) feature

PROFIBUS DP V1 communication with DTM

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

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

PROFIBUS PA communication with DTM

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

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

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

DeviceNet

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

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

HART Communication with DTM

• Complies with HART Communication Protocol Specification (Document HCF_SPEC-13) for Revision 7.3
• Digital signal on conventional 4-20m ADC analog signal
• 1200 bps binary phase — continuous Frequency-Shift-Keying
• Master-Slave communication method
• Point-to-point or multi-drop network topology
• Distances up to 1800 meters/network (up to 15 devices)
• EDDL (IEC 61804-2, EDDL) with methods for all supported Common Practice & Device Specific commands"

MX Series Performance Ratings for Units 05 through 150

MX-05 through MX-40 (three-phase: 50 Hz/380, 400, 415, and 440 Volt: 60 Hz/208, 230, 380, 460, 480, 525, 575 Volt)

MX-85 through MX-150 (three-phase: 50 Hz/380*, 400, and 415 Volt: 60 Hz/380, 460, 575 Volt)   **380/50 multiply by 0.9*

MX-05 through MX-10 (single phase ACV: 50 Hz/240, and 60 Hz/115, 125, 230)

		MX-05		MX-10		MX-20		MX-40		MX-85		MX-140		MX-150	
Output Speed (RPM)		**Rated Output Torque**													
60 Hz	**50 Hz**	**ft-lb**	**N m**	**ft-lb**	**N m**	**ft-lb**	**N m**	**ft-lb**	**N m**	**ft-lb**	**N m**	**ft-lb**	**N m**	**ft-lb**	**N m**
18	15	55	75	125	170	225	305	440	597	N/A	N/A	N/A	N/A	N/A	N/A
26	22	55	75	125	170	225	305	440	597	850	1153	1500	2036	N/A	N/A
40	33	55	75	125	170	225	305	440	597	1225	1662	1700	2307	N/A	N/A
52	43	55	75	125	170	225	305	440	597	1150	1561	1600	2171	N/A	N/A
77	65	48	65	107	145	178	241	345	468	850	1153	1200	1628	N/A	N/A
100 131[1]	84 110[1]	39	53	89	121	148	201	286	388	600	814	815	1105	1500	2036
155 170[1]	127 143[1]	41	56	89	121	140	190	260	353	450	611	650	882	1150	1561
200	165	34	46	73	99	114	155	210	285	N/A	N/A	N/A	N/A	N/A	N/A

Note 1: MX-85, MX-140 and MX-150

	lb	**kN**	**lb**	**kN**	**lb**	**kN**	**lb**	**kN**	**lb**	**kN**	**lb**	**kN**	**lb**	**kN**
Thrust Ratings (lb/kN)	8000	35	15000	66	25000	111	36000	160	50000	222	75000	333	75000	333
B4 Base (Torque Only)	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**
Weights (lb/kg)	52	24	65	29	109	49	133	60	250	114	300	136	431	182

A1 Base (Thrust Only) Weight	**lb**	**kg**
MX-05 & MX-10	9	4
MX-20 & MX-40	29	13
MX-85 w/ F16/FA16 base	72	33
MX-140/MX-150 w/ F25/FA25 base	111	50

Linear Base Weight	**lb**	**kg**
LB1	24	11
LB2	65	29.5

Maximum Stem Capacity

Type A Couplings	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**
Type A1	1.26	32	1.57	40	2.36	60	2.64	67	3.50	88	3.50	88	3.50	88
Type A1E (Extended Nut)	1.26	32	1.57	40	2.36	60	2.64	67	3.50	88	3.50	88	3.50	88
Type B Couplings (Torque Only)[2]	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**
Type B4	1	25.4	1.25	30	1.94	50	2.2	55	2.88	73	2.88	73	2.625	65
Type B4E (Extended)	0.75	19	0.91	22	1.56	41	1.78	46	2.25	57	2.25	57	2.625	65
Type B1 (Fixed Bore)[3]	N/A	42	N/A	42	N/A	60	N/A	60	N/A	N/A	N/A	N/A	N/A	N/A
Type BL (Splined)	6 & 38 Splines		6 & 38 Splines		6 & 36 Splines		6 Splines		N/A	N/A	N/A	N/A	N/A	N/A
Maximum Bore and Keyway	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**
Maximum Bore (B4)	1	25	1.25	30	1.94	50	2.2	55	2.75	65	2.65	65	2.625	65
Maximum Key dimensions	¼ sq.	8 x 7	¼ sq.	10 x 8	½ x ⅜	14 x 9	½ x ⅜	16 x 10	⅝ x $^7/_{16}$	18 x 11	⅝ x $^7/_{16}$	18 x 11	⅝ x $^7/_{16}$	18 x 11
Maximum Bore (B4E)	.75	18	0.91	22	1.56	41	1.78	46	2.25	56	2.25	56	2.5	65
Maximum Key dimensions	$^3/_{16}$ sq.	6 x 6	¼ sq.	8 x 7	⅜ sq.	12 x 8	½ x ⅜	14 x 9	½ x ⅜	16 x 10	½ x ⅜	16 x 10	0.625 sq.	18 x 11

Note 2: Maximum bores for Type B couplings may require rectangular keys.

	MX-05	**MX-10**	**MX-20**	**MX-40**	**MX-85**	**MX-140**	**MX-150**
Mounting Base (MSS SP-102/ISO 5210)	FA10/F10	FA10/F10	FA14/F14	FA14/F14	FA16/F16	FA25/F25	FA25/F25
Handwheel Ratio (STD/Optional)	Direct	Direct/8:1	Direct/12:1	Direct/24:1	16/48	16/48	16/48
Side-Mounted Handwheel Efficiencies	N/A	52%	54%	51%	53%/51%[4]	53%/51%[4]	53%/51%[4]

Note 4: Efficiencies for MX-85, MX-140 and 150 are 51% with SGA and 53% without SGA.

Note 3: Available in ISO base only.

MX Standard & Optional Features

Limitorque MX electronic valve actuators are designed for the operation of ON-OFF and modulating valves. They include a three-phase electric motor, worm gear reduction, absolute encoder, electronic torque sensor, reversing motor contactor, electronic control, protection and monitoring package, handwheel for manual operation, valve interface bushing, 32-character LCD, and local control switches—all contained in an enclosure sealed to NEMA 4, 4X, 6, and IP68. Explosionproof (XP) enclosures can also be provided when required. All MX actuators comply with applicable European Directives and exhibit the CE mark.

Power transmission and lubrication

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

LUBRICATION & TEMPERATURE RANGE	SYNTHETIC BRAND
Standard Lubrication, -30ºC to +70ºC	Mobil SHC 323
Optional Food Grade Lubrication, -30ºC to +70ºC	Dow Molykote

Motor, 3-phase ACV

The MX motor is a 3-phase squirrel cage designed for electronic valve actuators. It is specifically designed for the MX actuator and complies with IEC 34, S2-33 percent duty cycle at 33 percent of rated torque. The motor is a true bolt-on design with a quick-disconnect plug that can be changed rapidly without sacrificing motor leads. It is equipped with a solid-state motor thermistor to prevent damage due to temperature overloads.

ON-OFF MODULATING
Standard insulation class is F to IEC 34, S4_50% for stated operating times 100-600 starts per hour
600-1800 starts per hour, IEC 34, S4_50%_1800 S/H

The MX motor permits a global range of 3-phase voltages to be connected without modification. The motor can energize, provided either of the listed voltages are connected:

Phase/Frequency	Application Voltage
3ph - 60 Hz	208, 220, 230, 240, 380, 440, 460, 480, 550, 575, 600
3ph - 50 Hz	380, 400, 415, 440, 525

Motor - 1 phase ACV

The MX motor used for single phase ACV applications is unique to multi-turn electronic valve actuators. It is a brushless DC motor specifically designed for the MX actuator and complies with IEC 60034, S2-50 percent duty cycle at 50 percent of rated torque. The motor is a true bolt-on design with a quick-disconnect plug that can be changed rapidly without sacrificing motor leads. It is equipped with a solid-state motor thermistor to prevent damage due to temperature overloads.

Modulating:
Standard insulation class is H to IEC 60034, S2-50% for stated operating times 100-600 starts per hour 600-1800 starts per hour, IEC 60034, S4_50%_1800 S/H

Electronic control modules

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

Double-sealed terminal compartment and terminal block
All customer connections are located in a terminal chamber that is separately sealed from all other actuator components. Site wiring doesn't expose actuator components to the environment. The internal sealing within the terminal chamber is suitable for NEMA 4, 6, and IP68 to 15M for 96 hours. The terminal block includes screw-type terminals; three for

power and 54 for control. Customer connections are made via conduits located in the terminal housing.

Three Standard Conduit Openings (NPT threads standard, M optional)
(2) – 1.25" NPT or M32 (optional)
(1) – 1.5" NPT (standard) or M38 (optional)
(1) – 1.0" NPT (optional) or M25 (optional)

Controls

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

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

Using the knobs and LCD screen the MX is configurable in 11 languages: English, Spanish, French, German, Portuguese, Italian, Mandarin, Russian, Bahasa Indonesia, Turkish and Katakana.

S contacts for remote indication

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

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

Actuator Status Message	Function
"CLOSED"	– valve closed "(0% OPEN)"
"OPENED"	– valve open "(100% OPEN)"
"CLOSING"	– valve closing
"OPENING"	– valve opening
"STOPPED"	– valve stopped in mid-travel
"VALVE MOVING"	– either direction
"LOCAL SELECTED"	– red selector knob in "LOCAL"
"MOTOR OVERTEMP"	– thermistor range exceeded
"OVERTORQUE"	– torque exceeded in mid-travel
"MANUAL OVERRIDE"	– actuator moved by handwheel
"VALVE JAMMED"	– valve can't move
"CLOSE TORQUE SW"	– torque switch trip at "CLOSED"
"OPEN TORQUE SW"	– torque switch trip at "OPEN"
"LOCAL STOP/OFF"	– red selector knob at "STOP"
"LOST PHASE"	– one or more of the incoming supply lost
"ESD SIGNAL"	– signal active
"CLOSE INHIBIT"	– close inhibit signal active
"OPEN INHIBIT"	– open inhibit signal active
"ANALOG IP LOST"	– 4-20 mA not present
"REMOTE SELECTED"	– red selector in "REMOTE"
"HARDWARE FAILURE"	– indication
"NETWORK CONTROLLED"	– permits relay control via DDC, FF, or other network driver
"FUNCTION"	– LimiGuard circuit protection activated
"MID-TRAVEL"	– valve position, 1-99% open
"CSE CONTROL"	– CSE station in LOCAL or STOP and controls actuator
"PS ACTIVE"	–Partial Stroke test in operation
"PS PASSED"	–PS test complete & Successful
"PS FAILED TARGET"	–PS test did not achieve target value
"PS FAILED RETUNS"	–PS test did not return to start position
"PS"	–Partial stroke, active if "PS" configured,
"RUN LOAD ALARM"	–Single phase only

Monitor relay for remote indication

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

Monitor Relay AC	Monitor Relay DC
0.5 Amps @ 125 VAC	1A @ 50 VDC, 2A @ 30 VDC (Resistive)

Remote control

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

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

Speed control

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

Two-Speed Timer Span "ON" Pulse	Two-Speed Timer Span "Off" Pulse
0.5 to 20 seconds (0.5 sec. increments)	1.0 to 200 seconds (1.0 sec. increments)

Software

Limigard

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

Phase detection and correction (three phase)

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

Multi-mode remote control

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

ESD

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

Inhibits

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

Diagnostics

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

Valve and actuator position sensing

Valve position is sensed by an 18-bit, optical, absolute position encoder with redundant position sensing circuits designed for Built-In-Self-Test (BIST). Each of the position sensing circuits is redundant, facilitating BIST. The BIST feature discerns which failures will signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions are stored in permanent, nonvolatile memory. The encoder measures valve position at all times, including both motor and handwheel operation, with or without power present, and without the use of a battery. The absolute encoder is capable of resolving ±7° of output shaft position over 10,000 output drive rotations. This design permits continuous monitoring of valve position during motor and handwheel operation. The encoder is 100% repeatable and requires no backup power source for operation. The output is used to control the open and closed valve position and measure and report valve position, as well as provide local and remote position feedback. The positioning accuracy is better than 99% for valves requiring 50 or more turns.

• Maximum actuator turns = 10,000
• Resolution = ± 7 degrees

Valve and actuator torque sensing

The MX and QX are the only electric actuators that sense torque electronically. A microprocessor calculates output torque from motor speed, voltage, and temperature. Torque limit may be set from 40–100% of rating in 1% increments. A "Jammed Valve Protection" feature, with automatic retry sequence, is included to de-energize the motor if the output torque requirement exceeds the boost torque. A boost function is included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (from 0ºC down to -60ºC). The MX monitors for "jammed valve" as a protection feature and initiates an automatic retry sequence if no movement occurs.

Exterior corrosion protection

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

Manual operation

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

Factory testing

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

Design life and endurance testing
• Design Life - One million drive sleeve turns is considered typical life expectancy under normal operating conditions approved ambient working environments.

• Endurance – 50 million collective drive sleeve turns of endurance testing were performed on the MX for proof of design.

• AWWA C540-02 – "Standard for Power Actuating Devices for Valves and Sluice Gates" – 10,000 cycles with confirmation of specified torque and position accuracy.

Options

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

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

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

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

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

Modutronic option

A controller that alters valve position in proportion to a 4-20 mA analog command signal can be ordered. Positioning is accomplished by comparing the command signal to a non-contacting internal position feedback. An automatic pulsing feature to prevent overshoot at the setpoint is included. Proportional bands, deadband, signal polarity, motion inhibits time, and fail are adjustable using either the Local control mode of configuration or MX/QX Dashboard. Deadband is adjustable to +/- 0.1% percent full span.

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

Relays for status and alarms

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

"R" Contact and Monitor Relay AC Ratings	"S" Contact and Monitor Relay DC Ratings
5.0 Amps @ 250 VAC	1A @ 50 VDC, 5A @ 30 VDC (Resistive)

Custom software—Momentary contact ESD and partial stroke ESD

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

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

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

Please contact factory for application and purchase.
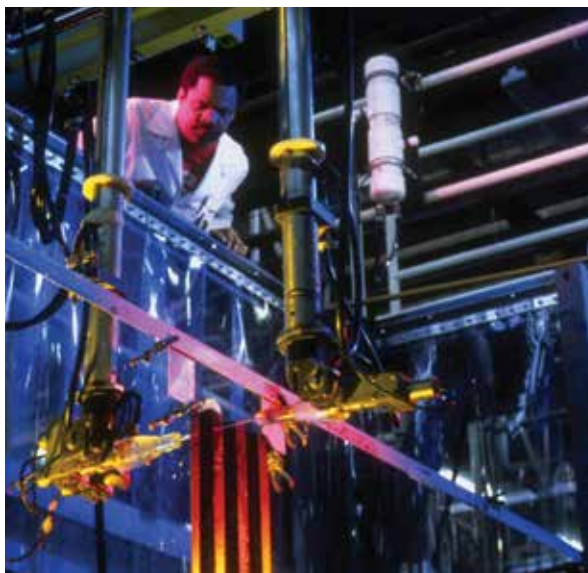
Global Certifications

Non-hazardous (weatherproof / submersion) certifications
IEC 529 protection code IP68; 15 meters for 96 hours
USA & CSA; NEMA 3, 4, NEMA 4X, NEMA 6

Geographic Locations	Weatherproof/ Submersion	Standard Temperature	Optional Temperature
IEC 529 Protection Code IP68	15M for 96 hours	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +50ºC (-58ºF to 122ºF)
USA & Canada, NEMA 3, 4, 6	20 ft. for 24 hours	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +50ºC (-58ºF to 122ºF)
USA & Canada, NEMA 4X	1500 hrs. to ASTM B117	-30ºC to +70ºC (-22ºF to 156ºF)	-50ºC to +50ºC (-58ºF to 122ºF)

Standard hazardous global certifications

FM – Class I, Groups B, C & D, Div. 1 & Class II, Groups E, F & G, T4

ATEX EExd IIB T4 ATEX II 2 G, CENELEC Norm EN 60079-0:2006 and EN 60079-1:2004

ATEX EExd IIC T4 ATEX II 2 G, CENELEC Norm EN60079-1:2004

EEx de IIB T4 ATEX II G, Increased Safety, CENELEC Norm EN 60079-7:2003

ATEX EEx de II C T4

CSA – Class I, Group C & D, Div. 1 and Class II, Groups E, F & G, T4

TR-RU C-US GB08.B.01021, #0220417, GOST IEC 60079-2011, for IECEx d IIB, T4, Gb, X from -60C to +60C

IECEx d IIC, T4, Gb, X from -20C to +60C

IECEx de IIB/IIC, T4, Gb, X from -20C to +60C

IECEx d IIB T4 -60°C ≤ TAMB ≤ +60°C; IP68 - Size 05, 10, 20, 40. Actuators with marked TAMB below -20°C require special construction. Contact factory.

IECEx d IIB (or IIC) T4 -20°C ≤ TAMB ≤ +60°C; IP68 - Size 05, 10, 20, 40, 85, 140, or 150

IECEx d e IIB (or IIC) T4 -20°C ≤ TAMB ≤ +60°C; IP68 - Size 05, 10, 20, 40, 85, 140, or 150. Group IIC design also available and requires special construction. Contact factory Inmetro - same as IECEx, except that -60C is N/A.

Geographic Locations	Explosionproof Classifications	Standard Temperature	Optional Temperature
USA to Factory Mutual (FM)	Class I, Groups B, C, & D, Div. 1, T4 and Class II, Groups E, F, & G, Div. 2, T4	-30ºC to +65ºC (-22ºF to 149ºF)	-50ºC to +40ºC (-58ºF to 104ºF)*
Canada to Canadian Standards Association	Class I, Groups B, C, & D, Div. 1, T4 and Class II, Groups E, F, & G, Div. 2, T4	-30ºC to +65ºC (-22ºF to 149ºF)	-50ºC to +40ºC (-58ºF to 104ºF)*
ATEX II 2 G, CENELEC Norm EN 50014 & 50018	Eex d IIB T4, Eex d IIC T4, and Eex de IIB T4, Eex de IIC T4	-30ºC to +65ºC (-22ºF to 149ºF)	-60ºC to +40ºC (-76ºF to 104ºF)*
IECEx	Ex d IIB T4; IP68 & Ex d IIB (or IIC) T4; IP68 & Ex d e IIB (or IIC) T4	-20ºC to +60º -4ºF to 140ºF)	-60ºC to +60ºC (-74ºF to 140ºF)*

NOTE: Options are available to -60°C for TR-CU (Russia). Consult factory for availability. *Consult factory for limitations.

European directives

All MX actuator designs have been tested to comply with pertinent EU Directives and shipped with the Declaration of Conformity listed in the Regulatory Section of LMENIM2306. The actuator is also tagged with the CE mark to demonstrate compatibility with the following European Directives:

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

• 2006/42/EC - Machinery Directive

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

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

• Drop test – ASTM-D3332-88, method A

• 2003/10/EC -Airborne Noise to EN 60204-1
The MX has been tested for noise emissions and at 1 m distance is less than 74 dB per grade A noise requirement of MIL-STD-740 and ANSI/ISA-S82.01-1994 (harmonized std. to IEC 1010-1).

• 2004/108/EC -EMC – Electromagnetic Compatibility and 93/68/EC -Low Voltage; EN 50081-1 & 2 – Three phase ACV actuator actuator complies with all pertinent require- ments of Class A service categories in the listed table.

Three phase ACV actuators comply with all pertinent requirements of Class A service categorizes in the listed table:

Applicable emissions standards	EN61326-1 (CISPR11)	Industrial Environments - Class A - Test Limits & Levels	
Radiated Emissions	EN55011:2009+A1:2010 (CISPR11)	30 MHz to 230 MHz 230 MHz to 1 GHz	40 dB (μV/m) 47 dB (μV/m)
	FCC Part 15, (CFR47 Part 15.109)	30 MHz to 88 MHz 88 MHz to 216 MHz 216 MHz to 960 MHz > 960 MHz	90 dB (μV/m) 150 dB (μV/m) 210 dB (μV/m) 300 dB (μV/m)
Conducted Emissions	EN55011:2009+A1:2010 (CISPR11)	150 kHz to 500 kHz	79 dB (μV) (quasi-pk), 66 dB (μV) (avg)
	FCC Part 15, (CFR47 Part 15.107)	500 kHz to 30 MHz	73 dB (μV) (quasi-pk), 60 dB (μV) (avg)
Applicable immunity standards		Industrial Environments - Test Limits & Levels	
ESD	IEC61000-4-2 (B)	Air: AC, DC, Signal	±2 kV, ±4 kV, ±8 kV
		Contact: AC, DC, Signal	±1 kV, ±2 kV, ±4 kV
Radiated RF immunity	IEC61000-4-3 (A)	Enclosure @ 80 MHz to 1 GHz	10 Vrms/m @ 80% AM, 1 kHz
		Enclosure @ 1 GHz to 2.7 GHz	3 Vrms/m @ 80% AM, 1 kHz
Fast transients/burst	IEC61000-4-4 (B)	AC, Signal	±2 kV, ±1 kV
Voltage surges	IEC61000-4-5 (B)	Common: AC, Signal Differential: AC, Signal	±2 kV, ±1 kV ±1 kV, ±1 kV
Conducted RF immunity	IEC61000-4-6 (A)	AC @ 150 kHz to 80 MHz	10 Vrms @ 80% AM, 1 kHz
Magnetic field immunity	IEC61000-4-8 (A)	Three mounting axis	30 A/m
Voltage dips and interrupts	IEC61000-4-11 (B)	3 dips, 10 sec apart	> 95% dip for 1 cycle @ 50/60 Hz 30% dip for 500 ms @ 50/60 Hz 60% dip for 200 ms @ 50/60 Hz
	IEC61000-4-11 (C)	3 dips, 10 sec apart	> 95% interrupt for 5 sec @ 50/60 Hz

Single phase ACV actuators comply with all pertinent requirements of Class A service categorizes in the listed table:

Applicable emissions standards	EN61326-1 (CISPR11)	Industrial Environments - Class A - Test Limits & Levels	
Radiated Emissions	EN55011:2009+A1:2010 (CISPR11)	30 MHz to 230 MHz 230 MHz to 1 GHz	40 dB (μV/m) 47 dB (μV/m)
	FCC Part 15, (CFR47 Part 15.109)	30 MHz to 88 MHz 88 MHz to 216 MHz 216 MHz to 960 MHz > 960 MHz	90 dB (μV/m) 150 dB (μV/m) 210 dB (μV/m) 300 dB (μV/m)
Conducted Emissions	EN55011:2009+A1:2010 (CISPR11)	150 kHz to 500 kHz	79 dB (μV) (quasi-pk), 66 dB (μV) (avg)
	FCC Part 15, (CFR47 Part 15.107)	500 kHz to 30 MHz	73 dB (μV) (quasi-pk), 60 dB (μV) (avg)
Applicable immunity standards	EN61326-1 (Performance Criterion)	Industrial Environments - Test Limits & Levels	
Electrostatic Discharge	EN61000-4-2 (B)	Contact Air	±1 kV, ±2 kV, ±4 kV ±2 kV, ±4 kV, ±6kV, ±8 kV
Radiated RF Susceptibility	EN61000-4-3 (A)	Enclosure @ 80 MHz to 1 GHz Enclosure @ 1.4 GHz to 2 GHz Enclosure @ 2 GHz to 2.7 GHz	10 Vrms/m @ 80% AM, 1 kHz 3 Vrms/m @ 80% AM, 1 kHz 1 Vrms/m @ 80% AM, 1 kHz
Electrical Fast Transient/Burst	EN61000-4-4 (B)	AC Power, DC Power I/O (mains connected) I/O (non-mains)	±2 kV ±2 kV ±1 kV
Voltage Surge	EN61000-4-5 (B)	AC Power, DC Power I/O (mains connected) I/O (non-mains)	±1 kV (DM), ±2 kV (CM) ±2 kV (CM) ±1 kV (CM)
Conducted RF Immunity	EN61000-4-6 (A)	AC Power, DC Power, I/O @ 150 kHz to 80 MHz	3 Vrms @ 80% AM, 1 kHz
Magnetic Immunity	EN61000-4-8 (A)	Three mounting axis, X, Y, Z	30 A/m, 60 sec dwell
Voltage Dips and Interrupts	EN61000-4-11 (B)	3 dips, 10 sec apart 3 dips, 10 sec apart 3 dips, 10 sec apart	100% dip for 1 cycle @ 50/60 Hz 60% dip for 200 ms @ 50/60 Hz 30% dip for 500 ms @ 50/60 Hz
	EN61000-4-11 (C)	3 dips, 10 sec apart	100% interrupt for 5 sec @ 50/60 Hz

Conduit entries

Three threaded conduit entries are provided tapped: 1 x 1½˝ and 2 x 11/4˝ NPT. Unless otherwise specified, actuator will be dispatched with adapters: 1 x M40 and 2 x M32 metric to BS3643, PG adapters are available upon request. An optional, 4th conduit, tapped to 1.0" NPT or 25 mm is available.

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

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ISO 9001
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NOTES: (SEE INSTALLATION & OPERATION MANUAL LMENIM 2306 FOR DETAILS)
CIRCUIT SHOWN WITH VALVE IN FULLY CLOSED POSITION AND WITH POWER OFF.

MECHANICAL REVERSING CONTACTOR
AND POWER BOARD
WITH FUSES FS1 AND FS2
(SEE TABLE 1 & NOTE 6)

MOTOR

L3
L2   AC
L1   3-PHASE
       SUPPLY
PE

1. REMOTE INPUTS
SIGNAL THRESHOLD – MINIMUM "ON" 19.2V AC/DC
MAXIMUM "OFF" 5.0V AC/DC
MAX LOAD – 10 mA / 110V AC
2 mA / 24V DC
REQUIRED CONTROL SIGNAL DURATION = 350ms MIN.
INPUTS 0,1,2 ARE FIELD CONFIGURABLE FOR
CLOSE/OPEN INHIBIT, USER INPUT, OR ESD.
INPUT 1 MAY ALSO BE CONFIGURED FOR
PARTIAL STROKE TEST.
INPUT 2 MAY ALSO BE CONFIGURED FOR CSE
REMOTE SELECTION INDICATION.
DEFAULT INPUT CONFIGURATION
INPUT 0 – ESD,
INPUT 1 – OPEN INHIBIT,
INPUT 2 – CLOSE INHIBIT.

