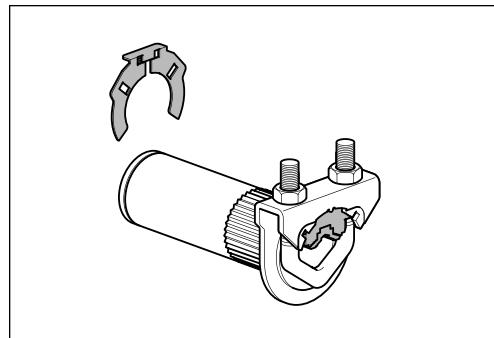


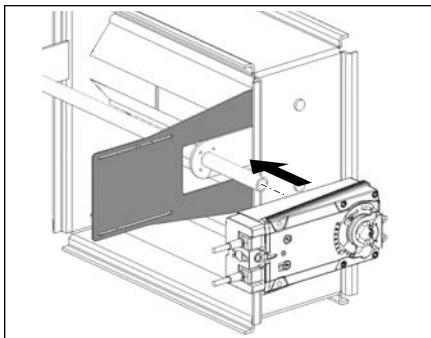
Minimum 270 in-lb Torque

- For damper areas up to 66 sq-ft* (For lower torque, see AFB, AF, NFB, LF, or TF series)

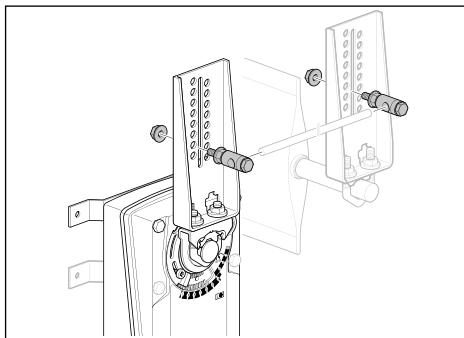
Applications



New standard clamp fits standard 1/2" shafts to 1.05" jackshafts.



Mount directly to 1.05" jackshafts. (new ZG-120 bracket shown)



Linkage solutions are available when direct coupling is not possible.



All Actuators
have BDCM

EFB, EFX Series - At A Glance

	EFB24, EFX24 (p. 21)	EFB24 N4, EFX24 N4 (p. 23)	EFB24-S, EFX24-S (p. 21)	EFB24-S N4, EFX24-S N4(H) (p. 23)	EFB120, EFX120 (p. 25)	EFB120-S, EFX120-S (p. 25)	EFB24-SR, EFX24-SR (p. 29)	EFB24-SR N4, EFX24-SR N4(H) (p. 27)	EFB24-SR N4 (p. 31)	EFB24-SR-S, EFX24-SR-S (p. 29)	EFB24-SR-S N4, EFX24-SR-S N4(H) (p. 31)	EFB24-MFT, EFX24-MFT (p. 33)	EFB24-MFT-S, EFX24-MFT-S (p. 33)	EFB24-MFT-S N4, EFX24-MFT-S N4(H) (p. 35)
Torque:	270 in-lb	●	●	●	●	●	●	●	●	●	●	●	●	●
Power supply:	24 VAC/DC	●	●	●	●	●	●	●	●	●	●	●	●	●
	120 VAC													
	230 VAC													
Control signal:	On/Off	●	●	●	●	●	●	●	●	●	●	●	●	●
	2 to 10 VDC													
	Multi-function**													
Feedback signal:	2 to 10 VDC													
	VDC variable**													
Running time motor:	75 seconds	●	●	●	●	●	●	●	●	●	●	●	●	●
	95 seconds													
	Adj. 60 to 150 seconds***													
	spring: <20 seconds	●	●	●	●	●	●	●	●	●	●	●	●	●
Brushless DC Motor		●	●	●	●	●	●	●	●	●	●	●	●	●
External direction of rotation switch														
Manual override	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Appliance rated cable, 18 GA [†] (default)	●		●		●	●	●	●	●	●	●	●	●	●
Plenum rated cable, 18 GA (optional)	●							●						
Built-in auxiliary switch, Two SPDT		●		●		●	●	●	●	●	●	●	●	●
NEMA 4 rated housing		●		●			●	●	●	●	●			●
Installation instructions.....(p. 37-43)														
General wiring.....(p. 45)														
Start-up and checkout.....(p. 46)														
Electrical operations.....(p. 44)														

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals. **Default 2 to 10 VDC. ***Default 150 seconds.

A CLOSER LOOK...

- Cut labor costs with simple direct coupling.
- True mechanical spring return – the most reliable fail-safe.
- Reverse mount for clockwise or counterclockwise fail-safe.
- Check damper position easily with clear position indicator.
- Overload-proof throughout rotation
- Temporary restrictions in damper movement will not change actuator operation. Actuator returns to normal operation when restriction is removed (modulating actuators).
- Built-in mechanical stop to adjust angle of rotation.
- By eliminating internal condensation incorporated breather membrane optimizes performance in harsh airstream environments.
- Built-in auxiliary switches is easy to use, offers feedback or signal for additional device (-S models).
- Manual override crank speeds installation
- Need to change control direction?
Do it easily with a simple switch (modulating actuators).
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged metal on plastic housing withstands rough handling in the mechanical room.
- Standard 3 ft. appliance cable and conduit connector eases installation.
- Double insulated – no need for separate safety ground.
A Belimo exclusive (-S models).
- Automatically compensates for damper seal wear, ensuring tight close-off.
- Added Flexibility to Select Clamp, Electrical Connection, and Running Time to fit your Specific Application with Belimo's Flexible Line of Actuators (EFX).



The Belimo Difference

- ***Customer Commitment.***
Extensive product range. Application assistance.
Same-day shipments. Free technical support. Five year warranty.
- ***Low Installation and Life-Cycle Cost.***
Easy installation. Accuracy and repeatability.
Low power consumption. No maintenance.
- ***Long Service Life.***
Components tested before assembly. Every product tested before shipment.
30+ years direct coupled actuator design.

EFB24, EFB24-S, EFX24, EFX24-S

On/Off, Spring Return, 24 V

BELIMO



Technical Data		EFB24, EFB24-S, EFX24, EFX24-S
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	9.5 W
	holding	4.5 W
Transformer sizing		16 VA (class 2 power source)
Electrical connection	EFB24...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	EFX24...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		270 in-lb [30 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	75 seconds
	spring	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		aluminum diecast and plastic casing
Agency listings †		cULus acc. to UL60730-1A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤56.5dB(A) motor @ 75 seconds ≤71.4dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.82 lbs [4.45 kg], 10.14 lbs [4.6 kg] with switches
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.		
EFB24-S, EFX24-S		
Auxiliary switches		2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 85°

Torque min. 270 in-lb, for control of air dampers

Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The EFB and EFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

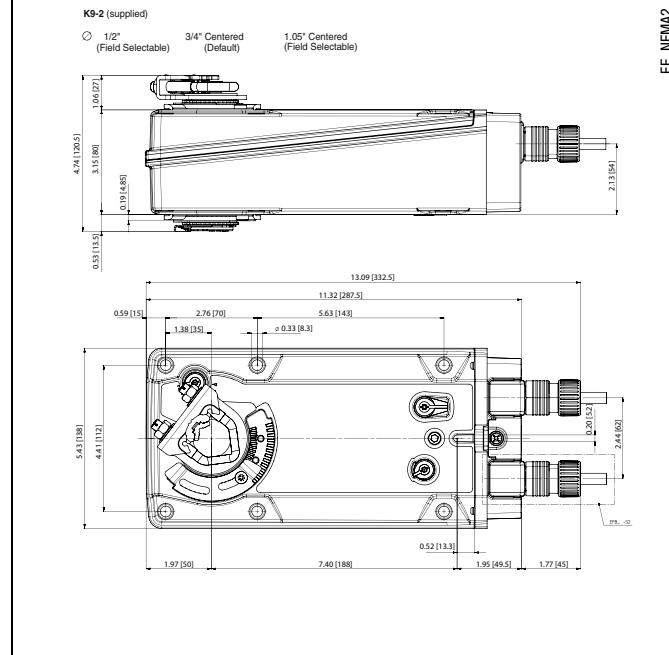
The EFB and EFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB24-S and EFX24-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +85°. The EFB24, EFB24-S, EFX24 and EFX24-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Installation Note: Use flexible metal conduit. Push the UL listed conduit fitting device over the actuator's cable to butt against the enclosure. Screw in conduit connector. Jacket the actuators input wiring with UL listed flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



EF_NEMA2_dims

Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
TF-CC US	Conduit fitting
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

Note: When using EFB24, EFB24-S, EFX24, EFX24-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

Actuators may also be powered by 24 VDC.

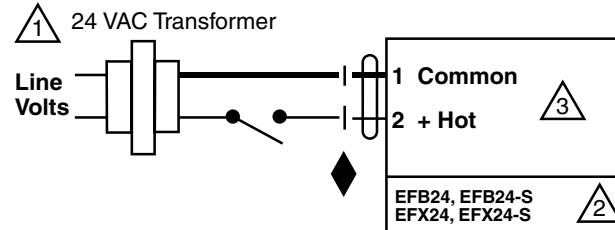
For end position indication, interlock control, fan startup, etc., EFB24-S and EFX24-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 85°.

APPLICATION NOTES

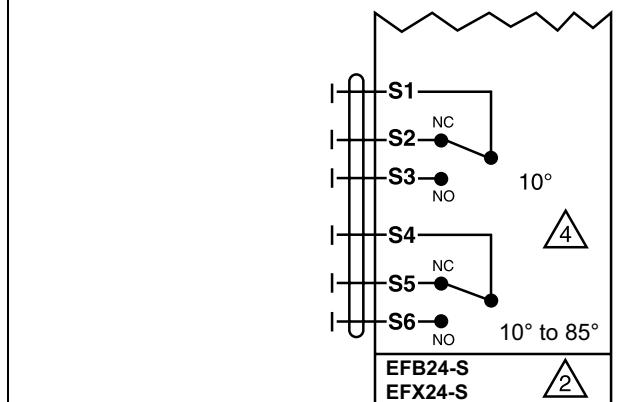
Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring



Auxiliary Switches for EFB24-S, EFX24-S

EFB24 N4, EFB24-S N4, EFX24-S N4(H)

NEMA 4, On/Off, Spring Return, 24 V

BELIMO



Technical Data		EFB24 N4, EFB24-S N4, EFX24-S N4(H)
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	9.5 W / heater 21 W
	holding	4.5 W
Transformer sizing		16 VA (class 2 power source) / heater 21 VA
Electrical connection		terminal block(s) inside junction box with knockouts
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		270 in-lb [30 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	75 seconds
	spring	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
	spring (w/heater)	< 20 seconds @ -22°F to 122°F [-30°C to 50°C]; < 60 seconds @ -40°F [-40°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-40°F to 122°F [-40°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA 4, IP66, Enclosure Type4
Housing material		aluminum diecast and plastic casing
Agency listings †		cULus acc. to UL60730-1A/2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤56.5dB(A) motor @ 75 seconds ≤71.4dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		10 lbs [4.54 kg], 10.1 lbs [4.59 kg] with heater
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 4.		
EFB24-S N4, EFX24-S N4(H)		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at 10° and one set at 85°	

Torque min. 270 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The EFB N4 and EFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

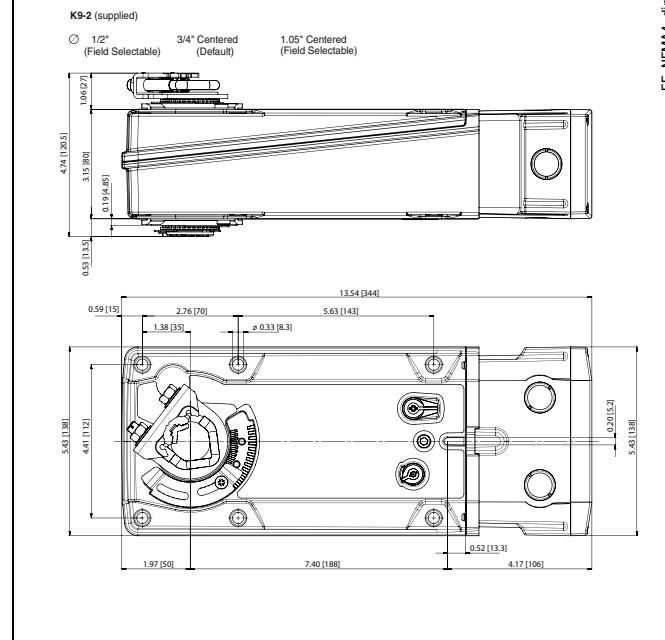
The EFB N4 and EFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB24-S N4 and EFX24-S N4 versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is fixed at 85°. The EFB24 N4, EFB24-S N4 and EFX24-S N4(H) actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Installation Note: Use 60°C/75°C copper (CU) conductor and wire size range 12-26 AWG, stranded or solid. If conduit is used, use flexible metal conduit; UL listed and CSA Certified Strain Relief or Conduit Fitting suitable for outdoor applications, rated NEMA type 4, 4X, 6 or 6X or watertight.

Dimensions (Inches [mm])



EF_NEMA4_dims

Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

Note: When using EFB24 N4, EFB24-S N4, EFX24-S N4(H) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

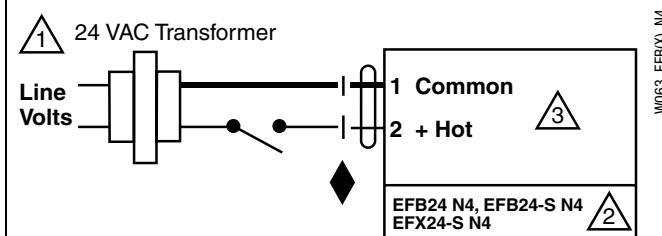
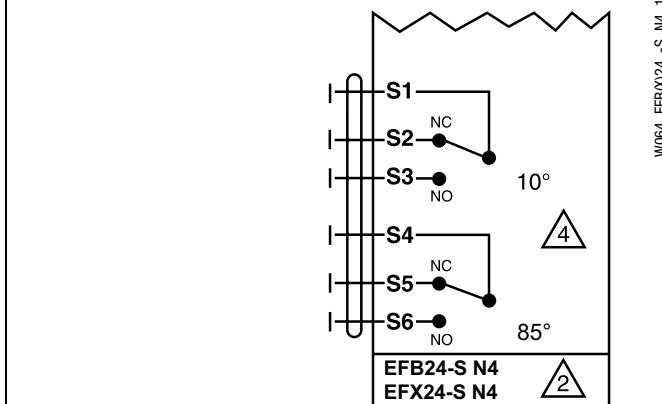
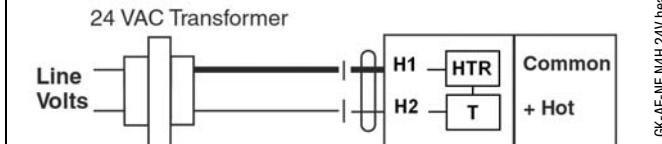
4 For end position indication, interlock control, fan startup, etc., EFB24-S N4 and EFX24-S N4(H) incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at 10°, the other is fixed at 85°.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off wiring****Auxiliary Switches****NEMA 4 Heater**

EFB120, EFB120-S, EFX120, EFX120-S

On/Off, Spring Return, 100 to 240 VAC



Technical Data		EFB120, EFB120-S, EFX120, EFX120-S
Power supply		100...240 VAC +10% / -20%, 50/60 Hz 100...125 VDC ±10%
Power consumption	running	9.5 W
	holding	4.5 W
VA rating		21 VA @ 100 VAC 29 VA @ 240 VAC
Electrical connection	EFB120...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	EFX120...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		270 in-lb [30 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	75 sec
	spring	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (9/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		aluminum diecast and plastic casing
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤56.5dB(A) motor @ 75 seconds ≤71.4dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.82 lbs [4.45 kg], 10.14 lbs [4.6 kg] with switches

† Rated Impulse Voltage 2.5kV, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

EFB120-S, EFX120-S

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL Approved one set at +10°, one adjustable 10° to 85°
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Torque min. 270 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The EFB and EFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

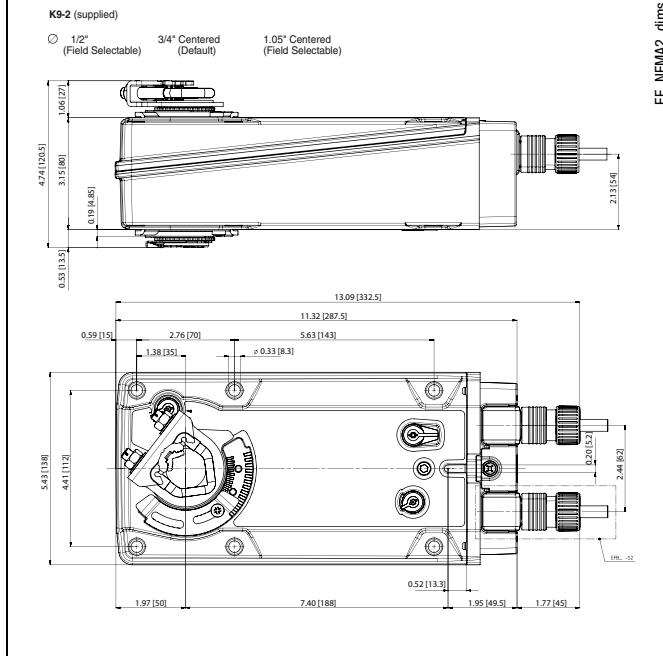
The EFB and EFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB120-S and EFX120-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +85°. The EFB120, EFB120-S, EFX120 and EFX120-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Installation Note: Use flexible metal conduit. Push the UL listed conduit fitting device over the actuator's cable to butt against the enclosure. Screw in conduit connector. Jacket the actuators input wiring with UL listed flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
TF-CC US	Conduit fitting
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

Note: When using EFB120, EFB120-S, EFX120, EFX120-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 No ground connection is required.

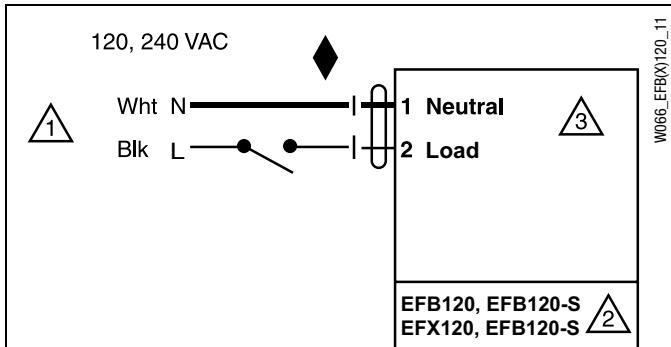
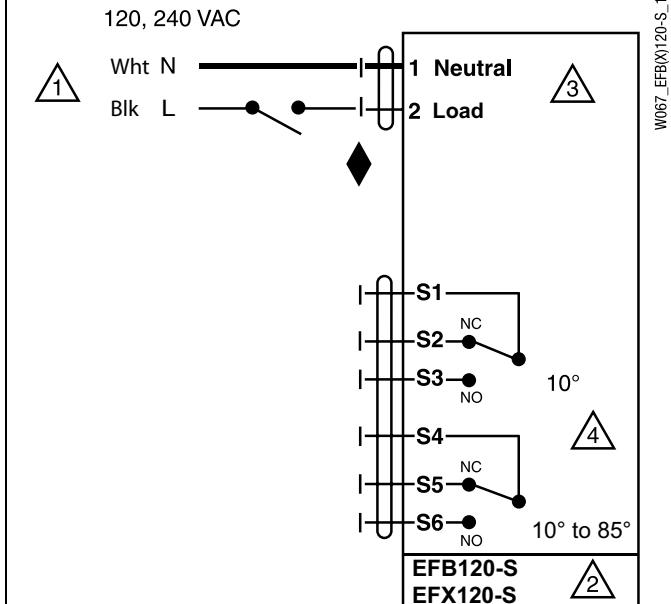
4 For end position indication, interlock control, fan startup, etc., EFB120-S and EFX120-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 85°.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off wiring****Auxiliary Switches for EFB120-S, EFX120-S**

EFB120-S N4, EFX120-S N4(H)

NEMA 4, On/Off, Spring Return, 100 to 240 VAC

BELIMO



Technical Data		EFB120-S N4, EFX120-S N4(H)
Power supply		100...240 VAC +10% / -20%, 50/60 Hz 100...125 VDC ±10%
Power consumption	running	9.5 W / heater 22 W
	holding	4.5 W
VA rating		21 VA @ 120 VAC / heater 22 VA 29 VA @ 240 VAC
Electrical connection		terminal block(s) inside junction box with knockouts
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		270 in-lb [30 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	75 sec
	spring	< 20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -22°F [-30°C]
	spring (w/heater)	< 20 sec @ -22°F to 122°F [-30°C to 50°C]; < 60 sec @ -40°F [-40°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-40°F to 122°F [-40°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA 4, IP66, Enclosure Type4
Housing material		aluminum diecast and plastic casing
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤56.5dB(A) motor @ 75 seconds ≤71.4dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		10 lbs [4.54 kg], 10.1 lbs [4.59 kg] with heater
† Rated Impulse Voltage 2.5kV, Type of action 1-AA (1-AA.B for -S version), Control Pollution Degree 4. EFX120-S N4H is only UL listed.		
EFB120-S N4, EFX120-S N4(H)		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL Approved one set at 10° and one set at 85°	

Torque min. 270 in-lb, for control of air dampers

Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The EFB N4 and EFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

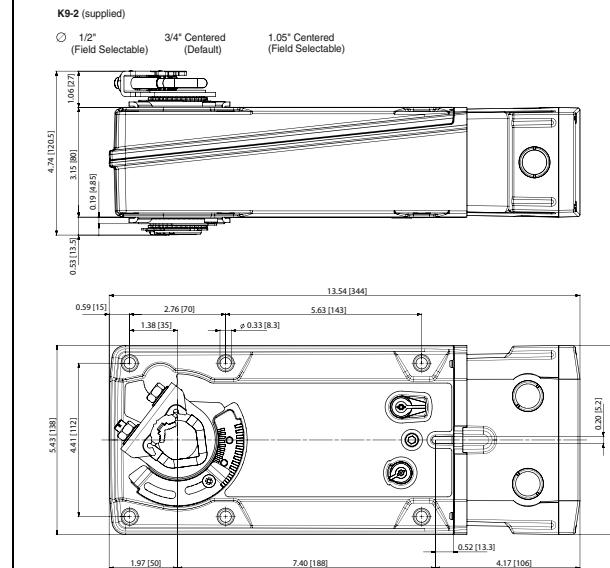
The EFB N4 and EFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB120-S N4 and EFX120-S N4(H) versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is fixed at 85°. The EFB120-S N4 and EFX120-S N4(H) actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Installation Note: Use 60°C/75°C copper (CU) conductor and wire size range 12-26 AWG, stranded or solid. If conduit is used, use flexible metal conduit; UL listed and CSA Certified Strain Relief or Conduit Fitting suitable for outdoor applications, rated NEMA type 4, 4X, 6 or 6X or watertight.

Dimensions (Inches [mm])



EF_NEMA4_dims

Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

Note: When using EFB120-S N4, EFX120-S N4(H) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

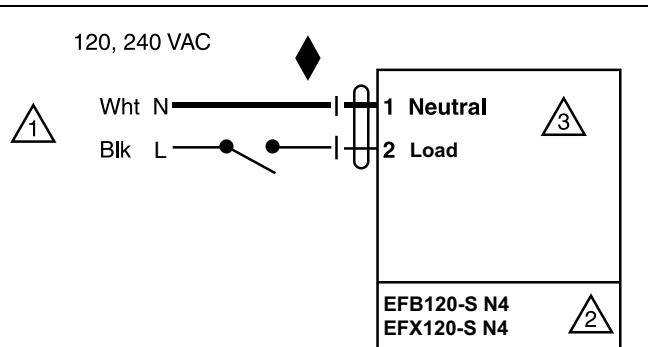
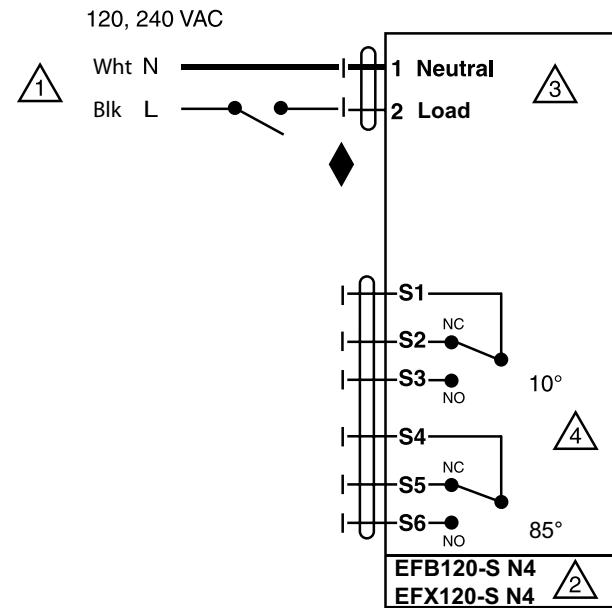
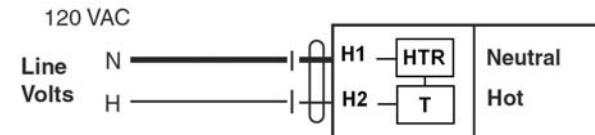
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3 No ground connection is required.
- 4 For end position indication, interlock control, fan startup, etc.,
EFB120-S N4 and EFX120-S N4(H) incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at 10°, the other is fixed at 85°.

APPLICATION NOTES

- ◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off wiring****Auxiliary Switches****NEMA 4 Heater**

EFB24-SR, EFB24-SR-S, EFX24-SR, EFX24-SR-S

Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data	EFB24-SR, EFB24-SR-S, EFX24-SR, EFX24-SR-S
Power supply	24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption running	8 W
holding	4.5 W
Transformer sizing	14 VA (class 2 power source)
Electrical connection	
EFB...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
EFX...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y	2 to 10 VDC, 4 to 20mA
Input impedance	100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U	2 to 10 VDC (max. 0.5 mA)
Torque	270 in-lb [30 Nm] minimum
Direction of rotation	spring reversible with CW/CCW mounting motor reversible with built-in switch
Mechanical angle of rotation	max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring < 20 seconds @ -4°F to 122°F [-20°C to 50°C]; motor < 60 seconds @ -22°F [-30°C]
Position indication	visual indicator, 0° to 95° (0° is full spring return position)
Manual override	5 mm hex crank (3/16" Allen), supplied
Humidity	max. 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	Nema 2, IP54, Enclosure Type2
Housing material	aluminum diecast and plastic casing
Agency listings†	cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level	≤56.5dB(A) motor @ 95 seconds ≤71.4dB(A) spring return
Servicing	maintenance free
Quality standard	ISO 9001
Weight	9.82 lbs [4.45 kg], 10.14 lbs [4.6 kg] with switches
† Rated Impulse Voltage 800V, Type of action 1-AA (1-AA.B for -S version), Control Pollution Degree 3.	
EFB24-SR-S, EFX24-SR-S	
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 85°

Torque min. 270 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

Operation

The EFB and EFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

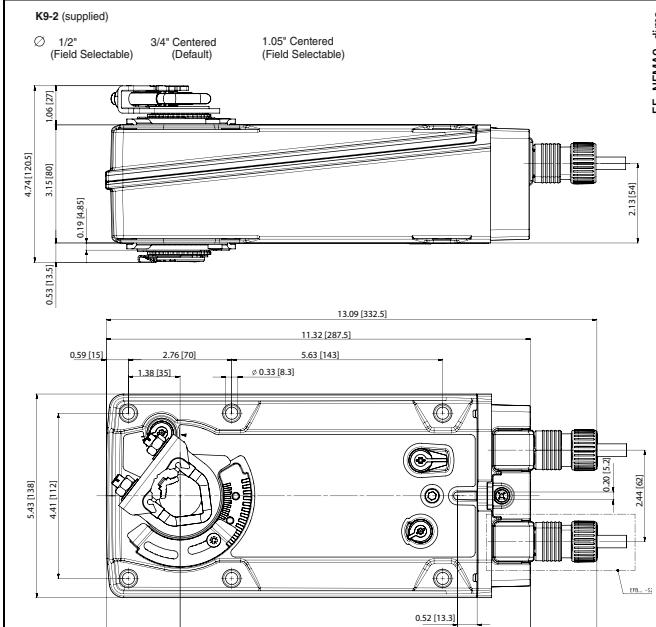
The EFB and EFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The EFB24-SR and EFX24-SR uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB24-SR-S and EFX24-SR-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +85°. The EFB24-SR, EFB24-SR-S, EFX24-SR and EFX24-SR-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Installation Note: Use flexible metal conduit. Push the UL listed conduit fitting device over the actuator's cable to butt against the enclosure. Screw in conduit connector. Jacket the actuators input wiring with UL listed flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
TF-CC US	Conduit fitting
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

NOTE: When using EFB24-SR, EFB24-SR-S, EFX24-SR and EFX24-SR-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**✗ INSTALLATION NOTES**

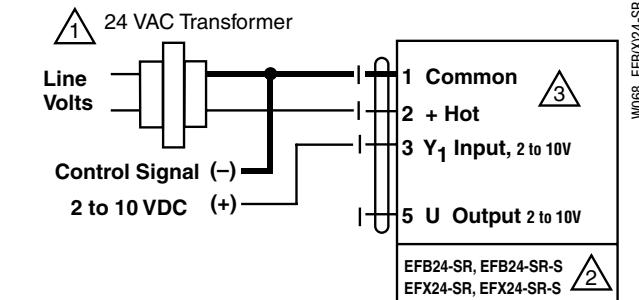
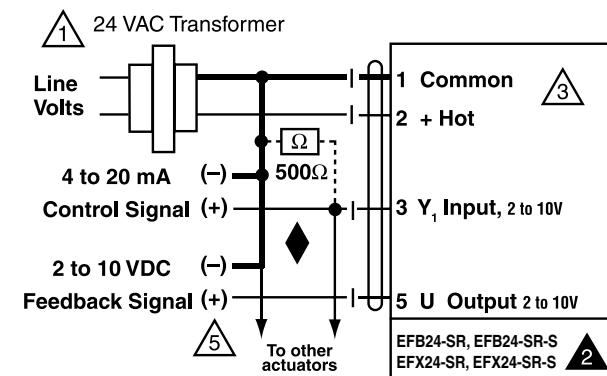
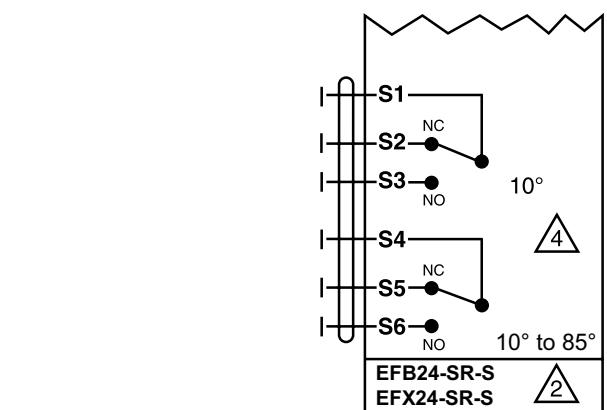
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
Up to 4 actuators may be connected in parallel if not mechanically mounted to the same shaft. With 4 actuators wired to one 500 Ω resistor.
Power consumption must be observed.
- 3 Actuator may also be powered by 24 VDC.
- 4 For end position indication, interlock control, fan startup, etc., EFB24-SR-S and EFX24-SR-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 85°.
- 5 Only connect common to neg. (-) leg of control circuits

APPLICATION NOTES

- ◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

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**2 to 10 VDC control****4 to 20 mA control with 2 to 10 VDC feedback output****Auxiliary switches for EFB24-SR-S, EFX24-SR-S**

EFB24-SR N4, EFB24-SR-S N4, EFX24-SR-S N4(H)

NEMA 4, Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data		EFB24-SR N4, EFB24-SR-S N4, EFX24-SR-S N4(H)
Power supply		24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption running		8 W / heater 21 W
holding		4.5 W
Transformer sizing		14 VA (class 2 power source) / heater 21 VA
Electrical connection		terminal block(s) inside junction box with knockouts
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U		2 to 10 VDC (max. 0.5 mA)
Torque		270 in-lb [30 Nm] minimum
Direction of rotation spring		reversible with CW/CCW mounting
motor		reversible with built-in switch
Mechanical angle of rotation		max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time spring		< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
motor		95 seconds
spring (w/heater)		< 20 sec @ -22°F to 122°F [-30°C to 50°C]; < 60 sec @ -40°F [-40°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature with heater		-22°F to 122°F [-30°C to 50°C] -40°F to 122°F [-40°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA 4, IP66, Enclosure Type4
Housing material		aluminum diecast and plastic casing
Agency listings†		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤56.5dB(A) motor @ 95 seconds ≤71.4dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		10 lbs [4.54 kg], 10.1 lbs [4.59 kg] with heater
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AAB for -S version), Control Pollution Degree 4.		
EFB24-SR-S N4, EFX24-SR-S N4(H)		
Auxiliary switches		2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at 10°, and one set at 85°

Torque min. 270 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

Operation

The EFB N4 and EFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

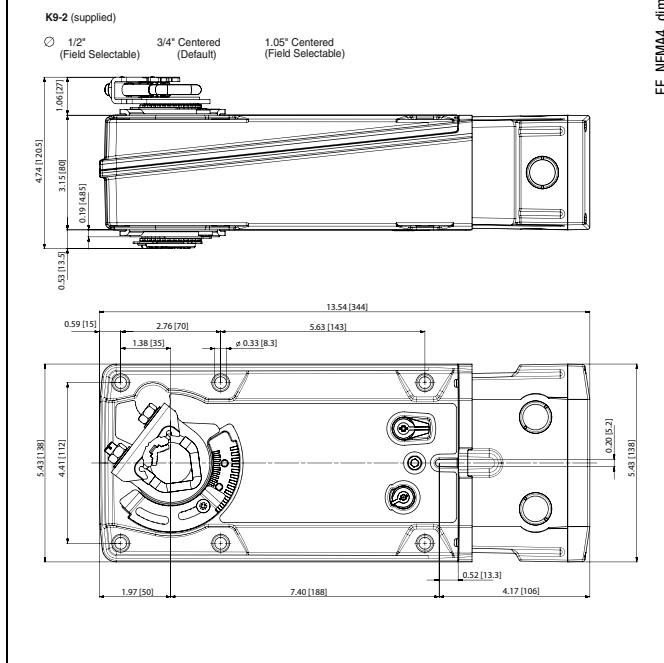
The EFB N4 and EFX N4 series provide 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The EFB N4 and EFX N4 series use a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB24-SR-S N4 and EFX24-SR-S N4(H) versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is fixed at 85°. The EFB24-SR N4, EFB24-SR-S N4, and EFX24-SR-S N4(H) actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Installation Note: Use 60°C/75°C copper (CU) conductor and wire size range 12-26 AWG, stranded or solid. If conduit is used, use flexible metal conduit; UL listed and CSA Certified Strain Relief or Conduit Fitting suitable for outdoor applications, rated NEMA type 4, 4X, 6 or 6X or watertight.

Dimensions (Inches [mm])



EF_NEM4_dims

Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

NOTE: When using EFB24-SR N4, EFB24-SR-S N4, and EFX24-SR-S N4(H) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

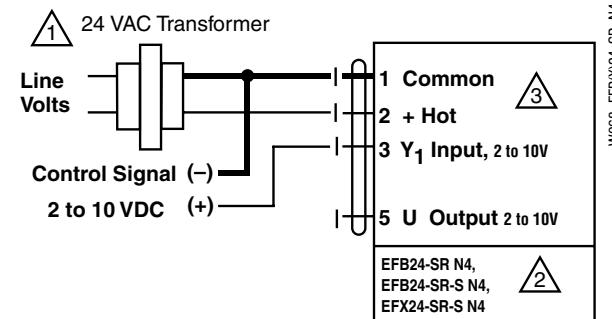
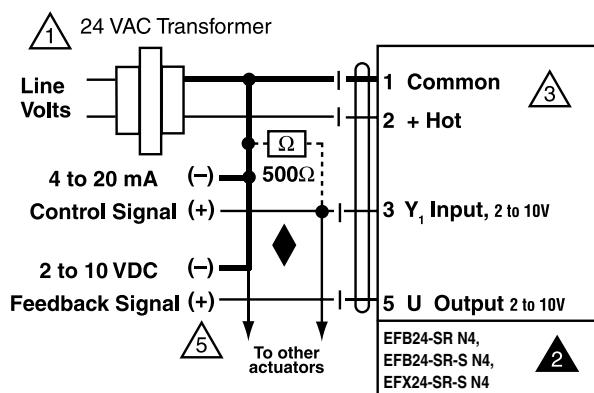
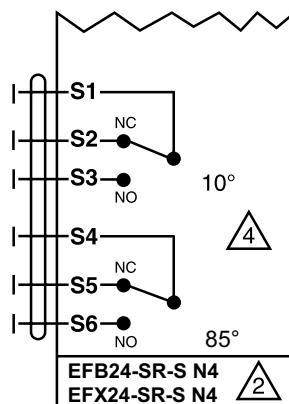
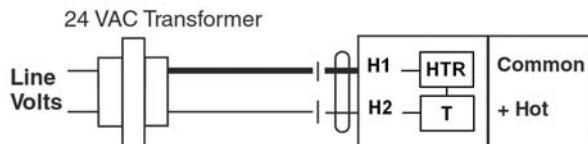
- 1** Provide overload protection and disconnect as required.
- 2** **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
Up to 4 actuators may be connected in parallel if not mechanically mounted to the same shaft. With 4 actuators wired to one 500 Ω resistor.
Power consumption must be observed.
- 3** Actuator may also be powered by 24 VDC.
- 4** For end position indication, interlock control, fan startup, etc., EFB24-SR-S N4 and EFX24-SR-S N4 incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, the other is fixed at 85°.
- 5** Only connect common to neg. (-) leg of control circuits

APPLICATION NOTES

- ◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

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**2 to 10 VDC control****4 to 20 mA control with 2 to 10 VDC feedback output****Auxiliary switches****NEMA 4 Heater**

Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
TF-CC US	Conduit fitting
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

NOTE: When using EFB24-MFT, EFB24-MFT-S, EFX24-MFT and EFX24-MFT-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

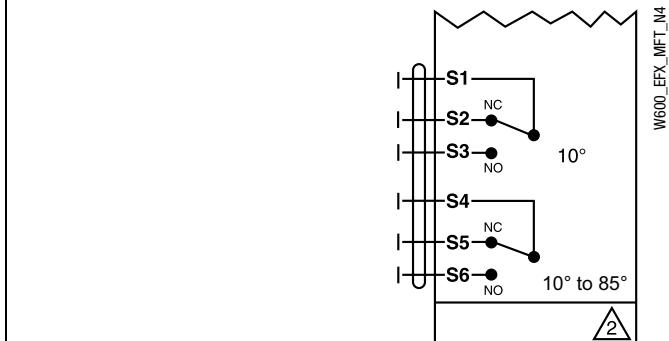
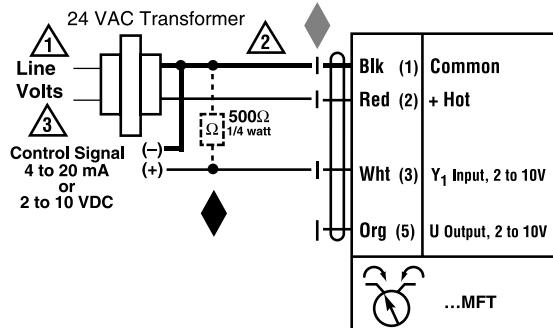
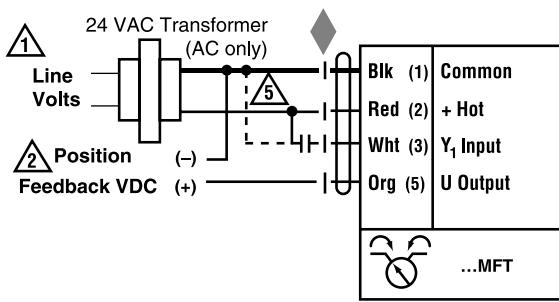
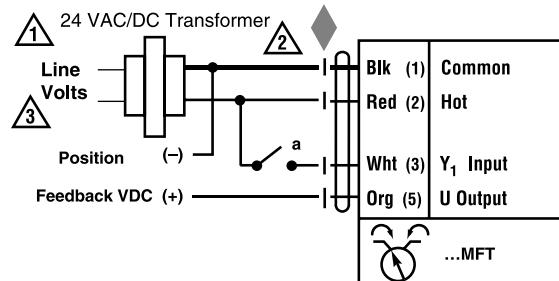
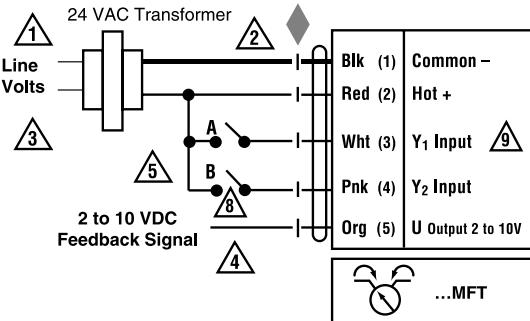
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!** Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Position feedback cannot be used with Triac sink controller. The actuator internal common reference is not compatible.
- 5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
- 6 Contact closures A & B also can be triacs.
- 7 A & B should both be closed for triac source and open for triac sink.
- 8 For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

APPLICATION NOTES

- Meets UL requirements without the need of an electrical ground connection.
- The ZG-R01 500 Ω resistor may be used.

WARNING Live Electrical Components!

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**Auxiliary Switches for EFB24-MFT-S, EFX24-MFT-S****VDC/4-20 mA****PWM****On/Off control****Floating Point control**

EFB24-MFT-S N4, EFX24-MFT-S N4(H)

NEMA 4, Proportional, Spring Return, Direct Coupled, 24V, Multi-Function Technology®



MFT



Technical Data		EFB24-MFT-S N4, EFX24-MFT-S N4(H)
Power supply		24 VAC, +/- 20%, 50/60 Hz 24 VDC, +20% / -10%
Power consumption♦	running holding	9.5 W / heater 21 W 4.5 W
Transformer sizing ♦		16 VA / heater 21 VA
Electrical connection		terminal block(s) inside junction box with knockouts
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y*		2 to 10 VDC, 4 to 20 mA (default) variable (VDC, PWM, floating point, on/off)
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point and on/off control
Feedback output U*		2 to 10 VDC, 0.5 mA max (default)
Torque		270 in-lb [30 Nm] minimum
Direction of rotation*	spring motor	reversible with cw/ccw mounting reversible with built-in switch
Mechanical angle of rotation*		max. 95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring	<20 sec @ -4°F to 122°F [-20° C to 50° C]; <60 sec @ -22°F [-30° C]
	motor*	150 seconds (default), variable (60 to 150 seconds)
	spring (w/heater)	< 20 sec @ -22°F to 122°F [-30°C to 50°C]; < 60 sec @ -40°F [-40°C]
Angle of rotation adaptation		off (default)
Override control*		min position = 0% mid. position = 50% max. position = 100%
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max 95% RH, non-condensing
Ambient temperature		-22 to 122°F (-30 to 50° C)
with heater		-40°F to 122°F [-40°C to 50°C]
Storage temperature		-40 to 176°F (-40 to 80° C)
Housing		NEMA 4, IP66, Enclosure Type4
Housing material		aluminum diecast and plastic casing
Noise level		≤45.3dB(A) motor @ 150 seconds, run time dependent ≤71.4dB(A) spring return
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Quality standard		ISO 9001
Servicing		maintenance free
Weight		10 lbs [4.54 kg], 10.1 lbs [4.59 kg] with heater

* Variable when configured with MFT options

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 4.

♦ Programmed for 60 sec motor run time. At 150 sec motor run time, transformer sizing is 12 VA and power consumption is 7 W running / 4.5 W holding.

EFB24-MFT-S N4, EFX24-MFT-S N4(H)

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at 10°, and one set at 85°
--------------------	---

- Torque min. 270 in-lb for control of air dampers
- Control 2 to 10 VDC (Default)
- Feedback 2 to 10 VDC (Default)

Application

For proportional modulation of dampers in HVAC systems. The EFB24-MFT-S N4, EFX24-MFT-S N4(H) provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 2 to 10 VDC applications of the EFB24-MFT-S N4, EFX24-MFT-S N4(H) actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set or custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool (version 3.4 or higher) software application.
- Handheld ZTH-GEN

Operation

The EFB24-MFT-S N4, EFX24-MFT-S N4(H) actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the physical damper mechanical stop and use this point for its zero position during normal control operations. A unique manual override allows the setting of any actuator position within its 95° of rotation with no power applied. This mechanism can be released physically by the use of a crank supplied with the actuator. When power is applied the manual override is released and the actuator drives toward the fail-safe position.

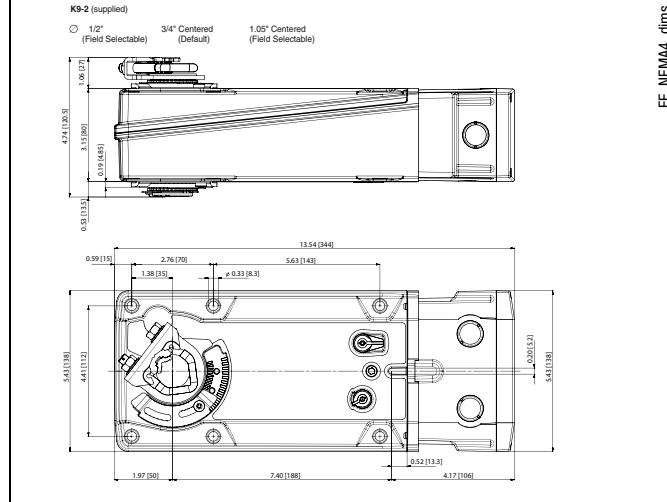
The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The EFB24-MFT-S N4, EFX24-MFT-S N4(H) is mounted directly to control shafts up to 1.05" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption. The EFB24-MFT-S N4, EFX24-MFT-S N4(H) actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

NOTE: Please see documentation on Multi-Function Technology.

