Actuators for High Torque Applications

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Application Definition

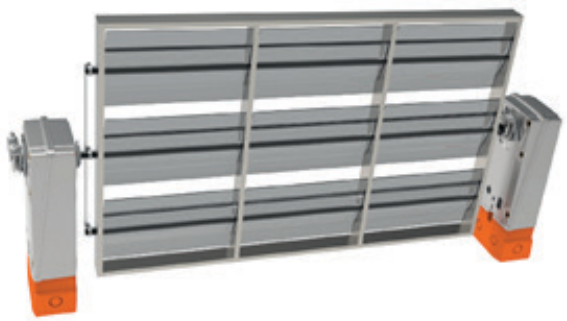
When designing commercial HVAC damper applications, there are many factors to consider that impact actuator selection, installation methods, and wiring options. Every actuator manufacturer has an applied torque limit to consider. With Belimo, we not only have the most comprehensive torque range available; Belimo has a few installation and configuration options that help satisfy the need for high torque of large multi-section dampers.

When factoring in the controllability of a damper, the control system is simply sending a control signal to "an actuator" to drive "a damper." The control signal does not care that multiple damper sections and multiple actuators are required to operate as "one" device.

Damper manufacturers also have specific product considerations to fill the designed rough opening with dampers, manage shipping size limits, damper assembly configurations, and damper performance.
Application, product, and manufacturer terminology vary when discussing large dampers or high torque applications. This document attempts to address terminology with a specific focus on actuation options for large multi-section dampers.

Common terms used to define multiple actuators installed to a damper shaft:

- Dual mounted actuators
- Tandem mounted actuators
- Multiple actuator mounting
- Close-coupled actuators
- Inter-connected sections



Belimo installation recommendations often do not default to use the largest torque actuator possible. Belimo may recommend multiple 'smaller' actuators mounted and wired to deliver high torque efficiently to damper shafts to optimize torque performance of torsional load and elasticity. However, this also has limits requiring Belimo to recommend splitting the factory damper assembly.

If a damper requires 300 in-lb of torque, Belimo may recommend one 180 in-lb actuator on the left and one 180 in-lb actuator on the right. Rather than one 360 in-lb actuator installed on one side—the application benefits by applying the actuator torque effectively to reduce the torsional load. A long and wide damper assembly may have a jackshaft assembly for interconnecting the damper sections. Torque applied to long jackshafts from one side can twist the shaft. Splitting the actuator torque across the damper dramatically improves the performance of the dampers. For example, when an actuator drives a long damper shaft from one side, it may twist when delivering the torque. Too much twist will actually reduce the farthest dampers' angle of rotation and ultimately affect the air volume or increase the pressure drop across the damper.

Common Belimo terminology used when discussing large damper assemblies:

- Dual or Multiple actuator mounting
- Parallel wiring
- Primary/Secondary wiring
- Piggy-Back mode (PGB)

Piggy-Back mode (PGB) is the primary functionality that enables actuators to work together to increase the delivered torque. This document details PGB functionality and application criteria for proper use of PGB mode.

What is Piggy-Back (PGB)?

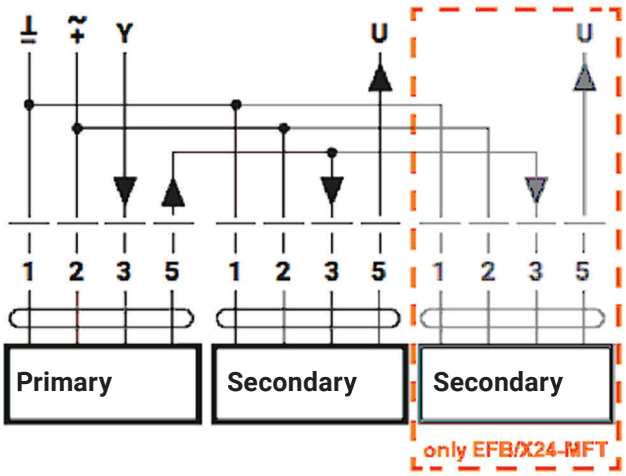
Overview

Piggy-Back (PGB) is used when coupling two or more actuators on one or multiple mechanically linked shafts to provide higher torque for an application. Thus, Piggy-Back (PGB) operation is typically available with the highest torque Multi-Function Technology (MFT) actuators and the AF, EF, GK, GM.. series with MFT.

The PGB mode activates automatically with actuator wiring for Primary/Secondary control applications. The wiring defines which actuator is Primary. The Primary actuator is responsible for the control and performance of the mechanically coupled Secondary actuators.

Piggy-Back MFT actuators provide the amount of actuator torque equal to the application's required torque.

The basis for Piggy-Back control requires a mechanical and rigid interconnection.