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

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

OUTPUT SWITCH CONTACT DEVELOPMENT

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

—— OPEN CONTACT
■■ CLOSED CONTACT

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

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

6. FUSES
FS1 (PRIMARY)   600V AC, 1A, 100kA Int RATING,
FS2 (PRIMARY)   FAST ACTING 10.3 x 38.1mm TUBE.
UL LISTED, CSA CERTIFIED

TABLE 1: TRANSFORMER TAPPING OPTIONS

TYPE	TAPS	APPL. VOLTAGES
1	106V	110V
1	115V	115V, 120V
1	200V	208V
1	212V	220V
2	226V	226V,230V,240V
2	366V	380V
2	392V	400V,415V
2	450V	440V,460V,480V
3	212V	220V
3	505V	525V
3	530V	550V
3	572V	575V,600V

(–) NEGATIVE COMMON

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

EXTERNAL SUPPLY 24 TO 110 VOLT AC/DC

INTERNAL SUPPLY 24V DC

SEE NOTE 2

0V AC/DC   24–110V AC/DC

REMOTE WIRING CONNECTIONS

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

CONTROL PANEL

MOTOR
THERMAL SENSOR
TORQUE SENSOR
POSITION SENSOR

0% OPEN
STATUS OK

REMOTE
STOP
LOCAL

OPEN (YES)
(NO) CLOSE

Limitorque

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

PRIMARY RELAYS (SEE NOTES 3 & 5)

MONITOR   RM   54 53 52
"CLOSE" POSITION   S1   a 44 45 49 b 48
"OPEN" POSITION   S2   a 46 47 51 b 50

GROUP 1
CLOSE   27
STOP   26
OPEN   25
DIG COM #1-Ve 28

GROUP 2
INPUT 2   35
INPUT 1   34
DIG COM #2-Ve 29
DIG COM #2A   31

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

SEE NOTE 2

LIMIGARD CONFIG. WIRING
OPEN   STOP   CLOSE
(25)(34) (26)(30) (27)(35)
24 VDC TO 120 VAC

DRAWN   DATE   RLP 10/30/12
CHECKED   DATE   ZKC 11/01/12
APPROVED   DATE   ZKC 11/01/12

FLOWSERVE Limitorque Actuation Systems
5114 WOODALL ROAD, LYNCHBURG, VIRGINIA 24506-1318

TITLE   MXa WIRING DIAGRAM
Standard
No Analog
Mechanical Contactor
OS, (2) 2A, (1) 2A monitor relay
3Wire/4Wire

UNIT TYPE MXa
DWG NO WD-MXa-000000-0000
REV 00F
SHEET 1 OF 1

Limitorque MX Electronic Actuator

FCD LMENIM2306-07-AQ - 05/16

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Figure 1.1 – MX-05 Actuator

Piece	Description
1	Handwheel
2	Declutch Lever (MX-05)
3	Oil Fill
4	Controls Cover
5	LCD
6	Control Knob
7	Ground Lug
8	Thrust/Torque Base
9	Conduit Entry
10	Terminal Compartment
11	Motor
12	Nameplate

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. Limitorque 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 are in accordance with local or national standards that are enforced at the particular site.

- To install and commission the actuator, only the terminal compartment cover needs to be removed. See Figure 1.1, Item 10. Settings for commissioning the actuator are done externally; therefore, no other covers need to be removed. The actuator was assembled in ideal dry conditions and the total sealing of the enclosure protects all electrical components against deterioration.

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

- During final field installation, ensure that all cable entries are correctly sealed in accordance with National Standards or Regulatory Authorities. All temporary transit plugs must be removed and any unused cable entries closed in an approved manner. See Section 3.3.3, Sealing Cable/Conduit Entries.

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2 Quick Start

Quick Start provides step-by-step instructions for commissioning each MX actuator. This information is also available in Bulletin LMENIM2310, Quick Start-Up Instructions. These instructions are for the following:

• Position limits calibration – can be performed one of two ways:

>   1. Electrical operation: See Section 2.1.2, Electrical Operation Feature.

>   2. Handwheel operation: See Section 2.1.3, Handwheel Operation Feature.

• DDC operation: See Section 2.2, DDC Option.

• FF operation: See Section 4.10, FF Option.

• PB operation: See Section 4.11, PB Option.

• DeviceNet operation: See Section 4.12. DN Option.

• HART Operation: See Section 4.13, HART Option

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

NOTE: The actuator has been configured with all customer-specified parameters and no further calibration should be necessary. If full valve data was not provided when ordering, or if changes are needed for parameters, see Sections 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 knob to the STOP position. The "SET CLOSE POSITION LIMIT" message will be displayed. When the red knob is in "LOCAL" or "REMOTE," the liquid crystal display (LCD) screen will read "SET POSITION LIMITS."

4.   Calibrate end position limits one of two ways:

>   • Electrically, using the control panel. See Section 2.1.2, Electrical Operation Feature and Figure 3.25 for control panel and Table 3.9 for LED indication.

>   • Manually, using the handwheel. See Section 2.1.3, Handwheel Operation Feature.

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

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

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

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

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

2.1.1 Entering the Setup Mode

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

2. Within 10 seconds, place the black control knob in the "YES" position, then the "NO" position, then again in the "YES" position (in quick succession—approximately one-two seconds).

3. The message "SETUP?" will appear in the LCD display for 10 seconds. If no setup action is taken within 10 seconds, the unit will reset.

4. Use the black control knob to answer "YES" or "NO" to the questions appearing in the display.

2.1.2 Electrical Operation Feature

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

1. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.

2. When screen prompt reads "CHANGE SETTINGS," select "YES."

3. The screen will display the "CHANGE SETTINGS" mode menu items. Select "NO" until screen displays "CHANGE POSITION SETUP." User may select to set close limit first or open limit first.

4. Select "YES." "CLOSE" or "OPEN VALVE - OK?" is displayed.

5. Place the red selector knob in the "LOCAL" position. Move the black knob in the intended direction. The LCD screens are shown in Figure 2.1.

6. When valve has reached desired position, return the red selector switch to "STOP" and complete calibration.

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

⚠ **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 of each other, an error message will be displayed: "KEEP OPEN(CLOSE) LIMIT?"

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 re-booting stating "IDENTICAL LIMITS". THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 2.1 – Electrical operation

NOTE 1: If open and close limits are not identical

NOTE 2: If open and close limits are identical
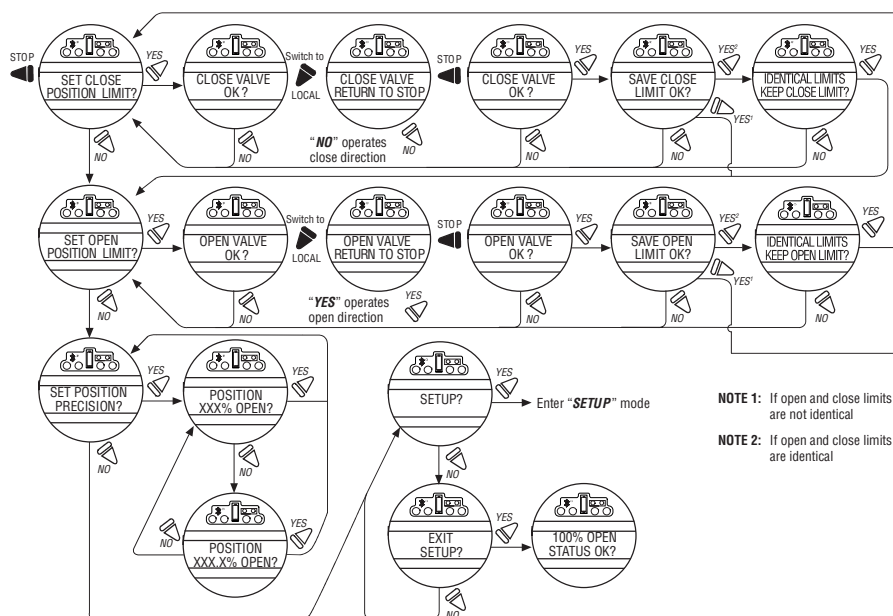
2.1.3 Handwheel Operation Feature

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

1. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.

2. When LCD reads "CHANGE SETTINGS?", select "YES."

3. The LCD will display the "CHANGE SETTINGS" mode menu items. Select "NO" until screen displays "CHANGE POSITION SETUP?"

4. Select "YES." See Figure 2.2. Manually set position limits:

   a. Close position limit

      1. "SET CLOSE POSITION LIMIT?" is displayed.

      2. Select "YES." "CLOSE VALVE - OK?" is displayed.

      3. Depress the declutch lever, and at the same time slowly rotate the handwheel until the clutch is fully engaged. Release the lever; the clutch will be retained in the handwheel mode by spring-loaded latches.

      4. Ensure the valve is fully closed, then move the valve in the open direction for one handwheel turn to allow for coasting of the motor.

      5. When the valve is in the desired position, select "YES" again. The LCD will read "SAVE CLOSE LIMIT OK?"

      6. Select "YES" if the valve's close limit position is correct. The close position limit is set.

   b. Open position limit

      1. "SET OPEN POSITION LIMIT?" is displayed.

      2. Select "YES." "OPEN VALVE - OK?" is displayed.

3. Depress the declutch lever, and at the same time slowly rotate the handwheel until the clutch is fully engaged. Release the lever; the clutch will be retained in the handwheel mode by spring-loaded latches.

4. Ensure the valve is fully open, then move the valve in the close direction for one handwheel turn to allow for coasting of the motor.

5. When the valve is in the desired position, select "YES" again. The LCD will read "SAVE OPEN LIMIT OK?"

6. Select "YES" if the valve's open position limit is correct. The open position limit is set.

7. Move the valve in the close direction. The open lamp should extinguish within one turn of the handwheel.

8. Move the valve back in the open direction and check that the open lamp illuminates just before the full open position is reached (approximately ½ to 1 turn).

9. If the calibration requires adjustment, select "NO" at the "SET CLOSE POSITION LIMIT?" prompt and repeat the "SET OPEN POSITION LIMIT?" routine.

10. Select "NO" to exit "POSITION SETUP?" or "YES" to return to "SET CLOSE POSITION LIMIT?"

⚠ **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: "KEEP OPEN(CLOSE) LIMIT?"

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 re-booting stating "IDENTICAL LIMITS". THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 2.2 – Handwheel operation
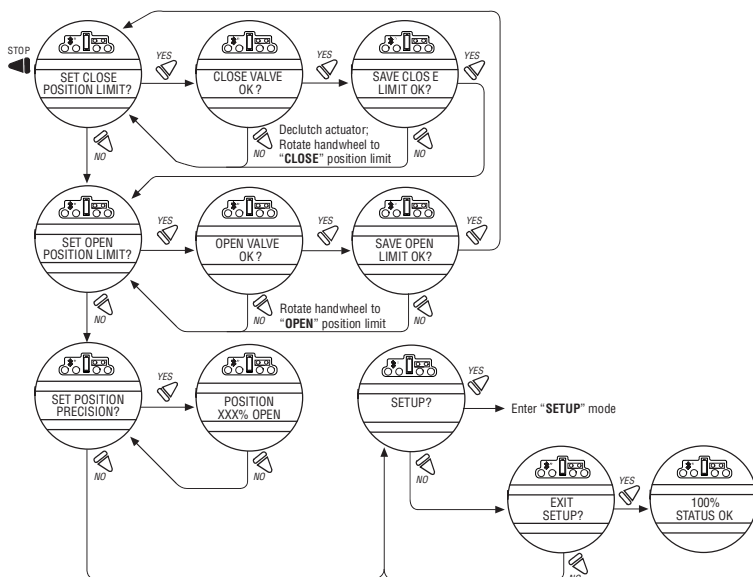
2.2 DDC/Modbus Option

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

1. After setting position limits, remain in the "SETUP" mode. If not in the "SETUP" mode, enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.

2. When LCD reads "CHANGE SETTINGS?", select "YES."

3. The LCD will display the "CHANGE SETTINGS" mode menu items. Select "NO" until screen displays "CHANGE DDC?" Select "YES." LCD will display DDC menu items.

4. Select "YES" for each menu item until "DDC ADDRESS OK?" appears. Select "NO."

5. Enter an address from 1 to 250 by toggling "NO" until the correct address is displayed. User may select to hold the knob in the "NO" direction and the number will automatically increment by one until the preferred address is reached.

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

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

2.3 Check the Settings

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

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

3

Installation and Operation

3.1 Preparing the Stem Nut

The MX has two (2) basic base designs:

• Torque-only base, designated by a "B" prefix

• Thrust-only base, designated by an "A" prefix

3.1.1 Type "B" Bases: Torque-only Applications

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. The MX actuator maybe 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 shown)

Baseplate

Drive sleeve

MX base

Torque nut
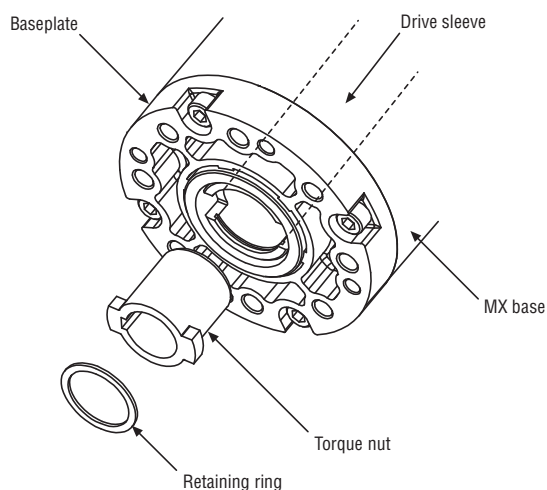
Retaining ring

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 the torque nut is difficult to remove, insert a suitable device into the drive sleeve through bore and gently tap it loose from the handwheel end.

3. Machine the torque nut to suit the valve stem or gearbox input shaft (see LMENSS2326, MX Performance and Dimensions 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 the torque nut meshes with the drive lugs.

3. Refit the retaining ring (B4 base) or spiral-wound ring (B4E base).

Optional B1 Base (not available for MX-85, MX-140 and MX-150)

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

No disassembly 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.

Figure 3.5 – Exploded view of B1 base
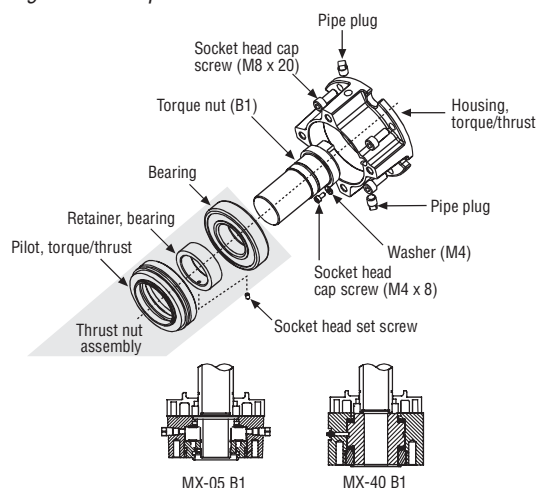
3.1.2 Type "A" Bases: Thrust-only Applications

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 3.6 – A1 base

Disassembly – Units MX-05/10/20/40

Refer to Figure 3.7.

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

Pilot removal

MX-10/20: Remove the screw and washer holding the valve pilot to the thrust base and remove pilot.

MX-40: Turn counterclockwise (CCW) 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 – Units MX-05/10/20/40

Refer to Figure 3.7.

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-05/10/20: Slide pilot into thrust base assembly and secure with washer and screw. Tighten fully.

MX-40: Place pilot into thrust base and turn clockwise (CW) 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.

Disassembly – Units MX-85

Refer to Figure 3.8.

Disassembly of the main housing from the base may be 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 housing and remove mounting plate.

Figure 3.7 – Exploded view of A1/A1E base (MX-05/10/20/40 only)
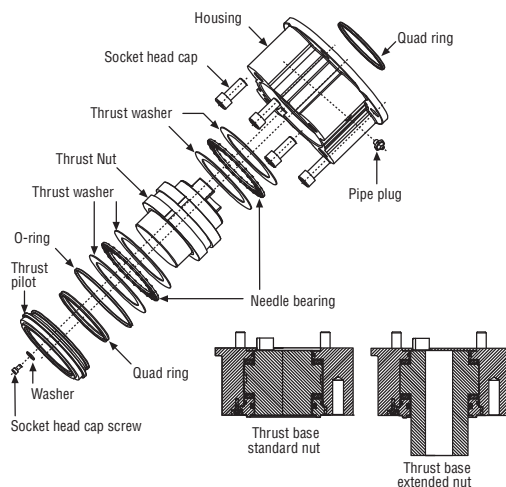
Thrust bearing and nut removal

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 – Units MX-85
Refer to Figure 3.8.

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

Screw Size	Torque	
	ft-lb	N m
M8 or ⁵⁄₁₆ in. (8 mm)	12-14	16-19
M10 or ⅜ in. (9 mm)	25-30	33-40
M12 or ½ in. (13 mm)	40-50	53-67
M16 or ⅝ in. (16 mm)	90-100	122-135
M20 or ¾ in. (19 mm)	180-200	244-271

NOTE: Screw mounting torque for mounting thrust base to main housing or thrust baseplate to thrust base housing.

Figure 3.8 – Exploded view of thrust base (MX-85 only)
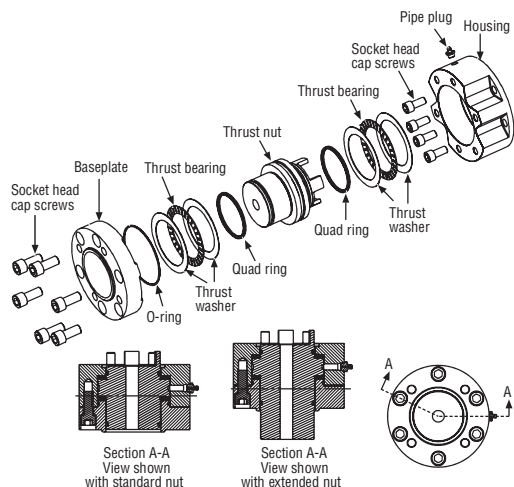
Disassembly – Units MX-140/MX-150
Refer to Figure 3.9.

Disassembly of the main housing from the base may be 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 – Units MX-140
Refer to Figure 3.9.

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 632, 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.

3.1.3 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 is the same as the B4 base and the torque nut. See Section 3.1.1, Type "B" Bases: Torque-only Applications.

Figure 3.9 – Exploded view of thrust base (MX-140/MX-150 only)

3.2 Mechanical Installation Onto Valve or Gearbox
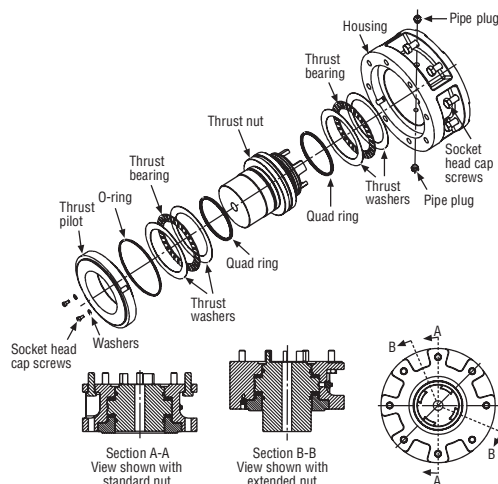
NOTE: Refer to MX Maintenance and Spare Parts bulletin (LMENIM2314) for more detailed instructions.

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: hex and socket head cap screws per Property Class 12.9.

• Clean and lubricate the valve stem or input shaft.

• Ensure adequate lifting facilities and slings are available at the installation site.

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

3.2.1 Mounting (Type "B" Bases): Torque-only

Refer to Figures 3.1 - 3.5.

1. Ensure torque nut is secured inside actuator drive sleeve with 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.

3.2.2 Removal (Type "B" Bases): Torque-only

Refer to Figures 3.1 – 3.5.

1. Remove the bolts that secure the actuator to the valve mounting adapter. If 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.

3.2.3 Mounting (Type "A" Bases): Thrust-only

Refer to Figures 3.6 – 3.9.

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 two.

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.

3.2.4 Removal (Type "A" Bases): Thrust-only

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 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 to commission the actuator.

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

3.3.1 Removing Terminal Cover

Remove the terminal cover as follows:

1. Remove the four cover screws using a 6 mm hexagonal wrench.

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

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

3.3.4 Recommended Terminal Connections

Power Terminals
Ring tongue connectors used on the power terminals should comply with the dimensions shown in Figure 3.10. For Additional information, consult terminal manufacturer.

Figure 3.11 details the allowable voltage and current parameters for the terminal block power terminals. Preload the M5 screws to 1.6-3.2 N m (1.2-2.33 ft-lb).

Control Terminals
Ring tongue connectors used on the control terminals should comply with the dimensions shown in Figure 3.12. For additional information, consult terminal manufacturer. Preload the M3 screws to 0.33-0.66 N m (0.25-0.50 ft-lb).

NOTE: Alternative manufacturers may be substituted only if dimensions are in accordance with Figure 3.12.
NOTE: The use of spade terminals is not recommended for secure electrical connections.

Figure 3.10 – Power terminal connector size limitations

MAX. THICKNESS = 1.6 mm

NOT TO EXCEED 3.5

NOT TO EXCEED 9.8

NOT TO EXCEED 6.5

NOT TO EXCEED 15

NOT TO EXCEED Ø9.6

TO BE SIZED FOR M5 SCREW

TO BE SIZED FOR M5 SCREW

NOT TO EXCEED 15

SPADE AND SNAP TERMINALS

FLANGED SPADE TERMINAL

RING TERMINAL
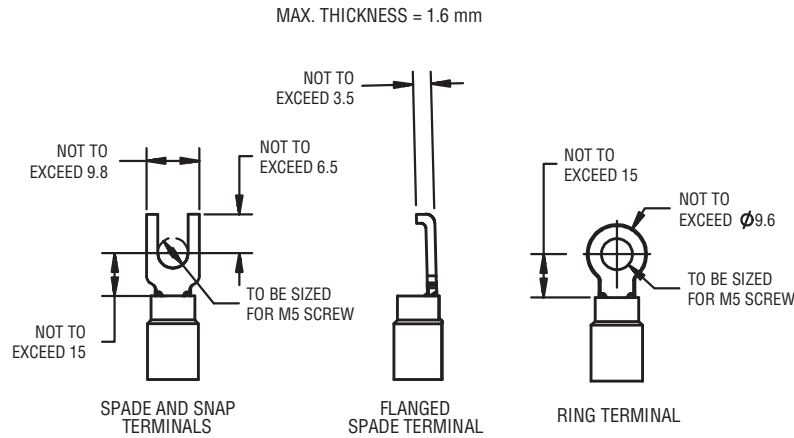
Figure 3.11 – Terminal block rating; power terminals

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

Note: Ratings will be the same for L1, L2, or L3, e.g., if 10 Awg is selected, then L1, L2 and L3 will have the same limitations.

Figure 3.12 – Control terminal connector size limitations

MAX. THICKNESS = 1.0 mm

NOT TO EXCEED 7.6

NOT TO EXCEED 4.0

NOT TO EXCEED 5

NOT TO EXCEED 5

NOT TO EXCEED Ø8.2

TO BE SIZED FOR M3 SCREW

TO BE SIZED FOR M3 SCREW

SPADE AND SNAP TERMINAL

RING TERMINAL

3X M5 SCREW

3X M5 SPRING WASHER

54X M3 SCREW

54X M3 SPRING WASHER
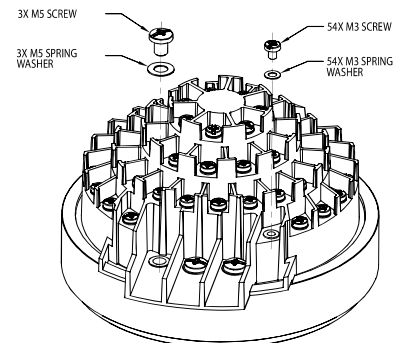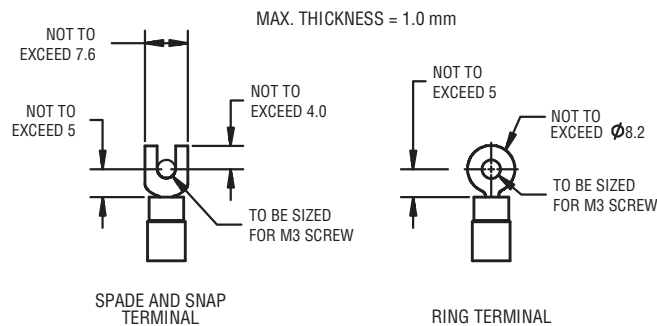
FIGURE 3.13
THE USE OF THE SPRING WASHERS ARE REQUIRED ON INCREASED SAFETY APPLICATIONS.

NOTE: All dimensions are in mm.

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

NOTE: Alternative manufacturers may be substituted only if the dimensions are in accordance with Figure 3.12.

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

Table 3.2 – Terminal block rating; control terminals

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

3.3.5 Termination of Cables

All terminations should be made with insulated ring terminals using the appropriate crimping tool. See Figures 3.10 and 3.11 for power terminal connection recommendations. See Figure 3.12 and Table 3.2 and 3.3 for control terminal connection recommendations.

3.3.6 Cable Connections

See Figure 3.14 for connection information.

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

2. Attach the earth/ground wire to the separate screw on the inside of the terminal compartment.

3. Use the M3 screws installed in the terminal block to connect the control cables in accordance with the wiring diagram and the project specification.

4. Ensure that all connections are tight, including any spare termination screws that have not been used.

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

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

Table 3.3 – Required ratings for external wires

Up to	Use wire rated at least
40°C Ambient	75°C
55°C Ambient	90°C
60°C, 65°C & 70°C Ambient[1]	105°C

Note 1: Refer to unit nameplate.
Note 2: See section 7.3 for single phase high and low ambient FLA values

3.3.7 Network Installations

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

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

• Nominal impedance: 120 ohms @ 1 MHz

• Line to shield capacitance: 23.0 pF/ft (75.5 pF/m)

• Line to line capacitance: 12.8 pF/ft (42.0 pF/m)

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

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

Limitorque strongly recommends remote communication wiring be routed separately from mains 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 the recommendation is not followed, the intergrity of instrumentation signals may be comprimised. If the signal is comprimised, the MX will enter a "safe-state" whereby all motion is prohibited until communication is sucessfully re-established.
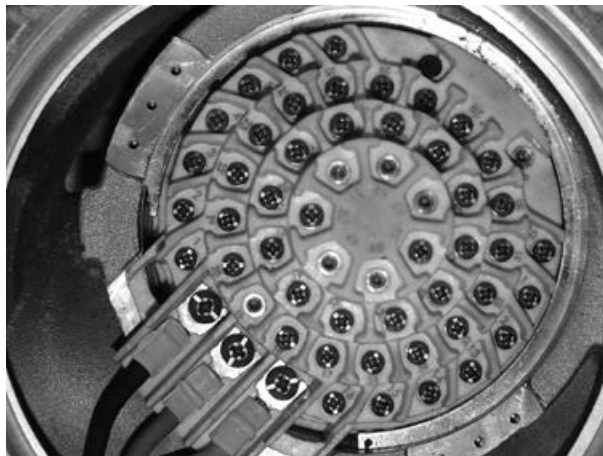
Figure 3.13 – View of terminal block

Figure 3.14 – Standard wiring diagram illustrating 3 phase motor voltage applied.
NOTE: Most current wiring diagram is shipped within the terminal compartment of the MX.
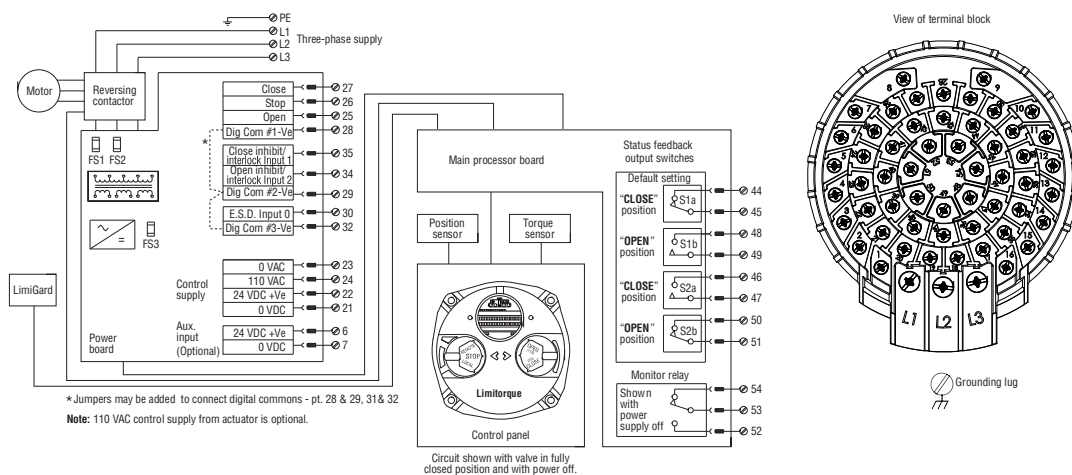
Cable Preparation
Prepare the network cable for connection to the MX actuator terminal block as illustrated in Figures 3.15 through 3.18.

