



MXa and QXM LB (Linear Base)

Limiterque control and automation
for process control valves



Experience In Motion

Electronic Actuators for Control Valves

The world of process control has mostly relied upon pneumatic linear actuators for many years. Advances in electric actuators, especially electronic actuators, have achieved similar functionality as pneumatics with the added advantages of electrical operation. Flowserve Limitorque introduced the MX, the first multi-turn electronic, non-intrusive actuator with an absolute encoder, almost 20 years ago. The QXM, also with an absolute B.I.S.T (Built In Self-Test) encoder followed; it uses a brushless DCV motor (BLDC) specifically designed for the choke and control valve industry.

In order to meet the demands of the choke and control valve markets, a linear base can be added to complement the MX and QXM products to provide a linear output. The LB (Linear Base) is available in two sizes and can sustain thrust up to 25 000 lb/109 kN. Please see Linear Base 1 and 2 Selection Tables for the ratings of LB1 and LB2 when combined with either the MX or QXM products.

QXM and LB1 Testing and Modulating Performance

Process control demands actuators that perform consistently and repetitively to changing position parameters. To that end, the QXM and LB1 have undergone extensive development tests to EN 15714, Electric Actuators for Industrial Valves, in order to meet and exceed the test envelope for modulating service. Both the QXM and LB1 have been tested to the Class C modulating requirements of EN 15714 and can perform to the listed thresholds:

- The BLDC motor used in the QXM can perform to IEC 60034 defined as:
 - Open to Close Control = S2_30 minutes
 - Maximum modulating capability = S4_50%_1800 starts per hour
- Position deadband for modulating can be configured to +/- 0.1%, if the position precision for the actuator is configured to 0.1%. This is dependent upon the minimum overall span of the actuator being 10 mm or greater.
- Motor starts per hour monitoring can be configured from 100–1800 starts based upon user process requirements. The QXM is always 100% solid state controls to increase design life and maximum performance.
- Overall accuracy for the QXM is +/-0.1% from the setpoint when the deadband is set to 0.1%. Total deadband will be 0.3%, or +/-0.1% from the setpoint, as long as the minimum stroke length is greater than 10 mm.

- Analog process control signals can be susceptible to electro-magnetic noise. For this reason the QXM features a “filter factor” which improves its performance envelope. The greater the filter “factor”, the higher the degree of noise protection, but more time is required to respond to 4-20 mA analog signal changes. The default filter factor is “20”. The factor may be set as low as “3” which permits a quicker response to the 4-20 mA analog signal, or as high as “100”, in effect smoothing the received analog noise but slowing the actuator’s response to the analog signal. For example, if the 4-20 mA signal is 12 mA, then the actuator is requested to move to 50% Open. A filter setting of “3” improves the response time of the actuator to step inputs (mA), but correspondingly increases the chance the actuator will move in response to a noisy input signal and not an actual change in the command position. To select the proper “filter factor”, it is incumbent upon the user to consider the following:

- The quality of the analog signal generator to be used
- The quality of analog cabling and shielding to be used
- The length of the cable to be used
- The noise characteristics of the environment where the valve/actuator combination is installed