Products with PGB Mode

Product Range	AFB(X)24-MFT AFB(X)24-MFT-X1	EFB(X)24-MFT	GMB(X)24-MFT GMB(X)24-MFT-X1	GKB(X)24-MFT
				
Running time	70… 220 s	60…150 s	90…150 s	75…290 s
Wiring	Primary/Secondary	Primary/Secondary	Primary/Secondary	Primary/Secondary
Piggy-Back option	■	■	■	■
Control options	on/off, floating point, modulating	on/off, floating point, modulating	on/off, floating point, modulating	on/off, floating point, modulating
Auxiliary switch	-S models	-S models	Add-on	Add-on
Actuator torque	180 in-lb [20 Nm]	270 in-lb [30 Nm]	360 in-lb [40 Nm]	360 in-lb [40 Nm]
Torque multiplier	2 x = 360 in-lb [40 Nm]	2 x = 540 in-lb [60 NM] 3 x = 810 in-lb [90 Nm]	2 x = 720 in-lb [80 Nm]	2 x = 720 in-lb [80 Nm]

Note: With no fixed mechanical connections, –SR models operated in parallel; Piggy Back (PGB) mode is not an option.

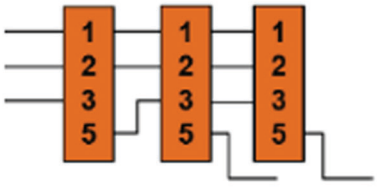
Piggy-Back Mode Function

Primary/Secondary is the preferred wiring method for Piggy-Back applications. The Primary actuator receives the control signal from the controller. Every Secondary actuator connected to the Primary (U5) receives operational commands from the Primary. For position feedback, select one Secondary feedback signal (5) back to the controller (if applicable). If the Primary fails, the Secondaries will not respond to the control signal.

Belimo Multi-Function Technology (MFT) actuators offer the ability to configure functions to match application needs. Such as configuring:

- Control signal
- Feedback signal
- Runtime
- Adaption of the angle of rotation

The MFT platform increases a contractor's field flexibility with one configurable product. With the PC-Tool and or ZTH, the field technician can easily configure specific actuator functionality. Additionally, all MFT-based products incorporate Belimo MP-Bus communications. MP-Bus is a Belimo designed digital communication field bus that works over a three-wire low voltage circuit. When activated, Piggy-Back mode uses MP-Bus to control mechanically connected actuators (Secondary). To understand how we use the MP-Bus, let's first establish how position feedback functions with conventional 2...10 VDC -SR actuators, MFT, MFT in PGB mode, and MP-Bus actuator models.

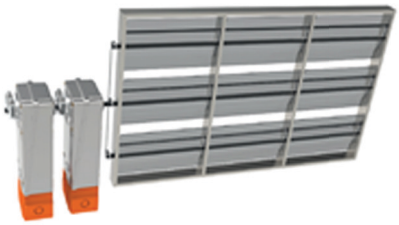


Review of position feedback signals.

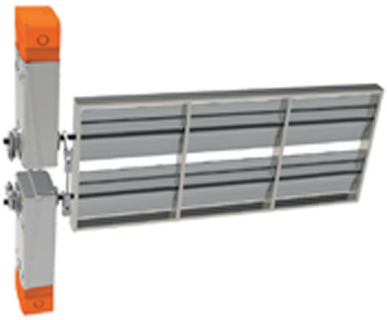
Model	Measuring Tool	Description
-SR feedback	Digital voltage meter (DVM)	• Proportional 2...10 VDC signal measured between actuator 24V common (1) and feedback U (5). o 2 VDC = '0' percent mechanical position o 10 VDC = '100' percent mechanical position
-MFT feedback	Digital voltage meter (DVM)	• Proportional 2...10 VDC (or variable) signal between actuator 24V common (1) and feedback U (5). • During adaption, position feedback is fixed at 2 VDC over the entire adaption cycle. • Adaption completed, the configured feedback VDC can be measured.
-MFT in PGB mode	Digital voltage meter (DVM)	• The Primary actuators voltage while connected to a Secondary, between the Primary's 24V common (1) and feedback U (5) represents: o Signal of 6 VDC, ±3.5 VDC o 6 VDC = measured while at satisfied setpoint o 6.5...10 VDC (+3.5) = drive "CW" o 5.5...2 VDC (-3.5) = drive "CCW" • The higher or lower the voltage from 6 VDC is an indication of the additional torque and speed required.
-MFT in MP-Bus mode	Uses the ZTH and PC-Tool with a built-in bus analyzer	• Actuator address, name identification, and functional commands are represented with a low voltage signal (U). • Due to MP-Bus speed, the commands are readable.
	MP-Primary	• **Primary/Secondary is NOT ALLOWED when controlled by an MP-Bus Primary because the Primary's feedback wire is allocated for MP-Bus communications.**

Basic Mechanical Requirements

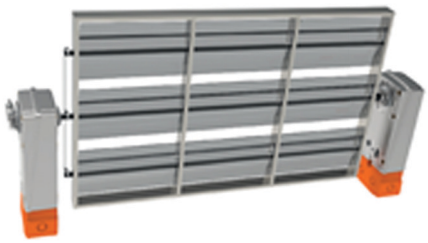
In the Piggy-Back operation, the Secondary is directly controlled by the Primary, leading to even load distribution. The prerequisite is a rigid mechanical connection between the Primary and Secondary. Best results are achieved when both actuators are mounted as close together on the same rigid shaft. Large multi-section dampers benefit by distributing the torque across the damper surface. Belimo has taken steps to ensure the actuators are in sync and accurately reporting feedback position, which ultimately represents the damper's position with a 2...10 VDC signal.