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

1. Remove 2 to 3 in. (5 to 8 cm) of the outer plastic jacket as shown in Figure 3.15. Do not cut or nick the drain wire or the insulated conductors.

Figure 3.15 – Removing outer plastic jacket

2. Separate the cable parts. Unbraid the braided shield and peel back the foil shield to the same point where the outer jacket was removed as shown in Figure 3.16.

3. Cut away the braided shield and the foil shield. Strip the insulation from the conductors approximately ½ inch (1 cm) as shown in Figure 3.17.

4. Apply heat shrink tubing to insulate the drain wire and to provide stress relief to the cable.

5. Install ring tongue connectors as shown in Figure 3.18.

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

6. Connect the network cables to the MX actuator terminal block per Table 3.4 and appropriate wiring diagram. Table 3.3 details a connection for the loop topology.

Figure 3.16 – Separating cable parts
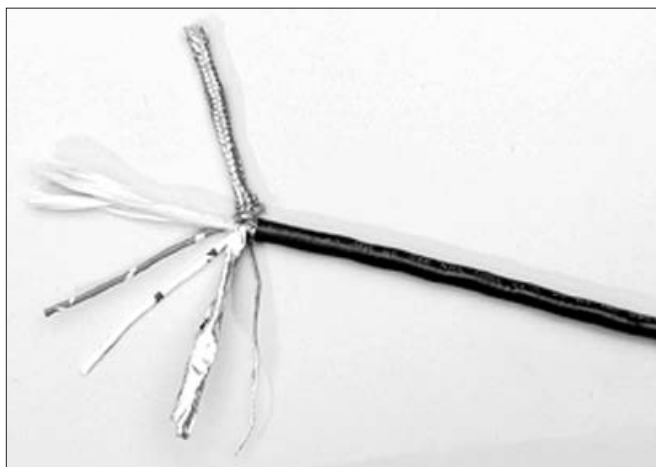
Figure 3.17 – Stripping conductors and applying heat shrink tubing

Figure 3.18 – Ring tongue connectors

Table 3.4 – Loop topology connections

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

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

NOTE: Surge protection must be grounded to be effective.

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

Limitorque defines an effective local earth ground as the M3 taps on the housing next to the terminal block. See figure 3.21.

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 3.20.

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

There should not be:

• Nicks in the insulation—this can cause a short to the grounded shield.

• Cut strands in a stranded conductor—this can cause a poor connection and eventually an open circuit.

• Cable armor shorted to the cable shield/drain wire—this may not be at ground potential and could be subject to lightning surges.

• Shield/drain wire grounded at more than one end of each cable segment (the section between each adjacent actuator on the loop). This will avoid ground loop problems.

• Ground/earth connection except at true ground potential and effective at all times.

3.3.8 Foundation Fieldbus Installation

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

• Characteristic impedance: 100 ohms @ 31.25 kHz

• Resistance, each wire: 7.32 ohms/1000 ft

• Attenuation: 0.914 dB/1000 ft @ 39 kHz

• Capacitative Unbalance: 3.6 pF/ft

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

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

Cable Preparation
Prepare the network cable for connection to the MX actuator terminal block as follows in Figure 3.15 through 3.18. Table 3.5 details connections for Foundation Fieldbus.

Table 3.5 – Foundation fieldbus connections

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

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

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

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

3.3.9 Network Wiring – Profibus DP/PA Installation

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

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

Table 3.6 – Profibus cable specifications

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

The Profibus DP cable is a shielded twisted pair cable.

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

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

Key Specifications
• Capacitance/ft = 8.5 pF

• Nominal Impedance (ohms) – 150.0

Network Wiring - Profibus PA
Please refer to IEC 61158 & ANSI/ISA S.50.02 Part 2-1992 for network wiring guidelines. Refer to Table 3.5 for connections.

3.3.10 Network Wiring – DeviceNet

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

Table 3.7 – DeviceNet cable specifications

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

Please refer to Table 3.4 for connections.

3.3.11 HART Installation Wiring

HART, or Highway Addressable Remote Transducer, is a digital signal over analog 4-20 mA communications. Please consult LMENIM2340, HART Network Installation and Operation Manual for correct wiring preparation and installation.

3.3.12 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.

3.3.13 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 3.21. This is in addition to the ground connection inside the terminal compartment.

3.4 Terminal Block Shield Installation

STEP 1

Remove terminal block cover.

STEP 2

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

STEP 3

Remount terminal block cover.

Figure 3.19 – Terminal block shield

M3 X 5 SELF LOCK SCREW

USE QTY. OF TWO (2) TO MOUNT SHIELD. USE 2 SCREWS FROM TERMINAL BLOCK OR FROM END USERS BAG.

SHIELD-TERMINAL BLOCK
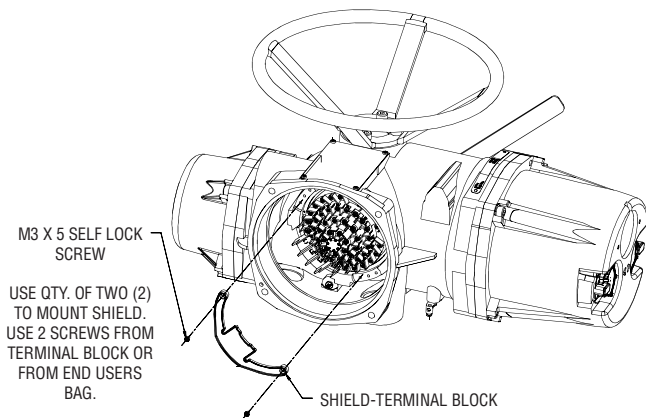
3.5 Commissioning the Actuator

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

After making the initial electrical connections detailed in Section 3.3, 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 knob in the "LOCAL" position.

2. Move the black knob to the "OPEN" or "CLOSE" position.

For configuring the actuator:

1. Place the red knob in the "STOP" position.

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

The OPEN and CLOSE position limits must be set after the actuator has been mounted on the valve. See Section 3.5.4, Setting Position Limits. All other actuator parameters are factory-set either in accordance with a Limitorque standard set of default values (see Section 3.5.1, 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:

• When Open stopped by position limit; Open seating (position)

• When Close stopped by position limit; Close seating (position)

• Maintained local control; Mode (maintained)

• Clockwise to close; Close direction (CW)

• ESD – User configurable inputs; default is "OFF"

• Inhibits on; Inhibit status (Default = OFF)

• Remote control – three-wire maintained

• Password – 100

*Figure 3.20 – User network connection for loop topology/
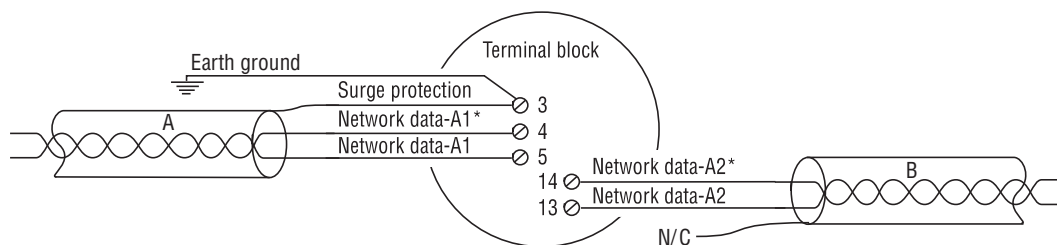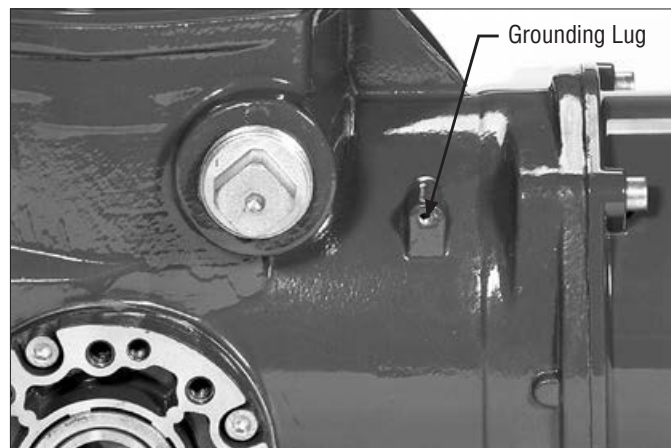Typical for all two-wire network protocols*

Figure 3.21 – External earth/ground connection – housing

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

Table 3.8 – Default configurations

Modutronic Option	Modbus RTU protocol
Proportional band – 5%	9600 baud
Deadband – 2%	Analog scale = 0-100
Polarity – 20 mA = Open	Proportional band – 5%
Action on loss of signal = Close	Deadband – 2%
FF Option and PB Option	Offset – 0 mA
Analog scale = 0-100	
Proportional band – 5%	
Deadband – 2%	

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

3.5.2 View the Existing Settings

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

1. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.

2. Select the dialog language. Toggle "NO" to scan the language options. Select "YES" when the desired language appears on the LCD.

3. Scan menu selections on LCD and select "YES" when "VIEW SETTINGS" appears.

4. Scan through the series of displays and answer "YES" or "NO" at the appropriate prompts. Each display shows the state or value of the existing settings. See Figure 3.22.

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

3.5.3 Entering the Setup Mode

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

Enter the "SETUP" mode as follows:

1. Place the red knob in the "STOP" position.

2. Within 10 seconds, place the black control knob in the "YES" position, then the "NO" position, then again in the "YES" position (in quick succession—approximately one-two seconds).

3. The LCD will display "SETUP?" for 10 seconds. If no action is taken within the 10 seconds, the unit will return to "STATUS OK."

4. Using the black knob, answer "YES" or "NO" to the questions appearing on the LCD display.

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

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

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

Figure 3.22 – View settings
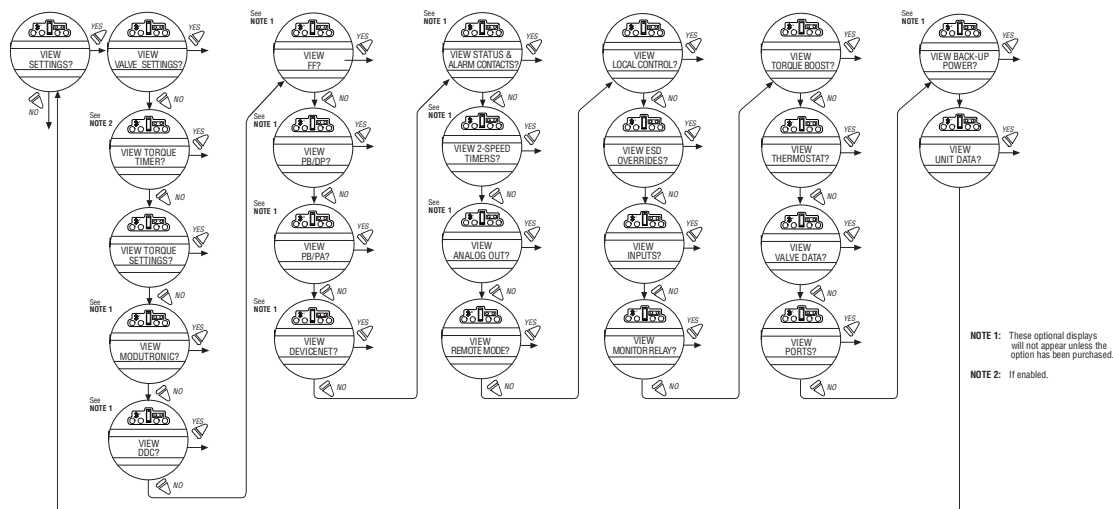
3.5.4 Setting Position Limits

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

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

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

Set Close Position Limit (Handwheel Operation)
1. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.

2. Enter "POSITION SETUP?" routine.

3. From the "SET CLOSE POSITION LIMIT?" display, select "YES." "CLOSE VALVE OK?" will be displayed on the LCD.

4. Engage manual override as detailed in Section 3.6.1, Manual Operation.

5. Ensure that the valve is fully closed.

6. Move the valve in the open direction for one handwheel turn to allow for coasting of the motor.

7. When the valve is positioned correctly, select "YES" again. The LCD will display "SAVE CLOSE LIMIT OK?"

8. Select "YES."

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

1. Move the valve in the open direction. The close lamp should extinguish with approximately one turn of the handwheel.

2. Move the valve back in the close direction and check that the close lamp illuminates just before the full close position is reached (approximately ½ to 1 turn).

3. Select "YES" at the "SET OPEN POSITION LIMIT?" prompt.

4. Set Position Precision? The MX permits position to be reported to the User in either default mode of XXX% OPEN, or single precision mode of XXX.X% OPEN. This may be preferred in Modulating or other positioning applications such as network move-to, analog fail move-to, communication loss move-to, or ESD move-to.

If the calibration requires adjustment:

1. Select "NO" at the "SET OPEN POSITION LIMIT?" prompt.

2. Repeat the "SET CLOSE POSITION LIMIT?" routine.

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

Set Open Position Limit (Handwheel Operation)

1. From the "SET OPEN POSITION LIMIT?" display, select "YES." "OPEN VALVE OK?" will be displayed on the LCD.

2. Engage manual override as detailed in Section 3.6.1, Manual Operation.

3. Ensure that the valve is fully open.

4. Move the valve in the close direction for one handwheel turn to allow for coasting of the motor.

5. When the valve is positioned correctly, select "YES" again. The LCD will display "SAVE OPEN LIMIT OK?"

6. Select "YES."

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

1. Move the valve in the close direction. The open lamp should extinguish with approximately one turn of the handwheel.

2. Move the valve back in the open direction and check that the open lamp illuminates just before the full close position is reached (approximately ½ to 1 turn).

3. Select "YES" at the "SET OPEN POSITION LIMIT?" prompt or "NO" to exit "POSITION SETUP?" dialog.

If the calibration requires adjustment:

1. Select "NO" at the "SELECT CLOSE POSITION LIMIT?" prompt.

2. Repeat the "SELECT OPEN POSITION LIMIT?" routine.

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

Set Close or Open Position Limit (Electrical Operation)

1. Enter the "SETUP" mode detailed in Section 2.1.1, Entering the Setup Mode.

2. Enter "POSITION SETUP?" routine.

3. During "CLOSE VALVE - OK?" or "OPEN VALVE - OK?," move the red knob to "LOCAL" and use the "OPEN" and "CLOSE" switch.

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

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

CLOSE VALVE RETURN TO STOP   **OR**   **OPEN VALVE RETURN TO STOP**
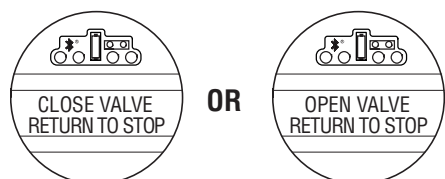
2. Once the "CLOSE" or "OPEN" valve position limit has been reached, return the red knob to "STOP" and complete setting the "CLOSE" or "OPEN" position limit. See Figure 3.23.

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

⚠ **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: "KEEP OPEN(CLOSE) LIMIT?"

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 re-booting stating "IDENTICAL LIMITS". THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 3.23 – Position setup – electrical operation
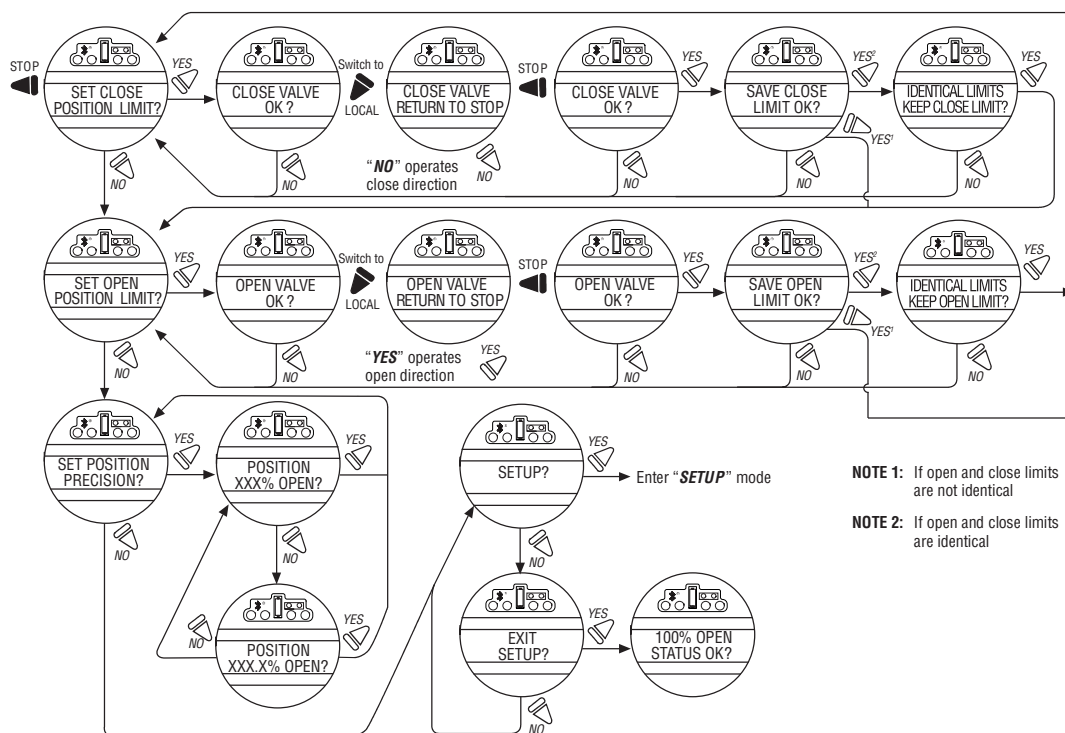
Moving the red knob from "STOP" to "LOCAL" or "REMOTE" automatically saves to non-volatile memory all the changes that have been made.

3.6 Operating the MX Actuator

3.6.1 Manual Operation

Operate the actuator with the handwheel as follows:

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

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

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

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

Figure 3.24 – Declutch lever shows direction of engagement (MX-05 shown)

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 the maintained mode, the actuator can be controlled locally from the control panel.

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

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

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

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

3.6.4 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/CLOSE" mode will be prevented.

2. Rotating the red selector knob to the "STOP" position will automatically stop the actuator regardless of the remote control signal unless ESD override has been selected. See Section 4.18, ESD (Emergency Shutdown) Overrides.

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

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

3.6.5 Local Indication

Figure 3.25 – Control panel
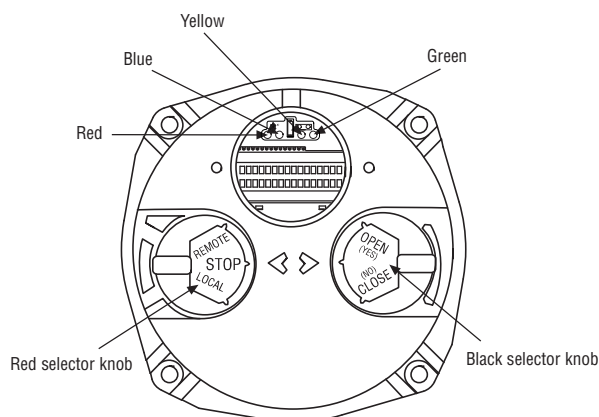
Table 3.9 – LED indicators – default settings

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

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

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

4   Customizing the Actuator

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

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

4.1 Changing the Existing Settings

1. Verify main power is ON.

2. Enter the "SETUP" mode as detailed in Section 2.1.1, Entering the Setup Mode.

3. Answer "YES" to "Change Settings."

4. Enter password if required. See Section 4.2, Password Entry. To change any of the existing settings or to set the end-of-travel limits for the Open and Close positions of the valve, it may be necessary to enter a password.

5. Answer "YES" or "NO" to each of the following groups of setup data. A "YES" allows the selected setup data group menu to be displayed. A "NO" moves the user to the next setup data group. For details of each data group, see Sections 4.2 – 4.27, Password Entry through Change Port.

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

- LCD contrast
- Password
- Motor thermostat
- Valve Data
- Port
- Back-up Power
- Restricted Setup (consult factory)

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

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

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

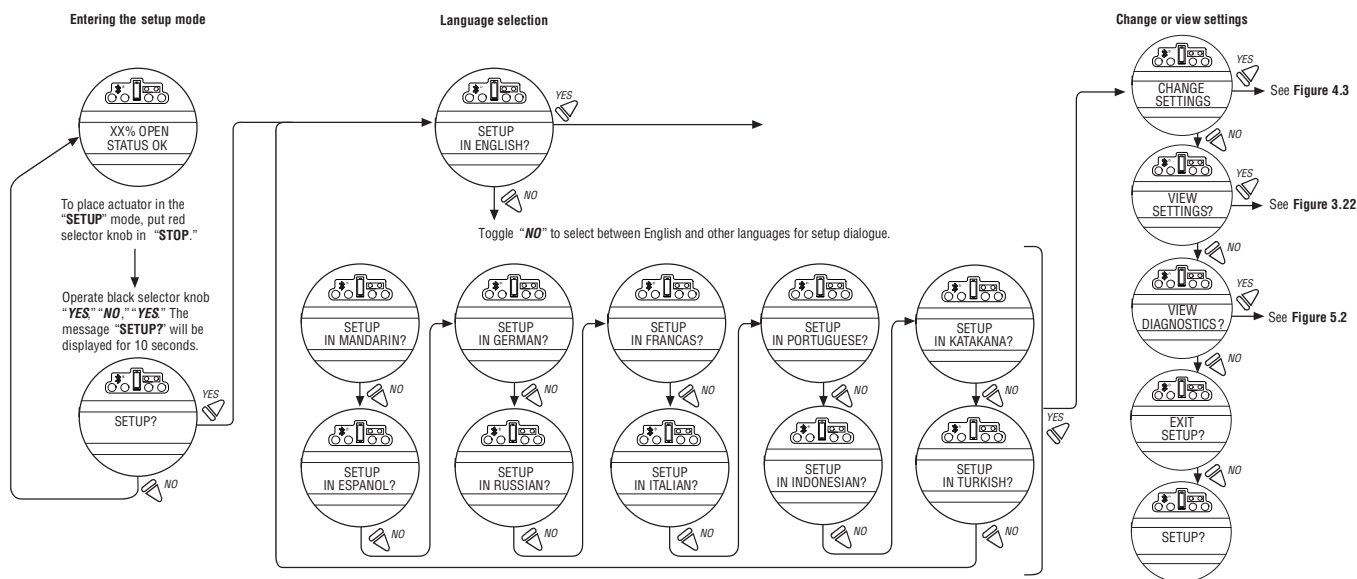*Figure 4.1 – Entering the setup mode*
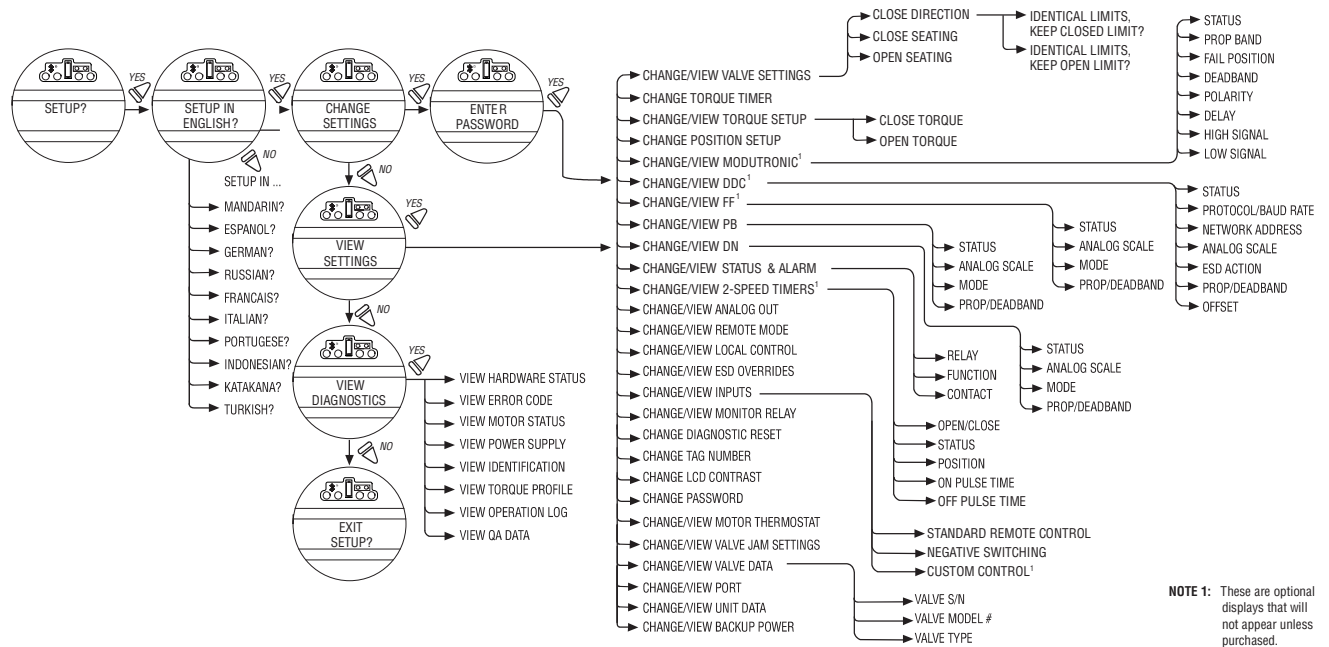
FLOWSERVE

Figure 4.2 – Main menu selections

CLOSE DIRECTION
CLOSE SEATING
OPEN SEATING
IDENTICAL LIMITS, KEEP CLOSED LIMIT?
IDENTICAL LIMITS, KEEP OPEN LIMIT?
STATUS
PROP BAND
FAIL POSITION
DEADBAND
POLARITY
DELAY
HIGH SIGNAL
LOW SIGNAL

SETUP?
SETUP IN ENGLISH?
CHANGE SETTINGS
ENTER PASSWORD
SETUP IN ...
MANDARIN?
ESPANOL?
GERMAN?
RUSSIAN?
FRANCAIS?
ITALIAN?
PORTUGESE?
INDONESIAN?
KATAKANA?
TURKISH?

VIEW SETTINGS
VIEW DIAGNOSTICS
EXIT SETUP?