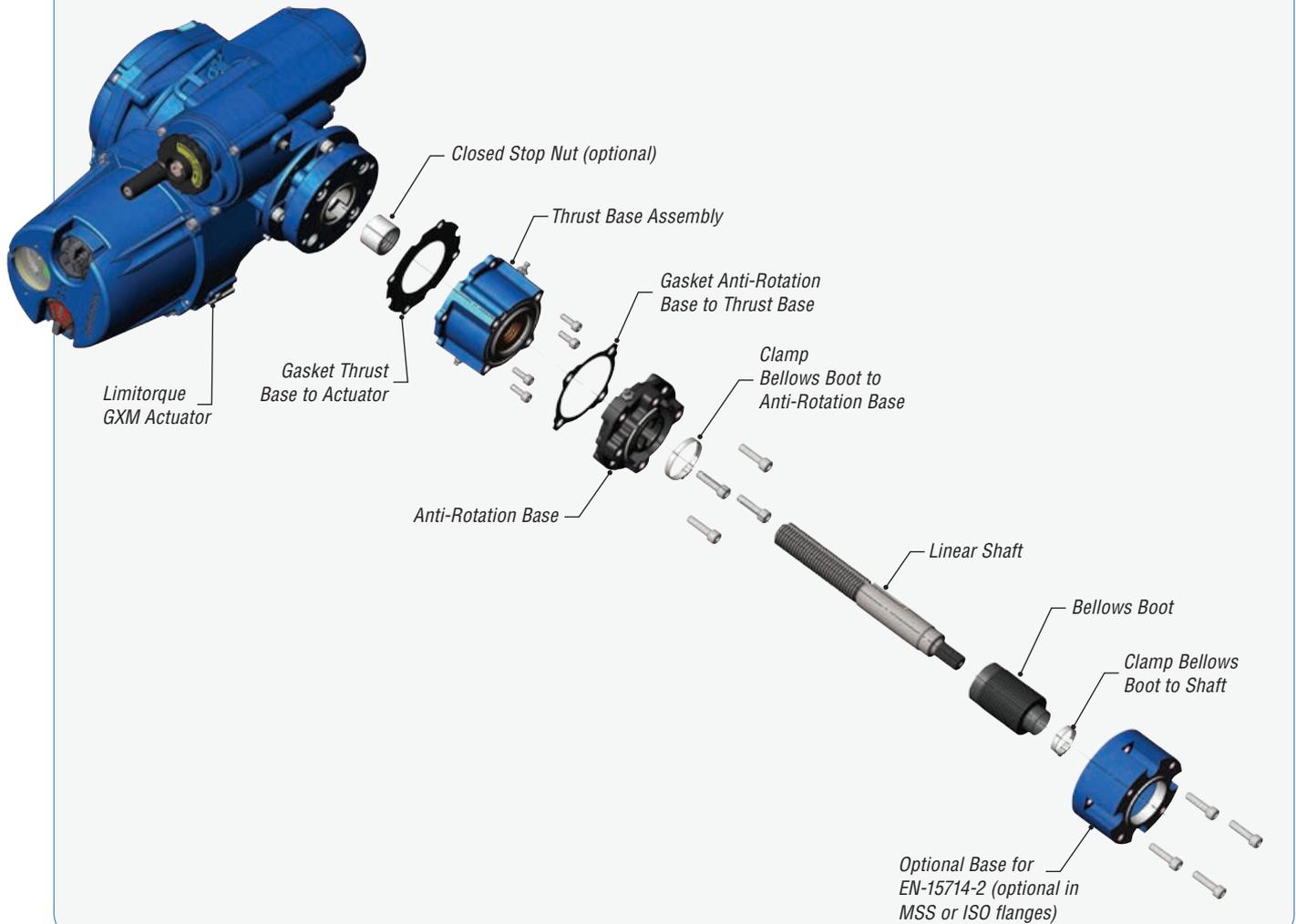
- Please refer to LMENIM3306, QX Installation and Operation manual for the menu configuration screens permitting adjustment of modulating starts and filter factor.
- Please refer to LMENTB2300, MX/QX Protection, Control, and Monitoring document for wiring diagrams and modulating performance characteristics.

MX and LB2 Testing and Modulating Performance

While the QXM and LB1 will meet the majority of requirements for smaller choke and control valves, the MX can also be fitted to the LB1. For larger control or choke valves, the MX-20 and MX-40 assembled to the LB2 have also undergone extensive development tests to EN 15714, Electric Actuators for Industrial Valves in order to meet and exceed the test envelope for modulating service. They, too, have been tested to the Class C modulating requirements of EN 15714 and can perform to the listed thresholds:

- The three-phase asynchronous ACV motor used in the MXa can perform to IEC 60034 defined as:
- Open to Close Control = S2_15 minutes (option for S2_30 minutes)
- Maximum modulating capability = S4_50%_1800 starts per hour

Exploded View QX1-M With Linear Base



- Position deadband for modulating can be configured to $\pm 0.5\%$, if the position precision for the actuator is configured to 0.1%, provided the overall span of the actuator is 28 mm or greater.
- MX Motor starts per hour can be configured from 100 – 1800 starts based upon user process requirements. When the process demand is greater than 600 starts per hour, Limitorque recommends the use of an optional solid state starter.
- Please refer to LMENIM2306, MX Installation and Operation manual for the menu configuration screens permitting adjustment of modulating starts.
- Please refer to LMENTB2300, MX/QX Protection, Control, and Monitoring document for wiring diagrams and modulating performance characteristics.