It is possible to mount two actuators on different control shafts, requiring a mechanically coupled or interlocked use of quality damper crank-arms, ball joints or rod ends, and linkage. Since a rigid connection is essential, set up damper crank arm assemblies to always form a parallelogram. See Belimo Mounting Methods Guide.



Damper Assembly Elasticity: In extreme cases, an increased distance between the mechanically connected actuators AND a combination of low torsion rated materials, flexible brackets, and weak connection points increases the elasticity of the overall mechanical system, which can lead to a significantly uneven load distribution on the Primary and Secondary. And could manifest as a different angular position of the two actuators with a deviation between the control input and feedback signals.

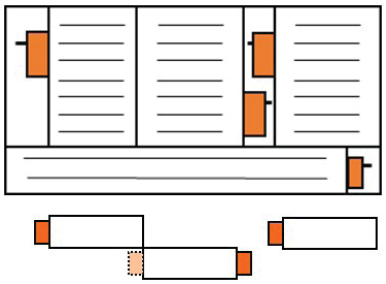


Basic PGB Dependencies

Application sizing

Preferred damper sizing:

- 10 Steps for sizing a damper
- Multi-section dampers
  - One actuator per section
  - Wired in parallel
  - Dedicated OA dampers
  - Stagger dampers for access to control shaft



Valve assembly sizing:

- Belimo ensures that factory assemblies have sufficient torque for the intended application.

Two actuators, one shaft

- The shaft is the mechanical element, which rigidly interconnects two actuators.
- **Piggy-Back operation: YES**

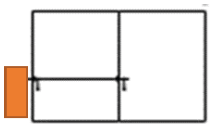
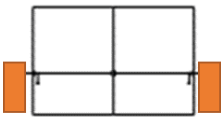
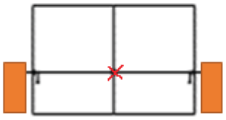
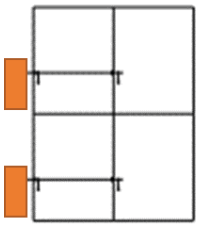
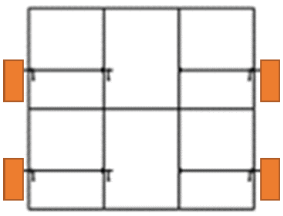
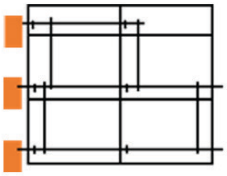
Two actuators, two shafts with a stable mechanical connection

- Additional mechanical components are rigidly interconnecting two shafts. The linkage can connect directly to the actuators via the universal shaft clamp.
- The linkage and crank-arm connection typically forms a parallelogram.
- **Piggy-Back operation: YES**

Two actuators, two shafts without mechanical connection

- No mechanical element is used for connecting between the shafts.
- Belimo recommends – SR models wired in **PARALLEL.**
- **Piggy-Back operation: NO**

Application Configurations

Single actuator, multiple sections, mechanically connected	You can think of this as “one” larger damper. Calculating the total connected area and determining that the torque of one actuator will efficiently rotate the damper.	
Two actuators, two sections, mechanically connected	Requires MFT actuator model wired Primary/Secondary	
Two actuators, two sections, NOT mechanically connected	Requires the use of -SR model actuators, wired parallel or Primary/Secondary	
Two actuators, four damper sections, Upper and Lower sections are not interconnected. But the L-R sections ARE connected.	Requires the use -SR actuators, wired parallel or Primary/Secondary	
Four actuators, six damper sections, Upper Center-Left, connected Lower Center-Left, connected Upper Right, Lower Right sections are NOT connected, Essentially “four” dampers not mechanically connected	Requires the use of -SR model actuators wired in parallel Alternately -SR actuators wired Primary/Secondary	
Three actuators with six interconnected damper sections.	The entire damper is sized for three “EF” series actuators, to deliver the torque efficiently each damper section is inter-connected via linkage.	

Application Non-Conformance

Identifying the applications' mechanical set-up is critical to ensure accurate application control to ensure long life. What are the application options upon determining MFT and Primary/Secondary is not the solution?

For example, damper with four sections that ARE NOT mechanically connected, this is a traditional -SR actuator application wired in parallel. What happens with MFT actuators when installed on Mechanically Separate dampers? As established, Primary/Secondary mode is activated simply by wiring the actuators for Primary/Secondary. However, the activation during start-up does not know that the damper sections are not connected; therefore, the working relationship and Primary/Secondary performance is not realized.

The Primary will enter PGB mode, but mechanically the load dynamics between the Primary and Secondary are disconnected. Remember that the Primary and Secondary signal represents a few dynamic aspects of control, such as Normal or PGB mode, control signal, runtime, and position feedback. The mechanical connection is critical to proper operation and for the Secondary to know how much torque to contribute.

The Primary actuator can become the weak link. If the Primary were to fail, all connected Secondaries are affected. With a parallel wiring configuration, if one actuator failed, all parallel actuators continue to function. In some applications, the system can continue to function with reduced flow, increase pressure drop. If below an alarm threshold.

Primary/Secondary remains the right solution for controlling the mixing damper sections of an AHU (OA, RA, EA) with ..-SR actuators. Wire as Primary/Secondary, the three sections will track each other. The electrical load on the controller output is only one actuator.