VIEW HARDWARE STATUS
VIEW ERROR CODE
VIEW MOTOR STATUS
VIEW POWER SUPPLY
VIEW IDENTIFICATION
VIEW TORQUE PROFILE
VIEW OPERATION LOG
VIEW QA DATA

CHANGE/VIEW VALVE SETTINGS
CHANGE TORQUE TIMER
CHANGE/VIEW TORQUE SETUP
CHANGE POSITION SETUP
CHANGE/VIEW MODUTRONIC[1]
CHANGE/VIEW DDC[1]
CHANGE/VIEW FF[1]
CHANGE/VIEW PB
CHANGE/VIEW DN
CHANGE/VIEW STATUS & ALARM
CHANGE/VIEW 2-SPEED TIMERS[1]
CHANGE/VIEW ANALOG OUT
CHANGE/VIEW REMOTE MODE
CHANGE/VIEW LOCAL CONTROL
CHANGE/VIEW ESD OVERRIDES
CHANGE/VIEW INPUTS
CHANGE/VIEW MONITOR RELAY
CHANGE DIAGNOSTIC RESET
CHANGE TAG NUMBER
CHANGE LCD CONTRAST
CHANGE PASSWORD
CHANGE/VIEW MOTOR THERMOSTAT
CHANGE/VIEW VALVE JAM SETTINGS
CHANGE/VIEW VALVE DATA
CHANGE/VIEW PORT
CHANGE/VIEW UNIT DATA
CHANGE/VIEW BACKUP POWER

CLOSE TORQUE
OPEN TORQUE

STATUS
ANALOG SCALE
MODE
PROP/DEADBAND

STATUS
PROTOCOL/BAUD RATE
NETWORK ADDRESS
ANALOG SCALE
ESD ACTION
PROP/DEADBAND
OFFSET

RELAY
FUNCTION
CONTACT
STATUS
ANALOG SCALE
MODE
PROP/DEADBAND

OPEN/CLOSE
STATUS
POSITION
ON PULSE TIME
OFF PULSE TIME

STANDARD REMOTE CONTROL
NEGATIVE SWITCHING
CUSTOM CONTROL[1]

VALVE S/N
VALVE MODEL #
VALVE TYPE

NOTE 1: These are optional displays that will not appear unless purchased.

Figure 4.3 – Changing settings

CHANGE SETTINGS?
ENTER PASSWORD
CHANGE VALVE SETUP?
CHANGE TORQUE TIMER?
CHANGE TORQUE SETUP?
CHANGE POSITION SETUP?

CHANGE MODUTRONIC?
CHANGE DDC?
CHANGE FF?
CHANGE PB/DP?

CHANGE PB/PA?
CHANGE DEVICENET?
CHANGE STATUS &ALARM CONTACTS?
CHANGE 2-SPEED TIMER?

CHANGE ANALOG OUT?
CHANGE REMOTE MODE?
CHANGE LOCAL CONTROL?
CHANGE ESD OVERRIDES?

CHANGE INPUTS?
CHANGE MONITOR RELAY?
CHANGE DIAGNOSTIC RESET?
CHANGE TAG?

CHANGE LCD CONTRAST?
CHANGE PASSWORD?
CHANGE TORQUE BOOST?
CHANGE MOTOR THERMOSTAT?

CHANGE VALVE DATA?
CHANGE PORT?
CHANGE BACK-UP POWER?
RESTRICTED SETUP?

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

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4.2 Password Entry

Default = 100

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

1. Enter the password digit by digit. The password is a three-digit number, ranging from 000-999. The factory default is 100.

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

Figure 4.4 – Password entry
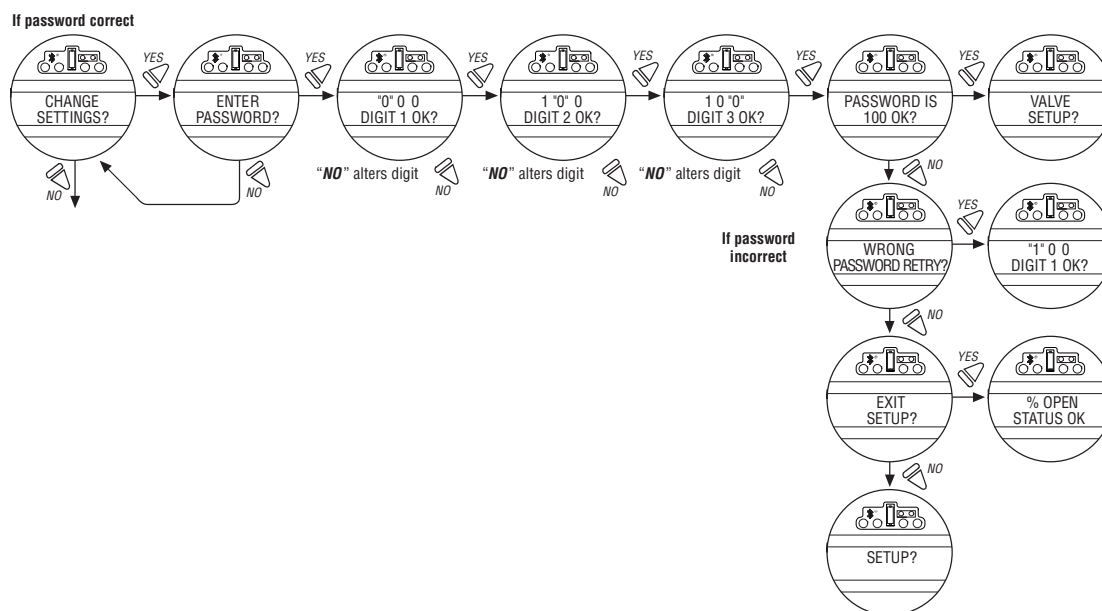
4.3 New Password

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

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

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

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

Figure 4.5 – New password
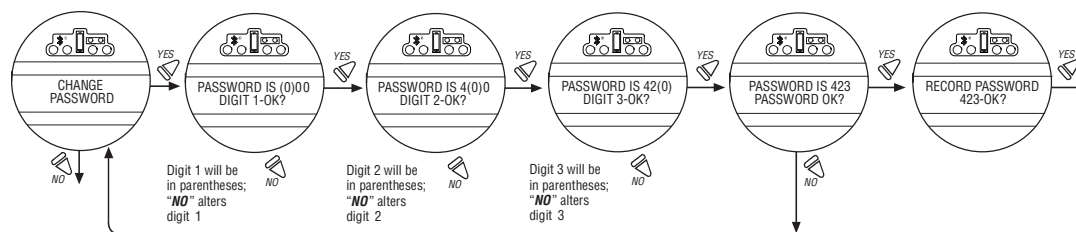
4.4 Valve Setup

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

4.4.1 Close Direction

Default = CW to Close

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

1. Engage manual override and check whether the valve closes with CW or CCW rotation of the handwheel.

2. Select "NO" until the required direction is displayed, then "YES."

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

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

4.4.2 Close Seating

Default = Position Seating

1. Configure the actuator to close on "TORQUE" limit for seating valve types such as wedge gate and globe.

2. Select "POSITION" limit for valve types such as ball, butterfly, plug, sluice gate, parallel slide, knife gate, and through conduit.

3. Select "NO" until the required seating is displayed.

4. Select "YES."

4.4.3 Open Seating

Default = Position Seating

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

1. Select "NO" until the required seating is displayed.

2. Select "YES" to return to the "VALVE SETUP?" display.

4.5 Torque Switch Timer

Torque switch timer permits a user to select a time 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 one (1) second to a maximum of fifteen (15) seconds. The default is five (5) seconds.

NOTE: It should be noted that 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. From "VALVE SETUP?" select "NO" to enter "CHANGE TORQUE TIMER" routine. This option will only appear if either the open or close valve setting is set to torque seating.

2. Select "YES" to change setting. If "NO" is selected, the "POSITION SETUP?" routine will be entered.

4.5.1 Status

Default = ON

1. Select "NO" to change torque timer status to "OFF". If "OFF" is selected you will not advance to timer selection for that direction.

4.5.2 Torque Timer

The timer value is how long in seconds that the unit will run once it has passed the expected position limit.

Default = 5 seconds

1. Select "NO" to increase the timer value. The timer is configurable from 1-15 seconds. The counter will wrap around to 1 second when you attempt to increase after 15 seconds.

NOTE: If the unit is only setup for open torque seating, then only the open torque timer will be available to change. This is the same with close torque seating and the close torque timer. If both open and close torque seating are selected then you will be prompted to change close torque timer first, followed by open torque timer.

Figure 4.6 – Torque Switch Timer
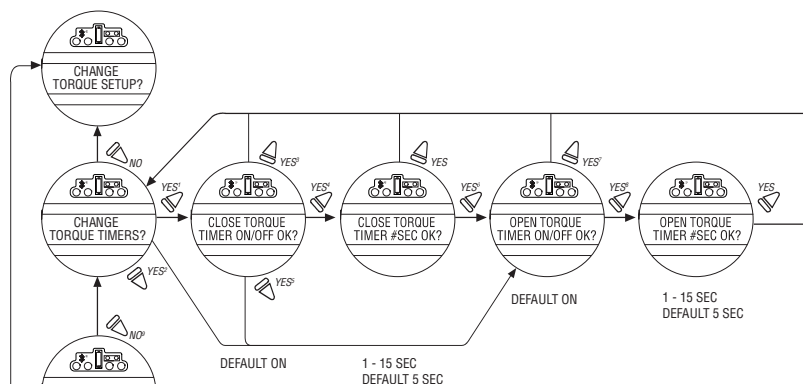
Note 1: YES & CLOSE Torque Seated
Note 2: YES & OPEN Torque Seated CLOSE Position Seated
Note 3: YES & TIMER OFF
Note 4: YES & TIMER ON
Note 5: YES & TIMER OFF & OPEN Torque Seated

Note 6: YES & OPEN Torque Seated
Note 7: YES & TIMER OFF
Note 8: YES & TIMER ON
Note 9: NO & Open or Close Torque Seated
Note 10: NO & OPEN/CLOSE Position Seated

4.6 Torque Setup

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

1. From "VALVE SETUP?" or "CHANGE TORQUE TIMER?" (if enabled) select "NO" to enter the "TORQUE SETUP?" routine.

2. Select "YES" to change the settings.

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

NOTE: Except for arctic temperature actuators (-30°C or below), which permit torque to be changed from 60%-100%.
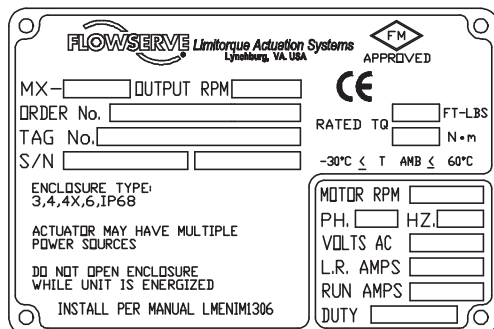
4.6.1 Close Torque Valve or Open Torque Valve

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

To Increase the % of Torque Required:
1. Select "NO" until the desired % is indicated.

2. Select "YES" to save the required torque.

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

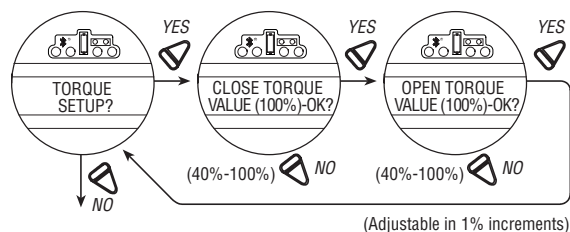*Figure 4.7 – MX Nameplate*

Figure 4.8 – Torque setup

4.7 Position Setup

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

4.7.1 Set Position Limits for Electrical Operation

1. Set closed valve position. At the "CLOSE VALVE–OK?" prompt, move the red control knob to "LOCAL." Hold the black control knob in the "CLOSE" position until the valve has reached the desired position. Move the red control knob to "STOP."

2. Set the open valve position. At the "OPEN VALVE–OK?" prompt, move the red control knob to "LOCAL." Hold the black control knob in the "OPEN" position until the valve has reached the desired position. Move the red control knob to "STOP."

3. Inspect for correct operation. If the position limits are set adjacent to each other then an error message will be displayed: "KEEP OPEN (CLOSE) LIMIT?" The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running actuator electrically.

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

⚠ **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 of each other, an error message will be displayed: "KEEP OPEN(CLOSE) LIMIT?"

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 re-booting stating "IDENTICAL LIMITS". THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

4.7.2 Set Position Limits for Manual Operation

1. Set close position. At "SET CLOSE POSITION LIMIT?" answer "YES." At "CLOSE VALVE-OK?" depress declutch lever and slowly rotate handwheel until clutch is fully engaged. Release declutch lever; the clutch will stay in hand-wheel mode. If the valve is fully closed, move the handwheel one turn in the open direction to allow for coasting of the motor. When valve is in the desired location, select "YES." At "SAVE CLOSE LIMIT-OK?" select "YES" to set the close position or "NO" to adjust the setting.

2. Set open position. At "SET OPEN POSITION LIMIT?" select "YES" to get "OPEN VALVE-OK?." Engage the clutch (see step 1). Valve should be fully opened. Move the handwheel one turn toward the closed position to allow for coasting of the motor. When valve is in the desired location, select "YES" again to set the open position or "NO" to adjust the setting.

3. Checking the settings. Turn the handwheel and verify that the open and close LED's function correctly (see Checking the Settings). If adjustments are necessary, select "NO" to return to "CHANGE POSITION SETUP?" and repeat from step 1.
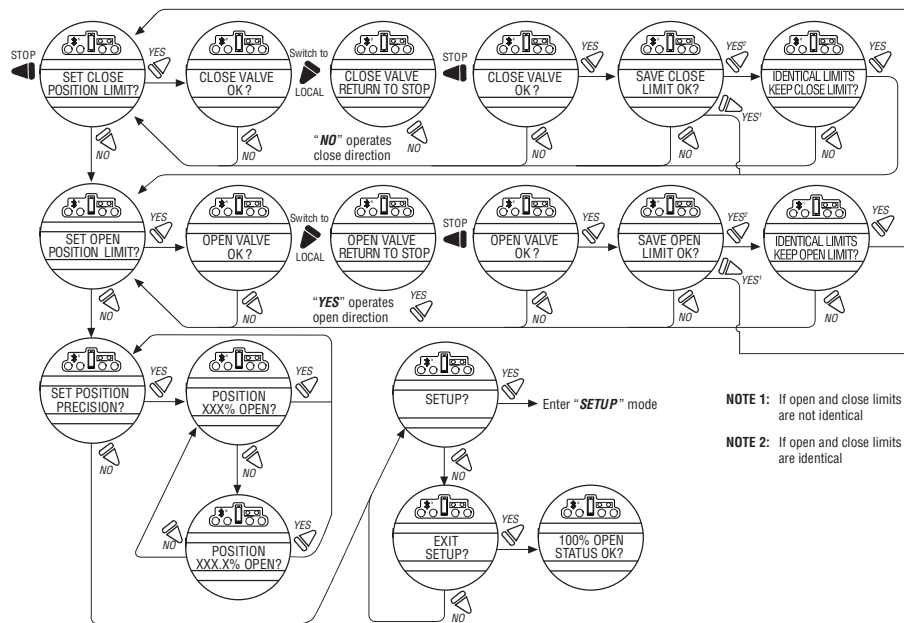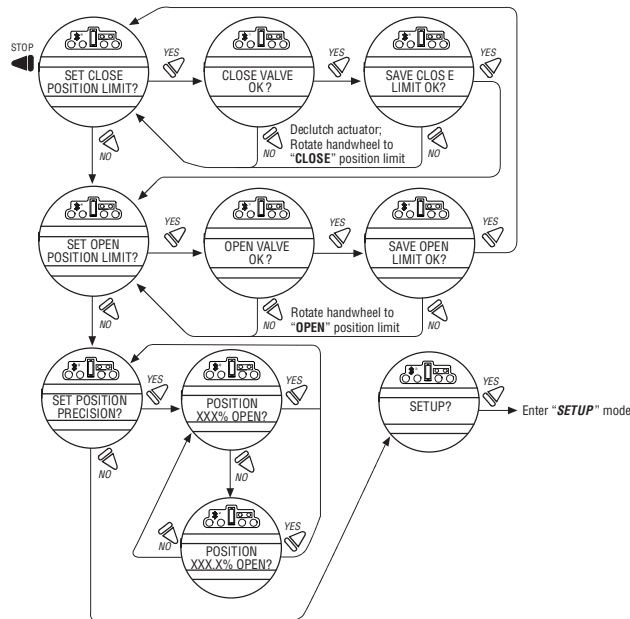
Figure 4.9 – Electrical operation

NOTE 1: If open and close limits are not identical

NOTE 2: If open and close limits are identical

Figure 4.10 – Handwheel operation

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4.8 Modutronic Option

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

• If the Modutronic option has been purchased, it is automatically calibrated when position limits are set. No further adjustments are required, unless the defaults do not suit the application.

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

4.8.1 Status

Default = OFF

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

4.8.2 Proportional Band

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

Default = 5%

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

4.8.3 Fail Position

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

Default = "CLOSE" Position

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

To Change the Default Position:
Select "NO" to choose whether the valve moves to "CLOSE" position, or "OPEN" position, or "STOP" (stops) in its present position at the time of signal failure.

4.8.4 Deadband

Default = 2%

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

To Change from the Default:
Select "NO" to adjust the value between 1% and 50%, in 1% increments to suit the application, or 0.5% to 50.0% if the position precision is set to XXX.X%.

4.8.5 Polarity (20 mA)

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

Default Setting is: 20 mA = Full Open

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

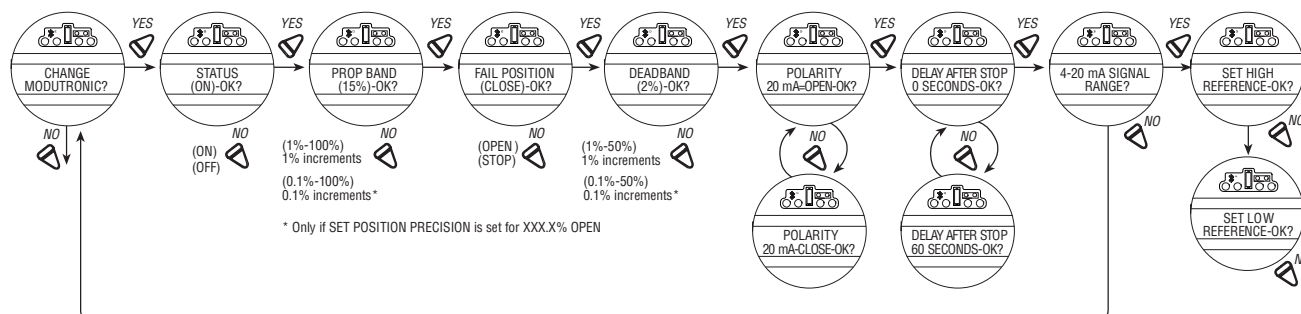Choose between: 20 mA = Full Close or Full Open.

4.8.6 Delay After Stop

Default setting = 0 seconds

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

Figure 4.11 – Modutronic option

4.8.7 4-20 mA Signal Range

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

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

Default Setting for Low Reference = 4 mA

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

## 4.8.8 Set High Reference

Default = 20 mA

1. Select "NO" to accept pre-existing setting (no change).

2. Select "YES" to enter the display "APPLY HIGH LEVEL CONTROL SIGNAL."

3. Apply this signal to terminal 19 and 20 indicated on the wiring diagram.

4. Select "YES" again to record this signal as the high reference. See Figure 4.10.

4.8.9 Set Low Reference

Default = 4 mA

1. Select "NO" to move from "SET HIGH REFERENCE" to "SET LOW REFERENCE."

2. Select "YES" to enter the display "APPLY LOW LEVEL CONTROL SIGNAL."

3. Using a calibrator, apply the low signal, and select "YES" to record this signal as the low reference.

Figure 4.12 – Modutronic signals

Flow to "**CHANGE MODUTRONIC**"
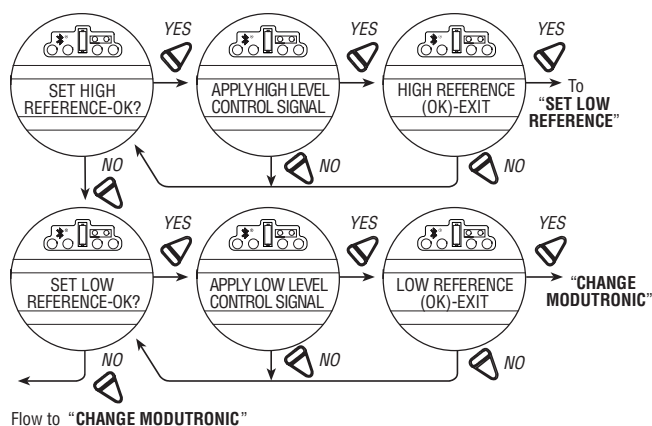
4.8.10 Modutronic LCD Display

When the Modutronic option has been purchased, is set to "ON," and the red selector switch is in "REMOTE," the normal LCD display will read:
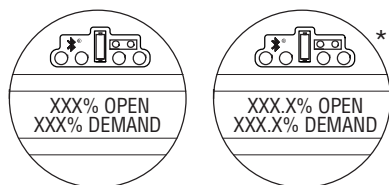
* If SET POSITION PRECISION is set to XXX.X% OPEN

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

4.9 DDC/Modbus Option

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

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

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

4.9.1 Status

Default = ON

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

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

4.9.2 Network Address

Default = 1

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

1. The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network.

2. Select "NO" for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 250.

4.9.3 Protocol

Default = Modbus RTU 9600 Baud

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

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

4.9.4 Analog Scale

Default = 0-100

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

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

4.9.5 ESD Action

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

Figure 4.13 – DDC
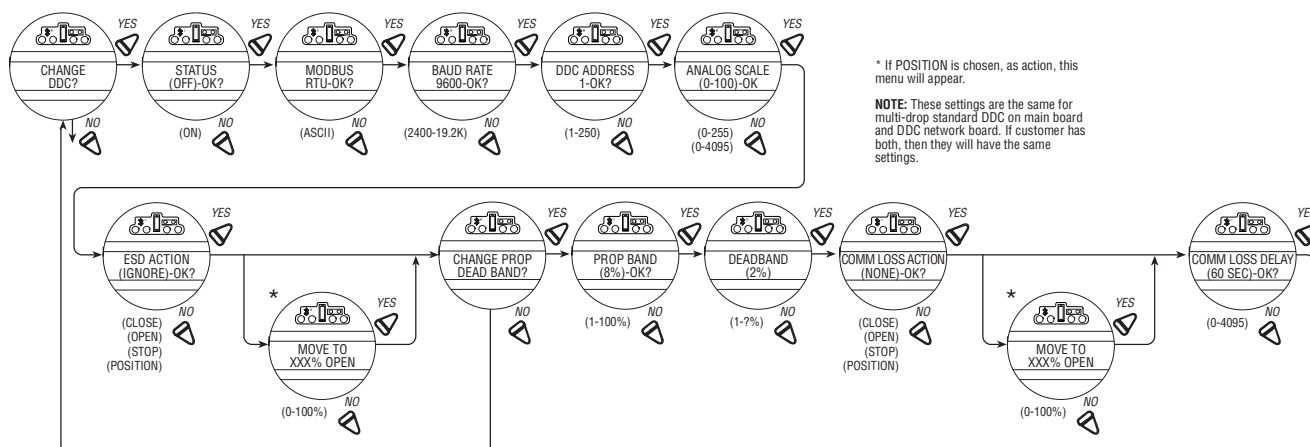
4.9.6 Proportional Band

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

Default = 5%

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

4.9.7 Deadband

Default = 2%

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

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

4.9.8 Offset

Default = 4 mA/20 mA

No options are available. Select "YES."

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

4.9.9 Move To

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

4.9.10 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.9.11 Comm Loss Action

Default = None

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

4.10 FF Option

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

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

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

4.10.1 Status

Default = ON

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

4.10.2 Analog Scale

Default = 0-100

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

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

4.10.3 ESD Action

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

4.10.4 OPEN/CLOSE Mode

Default = YES

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

4.10.5 Proportional Band

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

Default = 5%

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

4.10.6 Deadband

Default = 2%

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

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

Figure 4.14 – FF
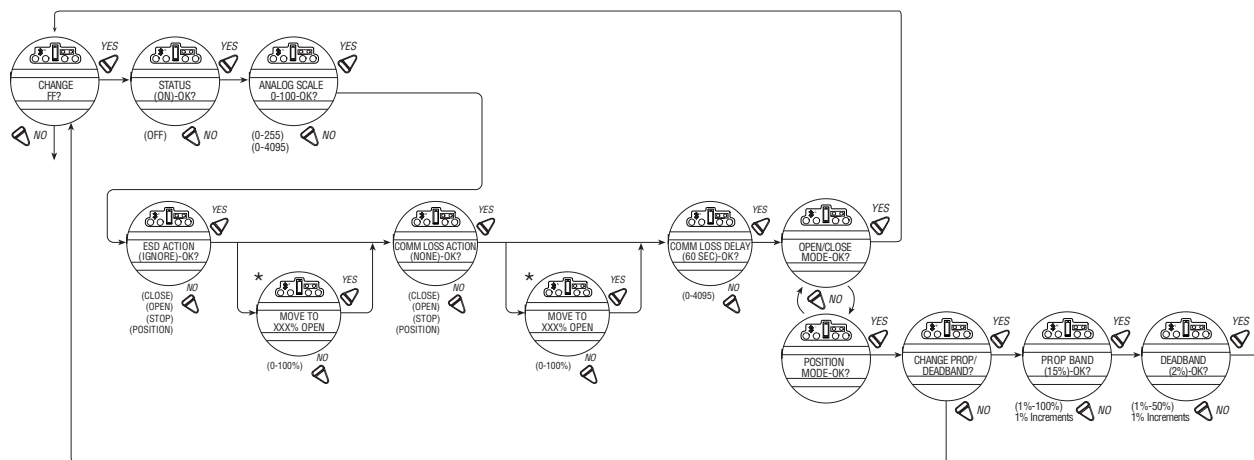
* If POSITION is chosen, as action,
this menu will appear.

4.10.7 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.10.8 Comm Loss Action

Default = None

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

4.11 PB Option

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

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

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

Figure 4.15 – Profibus DP

* If POSITION is chosen, as action,
this menu will appear.
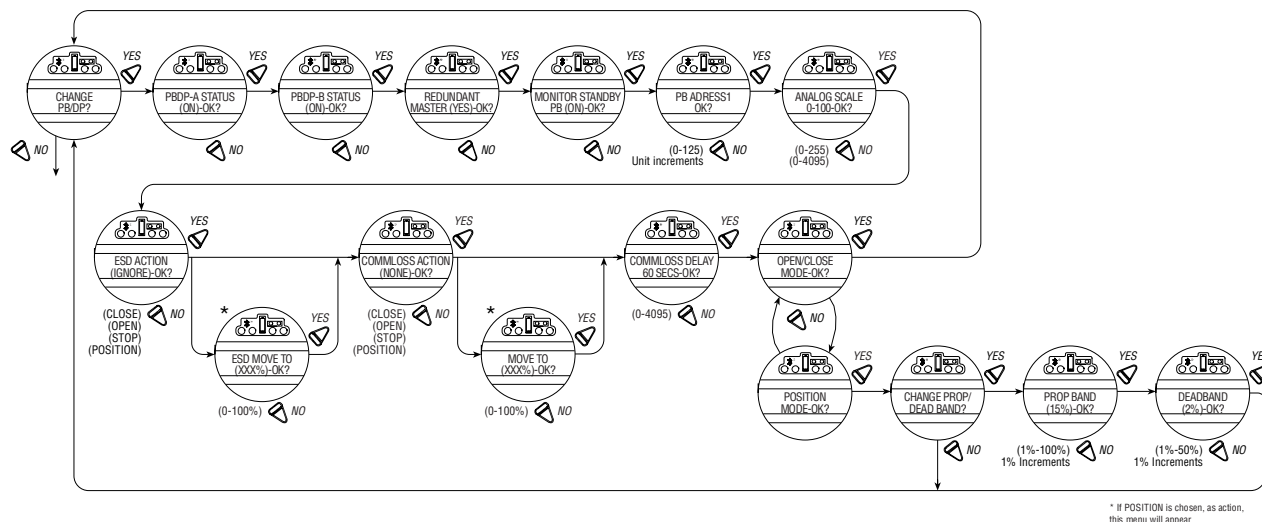
4.11.1 Status

Default = ON

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

4.11.2 PB DP Operation

Figure 4.15 illustrates the setup sequence for the MX/QX PB DP field unit. For proper operation, either Position Mode or Open/Close Mode must be selected.