Installation Note: Use 60°C/75°C copper (CU) conductor and wire size range 12-26 AWG, stranded or solid. If conduit is used, use flexible metal conduit; UL listed and CSA Certified Strain Relief or Conduit Fitting suitable for outdoor applications, rated NEMA type 4, 4X, 6 or 6X or watertight.

Dimensions (Inches [mm])



EF_NEMA4_dims

Accessories

IND-EFB	Damper position indicator
KH-EFB	Crank arm
K9-2	Universal clamp for up to 1.05" diameter jackshafts
Tool-07	13 mm wrench
ZG-EFB	Crank arm adaptor kit

NOTE: When using EFB24-MFT-S N4, and EFX24-MFT-S N4(H) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

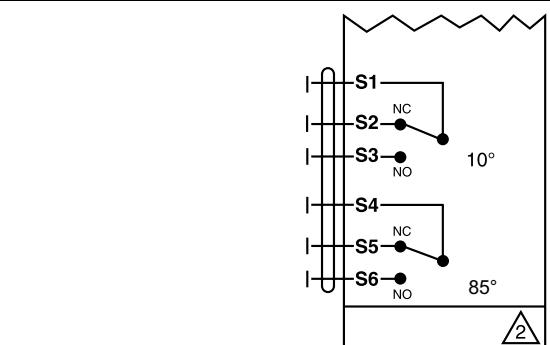
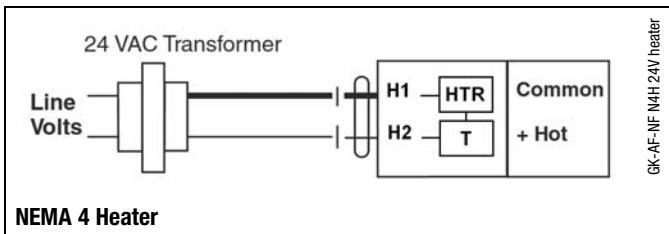
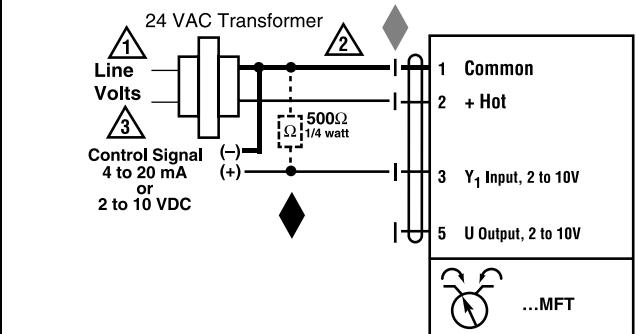
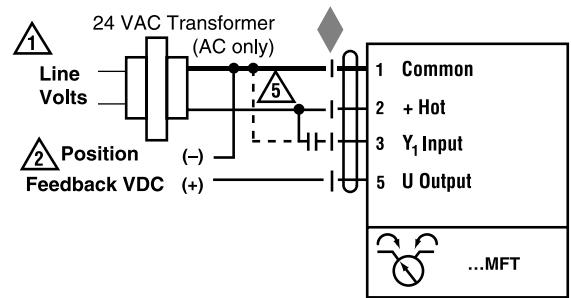
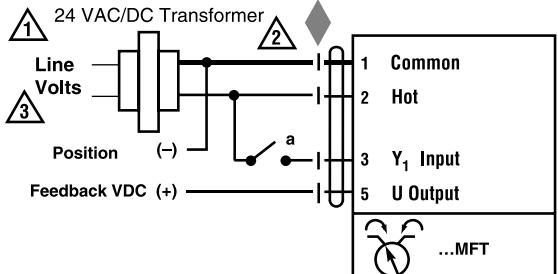
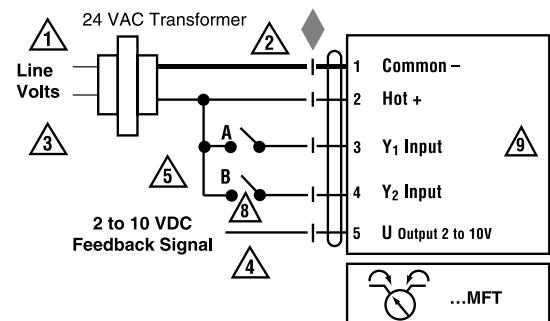
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Position feedback cannot be used with Triac sink controller.
The actuator internal common reference is not compatible.
- 5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
- 6 Contact closures A & B also can be triacs.
- 7 A & B should both be closed for triac source and open for triac sink.
- 8 For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

APPLICATION NOTES

- Meets UL requirements without the need of an electrical ground connection.
- The ZG-R01 500 Ω resistor may be used.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**Auxiliary Switches for EFB24-MFT-S N4, EFX24-MFT-S N4****VDC/4-20 mA****PWM****On/Off control****Floating Point control**

Installation Instructions

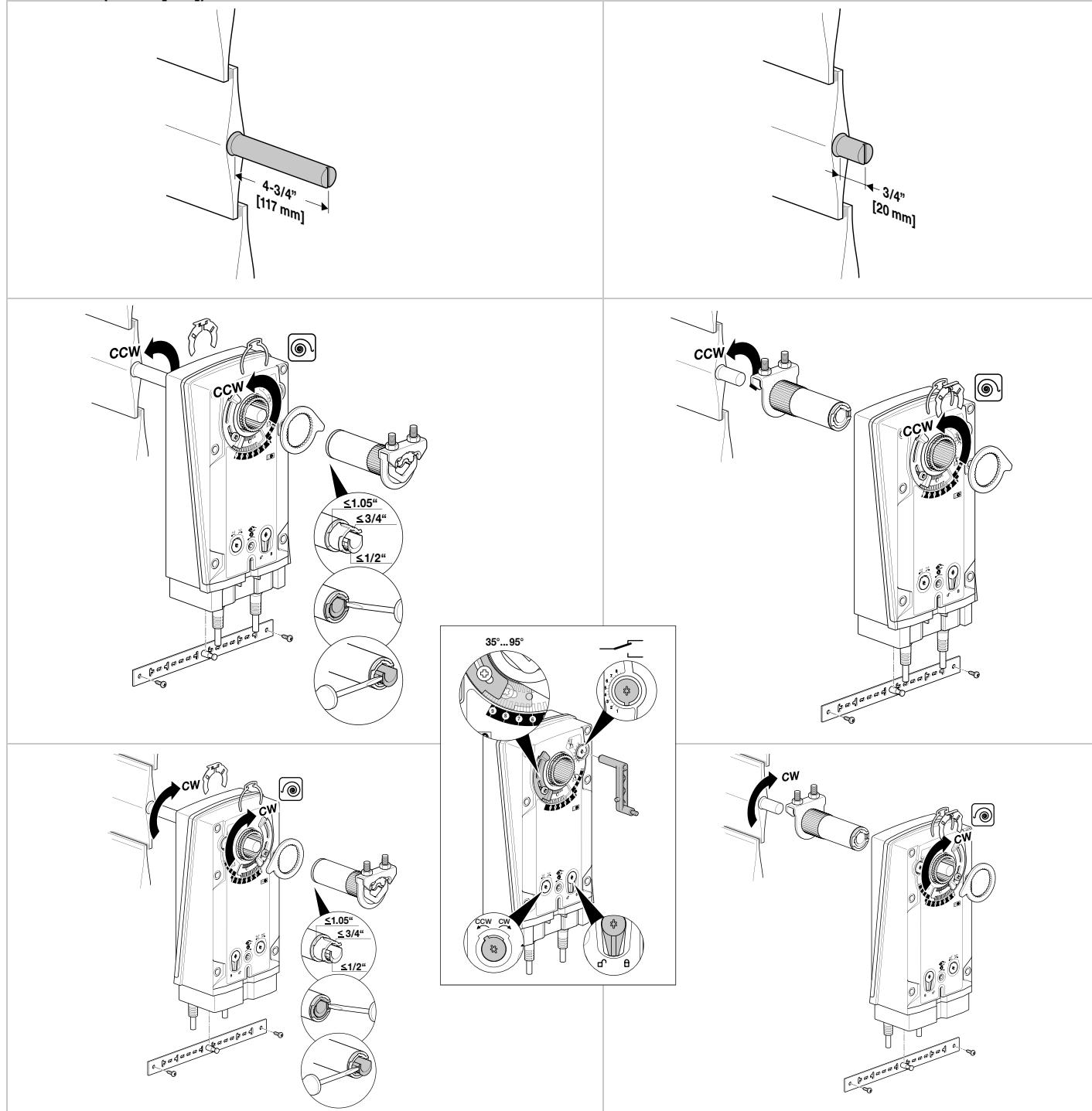
Quick-Mount Visual Instructions for Mechanical Installation

BELIMO

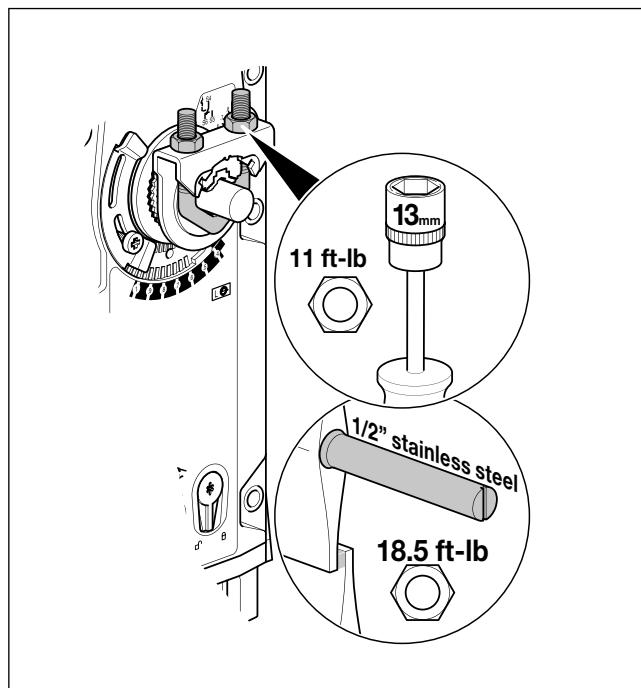
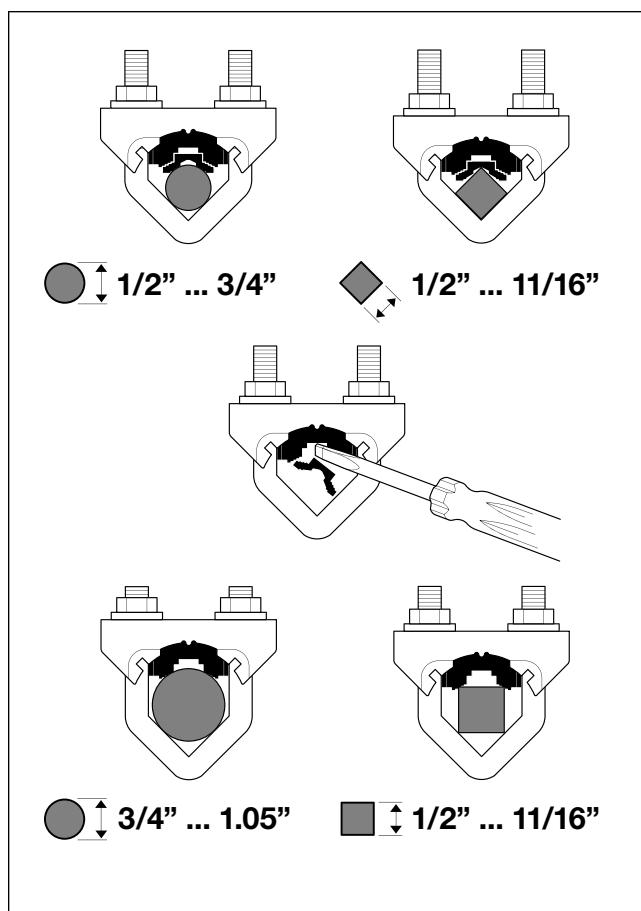
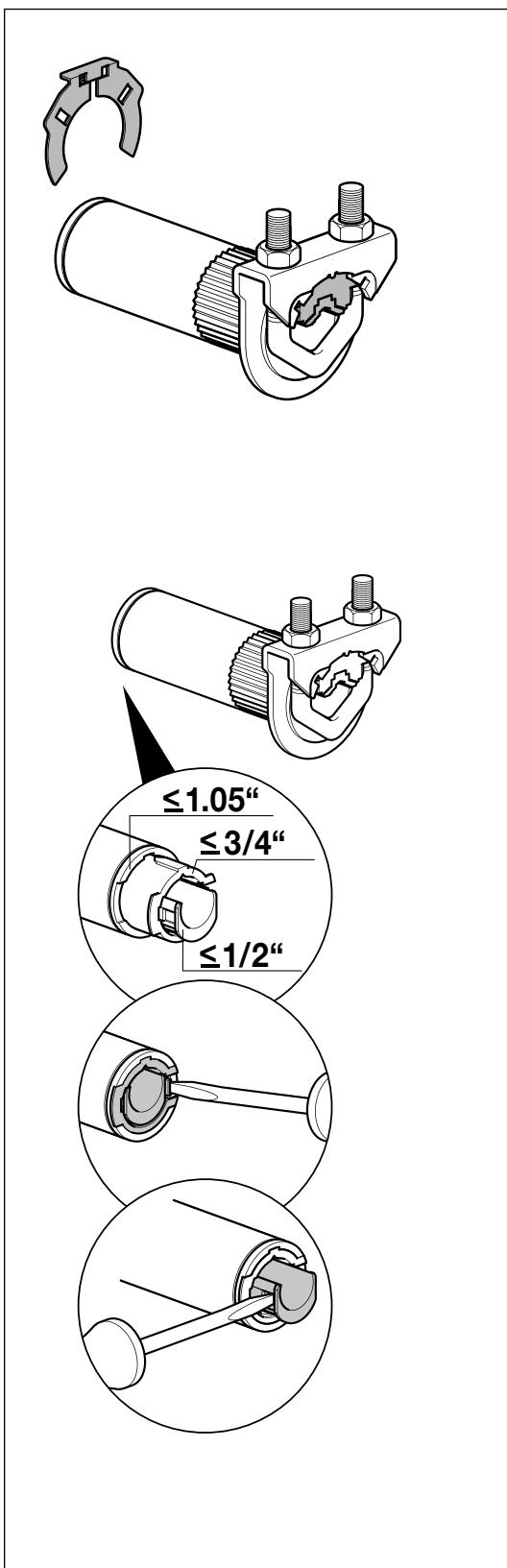
Quick-Mount Visual Instructions

1. Rotate the damper to its fail-safe position.
If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out.
If it rotates clockwise, mount the actuator with the "CW" side out.
 2. If the universal clamp is not on the correct side of the actuator, mount it onto the correct side.
 3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 13mm wrench to 11 ft-lb of torque.
 4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.
- NOTE: Read the "Standard Mounting" instructions, on the next page, for more detailed information.

Dimensions (Inches [mm])



N40103 - 09/11 - Subject to change. © Belimo Aircontrols (USA), Inc.



Installation Instructions

Mechanical Installation

BELIMO®

Determining Torque Loading and Actuator Sizing

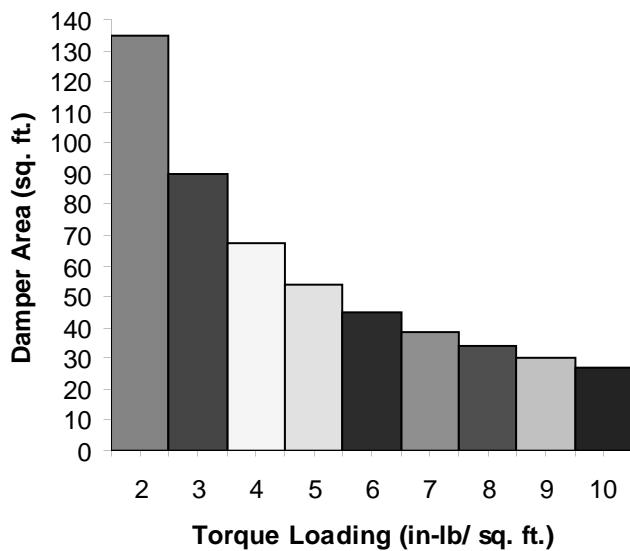
Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications with 1000 FPM face velocity. For applications between this criteria and 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 3000 FPM, use a multiplier of 2.0.

Torque Loading Chart

Torque Loading Chart



General Information

Belimo actuators should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator.

For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft. The damper shaft must extend at least 4-3/4" from the duct. If the shaft extends less than 4-3/4" or if an obstruction blocks access, the shaft can be extended with the AV 8-25 shaft extension accessory or the actuator may be mounted in its short shaft configuration.

Mechanical Operation

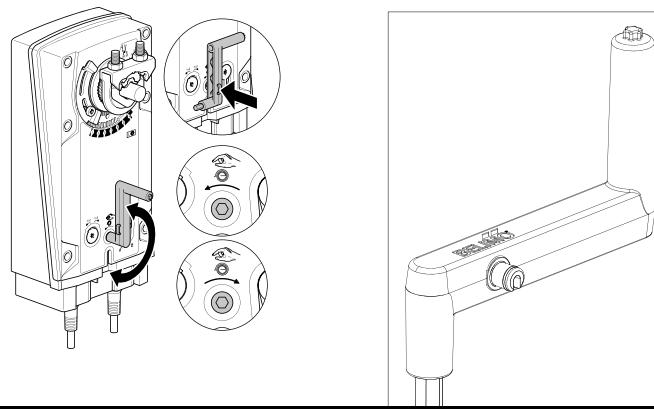
The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The EFB, EFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The EFB...-S, EFX...-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +85° (for NEMA 4 versions, the second switch is fixed at +85°.)

Automatic Airtight Dampers/Manual Override

The EFB, EFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The EFB, EFX has a unique built in manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. A pre-tensioned spring automatically tightens the damper when power is applied to the actuator, compensating for damper seal deterioration..

The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position.



Standard Mounting

NOTE: The EFB, EFX...series actuator is shipped with the manual override adjusted for a +5° position at the universal clamp (not at full fail-safe, 0°). This allows for automatic compression of damper blade seals when the actuator is in use, providing tight shut-off. This assumes that the damper is to have tight shut-off at the fail-safe position. If tight close-off is desired at the opposite direction from fail-safe, the manual override should be released so the actuator can go to the full fail-safe position. See the manual override instructions.

1. Manually move the damper to the fail-safe position (usually closed). If the shaft rotated counterclockwise (↷), this is a CCW installation. If the shaft rotated clockwise (↶), this is a CW installation. In a CCW installation, the actuator side marked "CCW" faces out, while in a CW installation, the side marked "CW" faces out. All other steps are identical.
2. The actuator is usually shipped with the universal clamp mounted to the "CCW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CCW" (or the "CW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
3. If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out,

position the clamp so that the pointer section of the tab is pointing to 0° (see Figure C) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.) If your application requires a mechanical minimum position, read the *Rotation Limiting, Mechanical Minimum Damper Position* section.

4. Lock the clamp to the actuator using the retaining clip.
5. Verify that the damper is still in its full fail-safe position.
6. Slide the actuator over the shaft.
7. Position the actuator in the desired location.
8. Tighten the two nuts on the clamp using a 13mm wrench or socket using 11 ft-lb of torque.
9. Slip the stud of the anti rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.

Short Shaft Installation

If the shaft extends at least 3/4" from the duct, follow these steps:

1. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
2. Engage the clamp to the actuator as close as possible to the determined location.
3. Lock the clamp in place using the remaining retainer clip.
4. Verify that the damper is still in its full fail-safe position.
5. Slide the actuator over the shaft.
6. Position the actuator in the desired location.
7. Tighten the two nuts on the clamp using a 13mm wrench or socket using 11 ft-lb of torque.
8. Slip the stud of the anti-rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.
9. If damper position indication is required, use the optional IND-EFB pointer. See **Figure A**.

Jackshaft Installation

The EFB, EFX... series actuator is designed for use with jackshafts up to 1.05" in diameter. In most applications, the EFB, EFX actuator may be mounted in the same manner as a standard damper shaft application. If more torque is required than one EFB, EFX actuator can provide, a second EFB, EFX actuator may be mounted to the jackshaft using the ZG-102 multiple actuator mounting bracket. *See wiring guide for wiring details.*

EF ACTUATORS WHICH MAY BE USED ON ONE SHAFT

Model	Maximum Quantity Per Shaft	Minimum Shaft Diameter
EFB24(-S)(N4)		
EFX24(-S)(N4)	2*	
EFB120(-S)(N4)		
EFX120(-S)(N4)		
EFB24-MFT(-S)(N4)		3/4" for 2x
EFX24-MFT(-S)(N4)	3**	1" for 3x

* Wired in parallel

** Wired master-slave

MOUNTING: If the actuators are mounted on the opposed ends of the shaft, the actuator direction must be selected carefully. Usually, the direction of rotation is reversed.

Multiple Actuator Mounting

If more torque is required than one EFB, EFX actuator can provide, a second EFB, EFX actuator may be mounted to the shaft using the ZG-102 multiple mounting bracket.

NOTE: The manual positioning mechanism cannot be used in multiple actuator applications.

Special Wiring and Additional Information: See wiring guide

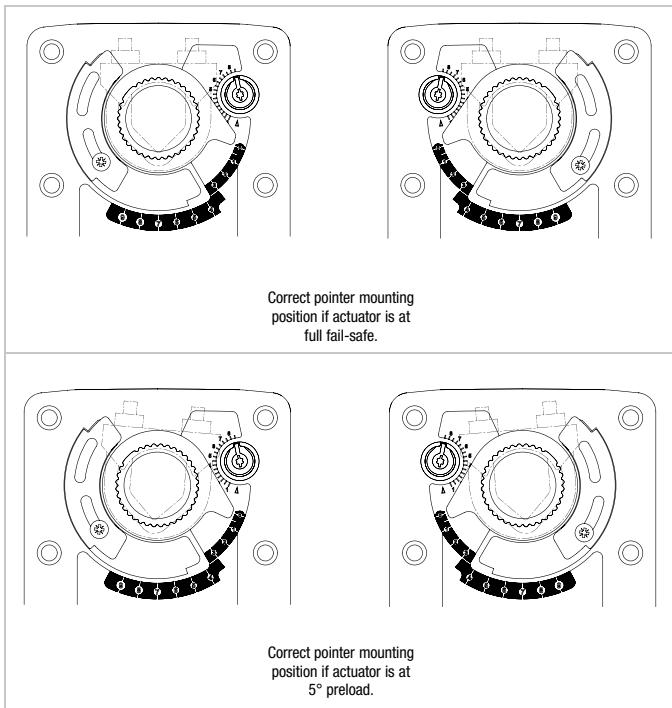


Figure A

Installation Instructions

Mechanical Installation

BELIMO[®]

Rotation Limitation

The angle of rotation limiter, which is built into the actuator, is used in conjunction with the tab on the universal clamp or IND-EFB position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

See **Figure A**.

The rotation limiter may not work in certain mounting orientations using the ZG-EFB mounting kit. Limiting the damper rotation must be accomplished by adjusting the crank arm linkage.

The built-in rotation limiter may be used in 2 ways to control the rotational output of the EFB, EFX series actuator. One use is in the application where a damper has a designed rotation less than 90°. An example would be a 45° or 60° rotating damper. The other application would be to set a minimum damper position which can be easily set or changed without having to remove the actuator from the damper.

Damper Rotation Limiting

1. Determine the amount of damper rotation required.
2. Locate the Angle of Rotation Limiter on the actuator **Figure B**.
3. Position the limiter to the desired position, making sure the locating "teeth" on the limiter are engaged into the locating holes on the actuator.
4. Fasten the limiter by screwing the attached screw.
5. Test the damper rotation either manually with the manual crank or apply power and if required, a control signal. Re-adjust if necessary.

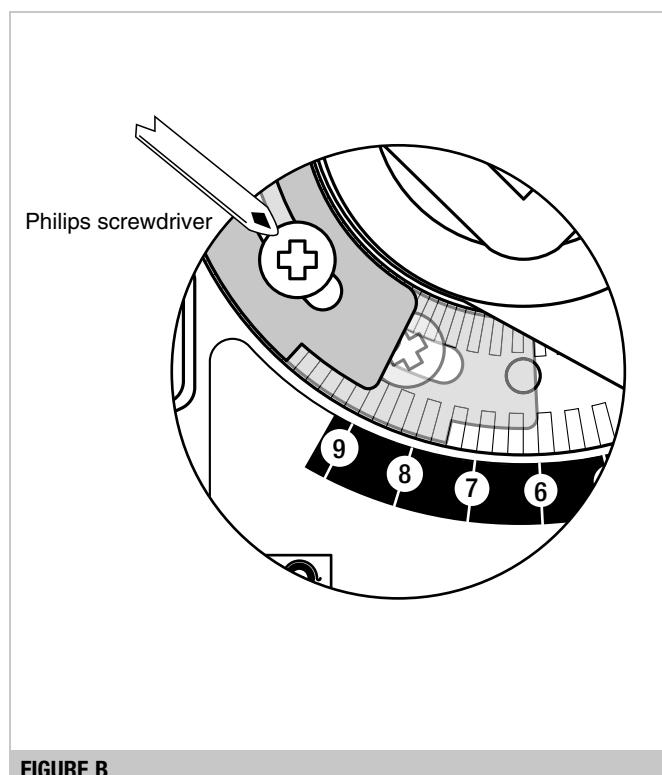
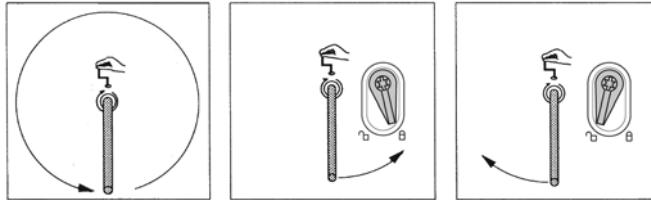


FIGURE B

Manual Override

The EFB, EFX series actuators can be manually positioned to ease installation or for emergency positioning.

1. The manual override will only work if no power is available to the actuator.
2. Insert the manual crank (shipped with the actuator) into the hexagon hole located on either side of the actuator. An illustration, located on the label, shows the location.
3. Turn the crank in the direction shown on the label (clockwise on the "CW" side, counterclockwise on the "CCW" side). It will take approximately 34 revolutions to rotate the full 95° of rotation.
4. To lock the actuator in the required position, flip the switch to the locked position that is located to the right of the crank on the CCW side of the actuator (left of the crank on the CW side).
5. The manual override may be disengaged in 2 ways.
 - Flip the switch to the unlocked position and the actuator will go to its fail-safe position.
 - Apply power to wire 1 and 2. The actuator will automatically disengage the override function and will go to the "on" position in the case of the On/Off versions. Or, in the case of the proportional versions, go to the 0 signal position and then go to the position corresponding to the control signal. The actuator will now work normally.

CCW Side Example:

- | | | |
|--|--|---|
| Winding the damper actuator | Locking the damper actuator | Unlocking the damper actuator |
| <ul style="list-style-type: none"> - insert crank handle - turn handle in direction of arrow | <ul style="list-style-type: none"> - Flip the lock switch to the position pointing to the "locked" symbol | <ul style="list-style-type: none"> (2 options) - Flip the lock switch to the position pointing to the "unlocked" symbol. - Remote control by supplying power to the unit for > 3 sec. |

Testing the installation Without Power

The actuator/damper installation may be tested without power at the actuator. Refer to the manual positioning section of the instructions. Move the damper to its full non-fail-safe position using the manual crank. Disengage the manual position mechanism and have the damper go to full fail-safe position. Correct any mechanical problems and retest.

Auxiliary Switches

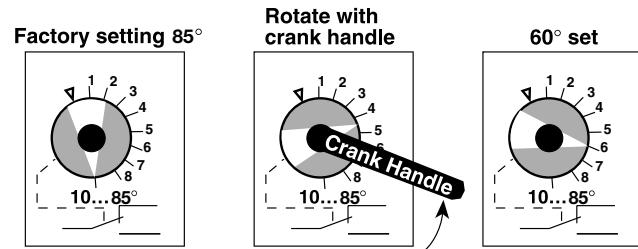
The EFB, EFX series actuators may be ordered with two built-in SPDT auxiliary switches used for safety interfacing or signaling, for example, for fan start-up. The switch position near the fail-safe position is fixed at 10°. The other is adjustable between 10° and 85° of rotation (for NEMA 4 versions, the second switch is fixed at +85°.) The crank that is supplied with the actuator is used to change the switch position.

SWITCH RATING		
Voltage	Resistive Load	Inductive Load
120 VAC	3A	1.03A
250 VAC	3A	0.5A

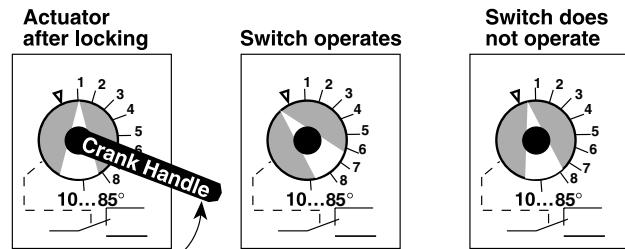
Two methods may be used to adjust the switching point of the adjustable switch.

Method 1 - See Figure F

1. The actuator must be in its fail-safe position.
2. Insert the crank handle into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the crank until the switch pointer is at the desired switch point in degrees as shown.

EFB, EFX... Series**FIGURE F****Method 2 - See Figure G**

1. Position the damper to the point at which you want the switch to activate. This may be done by using the manual override or by providing the appropriate proportional signal to EFB24, EFX24... modulating type actuator. The position of the switch pointer is not important during this step.
2. Insert the crank into the hexagon shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the switch pointer to just past the switch point indicating arrow as shown.

EFB, EFX... Series**FIGURE G**

Installation Instructions

Non-Direct Mounting Methods

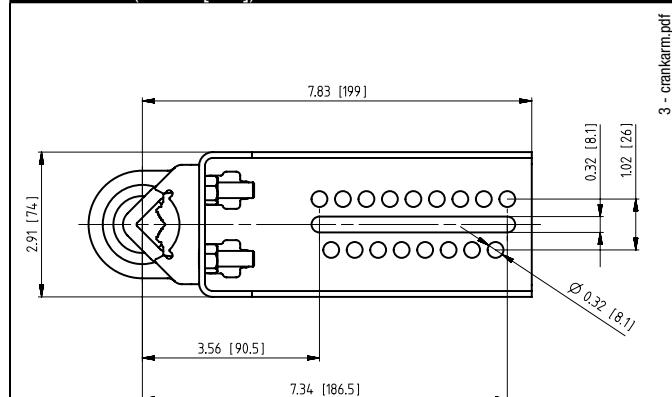
BELIMO
www.belimo.com

KH-EFB Crank Arm Including Retaining Ring

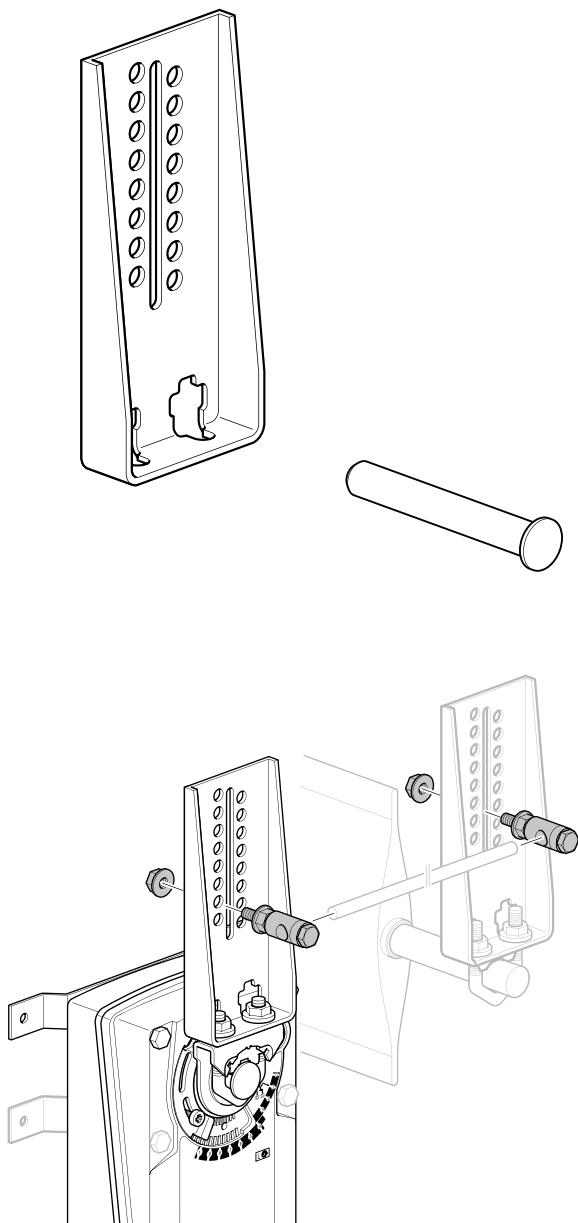
The KH-EFB crank arm is used in non-direct coupled mounting applications. The KH-EFB may also be used to simultaneously direct couple to a damper shaft and provide an additional crank arm connection to a second damper.

KH-EFB For round shafts up to 1.05" or square shafts up to 11/16"

Dimensions (Inches [mm])



NOTE: The KH-EFB crank arm is designed to attach itself with the K9-2 clamp. The supplied rod must be used when the actuator is not direct coupled onto a shaft.



Non-direct mounting with ZG-EFB crank arm adaptor kit

General

The EFB, EFX series actuators utilize both DC Motors and brushless DC motor technology. The EFB, EFX uses this motor in conjunction with an Application Specific Integrated Circuit (ASIC). In the On/Off versions of the EFB and EFX, the ASIC monitors and controls the actuator's rotation and a digital rotation sensing function to prevent damage to the actuator. The EFB24, EFX24... modulates type actuators incorporate a built in microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and knows the actuator's exact zero position.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside of a rotating permanent magnet. The electromagnetic poles are switched by a special ASIC circuit developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Overload Protection

The EFB, EFX series actuators are protected from overload at all angles of rotation. The ASIC circuit constantly monitors the rotation of the DC motor inside the actuator and stops the pulses to the motor when it senses a stall condition. The DC motor remains energized and produces full rated torque to the load. This helps ensure that dampers are fully closed and that edge and blade seals are always properly compressed.

Motor Position Detection

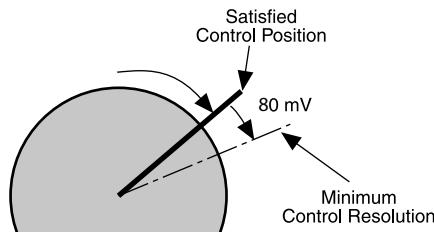
Belimo brushless DC motors eliminate the need for potentiometers for positioning in modulating type actuators. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Control Accuracy and Stability

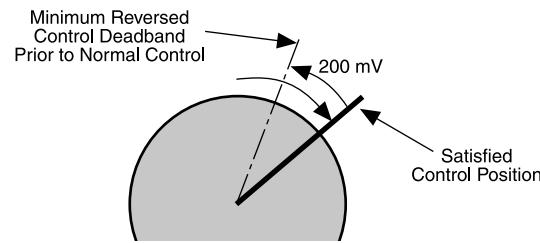
-SR and MFT EF actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The -SR and MFT EF actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

EF Actuator responds to an 80 mV signal when not changing direction from stop



EF Actuator responds to a 200 mV signal when reversing direction from stop position.



Note: Resolution is a percentage of operating range. 1% in one direction, 2.5% when changing direction. 2-10 VDC control example shown above.

Installation Instructions

General Wiring Instructions



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The EFB24, EFX24...actuators require a 24 VAC class 2 transformer and draws a maximum of 16 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 2004/108/EC
- Software class A: Mode of operation type 1
- Low voltage directive: 2006/95/EC

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for EFB..., EFX... Actuators

Keep power wire runs below the lengths listed in the **Figure H**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example: 3 actuators, 16 Ga wire

$$225 \text{ Ft} \div 3 \text{ Actuators} = 75 \text{ Ft. Maximum wire run}$$

MAXIMUM WIRE LENGTH FOR 16VA

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	550 Ft.	18 Ga	145 Ft.
14 Ga	360 Ft.	20 Ga	75 Ft.
16 Ga	225 Ft.	22 Ga	37 Ft.

FIGURE H

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the EFB24, EFX24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The EFB24, EFX24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. **Do not** connect it to the actuator common.

Initialization of the -SR and MFT

When power is initially applied, the actuator will first release its manual preload position (This assumes a manual position has been set). The actuator will then rotate to the full fail-safe position. At this point the microprocessor recognizes that the actuator is at full fail-safe and uses this position as the base for all of its position calculations. The microprocessor will retain the initialized zero during short power failures of up to 20 seconds. The -SR and MFT will also return to its position prior to the 20-second-or-less power loss. For power failures greater than 20 seconds, the actuator would naturally return to its full fail-safe position prior to the microprocessor losing its memory. The actuator will also re-initialize if the manual position mechanism is used.

EFB24-SR, EFX24-SR Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step...	Does Not Give Expected Response Go To Step...
1.	Control signal is applied to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4.
2.	Check power wiring. Correct any problems. See Note 1.	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive Step 1.	Power wiring corrected, actuator still does not drive Step 4.
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	Does not drive toward "Control Signal Position" Step 4.
4.	Make sure the control signal positive (+) is connected to Wire No. 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly Step 7.	Step 5.
5.	Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. NOTE: The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicates.	Controller output (actuator input) is correct. Input Polarity Correct Step 6.	Reprogram, adjust repair or replace controller as needed Step 1.
6.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - See Note 2.	Recalculate actuator requirement and correct installation.
7.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

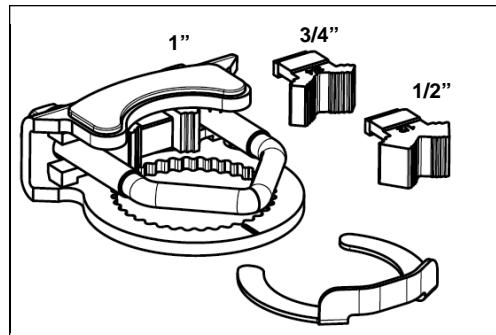
- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original purchase date, notify Belimo and give details of the application.

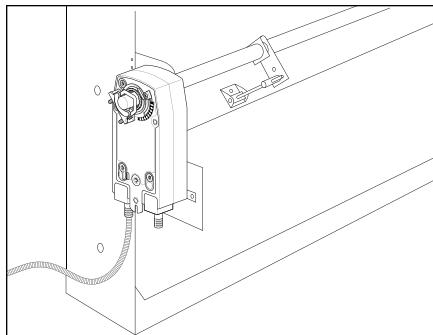
Minimum 180 in-lb Torque

- For damper areas up to 45 sq-ft* (For lower torque, see AF, NFB, LF, or TF series)

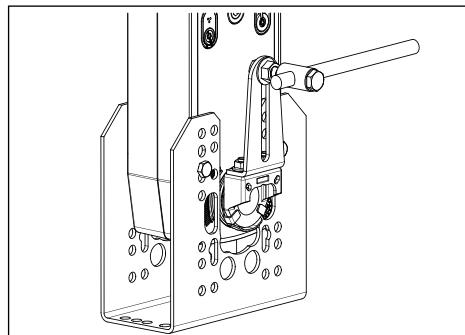
Applications



New standard clamp fits standard 1/2" shafts to 1.05" jackshafts.



Mount directly to 1.05" jackshafts.



Linkage solutions are available when direct coupling is not possible.



All Actuators have BDCM

AFB, AFX Series - At A Glance

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals. **Default 2 to 10 VDC. ***Default 150 seconds.

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A CLOSER LOOK...

- Cut labor costs with simple direct coupling.
- True mechanical spring return – the most reliable fail-safe.
- Reverse mount for clockwise or counterclockwise fail-safe.
- Check damper position easily with clear position indicator.
- Overload-proof throughout rotation
- Temporary restrictions in damper movement will not change actuator operation. Actuator returns to normal operation when restriction is removed (modulating actuators).
- Built-in mechanical stop to adjust angle of rotation.
- By eliminating internal condensation incorporated breather membrane optimizes performance in harsh airstream environments.
- Built-in auxiliary switches is easy to use, offers feedback or signal for additional device (-S models).
- Manual override crank speeds installation
- Need to change control direction?
Do it easily with a simple switch (modulating actuators).
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged metal on plastic housing withstands rough handling in the mechanical room.
- Standard 3 ft. appliance cable and conduit connector eases installation.
- Double insulated – no need for separate safety ground.
A Belimo exclusive (-S models).
- Automatically compensates for damper seal wear, ensuring tight close-off.
- Added Flexibility to Select Clamp, Electrical Connection, and Running Time to fit your Specific Application with Belimo's Flexible Line of Actuators (AFX).



The Belimo Difference

- *Customer Commitment.*
Extensive product range. Application assistance.
Same-day shipments. Free technical support. Five year warranty.
- *Low Installation and Life-Cycle Cost.*
Easy installation. Accuracy and repeatability.
Low power consumption. No maintenance.
- *Long Service Life.*
Components tested before assembly. Every product tested before shipment.
30+ years direct coupled actuator design.



Technical Data		AFB24, AFB24-S, AFX24, AFX24-S
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	5 W
	holding	2.5 W
Transformer sizing		7.5 VA (class 2 power source)
Electrical connection	AFB24...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
AFX24...		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		180 in-lb [20 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 seconds
	spring	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		zinc coated metal and plastic casing
Agency listings †		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.6 lbs (2.1 kg); 4.9 lbs (2.25 kg) with switches
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.		
AFB24-S, AFX24-S		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°	

Torque min. 180 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

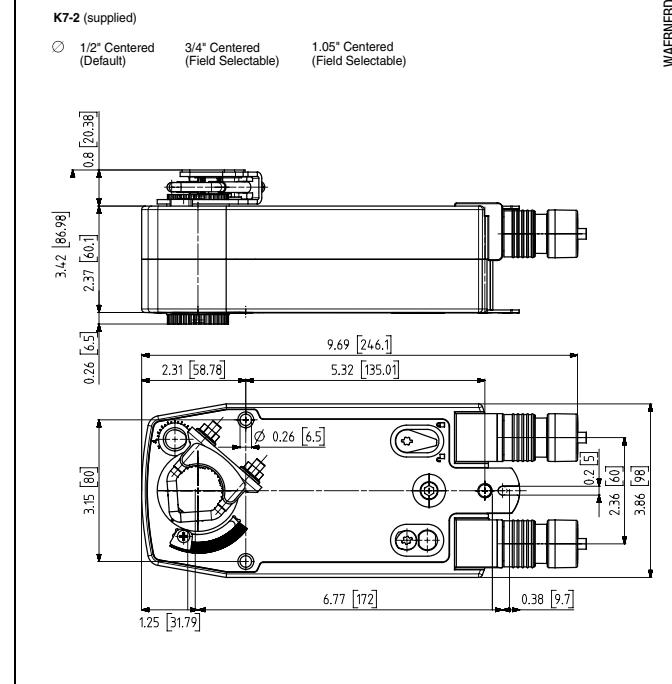
The AFB and AFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AFB and AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-S and AFX24-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The AFB24, AFB24-S, AFX24 and AFX24-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Dimensions (Inches [mm])



Accessories

AV-825	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3./4., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

Note: When using AFB24, AFB24-S, AFX24, AFX24-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

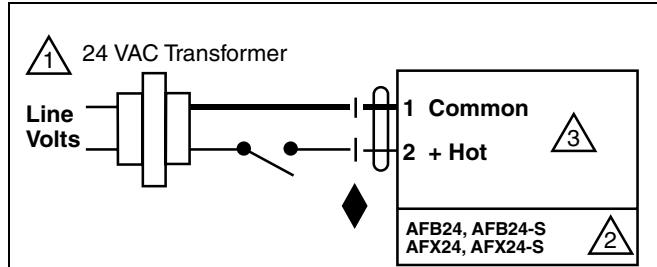
4 For end position indication, interlock control, fan startup, etc., AFB24-S and AFX24-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

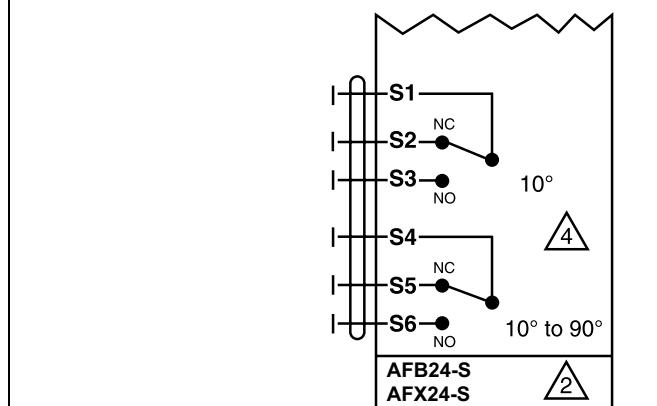
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for AFB24, AFX24



Auxiliary Switches for AFB24-S, AFX24-S

AFB24 N4(H), AFB24-S N4(H), AFX24 N4, AFX24-S N4

NEMA 4, On/Off, Spring Return, 24 V



Technical Data		AFB24 N4(H), AFB24-S N4(H), AFX24 N4, AFX24-S N4
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption	running holding	5 W / heater 25 W 2.5 W
Transformer sizing		7.5 VA (class 2 power source) / heater 25 VA
Electrical connection	AFB... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 26-16 GA
AFX... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		180 in-lb [20 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting in housing
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor spring	< 75 seconds 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
	spring (with heater)	20 seconds @ -4°F to 122°F [-20°C to 50°C]; <60 seconds @ -49°F [-45°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.7 lbs (4.4 kg); 10 lbs (4.5 kg) with switches; 10.5 lbs (4.8 kg) with heater

† Rated Impulse Voltage 800V, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.