LB (Linear Base) Advantages

Advantages of the LB include an easily assembled mechanical base that converts actuator torque to linear thrust. The standard A1 base is used to accept the valve thrust component, and both the LB and A1 base are available in either MSS or ISO flanges. This means that either an MX or QXM actuator that has an A1 thrust base can be readily fitted for its corresponding LB1 or LB2 base. Both the LB1 and LB2 can be ordered with the “EN” base as optional. This permits stem protection and satisfaction of EN 15714, Electric Actuators for Industrial Valves Requirements. The bases are also compliant with ATEX 94/9/EC certification.

QXM Selections With Linear Base (LB1)

F10/FA10 Mounting Base and a Maximum Stroke of 3.00 in /76 mm

Seating/Unseating Thrust (Lb/KN)	Modulating Thrust (Lb/KN)	Actuator Model	Actuator RPM	Linear Speed (mm/Sec)	Linear Speed (In/Min)
9065 / 40	9065 / 40	QX1-M	3	0.20	0.47
8159 / 36	8159 / 36	QX1-MH	6	0.40	0.94
7071 / 31	7071 / 31	QX1-MH	12	0.80	1.89
4986 / 22	4986 / 22	QX1-MH	18	1.20	2.83
2538 / 11	2538 / 11	QX1-MH	24	1.60	3.77
3173 / 14	3173 / 14	QX1-ML	6	0.40	0.94
2720 / 12	2720 / 12	QX1-ML	12	0.80	1.89
1813 / 8	1813 / 8	QX1-ML	18	1.20	2.83
725 / 3	725 / 3	QX1-ML	24	1.60	3.77
7418 / 33	7418 / 33	QX1-M	3	0.50	1.18
6677 / 30	6677 / 30	QX1-MH	6	1.00	2.36
5786 / 26	5786 / 26	QX1-MH	12	2.00	4.72
4080 / 18	4080 / 18	QX1-MH	18	3.00	7.07
2077 / 9	2077 / 9	QX1-MH	24	4.00	9.43
2596 / 12	2596 / 12	QX1-ML	6	1.00	2.36
2226 / 10	2226 / 10	QX1-ML	12	2.00	4.72
1484 / 7	1484 / 7	QX1-ML	18	3.00	7.07
593 / 3	593 / 3	QX1-ML	24	4.00	9.43

MX Selections With Linear Base (LB1)

F10/FA10 Mounting Base and a Maximum Stroke of 4.77 in/121 mm

Seating/Unseating Thrust (Lb/KN)	Modulating Thrust (Lb/KN)	Actuator Model	50 Hz Linear Speed (mm/Sec)	50 Hz Linear Speed (In/Min)	60 Hz Linear Speed (mm/Sec)	60 Hz Linear Speed (In/Min)
1994 / 9	1595 / 7	MX-05	1.00	2.35	1.20	2.83
1994 / 9	1595 / 7	MX-05	1.41	3.33	1.70	4.01
4986 / 22	3989 / 18	MX-05	2.24	5.28	2.70	6.37
4986 / 22	3989 / 18	MX-05	2.91	6.85	3.50	8.25
4351 / 19	3916 / 17	MX-05	4.23	9.98	5.10	12.03
4533 / 20	3626 / 16	MX-10	1.00	2.35	1.20	2.83
4533 / 20	3626 / 16	MX-10	1.41	3.33	1.70	4.01
11 332 / 50	9065 / 40	MX-10	2.24	5.28	2.70	6.37
11 332 / 50	9065 / 40	MX-10	2.91	6.85	3.50	8.25
9700 / 43	7760 / 34	MX-10	4.23	9.98	5.10	12.03
1632 / 7	1306 / 6	MX-05	2.49	5.87	3.00	7.07
1632 / 7	1306 / 6	MX-05	3.57	8.42	4.30	10.14
4080 / 18	3264 / 15	MX-05	5.56	13.11	6.70	15.80
4080 / 18	3264 / 15	MX-05	7.22	17.03	8.70	20.51
3561 / 16	2849 / 13	MX-05	10.62	25.05	12.80	30.18
3709 / 16	2967 / 13	MX-10	2.49	5.87	3.00	7.07
3709 / 16	2967 / 13	MX-10	3.57	8.42	4.30	10.14
9273 / 41	7418 / 33	MX-10	5.56	13.11	6.70	15.80
9273 / 41	7418 / 33	MX-10	7.22	17.03	8.70	20.51
7938 / 35	6350 / 28	MX-10	10.62	25.05	12.80	30.18

MX Selections With Linear Base (LB2)