Follow these steps to enter and configure the setup mode:

1. Proceed through the Setup to the CHANGE PBDP? display.

2. Select YES to proceed to the PBDP-A STATUS (ON)-OK? display. PBDP-A Status enables the user to change from the default condition to turn on and off the digital control capability of the actuator.

3. Select YES to proceed to the PBDP-B STATUS (ON)-OK? display. PBDP-B Status enables the user to change from the default condition to turn on and off the redundant digital control capability of the actuator, if installed.

4. Select YES to proceed to the REDUNDANT MASTER (YES)-OK? display. Selecting REDUNDANT MASTER will allow for System Redundancy with two independent connections to Profibus masters. REDUNDANT MASTER must be set to NO for Flying Redundancy (single Profibus master connection).

5. If YES is selected, MONITOR STANDBY PB (ON)-OK? is displayed.

6. To allow the standby Profibus master to monitor the health of the actuator's standby PB DP board, select YES.

7. The unit will display PB ADDRESS 1–OK? If OK, select YES. If NO, select different address (1-125).

8. Select YES to proceed to the ANALOG SCALE display.

9. From ANALOG SCALE, if the default value of 0-100 is OK, select YES. If not, select NO.

10. If YES is selected, ESD ACTION (IGNORE) – OK? is displayed.

11. For ignoring ESD ACTION, select YES. For setting ESD ACTION, select NO. If POSITION is chosen as action, ESD MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.

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12. If YES is selected, COMM LOSS ACTION (NONE) – OK? is displayed.

13. For no COMM LOSS ACTION, select YES. For setting COMM LOSS ACTION, select NO. If POSITION is chosen, as action, COMM LOSS MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.

14. If YES is selected, COMM LOSS DELAY (60 SEC) – OK? is displayed.

15. For a 60-second delay, select YES. Otherwise, select NO until the required value is displayed.

16. If YES is selected, OPEN/CLOSE MODE-OK? is displayed.

17. For OPEN/CLOSE MODE, select YES. For POSITION MODE, select NO. In position mode, the host device can set the valve position to any desired value; in OPEN/CLOSE MODE the host can only fully open or fully close the valve. The user must locally configure one of these two modes.

18. Proceed to configure the proportional band and deadband as discussed in the next sections.

4.11.3 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.11.4 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 Close, Open, Stop, Position.

Figure 4.16 – Profibus PA
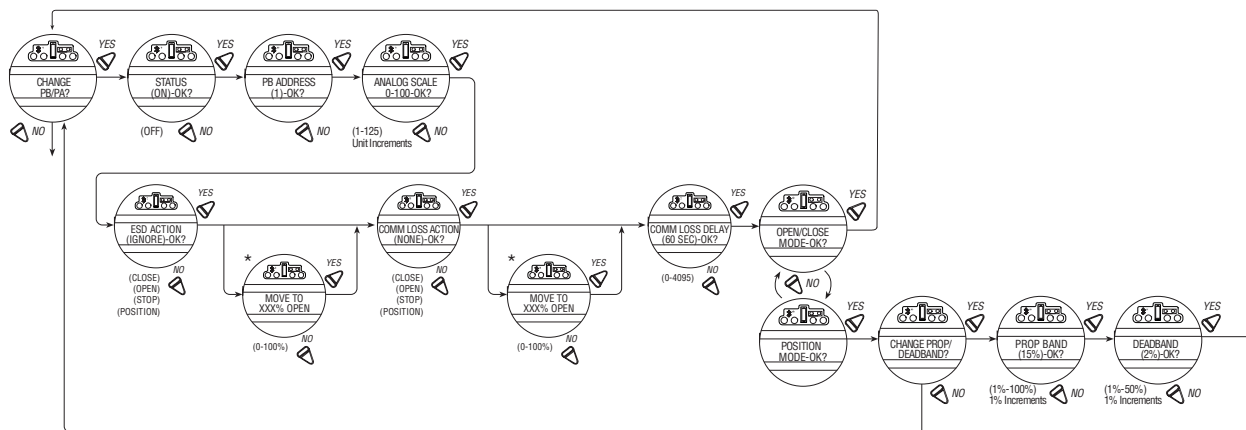
4.12 DN Option

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

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

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

4.12.1 Status

Default = ON

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

4.12.2 Baud Rate

Default = 125K Baud

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

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

4.12.3 Network Address

Default = 1

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

1. The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network.

2. Select "NO" for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 63.

4.12.4 Analog Scale

Default = 0-100

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

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

4.12.5 ESD Action

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

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4.12.6 Proportional Band

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

Default = 5%

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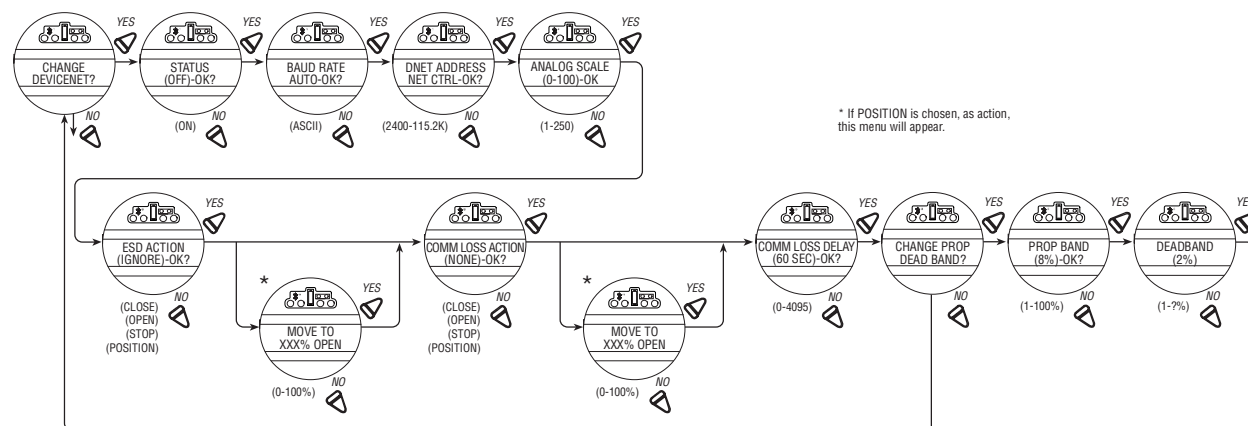
4.12.7 Deadband

Default = 2%

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

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

Figure 4.17 – DN option

4.12.8 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.12.9 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 Close, Open, Stop, Position.

4.13 HART Option

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 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 consult Limitorque service at (434) 528-4400.

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

Figure 4.18 – HART
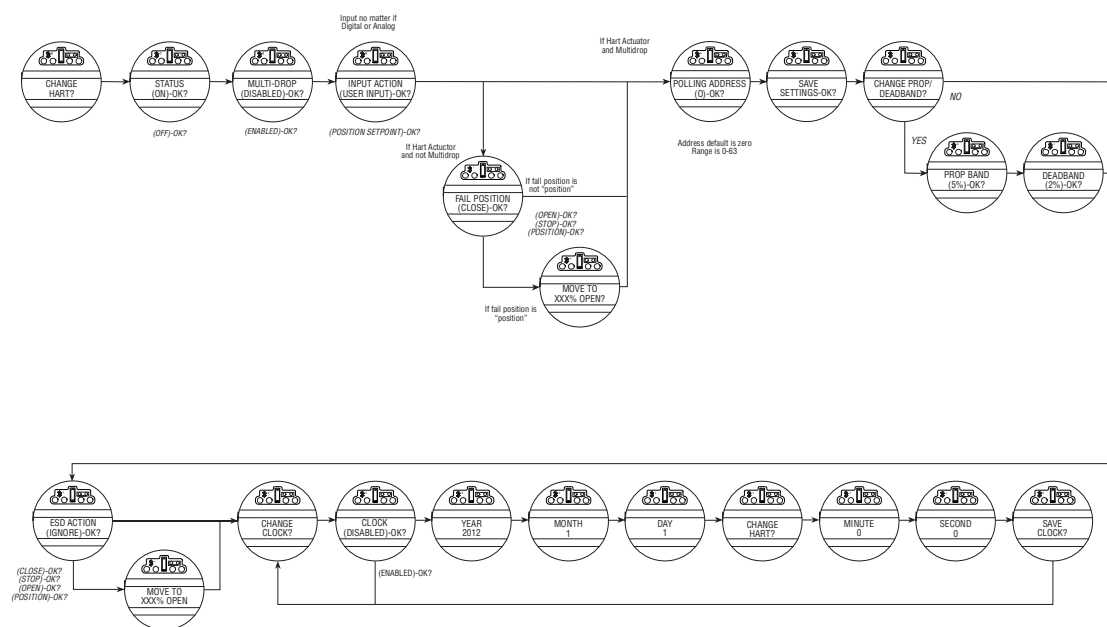
4.13.1 Status

Default = ON

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

4.13.2 Multi-drop

Default = Disabled

MULTI-DROP (ENABLED) or (DISABLED) allows the user to select the desired network topology. To change the setting, select NO until the required option is displayed. Select YES if the setting is correct to go to the next display.

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

4.13.3 Input Action

Default = User Input

INPUT ACTION allows the user to set the input action as USER INPUT or POSITION SETPOINT.

NOTE: If MULTI-DROP ENABLED was chosen, skip to POLLING ADDRESS. Otherwise, FAIL POSITION display is shown. In multi-drop mode the input is digital only (write PV over network), so there is no analog fail action.

4.13.4 Fail Position

Default = Close

FAIL POSITION allows the user to configure the action desired upon loss of the analog input signal. The selections are CLOSE, OPEN, STOP, and POSITION. Select the desired setting and proceed to the next display.

NOTE: If POSITION is chosen as the action, a MOVE TO display will be shown where the user can select the desired position between 0 and 100% open, in one percent increments, by selecting NO until the desired position is selected. Select YES once the setting is correct to go to the next display.

4.13.5 Polling Address

Default = 0

POLLING ADDRESS allows the user to set the HART polling address of the unit. Point-to-Point units are typically set to address 0, and Multi-drop units are typically set from 1-63. HART 5 masters will always set Point-to-Point units to address 0.

4.13.6 Save Settings

SAVE SETTINGS allows the user to save the settings and make them active. This can result in a change in the hardware configuration on the HART board to support the change in configuration. Select NO to return to STATUS and change settings. Select YES to save the HART configuration settings and go to additional network settings.

NOTE: The configuration set in steps 1-6 will not be saved if the user does not select YES for SAVE SETTINGS.

4.13.7 Change Prop / Deadband

CHANGE PROP / DEADBAND allows for the setting of proportional band and deadband. Proportional band is the range of errors between the position and demand signal that will produce reduced speed (pulsing). The default value is 5%. To change from default, select NO until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments. The default deadband value is 2%. For error signals less than this, no motion occurs. The deadband should be wide enough to prevent "hunting" of the actuator but as low as possible to give adequate response to changes in the error signal. To change from the default, select NO to adjust the value between 1% and 50%, in 1% increments to suit the application.

4.13.8 ESD Action

Default = None

ESD ACTION allows a network ESD function to be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to do one of the following: ignore the command (NONE), CLOSE, OPEN, STOP, or POSITION the actuator. To change from the default setting, select NO until the required option is displayed. Select YES if the setting is correct to go to the next display.

NOTE: If POSITION is chosen as the action, a MOVE TO display will be shown where the user can select the desired position between 0 and 100% open, in one percent increments, by selecting NO until the desired position is selected. Select YES once the setting is correct to go to the next display.

4.13.9 Change Clock

CHANGE CLOCK allows the user to select the real time clock settings. Select NO if you do not wish to set the clock and the menus will return to CHANGE HART. Select YES to enable clock and set YEAR, MONTH, DAY, HOUR, MINUTE, and SECOND values. SAVE CLOCK allows the clock settings to be saved. The clock is non-volatile if power is lost or the unit is reset, the clock must be set again. If the clock is enabled, the LCD will display "SET CLOCK" after a power cycle/reset. If the clock is not enabled, the LCD will not display "SET CLOCK". The clock may also be set and read from the network via HART commands 89 and 90. If the clock is not set, the HART board will keep a running counter in place of the clock.

4.14 Status and Alarm Contacts

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

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

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

4.14.1 Status and Alarm Contact Default Settings

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

Status Contacts

S1a – Normally closed contact at valve fully Close

S1b – Normally closed contact at valve fully Open

S2a – Normally open contact at valve fully Close

S2b – Normally open contact at valve fully Open

Alarm Contacts (Optional/requires I/O board)

R1 – Normally closed contact at valve fully Close   R5 – Motor Overtemp

R2 – Normally closed contact at valve fully Open   R6 – Remote Selected

R3 – Normally open contact at valve fully Close   R7 – Overtorque

R4 – Normally open contact at valve fully Open   R8 – Analog I/P (Input)

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

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

4.14.2 Status Function

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

Figure 4.19 – Status and alarm contacts (Shown with optional boards added)
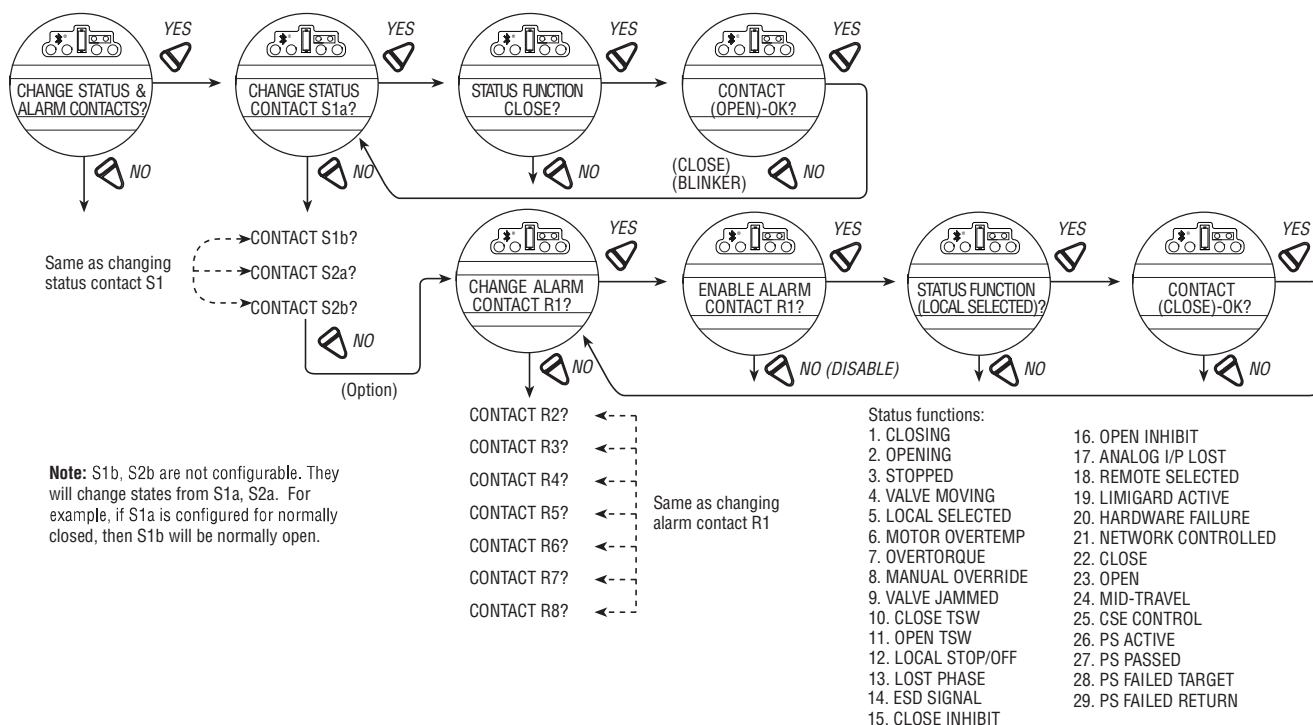
Note: S1b, S2b are not configurable. They will change states from S1a, S2a. For example, if S1a is configured for normally closed, then S1b will be normally open.

Status functions:
1. CLOSING
2. OPENING
3. STOPPED
4. VALVE MOVING
5. LOCAL SELECTED
6. MOTOR OVERTEMP
7. OVERTORQUE
8. MANUAL OVERRIDE
9. VALVE JAMMED
10. CLOSE TSW
11. OPEN TSW
12. LOCAL STOP/OFF
13. LOST PHASE
14. ESD SIGNAL
15. CLOSE INHIBIT
16. OPEN INHIBIT
17. ANALOG I/P LOST
18. REMOTE SELECTED
19. LIMIGARD ACTIVE
20. HARDWARE FAILURE
21. NETWORK CONTROLLED
22. CLOSE
23. OPEN
24. MID-TRAVEL
25. CSE CONTROL
26. PS ACTIVE
27. PS PASSED
28. PS FAILED TARGET
29. PS FAILED RETURN

4.14.3 Contact

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

4.14.4 Valve Position

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

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

4.15 Two-speed Timer (Optional)

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

1. Select "CHANGE 2-SPEED TIMERS?"

2. Select "YES" to enter the "CHANGE OPEN TIMER?" routine.

3. If slow opening is required, select "YES;" otherwise select "NO" to move into the "CHANGE CLOSE TIMER?" routine.

4.15.1 Status

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

4.15.2 Start Position

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

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

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

4.15.3 Stop Position

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

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

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

4.15.4 Pulse Time – ON

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

Default Setting = 2.0 Second

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

Figure 4.20 – Two-speed timers
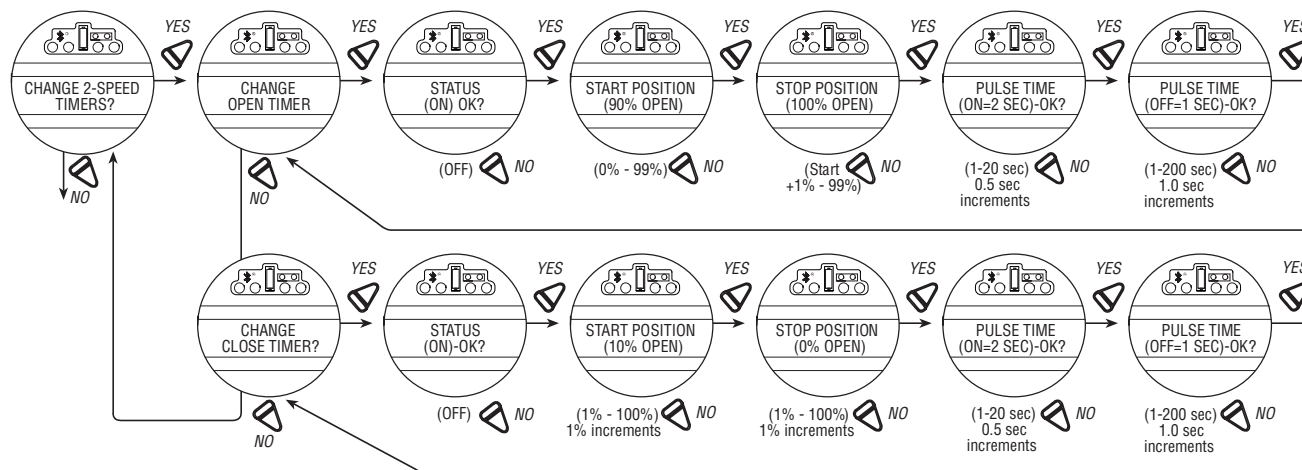
4.15.5 Pulse Time – OFF

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

Default Setting = 1 Second

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

4.16 Analog Output

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

Figure 4.21 – Change analog out

Figure 4.22 – Change analog out voltage – APT

Figure 4.23 – Change analog out current – APT

Figure 4.24 – Change analog out voltage – ATT

Figure 4.25 – Change analog out current – ATT

4.16.1 APT Polarity Option

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

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

During position limit calibration (see Section 3.5.4, Setting Position Limits) the APT is automatically calibrated to default settings: Default = 20 mA OPEN, 4 mA CLOSE.

To Customize the Settings:
1. Select "CHANGE APT?" from the "SETUP" routine. Select "YES."

2. Select "NO" to select the status if OFF. If ON, select "YES" to enter the "Status Function APT?" display. Select "NO" to select ATT display.

3. Select "NO" to select 4 ma/0 VDC2. Select "YES" to enter the "POLARITY" display.

4. Select "NO" to choose between:

    20 mA = OPEN

    or

    20 mA = CLOSE

    OR

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

4.16.2 ATT Polarity Option

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

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

To Customize the Settings:
1. Select "CHANGE ATT?" from the "SETUP" routine, then "YES" to select ATT status as "ON" or "OFF."

2. Select "NO" to select the status if OFF. If ON, select "YES" to enter the "Status Function?" display. Select "NO" to select ATT display.

3. Select "NO" to select 4 ma/0 VDC2. Select "YES" to enter the "POLARITY" display.

4. Select "NO" to choose between:
    20 mA = OPEN
    or
    20 mA = CLOSE
    or

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

4.17 Remote Mode

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

• Multi Control mode (default): There are three modes of remote control for the MX actuator allowed when the remote mode is configured for multi-control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog control operation in initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog signal.

• Digital Control Only: the unit will operate only upon the last digital input command received.

• Network Control Only: the unit will operate only upon the last network command received.

• Analog Control only: the unit will operate only upon the last analog input command received.

Figure 4.26 – Remote mode
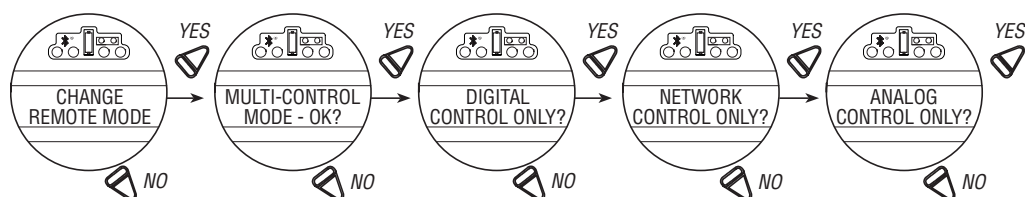
4.17.1 Local Control

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

Default = On & Maintain Mode

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

Figure 4.27 – Local control
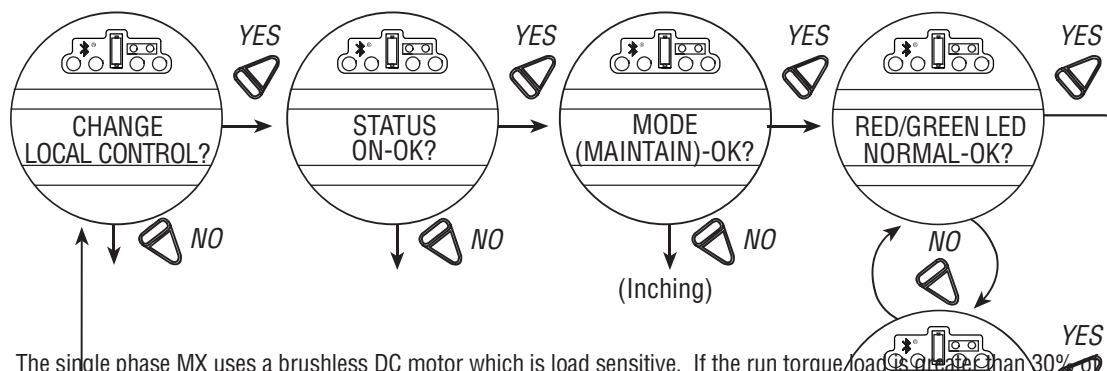
 The single phase MX uses a brushless DC motor which is load sensitive. If the run torque/load is greater than 30% of the torque setting, there is a possibility that the output RPM speed will decrease. For that reason a "Run Load Alarm" is supplied with the single phase MX. The alarm default setting is "Off", but it can be enabled and the minimum speed percentage adjusted per the User's preference. A "High Load Time" can be configured to permit the "Run Load Alarm" to activate after a percentage of the overall cycle time.

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

- Inching mode: the unit will operate only when the black knob is held in the open or close position. If the black knob is released, the unit will stop.

To Customize the Settings:

1. Select "CHANGE LOCAL CONTROL?" from the "SETUP" routine.

2. Select "YES" to enter the mode display.

3. Select "NO" to change from Maintain to Inching control.

4.17.2 LED Customization

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

Default = Red-Open/Green-Close

1. After mode selection, select "YES" to change the colors of the LEDs.

2. Select "NO" to change from the default to Red-Close/Green-Open.
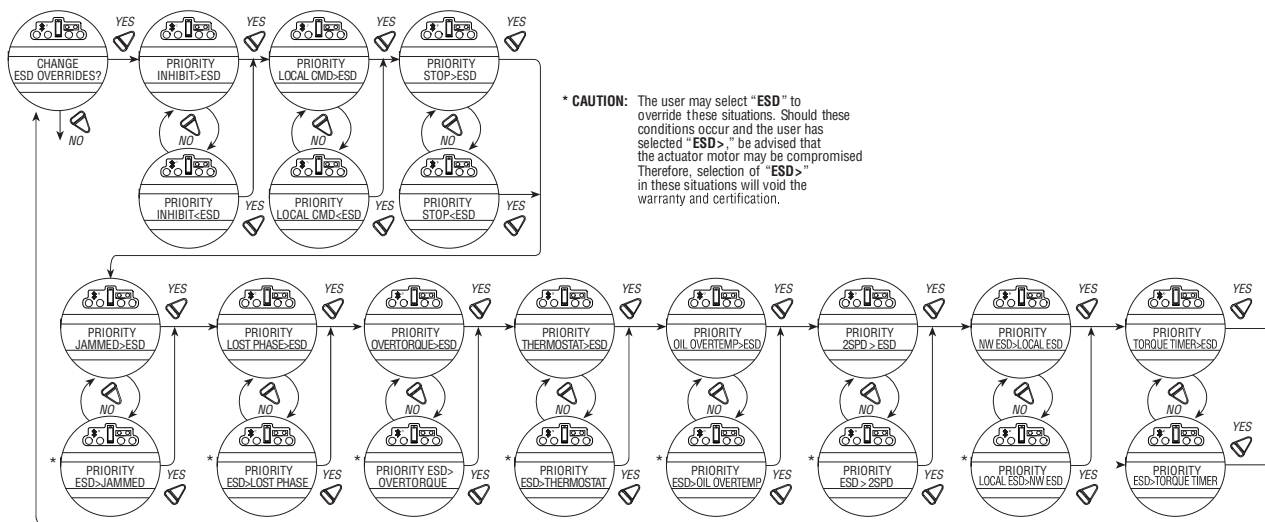
4.18 ESD (Emergency Shutdown) Overrides

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

The ESD Action and Signal presence is selected in Section 4.20, Inputs. The default ESD input = Input 0., pt. 30 on wiring diagram.