AFB24-S N4(H), AFX24-S N4

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°
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Torque min. 180 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The AFB N4(H) and AFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

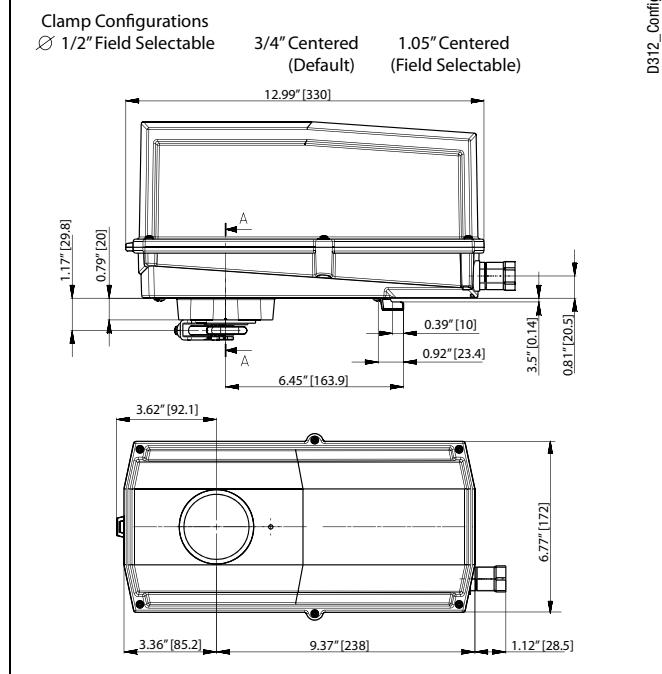
The AFB N4(H) and AFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-S N4(H), AFX24-S N4 version are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using AFB24 N4(H), AFB24-S N4(H), AFX24 N4, AFX24-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

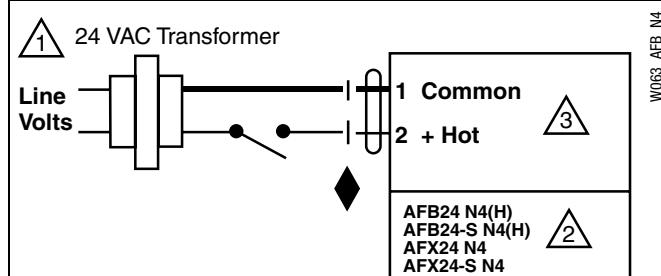
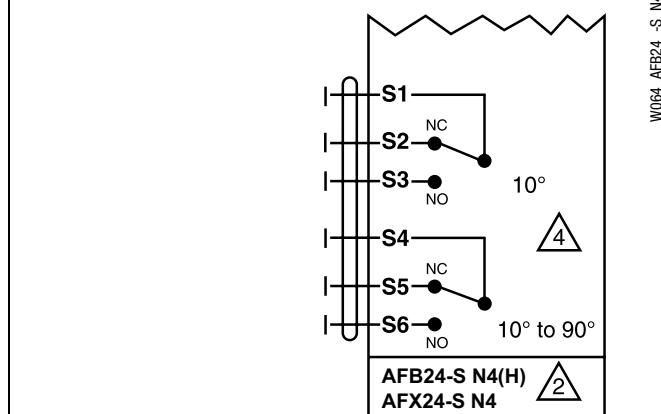
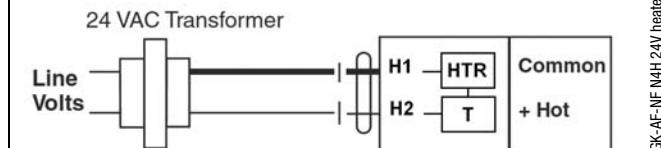
4 For end position indication, interlock control, fan startup, etc., AFB24-S N4(H), AFX24-S N4 incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

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**On/Off wiring****Auxiliary Switches****NEMA 4 Heater**

AFBUP, AFBUP-S, AFXUP, AFXUP-S

On/Off, Spring Return, 24 to 240 VAC



Technical Data		AFBUP, AFBUP-S, AFXUP, AFXUP-S
Power supply		24...240 VAC -20% / +10%, 50/60 Hz 24...125 VDC ±10%
Power consumption	running	7 W
	holding	3.5 W
Transformer sizing		7 VA @ 24 VAC (class 2 power source) 8.5 VA @ 120 VAC 18 VA @ 240 VAC
Electrical connection	AFBUP...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	AFXUP...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		Electronic throughout 0 to 95° rotation
Control		On/Off
Torque		180 in-lb [20 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 sec
	spring	20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (9/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		Zinc coated metal and plastic casing
Agency listings †		cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.6 lbs (2.1 kg), 4.9 lbs (2.25 kg) with switches
† Rated Impulse Voltage 4kV, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.		
AFBUP-S, AFXUP-S		
Auxiliary switches		2 x SPDT 3A (0.5A) @ 250 VAC, UL Approved one set at +10°, one adjustable 10° to 90°

Torque min. 180 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

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Operation

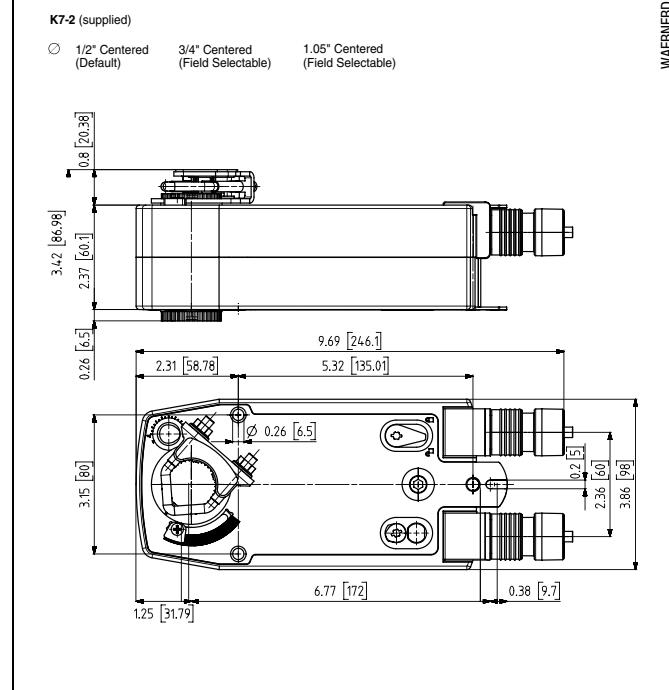
The AFB and AFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AFB and AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFBUP-S and AFXUP-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The AFBUP, AFBUP-S, AFXUP and AFXUP-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Dimensions (Inches [mm])



Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
K7-2	Universal clamp for up to 1.05" dia jackshafts
KH-AFB	Crank arm
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3./4., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

Note: When using AFBUP, AFBUP-S, AFXUP, AFXUP-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 No ground connection is required.

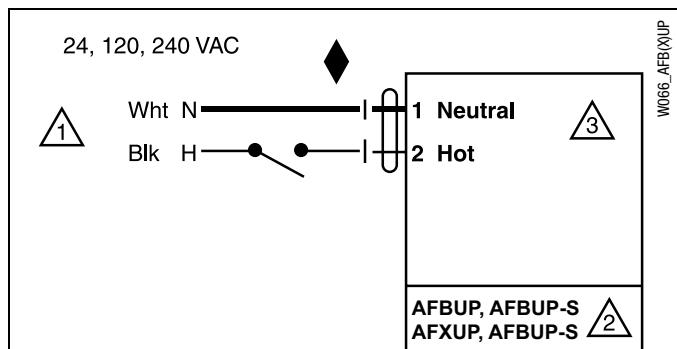
4 For end position indication, interlock control, fan startup, etc., AFBUP-S and AFXUP-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

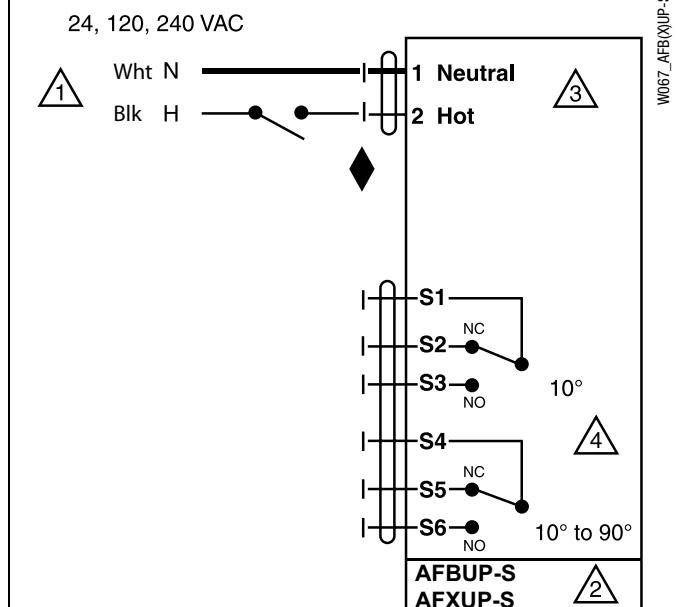
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for AFBUP, AFXUP



Auxiliary Switches for AFBUP-S, AFXUP-S

AFBUP N4(H), AFBUP-S N4(H), AFXUP N4, AFXUP-S N4

NEMA 4, On/Off, Spring Return, 24 to 240 VAC



Technical Data		AFBUP N4(H), AFBUP-S N4(H), AFXUP N4, AFXUP-S N4
Power supply		24...240 VAC -20% / +10%, 50/60 Hz 24...125 VDC ±10%
Power consumption	running	7 W / heater 25 W
	holding	3.5 W
Transformer sizing		7 VA @ 24 VAC (class 2 power source) 8.5 VA @ 120 VAC / heater 25 VA @120 VAC 18 VA @ 240 VAC
Electrical connection	AFBUP... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 18-16 GA
AFXUP... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		180 in-lb [20 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting inside housing
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 sec
	spring	20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -22°F [-30°C]
	spring (with heater)	20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -49°F [-45°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.7 lbs (4.4 kg), 10 lbs (4.5 kg) with switches 10.5 lbs (4.8 kg) with heater
† Rated Impulse Voltage 4kV, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 4.		
AFBUP-S N4(H), AFXUP-S N4		
Auxiliary switches		2 x SPDT 3A (0.5A) @ 250 VAC, UL Approved one set at +10°, one adjustable 10° to 90°

Torque min. 180 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The AFB N4(H) and AFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

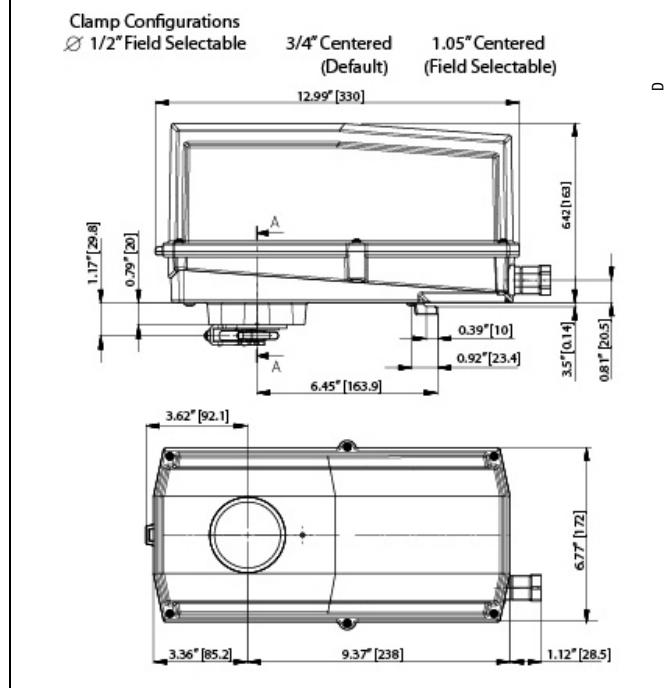
The AFB N4(H) and AFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFBUP-S N4(H), AFXUP-S N4 versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using AFBUP N4(H), AFBUP-S N4(H), AFXUP N4, AFXUP-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

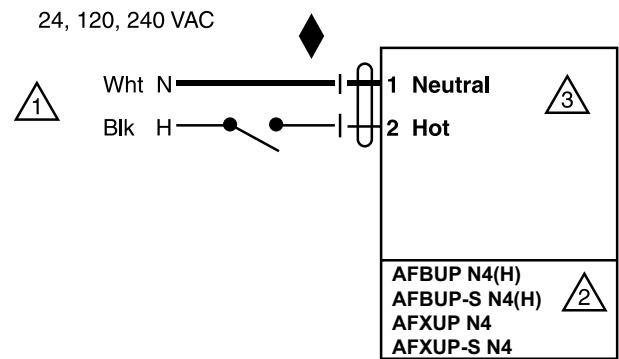
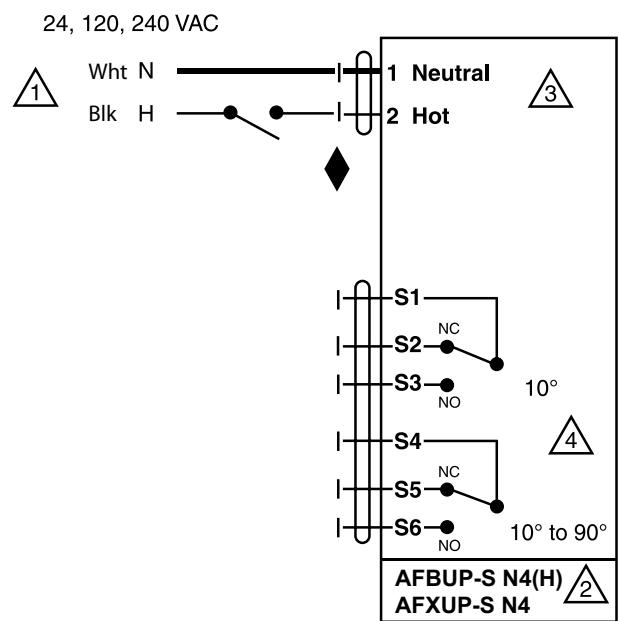
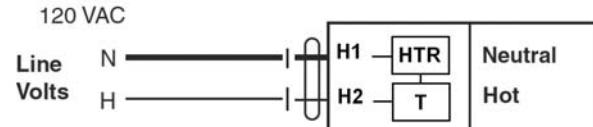
- 1** Provide overload protection and disconnect as required.
- 2** **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3** No ground connection is required.
- 4** For end position indication, interlock control, fan startup, etc.,
AFBUP-S N4(H), AFXUP-S N4 incorporates two built-in auxiliary switches:
2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°,
one is adjustable 10° to 90°.

APPLICATION NOTES

- ◆** Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off Wiring****Auxiliary Switches****NEMA 4 Heater**

AFB24-SR, AFB24-SR-S, AFX24-SR, AFX24-SR-S

Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data		AFB24-SR, AFB24-SR-S, AFX24-SR, AFX24-SR-S
Power supply		24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	5.5 W
	holding	3 W
Transformer sizing		8.5 VA (class 2 power source)
Electrical connection		
AFB...		3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
AFX...		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U		2 to 10 VDC (max. 0.5 mA)
Torque		180 in-lb [20 Nm] minimum
Direction of rotation	spring motor	reversible with CW/CCW mounting reversible with built-in switch
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring motor	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		zinc coated metal and plastic casing
Agency listings†		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤40dB(A) motor @ 95 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.6 lbs (2.1 kg); 4.9 lbs (2.25 kg) with switches
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.		
AFB24-SR-S, AFX24-SR-S		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°	

Torque min. 180 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

Operation

The AFB and AFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

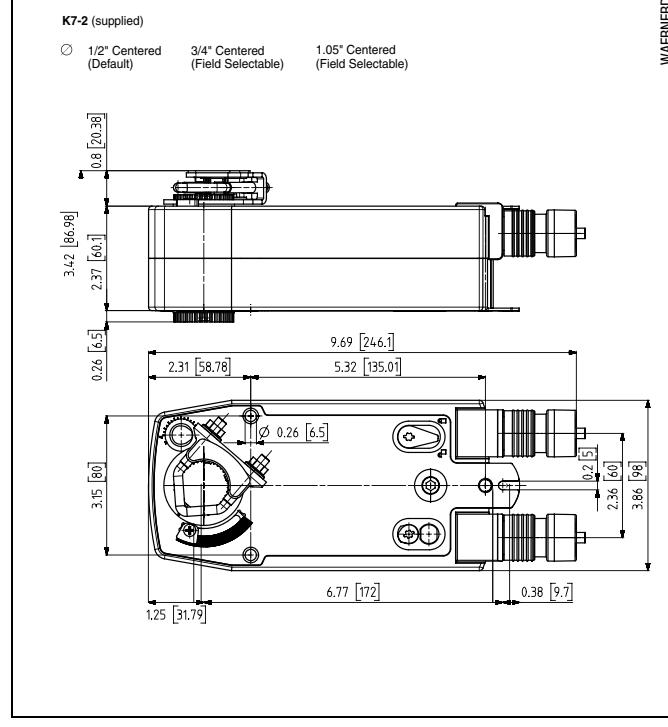
The AFB and AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The AFB24-SR and AFX24-SR uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-SR-S and AFX24-SR-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The AFB24-SR, AFB24-SR-S, AFX24-SR and AFX24-SR-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

ATTENTION: AFB24-SR(-S) and AFX24-SR(-S) **cannot** be tandem mounted on the same damper or valve shaft. Only On/Off and MFT AF models can be used for tandem mount applications.

Dimensions (Inches [mm])



Accessories

AV-8-25	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3./4., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AFB24-SR, AFB24-SR-S, AFX24-SR and AFX24-SR-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
Up to 4 actuators may be connected in parallel if not mechanically mounted to the same shaft. With 4 actuators wired to one 500 Ω resistor.
Power consumption must be observed.
- 3 Actuator may also be powered by 24 VDC.
- 4 For end position indication, interlock control, fan startup, etc., AFB24-SR-S and AFX24-SR-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.
- 5 Only connect common to neg. (-) leg of control circuits

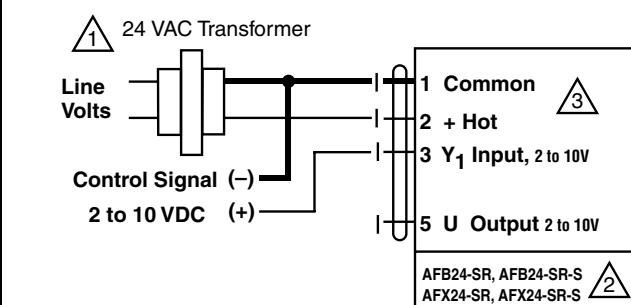
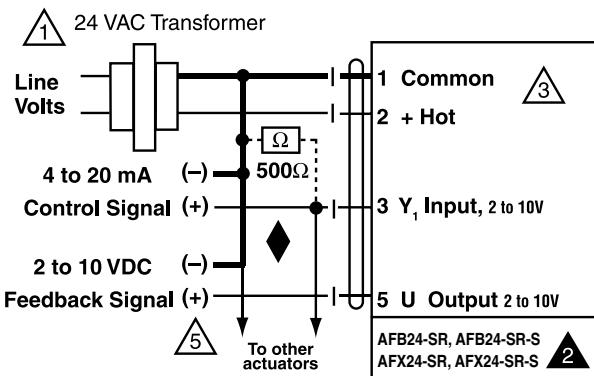
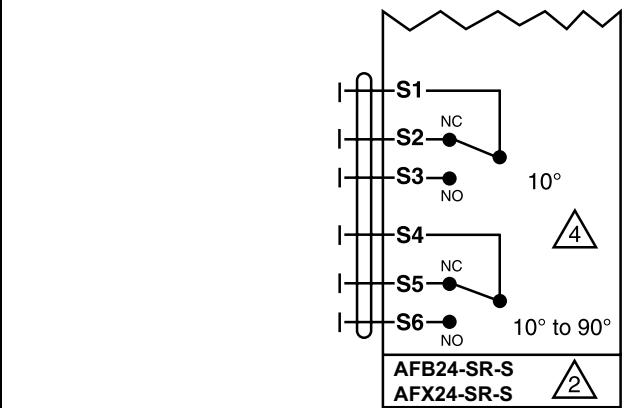
APPLICATION NOTES

- The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

ATTENTION: AFB24-SR(-S) and AFX24-SR(-S) cannot be tandem mounted on the same damper or valve shaft. Only On/Off and MFT AF models can be used for tandem mount applications.

WARNING Live Electrical Components!

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**2 to 10 VDC control of AFB24-SR and AFX24-SR****4 to 20 mA control of AFB24-SR and AFX24-SR with 2 to 10 VDC feedback output****Auxiliary switches for AFB24-SR-S, AFX24-SR-S**

AFB24-SR N4(H), AFB24-SR-S N4(H), AFX24-SR N4, AFX24-SR-S N4

NEMA 4, Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data		AFB24-SR N4(H) AFB24-SR-S N4(H), AFX24-SR N4 AFX24-SR-S N4
Power supply		24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	5.5 W / heater 25 W
	holding	3 W
Transformer sizing		6 VA (class 2 power source) / heater 25 VA
Electrical connection	AFB... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 26-16 GA
AFX... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U		2 to 10 VDC (max. 0.5 mA)
Torque		180 in-lb [10 Nm] minimum
Direction of rotation	spring motor	reversible with CW/CCW mounting Inside housing reversible with built-in switch
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	95 seconds
	spring	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
	spring (with heater)	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -49°F [-45°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Agency listings†		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤40dB(A) motor @ 95 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.7 lbs (4 kg); 10 lbs (4.5 kg) with switches 10.5 lbs (4.8 kg)

† Rated Impulse Voltage 800V, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.

AFB24-SR-S N4(H), AFB24-SR-S N4

Auxiliary switches 2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°

Torque min. 180 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

Operation

The AFB N4(H), AFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AFB N4(H), AFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The AFB24-SR N4(H), AFX24-SR N4 uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-SR-S N4(H), AFX24-SR-S N4 version are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

ATTENTION: AFB24-SR(-S) N4(H) and AFX24-SR(-S) N4 **cannot** be tandem mounted on the same damper or valve shaft. Only On/Off and MFT AF models can be used for tandem mount applications.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])

312_Config

Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using AFB24-SR N4(H), AFB24-SR-S N4(H), AFX24-SR N4, AFX24-SR-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

2 Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

2 Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor. Power consumption must be observed.

3 Actuator may also be powered by 24 VDC.

4 For end position indication, interlock control, fan startup, etc., AFB24-SR-S N4(H), AFX24-SR-S N4 incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

5 Only connect common to neg. (-) leg of control circuits

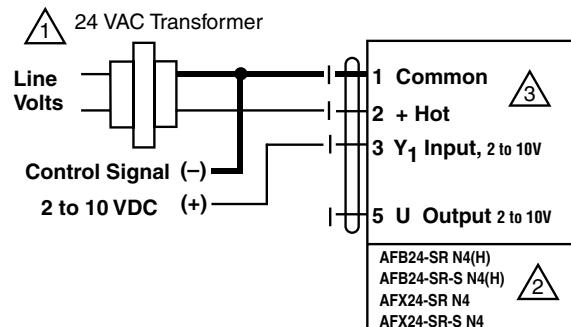
APPLICATION NOTES

The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

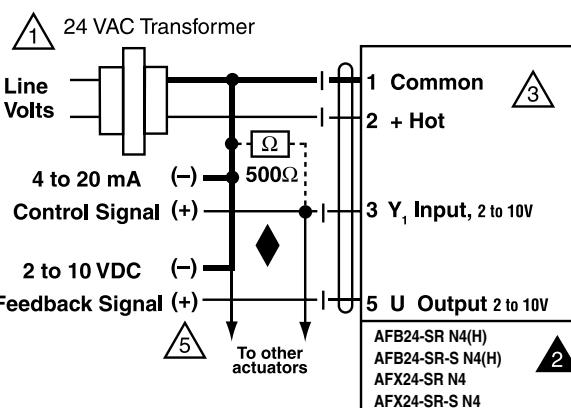
ATTENTION: AFB24-SR(-S) N4(H) and AFX24-SR(-S) N4 cannot be tandem mounted on the same damper or valve shaft. Only On/Off and MFT AF models can be used for tandem mount applications.

WARNING Live Electrical Components!

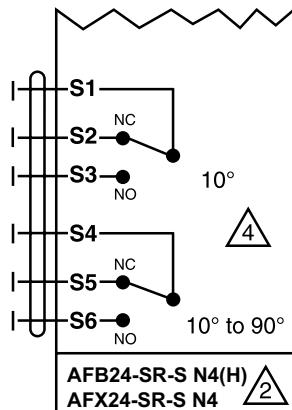
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



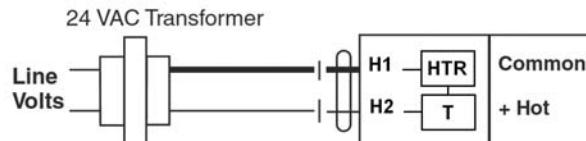
W068_AFB24-SR_N4

2 to 10 VDC control

W069_AFB24-SR_N4

4 to 20 mA control with 2 to 10 VDC feedback output

W064_AFB24-SR-S_N4

Auxiliary switches

GKAF-NF N4H 24V heater

NEMA 4 Heater

AFB24-MFT, AFB24-MFT-S, AFX24-MFT, AFX24-MFT-S

Proportional, Spring Return, 24 V, Multi-Function Technology®



MFT



Technical Data		AFB24-MFT, AFB24-MFT-S, AFX24-MFT, AFX24-MFT-S
Power supply		24 VAC, +/- 20%, 50/60 Hz 24 VDC, +20% / -10%
Power consumption♦	running holding	7.5 W 3 W
Transformer sizing ♦		10 VA (Class 2 power source)
Electrical connection	AFB...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	AFX...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y*		2 to 10 VDC, 4 to 20 mA (default) variable (VDC, PWM, floating point, on/off)
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point and on/off control
Feedback output U*		2 to 10 VDC, 0.5 mA max
Torque		minimum 180 in-lb (20 Nm)
Direction of rotation*	spring motor	reversible with cw/ccw mounting reversible with built-in switch
Mechanical angle of rotation*		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring motor*	<20 sec @ -4°F to 122°F [-20°C to 50°C]; <60 sec @ -22°F [-30°C] 150 seconds (default), variable (70 to 220 seconds)
Angle of Rotation adaptation		off (default)
Override control*		min position = 0% mid. position = 50% max. position = 100%
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH, non-condensing
Ambient temperature		-22 to 122°F (-30 to 50°C)
Storage temperature		-40 to 176°F (-40 to 80°C)
Housing		NEMA 2, IP54, Enclosure Type 2
Housing material		zinc coated metal and plastic casing
Noise level		≤40dB(A) motor @ 150 seconds, run time dependent ≤62dB(A) spring return
Agency listings †		cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02; CE acc. to 2004/108/EC & 2006/95/EC
Quality standard		ISO 9001
Servicing		maintenance free
Weight		4.6 lbs. (1.9 kg), 4.9 lbs. (2 kg) with switch

* Variable when configured with MFT options

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

♦ Programmed for 70 sec motor run time. At 150 sec motor run time, transformer sizing is 8.5 VA and power consumption is 6 W running / 3 W holding.

AFB24-MFT-S, AFX24-MFT-S

Auxiliary switches 2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°

- Torque min. 180 in-lb
- Control 2 to 10 VDC (DEFAULT)
- Feedback 2 to 10 VDC (DEFAULT)

Application

For proportional modulation of dampers and control valves in HVAC systems. The AFB24-MFT, AFX24-MFT provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 2 to 10 VDC applications of the AFB24-MFT, AFX24-MFT actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool (version 3.4 or higher) software application.
- Handheld ZTH-GEN

Operation

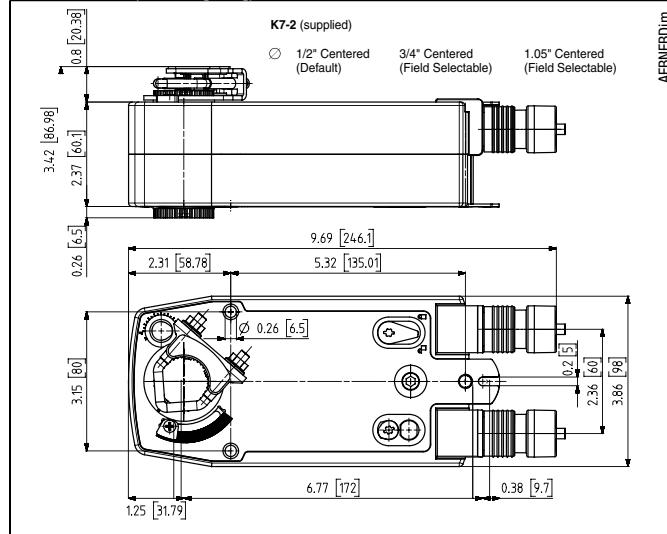
The AFB24-MFT, AFX24-MFT actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the physical damper or valve mechanical stop and use this point for its zero position during normal control operations. A unique manual override allows the setting of any actuator position within its 95° of rotation with no power applied. This mechanism can be released physically by the use of a crank supplied with the actuator. When power is applied the manual override is released and the actuator drives toward the fail-safe position.

The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-MFT, AFX24-MFT is mounted directly to control shafts up to 1.05" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption. The AFB24-MFT, AFX24-MFT actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

NOTE: Please see documentation on Multi-Function Technology.

Dimensions (Inches [mm])



Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3.../4..., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AFB24-MFT, AFB24-MFT-S, AFX24-MFT and AFX24-MFT-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams
INSTALLATION NOTES

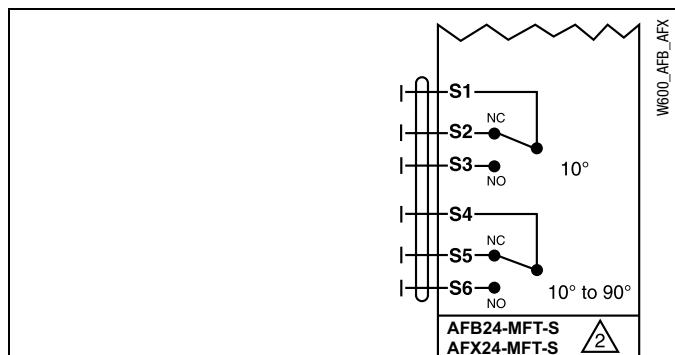
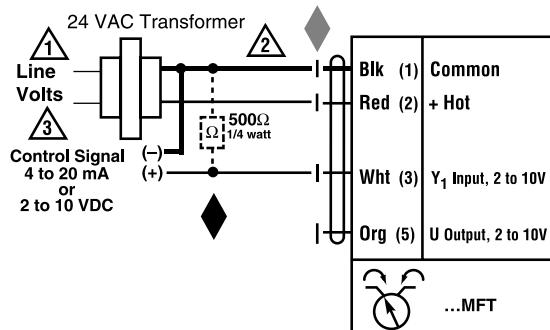
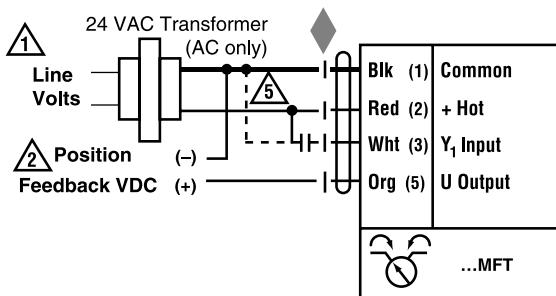
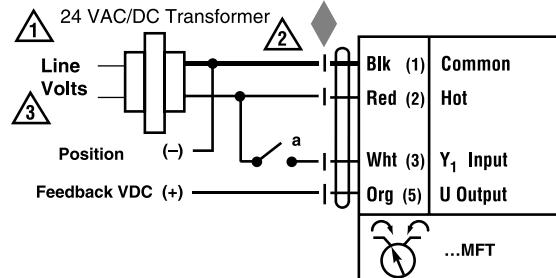
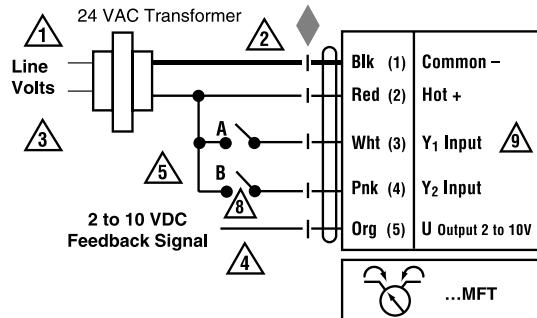
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!** Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Position feedback cannot be used with Triac sink controller. The actuator internal common reference is not compatible.
- 5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
- 8 Contact closures A & B also can be triacs.
- 9 A & B should both be closed for triac source and open for triac sink. For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

APPLICATION NOTES

- Meets UL requirements without the need of an electrical ground connection.
- The ZG-R01 500 Ω resistor may be used.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.


Auxiliary Switches for AFB24-MFT-S, AFX24-MFT-S

VDC/4-20 mA

PWM

On/Off control

Floating Point control

AFB24-MFT N4(H), AFB24-MFT-S N4(H), AFX24-MFT N4, AFX24-MFT-S N4

NEMA 4, Proportional, Spring Return, Direct Coupled, 24V, Multi-Function Technology®



MFT



Technical Data		AFB24-MFT N4(H), AFB24-MFT-S N4(H), AFX24-MFT N4, AFX24-MFT-S N4
Power supply		24 VAC, +/- 20%, 50/60 Hz 24 VDC, +20% / -10%
Power running		7.5 W / heater 25 W
consumption♦ holding		3 W
Transformer sizing		10 VA (Class 2 power source) / heater 25 VA
Electrical connection	AFB... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 26-16 GA
AFX... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cables, with 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y*		2 to 10 VDC, 4 to 20 mA (default) variable (VDC, PWM, floating point, on/off)
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point and on/off control
Feedback output U*		2 to 10 VDC, 0.5 mA max
Torque		minimum 180 in-lb (20 Nm)
Direction of rotation*	spring motor	reversible with cw/ccw mounting inside housing reversible with built-in switch
Mechanical angle of rotation*		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor*	150 seconds (default), variable (70 to 220 seconds)
	spring	<20 sec @ -4°F to 122°F [-20°C to 50°C]; <60 sec @ -22°F [-30°C]
	spring (with heater)	<20 sec @ -4°F to 122°F [-20°C to 50°C]; <60 sec @ -49°F [-45°C]
Angle of Rotation adaptation		off (default)
Override control*		min position = 0% mid. position = 50% max. position = 100%
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F (-30°C to 50°C)
with heater		-49°F to 122°F (-45°C to 50°C)
Storage temperature		-40°F to 176°F (-40°C to 80°C)
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Noise level		≤40dB(A) motor @ 150 seconds, run time dependent ≤62dB(A) spring return
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Quality standard		ISO 9001
Servicing		maintenance free
Weight		9.7 lbs. (4.4 kg), 10 lbs. (4.5 kg) with switches 10.5 lbs (4.8 kg) with heater

* Variable when configured with MFT options

† Rated Impulse Voltage 800V, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.

♦ Programmed for 70 sec motor run time. At 150 sec motor run time, transformer sizing is 8.5 VA and power consumption is 6 W running / 3 W holding.

AFB24-MFT-S N4(H), AFX24-MFT-S N4

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°
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Torque min. 180 in-lb for control of damper surfaces up to 45 sq ft.

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp.

The default parameters for 2 to 10 VDC applications of the ...MFT actuator are assigned during manufacturing. If necessary, custom versions of the actuators can be ordered. The parameters can be changed by two means: pre-set and custom configurations from Belimo or on-site configurations using the Belimo PC-Tool software.

Operation

The actuator is not provided with and does not require any limit switches, but is electronically protected against overload. The anti-rotation strap supplied with the actuator will prevent lateral movement.

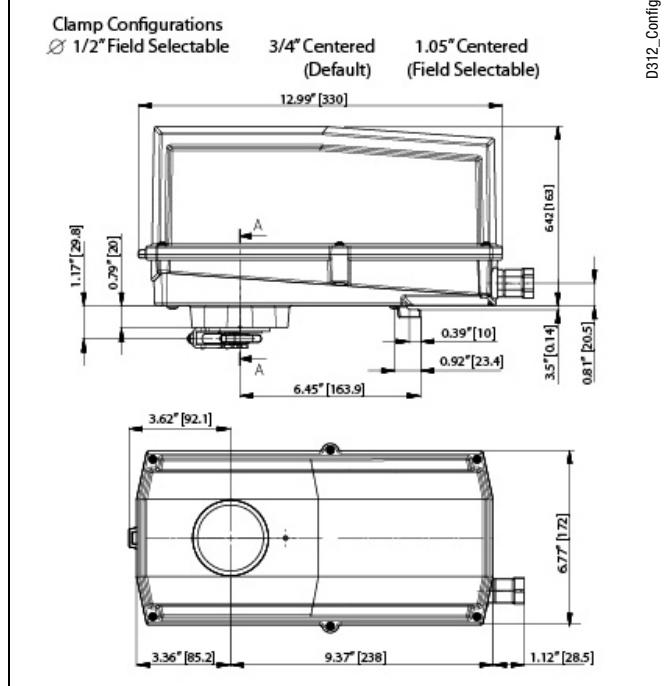
The AFB24-MFT N4(H), AFB24-MFT-S N4(H), AFX24-MFT N4, AFX24-MFT-S N4 provides 95° of rotation and a visual indicator indicates position of the actuator. When reaching the damper or actuator end position, the actuator automatically stops. The actuator can be manually operated with the manual crank that is supplied after the cover is removed.

The AFB24-MFT N4(H), AFB24-MFT-S N4(H), AFX24-MFT N4, AFX24-MFT-S N4 actuators use a brushless DC motor, which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing (DRS) function to prevent damage to the actuator in a stall condition. Power consumption is reduced in holding mode.

Add-on auxiliary switches or feedback potentiometers are easily fastened directly onto the actuator body for signaling and switching functions.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using AFB24-MFT N4(H), AFB24-MFT-S N4(H), AFX24-MFT N4 and AFX24-MFT-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

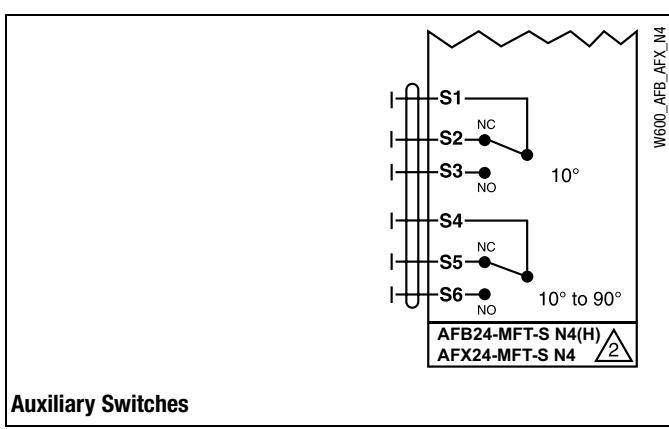
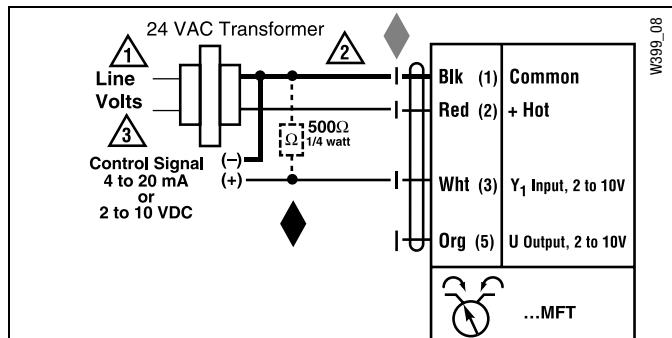
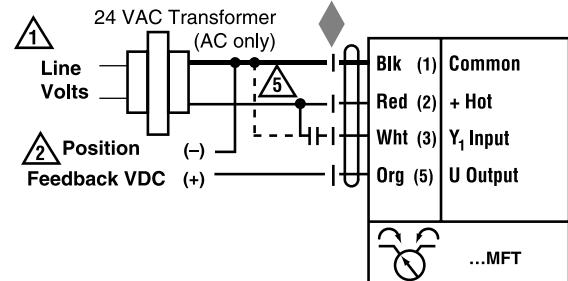
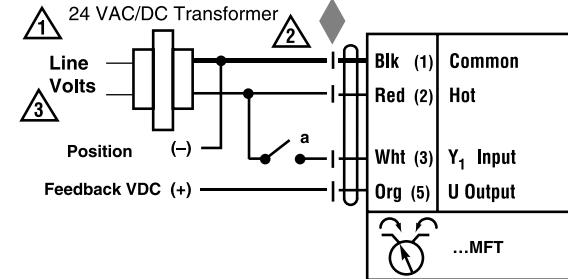
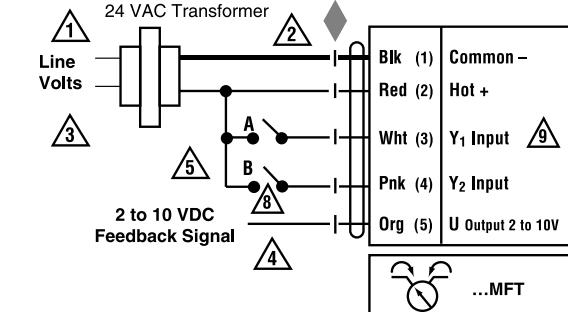
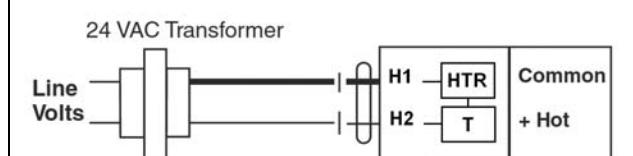
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Position feedback cannot be used with Triac sink controller.
The actuator internal common reference is not compatible.
- 5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
- 6 Contact closures A & B also can be triacs.
A & B should both be closed for triac source and open for triac sink.
- 7 For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

APPLICATION NOTES

- 8 Meets UL requirements without the need of an electrical ground connection.
- 9 The ZG-R01 500 Ω resistor may be used.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**Auxiliary Switches****VDC/4-20 mA****PWM****On/Off Control****Floating Point Control****NEMA 4 Heater**

AFB24-MFT95, AFX24-MFT95

Proportional, Spring Return, 24 V, for Use with Honeywell® Electronic Series 90 or a 0 to 135 Ω Input

BELIMO



MFT



Technical Data **AFB24-MFT95, AFX24-MFT95**

Power supply	24 VAC, +/- 20%, 50/60 Hz 24 VDC, +20% / -10%
Power consumption♦	running 7.5 W holding 3 W
Transformer sizing♦	10 VA (Class 2 power source)
Electrical connection	AFB24-MFT95 3 ft, 18 GA plenum cable, with 1/2" conduit connector
	AFX24-MFT95 3 ft [1m], 18 GA plenum cable, with or without 1/2" conduit connector
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y	0 to 135 Ω Honeywell Electronic Series 90, 0 to 135 Ω input
Feedback output U*	2 to 10 VDC, 0.5 mA max
Torque	minimum 180 in-lb (20 Nm)
Direction of rotation*	spring reversible with cw/ccw mounting motor reversible with built-in switch
Mechanical angle of rotation*	95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring <20 seconds @ -4°F to 122°F [-20°C to 50°C]; motor* <60 seconds @ -22°F [-30°C] 150 seconds (default), variable (70 to 220 seconds)
Angle of Rotation adaptation	off (default)
Position indication	visual indicator, 0° to 95° (0° is spring return position)
Manual override	5 mm hex crank (3/16" Allen), supplied
Humidity	max. 95% RH, non-condensing
Ambient temperature	-22 to 122°F (-30 to 50°C)
Storage temperature	-40 to 176°F (-40 to 80°C)
Housing	NEMA 2, IP54, Enclosure Type 2
Housing material	zinc coated metal and plastic casing
Noise level	≤40dB(A) motor @ 150 seconds, run time dependent ≤62dB(A) spring return
Agency listings †	cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Quality standard	ISO 9001
Servicing	maintenance free
Weight	4.6 lbs. (1.9 kg)

* Variable when configured with MFT options

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AAB for -S version), Control Pollution Degree 3.

♦ Programmed for 70 seconds motor run time. At 150 sec motor run time, transformer sizing is 8.5 VA and power consumption is 6 W running / 3 W holding.

- Torque min. 180 in-lb
- Control fixed, 0 to 135 Ω input, or Honeywell series 90 (fixed)
- Feedback 2 to 10 VDC (DEFAULT)

Application

For proportional modulation of dampers and control valves in HVAC systems. The AFB24-MFT95, AFX24-MFT95 provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 0 to 135 Ω Input applications of the AFB24-MFT95 and AFX24-MFT95 actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. However the control input cannot be modified via MFT PC tool software. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool (version 3.4 or higher) software application.

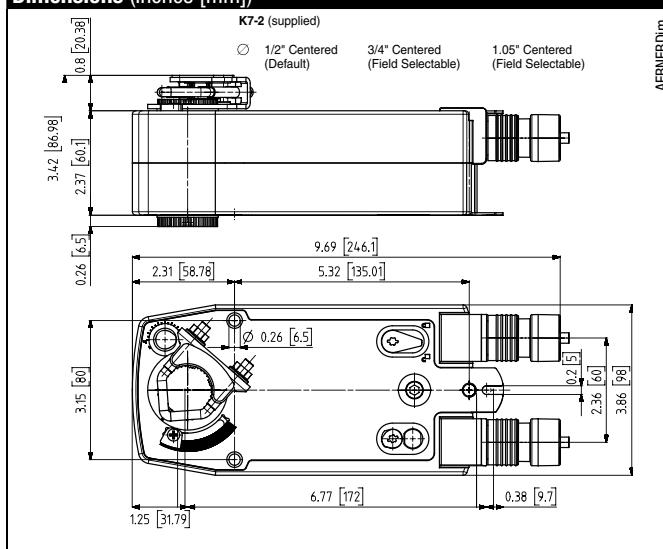
Operation

The AFB24-MFT95, AFX24-MFT95 actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the physical damper or valve mechanical stop and use this point for its zero position during normal control operations. A unique manual override allows the setting of any actuator position within its 95° of rotation with no power applied. This mechanism can be released physically by the use of a crank supplied with the actuator. When power is applied the manual override is released and the actuator drives toward the fail-safe position.