Electrical Connection

Power supply

Actuators wired for Primary/Secondary must use the same power supply.
The mode detection learning process begins with power simultaneously applied and with Primary/Secondary wiring connected.

Piggy-Back mode detection is very fast (a few seconds) and nearly undetectable.

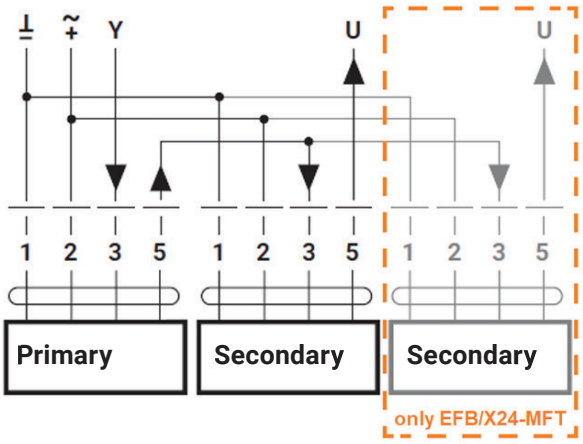
Wire colors and function

Cable Colors	Actuator Function
1=black	1=common
2=red	2=hot
3=white	3=(Y) signal
5=orange	5=(U) feedback

Wiring diagrams

Wiring an actuator for Primary/Secondary control requires:

- Same power source
- The control signal to Primary actuator wire #3 (Y), e.g., 2...10 VDC
- Primary's feedback signal wire #5 (U) to Secondary's control signal input #3 (Y)
- If damper or valve position is required, one of the Secondary's position feedback wire #5 (U) to the controller.



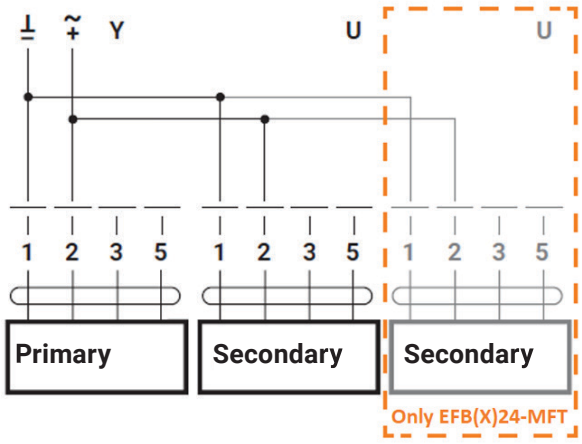
Restore Normal Control Mode

Restoring an actuator to normal control mode (not Primary/Secondary mode) requires:

Same power source
- Shut-off actuator power
- Completely remove control signal and feedback wires.
- Loosen the actuator clamp so the actuator rotates free.
- Cycle power on
- Measure the Position Feedback on wire U5 with a voltmeter.

Normal mode feedback is a 2...10 VDC signal proportional to 0 to 100% actuator rotation. Test cycle each actuator while measuring feedback voltage. When the Feedback voltage begins to track the position signal, the actuators are ready for single mount installation. Or re-installation for Primary/ Secondary.

- Repeat the process if or as needed.



Settings

The Piggy-Back operation does NOT require activation or configuration. The actuators detect this autonomously with the correct wiring.

If parameters such as running time need to be adjusted, the table below indicates which actuator and tools are required. It is not recommended to make any additional adjustments other than what is listed. Contact Belimo for assistance.

The angle of rotation limitation

For Piggy-Back operation, the actuators' angle of rotation limiters and or mechanical stops are not designed for 2-times the torque. An application end stop is preferred to absorb the torque of both actuators.

Angle restrictions via end stop on the actuator or the programmed angle require close attention to detail set-up.
If possible, avoid reduced angles.

Adaptation of the angle of rotation

An adaption is recommended for all new Piggy-Back applications.

Performing an adaption with AFB24-MFT:
1. Power and control wiring to all actuators.
2. Primary only, click the CW-CCW (L-R) switch two full cycles.
3. Both actuators begin driving 'open' to the applications end stop
    a. Hitting the stop sets the new angle representing 100% position at 10 VDC input.
4. Actuators then drive to the control signal.
5. Refer to other actuator datasheets for more details.

The adaptation is initiated at the Primary. The Secondary moves with the adaptation and keeps the factory angle feedback resulting in different angles at the Primary and Secondary with input and feedback signal.

Parameters	Tool	Changes required with
Control signal Y (Open/close, 3-point, modulating)	PC-Tool / ZTH	Primary*
Feedback U5	PC-Tool / ZTH	Secondary*
Running time	PC-Tool / ZTH	Primary*
POP (fail-safe) GKB/X24-MFT only	PC-Tool / ZTH	Primary*
Bridging time (GKB/X24-MFT only)	PC-Tool / ZTH	Primary*

* Control signal and feedback signals can also display different values depending on MFT programming and controller needs