4.18.1 ESD Override

It may be desirable that ESD override other events. These events are selectable. The ">" symbol after ESD indicates that ESD will override that particular event. Sections 4.19.2 through 4.19.12 list the choices.

Figure 4.28 – ESD overrides

* CAUTION: The user may select "**ESD**" to override these situations. Should these conditions occur and the user has selected "**ESD>**," be advised that the actuator motor may be compromised Therefore, selection of "**ESD>**" in these situations will void the warranty and certification.

4.18.2 Inhibit

Default = INHIBIT>ESD

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

• "ESD>INHIBIT" – ESD overrides active inhibit signal

• "INHIBIT>ESD" – Active inhibit signal will override ESD

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

4.18.3 Local Command

Default = LOCAL>ESD

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

• "ESD>LOCAL" – ESD overrides local command to operate actuator

• "LOCAL>ESD" – Local command to operate actuator overrides ESD

4.18.4 Stop

Default = STOP>ESD

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

• "ESD>STOP" – ESD overrides stop command

• "STOP>ESD" – Stop command overrides ESD

4.18.5 Jammed Valve*

Default = JAMMED VALVE>ESD

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

• "ESD>JAMMED VALVE" – ESD overrides jammed valve indication

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

 See CAUTION on Figure 4.29.

4.18.6 Lost Phase (three phase ACV actuators only) *

Default = LOST PHASE>ESD

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

• "ESD>LOST PHASE" – ESD overrides lost phase indication

• "LOST PHASE>ESD" – Lost phase indication overrides ESD

 See CAUTION on Figure 4.29.

4.18.7 Overtorque*

Default = OVERTORQUE>ESD

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

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

 * See CAUTION on Figure 4.29.

4.18.8 Motor Thermostat

Default = ENABLED

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

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

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

4.18.9 Oil Over Temperature

Default = OIL OVERTEMP>ESD

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

- "ESD>OIL OVERTEMP"– ESD overrides high oil temperature
- "OIL OVERTEMP>ESD" – High oil temperature overrides ESD

4.18.10 Two-Speed Timer

Default = 2SPD > ESD

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

- "ESD > 2SPD" - ESD overrides 2 speed timer
- "2SPD > ESD" - 2 speed timer overrides ESD

4.18.11 Network ESD

Default = Local ESD > NW ESD

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

- "NW ESD > LOCAL ESD" - Network ESD overrides Local ESD
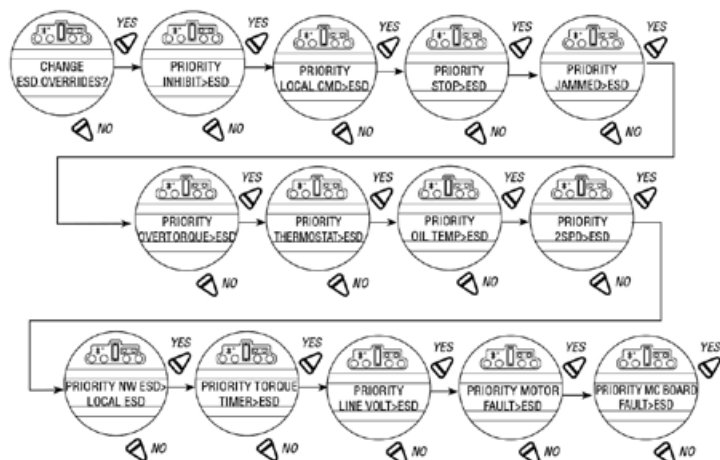- "LOCAL ESD > NW ESD" - Local ESD overrides Network ESD

4.18.12 Torque Switch Timer

Default = TORQUE TIMER>ESD

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

• "ESD>TORQUE TIMER" - ESD overrides torque switch timer

• "TORQUE TIMER>ESD" - Torque switch timer overrides ESD

Change ESD Overrides

4.19 Inputs

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

• ESD

• Inhibits

• User defined

• CSE

• PST

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

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

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

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

4.19.1 Input Standard Remote Control

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

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

Default = Three-wire Maintain Control

1. Select "CHANGE INPUTS?" from the "SETUP" routine.

2. Select "YES" to enter the display that indicates the type of remote control selected.

3. Select "NO" until the required control is displayed. The selections available are:

  • Three-wire Maintain Control (default except Modutronic)
    Requires two maintained contacts for self-maintained control in OPEN or CLOSE direction.

  • Three-wire Inching Control
    Requires two momentary contacts to OPEN or CLOSE the valve, or STOP it in mid-travel.

  • Two-wire Control
    Requires one NO or NC contact. Select "YES" for either.
    Valve OPENS if signal "ON."
    or
    Valve OPENS if signal "OFF."

  • Four-wire Control

4.19.2 Status

Default Setting is: OFF

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

4.19.3 Custom Input Mode #1 – Momentary ESD/PSESD (Optional)

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

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

Input 0 (normal default – ESD) terminal 30:

• Set as disabled, user input function, signal present

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

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

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

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

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

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

Input 3 (normal default – stop) terminal 26:

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

Input 4 (normal default – open) terminal 25:

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

Input 5 (normal default – close) terminal 27:

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

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

Figure 4.29 – Custom input modes

The following menus will appear if the customer has the custom mode input option, and has enabled custom mode 1 (in remote control menu). Custom mode 2 is same as mode 1 except there is no PS sequence available. See Table 4.1.
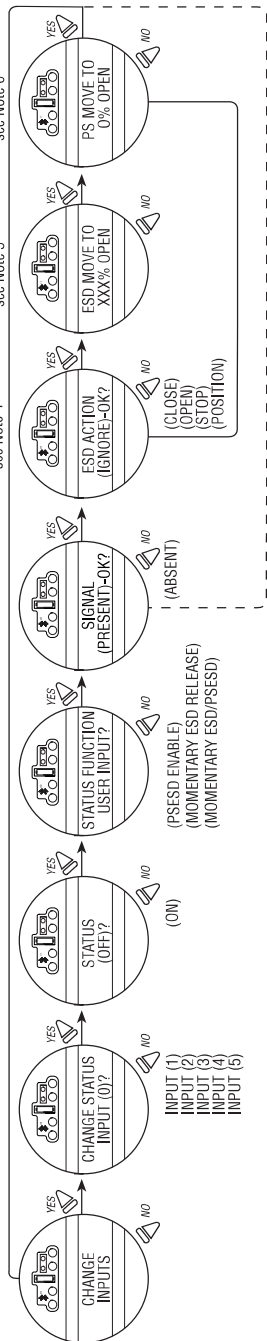
Note 4: The "ESD ACTION" menu will only appear if the status function for the input is "MOMENTARY ESD/PSESD". Otherwise the "SIGNAL PRESENT" menu will return to the "CHANGE INPUTS" menu.

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

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

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

INPUT 0: ON, ESD Time Delay Relay, signal present, ESD action closed.
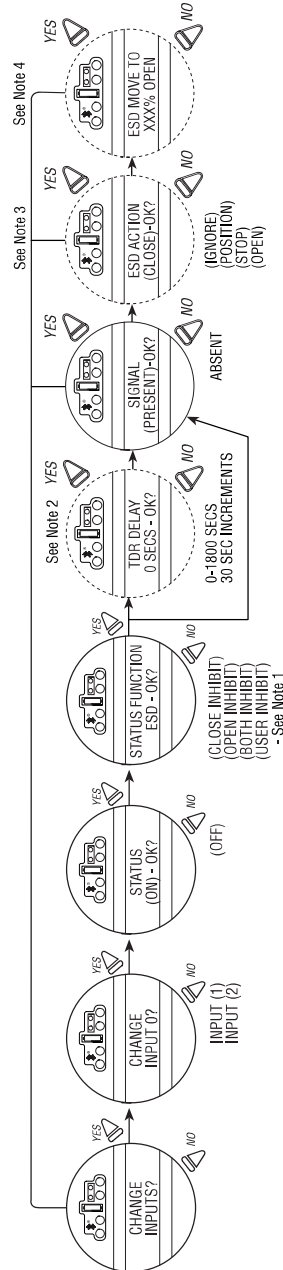**INPUT 1:** ON, User Input, signal present
INPUT 2: ON, User Input, signal present
INPUT 3: ON, Stop
INPUT 4: ON, Open
INPUT 5: ON, Close

The following menus will appear if the customer has the custom mode input option, and has enabled custom mode 3 (in remote control menu).

Note 1: ESD is hard oded for INPUT 0. You can only configure INPUTS 1 and 2 for the other options.
Note 2: TDR DELAY will only show for INPUT 0. All other inputs this is skipped.
Note 3: ESD ACTION menu will only appear if the STATUS FUNCTION for inputs is ESD otherwise the SIGNAL PRESET menu will return to the CHANGE INPUTS menu.
Note 4: The ESD MOVE TO menu only appears if position is chosen as action.

INPUT 0: ON, ESD Time Delay Relay, signal present, ESD action closed.
INPUT 1: ON, User Input, signal present
INPUT 2: ON, User Input, signal present
INPUT 3: ON, Stop
INPUT 4: ON, Open
INPUT 5: ON, Close

4.19.4 Custom Input Mode #2 – Momentary ESD/CSE (Optional)

Custom software is available for the MX that permits the user to establish certain performance characteristics momentary contact closure ESD and 4-wire remote control.

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

Input 0 (normal default – ESD) terminal 30:
       Set as remote stop

Input 1 (normal default – Open Inhibit) terminal 34:
       Set as remote close

Input 2 (normal default – Close Inhibit) terminal 35:
       Set as remote open

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

Input 3 (normal default – Stop) terminal 26:
       Set as enabled, ESD release function, signal absent = active

Input 4 (normal default – Open) terminal 25:
       Set as enabled, ESD Release function, signal present = active

Input 5 (normal default – Close) terminal 27:
       Set as enabled, momentary ESD function, signal present > 800 ms = active, ESD action = Close.

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

4.19.5 Custom Input Mode #3 – ESD Time Delay Relay

Custom software is available for the MX that permits the User to establish certain performance characteristics for ESD.

NOTE: These three inputs are normally all configurable. However, when this custom mode is enabled, the customer still retains the ability to change inputs 1 and 2 to their choosing, but Input 0 will always remain ESD. The timer is default 0-30 min (30 sec increment with default 0 sec).

Input 0 (normal default – ESD) terminal 30:
       Set as enabled, ESD, 0 sec Delay(default), Signal present = active, ESD action Close

Input 1 (normal default – Open Inhibit) terminal 34:
       Set as enabled, User Input, Signal present = active

Input 2 (normal default – Close Inhibit) terminal 35:
       Set as enabled, User Input, Signal present = active

The ESD Time Delay Relay input (input 0) functions like any normal ESD input signal. Only if a time has been entered into the Delay Timer value then the unit will not act on that ESD for that delayed amount of time. If the ESD signal is removed, then the timer is canceled and will start fresh with the next assertion. You cannot change that Input 0 is ESD, but it can be enabled/disabled, set to signal present/absent, or you can change the ESD action.

NOTE: These three inputs are kept as open-stop-close inputs. When the custom mode is enabled, the wire mode is preset to 4-wire control and cannot be altered.

Input 3 (normal default – Stop) terminal 26
Input 4 (normal default – Open) terminal 25
Input 5 (normal default – Close) terminal 27

4.19.6 Custom Input Mode #4 - Four-position Mode (Optional)

Custom software is available for the MX that permits the User to establish certain performance characteristics for Four Position controls for remote and local operations.

Input 0 (normal default - ESD) terminal 30:
• Set as enabled MI Move To, signal present = active

Input 1 (normal default - Open Inhibit) terminal 34:
• Set as disabled, User Input, signal present = active

Input 2 (normal default - Close inhibit) terminal 35:
• Set as disabled, User Input, signal present = active

The custom input Four Position Mode allows the user to configure up to 2 mid travel stop positions. The user will be able to send the actuator to either of these positions in either remote or local controls. In order to use local controls in multi-mode, that option will need to be selected in the CHANGE LOCAL Control menu. The user can select any of the standard wire controls for inputs 3, 4, and 5 (4-wire, 3- wire Maintain, or 3-wire Inching).
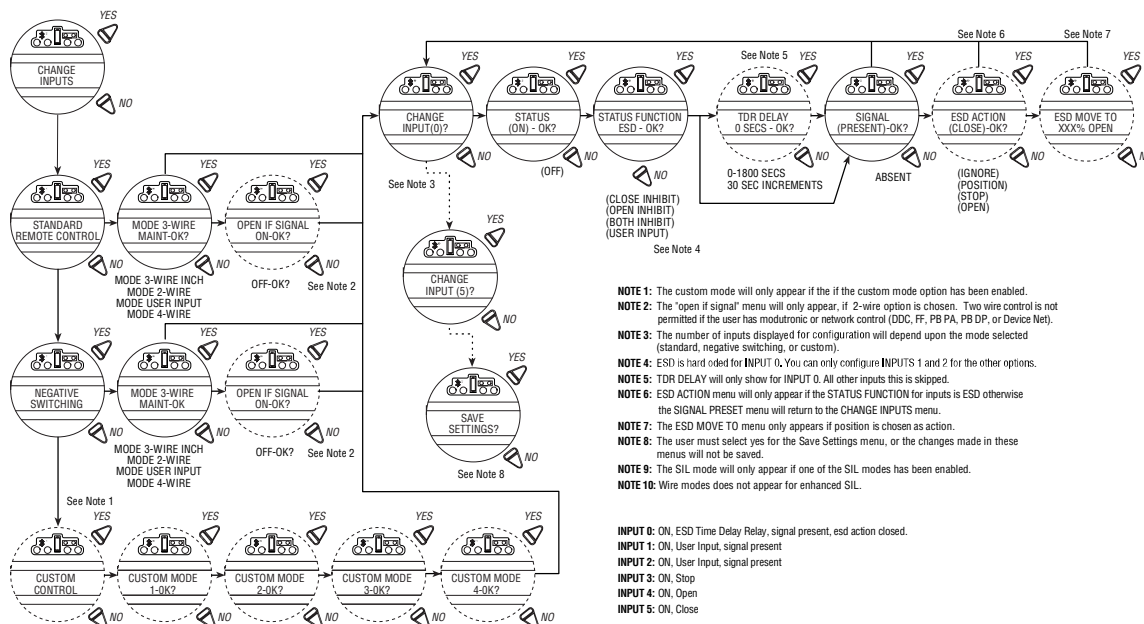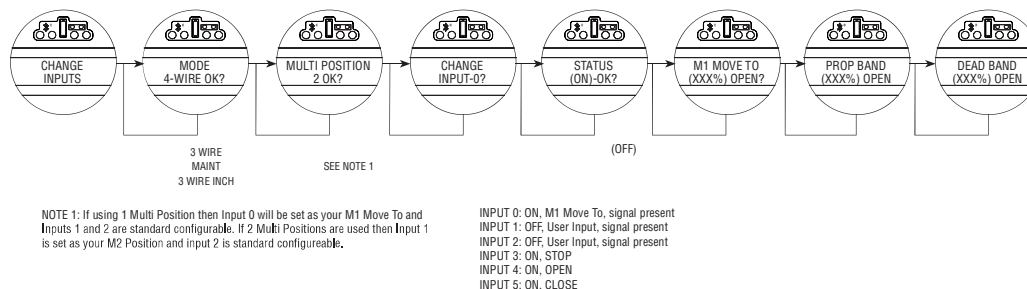
Figure 4.30 – Inputs

Figure 4.31 – Inputs

| CHANGE INPUTS | MODE 4-WIRE OK? | MULTI POSITION 2 OK? | CHANGE INPUT-0? | STATUS (ON)-OK? | M1 MOVE TO (XXX%) OPEN? | PROP BAND (XXX%) OPEN | DEAD BAND (XXX%) OPEN |

3 WIRE
MAINT
3 WIRE INCH

SEE NOTE 1

(OFF)

NOTE 1: If using 1 Multi Position then Input 0 will be set as your M1 Move To and Inputs 1 and 2 are standard configurable. If 2 Multi Positions are used then Input 1 is set as your M2 Position and input 2 is standard configureable.

INPUT 0: ON, M1 Move To, signal present
INPUT 1: OFF, User Input, signal present
INPUT 2: OFF, User Input, signal present
INPUT 3: ON, STOP
INPUT 4: ON, OPEN
INPUT 5: ON, CLOSE

4.19.7 Limigard Controls

The Limigard controls is available for the MX that presents the user with redundant inputs at Inputs 0 and 5 for close, Inputs 1 and 4 for open, and Inputs 2 and 3 for stop. Both inputs need to be asserted in order for the actuator to move open or close. Only 1 stop input needs to be asserted in order for the actuator to stop.

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

Input 0 (normal default - ESD) terminal 30:
Set as remote close

Input 1 (normal default - Open Inhibit) terminal 34:
    • Set as remote open
Input 2 (normal default - Close Inhibit) terminal 35:
    • Set as remote stop

Input 3 (normal default - Stop) terminal 26:
Input 4 (normal default - Open) terminal 25:
Input 5 (normal default - Close) terminal 27:

4.19.8 SIL Mode – Standard SIL (Optional - three phase ACV actuators only)

NOTE: Please refer to LMENIM2350 for SIL Safety IOM

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

NOTE: These three inputs are normally configurable. When this SIL mode is enabled, input 0 is preconfigured to ESD, input 1 is pre-configured to partial stroke, and both inputs cannot be changed by the customer. Input 2 can be configured to user input, inhibit, ESD or CSE.

Input 0 (normal default - ESD) terminal 30:
    • Set as enabled, ESD, signal present
Input 1 (normal default - Open Inhibit) terminal 34:
    • Set as enabled, partial stroke function, signal present = active
Input 2 (normal default - Close Inhibit) terminal 35:
    • Set as disabled, user input, signal absent = active

When this mode is selected, the ESD overrides are set so that ESD had priority over stop, local, and network ESD. You cannot change that Input 0 is ESD, but it can be enabled/disabled, set to signal present/absent, or you can change the ESD action.

NOTE: These three inputs are kept as open-stop-close inputs. When the custom mode is enabled, the wire mode is preset to 4-wire control and cannot be altered.

Input 3 (normal default - stop) terminal 26
Input 4 (normal default - open) terminal 25
Input 5 (normal default - close) terminal 27

Figure 4.32 – SIL control (standard)
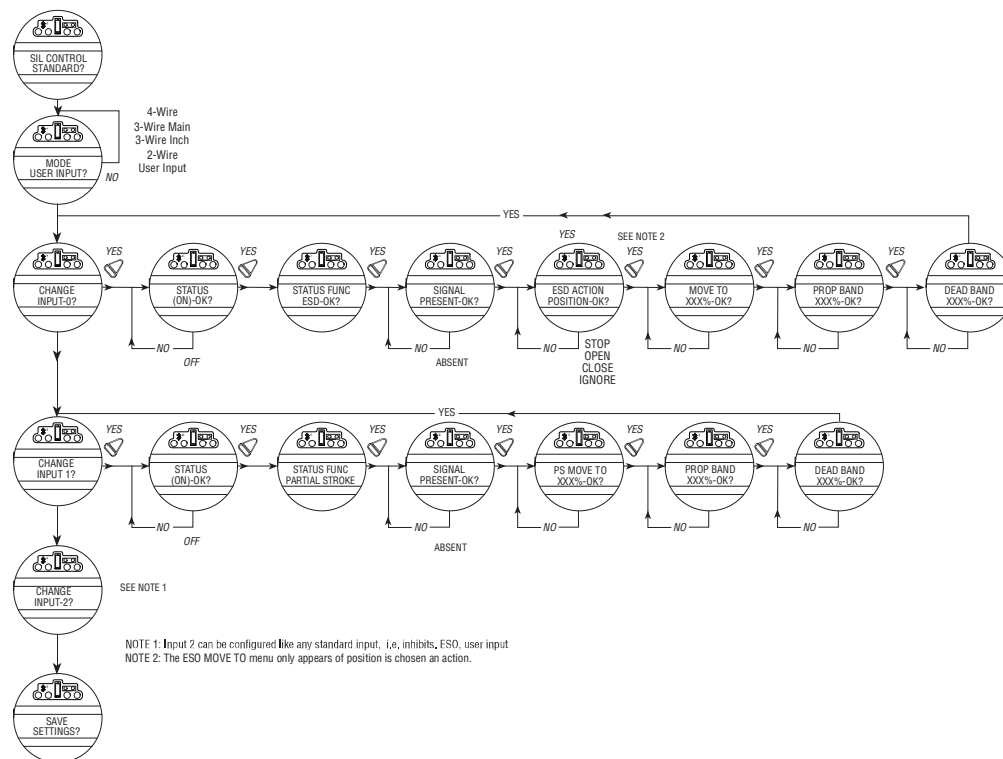
4.19.9 SIL Mode – Enhanced SIL (Optional)

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

NOTE: These three inputs are normally configurable. When this SIL mode is enabled, input 0 is configurable to 2 wire control, user defined or inhibit. Inputs 1 and 2 are pre-configured for partial stroke enable and cannot be changed by the customer.

Input 0 (normal default - ESD) terminal 30:
• Set as disabled, user input function, signal present

Input 1 (normal default - Open Inhibit) terminal 34:
• Set as enabled, partial stroke enable function, signal present = active

Table 4.1 – Digital input terminals

Negative Switching (Positive Earth)						
Mode	**Input 0**	**Input 1**	**Input 2**	**Input 3**	**Input 4**	**Input 5**
2-wire	configurable	open	not used	configurable	not used	not used
3-wire inch	close	open	not used	configurable	not used	not used
3-wire maint	close	open	not used	configurable	not used	not used
4-wire	close	open	not used	stop	not used	not used
User Input	configurable	configurable	not used	configurable	not used	not used

Terminal connections											
Input 0		**Input 1**		**Input 2**		**Input 3**		**Input 4**		**Input 5**	
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC
30	32	34	29	N/A	N/A	26	28	N/A	N/A	N/A	N/A

Custom 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, 33, to VDC source common.

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

Sil Modes						
Mode	**Input 0**	**Input 1**	**Input 2**	**Input 3**	**Input 4**	**Input 5**
Standard	ESD	Partial Stroke Test	configurable	stop	open	close
Enhanced	configurable	PS Enable 1	PS Enable 2	ESD Release 2	ESD Release 1	MO ESD/PSESD

Input 2 (normal default - Close Inhibit) terminal 35:
• Set as enabled, partial stroke enable function, signal absent = active

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

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

Input 3 (normal default - stop) terminal 26:
• Set as enabled, ESD release function, signal absent = active

Input 4 (normal default - open) terminal 25:
• Set as enabled, ESD Release function, signal present = active

Input 5 (normal default - close) terminal 27:
• Set as enabled, momentary ESD/PSESD function, signal present> 800 ms = active, ESD action =

Close, partial stroke target position = 0% open The ESD release signals are setup as redundant signals for safety. There are two signal inputs, and BOTH must be in the active state. If there is an active ESD and both ESD release inputs are in the active state, the ESD will be unlatched and the unit will return to normal operation. If the ESD release inputs are in a fault state, an active ESD will NOT be released. The ESD release inputs will have no effect on a partial stroke ESD test. The momentary ESD/PSESD input will be ignored if there is a signal present for less than 100 ms, and is guaranteed to latch in the ESD/PSESD if the signal is present for greater than 800 ms. Once the ESD is latched in, the unit will perform the ESD action. In this case the ESD will move the unit to the close limit and remain in ESD mode until the ESD release indication is given using the ESD release inputs.

Figure 4.33 – SIL control (Enhanced)
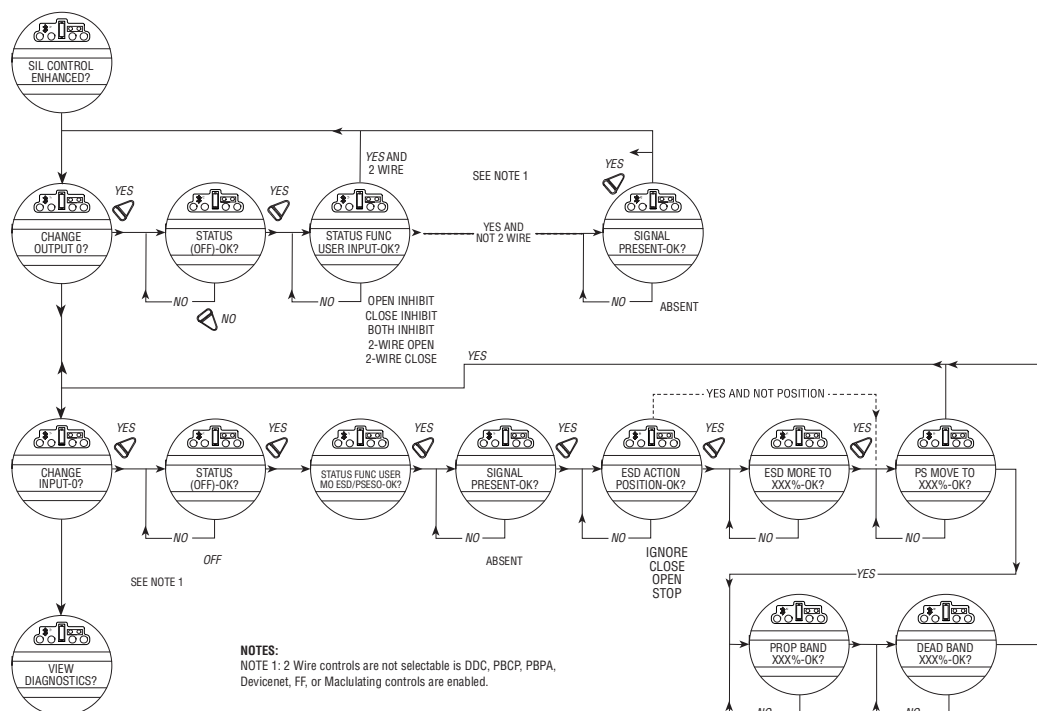
4.20 Monitor Relay

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

Normal operation
Each selection is User configurable. Select "Enabled" to turn the feature on, and "Disabled" to turn the feature off.

• "LOCAL STOP/OFF" – Red selector knob in "STOP/OFF"

• "LOCAL SELECTED" – Red selector knob in "LOCAL"

• "TORQUE TIMER" - if enabled

Fault indication
Each selection is User configurable. Select "Enabled" to turn the feature on, and "Disabled" to turn the feature off.
• "LOST PHASE" – Single phasing

• "VALVE JAMMED" – Valve cannot move when energized to pull out of valve seat

• "MOTOR OVERTEMP" – Thermistor range exceeded

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

Figure 4.34 – Monitor Relay Configuration
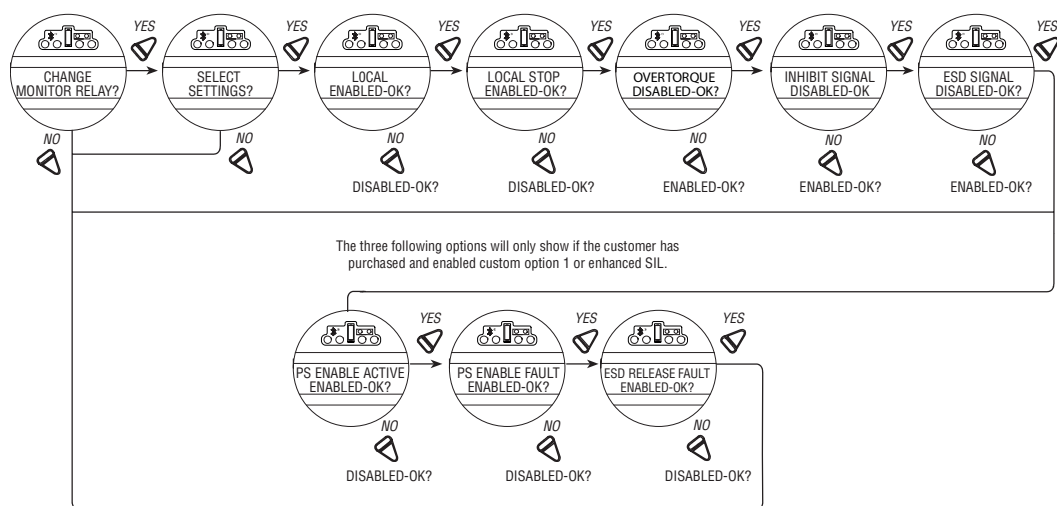
These functions are monitored continuously and may not be changed, but an additional three functions may be configured individually during setup.