The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-MFT95, AFX24-MFT95 is mounted directly to control shafts up to 1.05" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption. The AFB24-MFT95, AFX24-MFT95 actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Dimensions (Inches [mm])

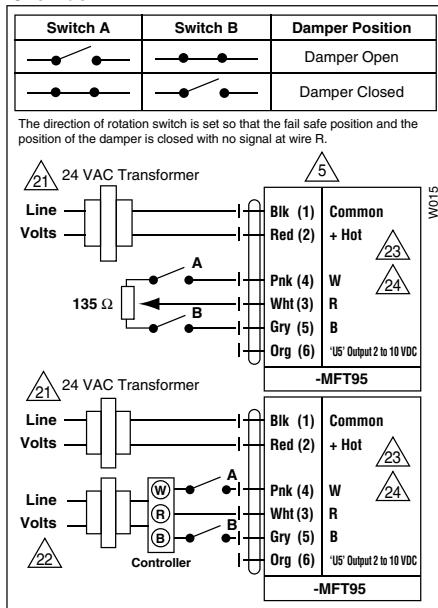
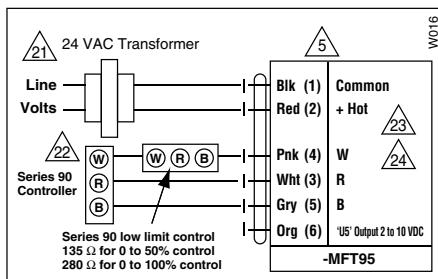
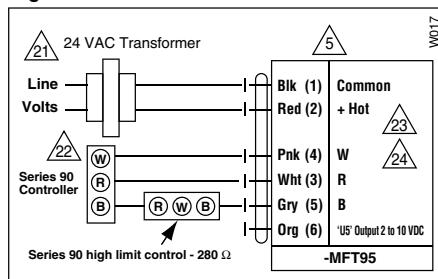


Proportional Potentiometric Control - Wiring Diagrams**INSTALLATION NOTES**

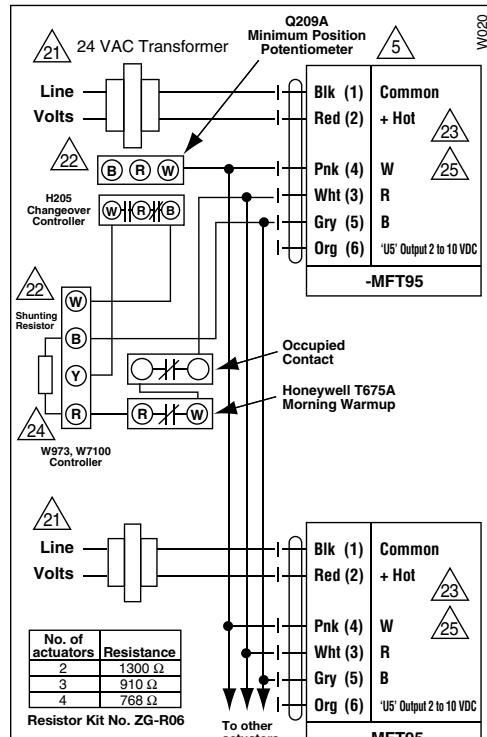
- 5** Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- 21** Provide overload protection and disconnect as required.
- 22** Actuators and controller must have separate transformers.
- 23** Consult controller instruction data for more detailed information.
- 24** Resistor value depends on the type of controller and the number of actuators. No resistor is used for one actuator. Honeywell® resistor kits may also be used.
- 25** To reverse control rotation, use the reversing switch.

Wire Colors

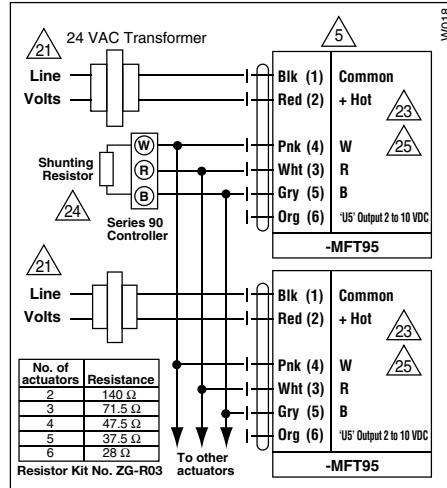
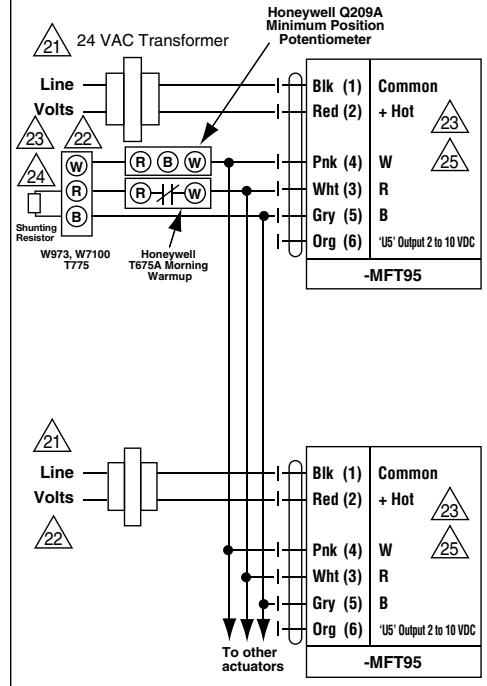
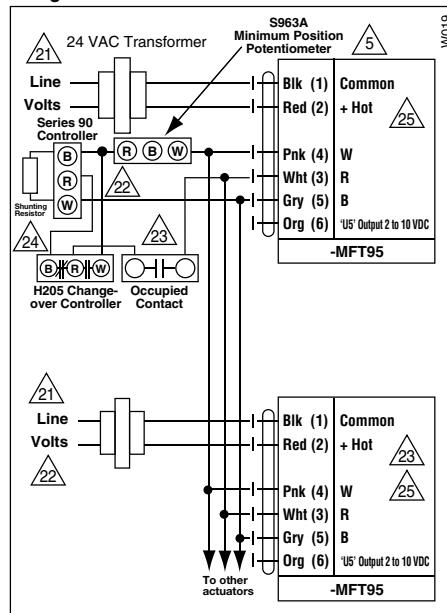
1 = Black	3 = White	5 = Gray
2 = Red	4 = Pink	6 = Orange

Override**Low Limit Control****High Limit Control****WARNING Live Electrical Components!**

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Typical wiring diagrams for multiple actuators used with the W973, W7100 and T775 controllers

Used with the W973 and W7100 controllers

Wiring Multiple Actuators to a Series 90 Controller**Wiring Multiple Actuators to a Series 90 Controller using a Minimum Position Potentiometer**

AFB24-MFT95 N4(H), AFX24-MFT95 N4

NEMA 4, Proportional, Spring Return, 24 V, for Use with Honeywell® Electronic Series 90 or a 0 to 135 Ω Input



Technical Data		AFB24-MFT95 N4(H), AFX24-MFT95 N4
Power supply		24 VAC, +/- 20%, 50/60 Hz 24 VDC, +20% / -10%
Power consumption♦	running holding	7.5 W / heater 25 W 3 W
Transformer sizing♦		10 VA (Class 2 power source) / heater 25 VA
Electrical connection	AFB24-MFT95 N4	3 ft, 18 GA plenum cable, with 1/2" conduit connector
	heater (N4H)	terminal block, 26-16 GA
AFX24-MFT95 N4		3 ft [1m], 18 GA plenum cable, with 1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		0 to 135 Ω Honeywell Electronic Series 90, 0 to 135 Ω input
Feedback output U*		2 to 10 VDC, 0.5 mA max
Torque		minimum 180 in-lb (20 Nm)
Direction of rotation*	spring motor	reversible with cw/ccw mounting inside housing reversible with built-in switch
Mechanical angle of rotation*		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor* spring	150 seconds (default), variable (70 to 220 seconds) <20 seconds @ -4°F to 122°F [-20°C to 50°C]; <60 seconds @ -22°F [-30°C]
	spring (with heater)	<20 seconds @ -4°F to 122°F [-20°C to 50°C]; <60 seconds @ -49°F [-45°C]
Angle of rotation adaptation		off (default)
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature	with heater	-22°F to 122°F [-30°C to 50°C] -49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Noise level		≤40dB(A) motor @ 150 seconds, run time dependent ≤62dB(A) spring return
Agency listings †		cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Quality standard		ISO 9001
Servicing		maintenance free
Weight		9.7 lbs. (4.4 kg); 10.5 lbs (4.8 kg) with heater

* Variable when configured with MFT options

† Rated Impulse Voltage 800V, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.

♦ Programmed for 70 seconds motor run time. At 150 sec motor run time, transformer sizing is 8.5 VA and power consumption is 6 W running / 3 W holding.

- Torque min. 180 in-lb
- Control fixed, 0 to 135 Ω input, or Honeywell series 90 (fixed)
- Feedback 2 to 10 VDC (DEFAULT)

Application

For proportional modulation of dampers and control valves in HVAC systems. The AFB24-MFT95 N4(H), AFX24-MFT95 N4 provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 0 to 135 Ω Input applications of the AFB24-MFT95 N4(H) and AFX24-MFT95 N4 actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. However the control input cannot be modified via MFT PC tool software. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool (version 3.4 or higher) software application.

Operation

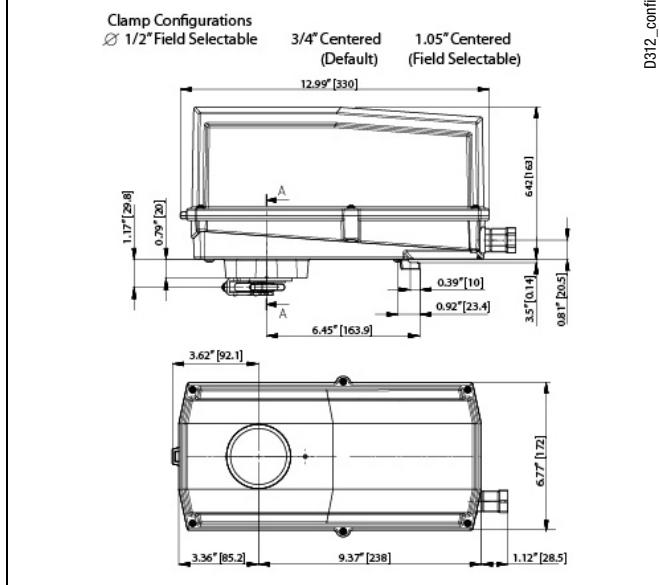
The AFB24-MFT95 N4(H), AFX24-MFT95 N4 actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the physical damper or valve mechanical stop and use this point for its zero position during normal control operations. A unique manual override allows the setting of any actuator position within its 95° of rotation with no power applied. This mechanism can be released physically by the use of a crank supplied with the actuator. When power is applied the manual override is released and the actuator drives toward the fail-safe position.

The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AFB24-MFT95 N4(H), AFX24-MFT95 N4 is mounted directly to control shafts up to 1.05" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])

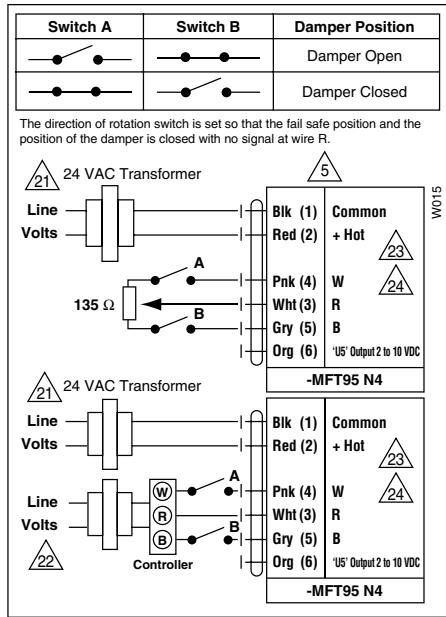
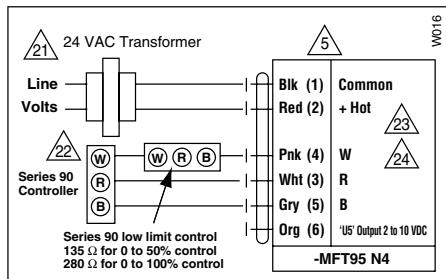
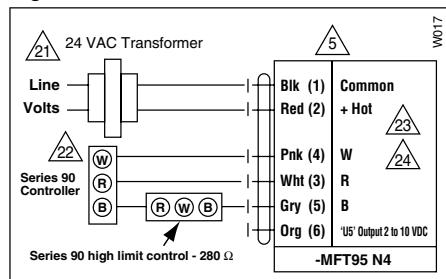


Proportional Potentiometric Control - Wiring Diagrams
INSTALLATION NOTES

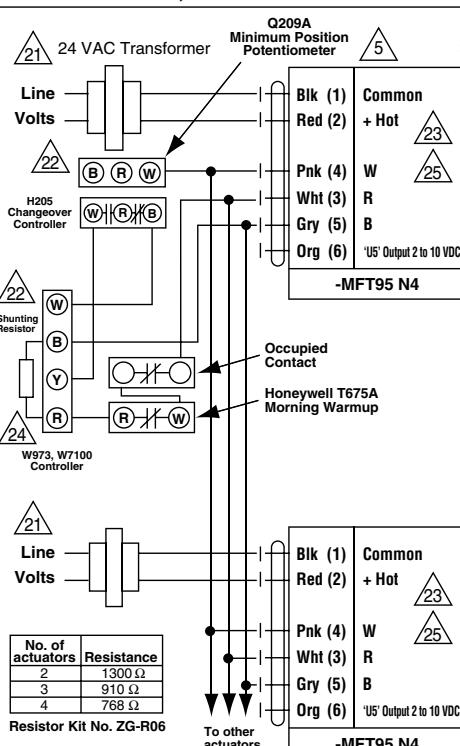
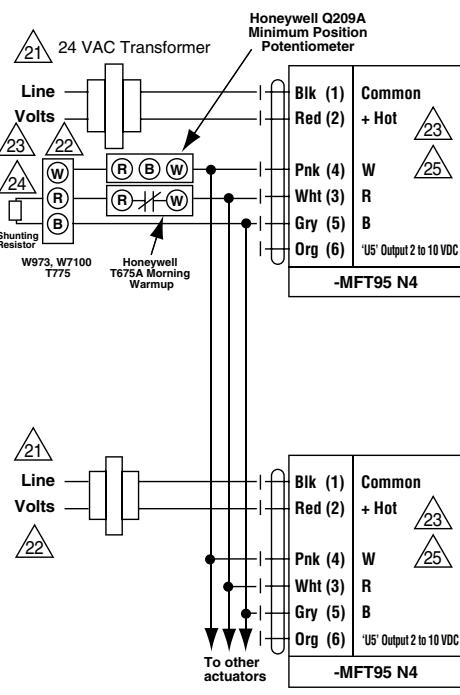
- 5** Actuators with plenum rated cable do not have numbers on wires; use color codes instead. Actuators with appliance cables are numbered.
- 21** Provide overload protection and disconnect as required.
- 22** Actuators and controller must have separate transformers.
- 23** Consult controller instruction data for more detailed information.
- 24** Resistor value depends on the type of controller and the number of actuators. No resistor is used for one actuator. Honeywell® resistor kits may also be used.
- 25** To reverse control rotation, use the reversing switch.

Wire Colors

1 = Black	3 = White	5 = Gray
2 = Red	4 = Pink	6 = Orange

Override

Low Limit Control

High Limit Control

WARNING Live Electrical Components!

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Typical wiring diagrams for multiple actuators used with the W973, W7100 and T775 controllers

Used with the W973 and W7100 controllers


Installation Instructions

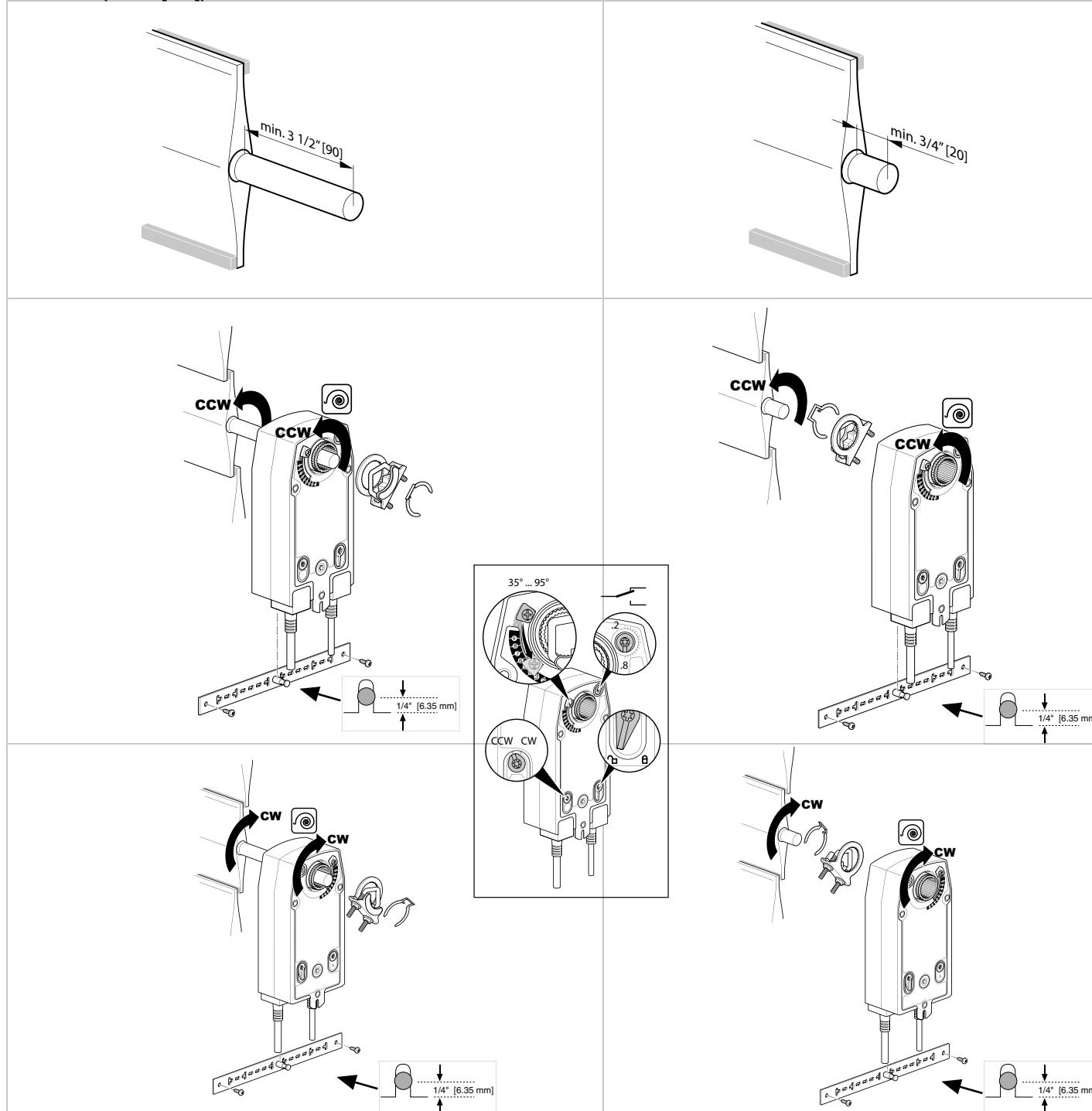
Quick-Mount Visual Instructions for Mechanical Installation

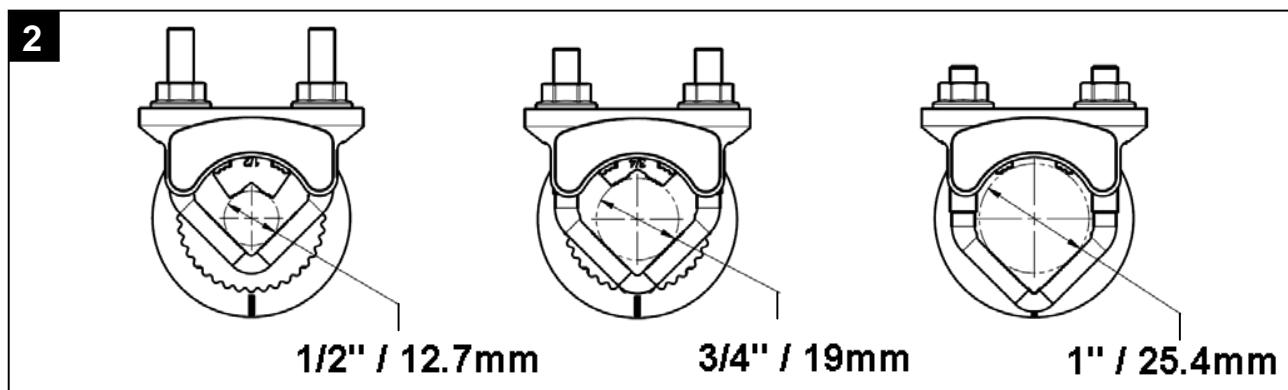
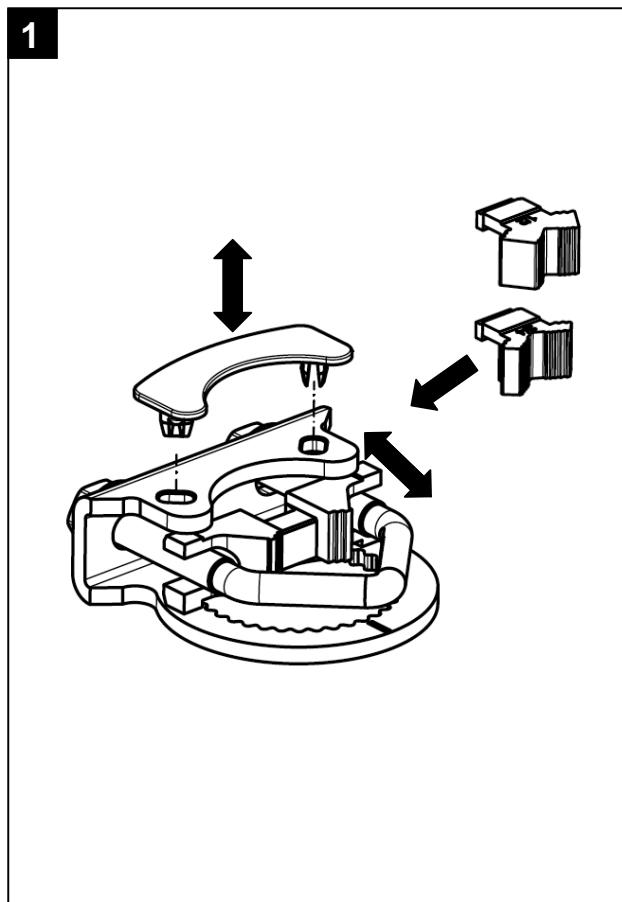
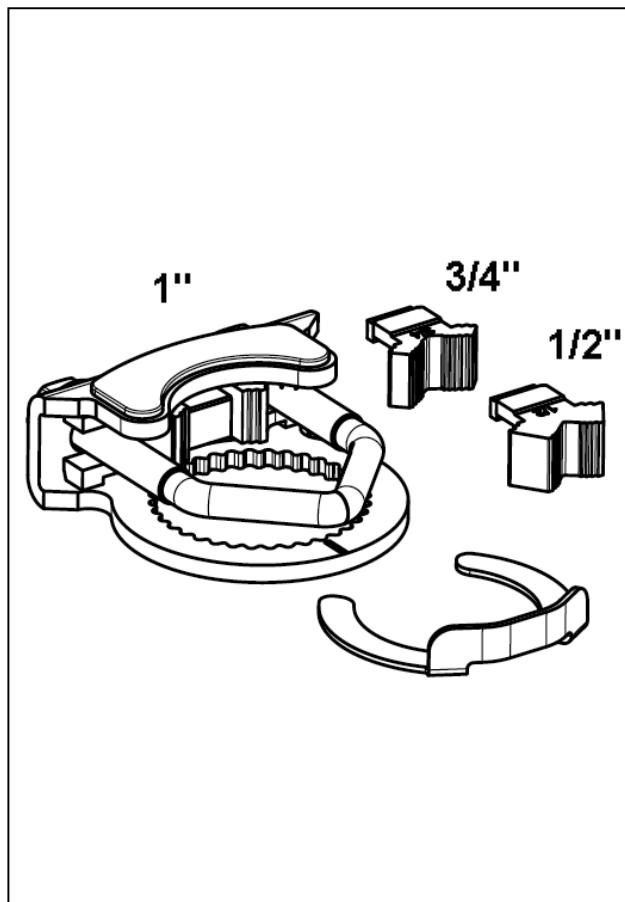
BELIMO

Quick-Mount Visual Instructions

1. Rotate the damper to its fail-safe position.
If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out.
If it rotates clockwise, mount the actuator with the "CW" side out.
 2. If the universal clamp is not on the correct side of the actuator, mount it onto the correct side.
 3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
 4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.
- NOTE: Read the "Standard Mounting" instructions, on the next page, for more detailed information.

Dimensions (Inches [mm])





N40103 - 09/11 - Subject to change. © Belimo Aircontrols (USA) Inc.

1/2"	mm	12.7	10 ... 19	---	14 ... 20
	inch	1/2	2/5 ... 3/4	---	9/16 ... 3/4
3/4"	mm	19	10 ... 22	10	14 ... 25.4
	inch	3/4	2/5 ... 3/4	3/8	9/16 ... 1
1"	mm	25.4	19 ... 26.7	12 ... 18	---
	inch	1	3/4 ... 1.05	1/2 ... 11/16	---

10mm

9 Nm / 80 in-lb

Installation Instructions

Mechanical Installation

BELIMO®

Determining Torque Loading and Actuator Sizing

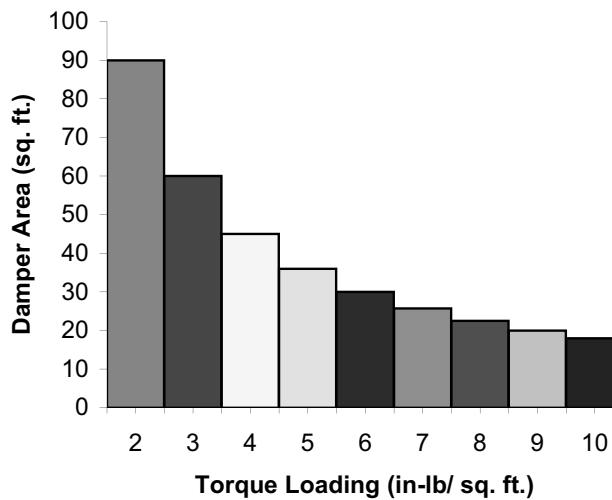
Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications with 1000 FPM face velocity. For applications between this criteria and 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 3000 FPM, use a multiplier of 2.0.

Torque Loading Chart

Torque Loading Chart



Mechanical Operation

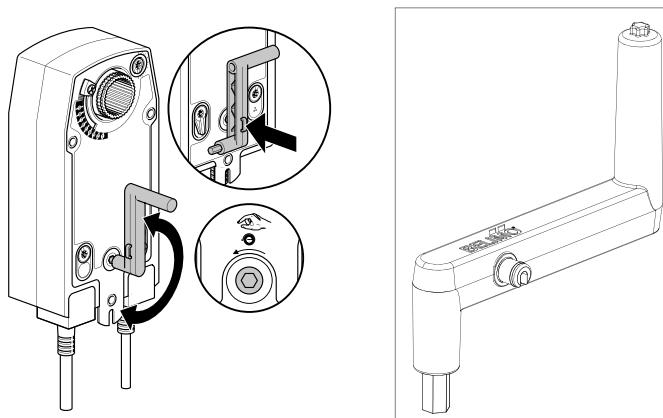
The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The AFB, AFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AFB...-S, AFX...-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Automatic Airtight Dampers/Manual Override

The AFB, AFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The AFB, AFX has a unique built in manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. A pre-tensioned spring automatically tightens the damper when power is applied to the actuator, compensating for damper seal deterioration..

The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position.



Standard Mounting

NOTE: The AFB, AFX...series actuator is shipped with the manual override adjusted for a +5° position at the universal clamp (not at full fail-safe, 0°). This allows for automatic compression of damper blade seals when the actuator is in use, providing tight shut-off. This assumes that the damper is to have tight shut-off at the fail-safe position. If tight close-off is desired at the opposite direction from fail-safe, the manual override should be released so the actuator can go to the full fail-safe position. See the manual override instructions.

1. Manually move the damper to the fail-safe position (usually closed). If the shaft rotated counterclockwise (↷), this is a CCW installation. If the shaft rotated clockwise (↶), this is a CW installation. In a CCW installation, the actuator side marked "CCW" faces out, while in a CW installation, the side marked "CW" faces out. All other steps are identical.
2. The actuator is usually shipped with the universal clamp mounted to the "CCW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CCW" (or the "CW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
3. If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out,

General Information

Belimo actuators should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator.

For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft. The damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3-1/2" or if an obstruction blocks access, the shaft can be extended with the AV 8-25 shaft extension accessory or the actuator may be mounted in its short shaft configuration.

position the clamp so that the pointer section of the tab is pointing to 0° (see Figure C) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out). If your application requires a mechanical minimum position, read the *Rotation Limiting, Mechanical Minimum Damper Position* section.

4. Lock the clamp to the actuator using the retaining clip.
5. Verify that the damper is still in its full fail-safe position.
6. Slide the actuator over the shaft.
7. Position the actuator in the desired location.
8. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
9. Slip the stud of the anti rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.

Short Shaft Installation

If the shaft extends at least 3/4" from the duct, follow these steps:

1. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
2. Engage the clamp to the actuator as close as possible to the determined location.
3. Lock the clamp in place using the remaining retainer clip.
4. Verify that the damper is still in its full fail-safe position.
5. Slide the actuator over the shaft.
6. Position the actuator in the desired location.
7. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
8. Slip the stud of the anti-rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.
9. If damper position indication is required, use the optional IND-AFB pointer. See **Figure A**.

Jackshaft Installation

The AFB, AFX... series actuator is designed for use with jackshafts up to 1.05" in diameter. In most applications, the AFB, AFX actuator may be mounted in the same manner as a standard damper shaft application. If more torque is required than one AFB, AFX actuator can provide, a second AFB, AFX actuator may be mounted to the jackshaft using the ZG-102 multiple actuator mounting bracket. **See wiring guide for wiring details.**

AF ACTUATORS WHICH MAY BE USED ON ONE SHAFT

Model	Maximum Quantity Per Shaft
AFB24-MFT(-S), AFX24-MFT (-S)	3**
AFB24(-S), AFX24(-S)	2*
AFBUP(-S), AFXUP(-S)	2*

* Wired in parallel **Wired master-slave

MOUNTING: If the actuators are mounted on the opposed ends of the shaft, the actuator direction must be selected carefully. Usually, the direction of rotation is reversed.

Multiple Actuator Mounting

If more torque is required than one AFB, AFX actuator can provide, a second AFB, AFX actuator may be mounted to the shaft using the ZG-102 multiple mounting bracket.

NOTE: The manual positioning mechanism cannot be used in multiple actuator applications.

Special Wiring and Additional Information: See wiring guide

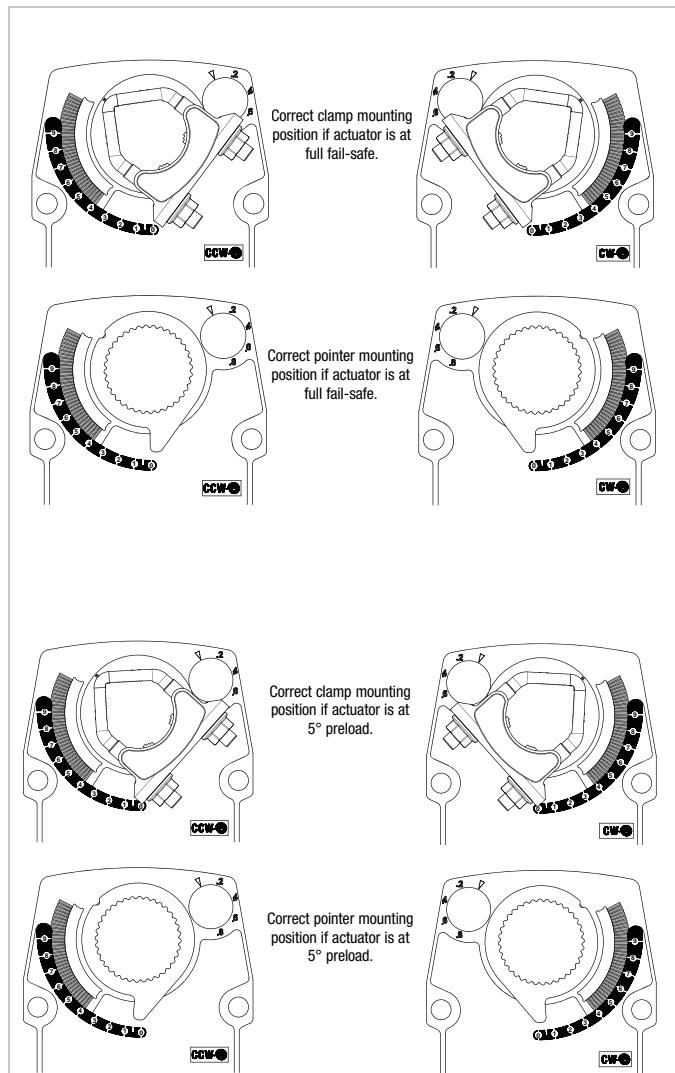


Figure A

Installation Instructions

Mechanical Installation

BELIMO

Rotation Limitation

The angle of rotation limiter, which is built into the actuator, is used in conjunction with the tab on the universal clamp or IND-AFB position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

See **Figure A**.

The rotation limiter may not work in certain mounting orientations using the ZG-118 mounting bracket. Limiting the damper rotation must be accomplished by adjusting the crank arm linkage.

The built-in rotation limiter may be used in 2 ways to control the rotational output of the AFB, AFX series actuator. One use is in the application where a damper has a designed rotation less than 90°. An example would be a 45° or 60° rotating damper. The other application would be to set a minimum damper position which can be easily set or changed without having to remove the actuator from the damper.

Damper Rotation Limiting

1. Determine the amount of damper rotation required.
2. Locate the Angle of Rotation Limiter on the actuator **Figure B**.
3. Position the limiter to the desired position, making sure the locating "teeth" on the limiter are engaged into the locating holes on the actuator.
4. Fasten the limiter by screwing the attached screw.
5. Test the damper rotation either manually with the manual crank or apply power and if required, a control signal. Re-adjust if necessary.

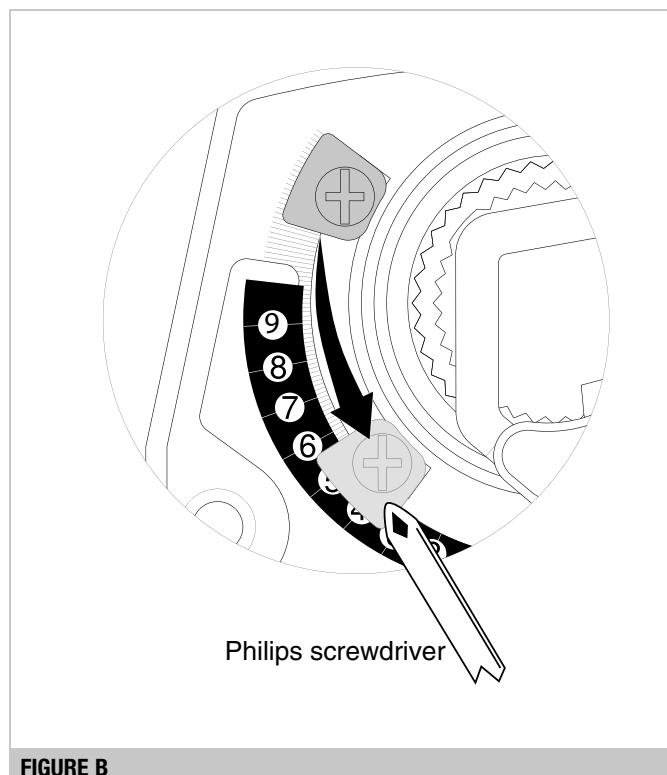
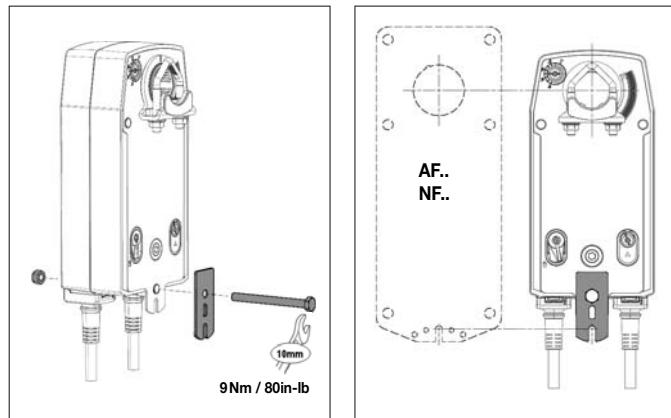


FIGURE B

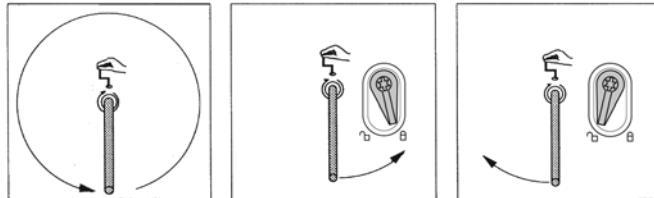
Z-AF For Replacing AF and NF Actuators



Manual Override

The AFB, AFX series actuators can be manually positioned to ease installation or for emergency positioning.

1. The manual override will only work if no power is available to the actuator.
2. Insert the manual crank (shipped with the actuator) into the hexagon hole located on either side of the actuator. An illustration, located on the label, shows the location.
3. Turn the crank in the direction shown on the label (clockwise on the "CW" side, counterclockwise on the "CCW" side). It will take approximately 23 revolutions to rotate the full 95° of rotation.
4. To lock the actuator in the required position, flip the switch to the locked position that is located to the right of the crank on the CCW side of the actuator (left of the crank on the CW side).
5. The manual override may be disengaged in 2 ways.
 - Flip the switch to the unlocked position and the actuator will go to its fail-safe position.
 - Apply power to wire 1 and 2. The actuator will automatically disengage the override function and will go to the "on" position in the case of the On/Off versions. Or, in the case of the proportional versions, go to the 0 signal position and then go to the position corresponding to the control signal. The actuator will now work normally.

CCW Side Example:

- | | | |
|--|--|---|
| Winding the damper actuator | Locking the damper actuator | Unlocking the damper actuator
(2 options) |
| <ul style="list-style-type: none"> - insert crank handle - turn handle in direction of arrow | <ul style="list-style-type: none"> - Flip the lock switch to the position pointing to the "locked" symbol | <ul style="list-style-type: none"> - Flip the lock switch to the position pointing to the "unlocked" symbol. - Remote control by supplying power to the unit for > than 3 sec. |

Testing the installation Without Power

The actuator/damper installation may be tested without power at the actuator. Refer to the manual positioning section of the instructions. Move the damper to its full non-fail-safe position using the manual crank. Disengage the manual position mechanism and have the damper go to full fail-safe position. Correct any mechanical problems and retest.

Auxiliary Switches

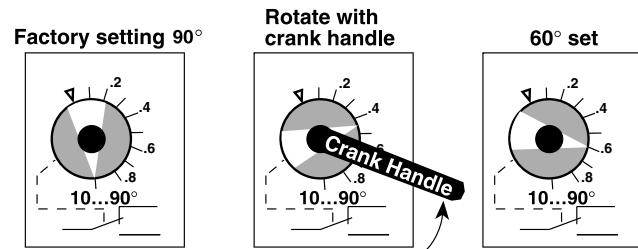
The AFB, AFX series actuators may be ordered with two built-in SPDT auxiliary switches used for safety interfacing or signaling, for example, for fan start-up. The switch position near the fail-safe position is fixed at 10°. The other is adjustable between 10° and 90° of rotation. The crank that is supplied with the actuator is used to change the switch position.

SWITCH RATING		
Voltage	Resistive Load	Inductive Load
120 VAC	3A	1.03A
250 VAC	3A	0.5A

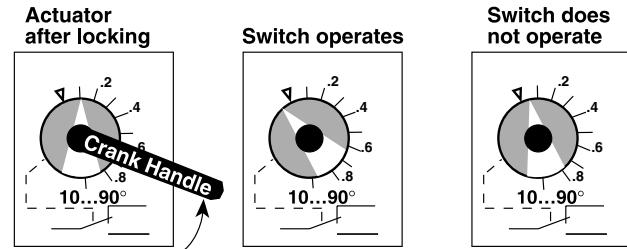
Two methods may be used to adjust the switching point of the adjustable switch.

Method 1 - See Figure F

1. The actuator must be in its fail-safe position.
2. Insert the crank handle into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the crank until the switch pointer is at the desired switch point in degrees as shown.

AFB, AFX... Series**FIGURE F****Method 2 - See Figure G**

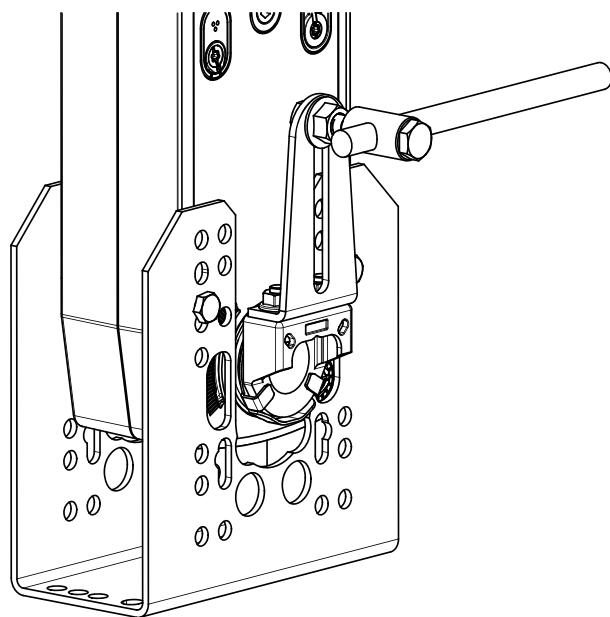
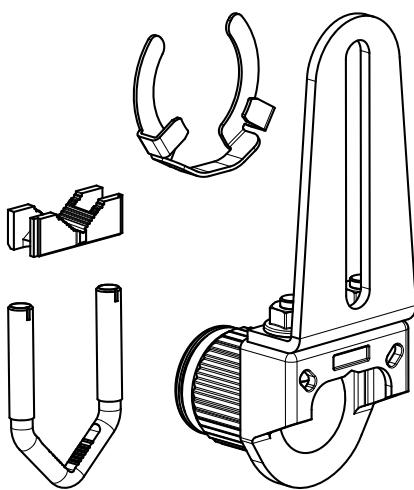
1. Position the damper to the point at which you want the switch to activate. This may be done by using the manual override or by providing the appropriate proportional signal to AFB24, AFX24... modulating type actuator. The position of the switch pointer is not important during this step.
2. Insert the crank into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the switch pointer to just past the switch point indicating arrow as shown.

AFB, AFX... Series**FIGURE G**

Installation Instructions

Non-Direct Mounting Methods

BELIMO[®]



KH-AFB non-direct mounting with ZG-118 mounting bracket

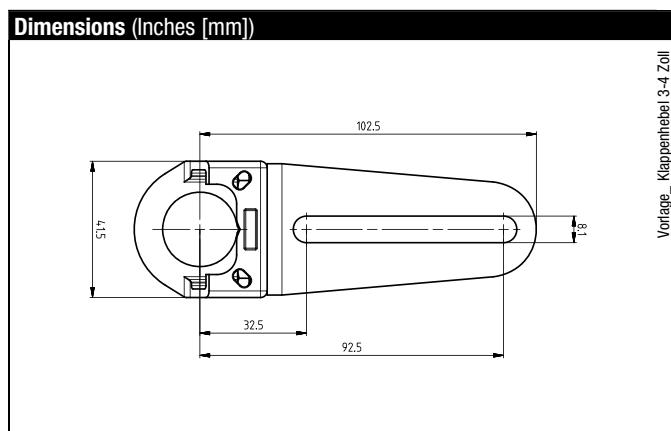
KH-AFB Crank arm Including Retaining Ring

CAUTION: The retaining clip supplied with the clamp is **not** used to mount the KH-AFB crank arm.

The KH-AFB crank arm is used in non-direct coupled mounting applications. The KH-AFB may also be used to simultaneously direct couple to a damper shaft and provide an additional crank arm connection to a second damper.

KH-AFB For round shafts up to 3/4" or square shafts up to 5/8"

Dimensions (Inches [mm])



General

The AFB, AFX series actuators utilize both DC Motors and brushless DC motor technology. The AFB, AFX uses this motor in conjunction with an Application Specific Integrated Circuit (ASIC). In the On/Off versions of the AFB and AFX, the ASIC monitors and controls the actuator's rotation and a digital rotation sensing function to prevent damage to the actuator. The AFB24, AFX24... modulates type actuators incorporate a built in microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and knows the actuator's exact zero position.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside of a rotating permanent magnet. The electromagnetic poles are switched by a special ASIC circuit developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Overload Protection

The AFB, AFX series actuators are protected from overload at all angles of rotation. The ASIC circuit constantly monitors the rotation of the DC motor inside the actuator and stops the pulses to the motor when it senses a stall condition. The DC motor remains energized and produces full rated torque to the load. This helps ensure that dampers are fully closed and that edge and blade seals are always properly compressed.