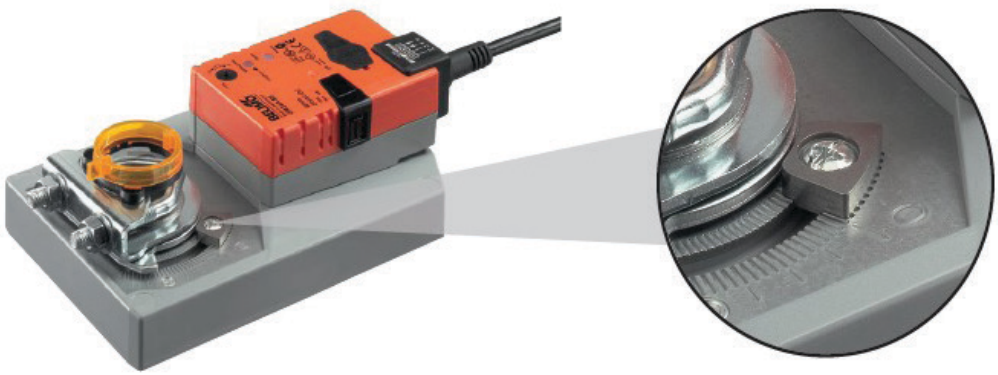
Advanced adaptation of the angle of rotation

General advanced set-up, Secondary angle of rotation adaption:
1. Previous step #4, DRIVE the actuators to the application's desired stopping angle, set both Primary and Secondary's mechanical stops.
2. Remove power, loosen BOTH actuators clamps, restore the power.
3. Perform an adaption with each actuator (individually click the Primary and Secondary's CW-CCW switch twice).
4. Re-install both actuators and tighten the universal clamps.
5. Test cycle the assembly, verify the Secondary's position feedback.
6. Application variables will influence the exact procedures; contact Belimo.

Restrictions

The mechanical end stop of the actuator should not be adjusted. Consult Belimo for options where applications require a unique configuration.

- Actuator power must be from the same transformer. The Piggy-Back mode recognition requires power at the same time.
- Actuator pre-tensioning must be removed before installation. Spring return actuators are shipped with 5 degrees of pre-tension, which must be removed.
- Ensure proper installation of factory anti-rotation bracket.
- Field fabricated anchor points or brackets MUST be rigid! No bending or flex is allowed in these field-fabricated brackets because we are increasing the application's torque!
- All actuators mechanically connected to one shaft must be of the same model.
- Neither the manual gear release nor the manual hand crank should be used to manually rotate the coupled actuators. Drive with a 2-10 VDC signal from Belimo signal positioner, SGA24.
- The mechanical stop is designed for a single actuator torque. Improperly adjusted stops will cause actuator damage.
- The installer must ensure the fail-safe position and the direction of rotation switches are correct based on installation needs.
- Ensure the actuators are rigidly interconnected.
- In the event of an actuator replacement, all coupled actuators must be changed.



Rotary Actuator AFB(X)24-MFT(-S, X1)

Rotary actuator with fail-safe function

A configurable rotary actuator with fail-safe operation is used for adjusting dampers in commercial HVAC buildings.

Nominal torque per actuator: 180 in-lb [20 Nm]
Piggy-Back operation: maximum 2 actuators = 360 in-lb [40 Nm]

Nominal voltage	AC/DC 24 V
Nominal voltage frequency	50/60 Hz
Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
Power consumption in operation	8.5 W
Power consumption in the rest position	3.5 W
Power consumption for wire sizing	11 VA
Connection supply / control cable	18 GA appliance cable, 3 ft. [1 m], with 1/2" conduit connector
Torque motor min.	180 in-lb [20 Nm]
Positioning signal options	open/close 3-point (AC only) modulating (DC 0.5 / 2...10 V)
Direction of motion motor	direction of rotation switch
Direction of motion fail-safe	by mounting CW/CCW
Angle of rotation	Max. 95°
Running time motor	150 s / 90°
Running time motor	variable 70...220 s
Running time fail-safe	<20 s / 90°
Adaptation setting range	manual
Mechanical interface universal shaft	1/2...1.05" round, centers on 1/2" and 3/4" with insert, 1.05" without insert [clamp 10...25.4 mm]

Properties

- A maximum of two actuators can be connected in the Primary/Secondary operation.
- Both actuators must have the same model number.
- The Primary/Secondary operation is only permitted on a rigid connected mechanical shaft.
- The wiring determines the controlled actuator to the Primary actuator.
- From the Primary, the Piggy-Back installation function can be checked by clicking the Primary's direction of rotation switch two full cycles to begin adaptation.

Restrictions

- Adjusting the mechanical end stops is not permitted in Piggy-Back operation.
- Both actuators must be precisely at the same angular position when mounting.
- The actuators must be powered using the same power supply.

For more information, refer to the AFB24-MFT datasheet.

AFB(X)24-MFT(-S, X1) continued

Installation and commissioning

1. Turn the damper to the starting position.
2. Bring both actuators into the same angular position.
3. Position the first actuator and set the direction of rotation switch.
4. Tighten the shaft clamp loosely (shaft can rotate freely).
5. Position the asecond actuator and set the direction of rotation switch.
6. Tighten the shaft clamp loosely (shaft can rotate freely).
7. Inspect and tighten all shaft clamps.
8. Without power, wire the Primary and Secondary (same power supply for all actuators).
9. Apply power; the actuators will stay at the start position for a few seconds.
10. To record the mechanical end stops, press the “Adaption” button on the Primary.
11. Check operation, test different damper position, and fail-safe position.