1. Select "CHANGE MONITOR RELAY?" from the "SETUP" routine.

2. Select "YES" to enter the "SELECT SETTINGS?" display. Select "YES" to access each of the following three functions:

    • "OVERTORQUE" – Torque range exceeded in mid-travel, thermistor temperature exceeded, or malfunction in thermistor

    • "INHIBIT SIGNAL" – Inhibit "ON" and active

    • "ESD SIGNAL" – ESD "ON" and active

3. Select "NO" to:

    • "ENABLED" – will trip monitor relay or

    • "DISABLED" – will not trip monitor relay.

4.21 Diagnostic Reset

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

• Proportional measurements of torque

• Drive sleeve turns

• Contactor operations

• Maximum and minimum voltage

• Motor run time

• Stroke time

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

1. Select "RESET TORQUE PROFILE?" from the "RESET DIAGNOSTICS" routine.

2. Select "YES" to enter the "SAVE NEXT CYCLE?" display.

3. Select "NO" to switch the reset ON or OFF.

    After the next complete cycling of the valve, in both the open and close directions, this reset will automatically be switched OFF.

4. Select "RESET COUNTERS" to reset all the listed parameters to "0."

Figure 4.35 – Diagnostic reset
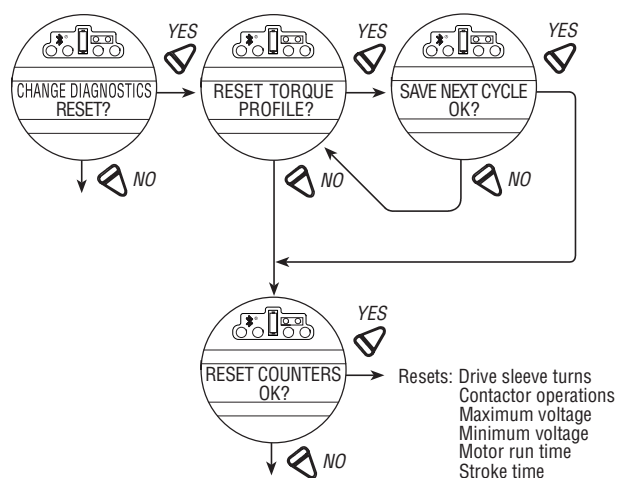
4.22 TAG Number

Defaults to blanks.

To Customize the Setting:

1. Select "CHANGE TAG?" from the "SETUP" routine.

2. Select "YES" to enter the "ENTER DIGIT" displays.

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3. Select "NO" to choose the required number or letter for each digit of the valve tag number, up to a maximum number of 16 digits.

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

Figure 4.36 – TAG number

CHANGE TAG? — YES — ENTER DIGIT #1 "0"------_ — YES — ENTER DIGIT #2 MO "0"----- — YES — Same procedure for digits 3-16 — ENTER DIGIT #16 MO00000000"0" — YES — RECORD TAG OK? — YES/NO

NO / "NO" changes digit / "NO" changes digit / NO

Up to 16 digits may be used. Alpha-numerics 0-9, then

Blank space appears first, then alphanumerics

This allows easy entry for tags of less than 16 digits
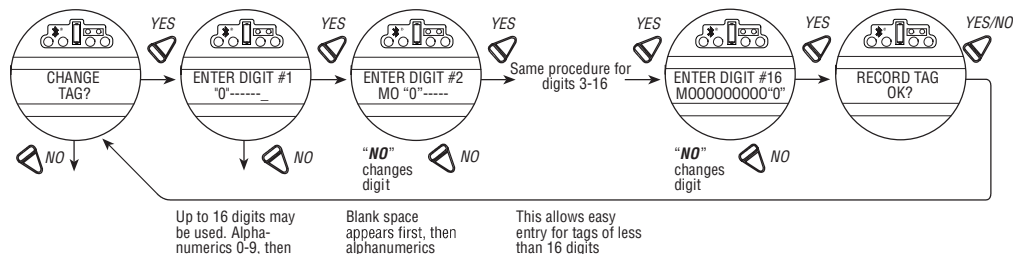
4.23 LCD Contrast

Permits adjustment of the viewing contrast of the LCD.

1. Select "YES" to enter the "LCD CONTRAST" display.

2. Select "NO" to adjust contrast to desired level.

Figure 4.37 – LCD contrast

CHANGE LCD CONTRAST? — YES — LCD CONTRAST OK? — YES

NO / "NO" adjusts LCD contrast / NO
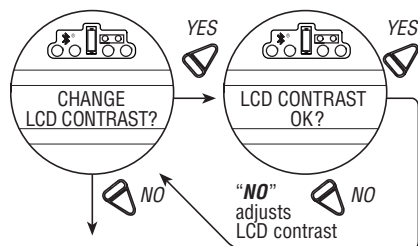
4.24 Torque Boost – only available for arctic temperature actuators

Default = "AUTO"

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

Figure 4.38 – Torque boost
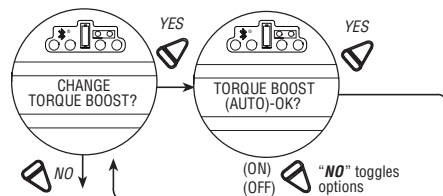
4.25 Motor Thermostat

The thermostat setting may be customized:

1. Select "CHANGE MOTOR THERMOSTAT?" from the "SETUP" routine.

2. Select "YES" to enter the "MOTOR THERMOSTAT" display.

3. Select "NO" to choose between "ENABLED" and "DISABLED."

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

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

Figure 4.39 – Motor thermostat
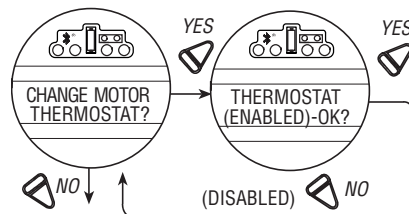
4.26 Change Valve Data

"Change Valve Data" allows the user to identify the type of valve the MX actuator is mounted to.

• Select "YES" to "Change Valve S/N?" Then select "YES" to "ENTER DIGIT" displays.

• Select "NO" to choose the required number or letter for each digit of the valve S/N, up to a maximum of 16 digits.

• Select "YES" when the desired number or letter is displayed. When all digits have been entered select "YES" to "Record S/N OK?"

• Follow same sequence for "CHANGE VALVE MODEL #?", "CHANGE VALVE TYPE?"

• If "YES" to "CHANGE VALVE TYPE?" then "VALVE TYPE UNDEFINED-OK?" is displayed. "VALVE TYPE UNDEFINED-OK?" is only shown until the valve type is chosen. In the rare event that the user would need to "REINITIALIZE" the MX actuator, the screen will reappear. See Figure 5.1.

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

Figure 4.40 – Change valve data

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

4.27 Change Port

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

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

Default = Local Port

Figure 4.41 – Change port and Bluetooth settings

5 Troubleshooting

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

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

• LCD display reads "XX% OPEN," "STATUS OK."

• Red selector switch is not in the STOP position.

• All three phases of the main power supply is properly connected to the actuator terminals.

• The supply voltage is the same as that stated on the actuator nameplate.

• Optional 110 VAC is measured at terminals 23 and 24.

• 24 VDC is measured at terminals 22 (+Ve) and 21.

• If 24 VDC power supply is ON, check that the loading does not exceed 5 W across terminals 21 and 22 (remove wires from 21, 22, 23, and 24).

• LCD and LED display on the control panel are illuminated.

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

5.1 View Diagnostics Routine

1. Enter "VIEW DIAGNOSTICS" as detailed in Section 5.3, View Diagnostics.

2. Review the various displays to try to find the reason the actuator will not operate. The displays that may help to isolate the fault are as follows:

    • View Hardware Status

    • View Motor Status

    • View Power Supply

    • View MC Faults

5.2 Troubleshooting Problems/Corrective Action

(Refer to LMENIM2314, MX Maintenance and Spare Parts and the standard wiring diagram in the Section 3.3, Electrical Connections). We recommend that only Limitorque service personnel perform this operation.

1. Switch off the main power supply and 24 VDC supply at terminals 6 and 7 (if used).

2. Remove control compartment cover (ACP) and protect against the ingress of moisture or dust.

3. Remove any wiring that has been connected to terminals 21, 22, 23 and 24.

4.   Switch on main power supply.

5.   Measure VAC at 23, 24 – should be 110 VAC if actuator is supplied with optional 110 VAC circuit. If no power, check fuses FS1, FS2 (600 VAC, 1 A, fast acting, 10.3 x 38.1 mm tube) and FS3 (250 VAC, 0.1A, time delay, 5 x 20 mm glass tube) and replace if necessary. If replacing fuses does not fix the problem, replace damaged board. Contact Limitorque Service at (434) 528-4400.

Fuse Designator	MXa Three Phase	MXa Single Phase
FS1, FS2	600 VAC, 0.5A, fast acting, 6.3 x 32 mm	600 VAC, 1A, fast acting, 10.3 x 38.1 mm
FS3	250 VAC, 0.1A, time delay, 5 x 20 mm	

6.   Measure VDC at 21, 22 – should be 24 VDC, maximum power of 5W. If not, replace damaged board.

7.   Replace the control compartment cover (ACP).

5.2.1 Actuator Fails to Operate

Actuator Fails to Operate from LOCAL Controls

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

2.   If motor runs but actuator output does not turn, check that declutch lever has returned to motor operation position.

3.   Check LCD display for following alarms:
   • If motor runs but no actuator movement is detected, check if the display says "JAMMED VALVE" & 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 below.

2.   Check that the red knob is in "REMOTE."

3.   ESD signal may be present or absent at the terminals. Check for signal and adjust as necessary. ("ESD ACTIVE" at display.) If actuator was previously operated in "LOCAL," then the fault is probably in the remote control circuit. Check the integrity of the cabling and that the connections to the terminals are in accordance with the wiring diagram. If motor runs in "LOCAL," but not "REMOTE," adjust ESD to be greater than local ("ESD>LOCAL").

4.   Confirm correct monitor relay operation. See Table 3.5.

5.2.2 Jammed Valve Detected

1.   Check that position limits have been set correctly. If valve is position-seated, the limits should stop the motor just before the end-of-travel. Recalibrate the position limits if necessary. See Section 3.5.4, Setting Position Limits.

2.   Check that torque settings are correct for the valve. Recalibrate if necessary. See Section 4.6, Torque Setup.

3.   Check the condition of the valve and lubrication of the valve stem and thrust bearings. The valve may have remained in the same position for a long time and become corroded internally or externally. Engage manual override and employ the handwheel drive to unseat the valve.

4.   Verify that the actuator will now operate the valve. Open and close the valve a few times to check for correct operation throughout the travel.

NOTE: To free a jammed valve from the "CLOSE" or "OPEN" position, engage manual override and attempt to unseat it using the handwheel drive. If a rising stem valve is jammed in the close position, loosen the fixing bolts that attach the

thrust base to the valve. This will release the compression in the drive components and reduce the effort to unjam the valve. Partly open the valve, then retighten the bolts.

5.2.3 Actuator Operates but Does Not Drive Valve

1.   Verify that the declutch lever has returned to motor-operated position.

2.   Verify that the stem nut is fitted correctly in the actuator base.

3.   Verify that the stem nut has sufficient engagement with the valve stem.

4.   Verify that the key is fitted in bore/keyway applications.

5.2.4 Valve Does Not Seat Correctly

1.   Verify that position limits are calibrated correctly for the valve travel.

2.   Verify that the torque-seating valves have been configured to close on torque, not position.

3.   Verify that closing torque value has been set high enough to suit the process conditions.

4.   Verify that the valve is not obstructed.

5.2.5 Status Messages

Normal display status is listed in Section 3.6.5, 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 (one message per four seconds).

Status or Alarm Messages (XX = Input # (0, 1, 2))
"---% OPEN, STATUS OK" – Normal display

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

---% 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

---% OPEN, MC OVER TEMP X

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

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

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

"XXX% OPEN"

"RAM ERROR"

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

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

"XXX% OPEN"

"ROM ERROR"

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

Figure 5.1 – Initialize routine
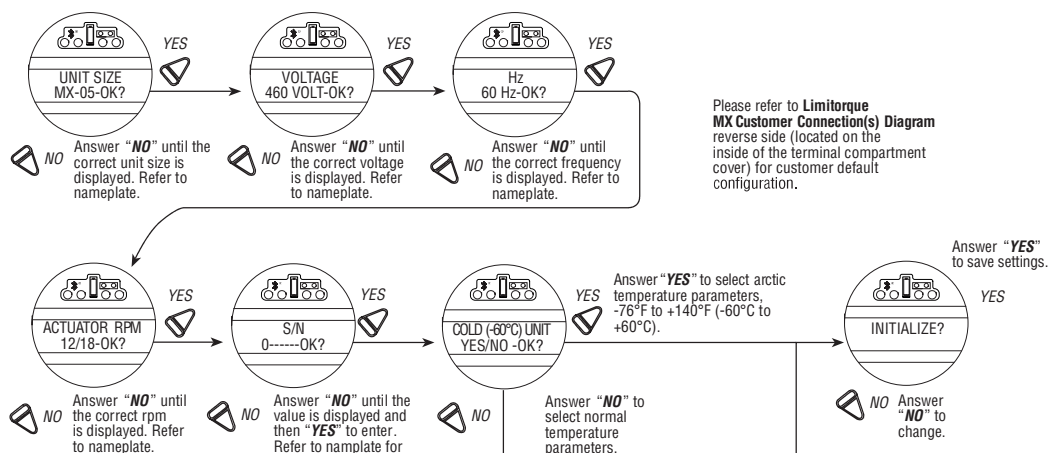
Figure 5.2, Single phase only Initialize Routine
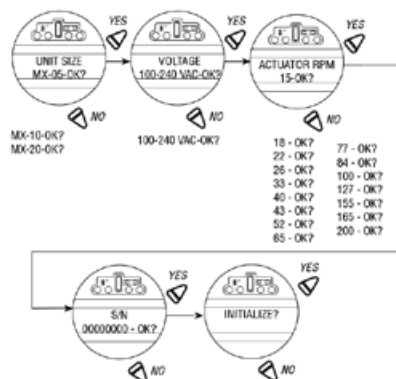
Run Load Alarm – Single phase MX only

The run load and LCD torque setting need to follow the requirements of the table below. If the run load exceeds the table value, the output RPM of the actuator may be reduced when compared to the nameplate value. The run load alarm feature may report a reduced speed if the run load exceeds the table values.

Run Load (% of nameplate rating)	Required LCD torque setting
≤15%	≥40%
>15% up to 25%	≥50%
>25% up to 35%	≥60%
>35% up to 40%	≥70%

5.3 View Diagnostics

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

1. Enter the "SETUP" mode routine detailed in Section 2.1.1, Entering the Setup Mode.

2. Select "VIEW DIAGNOSTICS?"

3. Select "YES" to access the first display "VIEW HARDWARE?"

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

Figure 5.3 – Diagnostic overview
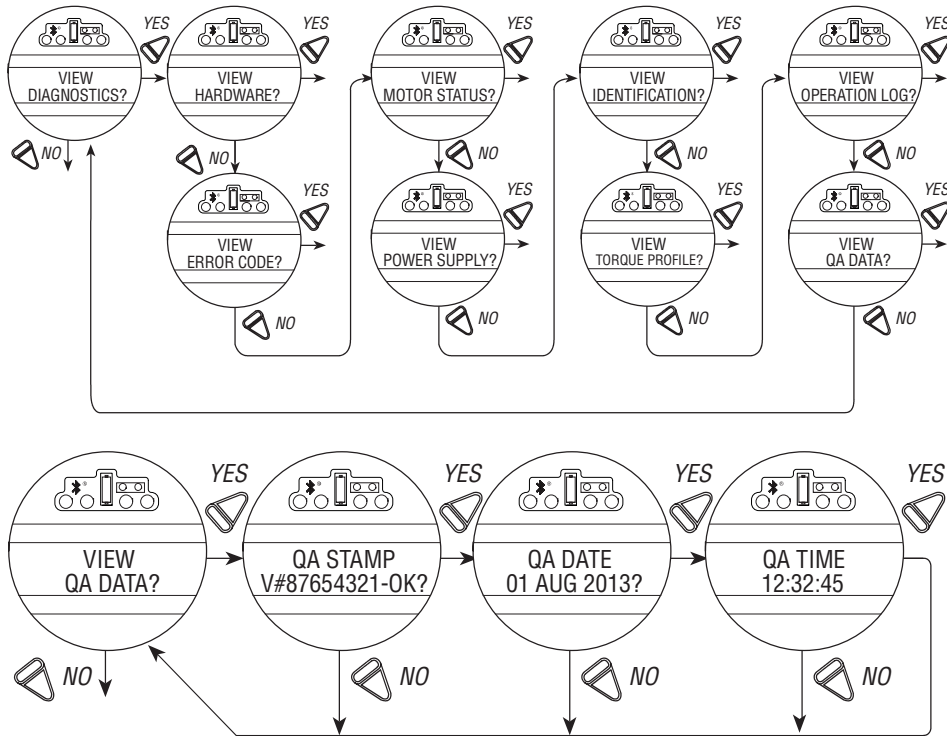
5.4 View Hardware Status

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

Figure 5.4 – View Hardware Status for Single Phase
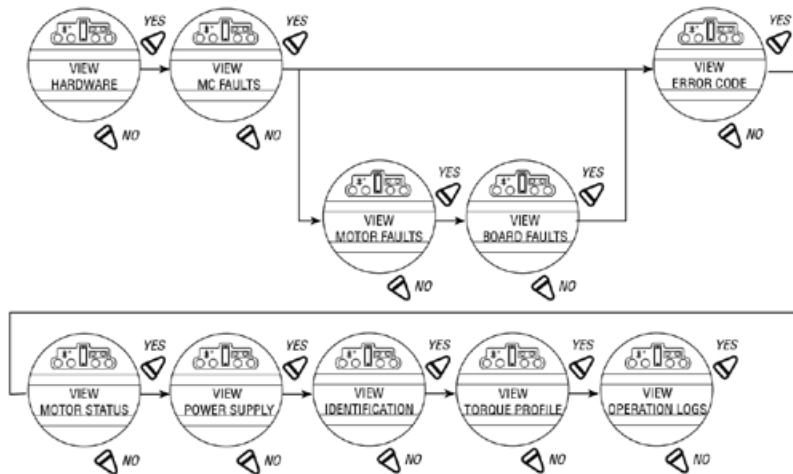
Figure 5.5 - View three phase ACV hardware status

NOTE 1: If ordered.
NOTE 2: Reserved for future. LimiGard functionality through monitor relay.

" **NO** " toggles options
??? (Analog input present 0-100%)
OP (Open input present)
CL (Close input present)
STOP (Stop input present)
ESD (ESD input present)
IO (Open inhibit input present)
IC (Close inhibit input present)
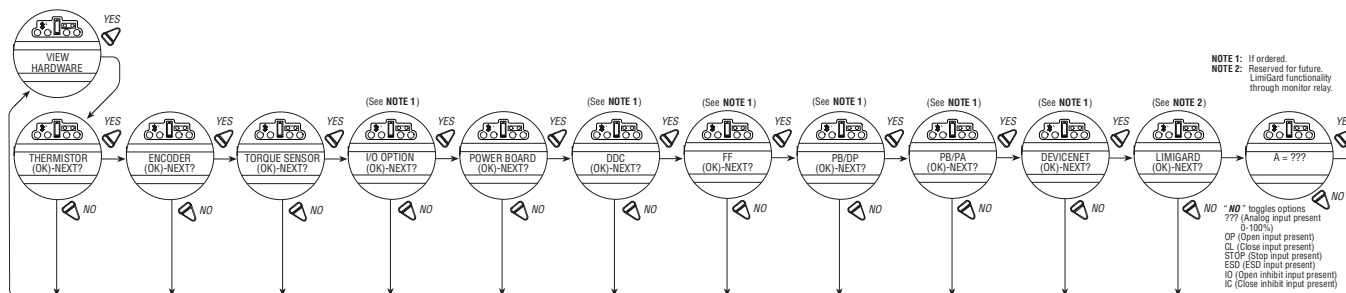
When VIEW QA DATA is approached, enter by saying YES.

QA STAMP: This identification number relates to the mainboard serial number. It is the same 8 alpha-numeric that is used to generate key codes that are required for the RESTRICTED MENU selections in the CHANGE SETTINGS.

QA DATE If the whole unit was tested at the Lynchburg EOL or any of the QRCs, the date is the date the unit was tested. If the mainboard was replaced, the date shown relates to the day the board was tested during board manufacturing by supplier.

QA TIME: Same as date but with time. Shows Hours: Minutes: Seconds.

5.5 View Motor Status

Viewing "MOTOR STATUS" will provide information on the following:

• If the three-phase power supply is connected correctly.

• If autophase correction is in operation.

• If there is a fault or loss of a phase.

• Temperature of the windings in the motor.

Figure 5.6 – View three phase ACV motor status
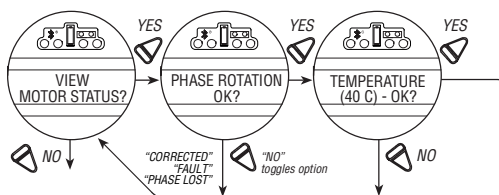
Figure 5.7 View Single Phase Motor Status
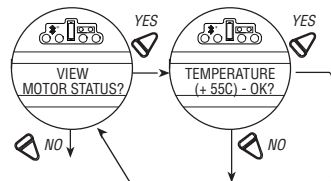
5.6 View Power Supply

Viewing "POWER SUPPLY" will provide historical data on the maximum and minimum voltages that have been applied to the actuator, as well as the frequency of the AC supply. These can be reset. See Section 4.21, Diagnostic Reset.
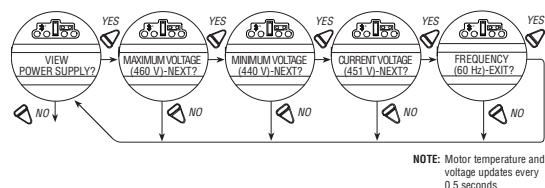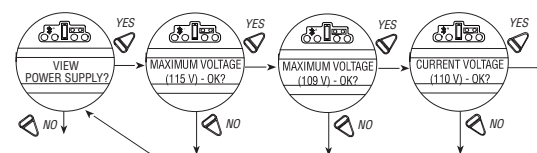
Figure 5.8 – View power supply

NOTE: Motor temperature and voltage updates every 0.5 seconds.

Figure 5.9 – View Single Phase Power supply

5.7 View Identification

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

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

FIGURE 5.10 – VIEW IDENTIFICATION

*Network revisions will only be displayed if the optional network board is installed within the MX.
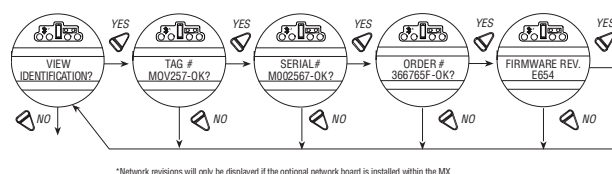
FIGURE 5.11 – VIEW SINGLE PHASE IDENTIFICATION
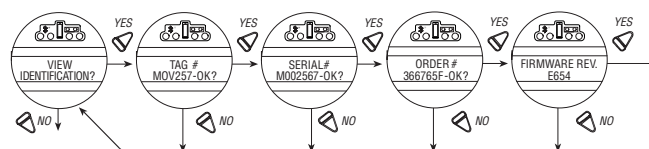
*Network revisions will only be displayed if the optional network board is installed within the MX.

5.8 View Torque Profile

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

Details are given for the REFERENCE and the LAST torque, expressed as a percentage of the rated torque (stated on the nameplate, Figure 4.7) that occurred at BREAKOUT, ENDING, and PEAK RUNNING for both the opening and closing directions. Torque will be expressed proportionally as a reference only from 40% to 100% inclusive. Initial indication may read 0% until torque exceeds 40% minimum.

• "BREAKOUT" – Amount of torque required to unseat the valve.

• "ENDING" – Amount of torque required to seat the valve.

• "PEAK RUNNING" – Maximum torque detected while cycling from BREAKOUT to ENDING. (Maximum mid-travel torque.)

*Figure 5.12 – View torque profile*
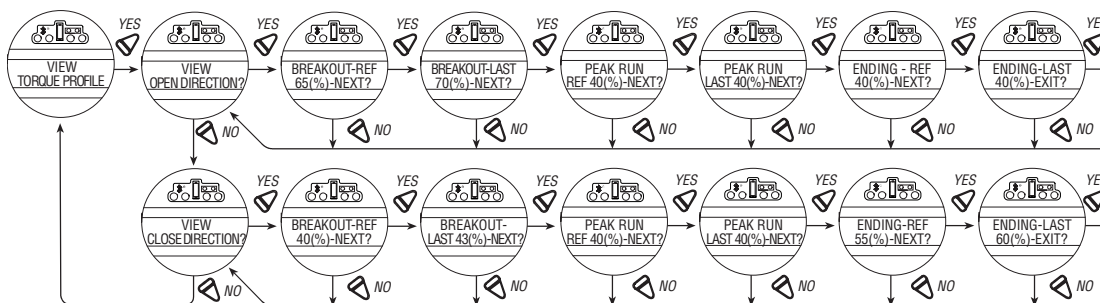
5.9 View Operation Log

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

The LCD screen definitions are as follows:

- "STROKE TIME" – Length of time of last actuator operation

- "TURNS TOTAL" – Total number of drive sleeve revolutions

- "TURNS RECENT" – Number of drive sleeve revolutions since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.

- "CONTACTOR OPS" – Total number of contactor operations

- "OPS RECENT" – Number of contactor operations since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.

- "MOTOR RUN TIME" – Total motor operational time

- "TIME RECENT" – Motor operational time since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.