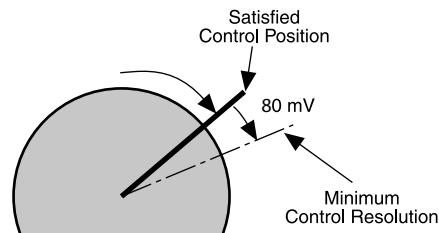
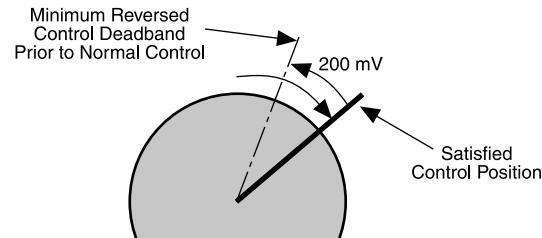
Motor Position Detection

Belimo brushless DC motors eliminate the need for potentiometers for positioning in modulating type actuators. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Control Accuracy and Stability

-SR and MFT AF actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The -SR and MFT AF actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

AF Actuator responds to an 80 mV signal when not changing direction from stop**AF Actuator responds to a 200 mV signal when reversing direction from stop position.**

Note: Resolution is a percentage of operating range. 1% in one direction, 2.5% when changing direction. 2-10 VDC control example shown above.

Installation Instructions

General Wiring Instructions



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The AFB24, AFX24...actuators require a 24 VAC class 2 transformer and draws a maximum of 10 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 2004/108/EC
- Software class A: Mode of operation type 1
- Low voltage directive: 2006/95/EC

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for AFB..., AFX... Actuators

Keep power wire runs below the lengths listed in the **Figure H**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example: 3 actuators, 16 Ga wire

$$350 \text{ Ft} \div 3 \text{ Actuators} = 117 \text{ Ft. Maximum wire run}$$

MAXIMUM WIRE LENGTH FOR 10VA

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	900 Ft.	18 Ga	220 Ft.
14 Ga	550 Ft.	20 Ga	120 Ft.
16 Ga	350 Ft.	22 Ga	60 Ft.

FIGURE H

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the AFB24, AFX24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The AFB24, AFX24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. **Do not** connect it to the actuator common.

Initialization of the -SR and -MFT

When power is initially applied, the actuator will first release its manual preload position (This assumes a manual position has been set). The actuator will then rotate to the full fail-safe position. At this point the microprocessor recognizes that the actuator is at full fail-safe and uses this position as the base for all of its position calculations. The microprocessor will retain the initialized zero during short power failures of up to 20 seconds. The -SR and -MFT will also return to its position prior to the 20-second-or-less power loss. For power failures greater than 20 seconds, the actuator would naturally return to its full fail-safe position prior to the microprocessor losing its memory. The actuator will also re-initialize if the manual position mechanism is used.

AFB24-MFT, AFX24-MFT + P-100... Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step...	Does Not Give Expected Response Go To Step...
1.	Control signal is applied to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4.
2.	Check power wiring. Correct any problems. See Note 1.	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive Step 1.	Power wiring corrected, actuator still does not drive Step 4.
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	Does not drive toward "Control Signal Position" Step 4.
4.	Make sure the control signal positive (+) is connected to Wire No. 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly Step 7.	Step 5.
5.	Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. NOTE: The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicates.	Controller output (actuator input) is correct. Input Polarity Correct Step 6.	Reprogram, adjust repair or replace controller as needed Step 1.
6.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - See Note 2.	Recalculate actuator requirement and correct installation.
7.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

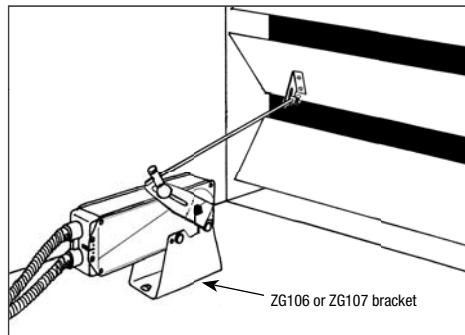
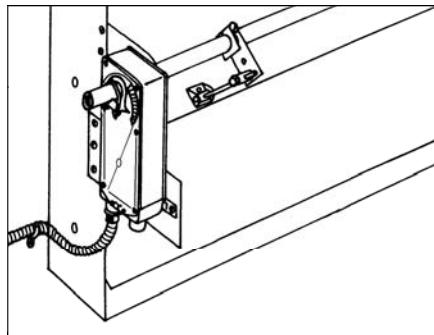
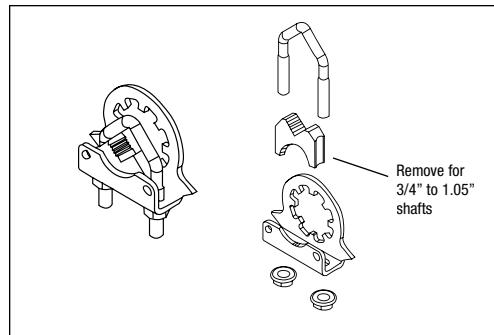
- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original purchase date, notify Belimo and give details of the application.

Minimum 133 in-lb Torque

- For damper areas up to 35 sq-ft* (For lower torque, see NFB, NFX, LF, or TF series)

Applications



All Actuators have BDCM

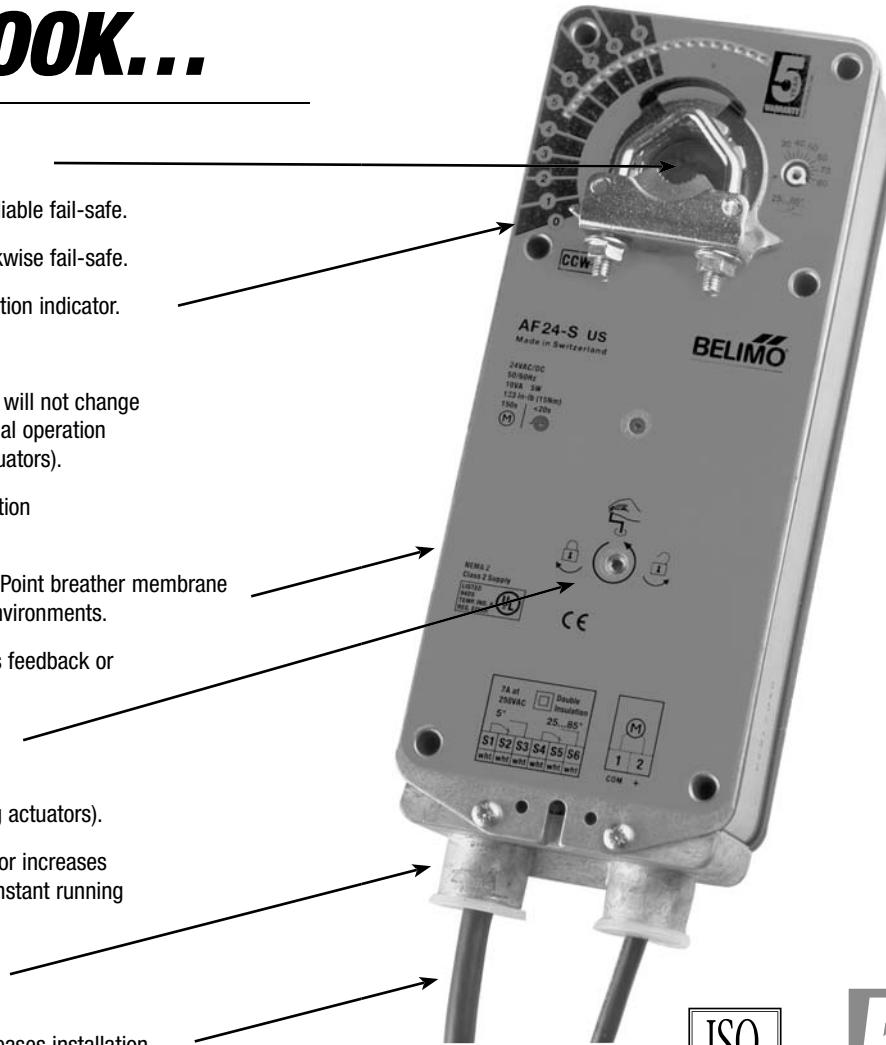
AF Series - At A Glance

	AF24-US (p. 81)	AF24-S-US (p. 81)	AF120-US (p. 83)	AF120-S-US (p. 83)	AF230-US (p. 83)	AF230-S-US (p. 83)	AF24-SR-US (p. 85)	AF24-ECON-R03-US (p. 89)	AF24-PC-US (p. 91)
Torque:	133 in-lb	●	●	●	●	●	●	●	●
Power supply:	24 VAC/DC	●	●				●	●	●
	120 VAC		●	●					
	230 VAC				●	●			
Control signal:	On/Off	●	●	●	●	●			
	2 to 10 VDC						●	●	
	3 kΩ NTC Type 10 thermistor							●	
	0 to 20 V phasecut								●
Feedback signal:	2 to 10 VDC					●		●	●
Running time motor:	150 sec constant	●	●	●	●	●	●		●
	95 sec constant							●	
	spring: <20 seconds	●	●	●	●	●	●	●	●
Brushless DC Motor		●	●	●	●	●	●	●	●
External direction of rotation switch						●	●	●	●
Manual override	●	●	●	●	●	●	●	●	●
Plenum rated cable, 18 GA							●		
Appliance rated cable, 18 GA	●	●	●	●	●	●	●		●
Built-in auxiliary switch, two SPDT	●		●		●				
Installation instructions.....(p. 93-98)	General wiring.....(p. 100)		Start-up and checkout.....(p. 101)		Electrical operations.....(p. 99)				

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals.

A CLOSER LOOK...

- Cut labor costs with simple direct coupling.
- True mechanical spring return – the most reliable fail-safe.
- Reverse mount for clockwise or counterclockwise fail-safe.
- Check damper position easily with clear position indicator.
- Overload-proof throughout rotation
- Temporary restrictions in damper movement will not change actuator operation. Actuator returns to normal operation when restriction is removed (modulating actuators).
- Easy mechanical stop to adjust angle of rotation (add ZDB-AF2 US US accessory).
- By eliminating internal condensation Golden Point breather membrane optimizes performance in harsh airstream environments.
- Built-in auxiliary switch is easy to use, offers feedback or signal for additional device (-S models).
- Manual override crank speeds installation
- Need to change control direction? Do it easily with a simple switch (modulating actuators).
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged metal housing withstands rough handling in the mechanical room.
- 3 ft. appliance cable and conduit connector eases installation.
- Double insulated – no need for separate safety ground. A Belimo exclusive (-S, 120V, 230V models).
- Automatically compensates for damper seal wear, ensuring tight close-off.



ISO
9001

5
YEAR
WARRANTY



The Belimo Difference

- **Customer Commitment.**
Extensive product range. Application assistance.
Same-day shipments. Free technical support. Five year warranty.
- **Low Installation and Life-Cycle Cost.**
Easy installation. Accuracy and repeatability.
Low power consumption. No maintenance.
- **Long Service Life.**
Components tested before assembly. Every product tested before shipment.
30+ years direct coupled actuator design.



Technical Data		AF24... US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	5 W
	holding	1.5 W
Transformer sizing		10 VA (class 2 power source)
Electrical connection		3 ft, 18 GA appliance cable (-S models have 2 cables)
		1/2" conduit connector
Electrical protection		auxiliary switches are double insulated
Overload protection		electronic throughout 0° to 95° rotation
Angle of rotation		95°, adjustable 35 to 95° w/ZDB-AF2 US
Torque		133 in-lb [15 Nm] constant
Direction of rotation		reversible with CW/CCW mounting
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Manual override		3mm hex crank (shipped w/actuator)
Auxiliary switches		2 x SPDT 7A (2.5A) @ 250 VAC, UL approved one set at +5°, one adjustable 25° to 85°
Running time		150 seconds constant, independent of load, spring return < 20 seconds
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP54
Housing material		zinc coated steel
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level		max. 45 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		6.0 lbs (2.7 kg)

Torque min. 133 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

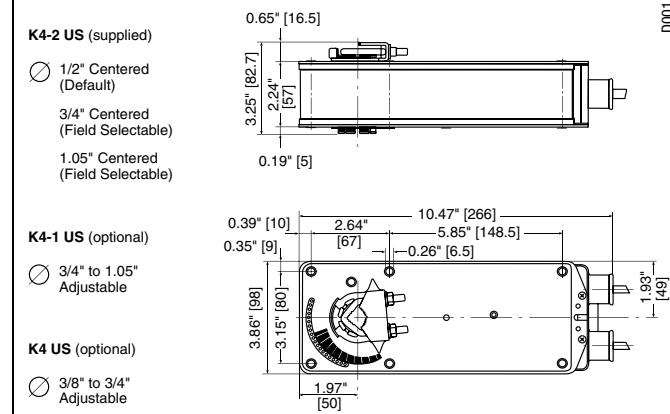
The AF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The AF series provide 95° of rotation and are provided with a graduated position indicator showing 0° to 95°. The AF has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. The AF series actuators are shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied to the AF series, the manual mechanism is released. The actuators will now try to close against the 0° position during its normal control operations. The manual override can also be released physically by the use of a crank supplied with the actuator.

The AF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The AF24-S US version is provided with two built in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +5°, the other switch function is adjustable between +25° to +85°.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension
IND-AF2	Damper position indicator
K4 US	Universal clamp for 3/8" to 3/4" shafts
K4-1 US	Universal clamp for up to 1.05" dia jackshafts
K4-H	Universal clamp for hexshafts 3/8" to 5/8"
KH-AF	Crank arm for up to 3/4" round shaft (Series 2)
KH-AF-1	Crank arm for up to 1.05" jackshaft (Series 2)
KH-AFV	V-bolt kit for KH-AF and KH-AF-1
Tool-06	8mm and 10 mm wrench
ZG-HTR	Thermostat/Heater Kit
ZDB-AF2 US	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-106	Mounting bracket for Honeywell® Mod IV
ZG-107	Mounting bracket for Honeywell® Mod III or Johnson® Series 100 replacement or new crank arm type installations
ZG-108	Mounting bracket for Barber Colman® MA 3.../4..., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AF US	Crank arm adaptor kit for AF/NF
ZG-AF108	Crank arm adaptor kit for AF/NF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AF24 US and AF24-S US actuators, only use accessories listed on this page.
For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have a manual positioning mechanism accessible on its cover. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. Run time shall be constant and independent of torque. If required, two SPDT auxiliary switches shall be provided with one switch having the capability of being adjustable. Actuators with switches must be constructed to meet the requirement for Double Insulation so an electrical ground connection is not required to meet agency listings. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

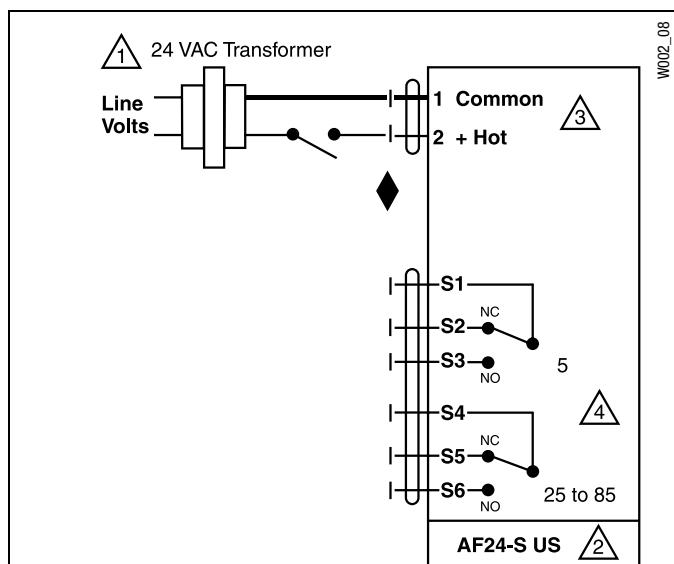
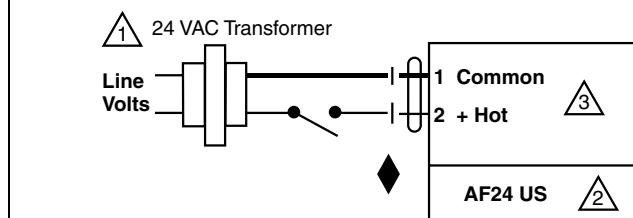
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 For end position indication, interlock control, fan startup, etc., AF24-S US incorporates two built-in auxiliary switches: 2 x SPDT, 7A (2.5A) @250 VAC, UL Approved, one switch is fixed at +5°, one is adjustable 25° to 85°.

APPLICATION NOTES

- ◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off control for AF24-S US****On/Off control for AF24 US**

AF120(-S) US, AF230(-S) US

On/Off, Spring Return, 120 or 230 VAC

BELIMO



Technical Data AF120... US, AF230... US

Power supply	
AF120(-S) US	120 VAC $\pm 10\%$ 50/60 Hz
AF230(-S) US	230 VAC $\pm 15\%$ 50/60 Hz
Power consumption	
AF120(-S) US	running 8 W holding 3 W
AF230(-S) US	running 8.5 W holding 3 W
Transformer sizing	
AF120(-S) US	11 VA
AF230(-S) US	11 VA
Electrical connection	3 ft, 18 GA appliance cable (-S models have 2 cables)
Electrical protection	actuators are double insulated
Overload protection	electronic throughout 0° to 95° rotation
Angle of rotation	95°, adjustable 35 to 95° w/ZDB-AF2 US
Torque	133 in-lb [15 Nm] constant
Direction of rotation	reversible with CW/CCW mounting
Position indication	visual indicator, 0° to 95° (0° is spring return position)
Manual override	3mm hex crank (shipped w/actuator)
Auxiliary switches	2 x SPDT 7A (2.5A) @ 250 VAC, UL approved (AF120/230-S)
Running time	150 seconds constant, independent of load, spring return < 20 seconds
Humidity	5 to 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA type 2 / IP54
Housing material	zinc coated steel
Agency listings	cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level	max. 45 dB (A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	6.9 lbs (3.1 kg)

Torque min. 133 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

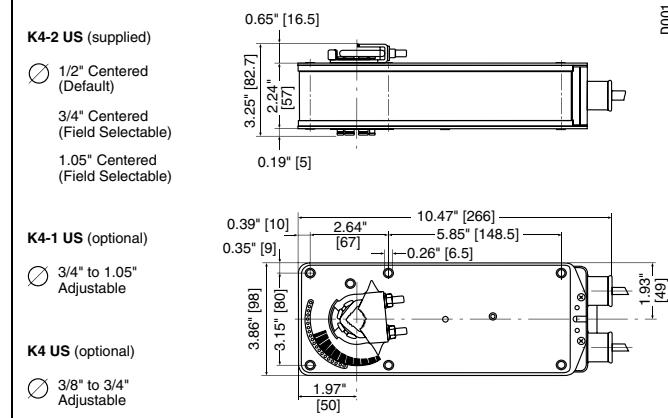
The AF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The AF series provide 95° of rotation and are provided with a graduated position indicator showing 0° to 95°. The AF has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. The AF series actuators are shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied to the AF series, the manual mechanism is released. The actuators will now try to close against the 0° position during its normal control operations. The manual override can also be released physically by the use of a crank supplied with the actuator.

The AF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC). The ASIC monitors and controls the actuator's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. The actuators are Double Insulated so a ground connection is not required.

The AF120/230-S US version is provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +5°, the other switch function is adjustable between +25° to +85°.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension
IND-AF2	Damper position indicator
K4 US	Universal clamp for 3/8" to 3/4" shafts
K4-1 US	Universal clamp for up to 1.05" dia jackshafts
KH-AF	Crank arm for up to 3/4" round shaft (Series 2)
KH-AF-1	Crank arm for up to 1.05" jackshaft (Series 2)
KH-AFV	V-bolt kit for KH-AF and KH-AF-1
Tool-06	8mm and 10 mm wrench
ZG-HTR	Thermostat/Heater Kit
ZDB-AF2 US	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-106	Mounting bracket for Honeywell® Mod IV replacement or new crank arm type installations
ZG-107	Mounting bracket for Honeywell® Mod III or Johnson® Series 100 replacement or new crank arm type installations
ZG-108	Mounting bracket for Barber Colman® MA 3.../4..., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AF US	Crank arm adaptor kit for AF/NF
ZG-AF108	Crank arm adaptor kit for AF/NF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AF120/230 US and AF120/230-S US actuators, only use accessories listed on this page. For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have a manual positioning mechanism accessible on its cover. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. Run time shall be constant and independent of torque. If required, two SPDT auxiliary switches shall be provided with one switch having the capability of being adjustable. Actuators must be constructed to meet the requirement for Double Insulation so an electrical ground connection is not required to meet agency listings. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

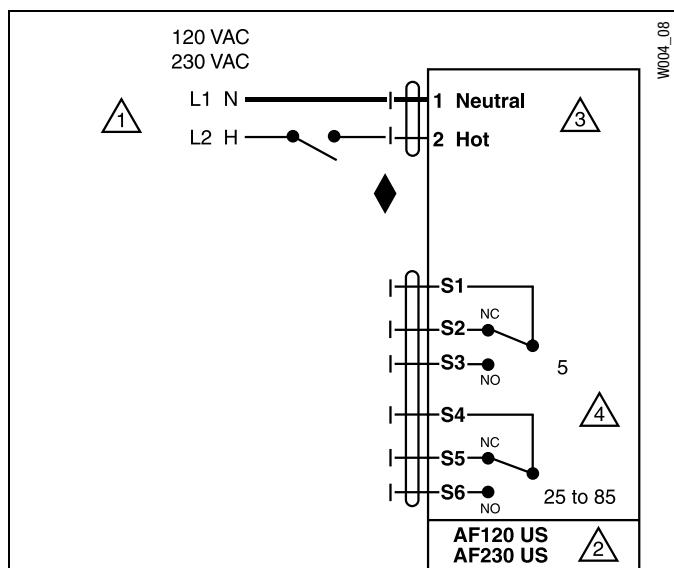
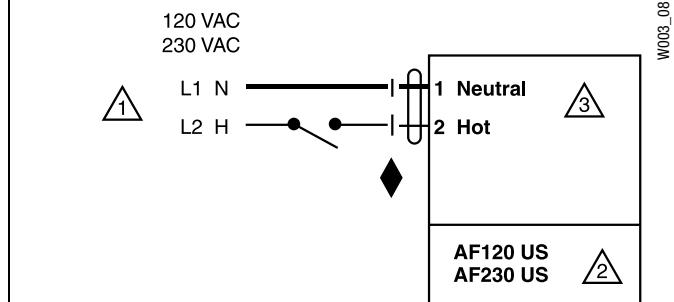
- 1** Provide overload protection and disconnect as required.
- 2** **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3** No ground connection is required.
- 4** For end position indication, interlock control, fan startup, etc., AF120/240-S US incorporates two built-in auxiliary switches: 2 x SPDT, 7A (2.5A) @250 VAC, UL Approved, one switch is fixed at +5°, one is adjustable 25° to 85°.

APPLICATION NOTES

- ◆** Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

! During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off wiring for AF120-S US and AF230-S US****On/Off wiring for AF120 US and AF230 US**



Technical Data	AF24... US
Power supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running 6 W holding 2 W
Transformer sizing	10 VA (class 2 power source)
Electrical connection	3 ft, 18 GA appliance cable 1/2" conduit connector
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y	2 to 10 VDC, 4 to 20 mA
Input impedance	100 kΩ (0.1 mA), 500 Ω
Feedback output U	2 to 10 VDC (max. 0.5 mA) for 95°
Angle of rotation	mechanically limited to 95°
Torque	133 in-lb [15 Nm] constant
Direction of rotation	spring reversible with cw/ccw mounting motor reversible with built-in switch
Position indication	visual indicator, 0° to 95° (0° is spring return position)
Manual override	3mm hex crank (shipped w/actuator)
Running time	150 seconds constant, independent of load, spring return < 20 seconds
Humidity	5 to 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA type 2 / IP54
Housing material	zinc coated metal
Agency listings	cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level	max. 45 dB (A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	6.0 lbs (2.7 kg)

Torque min. 133 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication or master-slave applications.

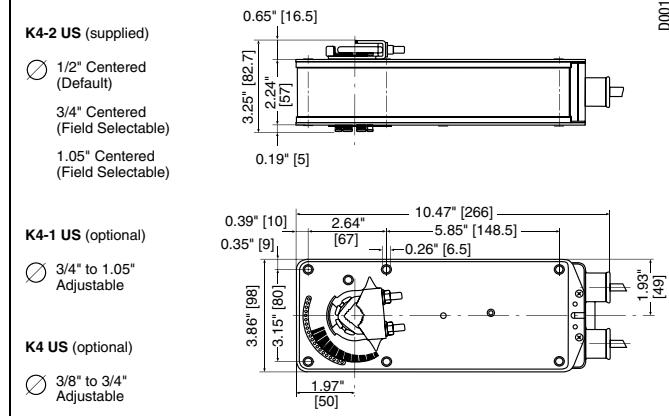
Operation

The AF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°. The AF has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. The actuator is shipped at +5° position (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position. The actuator will memorize the angle where it stops rotating and use this point for its zero position for its normal control operations. The manual override can also be released physically by the use of a crank supplied with the actuator.

The AF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact zero position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension
IND-AF2	Damper position indicator
K4 US	Universal clamp for 3/8" to 3/4" shafts
K4-1 US	Universal clamp for up to 1.05" dia jackshafts
K4-H	Universal clamp for hexshafts 3/8" to 5/8"
KH-AF	Crank arm for up to 3/4" round shaft (Series 2)
KH-AF-1	Crank arm for up to 1.05" jackshaft (Series 2)
KH-AFV	V-bolt kit for KH-AF and KH-AF-1
Tool-06	8mm and 10 mm wrench
SGA24	Min. and/or man. positioner in NEMA 4 housing
SGF24	Min. and/or man. positioner for flush panel mounting
ZG-R01	500 Ω resistor for 4 to 20 mA control signal
ZG-HTR	Thermostat/Heater Kit
ZDB-AF2 US	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-103	Universal mounting bracket
ZG-104	Universal mounting bracket
ZG-106	Mounting bracket for Honeywell® Mod IV replacement or new crank arm type installations
ZG-107	Mounting bracket for Honeywell® Mod III or Johnson® Series 100 replacement or new crank arm type installations
ZG-108	Mounting bracket for Barber Colman® MA 3..4.., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AF US	Crank arm adaptor kit for AF/NF
ZG-AF108	Crank arm adaptor kit for AF/NF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AF24-SR US actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have control direction of rotation switch accessible on its cover. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

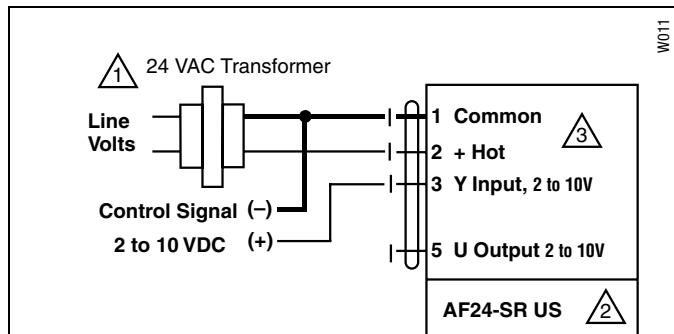
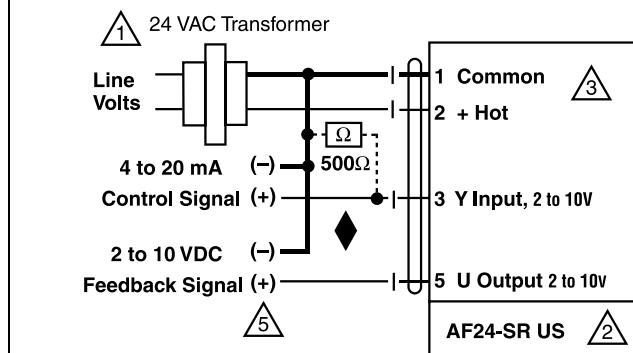
5 Only connect common to neg. (-) leg of control circuits.

APPLICATION NOTES

◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC, up to 2 actuators may be connected in parallel.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**2 to 10 VDC control****4 to 20 mA control**



Technical Data		AFA24... US
Power supply	24 VAC ± 20% 50/60 Hz	24 VDC ± 10%
Power consumption		
running	6 W	
holding	2 W	
Transformer sizing	10 VA (class 2 power source)	
Electrical connection	3 ft, 18 GA appliance cable 1/2" conduit connector	
Overload protection	electronic throughout 0 to 95° rotation	
Operating range Y	2 to 10 VDC, 4 to 20 mA	
Input impedance	100 kΩ (0.1 mA), 500 Ω	
Angle of rotation	mechanically limited to 95°	
Torque	133 in-lb [15 Nm] constant	
Direction of rotation	spring motor	reversible with cw/ccw mounting
		reversible with built-in switch
Position indication	visual indicator, 0° to 95° (0° is spring return position)	
Manual override	3mm hex crank (shipped w/actuator)	
Running time	150 seconds constant, independent of load, spring return < 20 seconds	
Humidity	5 to 95% RH non-condensing	
Ambient temperature	-22°F to 122°F [-30°C to 50°C]	
Storage temperature	-40°F to 176°F [-40°C to 80°C]	
Housing	NEMA type 2 / IP54	
Housing material	zinc coated metal	
Agency listings	cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93	
Noise level	max. 45 dB (A)	
Servicing	maintenance free	
Quality standard	ISO 9001	
Weight	6.0 lbs (2.7 kg.)	

Torque min. 133 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner.

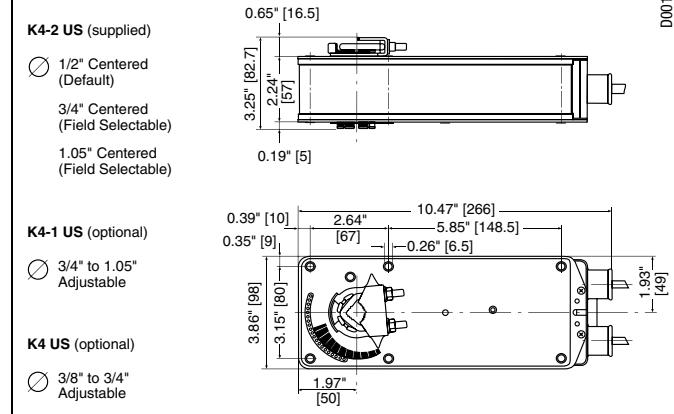
Operation

The AFA series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AFA series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°. The AFA has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. The actuator is shipped at +5° position (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position. The actuator will memorize the angle where it stops rotating and use this point for its zero position for its normal control operations. The manual override can also be released physically by the use of a crank supplied with the actuator.

The AFA uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact zero position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension
IND-AF2	Damper position indicator
K4 US	Universal clamp for 3/8" to 3/4" shafts
K4-1 US	Universal clamp for up to 1.05" dia jackshafts
K4-H	Universal clamp for hexshafts 3/8" to 5/8"
KH-AF	Crank arm for up to 3/4" round shaft (Series 2)
KH-AF-1	Crank arm for up to 1.05" jackshaft (Series 2)
KH-AFV	V-bolt kit for KH-AF and KH-AF-1
Tool-06	8mm and 10 mm wrench
SGA24	Min. and/or man. positioner in NEMA 4 housing
SGF24	Min. and/or man. positioner for flush panel mounting
ZG-R01	500 Ω resistor for 4 to 20 mA control signal
ZG-HTR	Thermostat/Heater Kit
ZDB-AF2 US	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-106	Mounting bracket for Honeywell® Mod IV replacement or new crank arm type installations
ZG-107	Mounting bracket for Honeywell® Mod III or Johnson® Series 100 replacement or new crank arm type installations
ZG-108	Mounting bracket for Barber Colman® MA 3../4.., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AF US	Crank arm adaptor kit for AF/NF
ZG-AF108	Crank arm adaptor kit for AF/NF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AFA24-SR US actuators, only use accessories listed on this page.
Actuator may not be tandem mounted on same shaft or otherwise mechanically linked.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jack-shaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have control direction of rotation switch accessible on its cover. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

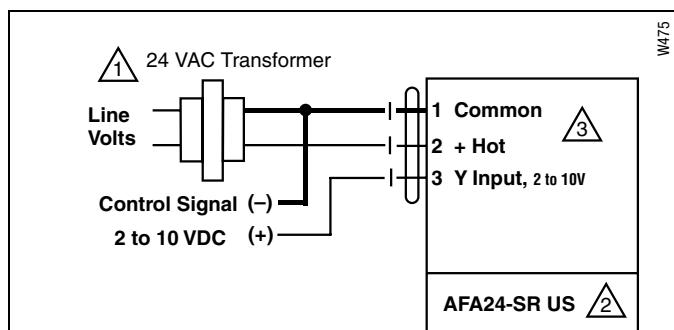
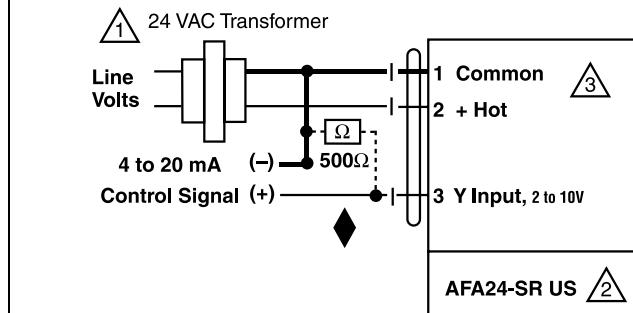
3 Actuators may also be powered by 24 VDC.

APPLICATION NOTES

◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC, up to 2 actuators may be connected in parallel.

WARNING Live Electrical Components!

! During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**2 to 10 VDC control****4 to 20 mA control**

AF24-ECON-R03 US

Proportional, Spring Return, 24V, for Stand-Alone Economizer Damper Control Using 3 kΩ
Mixed Air Sensor, Built-in Minimum Position Adjustment



Technical Data

AF24... US

Power supply	24 VAC ± 20% 50/60 Hz, 24 VDC ± 10%
Power consumption	
running	6 W
holding	2.5 W
Transformer sizing	10 VA (class 2 power source)
Electrical connection	3 ft, plenum rated cable 1/2" conduit connector
Overload protection	electronic throughout 0 to 95° rotation
Control Signal	Y1 3 kΩ NTC Type 10 thermistor, 3 kΩ @ 77°F (25°C) MA setpoint = 55°F
Input impedance	Y1 100 kΩ Y2 100 kΩ
Feedback output, U	2 to 10 VDC (max. 0.7 mA) for 95°
Angle of rotation	max. 95°, adjustable with mechanical stop
Torque	133 in-lb [15 Nm]
Override function	See override control table on opposite page
Direction of rotation	spring reversible with cw/ccw mounting
Position indication	visual indicator, 0° to 95° scaled as 0 to 1 (0° is spring return position)
Running time	motor 95 seconds constant, independent of load spring < 20 seconds @ -4°F to 122°F [-20°C to 50°C] < 60 seconds @ -22°F [-30°C]
Humidity	5 to 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA type 2 / IP54
Housing material	zinc coated steel
Agency listings	cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level	running <45 dB (A) spring return 62 dB (A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	6.0 lbs (2.7 kg)

- Torque min. 133 in-lb, for control of air dampers
- Built-in adjustable min-position
- Integrated mixed air PI-control

Application

For proportional control of mixed air setpoint on economizer dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to 3 kΩ thermistor.

Operation

The AF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

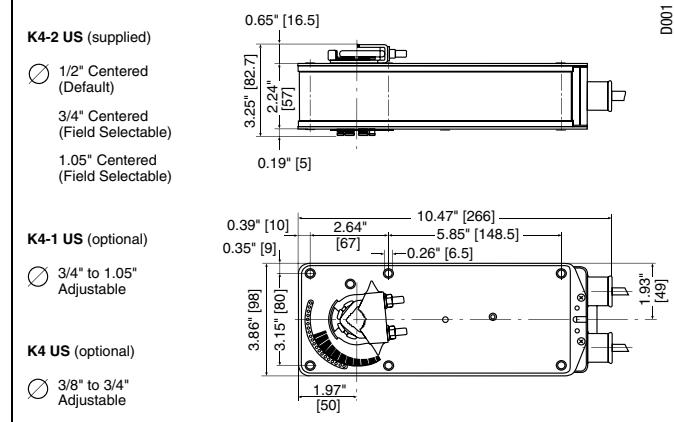
The AF24-ECON-R03 US provide 95° of rotation and are provided with a graduated position indicator showing 0° to 95°. The actuators are shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is first applied, the AF24-ECON-R03 US will move to 0° (full fail-safe). The actuator will now try to close against the 0° position during its normal control operations.

The AF24-ECON-R03 US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

Installation

Refer to AF Section of the Standard Actuation and Accessories, Technical Documentation.

Dimensions (Inches [mm])



Occupied - Economizer Mode

The AF24-ECON-R03 US enters Economizer Mode when either an external relay or controller completes the circuit between the actuator wire 3(Y1) and MA sensor. In this mode, the actuator moves proportionally to maintain a MA set-point of 55°F (fixed). A proportional band of 6°F modulates the actuator between 53 and 58°F. Also, a +/-1°F dead band eliminates hunting of the actuator, while maintaining suitable temperatures in the RTU mixed air chamber.

MA Dry Bulb Temperature	AF24-ECON... Position
< 53°F	Min. position
53°F < MAT < 58°F	Modulates between Min. Position and 100% open
> 58°F	100% open

Accessories, see page 308.**Typical Specification**

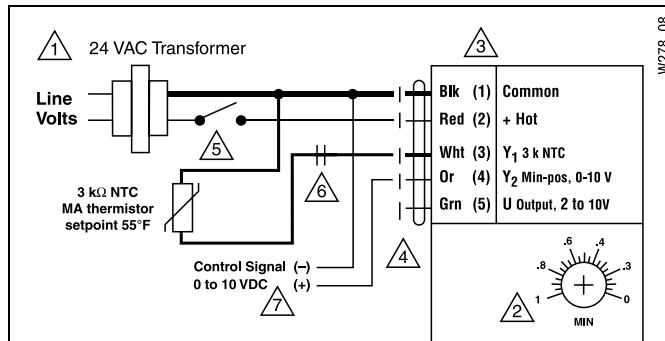
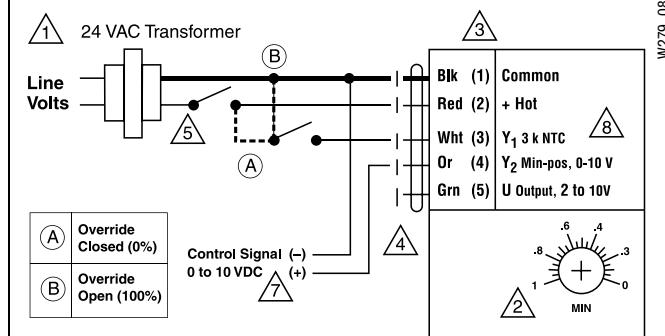
Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1.05" diameter. Actuator shall deliver a minimum output torque of 133 in-lbs. The actuator must provide proportional damper control in response to a 3 kΩ NTC thermistor, 55°F setpoint. Actuator must have a built-in minimum position potentiometer. Actuator must have minimum position override via 0 to 10 VDC on wire 4. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be independent of torque load. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications. The actuator must be designed so that they may be used for either clock-wise or counterclockwise fail safe operation. Actuators shall be cUL Approved, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

- 1** Provide overload protection and disconnect as required.
- 2** Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.
- 3** Actuators with plenum rated cable do not have numbers on wires; use color codes instead.
- 4** CW (default) indicates that motor drive starts at zero position.
- 5** A relay or switch can spring return the actuator when the RTU fan de-energizes, or if low ambient temperature is sensed.
- 6** A standard relay can be used to close the sensor circuit to engage economizer mode, e.g. outside air changeover device like a dry bulb or enthalpy limit switch.
- 7** A remote CO2 sensor or DDC controller with a 0 to 10 VDC output can change the standard relay can be used to open and close the sensor circuit. This device can be a relay or a dry bulb/enthalpy limit switch.
- 8** Override control for Y2 only accepts 0 to 10 VDC override control.

WARNING Live Electrical Components!

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**Standard Economizer Mode Wiring AF24-ECON-R03 US****Override for AF24-ECON-R03 US****Override control**

Wire	Input Signal	Position	Application
Y1	24 VAC	Drive closed (0%)	Morning warm-up cycle
Y1	Common	Drive open (100%)	Smoke Purge
Y1	Open wire	Drive to min position	Mechanical cooling in use, RTU thermostat calls for heat
Y2	0 VDC to 10 VDC	Min position of 0% to 100%	Override potentiometer via a remote CO2 sensor/controller or DDC controller



Technical Data	AF24... US
Power supply	24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	
running	6 W
holding	2.5 W
Transformer sizing	10 VA (class 2 power source)
Electrical connection	3 ft, 18 GA appliance cable 1/2" conduit connector
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y	0 to 20 V phasect control is only for the positive part of the sine wave (max of 10 volts)
Input impedance	8 kΩ (0.1 mA), 50 mΩ
Feedback output U	2 to 10 VDC (max. 0.5 mA) for 95°
Angle of rotation	mechanically limited to 95°
Torque	133 in-lb [15 Nm] constant
Direction of rotation	spring reversible with cw/ccw mounting motor reversible with built-in switch
Position indication	visual indicator, 0° to 95° (0° is spring return position)
Manual override	3mm hex crank (shipped w/actuator)
Running time	150 seconds constant, independent of load, spring return < 20 seconds
Humidity	5 to 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	NEMA type 2 / IP54
Housing material	zinc coated metal
Agency listings	cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level	max. 45 dB (A)
Servicing	maintenance free
Quality standard	ISO 9001
Weight	6.0 lbs (2.7 kg)

Torque min. 133 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 0-20 V phasect control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication or master-slave applications.

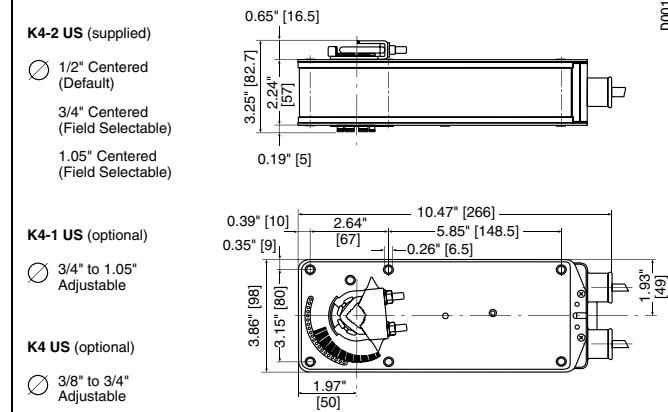
Operation

The AF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The AF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The AF has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. When power is applied to the AF series its "one time use" mechanism is released. The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position. The actuator will memorize the angle where it stops rotating and use this point for its zero position for its normal control operations. The manual override can also be released physically by the use of a crank supplied with the actuator.

The AF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact zero position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension
IND-AF2	Damper position indicator
K4 US	Universal clamp for 3/8" to 3/4" shafts
K4-1 US	Universal clamp for up to 1.05" dia jackshafts
K4-H	Universal clamp for hexshafts 3/8" to 5/8"
KH-AF	Crank arm for up to 3/4" round shaft (Series 2)
KH-AF-1	Crank arm for up to 1.05" jackshaft (Series 2)
KH-AFV	V-bolt kit for KH-AF and KH-AF-1
Tool-06	8mm and 10 mm wrench
SGA24	Min. and/or man. positioner in NEMA 4 housing
SGF24	Min. and/or man. positioner for flush panel mounting
ZG-R01	500 Ω resistor for 4 to 20 mA control signal
ZG-HTR	Thermostat/Heater Kit
ZDB-AF2 US	Angle of rotation limiter
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-102	Multiple actuator mounting bracket
ZG-106	Mounting bracket for Honeywell® Mod IV replacement or new crank arm type installations
ZG-107	Mounting bracket for Honeywell® Mod III or Johnson® Series 100 replacement or new crank arm type installations
ZG-108	Mounting bracket for Barber Colman® MA 3..4.., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AF US	Crank arm adaptor kit for AF/NF
ZG-AF108	Crank arm adaptor kit for AF/NF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using AF24-PC US actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 0 to 20 V phasect control output from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have control direction of rotation switch accessible on its cover. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagram**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

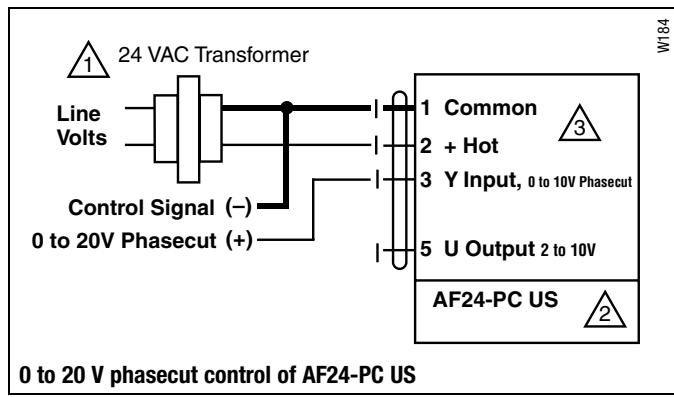
CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



0 to 20 V phasect control of AF24-PC US

Note: 0 to 20 V input range with a 0 to 10 V operating range. Controller output must be rescaled accordingly.