- Always mount actuators to rotate in the same direction.
- Set the direction of rotation switches on Primary and Secondary to the same position.
- The manual override should not be used with coupled actuators.

Rotary Actuator EFB(X)24-MFT

Rotary actuator with fail-safe function

A configurable rotary actuator with fail-safe function is used for adjusting dampers in commercial HVAC building installations.

Nominal torque per actuator: 270 in-lb [30 Nm]
Piggy-Back operation: maximum 3 actuators = 810 in-lb [90 Nm]

Nominal voltage	AC/DC 24 V
Nominal voltage frequency	50/60 Hz
Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
Power consumption in operation	9.5 W
Power consumption in the rest position	4.5 W
Power consumption for wire sizing	16 VA
Connection supply / control cable	18 GA appliance cable, 3 ft. [1 m], with 1/2" conduit connector
Torque motor min.	270 in-lb [30 Nm]
Positioning signal options	open/close 3-point (AC only) modulating (DC 0.5 / 2...10 V)
Direction of motion motor	direction of rotation switch
Direction of motion fail-safe	by mounting CW/CCW
Angle of rotation	max. 95°
Running time motor	150 s / 90°
Running time motor	variable 60...150 s
Running time fail-safe	<20 s / 90°
Adaptation setting range	manual
Mechanical interface universal shaft	1/2...1.05" round, centers on 3/4" with insert, 1.05" without insert. [clamp 12...26.7 mm]

Properties

- A maximum of three actuators can be connected in the Primary/Secondary operation.
- All actuators must have the same model number.
- The Primary/Secondary operation is only permitted on a rigid connected mechanical shaft.
- The wiring determines the controlled actuator to the Primary actuator.
- From the Primary, the Piggy-Back installation function can be checked by clicking the Primary's direction of rotation switch two full cycles to begin adaptation.

Restrictions

- Adjusting the mechanical end stops is not permitted in Piggy-Back operation.
- Both actuators must be precisely at the same angular position when mounting.
- The actuators must be powered using the same power supply.

For more information, refer to the EFB24-MFT datasheet.

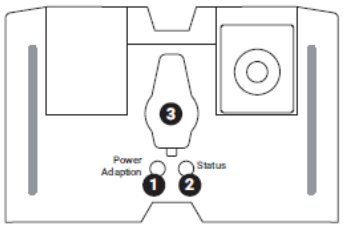
EFB(X)24-MFT continued

Installation and commissioning

1. Turn the damper to the starting position.
2. Bring both actuators into the same angular position.
3. Position the first actuator and set the direction of rotation switch.
4. Tighten the shaft clamp loosely (shaft can rotate freely).
5. Position the asecond actuator and set the direction of rotation switch.
6. Tighten the shaft clamp loosely (shaft can rotate freely).
7. Inspect and tighten all shaft clamps.
8. Without power, wire the Primary and Secondary (same power supply for all actuators).
9. Apply power; the actuators will stay at the start position for a few seconds.
10. To record the mechanical end stops, press the “Adaption” button on the Primary.
11. Check operation, test different damper position, and fail-safe position.

- Always mount actuators to rotate in the same direction.
- Set the direction of rotation switches on Primary and Secondary to the same position.
- The manual override should not be used with coupled actuators.

Operating controls and indicators



❶	**Push-button and LED display green**	
	Off:	No power supply or malfunction
	On:	In operation
	Press button:	Triggers angle of rotation adaptation, followed by standard control mode
❷	**Push-button and LED display yellow**	
	Off:	Standard mode
	On:	Adaptation or synchronization active
	Press button:	No function
❸	**Service plug**	
	For connecting theparametrization and service tools	ZTH and PC-Tool
	Check power supply connection	
	1 Off and 2 On	Possible wiring fault on the power supply

Rotary Actuator GKB(X)24-MFT

Rotary actuator with fail-safe function

A configurable rotary actuator with fail-safe and extended functionalities is used for dampers in commercial HVAC building installations.

Nominal torque per actuator: 360 in-lb [40 Nm]
Piggy-Back operation: max. 2 actuators = 720 in-lb [80 Nm]

Nominal voltage	AC/DC 24 V
Nominal voltage frequency	50/60 Hz
Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
Power consumption in operation	11 W
Power consumption in the rest position	3 W
Power consumption for wire sizing	21 VA
Connection supply / control cable	18 GA appliance cable, 3 ft. [1 m], with ½" conduit connector
Torque motor min.	360 in-lb [40 Nm]
Positioning signal options	open/close 3-point (AC only) modulating (DC 0/2...10 V)
Adjustment fail-safe position (POP)	0...100%, adj. in increments of 10% POP rotary knob on 0 corresponds to the left end stop
Bridging time (PF)	2 s
Bridging time (PF) variable	0...10 s
Direction of motion motor	direction of rotation switch (0 / 1)
Direction of motion fail-safe	can be selected with the POP rotary knob 0...100%
Angle of rotation	max. 95°
Running time motor	variable 90...150 s
Running time motor	150 s / 90°
Running time fail-safe	35 s / 90°
Adaptation setting range	manual
Mechanical interface universal shaft	1/2...1.05" round, centers on 1/2" and 3/4" with insert, 1.05" without insert [clamp 10...25.4 mm]

Properties

- A maximum of two actuators can be connected.
- Both actuators must have the same model number.
- The Piggy-Back is only permitted on a rigidly connected mechanical shaft.
- The wiring determines the controlled actuator to the Primary actuator.
- The function of the Piggy-Back installation can be checked by pressing the adaption button on the Primary actuator.