- "MOVED MANUAL #" – Total number of times unit has been operated manually

- "MANUAL # RECENT" – Number of times unit has been operated manually since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
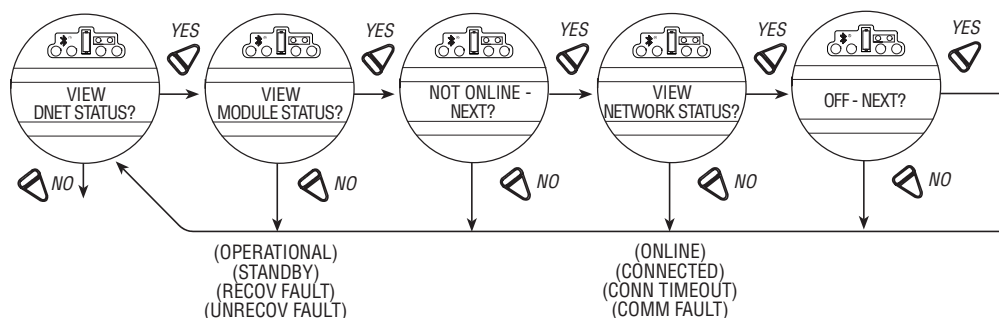
Figure 5.13– View operation log
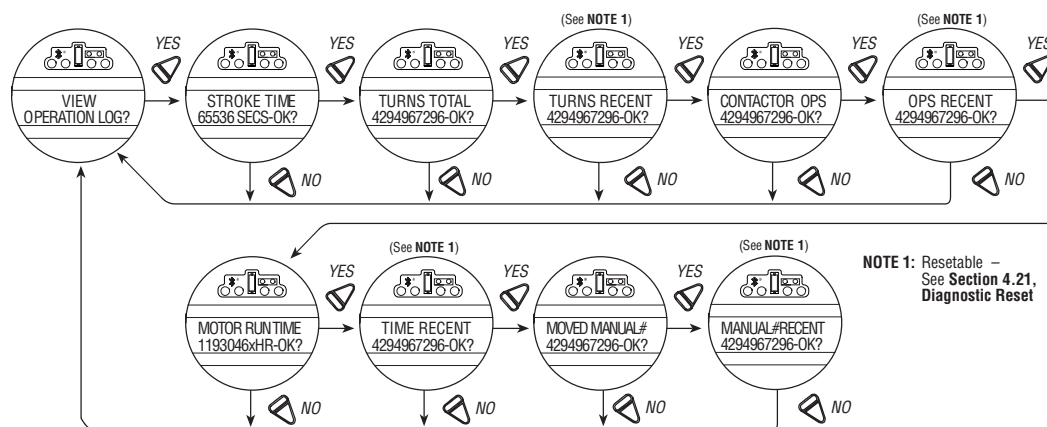
This selection permits the User to view pertinent information that summarizes the status of the DeviceNet option board

5.10 View DNET Status?

Figure 5.14 – View DNET status

VIEW MODULE STATUS?

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

Configuration choices are:

"OFF" = board installed but turned off

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

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

"UNRECOVERABLE FAULT" = Internal Diagnostic Fault detected e.g.

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

Device may need replacing.

"SELF TESTING" = The device is in self-test mode

VIEW NETWORK STATUS?

Answer "YES" to determine status of DN network.

"NOT ON LINE" = Device is not on-line.

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

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

- The device has passed the SELF test, is on-line, bus has no established connections to other nodes.

- For a Group 2 Only device it means that this device is not allocated to a master.

- For a UCMM capable device it means that the device has no established connections.

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

- For a Group 2 Only device it means that the device is allocated o a Master.

- For a UCMM capable device it means that the device has one or more established connections.

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

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

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

6 Maintenance

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

1. Check the oil level every 50 hours of operation at a minimum. Where conditions are severe due to frequent operation or high ambient temperatures, a more regular inspection interval should be maintained.

2. Change the gear oil every 100 hours of operation. See Section 6.1: Lubrication.

3. All ball bearings, oil seals, O-rings and quad-rings are to be replaced after 450 hours of operation. See Bulletin LMENIM2314, MX 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 Maintenance and Spare Parts.

6.1 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 -20°F to 250°F (-30°C to 120°C). For extreme low temperature conditions (< -30°C to 60°C), an alternative lubricant is available—Petro Canada TRAXON Synthetic 75W-90 with TOS. Consult factory for arctic temperature applications.

6.1.1 Oil Capacities

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

- MX-05 – 10 oz. (256 ml)   MX-85 – 192 oz. (5.7 liters)
- MX-10 – 21 oz. (.6 liters)   MX-140 – 192 oz. (5.7 liters)
- MX-20 – 48 oz. (1.4 liters)   MX-150 – 192 oz. (5.7 liters)
- MX-40 – 65 oz. (1.9 liters))

6.1.2 Checking Oil Level

To check the level:

1. Remove the uppermost filler plug on the gearcase.

2. Check that the level of oil is within 1 inch (25 mm) of the hole (when actuator is mounted with base horizontal).

7 Regulatory Information

Application of Council Directive(s)

2004/108/EC; EMC Directive

2006/42/EC; Machinery Directive

2003/10/EC; Airborne Noise Directive

94/9/EC; ATEX Directive

Standard(s) to which Conformity Is Declared

ATEX Harmonized Standards

EN 60079-1:2007

EN 60079-7:2007

EN 13463-1:2009

EN 13463-5:2011

EN 60079-0:2012 + A11:2013

IEC Standards

IEC 60079-0:2011

IEC 60079-1:2007

IEC 60079-7:2006

IEC 60079-31:2013

Machinery

EN 60204-1:2006+A1:2009

EMC-

Emissions

EN 61000-6-4:2007+A1:2011

EN 55011:2009+A1:2010

Immunity

EN 61000-6-2:2005

Airborne Noise

EN 21680/ ISO 1680

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

MX 3 phase Notified Body for ATEX
CSA Group Testing UK Ltd.
(Sira Certification Service)
Unit 6, Hawarden Industrial Park
Hawarden CH5 3US
United Kingdom
Notified Body Number- 0518

EC Type Examination Certificate
SIRA03ATEX1212X

Manufacturer's Name
Limitorque, a division of Flowserve Corporation

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 Messago (MB) Italy

Type & Description of Equipment
Valve Actuators

Model Numbers
MXa-05, -10, -20,-40, -85, -140, -150
MX Series Note: Tested with Limitorque products
only and with standards applicable at time of tests.

MX 3 phase Equipment Marking
II 2 G c
Ex d IIB or IIC T4
Tamb = -30°C to +65°C
Ex d IIB T4 (MX-05/10/20/40)
Tamb = -60°C to +65°C
Ex de IIB or IIC T4
Tamb = -30°C to +65°C
(ambient range dependent upon type)

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**MX Single Phase certification
FM16ATEX0017X and notified body:**
FM Approvals LTD
1 Windsor Dials
Windsor, Berkshire, UK. SL4 1RS

**Model Numbers MX-05 and
MX-10 Single Phase**

Equipment Marking for IECEx
FMG10.0023X
Ex d IIB or IIC T4 Gb
Ex tb IIIC T135C Db
Tamb -20°C to +60°C

FMG10.0023X
Ex de IIB or IIC T4 Gb
Ex tb IIIC T135C Db
Tamb -20°C to +60°C

FMG10.0023X
Ex d IIB T4 Gb
Ex tb IIIC T135C Db
Tamb -40°C to +40°C

FMG10.0023X
Ex d IIB T4 Gb
Ex tb IIIC T135C Db
Tamb -30°C to +65°C

**Model Numbers MX-05 and
MX-10 Single Phase**

Equipment Marking for ATEX
FM16ATEX0017X
II 2 G c Ex d IIB or IIC T4 Gb
II 2 D c Ex tb IIIC T135C Db
Tamb -20°C to +60°C

FM16ATEX0017X
II 2 G c Ex de IIB or IIC T4 Gb
II 2 D c Ex tb IIIC T135C Db
Tamb -20°C to +60°C

FM16ATEX0017X
II 2 G c Ex d IIB T4 Gb
II 2 D c Ex tb IIIC T135C Db
Tamb -40°C to +40°C

FM16ATEX0017X
II 2 G c Ex d IIB T4 Gb
II 2 D c Ex tb IIIC T135C Db
Tamb -30°C to +65°C

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

John Thilking
Sr. Certification Engineer, ATEX/IECEx
Authorized Person, Flowserve Limitorque
Flowserve Limitorque
5114 Woodall Rd
Lynchburg VA 24502
January 8, 2016

7.1   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/M10 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-05/10/20/40/85/140 (56 frame) 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 motor compartments.

5. Stainless steel, A2 or A4, ISO Class 70, M8 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 the terminal or control compartments of Group IIB actuators.

6. 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 (180 frame) or MX-150 motor compartments.

7. Consult the manufacturer if dimensional information on the flameproof joints is necessary.

8. 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 60079-32-1 for additional guidance.

7.2 Statement of Compliance With Applicable European Directives

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

> MX-05, 10, 20, 40, 85, 140 and 150 electronic valve actuator. The MX 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 94/9/EC on equipment before April 20, 2016 and address the Essential Health and Safety Requirements of Community Directive 2014/34/EU after April 20, 2016 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.

Table 7.1 – EMC – Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI) standards to which the three phase ACV MX actuator complies:

Applicable Emissions standards	EN61000-6-4:2007+A1:2011	Industrial Environments - Class A - Test Limits & Levels	
Radiated emissions	EN55011:2009+A1:2010 (CISPR11)	330 MHz to 230 MHz 230 MHz to 1 GHz	40 dB (µV/m) 47 dB (µV/m)
	FCC Part 15, (CFR47 Part 15.109	30 MHz to 88 MHz 88 MHz to 216 MHz 216 MHz to 960 MHz > 960 MHz	90 dB (µV/m) 150 dB (µV/m) 210 dB (µV/m) 300 dB (µV/m)
Conducted emissions	EN55011:2009+A1:2010 (CISPR11)	150 kHz to 500 kHz	79 dB (µV) (quasi-pk), 66 dB (µV) (avg)
	FCC Part 15, (CFR47 Part 15.107)	500 kHz to 30 MHz	73 dB (µV) (quasi-pk), 60 dB (µV) (avg)
Applicable immunity standards	EN61000-6-2:2005 (Perf. Criteron)	Industrial Environments - Test Limits & Levels	
ESD	IEC61000-4-2 (B)	Air: AC, DC, Signal Contact: AC, DC, Signal	±2 kV, ±4 kV, ±8 kV ±1 kV, ±2 kV, ±4 kV
Radiated RF immunity	IEC61000-4-3 (A)	Enclosure @ 80 MHz to 1 GHz	10 Vrms/m @ 80% AM, 1 kHz
		Enclosure @ 1 GHz to 2.7 GHz	3 Vrms/m @ 80% AM, 1 kHz
Fast transients/burst	IEC61000-4-4 (B)	AC, Signal	±2 kV, ±1 kV
Voltage surges	IEC61000-4-5 (B)	Common: AC, Signal Differential: AC, Signal	±2 kV, ±l kV ±l kV, ±l kV
Conducted RF immunity	IEC61000-4-6 (A)	AC @ 150 kHz to 80 MHz	10 Vrms @ 80% AM, 1 kHz
Magnetic field immunity	IEC61000-4-8 (A)	Three mounting axis	30A/m
Voltage dips and interrupts	IEC61000-4-11 (B)	3 dips, 10 sec apart	> 95% dip for 1 cycle @ 50/60 Hz 30% dip for 500 ms @ 50/60 Hz 60% dip for 200 ms @ 50/60 Hz
	IEC61000-4-11 (C)	3 dips, 10 sec apart	> 95% interrupt for 5 sec @ 50/60 Hz

EMC - standards to which the single phase ACV MX actuator complies:

Applicable Emissions standards	EN61326-1 (CISPR11)	Industrial Environments - Class A - Test Limits & Levels	
Radiated emissions	EN55011:2009+A1:2010 (CISPR11	330 MHz to 230 MHz 230 MHz to 1 GHz	40 dB (µV/m) 47 dB (µV/m)
	FCC Part 15, (CFR47 Part 15.109)	30 MHz to 88 MHz 88 MHz to 216 MHz 216 MHz to 960 MHz > 960 MHz	90 dB (µV/m) 150 dB (µV/m) 210 dB (µV/m) 300 dB (µV/m)
Conducted emissions	EN55011:2009+A1:2010 (CISPR11)	150 kHz to 500 kHz	79 dB (µV) (quasi-pk), 66 dB (µV) (avg)
	FCC Part 15, (CFR47 Part 15.107)	500 kHz to 30 MHz	73 dB (µV) (quasi-pk), 60 dB (µV) (avg)
Applicable immunity standards	EN61326-1 (Performance Criterion)	Industrial Environments - Test Limits & Levels	
Electrostatic Discharge	EN61000-4-2 (B)	Contact Air	±1 kV, ±2 kV, ±4 kV ±2 kV, ±4 kV, ±6kV, ±8 kV
Radiated RF Susceptibility	EN61000-4-3 (A)	Enclosure @ 80 MHz to 1 GHz Enclosure @ 1.4 GHz to 2 GHz Enclosure @ 2 GHz to 2.7 GHz	10 Vrms/m @ 80% AM, 1 kHz 3 Vrms/m @ 80% AM, 1 kHz 1 Vrms/m @ 80% AM, 1 kHz
Electrical Fast Transient/Burst	EN61000-4-4 (B)	AC Power, DC Power	±2 kV
		I/O (mains connected)	±2 kV
		I/O (non-mains)	±1 kV
Voltage surges	EN61000-4-5 (B)	AC Power, DC Power	±1 kV (DM), ±2 kV (CM)
		I/O (mains connected)	±2 kV (CM)
		I/O (non-mains)	±1 kV (CM)
Conducted RF Immunity	EN61000-4-6 (A)	AC Power, DC Power, I/O @ 150 kHz to 80 MHz	30 A/m, 60 sec dwell
Magnetic Immunity	EN61000-4-8 (A)	Three mounting axis, X, Y, Z	30 A/m, 60 sec dwell
Voltage Dips and Interrupts	EN61000-4-11 (B)	3 dips, 10 sec apart 3 dips, 10 sec apart 3 dips, 10 sec apart	100% dip for 1 cycle @ 50/60 Hz 60% dip for 200 ms @ 50/60 Hz 30% dip for 500 ms @ 50/60 Hz
	EN61000-4-11 (C)	3 dips, 10 sec apart	100% interrupt for 5 sec @ 50/60 Hz

7.3   Single-Phase MX Full Load Amperage Values (FLA)

The product nameplate lists Full Load Amperage values at 40°C. The Full Load Amperage values vary with temperature. The change in FLA over temperature is shown in the tables below.

MX-05 20% run load FLA@100/240 VAC

RPM	15/18	22/26	33 /40	43/52	65/77	84/100	127/155	165/200
+70°C	2.0/1.0	2.6/1.3	3.5/1.6	4.3/2.0	5.0/2.4	5.7/2.8	7.8/3.8	9.0/4.2
+25°C & +40°C	2.2/1.0	2.8/1.3	3.9/1.8	5.0/2.5	6.1 /2.9	6.3/3.1	9.5/4.3	9.8/4.8
-30°C & -40°C	4.1 /2.0	5.0/2.3	7.0/3.2	9.0/4.5	9.8/4.5	11/5.1	16.2/7.2	18/7.6

MX-10 20% run load FLA@100/240 VAC

RPM	15/18	22/26	33 /40	43/52	65/77	84/100	127/155	165/200
+70°C	3.4/1.6	4.4/2.2	6.3/3.0	7.9/3.8	9.5/5.7	10.2/5.4	15/7.0	15/7.4
+25°C & +40°C	3.8/1.8	5.0/2.3	7.2/3.4	9.1 /4.3	11.7/6.4	12.2/5.9	17/8.0	18/8.2
-30°C & -40°C	8.4/3.8	9/4.2	13/6.2	15/7.7	19.3/11.5	20/10	30/14	30/15.4

Notes

1.   -20°C/-30°C /-40 °C to +40°C values are the same value due to different gear lubrications being utilized

2.   40% run load FLA values are 1.5 times the 20% run load FLA values

3.   When operating at 115 VAC reduce nameplate FLA@100 VAC by 6%

4.   When operating at 230 VAC increase nameplate FLA @240 VAC by 8%

5.   When operating at 208 VAC increase nameplate FLA @240 VAC by 27%

Figure 7.1 – Typical three-phase ACV IEC nameplate
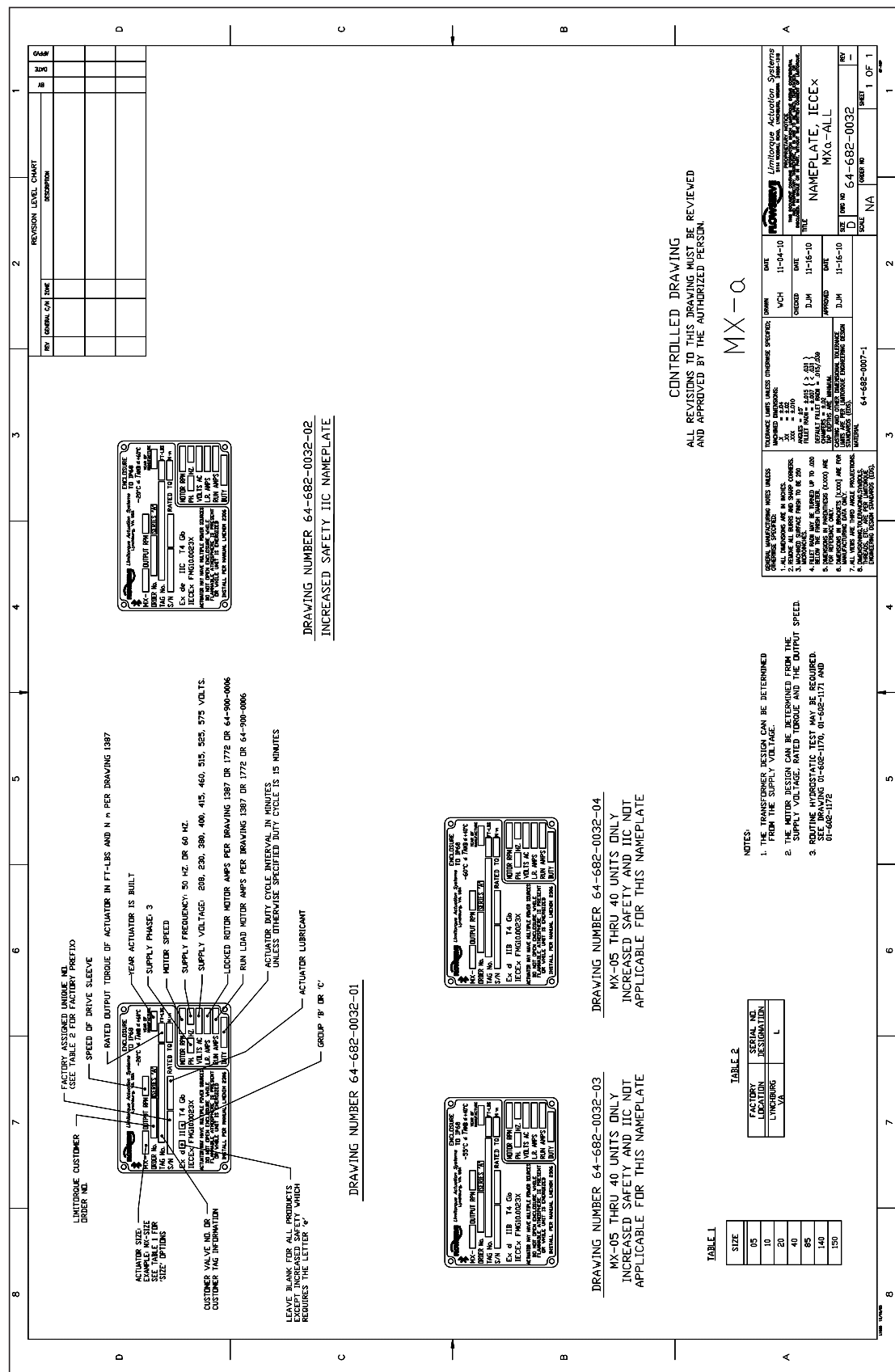
Figure 7.2 – Typical three-phase ACV ATEX nameplate
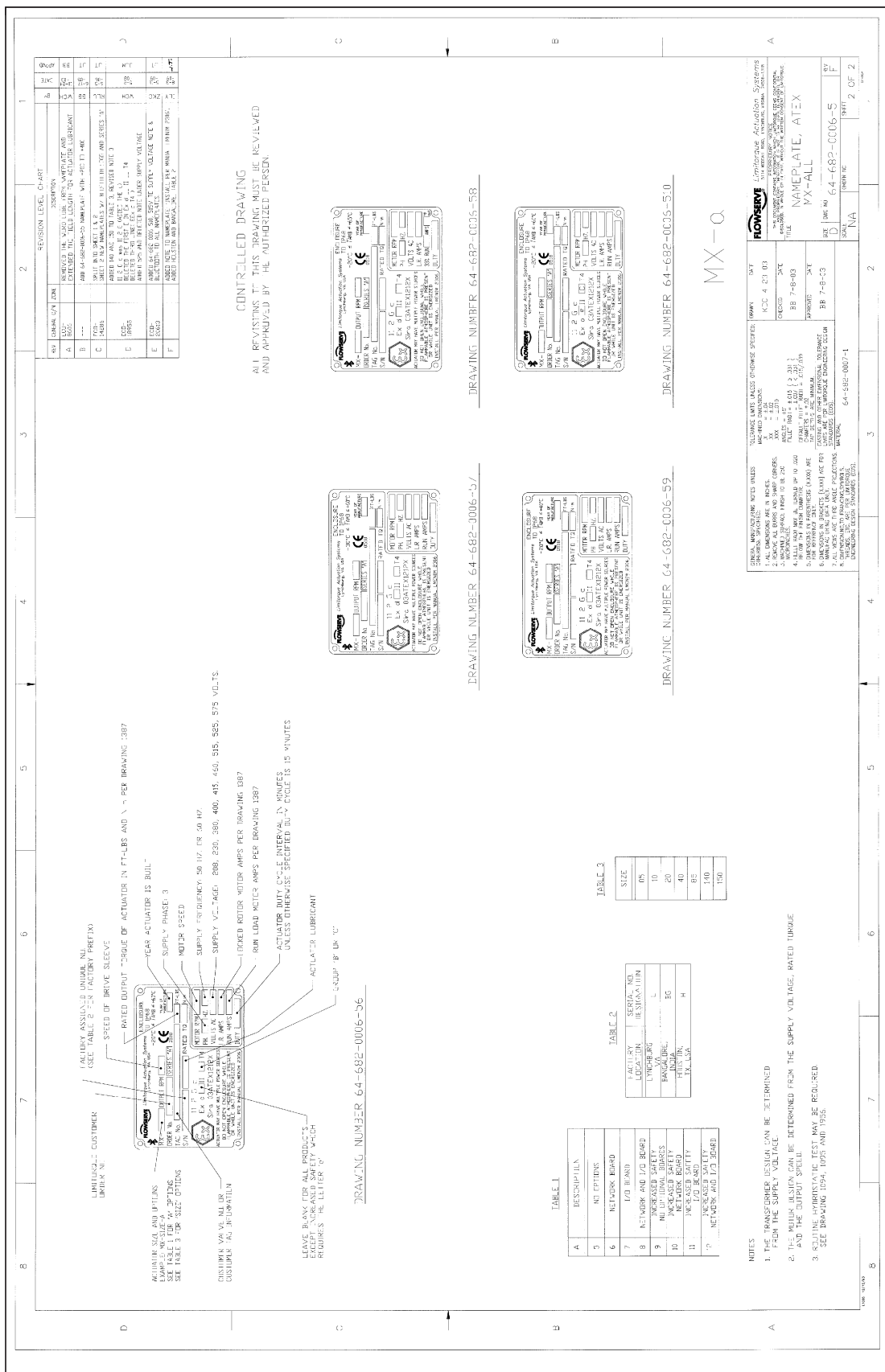
Figure 7.3 – Typical IECEx single phase MX nameplate (64-682-0032)
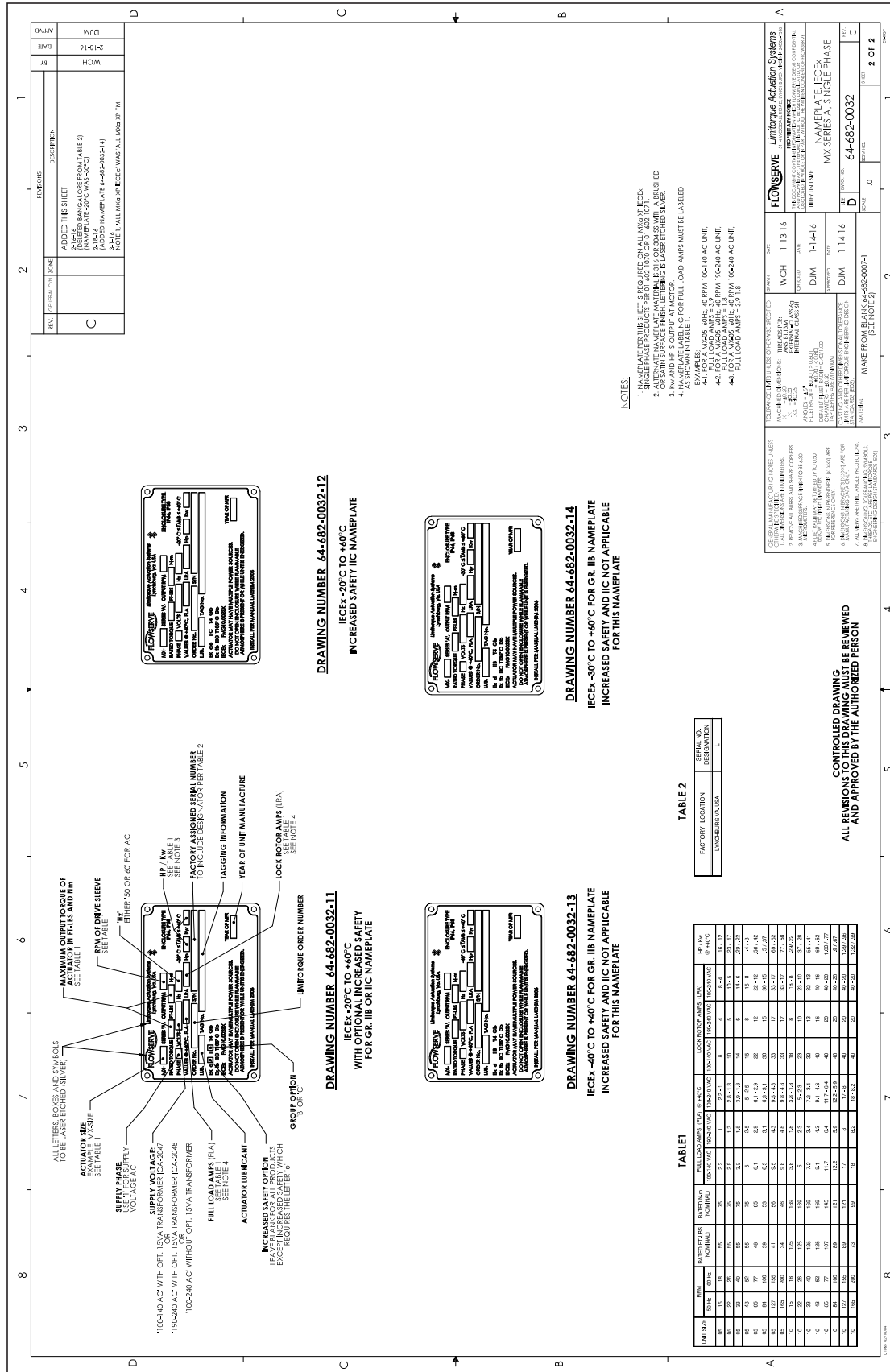
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Figure 7.4 – Typical ATEX single phase MX nameplate (64-682-0064)

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FCD LMENIM2306-07-AQ Printed in USA. May 2016

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www.flowserve.com.

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