F14/FA14 Mounting Base and a Maximum Stroke of 4.77 in/121 mm

Seating/Unseating Thrust (Lb/KN)	Modulating Thrust (Lb/KN)	Actuator Model	50 Hz Linear Speed (mm/Sec)	50 Hz Linear Speed (In/Min)	60 Hz Linear Speed (mm/Sec)	60 Hz Linear Speed (In/Min)
4997 / 22	3998 / 18	MX-20	0.75	1.76	0.9	2.12
4997 / 22	3998 / 18	MX-20	1.08	2.54	1.3	3.07
12 493 / 56	9994 / 44	MX-20	1.66	3.91	2.0	4.72
12 493 / 56	9994 / 44	MX-20	2.16	5.09	2.6	6.13
9883 / 44	7907 / 35	MX-20	3.24	7.63	3.9	9.20
9772 / 43	7818 / 35	MX-40	0.75	1.76	0.9	2.12
9772 / 43	7818 / 35	MX-40	1.08	2.54	1.3	3.07
24 431 / 109	19 545 / 87	MX-40	1.66	3.91	2.0	4.72
24 431 / 109	19 545 / 87	MX-40	2.16	5.09	2.6	6.13
19 156 / 85	15 325 / 68	MX-40	3.24	7.63	3.9	9.20
4500 / 20	3600 / 16	MX-20	1.99	4.70	2.4	5.66
4500 / 20	3600 / 16	MX-20	2.91	6.85	3.5	8.25
11 250 / 50	9000 / 40	MX-20	4.40	10.37	5.3	12.50
11 250 / 50	9000 / 40	MX-20	5.73	13.50	6.9	16.27
8900 / 40	7120 / 32	MX-20	8.55	20.16	10.3	24.29
8800 / 39	7040 / 31	MX-40	1.99	4.70	2.4	5.66
8800 / 39	7040 / 31	MX-40	2.91	6.85	3.5	8.25
22 000 / 98	17 600 / 78	MX-40	4.40	10.37	5.3	12.50
22 000 / 98	17 600 / 78	MX-40	5.73	13.50	6.9	16.27
17 250 / 77	13 800 / 61	MX-40	8.55	20.16	10.3	24.29

Charts shown with LB thrusts and actuator torques calculated at a modulating rate of 100 starts per hour. Contact factory for other modulating rates up to 1800 starts per hour.

Flowserve Limitorque selected two (2) standard stainless steel stems each for the LB1 and LB2. Other stems can be manufactured to meet the user's requirements. Connections of the LB stem to the valve stem can either be a male thread and split clamp or a female thread to mate with the corresponding valve stem.

When Flowserve Limitorque's QXM or MXa actuators are supplied with the linear base, most cycle and performance requirements for choke and control valves will be exceeded. The entire non-intrusive feature sets and network protocols, including HART, are available with either the QXM or MXa. Please contact the factory for feature specifics and available options.



Glossary

- *Deadband* = the maximum amount of signal target position variance permitted from setpoint before the motor is energized to minimize the variance: e.g., a 1.0% deadband is the actuator position variance about the setpoint in response to the input signal target position – a 12 mA analog input signal to an actuator with a 1.0% deadband means that the actuator will move to within 1.0% of the requested position, i.e., 12 mA = 50% Open, or actuator will move to within 49% – 51% Open.
- *Proportional band* = the position variance allowed before the actuator changes from continuous movement to pulsing in order to reach requested deadband position. Default = 5%, meaning the actuator will commence motor pulsing to prevent overshoot of the target deadband once the actuator is within 5% of requested target position. If the target position is 50%, then the actuator motor will begin pulsing, or slowing down, once the position reaches either 45% Open or 55% Open.
- *Filter Factor* = how much an analog input signal may be filtered or dampened to mitigate electrical noise that may be produced in the input signal. The higher the factor the greater the time required for the actuator to respond to the input signal.
- *LB* = linear base – a device that attaches to an actuator to convert actuator torque to linear thrust for either a control or choke valve.
- *Motor starts per hour* = the number of times the actuator motor is cycled "ON" and "OFF" for a period of 60 minutes (3600 seconds). The QXM with an LB1 may be modulated up to 1800 starts per hour, or one second "ON" and one second "OFF".
- *Modulating ratings* are from 100 starts per hour to 1800 starts per hour for the MXa and the QXM. The ratings displayed are for 100 starts per hour. Consult factory for ratings greater than 100 starts per hour for the MX. The QXM modulating ratings are the same as the Open/Close ratings up to a maximum of 1800 starts per hour.



For more information on the features, options and certifications of the Limitorque MX, consult Flowserve bulletin LMENBR0008.
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