Restrictions

- Adjusting the mechanical end stops is not permitted in Piggy-Back operation.
- Both actuators must be precisely at the same angular position when mounting.
- The actuators must be powered using the same power supply.

For more information, refer to GKB24-MFT or GKX24-MFT datasheet

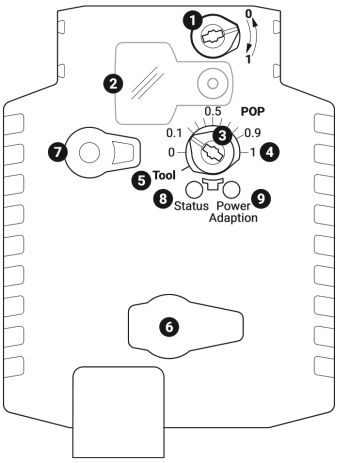
GKB(X)24-MFT continued

Installation and commissioning

1. Turn the damper to the starting position.
2. Bring both actuators into the same angular position.
3. Position the first actuator and set the direction of rotation switch.
4. Tighten the shaft clamp loosely (shaft can rotate freely).
5. Position the asecond actuator and set the direction of rotation switch.
6. Tighten the shaft clamp loosely (shaft can rotate freely).
7. Inspect and tighten all shaft clamps.
8. Without power, wire the Primary and Secondary (same power supply for all actuators).
9. Apply power; the actuators will stay at the start position for a few seconds.
10. To record the mechanical end stops, press the “Adaption” button on the Primary.
11. Check operation, test different damper position, and fail-safe position.

- Always mount actuators to rotate in the same direction.
- Set the direction of rotation switches on Primary and Secondary to the same position.
- The manual override should not be used with coupled actuators.

Operating controls and indicators



1	**Direction of rotation switch**		
2	**Cover, POP rotary button**		
3	**POP rotary knob**		
4	**Scale for manual adjustment**		
5	**Position for adjustment with tool**		
6	**Tool socket**		
7	**Disengagement switch**		
	LED displays		
	8 yellow	**9 green**	**Meaning / function**
	Off	On	Operation OK / without fault
	Off	Flashing	POP function active
	On	Off	Fault
	Off	Off	Not in operation
	On	On	Adaptation procedure running
	Flashing	On	Communication
9	**Press button:**	Triggers angle of rotation adaptation, followed by standard mode	

Rotary Actuator GMB(X)24-MFT (...X1)

Rotary actuator with fail-safe function

A configurable rotary actuator with extended functionalities is used on dampers in commercial HVAC building installations.

Nominal torque per actuator: 360 in-lb [40 Nm]
Piggy-Back operation: max. 2 actuators = 720 in-lb [80 Nm]

Nominal voltage	AC/DC 24 V
Nominal voltage frequency	50/60 Hz
Nominal voltage range	AC 19.2...28.8 V / DC 21.6...28.8 V
Power consumption in operation	4 W
Power consumption in the rest position	1.6 W
Power consumption for wire sizing	7 VA
Connection supply / control cable	18 GA appliance cable, 3 ft. [1 m], with 1/2" conduit connector
Torque motor min.	360 in-lb [40 Nm]
Positioning signal options	open/close 3-point (AC only) modulating (DC 0/2...10 V)
Direction of motion motor	direction of rotation switch (L / R)
Direction of motion fail-safe	by mounting CW/CCW
Angle of rotation	max. 95°
Running time motor	150 s / 90°
Running time motor	variable 75...290 s
Adaptation setting range	manual
Mechanical interface universal shaft	1/2...1.05" round, centers on 1/2" and 3/4" with insert, 1.05" without insert [clamp 12...26.7 mm]

Properties

- A maximum of two actuators can be connected in the Primary/Secondary operation.
- Both actuators must have the same model number.
- The Primary/Secondary operation is only permitted on a rigid connected mechanical shaft.
- The wiring determines the controlled actuator to the Primary actuator.
- From the Primary, the Piggy-Back installation function can be checked by clicking the Primary's direction of rotation switch two full cycles to begin adaptation.

Restrictions

- Adjusting the mechanical end stops is not permitted in Piggy-Back operation.
- Both actuators must be precisely at the same angular position when mounting.
- The actuators must be powered using the same power supply.