Installation Instructions

Quick-Mount Visual Instructions for Mechanical Installation

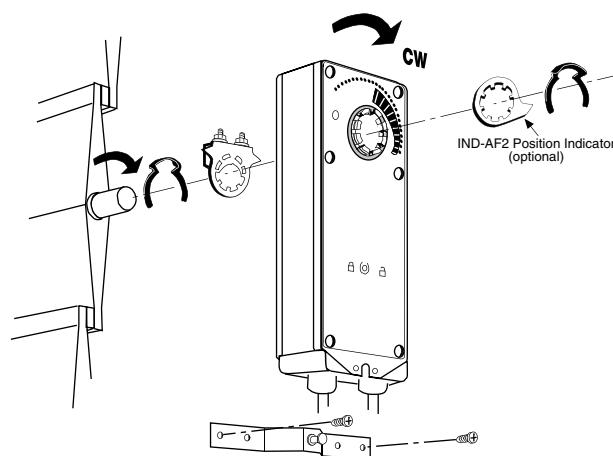
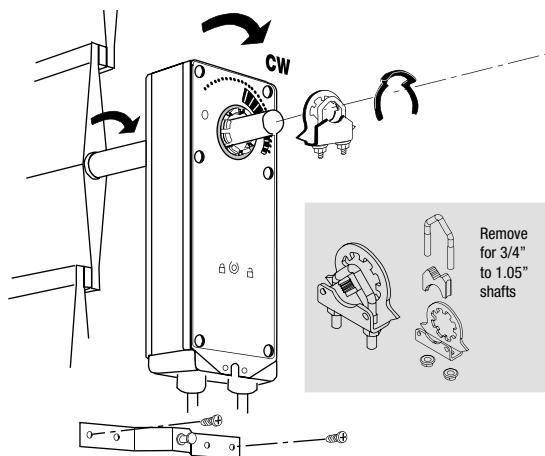
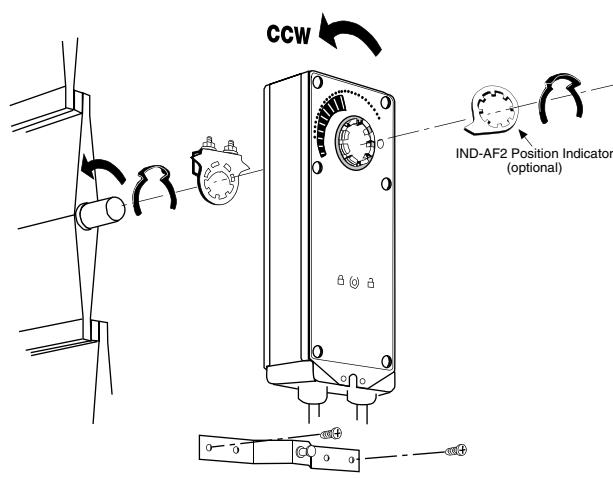
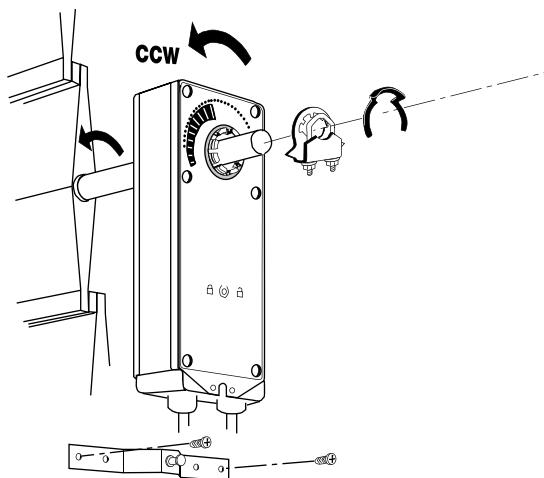
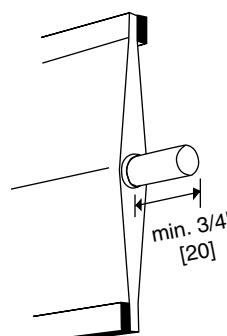
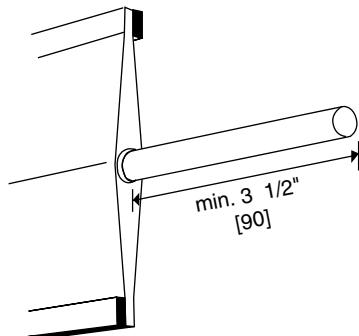
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Quick-Mount Visual Instructions

1. Rotate the damper to its fail-safe position.
If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out.
If it rotates clockwise, mount the actuator with the "CW" side out.
2. If the universal clamp is not on the correct side of the actuator, move it to the correct side.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

NOTE: Read the "Standard Mounting" instructions, on the next page, for more detailed information.

Dimensions (Inches [mm])

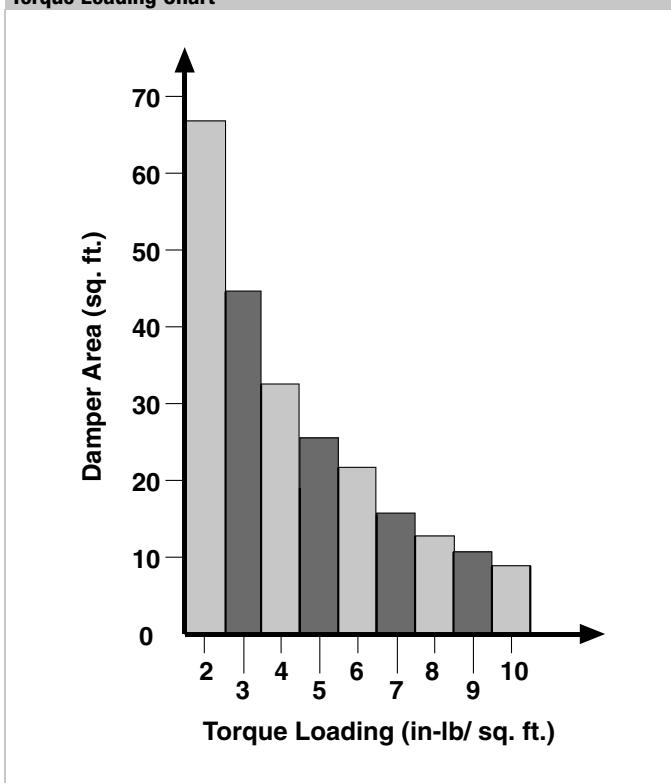


Determining Torque Loading and Actuator Sizing

Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications under 2 in. w.g. static pressure or 1000 FPM face velocity. For applications between this criteria and 3 in. w.g. or 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 4 in. w.g. or 3000 FPM, use a multiplier of 2.0.

Torque Loading Chart**General Information**

Belimo actuators should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator.

For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft. The damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3 1/2" or if an obstruction blocks access, the shaft can be extended with the AV 10-18 shaft extension accessory or the actuator may be mounted in its short shaft configuration.

Mechanical Operation

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The AF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The AF...-S versions are provided with 2 built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +5°, the other switch function is adjustable between +25 to +85°.

Automatic Airtight Dampers/Manual Override

The AF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The AF has a unique manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. A pre-tensioned spring automatically tightens damper when power is applied to the actuator, compensating for damper seal deterioration.

The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position.

Standard Mounting

NOTE: The AF...series actuator is shipped with the manual override adjusted for a +5° position at the universal clamp (not at full fail-safe, 0°). This allows for automatic compression of damper blade seals when the actuator is in use, providing tight shut-off. This assumes that the damper is to have tight shut-off at the fail-safe position. If tight close-off is desired at the opposite direction from fail-safe, the manual override should be released so the actuator can go to the full fail-safe position. See the manual override instructions.

- Manually move the damper to the fail-safe position (usually closed). If the shaft rotated counterclockwise (counter-clockwise), this is a CCW installation. If the shaft rotated clockwise (clockwise), this is a CW installation. In a CCW installation, the actuator side marked "CCW" faces out, while in a CW installation, the side marked "CW" faces out. All other steps are identical.
- The actuator is usually shipped with the universal clamp mounted to the "CCW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CCW" (or the "CW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
- If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out, position the clamp so that the pointer section of the tab is pointing to 0° (see **Figure C**) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.) If your application requires a mechanical minimum position, read the *Rotation Limiting, Mechanical Minimum Damper Position* section.
- Lock the clamp to the actuator using the retaining clip.
- Verify that the damper is still in its full fail-safe position.
- Slide the actuator over the shaft.
- Position the actuator in the desired location.
- Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
- Slip the stud of the anti rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.

Installation Instructions

Mechanical Installation

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Short Shaft Installation

If the shaft extends at least 3/4" from the duct, follow these steps:

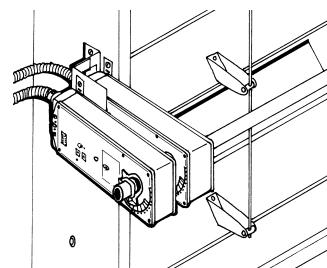
1. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
2. Engage the clamp to the actuator as close as possible to the determined location.
3. Lock the clamp in place using the remaining retainer clip.
4. Verify that the damper is still in its full fail-safe position.
5. Slide the actuator over the shaft.
6. Position the actuator in the desired location.
7. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
8. Slip the stud of the anti-rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.
9. If damper position indication is required, use the optional IND-AF2 pointer. See **Figure A**.

Jackshaft Installation

The AF... series actuator is designed for use with jackshafts up to 1.05" in diameter. In most applications, the AF actuator may be mounted in the same manner as a standard damper shaft application. If more torque is required than one AF actuator can provide, a second AF actuator may be mounted to the jackshaft using the ZG-102 multiple actuator mounting bracket. **See wiring guide for wiring details.**

AF ACTUATORS WHICH MAY BE USED ON ONE SHAFT

Model	Maximum Quantity Per Shaft
AF24(-S) US	4
AF120(-S) US	4
AF230(-S) US	4
AF24-SR US	4



MOUNTING: If the actuators are mounted on the opposed ends of the shaft, the actuator direction must be selected carefully. Usually, the direction of rotation is reversed.

Multiple Actuator Mounting

If more torque is required than one AF actuator can provide, a second AF actuator may be mounted to the shaft using the ZG-102 multiple mounting bracket.

NOTE: The manual positioning mechanism cannot be used in multiple actuator applications.

Special Wiring and Additional Information: See *wiring guide*

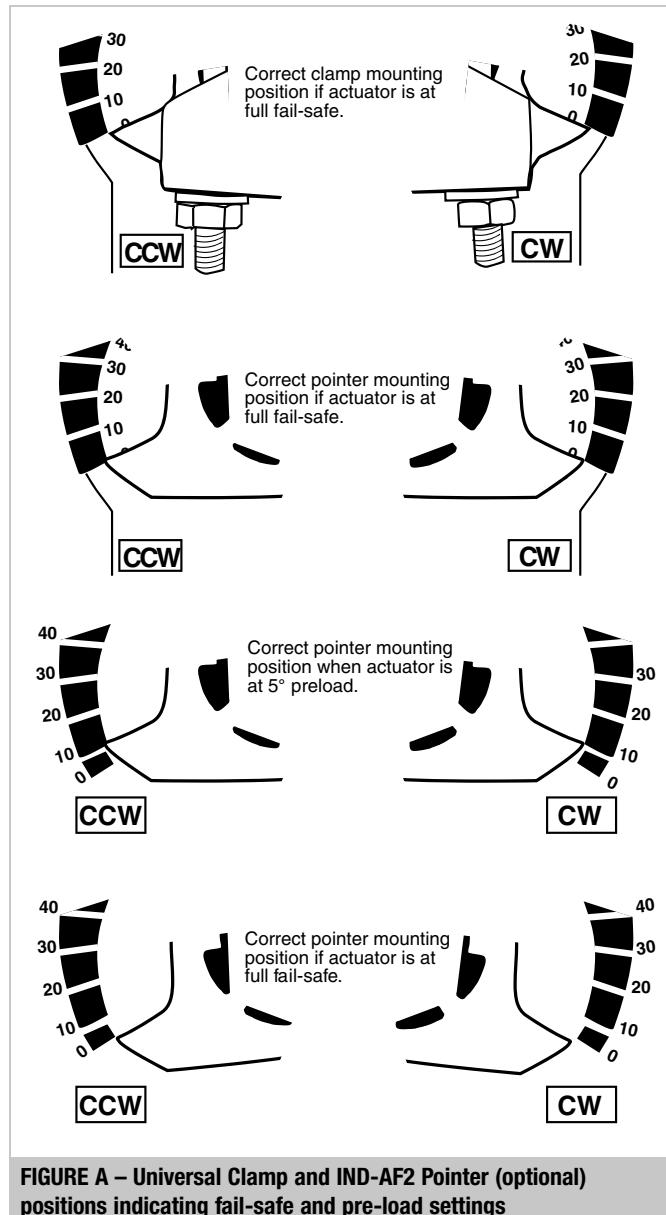


FIGURE A – Universal Clamp and IND-AF2 Pointer (optional) positions indicating fail-safe and pre-load settings

Rotation Limitation

The angle of rotation limiter, ZDB-AF2 US, is used in conjunction with the tab on the universal clamp or IND-AF2 position indicator which comes with the ZDB-AF2 US. In order to function properly, the clamp or indicator must be mounted correctly.

See **Figure A**.

The ZDB-AF2 US may not work in certain mounting orientations using the ZG-106 or ZG-107 mounting brackets. It will not work with the ZG-108 mounting bracket. Limiting the damper rotation must be accomplished by adjusting the crank arm linkage.

The ZDB-AF2 US may be used in 2 ways to control the rotational output of the AF series actuator. One use is in the application where a damper has a designed rotation less than 90°. An example would be a 45° or 60° rotating damper. The other application would be to set a minimum damper position which can be easily set or changed without having to remove the actuator from the damper.

Damper Rotation Limiting

1. Determine the amount of damper rotation required.
2. Locate the Angle of Rotation Limiter (ZDB-AF2 US) on the actuator so that its edge lines up with the degree graduation on the actuator face which corresponds with the required rotation. See **Figure C**.
3. Find the appropriate cross-hair location through the slot of the limiter. This is the screw mounting location.
4. Pierce through the label material to allow easy fastening of the retaining screw.
5. Position the limiter back to the desired position, making sure the locating "teeth" on the limiter are engaged into the locating holes on the actuator.
6. Fasten the limiter to the actuator using the self tapping screw provided.
7. Test the damper rotation either manually with the manual crank or apply power and if required, a control signal. Re-adjust if necessary.

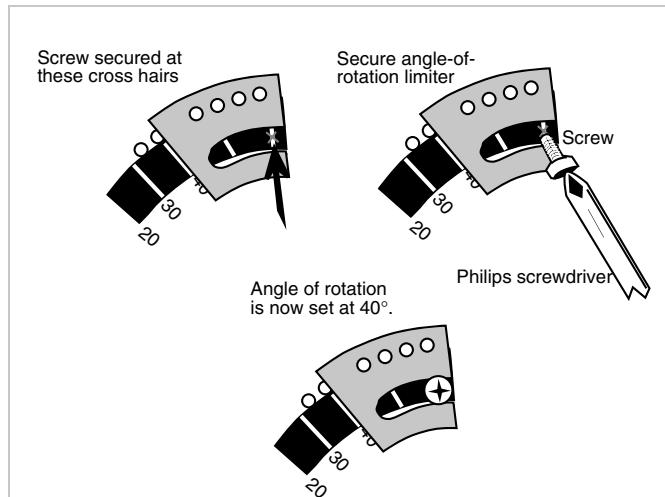


FIGURE C – ZDB-AF2 US, Securing the Angle of Rotation Limiter

Installation Instructions

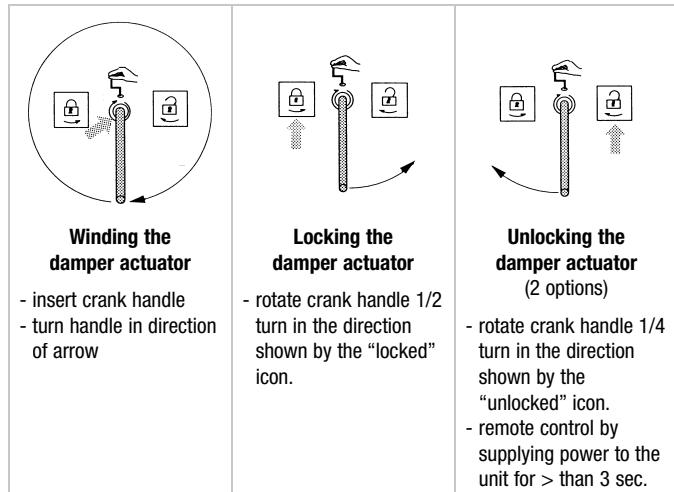
Mechanical Installation

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Manual Override

The AF series actuators can be manually positioned to ease installation or for emergency positioning.

1. The manual override will only work if no power is available to the actuator.
2. Insert the manual crank (shipped with the actuator) into the hexagon hole located on either side of the actuator. An illustration, located on the label, shows the location.
3. Turn the crank in the direction shown on the label (clockwise on the "CW" side, counterclockwise on the "CCW" side). It will take approximately 19 revolutions to rotate the full 95° of rotation.
4. To lock the actuator in the required position, rotate the crank quickly in the opposite direction, 1/2 of a revolution. The "lock closed" icon on the label shows the correct direction.
5. The manual override may be disengaged in 2 ways.
 - Rotate the crank about a 1/4 revolution in the same direction as the initial winding. The "lock open" icon shows the correct direction.
 - Apply power to wire 1 and 2. The actuator will automatically disengage the override function and will go to the "on" position in the case of the On/Off versions. Or, in the case of the proportional versions, go to the 0 signal position and then go to the position corresponding to the control signal. The actuator will now work normally.



Testing the Installation Without Power

The actuator/damper installation may be tested without power at the actuator. Refer to the manual positioning section of the instructions. Move the damper to its full non-fail-safe position using the manual crank. Disengage the manual position mechanism and have the damper go to full fail-safe position. Correct any mechanical problems and retest.

Auxiliary Switches

The AF series actuators may be ordered with 2 built-in SPDT auxiliary switches used for safety interfacing or signalling, for example, for fan start-up. The switch position near the fail-safe position is fixed at 5°. The other is adjustable between 25 and 85° of rotation. The crank, supplied with the actuator, or a 3mm allen wrench is used to adjust the switching position.

SWITCH RATING		Resistive Load	Inductive Load
Voltage		7A	5A
120 VAC		7A	2.5A
250 VAC		7A	2.5A

Two methods may be used to adjust the switching point of the adjustable switch.

Method 1 - See Figure F

1. The actuator must be in its fail-safe position.
2. Insert the crank into the hexagon shaped hole located in the center of the adjustable switch pointer.
3. Rotate the crank until the switch pointer is at the desired switch point in degrees as shown.

AF... Series

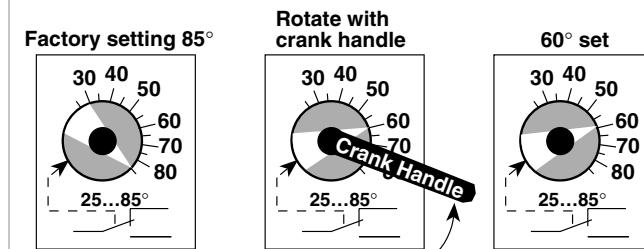


FIGURE F

Method 2 - See Figure G

1. Position the damper to the point at which you want the switch to activate. This may be done by using the manual override or by providing the appropriate proportional signal to AF24... modulating type actuator. The position of the switch pointer is not important during this step.
2. Insert the crank into the hexagon shaped hole located in the center of the adjustable switch pointer.
3. Rotate the switch pointer to just past the switch point indicating arrow as shown.

AF... Series

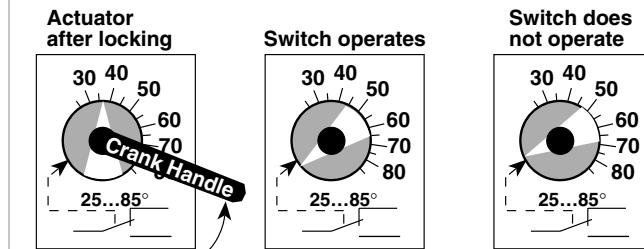
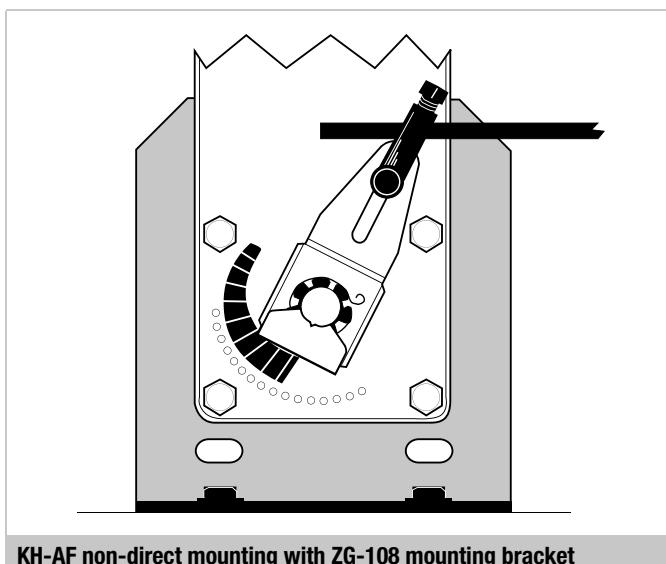
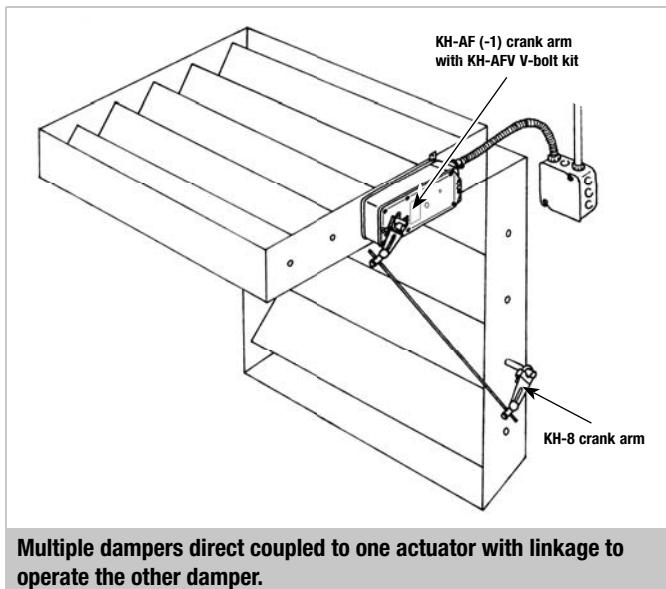


FIGURE G



KH-AF non-direct mounting with ZG-108 mounting bracket



Multiple dampers direct coupled to one actuator with linkage to operate the other damper.

KH-AF Crank arm Including Retaining Ring

CAUTION: The retaining clip supplied with the clamp is **not** used to mount the KH-AF crank arm.

The KH-AF (-1) crank arm is used in non-direct coupled mounting applications. The KH-AF (-1) may also be used to simultaneously direct couple to a damper shaft and provide an additional crank arm connection to a second damper. The KH-AFV V-bolt kit must be used for this non-direct application (see illustration this page).

TWO SIZES ARE AVAILABLE:

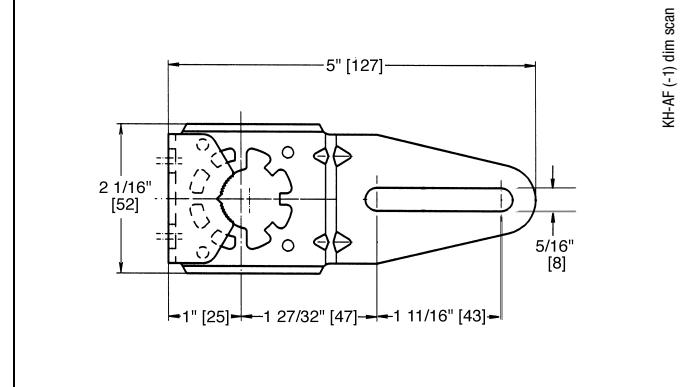
KH-AF For round shafts up to 3/4" or square shafts up to 5/8"

KH-AF-1 For jackshafts up to 1.05"

KH-AFV V-bolt kit for KH-AF(-1) crank arm

Note: KH-AF (-1) crank arms cannot be used on AF Series 1 actuators.

Dimensions (Inches [mm])



Installation Instructions

Electrical Operation

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General

The AF series actuators utilize brushless DC motor technology. The AF uses this motor in conjunction with an Application Specific Integrated Circuit (ASIC). In the On/Off versions of the AF, the ASIC monitors and controls the actuator's rotation and a digital rotation sensing function to prevent damage to the actuator. The AF24... modulating type actuators incorporate a built in microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and knows the actuator's exact zero position.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside of a rotating permanent magnet. The electromagnetic poles are switched by a special ASIC circuit developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Overload Protection

The AF series actuators are protected from overload at all angles of rotation. The ASIC circuit constantly monitors the rotation of the DC motor inside the actuator and stops the pulses to the motor when it senses a stall condition. The DC motor remains energized and produces full rated torque to the load. This helps ensure that dampers are fully closed and that edge and blade seals are always properly compressed.

Motor Position Detection

Belimo brushless DC motors eliminate the need for potentiometers for positioning in modulating type actuators. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

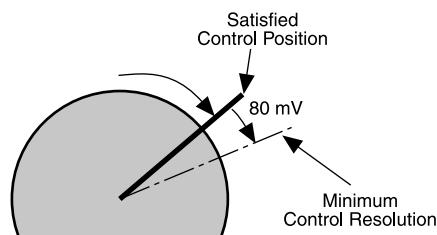
Control Accuracy and Stability

AF24-SR US actuators have built-in brushless DC motors which provide better accuracy and longer service life.

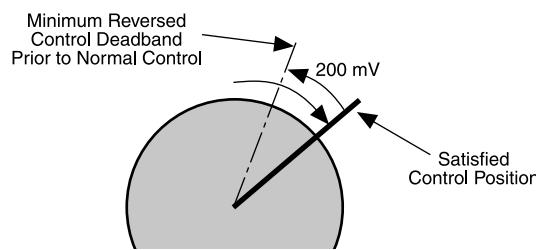
The AF24-SR US actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

AF Actuator responds to a 80 mV signal when not changing direction from stop.

(160 mV for AFA24-SR US)



AF Actuator responds to a 200 mV signal when reversing direction from stop position.



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The AF24 . . actuators require a 24 VAC class 2 transformer and draws a maximum of 10 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 2004/108/EC
- Software class A: Mode of operation type 1
- Low voltage directive: 2006/95/EC

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for AF... Actuators

Keep power wire runs below the lengths listed in the **Figure H**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example: 3 actuators, 16 Ga wire

$$350 \text{ Ft} \div 3 \text{ Actuators} = 117 \text{ Ft. Maximum wire run}$$

MAXIMUM WIRE LENGTH FOR 10VA

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	900 Ft.	18 Ga	220 Ft.
14 Ga	550 Ft.	20 Ga	120 Ft.
16 Ga	350 Ft.	22 Ga	60 Ft.

FIGURE H

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the AF24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The AF24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. **Do not** connect it to the actuator common.

Initialization of the AF24-SR US

When power is initially applied, the actuator will first release its manual preload position (This assumes a manual position has been set). The actuator will then rotate to the full fail-safe position. At this point the microprocessor recognizes that the actuator is at full fail-safe and uses this position as the base for all of its position calculations. The microprocessor will retain the initialized zero during short power failures of up to 20 seconds. For power failures greater than 20 seconds, the actuator would naturally return to its full fail-safe position prior to the microprocessor losing its memory. The actuator will also re-initialize if the manual position mechanism is used.

Startup and Checkout

Instructions For AF24-SR US



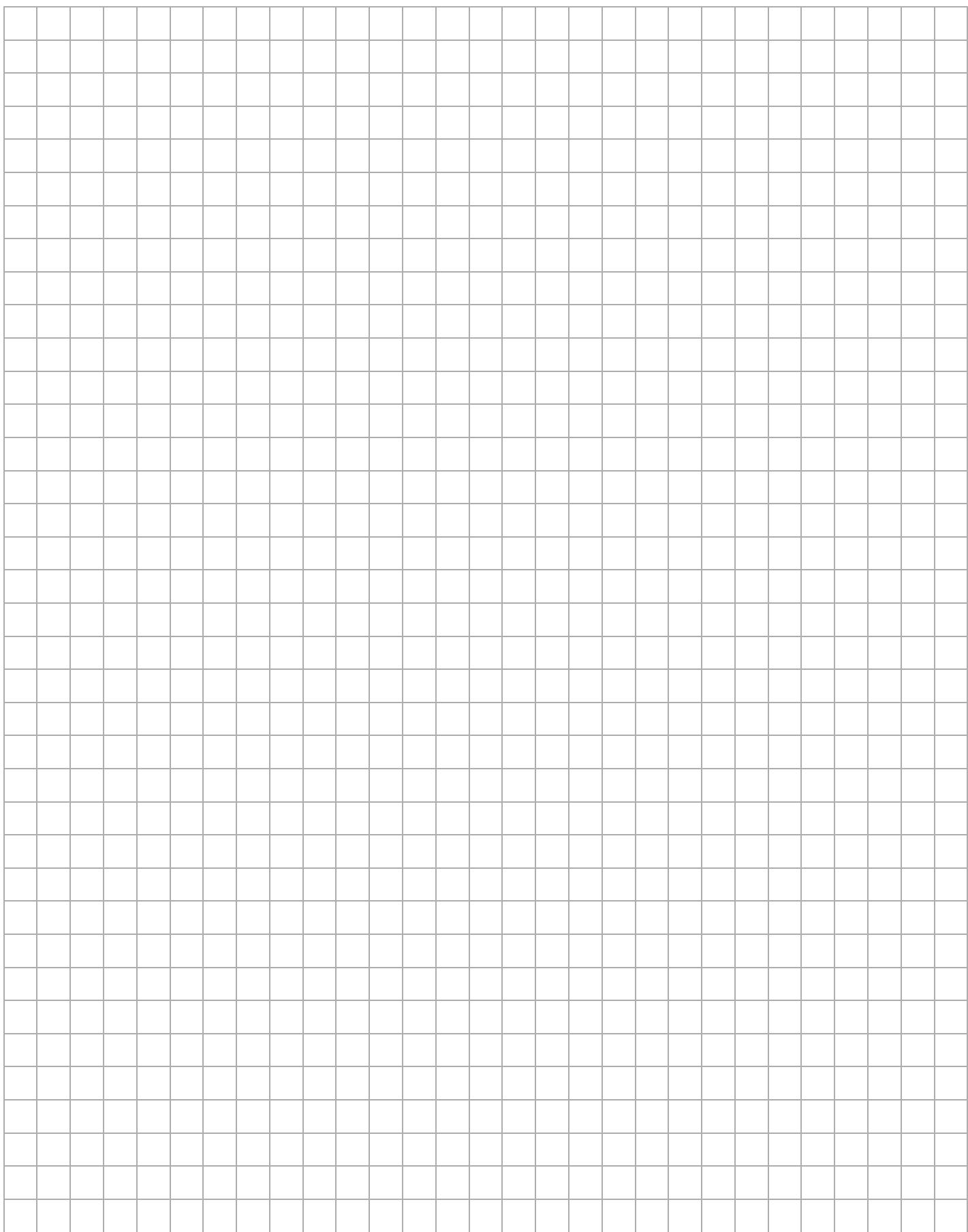
AF24-SR US Electrical Check-out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step...	Does Not Give Expected Response Go To Step...
1.	Control signal is applied to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4.
2.	Check power wiring. Correct any problems. See Note 1.	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive Step 1.	Power wiring corrected, actuator still does not drive Step 4.
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	Does not drive toward "Control Signal Position" Step 4.
4.	Make sure the control signal positive (+) is connected to Wire No. 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly Step 7.	Step 5.
5.	Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. For AF24-SR US this is 2 to 10 VDC or 4 to 20 mA. NOTE: The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicate.	Controller output (actuator input) is correct. Input Polarity Correct Step 6.	Reprogram, adjust repair or replace controller as needed Step 1.
7.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - See Note 2.	Recalculate actuator requirement and correct installation.
8.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

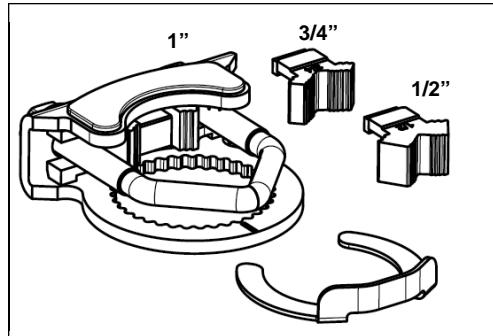
NOTE 2 If failure occurs within 5 years from original installation date, notify Belimo and give details of the application.



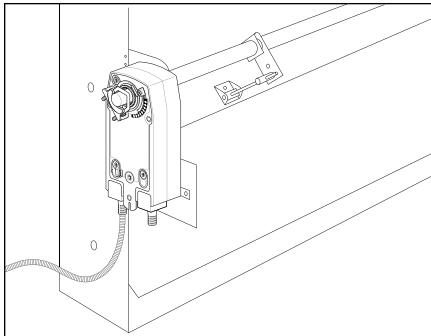
Minimum 90 in-lb Torque

- For damper areas up to 22 sq-ft*

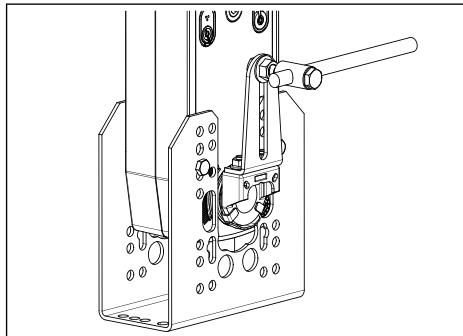
Applications



New standard clamp fits standard 1/2" shafts to 1.05" jackshafts.



Mount directly to 1.05" jackshafts.



Linkage solutions are available when direct coupling is not possible.



Actuators in bold have BDCM

NFB, NFX Series – At A Glance

Torque:	90 in-lb	NFB24, NFX24 (p. 105)	NFB24 N4(H), NFX24 N4 (p. 107)	NFB24-S, NFX24-S (p. 105)	NFB24-S N4(H), NFX24-S N4 (p. 107)	NFBUP, NFXUP (p. 109)	NFBUP N4(H), NFXUP N4 (p. 111)	NFBUP-S, NFXUP-S (p. 109)	NFBUP-S N4(H), NFXUP-S N4 (p. 111)	NFB24-SR, NFX24-SR (p. 113)	NFB24-SR N4(H), NFX24-SR N4 (p. 115)	NFB24-SR-S, NFX24-SR-S (p. 113)	NFB24-SR-S N4(H), NFX24-SR-S N4 (p. 115)	NFB24-MFT, NFX24-MFT (p. 117)	NFB24-MFT N4(H), NFX24-MFT N4 (p. 119)	NFB24-MFT-S, NFX24-MFT-S (p. 117)	NFB24-MFT-S N4(H), NFX24-MFT-S N4 (p. 119)
Power supply:	24 VAC/DC	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	120 VAC																
	230 VAC																
Control signal:	On/Off	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Proportional 2 to 10 VDC																
	Multi-function**																
Feedback signal:	2 to 10 VDC									●	●	●	●	●	●	●	
	VDC variable**																
Running time motor:	<75 seconds	●	●	●	●	●	●	●	●								
	95 seconds constant									●	●	●	●	●	●	●	
	Adj. 40 to 220 seconds***																
	spring: <20 seconds	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Brushless DC Motor																	
External direction of rotation switch																	
Manual override	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Appliance rated cable, 18 GA (default)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Plenum rated cable, 18 GA (optional)	●																
Built-in auxiliary switch, Two SPDT			●	●			●	●		●	●	●	●	●	●	●	
NEMA 4 rated housing		●		●		●		●		●	●	●	●	●	●	●	
Installation instructions.....(p. 121-127)																	
General wiring.....(p. 129)																	
Start-up and checkout.....(p. 130)																	
Electrical operations.....(p. 128)																	

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals. **Default 2 to 10 VDC. ***Default 150 seconds.

A CLOSER LOOK...

- Cut labor costs with simple direct coupling.
- True mechanical spring return – the most reliable fail-safe.
- Mount for clockwise or counterclockwise fail-safe.
- Check damper position easily with clear position indicator.
- Don't worry about actuator burn-out.
Belimo is overload-proof throughout rotation.
- Built-in mechanical stop to adjust angle of rotation.
- Manual override crank speeds installation
- Need to change control direction?
Do it easily with a simple switch (modulating actuators).
- Incorporated breather membrane optimizes performance in harsh airstream environments.
- Built-in auxiliary switches are easy to use, offers feedback or signal for additional device (-S models).
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged metal on plastic housing withstands rough handling in the mechanical room.
- Standard 3 ft. appliance rated cable and conduit connector eases installation.
- Added flexibility to select clamp, electrical connection, and running time to fit your specific application with Belimo's customized line of actuators (NFX).



ISO
9001

5
YEAR
WARRANTY

The Belimo Difference

- *Customer Commitment.*
Extensive product range. Application assistance.
Same-day shipments. Free technical support. Five year warranty.
- *Low Installation and Life-Cycle Cost.*
Easy installation. Accuracy and repeatability.
Low power consumption. No maintenance.
- *Long Service Life.*
Components tested before assembly. Every product tested before shipment.
30+ years direct coupled actuator design.



LISTED
94 D5
TEMP. IND. & C
REG. EQUIP. UL us





Technical Data		NFB24, NFB24-S, NFX24, NFX24-S
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	6 W
	holding	2.5 W
Transformer sizing		8.5 VA (class 2 power source)
Electrical connection	NFB24...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	NFX24...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 seconds
	spring	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		zinc coated metal and plastic casing
Agency listings †		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.15 lbs (1.9 kg); 4.4 lbs (2.0 kg) with switches
† Rated Impulse Voltage 800V, Type of action 1-AA (1-AA.B for -S version), Control Pollution Degree 3.		
NFB24-S, NFX24-S		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°	

- Torque min. 90 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

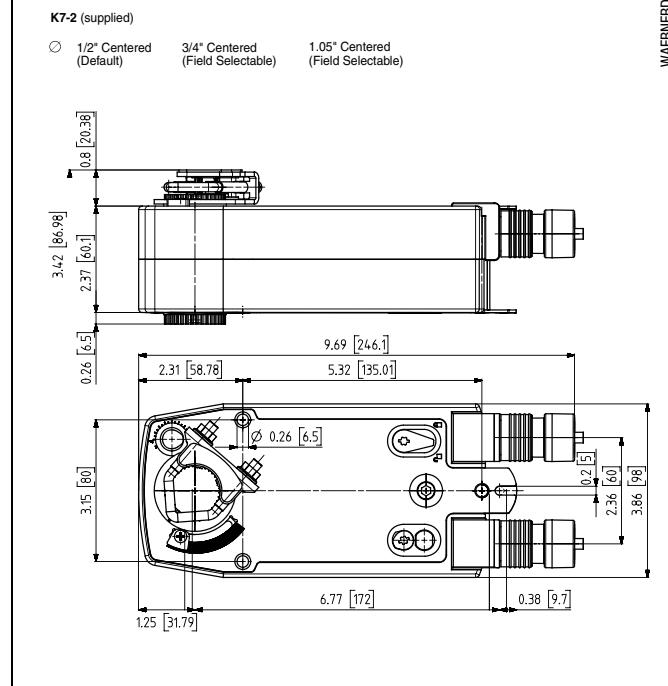
The NFB and NFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The NFB and NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-S and NFX24-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The NFB24, NFB24-S, NFX24 and NFX24-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Dimensions (Inches [mm])



Accessories

AV-825	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3./4., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

Note: When using NFB24, NFB24-S, NFX24, NFX24-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

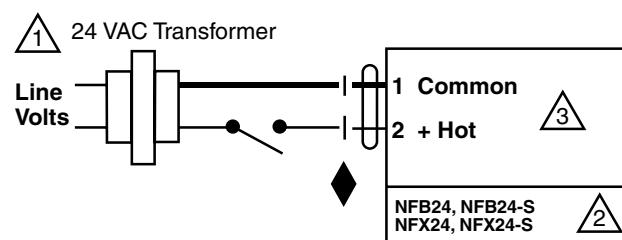
4 For end position indication, interlock control, fan startup, etc., NFB24-S and NFX24-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

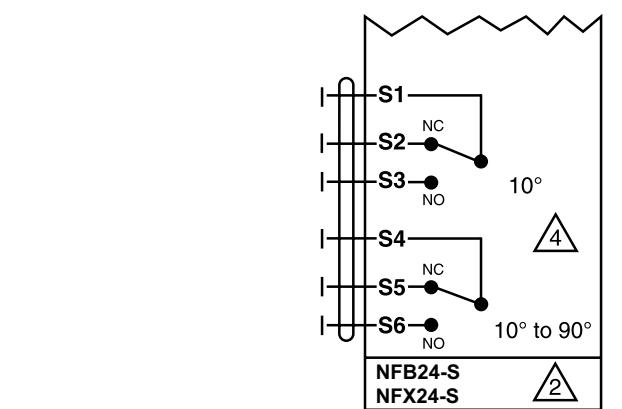
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for NFB24, NFX24



Auxiliary Switches for NFB24-S, NFX24-S



Technical Data		NFB24 N4(H), NFB24-S N4(H), NFX24 N4, NFX24-S N4
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	6 W / heater 25 W
	holding	2.5 W
Transformer sizing		8.5 VA (class 2 power source) / heater 25 VA
Electrical connection	NFB... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 26-16 GA
NFX... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting inside housing
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 seconds
	spring	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
	spring (with heater)	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -49°F [-45°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (5/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Agency listings †		cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.25 lbs (4.2 kg); 9.5 lbs (4.3 kg) with switches 10 lbs (4.5 kg) with heater

† Rated Impulse Voltage 800V, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.

NFB24-S N4(H), NFX24-S N4

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°
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- Torque min. 90 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The NFB N4(H), NFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

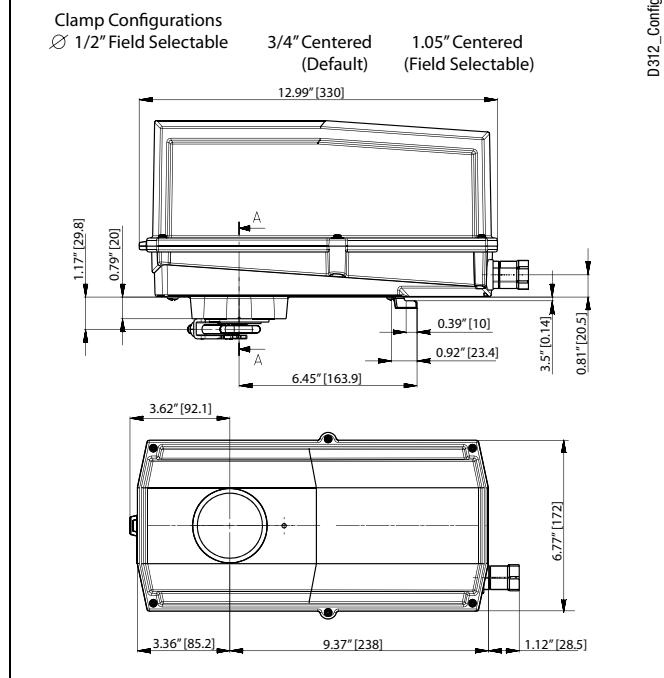
The NFB N4(H), NFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-S N4(H), NFX24-S N4 version are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using NFB24 N4(H), NFB24-S N4(H), NFX24 N4, NFX24-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

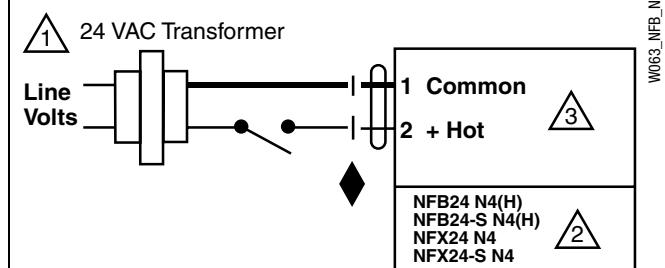
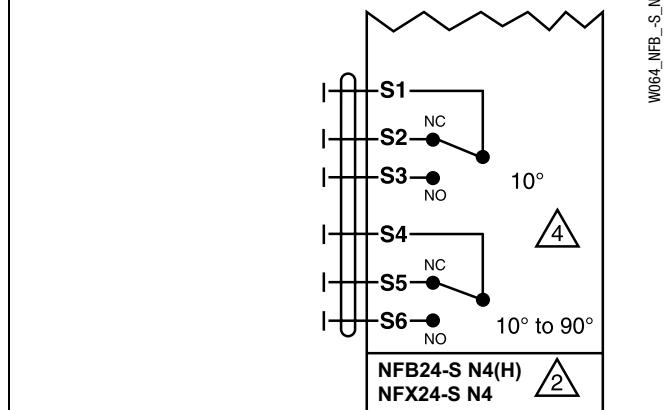
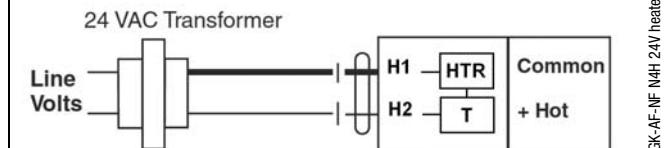
4 For end position indication, interlock control, fan startup, etc., NFB24-S N4(H), NFX24-S N4 incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

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**On/Off Wiring****Auxiliary Switches****NEMA 4 Heater**

NFBUP, NFBUP-S, NFXUP, NFXUP-S

On/Off, Spring Return, 24 to 240 VAC



Technical Data		NFBUP, NFBUP-S, NFXUP, NFXUP-S
Power supply		24...240 VAC -20% / +10%, 50/60 Hz 24...125 VDC ±10%
Power consumption	running	6 W
	holding	2.5 W
Transformer sizing		6 VA @ 24 VAC (class 2 power source) 6.5 VA @ 120 VAC 9.5 VA @ 240 VAC
Electrical connection	NFBUP...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	NFXUP...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 seconds
	spring	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (1/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		zinc coated metal and plastic casing
Agency listings †		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.15 lbs (1.9 kg), 4.4 lbs (2.0 kg) with switches
† Rated Impulse Voltage 4kV, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.		
NFBUP-S, NFXUP-S		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°	

Torque min. 90 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

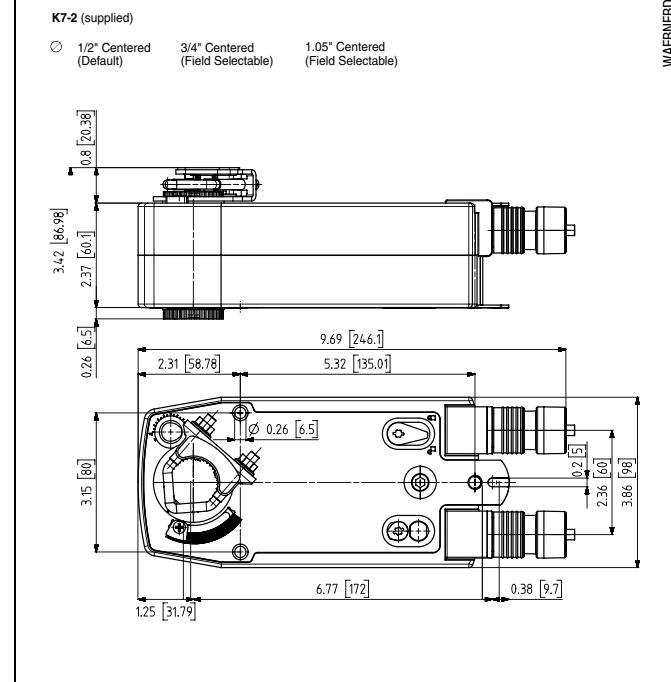
The NFB and NFX series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The NFB and NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFBUP-S and NFXUP-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The NFBUP, NFBUP-S, NFXUP and NFXUP-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Dimensions (Inches [mm])



Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
K7-2	Universal clamp for up to 1.05" dia jackshafts
KH-AFB	Crank arm
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3./4., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

Note: When using NFBUP, NFBUP-S, NFXUP, NFXUP-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 No ground connection is required.