For more information, see data sheet GMB24-MFT

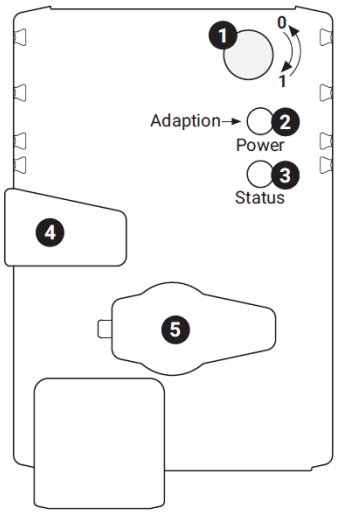
GMB(X)24-MFT continued

Installation and commissioning

1. Turn the damper to the starting position.
2. Bring both actuators into the same angular position.
3. Position the first actuator and set the direction of rotation switch.
4. Tighten the shaft clamp loosely (shaft can rotate freely).
5. Position the asecond actuator and set the direction of rotation switch.
6. Tighten the shaft clamp loosely (shaft can rotate freely).
7. Inspect and tighten all shaft clamps.
8. Without power, wire the Primary and Secondary (same power supply for all actuators).
9. Apply power; the actuators will stay at the start position for a few seconds.
10. To record the mechanical end stops, press the "Adaption" button on the Primary.
11. Check operation, test different damper position, and fail-safe position.

- Always mount actuators to rotate in the same direction.
- Set the direction of rotation switches on Primary and Secondary to the same position.
- The manual override should not be used with coupled actuators.

Operating controls and indicators



1	**Direction of rotation switch**	
	Switching	Direction of rotation changes
2	**Push-button and LED display green**	
	Off:	No power supply or malfunction
	On:	In operation
	Press button:	Triggers angle of rotation adaptation, followed by standard control mode
3	**Push-button and LED display yellow**	
	Off:	Standard mode
	On:	Adaptation or synchronization active
	Press button:	No function
4	**Manual override button**	
	Press button:	Gears disengage, motor stops, manually rotate damper of valve
	Release button:	Gear engage, actuator drives to synchronize position, followed by standard control mode.
5	**Service plug**	
	For connecting theparametrization and service tools	ZTH and PC-Tool
	Check power supply connection	
	1 Off and 2 On	Possible wiring fault on the power supply

Frequently Asked Questions (FAQ)

Which actuator models are designed for Piggy-Back operation?	-AFB(X)24-MFT (-S) -EFB(X)24-MFT (-S) -GKB(X)24-MFT -GMB(X)24-MFT
Which MP-Bus or communicating actuators (BAC, MOD, IP) are suitable for the Piggy-Back operation?	MP-Bus and communicating actuators are not suitable for Piggy-Back operation. Every communicating actuator has a unique address. As bus speeds vary, mounting two communicating actuators to one shaft would result in each actuator receiving a command at slightly different times, initially causing application control issues with a higher probability of mid-term actuator failure.
Can different actuator types be connected in Piggy-Back operation?	No, only the listed actuators of the same model.
Is the Piggy-Back operation possible without a fixed mechanical coupling?	With no fixed mechanical connection, only -SR actuator models must be operated in parallel.
Are there restrictions to service life and warranty?	If the installation was completed by the guidelines, the actuator's life expectancy is normal.
Is the Piggy-Back operation also possible with a 3-point control (floating)?	Yes, on the Primary actuator, the control can be adjusted with the ZTH or PC-Tool. The Secondary actuator adopts the settings from the Primary.
Can I adjust the running time of the actuators while in Piggy-Back mode?	Yes, the Primary actuator running time can be adjusted with the ZTH or PC-Tool.
Can I supply the two Piggy-Back actuators with different supply voltages?	No, both actuators must have the same voltage source.
How can I test the Piggy-Back installation?	To test the Piggy-Back, push the adaptation button on the Primary. If the actuators move together, the actuators are in Piggy-Back operation. If only the Primary actuator moves, the Piggy-Back operation has not been detected. The wiring should be checked and the power supply should be cycled off and on.

Frequently Asked Questions (FAQ)

Can I use a voltmeter to measure the signal between the Primary and Secondary?	Yes, for information only. The PGB mode is an internal control signal and the measure signals do not comply with the traditional feedback position signal of 2...10 VDC. See Piggy-Back Mode Function
What if the feedback signal of the Secondary does not comply with the input signal on the Primary?	With the manual adaptation only the Primary adapts the input signal to the adapted angle range. The Secondary relates its feedback signal still to 95°. If needed the U5 signal on the Secondary must be adjusted manually with PC-Tool.
How does the manual override work with fail-safe actuators?	The manual override should not be used with coupled actuators. The actuators are often installed at different sides of an application, making this a two person job.
How can I restrict the angle of rotation with the Piggy-Back operation?	The angle of rotation of the actuator should not be restricted. The applications end stops can be detected with the adaption of the Primary.
The damper angle of rotation is less than 95 degrees, is this allowed?	Yes, with caution, the application's end stops must absorb the double torque. After mounting the actuators, an adaptation must be triggered on the Primary actuator.
Can I trigger an adaptation of the angle of rotation while in Piggy-Back operation?	Yes, an adaptation of the angle of rotation can be triggered on the Primary actuator.
Why is the number of actuators restricted for Piggy-Back?	The number of actuators restricted for Piggy-Back is because of the mechanical loads on the actuator gears.
Which actuators can be used for a 0 to 135 ohm control input?	Use two actuators with the same torque rating, ONE with ..-MFT95 actuator as the Primary and One ..-MFT as the Secondary, wired for PGB mode.

Terms and Abbreviations

Primary/Secondary	Wiring solution for Piggy-Back installation
MFT	Multi-function Technology
PGB	Piggy-Back mode
POP	Power off Position / fail-safe position
PF	Power fail delay time / bridging time