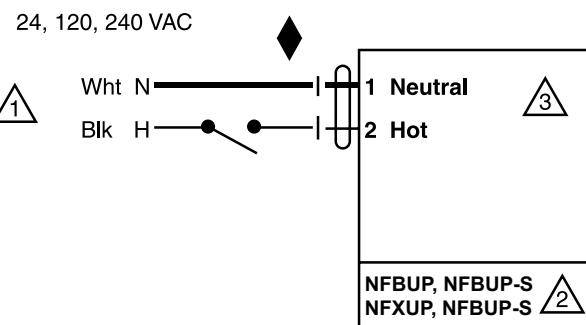
4 For end position indication, interlock control, fan startup, etc., NFBUP-S and NFXUP-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.05A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

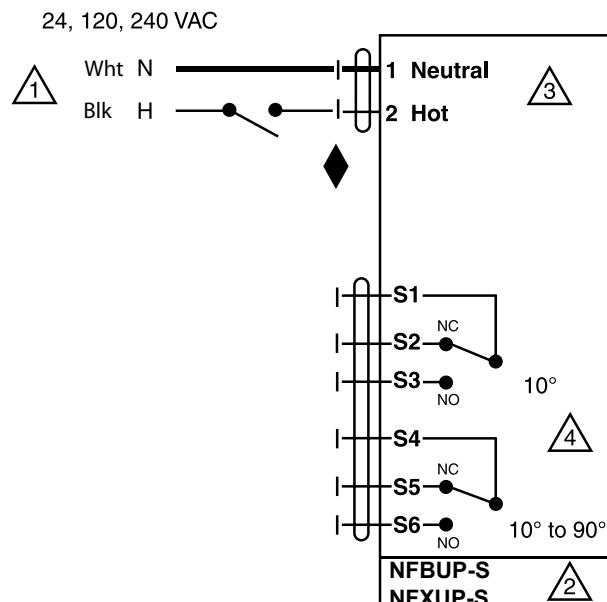
◆ Meets cULus requirements without the need of an electrical ground connection.

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On/Off wiring for NFBUP, NFXUP



Auxiliary Switches for NFBUP-S, NFXUP-S

NFBUP N4(H), NFBUP-S N4(H), NFXUP N4, NFXUP-S N4

NEMA 4, On/Off, Spring Return, 24 to 240 VAC



Technical Data		NFBUP N4(H), NFBUP-S N4(H), NFXUP N4, NFXUP-S N4
Power supply		24...240 VAC -20% / +10%, 50/60 Hz 24...125 VDC ±10%
Power consumption	running	6 W / heater 25 W
	holding	2.5 W
Transformer sizing		6 VA @ 24 VAC (class 2 power source) 6.5 VA @ 120 VAC / heater 25 VA @ 120 VAC 9.5 VA @ 240 VAC
Electrical connection	NFBUP... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: Two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 18-16 GA
NFXUP... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance cable, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Control		on/off
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting inside housing
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	< 75 seconds
	spring	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
	spring (with heater)	20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -49°F [-45°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (9/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Agency listings †		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		<50dB(A) motor @ 75 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.25 lbs (4.2 kg), 9.5 lbs (4.3 kg) with switches 10 lbs (4.5 kg) with heater
† Rated Impulse Voltage 4kV, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.		
NFBUP-S N4(H), NFXUP-S N4		
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°	

Torque min. 90 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The NFB N4(H), NFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

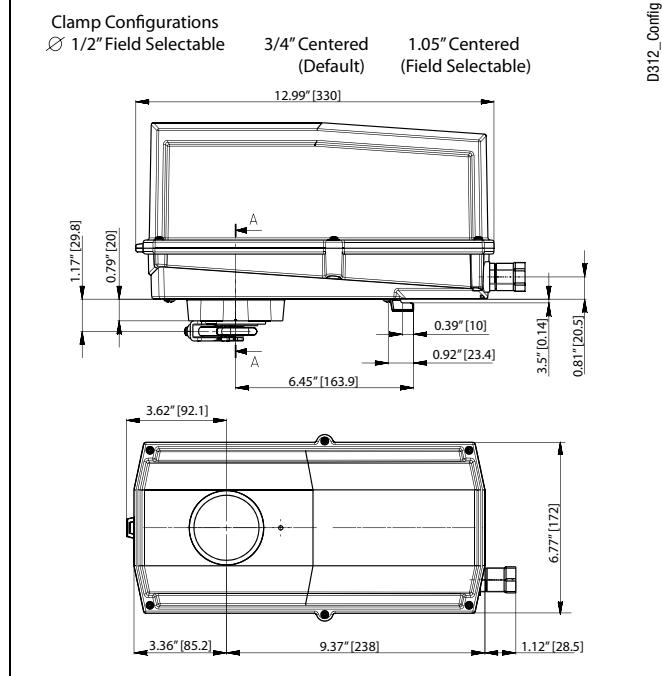
The NFB N4(H), NFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFBUP-S N4(H), NFXUP-S N4 version are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using NFBUP N4(H), NFBUP-S N4(H), NFXUP N4, NFXUP-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, two SPDT auxiliary switch shall be provided having the capability of one being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

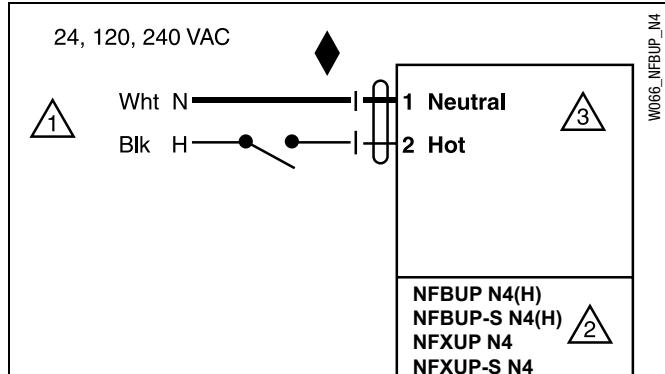
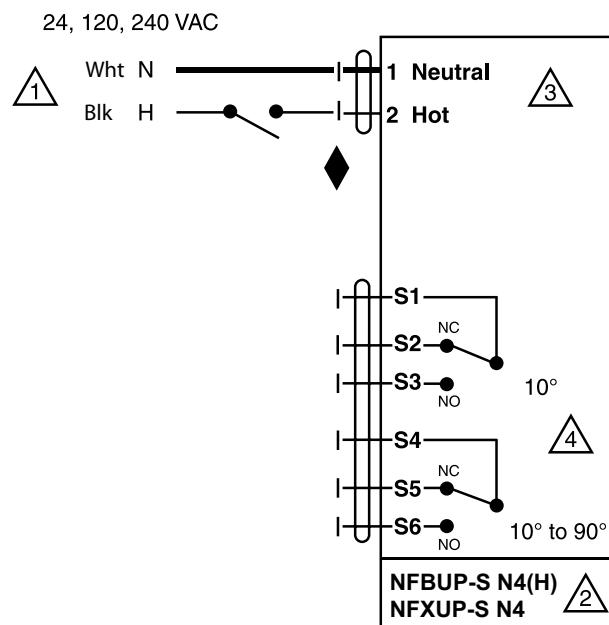
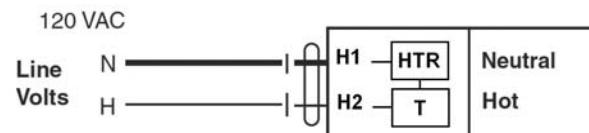
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3 No ground connection is required.
- 4 For end position indication, interlock control, fan startup, etc., NFBUP-S N4(H), NFXUP-S N4 incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.

APPLICATION NOTES

- Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**On/Off Wiring****Auxiliary Switches****NEMA 4 Heater**

NFB24-SR, NFB24-SR-S, NFX24-SR, NFX24-SR-S

Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data		NFB24-SR, NFB24-SR-S, NFX24-SR, NFX24-SR-S
Power supply		24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	3.5 W
	holding	2.5 W
Transformer sizing		6 VA (class 2 power source)
Electrical connection	NFB...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	NFX...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables, with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U		2 to 10 VDC (max. 0.5 mA)
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting
	motor	reversible with built-in switch
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring	< 20 seconds @ -4°F to 122°F [-20°C to 50°C];
	motor	< 60 seconds @ -22°F [-30°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		Nema 2, IP54, Enclosure Type2
Housing material		zinc coated metal and plastic casing
Agency listings†		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤40dB(A) motor @ 95 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		4.15 lbs (1.9 kg); 4.4 lbs (2.0 kg) with switches

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

NFB24-SR-S, NFX24-SR-S

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°
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Torque min. 90 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

Operation

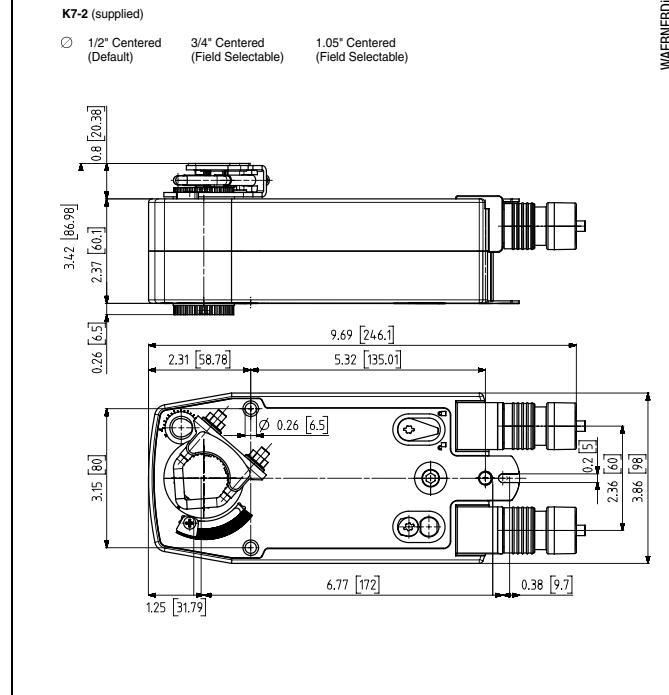
The NFB and NFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The NFB and NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The NFB24-SR and NFX24-SR uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-SR-S and NFX24-SR-S versions are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°. The NFB24-SR, NFB24-SR-S, NFX24-SR and NFX24-SR-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

Dimensions (Inches [mm])



Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3./4., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using NFB24-SR, NFB24-SR-S, NFX24-SR and NFX24-SR-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

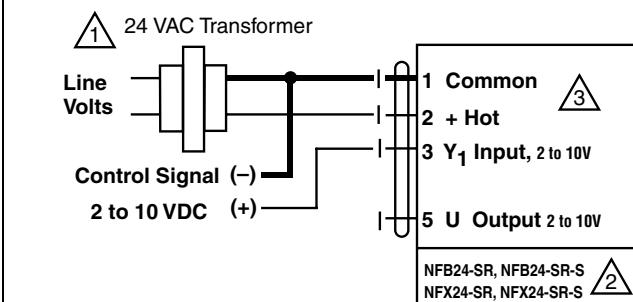
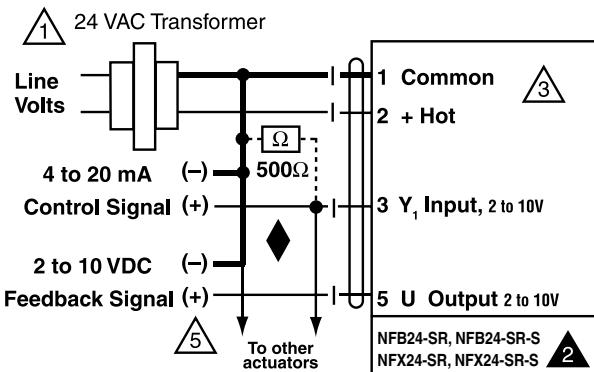
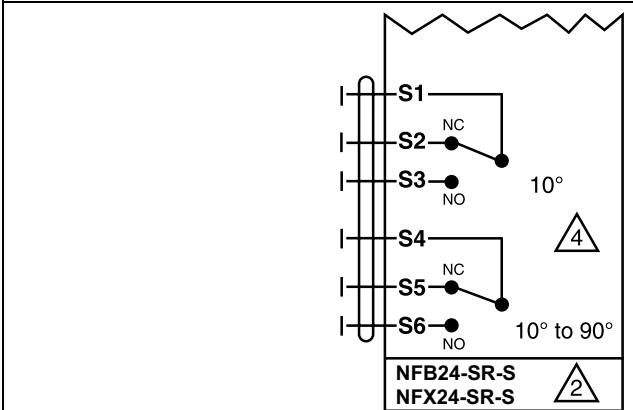
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3 Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor. Power consumption must be observed.
- 4 Actuator may also be powered by 24 VDC.
- 5 For end position indication, interlock control, fan startup, etc., NFB24-SR-S and NFX24-SR-S incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.
- 6 Only connect common to neg. (-) leg of control circuits

APPLICATION NOTES

- ◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

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**2 to 10 VDC control of NFB24-SR and NFX24-SR****4 to 20 mA control of NFB24-SR and NFX24-SR with 2 to 10 VDC feedback output****Auxiliary switches for NFB24-SR-S, NFX24-SR-S**

NFB24-SR N4(H), NFB24-SR-S N4(H), NFX24-SR N4, NFX24-SR-S N4

NEMA 4, Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



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Technical Data		NFB24-SR N4(H), NFB24-SR-S N4(H), NFX24-SR N4, NFX24-SR-S N4
Power supply		24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption	running	3.5 W / heater 25 W
	holding	2.5 W
Transformer sizing		6 VA (class 2 power source) / heater 25 VA
Electrical connection	NFB... N4	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	heater (N4H)	terminal block, 26-16 GA
NFX... N4		3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA
Feedback output U		2 to 10 VDC (max. 0.5 mA)
Torque		90 in-lb [10 Nm] minimum
Direction of rotation	spring	reversible with CW/CCW mounting inside housing
	motor	reversible with built-in switch
Mechanical angle of rotation		95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor	95 seconds
	spring	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -22°F [-30°C]
	spring (with heater)	< 20 seconds @ -4°F to 122°F [-20°C to 50°C]; < 60 seconds @ -49°F [-45°C]
Position indication		visual indicator, 0° to 95° (0° is full spring return position)
Manual override		5 mm hex crank (3/16" Allen), supplied
Humidity		max. 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
	with heater	-49°F to 122°F [-45°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		UL Type 4, NEMA 4, IP66
Housing material		polycarbonate
Agency listings†		CULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level		≤40dB(A) motor @ 95 seconds ≤62dB(A) spring return
Servicing		maintenance free
Quality standard		ISO 9001
Weight		9.25 lbs (4.2 kg); 9.5 lbs (4.3 kg) with switches 10 lbs (4.5 kg) with heater
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 4.		
NFB24-SR-S N4(H), NFB24-SR-S N4		
Auxiliary switches		2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°

Torque min. 90 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication. Not to be used for a master-slave application.

Operation

The NFB N4(H), NFX N4 series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

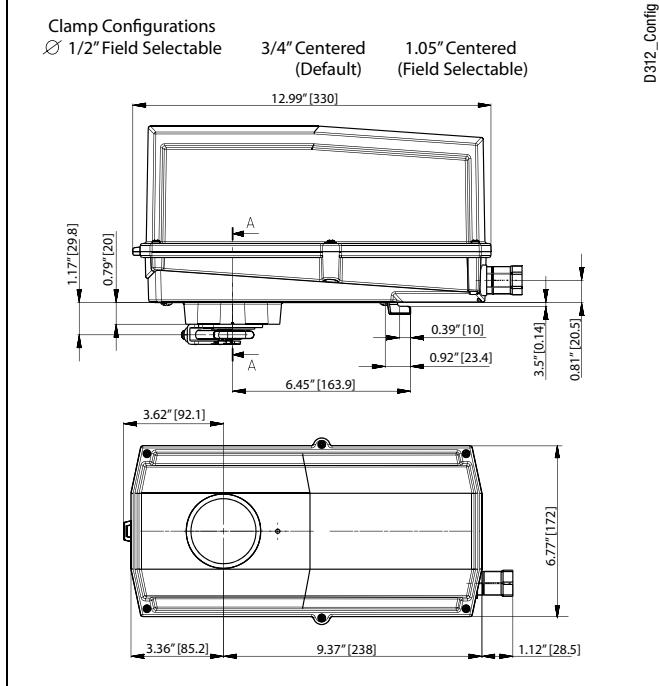
The NFB N4(H), NFX N4 series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The NFB24-SR N4(H), NFX24-SR N4 uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-SR-S N4(H), NFX24-SR-S N4 version are provided with two built-in auxiliary switches. These SPDT switches provide safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using NFB24-SR N4(H), NFB24-SR-S N4(H), NFX24-SR N4, NFX24-SR-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

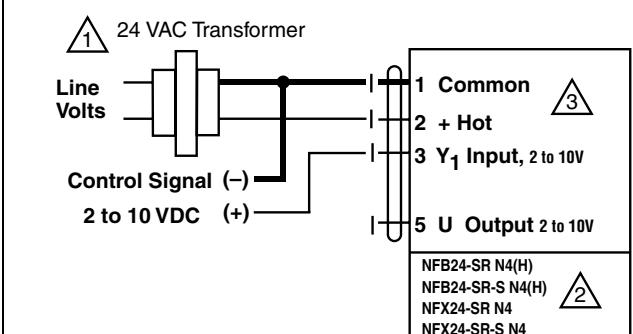
- 1** Provide overload protection and disconnect as required.
- 2** **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3** Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor. Power consumption must be observed.
- 4** Actuator may also be powered by 24 VDC.
- 5** For end position indication, interlock control, fan startup, etc., NFB24-SR-S N4(H), NFX24-SR-S N4 incorporates two built-in auxiliary switches: 2 x SPDT, 3A (0.5A) @250 VAC, UL Approved, one switch is fixed at +10°, one is adjustable 10° to 90°.
- 6** Only connect common to neg. (-) leg of control circuits

APPLICATION NOTES

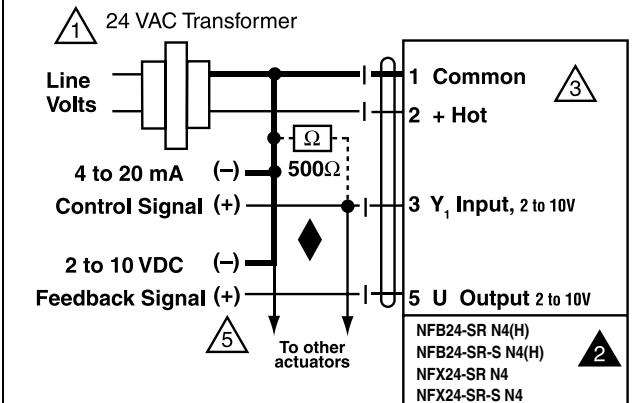
- The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

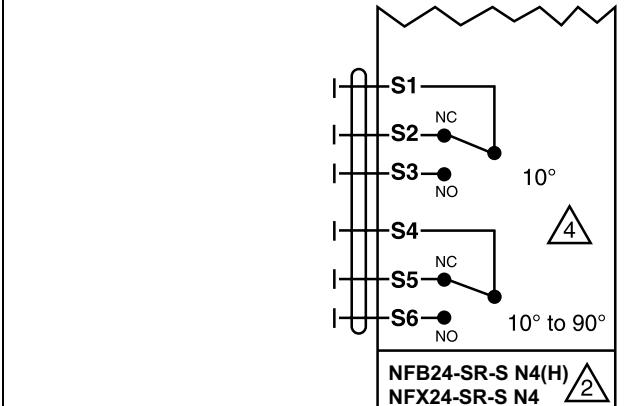
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



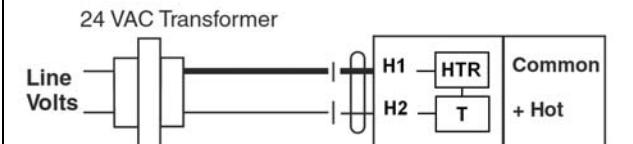
W068_NFB24-SR_N4

2 to 10 VDC control

W069_NFB24-SR_N4

4 to 20 mA control with 2 to 10 VDC feedback output

W064_NFB24_SR_S_N4

Auxiliary switches

GK-AF-NF N4H 24V heater

NEMA 4 Heater

NFB24-MFT, NFB24-MFT-S, NFX24-MFT, NFX24-MFT-S

Proportional, Spring Return, Multi-Function Technology®



MFT



Technical Data

**NFB24-MFT, NFB24-MFT-S,
NFX24-MFT, NFX24-MFT-S**

Power supply	24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption ◆	running 6.5 W holding 3 W
Transformer sizing ◆	9 VA (class 2 power source)
Electrical connection	NFB... 3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
NFX...	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: Two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y*	2 to 10 VDC, 4 to 20mA (default) variable (VDC, PWM, floating point, on/off)
Input impedance	100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point, on/off
Feedback output U*	2 to 10 VDC (max. 0.5 mA)
Torque	90 in-lb [10 Nm] minimum
Direction of rotation*	spring motor reversible with CW/CCW mounting reversible with built-in switch
Mechanical angle of rotation*	95° (adjustable with mechanical end stop, 35° to 95°)
Running time	spring < 20 sec @ -4°F to 122°F [-20°C to 50°C]; motor* < 60 sec @ -22°F [-30°C] 150 seconds (default), variable (40 to 220 secs)
Angle of Rotation Adaptation*	off (Default)
Override control*	min position = 0% mid. position = 50% max. position = 100%
Position indication	visual indicator, 0° to 95° (0° is full spring return position)
Manual override	5 mm hex crank (3/16" Allen), supplied
Humidity	max. 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	Nema 2, IP54, Enclosure Type2
Housing material	zinc coated metal and plastic casing
Agency listing†	cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level	≤40dB(A) motor @ 150 seconds, run time dependent ≤62dB(A) spring return
Servicing	maintenance free
Quality standard	ISO 9001
Weight	4.2 lbs (1.9 kg), 4.4 lbs (2.0 kg) with switches
*Variable when configured with MFT options.	
† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.	
◆ Programmed for 40 sec motor run time. At 150 sec motor run time, transformer sizing is 6.5 VA and power consumption is 4.5 W running / 3 W holding.	
NFB24-MFT-S, NFX24-MFT-S	
Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°

- Torque min. 90 in-lb
- Control 2 to 10 VDC (DEFAULT)
- Feedback 2 to 10 VDC (DEFAULT)

Application

For proportional modulation of dampers and control valves in HVAC systems. The NFB24-MFT and NFX24-MFT provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 2 to 10 VDC applications of the NFB24-MFT and NFX24-MFT actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool (version 3.4 or higher) software application.
- Handheld ZTH-GEN

Operation

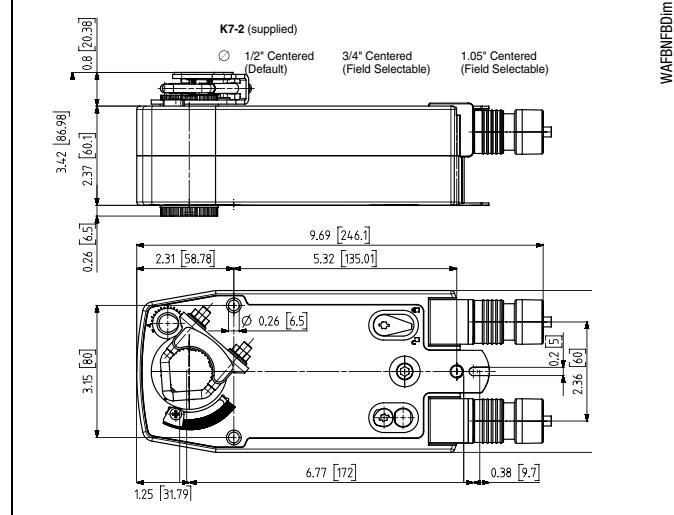
The NFB24-MFT, NFX24-MFT actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the damper or valves mechanical stop and use this point for its zero position during normal control operations.

The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated with out the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-MFT, NFB24-MFT-S, NFX24-MFT and NFX24-MFT-S is mounted directly to control shafts up to 1.05" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption. The NFB24-MFT, NFB24-MFT-S, NFX24-MFT and NFX24-MFT-S actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off.

NOTE: Refer to Multi-Function Technology documentation.

Dimensions (Inches [mm])



WAFBNFB01m

Accessories

AV 8-25	Shaft extension
IND-AFB	Damper position indicator
KH-AFB	Crank arm
K7-2	Universal clamp for up to 1.05" dia jackshafts
TF-CC US	Conduit fitting
Tool-06	8mm and 10 mm wrench
ZG-100	Universal mounting bracket
ZG-101	Universal mounting bracket
ZG-118	Mounting bracket for Barber Colman® MA 3.../4..., Honeywell® Mod III or IV or Johnson® Series 100 replacement or new crank arm type installations
ZG-AFB	Crank arm adaptor kit
ZG-AFB118	Crank arm adaptor kit
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing
ZS-300	NEMA 4X housing

NOTE: When using NFB24-MFT, NFB24-MFT-S, NFX24-MFT and NFX24-MFT-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

4 Position feedback cannot be used with Triac sink controller.

The actuator internal common reference is not compatible.

5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.

Contact closures A & B also can be triacs.

8 A & B should both be closed for triac source and open for triac sink.

For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

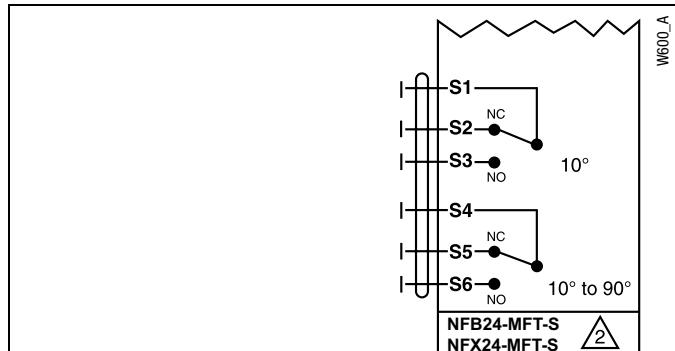
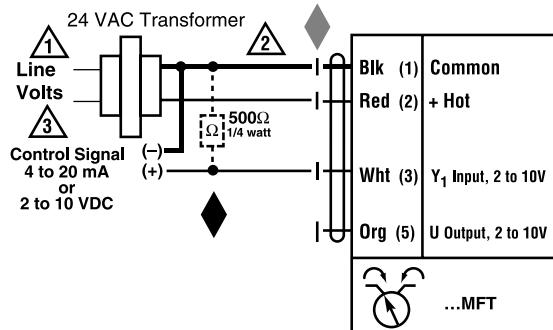
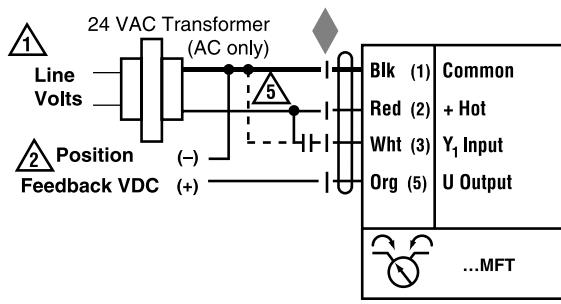
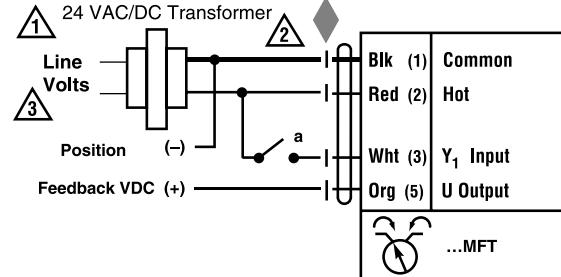
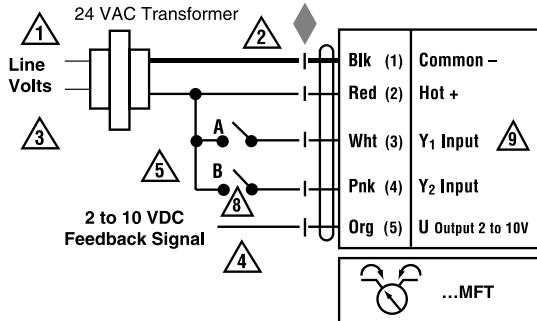
APPLICATION NOTES

Meets UL requirements without the need of an electrical ground connection.

The ZG-R01 500 Ω resistor may be used.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**Auxiliary Switches for NFB24-MFT-S, NFX24-MFT-S****VDC/4-20 mA****PWM****On/Off control****Floating Point control**

NFB24-MFT N4(H), NFB24-MFT-S N4(H), NFX24-MFT N4, NFX24-MFT-S N4

NEMA 4, Proportional, Spring Return, Multi-Function Technology®



MFT



Technical Data

**NFB24-MFT N4(H), NFB24-MFT-S N4(H),
NFX24-MFT N4, NFX24-MFT-S N4**

Power supply	24 VAC ±20%, 50/60 Hz 24 VDC +20% / -10%
Power consumption	running 6.5 W / heater 25 W holding 3 W
Transformer sizing	9 VA (class 2 power source) / heater 25 VA
Electrical connection	NFB... N4 3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors heater (N4H) terminal block, 26-16 GA
NFX... N4	3 ft [1m], 10 ft [3m] or 16 ft [5m] 18 GA appliance or plenum cables, with 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with 1/2" conduit connectors
Overload protection	electronic throughout 0 to 95° rotation
Operating range Y*	2 to 10 VDC, 4 to 20mA (default) variable (VDC, PWM, floating point, on/off)
Input impedance	100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point, on/off
Feedback output U*	2 to 10 VDC (max. 0.5 mA)
Torque	90 in-lb [10 Nm] minimum
Direction of rotation*	spring reversible with CW/CCW mounting inside housing motor reversible with built-in switch
Mechanical angle of rotation*	95° (adjustable with mechanical end stop, 35° to 95°)
Running time	motor* 150 seconds (default), variable (40 to 220 secs) spring < 20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -22°F [-30°C]
	spring (with heater) < 20 sec @ -4°F to 122°F [-20°C to 50°C]; < 60 sec @ -49°F [-45°C]
Angle of rotation adaptation*	off (Default)
Override control*	min position = 0% mid. position = 50% max. position = 100%
Position indication	visual indicator, 0° to 95° (0° is full spring return position)
Manual override	5 mm hex crank (3/16" allen), supplied
Humidity	max. 95% RH non-condensing
Ambient temperature	-22°F to 122°F [-30°C to 50°C] with heater -49°F to 122°F [-45°C to 50°C]
Storage temperature	-40°F to 176°F [-40°C to 80°C]
Housing	UL Type 4, NEMA 4, IP66
Housing material	polycarbonate
Agency listings†	CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC & 2006/95/EC
Noise level	≤40dB(A) motor @ 150 seconds, run time dependent ≤62dB(A) spring return
Servicing	maintenance free
Quality standard	ISO 9001
Weight	9.3 lbs (4.2 kg), 9.5 lbs (4.3 kg) with switches 10 lbs (4.5 kg) with heater

*Variable when configured with MFT options.

† Rated Impulse Voltage 800V, Type of action 1-AA (1.AA.B for -S version), Control Pollution Degree 4.

◆ Programmed for 40 sec motor run time. At 150 sec motor run time, transformer sizing is 6.5 VA and power consumption is 4.5 W running / 3 W holding.

NFB24-MFT-S N4(H), NFX24-MFT-S N4

Auxiliary switches	2 x SPDT 3A (0.5A) @ 250 VAC, UL approved one set at +10°, one adjustable 10° to 90°
--------------------	--

- Torque min. 90 in-lb
- Control 2 to 10 VDC (DEFAULT)
- Feedback 2 to 10 VDC (DEFAULT)

Application

For proportional modulation of dampers and control valves in HVAC systems. The NFB24-MFT N4(H) and NFX24-MFT N4 provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 2 to 10 VDC applications of the NFB24-MFT N4(H) and NFX24-MFT N4 actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool (version 3.4 or higher) software application.
- Handheld ZTH-GEN

Operation

The NFB24-MFT N4(H), NFX24-MFT N4 actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the damper or valves mechanical stop and use this point for its zero position during normal control operations.

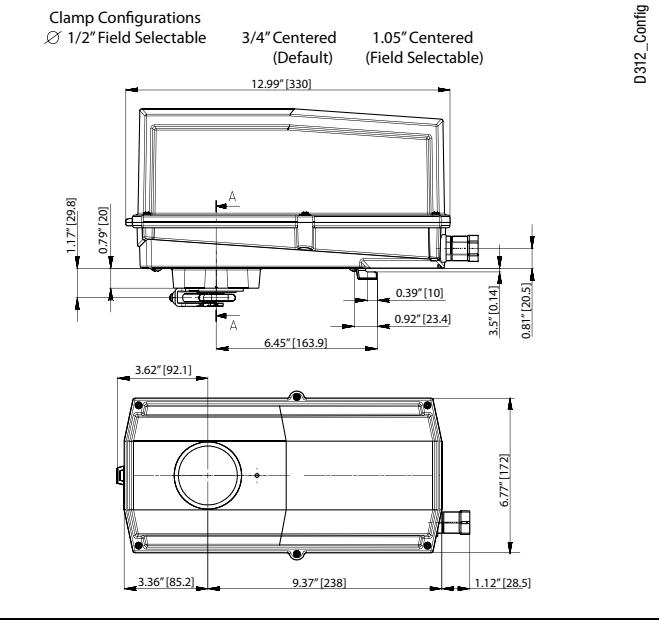
The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The NFB24-MFT N4(H), NFB24-MFT-S N4(H), NFX24-MFT N4 and NFX24-MFT-S N4 is mounted directly to control shafts up to 1.05" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption.

NOTE: Refer to Multi-Function Technology documentation.

Installation Note: Use suitable flexible metallic conduit or its equivalent with the conduit fitting.

Dimensions (inches [mm])



D312_Config

Accessories

Tool-06	8mm and 10 mm wrench
43442-00001	Gland (needed for additional wires)
11097-00001	Gasket for Gland (needed for additional wires)

NOTE: When using NFB24-MFT N4(H), NFB24-MFT-S N4(H), NFX24-MFT N4, NFX24-MFT-S N4 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a jackshaft up to a 1.05" diameter. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback. Actuators shall be cULus Approved and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

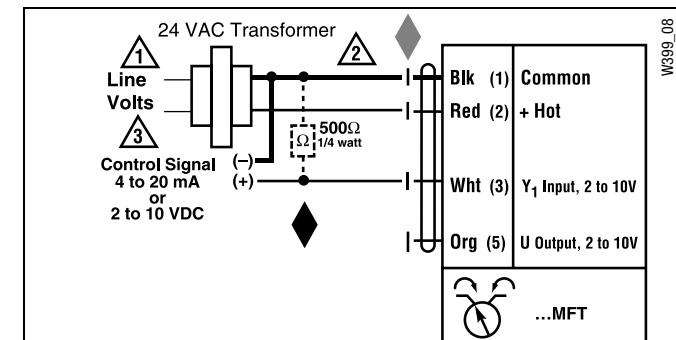
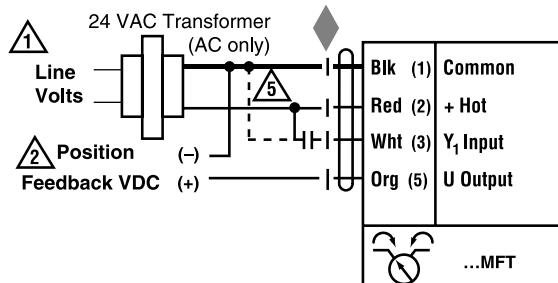
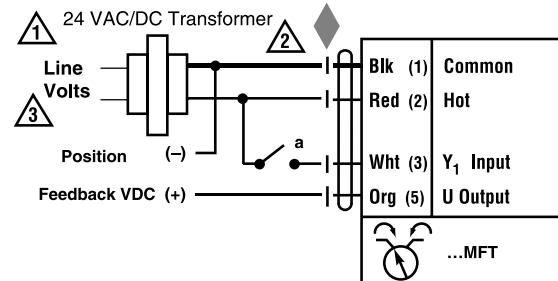
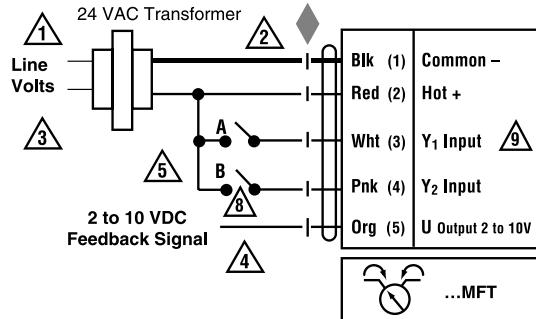
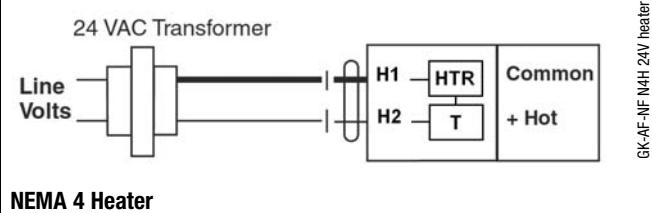
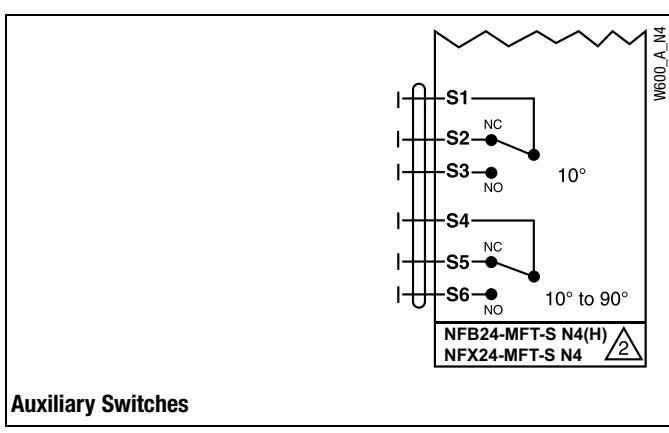
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Position feedback cannot be used with Triac sink controller.
- 5 The actuator internal common reference is not compatible.
- 6 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
- 7 Contact closures A & B also can be triacs.
- 8 A & B should both be closed for triac source and open for triac sink.
- 9 For triac sink the common connection from the actuator must be connected to the hot connection of the controller.

**APPLICATION NOTES**

Meets UL requirements without the need of an electrical ground connection.

**WARNING Live Electrical Components!**

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**VDC/4-20 mA****PWM****On/Off Control****Floating Point Control****NEMA 4 Heater****Auxiliary Switches**

Installation Instructions

Quick-Mount Visual Instructions for Mechanical Installation

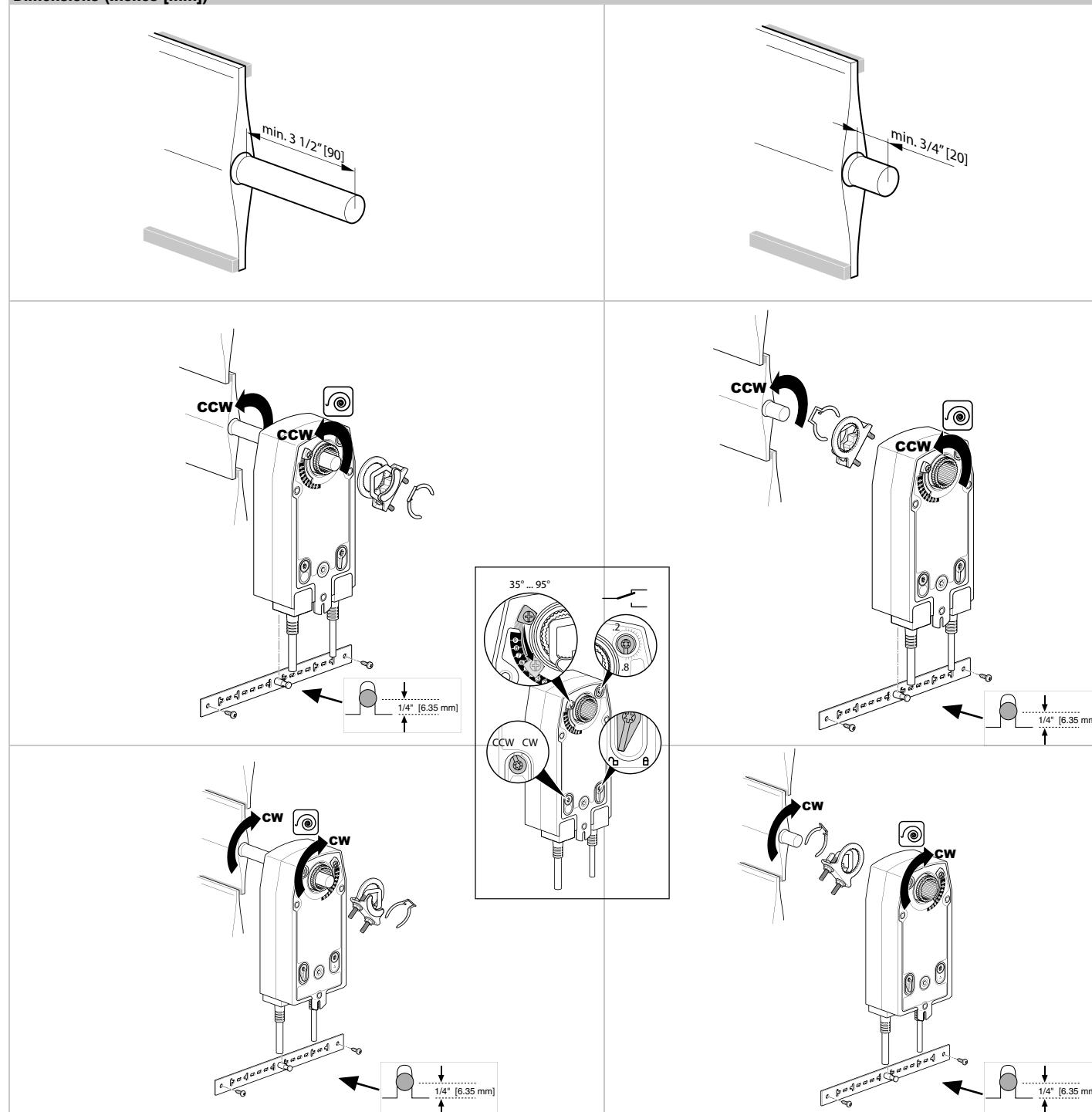
BELIMO

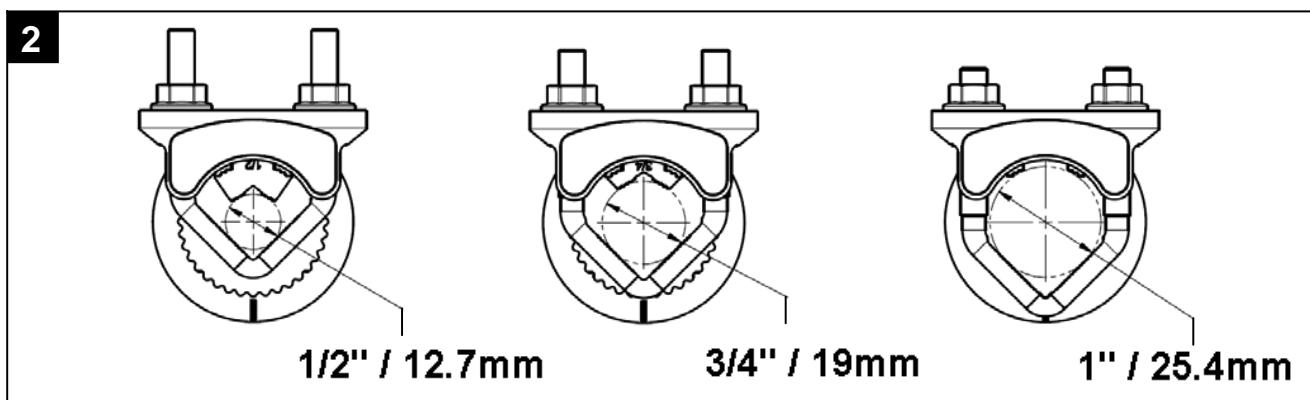
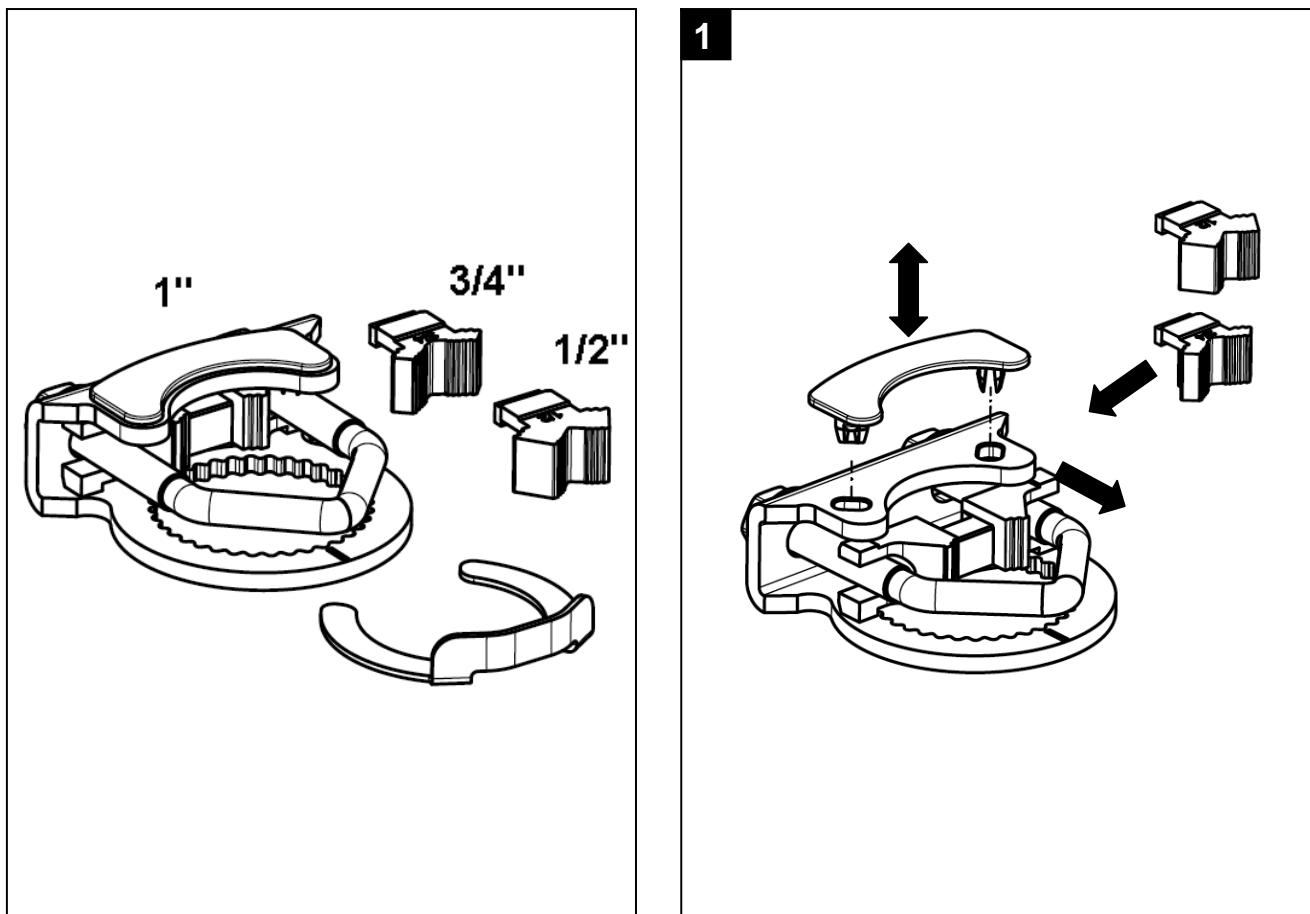
Quick-Mount Visual Instructions

1. Rotate the damper to its failsafe position.
If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out.
If it rotates clockwise, mount the actuator with the "CW" side out.
2. If the universal clamp is not on the correct side of the actuator, move it to the correct side for ease of installation.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

NOTE: Read the "Standard Mounting" instructions, on the next page, for more detailed information.

Dimensions (Inches [mm])





	Ø	Ø	---	---
1/2"	mm	12.7	10 ... 19	---
	inch	1/2	2/5 ... 3/4	---
3/4"	mm	19	10 ... 22	10
	inch	3/4	2/5 ... 3/4	3/8
1"	mm	25.4	19 ... 26.7	12 ... 18
	inch	1	3/4 ... 1.05	1/2 ... 11/16

10mm

9 Nm / 80 in-lb

Installation Instructions

Mechanical Installation



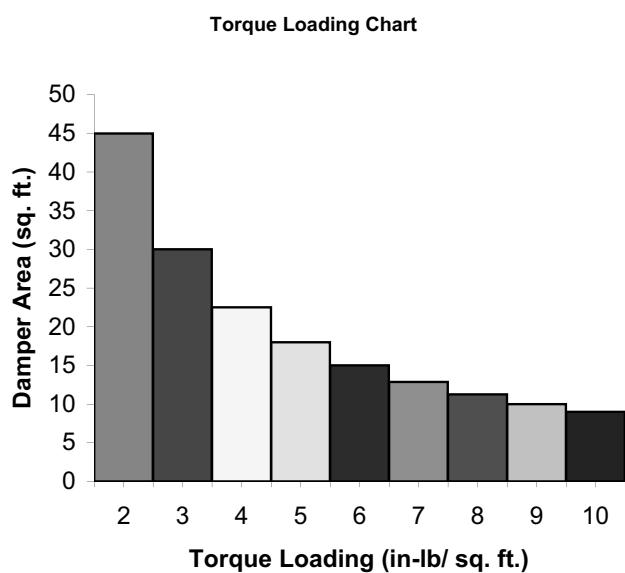
Determining Torque Loading and Actuator Sizing

Damper torque loadings, used in selecting the correct size actuator, should be provided by the damper manufacturer. If this information is not available, the following general selection guidelines can be used.

Damper Type	Torque Loading
Opposed blade, without edge seals, for non-tight close-off applications	3 in-lb/sq. ft.
Parallel blade, without edge seals, for non-tight close-off applications	4 in-lb/sq. ft.
Opposed blade, with edge seals, for tight close-off applications	5 in-lb/sq. ft.
Parallel blade, with edge seals, for tight close-off applications	7 in-lb/sq. ft.

The above torque loadings will work for most applications with 1000 FPM face velocity. For applications between this criteria and 2500 FPM, the torque loading should be increased by a multiplier of 1.5. If the application calls for higher criteria up to 3000 FPM, use a multiplier of 2.0.

Torque Loading Chart



General Information

Belimo actuators should be mounted indoors in a dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator.

For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft. The damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3-1/2" or if an obstruction blocks access, the shaft can be extended with the AV 8-25 shaft extension accessory or the actuator may be mounted in its short shaft configuration.

Mechanical Operation

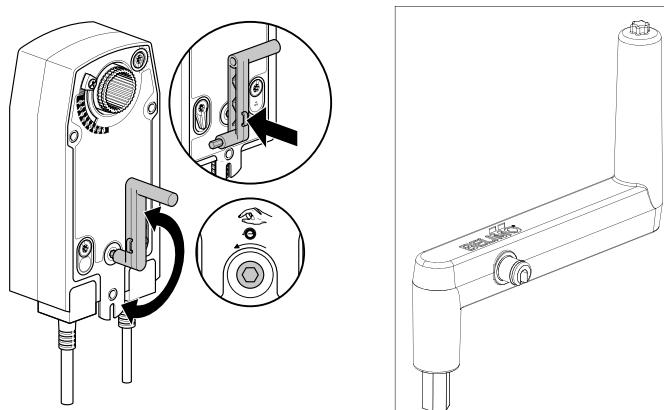
The actuator is mounted directly to a damper shaft up to 1.05" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The NFB, NFX series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator. The NFB...-S, NFX...-S versions are provided with two built-in auxiliary switches. These SPDT switches are provided for safety interfacing or signaling, for example, for fan start-up. The switching function at the fail-safe position is fixed at +10°, the other switch function is adjustable between +10° to +90°.

Automatic Airtight Dampers/Manual Override

The NFB, NFX series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The NFB, NFX has a unique built in manual positioning mechanism which allows the setting of any damper position within its 95° of rotation. A pre-tensioned spring automatically tightens the damper when power is applied to the actuator, compensating for damper seal deterioration..

The actuator is shipped at +5° (5° from full fail-safe) to provide automatic compression against damper gaskets for tight shut-off. When power is applied, the manual mechanism is released and the actuator drives toward the full fail-safe position.



Standard Mounting

NOTE: The NFB, NFX...series actuator is shipped with the manual override adjusted for a +5° position at the universal clamp (not at full fail-safe, 0°). This allows for automatic compression of damper blade seals when the actuator is in use, providing tight shut-off. This assumes that the damper is to have tight shut-off at the fail-safe position. If tight close-off is desired at the opposite direction from fail-safe, the manual override should be released so the actuator can go to the full fail-safe position. See the manual override instructions.

1. Manually move the damper to the fail-safe position (usually closed). If the shaft rotated counterclockwise (↷), this is a CCW installation. If the shaft rotated clockwise (↶), this is a CW installation. In a CCW installation, the actuator side marked "CCW" faces out, while in a CW installation, the side marked "CW" faces out. All other steps are identical.
2. The actuator is usually shipped with the universal clamp mounted to the "CCW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CCW" (or the "CW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
3. If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the

universal clamp. If you are mounting the actuator with the "CCW" side out, position the clamp so that the pointer section of the tab is pointing to 0° (see Figure C) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.) If your application requires a mechanical minimum position, read the *Rotation Limiting, Mechanical Minimum Damper Position* section.

4. Lock the clamp to the actuator using the retaining clip.
5. Verify that the damper is still in its full fail-safe position.
6. Slide the actuator over the shaft.
7. Position the actuator in the desired location.
8. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
9. Slip the stud of the anti rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.

Short Shaft Installation

If the shaft extends at least 3/4" from the duct, follow these steps:

1. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
2. Engage the clamp to the actuator as close as possible to the determined location.
3. Lock the clamp in place using the remaining retainer clip.
4. Verify that the damper is still in its full fail-safe position.
5. Slide the actuator over the shaft.
6. Position the actuator in the desired location.
7. Tighten the two nuts on the clamp using a 10mm wrench or socket using 6-8 ft-lb of torque.
8. Slip the stud of the anti-rotation strap into the slot at the base of the actuator. The stud should be positioned approximately 1/16 of an inch from the closed end of the slot. Bend the strap as needed to reach the duct. Attach the strap to the duct with #8 self tapping screws.
9. If damper position indication is required, use the optional IND-AFB pointer. See **Figure A**.

Jackshaft Installation

The NFB, NFX... series actuator is designed for use with jackshafts up to 1.05" in diameter. In most applications, the NFB, NFX actuator may be mounted in the same manner as a standard damper shaft application. If more torque is required than one NFB, NFX actuator can provide, refer to AFB, AFX or AF series actuators.

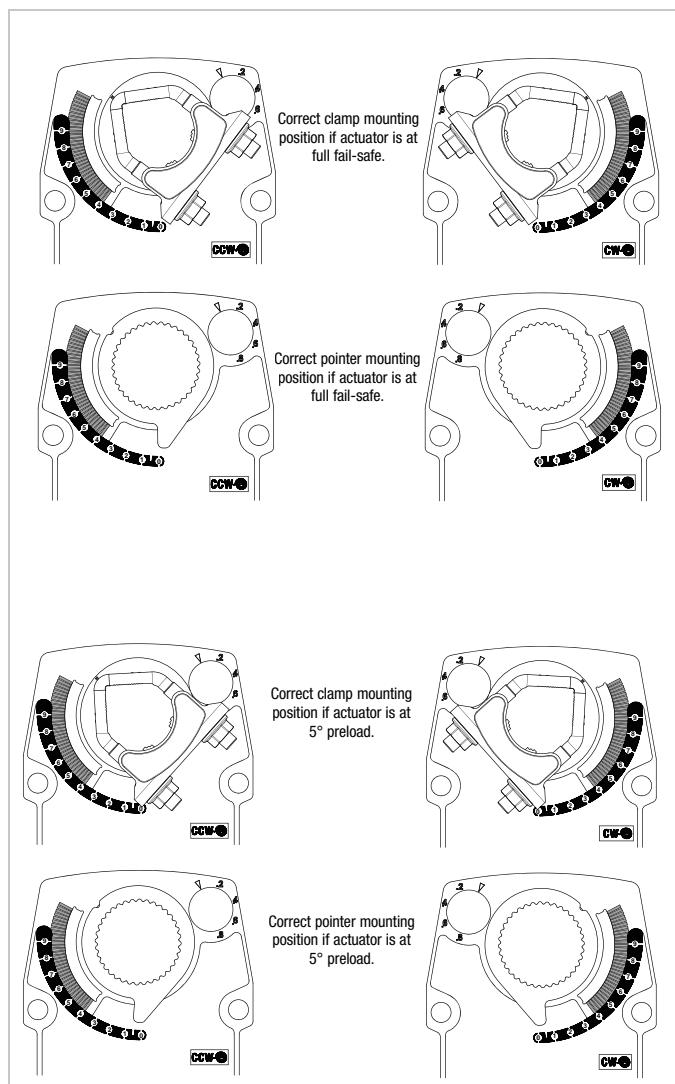


Figure A

Installation Instructions

Mechanical Installation

BELIMO®

Rotation Limitation

The angle of rotation limiter, which is built into the actuator, is used in conjunction with the tab on the universal clamp or IND-AFB position indicator. In order to function properly, the clamp or indicator must be mounted correctly.

See **Figure A**.

The rotation limiter may not work in certain mounting orientations using the ZG-118 mounting bracket. Limiting the damper rotation must be accomplished by adjusting the crank arm linkage.

The built-in rotation limiter may be used in 2 ways to control the rotational output of the NFB, NFX series actuator. One use is in the application where a damper has a designed rotation less than 90°. An example would be a 45° or 60° rotating damper. The other application would be to set a minimum damper position which can be easily set or changed without having to remove the actuator from the damper.

Damper Rotation Limiting

1. Determine the amount of damper rotation required.
2. Locate the Angle of Rotation Limiter on the actuator **Figure B**.
3. Position the limiter to the desired position, making sure the locating "teeth" on the limiter are engaged into the locating holes on the actuator.
4. Fasten the limiter by screwing the attached screw.
5. Test the damper rotation either manually with the manual crank or apply power and if required, a control signal. Re-adjust if necessary.

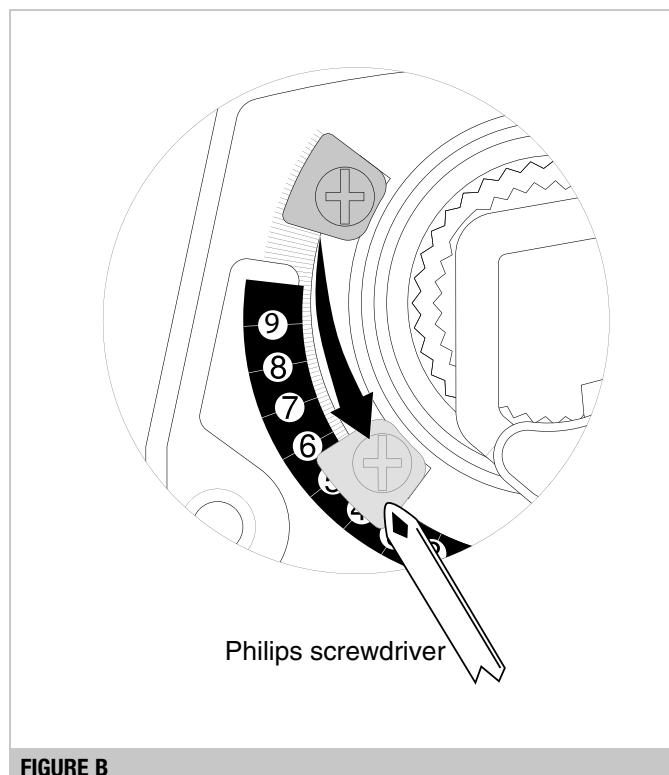
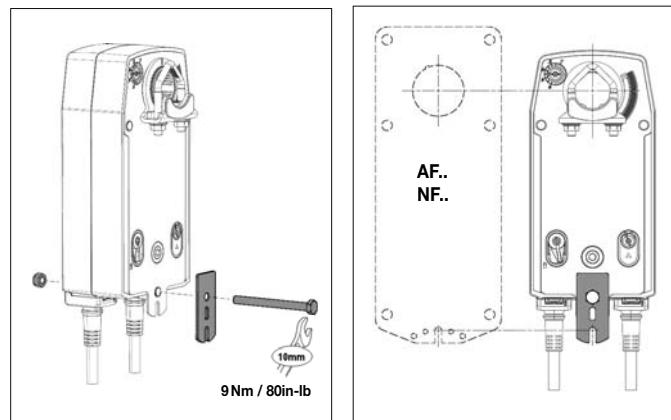


FIGURE B

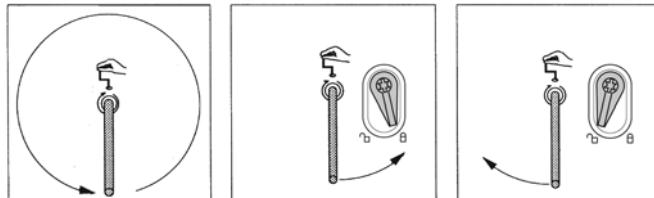
Z-AF For Replacing AF and NF Actuators



Manual Override

The NFB, NFX series actuators can be manually positioned to ease installation or for emergency positioning.

1. The manual override will only work if no power is available to the actuator.
2. Insert the manual crank (shipped with the actuator) into the hexagon hole located on either side of the actuator. An illustration, located on the label, shows the location.
3. Turn the crank in the direction shown on the label (clockwise on the "CW" side, counterclockwise on the "CCW" side). It will take approximately 23 revolutions to rotate the full 95° of rotation.
4. To lock the actuator in the required position, flip the switch to the locked position that is located to the right of the crank on the CCW side of the actuator (left of the crank on the CW side).
5. The manual override may be disengaged in 2 ways.
 - Flip the switch to the unlocked position and the actuator will go to its fail-safe position.
 - Apply power to wire 1 and 2. The actuator will automatically disengage the override function and will go to the "on" position in the case of the On/Off versions. Or, in the case of the proportional versions, go to the 0 signal position and then go to the position corresponding to the control signal. The actuator will now work normally.

CCW Side Example:

- | | | |
|--|--|--|
| Winding the damper actuator | Locking the damper actuator | Unlocking the damper actuator |
| <ul style="list-style-type: none"> - insert crank handle - turn handle in direction of arrow | <ul style="list-style-type: none"> - Flip the lock switch to the position pointing to the "locked" symbol | <ul style="list-style-type: none"> (2 options) - Flip the lock switch to the position pointing to the "unlocked" symbol. - Remote control by supplying power to the unit for > than 3 sec. |

Testing the installation Without Power

The actuator/damper installation may be tested without power at the actuator. Refer to the manual positioning section of the instructions. Move the damper to its full non-fail-safe position using the manual crank. Disengage the manual position mechanism and have the damper go to full fail-safe position. Correct any mechanical problems and retest.

Auxiliary Switches

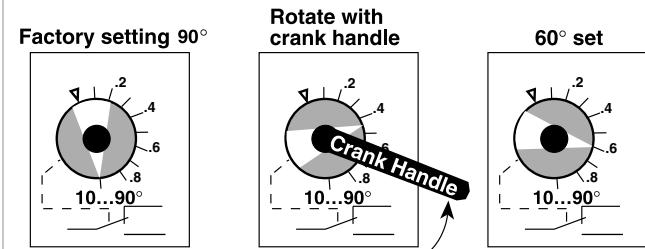
The NFB, NFX series actuators may be ordered with 2 built-in SPDT auxiliary switches used for safety interfacing or signaling, for example, for fan start-up. The switch position near the fail-safe position is fixed at 10°. The other is adjustable between 10° and 90° of rotation. The crank that is supplied with the actuator is used to change the switch position.

SWITCH RATING		
Voltage	Resistive Load	Inductive Load
120 VAC	3A	1.03A
250 VAC	3A	0.5A

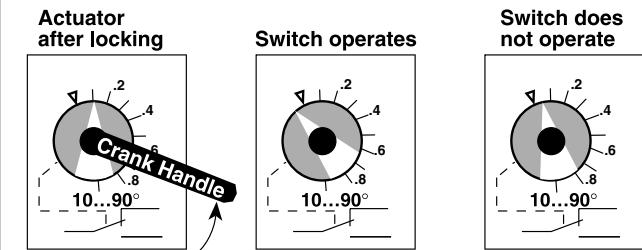
Two methods may be used to adjust the switching point of the adjustable switch.

Method 1 - See Figure F

1. The actuator must be in its fail-safe position.
2. Insert the crank handle into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the crank until the switch pointer is at the desired switch point in degrees as shown.

NFB, NFX... Series**FIGURE F****Method 2 - See Figure G**

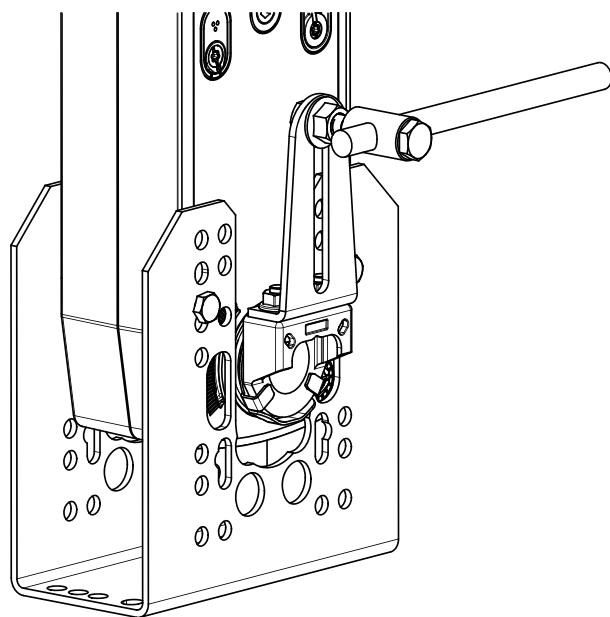
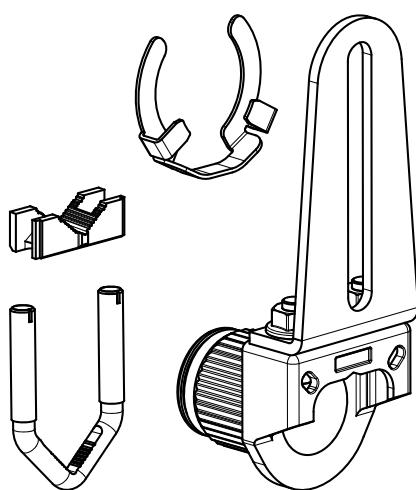
1. Position the damper to the point at which you want the switch to activate. This may be done by using the manual override or by providing the appropriate proportional signal to NFB24, NFX24... modulating type actuator. The position of the switch pointer is not important during this step.
2. Insert the crank into the torx shaped hole located in the center of the adjustable switch pointer.
3. Gently rotate the switch pointer to just past the switch point indicating arrow as shown.

NFB, NFX... Series**FIGURE G**

Installation Instructions

Non-Direct Mounting Methods

BELIMO[®]



KH-AFB non-direct mounting with ZG-118 mounting bracket

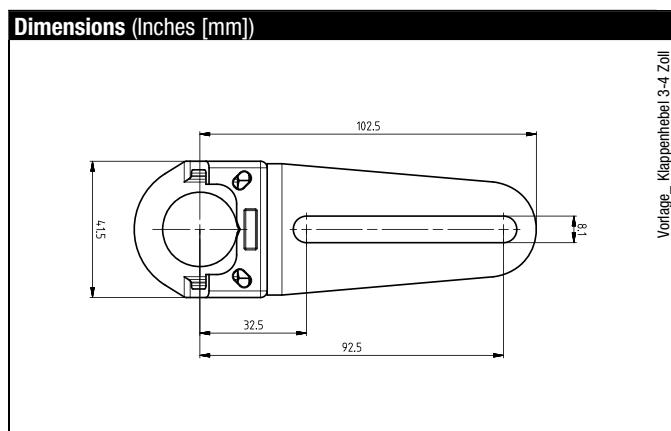
KH-AFB Crank arm Including Retaining Ring

CAUTION: The retaining clip supplied with the clamp is **not** used to mount the KH-AFB crank arm.

The KH-AFB crank arm is used in non-direct coupled mounting applications. The KH-AFB may also be used to simultaneously direct couple to a damper shaft and provide an additional crank arm connection to a second damper.

KH-AFB For round shafts up to 3/4" or square shafts up to 5/8"

Dimensions (Inches [mm])



General

The NFB, NFX series actuators utilize both DC Motors and brushless DC motor technology. The NFB, NFX uses this motor in conjunction with an Application Specific Integrated Circuit (ASIC). In the On/Off versions of the NFB and NFX, the ASIC monitors and controls the actuator's rotation and a digital rotation sensing function to prevent damage to the actuator. The NFB24, NFX24... modulates type actuators incorporate a built in microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and knows the actuator's exact zero position.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside of a rotating permanent magnet. The electromagnetic poles are switched by a special ASIC circuit developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Overload Protection

The NFB, NFX series actuators are protected from overload at all angles of rotation. The ASIC circuit constantly monitors the rotation of the DC motor inside the actuator and stops the pulses to the motor when it senses a stall condition. The DC motor remains energized and produces full rated torque to the load. This helps ensure that dampers are fully closed and that edge and blade seals are always properly compressed.

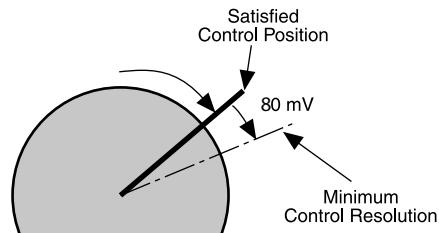
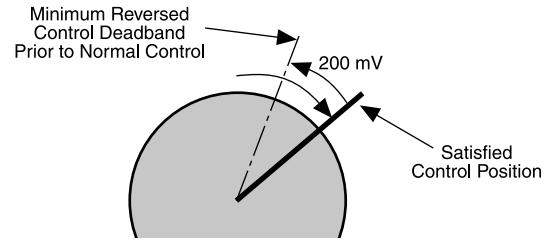
Motor Position Detection

Belimo brushless DC motors eliminate the need for potentiometers for positioning in modulating type actuators. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Control Accuracy and Stability

-SR and MFT NF actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The NFB24-MFT, NFX24-MFT actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

NF Actuator responds to an 80 mV signal when not changing direction from stop**NF Actuator responds to a 200 mV signal when reversing direction from stop position.**

Note: Resolution is a percentage of operating range. 1% in one direction, 2.5% when changing direction. 2-10 VDC control example shown above.

Installation Instructions

General Wiring Instructions



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The NFB24, NFX24...actuators require a 24 VAC class 2 transformer and draws a maximum of 10 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 2004/108/EC
- Software class A: Mode of operation type 1
- Low voltage directive: 2006/95/EC

CAUTION: It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for NFB..., NFX... Actuators

Keep power wire runs below the lengths listed in the **Figure H**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example: 3 actuators, 16 Ga wire

$$350 \text{ Ft} \div 3 \text{ Actuators} = 117 \text{ Ft. Maximum wire run}$$

MAXIMUM WIRE LENGTH FOR 10VA

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	900 Ft.	18 Ga	220 Ft.
14 Ga	550 Ft.	20 Ga	120 Ft.
16 Ga	350 Ft.	22 Ga	60 Ft.

FIGURE H

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the NFB24, NFX24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The NFB24, NFX24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. **Do not** connect it to the actuator common.

Initialization of the NFB24-MFT, NFX24-MFT

When power is initially applied, the actuator will first release its manual preload position (This assumes a manual position has been set). The actuator will then rotate to the full fail-safe position. At this point the microprocessor recognizes that the actuator is at full fail-safe and uses this position as the base for all of its position calculations. The microprocessor will retain the initialized zero during short power failures of up to 20 seconds. The NFB24-MFT and NFX24-MFT will also return to its position prior to the 20-second-or-less power loss. For power failures greater than 20 seconds, the actuator would naturally return to its full fail-safe position prior to the microprocessor losing its memory. The actuator will also re-initialize if the manual position mechanism is used.

NFB24-MFT, NFX24-MFT + P-100... Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step...	Does Not Give Expected Response Go To Step...
1.	Control signal is applied to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4.
2.	Check power wiring. Correct any problems. See Note 1.	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive Step 1.	Power wiring corrected, actuator still does not drive Step 4.
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 7.	Does not drive toward "Control Signal Position" Step 4.
4.	Make sure the control signal positive (+) is connected to Wire No. 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly Step 7.	Step 5.
5.	Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. NOTE: The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicates.	Controller output (actuator input) is correct. Input Polarity Correct Step 6.	Reprogram, adjust repair or replace controller as needed Step 1.
6.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - See Note 2.	Recalculate actuator requirement and correct installation.
7.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original purchase date, notify Belimo and give details of the application.

Minimum 35 in-lb Torque

- For damper areas up to 8.5 sq-ft*

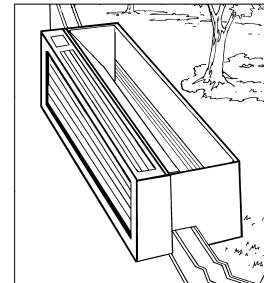
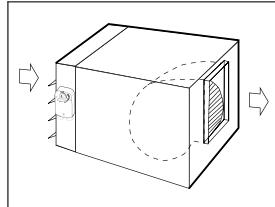
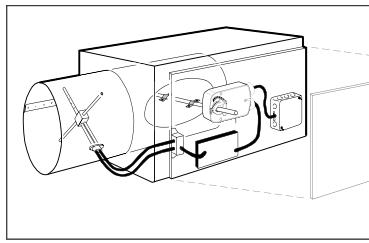
Applications

Cost effective quality and performance for a range of applications including:

- Classroom Unit Ventilators
- Fan/Coil Units
- Airhandlers
- VAV Terminal Units
- Economizer Units
- Control Dampers



Actuators in bold have BDCM



LF Series - At A Glance

	LF24 US (p. 133)	LF24-S US (p. 133)	LF120 US (p. 135)	LF230 US (p. 135)	LF230-S US (p. 135)	LF24-3-US (p. 137)	LF24-3-S US (p. 137)	LF24-3-R US (p. 139)	LF24-3-S US (p. 139)	LF24-SR US (p. 141)	LF24-SR-E US (p. 141)	LF24-SR-F US (p. 143)	LF24-ECON-R03 US (p. 147)	LF24-MFT US (p. 147)	LF24-MFT-S US (p. 151)	LF24-MFT-20 US (p. 153)	LF24-MFT-20-S US (p. 153)
Torque:	35 in-lb	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Power supply:	24 VAC/DC	●	●														
	120 VAC			●	●												
	230 VAC				●	●											
Control signal:	On/Off	●	●	●	●	●	●										
	floating point							●	●	●							
	proportional 2 to 10 VDC									●	●	●					
	6 to 9 VDC																
	multi-function**																
	3kΩ NTC type 10 thermistor																
	10kΩ NTC type 7 thermistor																
Feedback:	2 to 10 VDC									●	●	●	●				
	VDC variable**																
Auxiliary output, 20 VDC (to power controller)																	
Running time motor:	<40 to 75 seconds	●	●	●	●	●	●										
	150 seconds constant						●	●		●	●	●					
	90 seconds constant							●	●								
	95 seconds constant																
	adj. 75 to 300 seconds***																
spnng: <25 seconds	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
External direction of rotation switch																	
Plenum rated cable, 18 GA																	
Conduit fitting	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Appliance cable, 18 GA	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Built-in auxiliary switch	●		●		●		●		●		●		●		●		●

LF24-SR-E US operation.....(p. 145)

Installation instructions(p. 155-159)

General wiring(p. 160)

Start-up and checkout(p. 161)

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals. **Default 2 to 10 VDC. ***Default 150 seconds.

A CLOSER LOOK...

- Cut labor costs with (10 min. installation) simple direct coupling. Actuator Centers on 1/2" shaft (K6-1, 3/4" clamp optional).
- True mechanical spring return – the most reliable failsafe.
- Mount for clockwise or counterclockwise fail-safe.
- Easy-to-adjust mechanical stop to limit damper rotation.
- Check damper position easily with clear position indicator.
- Don't worry about actuator burn-out.
Belimo is overload-proof throughout rotation.
- Need to change control direction?
Do it easily with a simple switch (modulating actuators).
- Built-in auxiliary switch is easy to use, offers feedback or signal for additional device.
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged metal housing withstands rough handling in the mechanical room.
- 3 ft. cable and conduit connector eases installation.



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The Belimo Difference

- *Customer Commitment.*
Extensive product range. Application assistance.
Same-day shipments. Free technical support. Five year warranty.
- *Low Installation and Life-Cycle Cost.*
Easy installation. Accuracy and repeatability.
Low power consumption. No maintenance.
- *Long Service Life.*
Components tested before assembly. Every product tested before shipment.
30+ years direct coupled actuator design.

LF24(-S) US

On/Off, Spring Return, 24V

BELIMO[®]



Technical Data		LF24(-S) US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	5 W
	holding	2.5 W
Transformer sizing		7 VA (class 2 power source)
Electrical connection		3 ft, 18 GA appliance cable
(LF24-S US has 2 cables)		1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Angle of rotation		max. 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm]
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Running time (nominal)	motor	< 40 to 75 sec
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP54
Housing material		zinc coated steel
Agency listings		CULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running	< 50 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight	LF24	3.1 lbs (1.40 kg)
	LF24-S	3.2 lbs (1.45 kg)

LF24-S US

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL Approved adjustable 0° to 95° (double insulated)
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Torque min. 35 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, digital output, or a manual switch.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

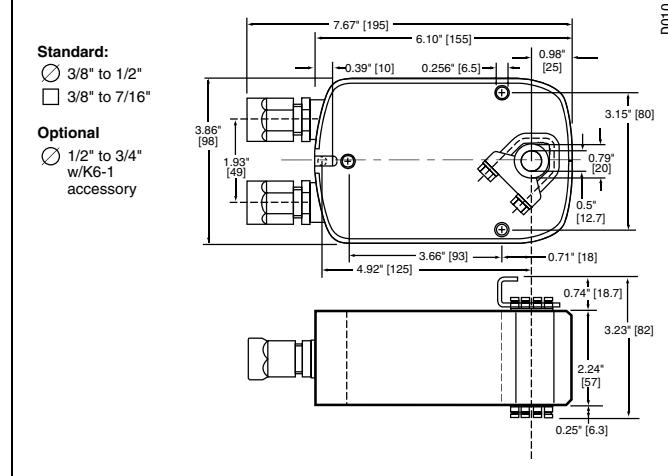
The LF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The LF24-S US version is provided with one built in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the LF24-S is double insulated so an electrical ground connection is not necessary.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for Honeywell Mod IV, M6415 type actuators, and new installations
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing

NOTE: When using LF24 US and LF24-S US actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption and input impedance must be observed.

3 Actuators may also be powered by 24 VDC.

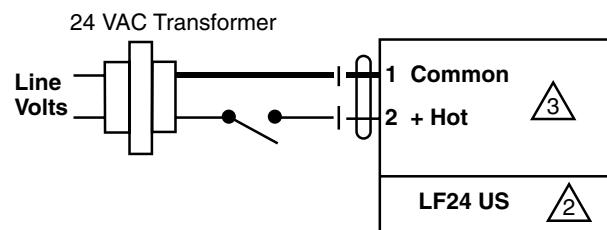
4 For end position indication, interlock control, fan startup, etc., LF24-S US incorporates a built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

APPLICATION NOTES

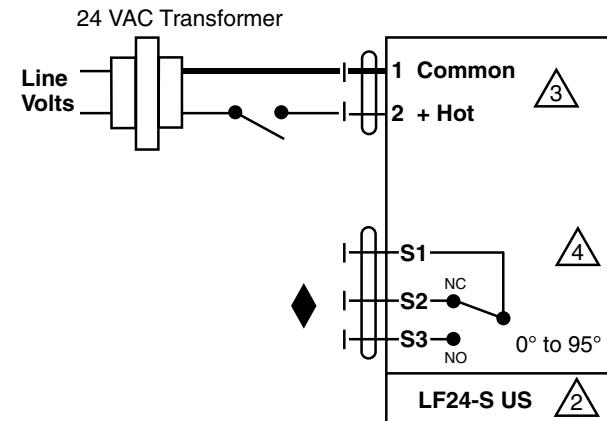
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for LF24 US



On/Off wiring for LF24-S US

LF120(-S) US / LF230(-S) US

On/Off, Spring Return, 120/230 VAC

BELIMO



Technical Data		LF120(-S) US / LF230(-S) US
Power supply	LF120(-S) US	120 VAC ± 10% 50/60 Hz
	LF230(-S) US	230 VAC ± 10% 50/60 Hz
Power consumption		
LF120(-S) US	running	5.5 W
	holding	3.5 W
LF230(-S) US	running	5 W
	holding	3 W
Transformer sizing		
LF120(-S) US		7.5 VA
LF230(-S) US		7 VA
Electrical connection		3 ft, 18 GA appliance cable 1/2" conduit connector
(-S models have 2 cables)		
Overload protection		electronic throughout 0 to 95° rotation
Electrical protection		actuators are double insulated
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm] constant torque
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Electrical protection		actuators are double insulated
Running time	motor	< 40 to 75 sec
(nominal)	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP54
Housing material		zinc coated steel
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running	< 50 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight	LF120/230	3.4 lbs (1.54 kg)
	LF120/230-S	3.5 lbs (1.60 kg)

LF120-S US / LF230-S US

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL Approved adjustable 0° to 95°
------------------	---

Torque min. 35 in-lb, for control of air dampers

Application

For On/Off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is On/Off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

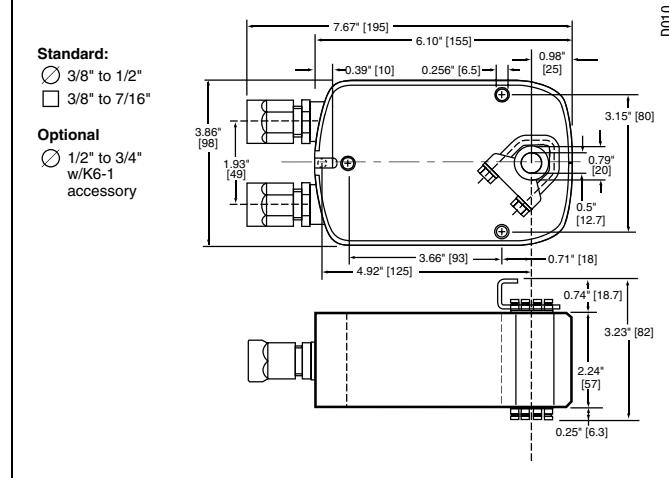
The LF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode. The actuator is double insulated so an electrical ground connection is not necessary.

The LF120-S US and LF230-S US versions are provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for Honeywell Mod IV, M6415 type actuators, and new installations
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing

NOTE: When using LF120/230 US & LF120-S/230-S US actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.

Power consumption and input impedance must be observed.

3 No ground connection is required.

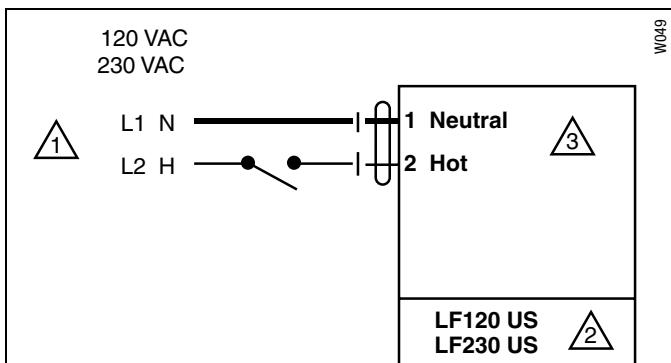
4 For end position indication, interlock control, fan startup, etc., LF120-S US and LF230-S US incorporate one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

APPLICATION NOTES

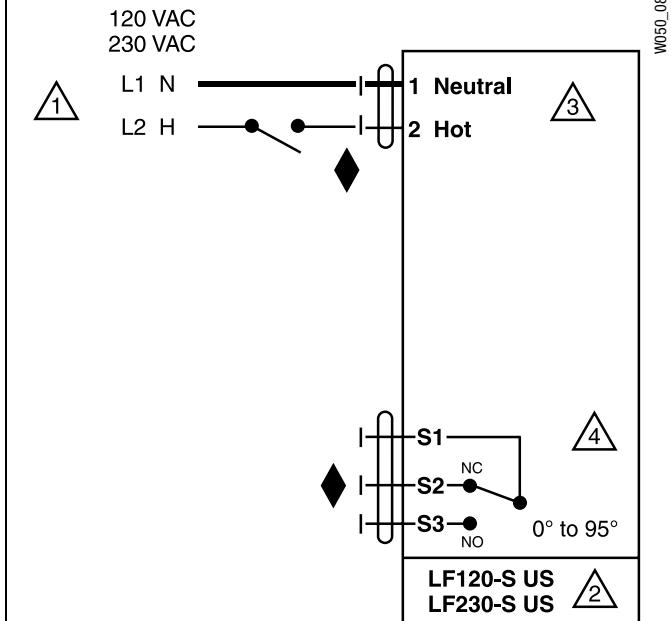
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for LF120 US / LF230 US



On/Off wiring for LF120-S US / LF230-S US

LF24-3(-S) US

On/Off, Floating Point, Spring Return, 24V

BELIMO



Technical Data		LF24-3(-S) US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection	LF24-3 US	3 ft, plenum rated cable 1/2" conduit connector
	LF24-3-S US	3 ft, 18 GA appliance cables (2) 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Input impedance		1000 Ω (0.6w) control inputs
Angle of rotation		max. 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm]
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Running time	motor	150 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 /IP54
Housing material		zinc coated metal
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running	< 30 db (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight	LF24-3	3.1 lbs (1.40 kg)
	LF24-3-S	3.6 lbs (1.45 kg)

LF24-3-S US

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL Approved adjustable 0° to 95° (double insulated)
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Torque min. 35 in-lb, for control of air dampers

Application

For modulation or On/Off control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Control is floating point from a triac or relay, or On/Off from an auxiliary contact from a fan motor contactor, controller, or manual switch.

Operation

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The LF24-3 (-S) US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

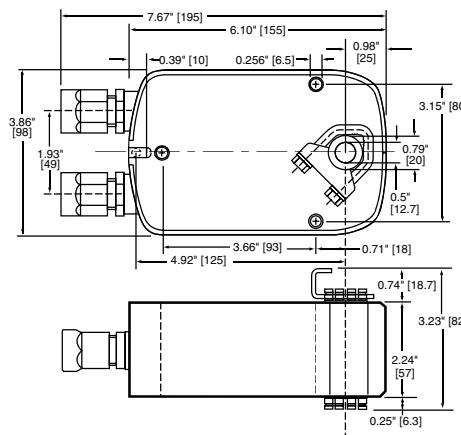
Power consumption is reduced in holding mode.

The LF24-3-S US version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the LF24-3-S US is double insulated so an electrical ground is not necessary.

Dimensions (Inches [mm])

Standard:
 3/8" to 1/2"
 3/8" to 7/16"

Optional
 1/2" to 3/4"
 w/K6-1
 accessory



D010

Accessories

AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for Honeywell Mod IV, M6415 type actuators, and new installations
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing

NOTE: When using LF24-3 (-S) US actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Floating point, On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have an external direction of rotation switch to reverse control logic. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Run time shall be constant and independent of torque. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams

INSTALLATION NOTES

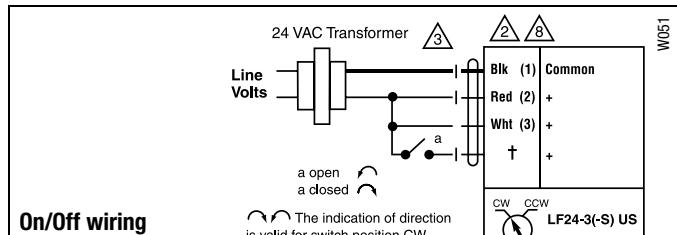
- 1** Provide overload protection and disconnect as required.
 - 2** ***CAUTION Equipment Damage!***
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
 - 3** Actuators may also be powered by 24 VDC.
 - 4** The Common connection from the actuator must be connected to the Hot connection of the controller.
 - 5** The actuator Hot must be connected to the control board Common.
 - 6** For end position indication, interlock control, fan startup, etc., LF24-3-S US LF120-S US and LF230-S US incorporate one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.
 - 7** Actuators with plenum rated cable do not have numbers on wires; use color coded instead. Actuators with appliance rated cable use numbers.
† LF24-3 US, Green wire #4, LF24-3-S US, White wire #5

APPLICATION NOTES

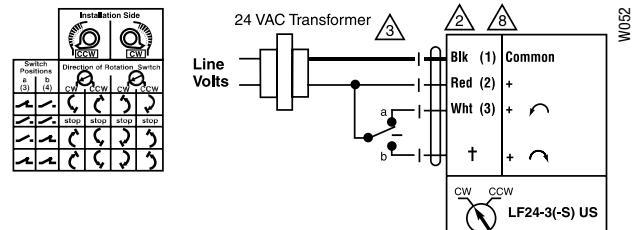
- ◆ Meets cULus requirements without the need of an electrical ground connection.

 **WARNING** Live Electrical Components!

 During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



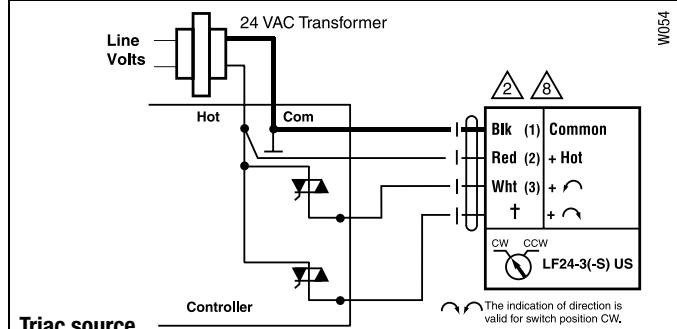
On/Off wiring for LF24-3(-S) IIS



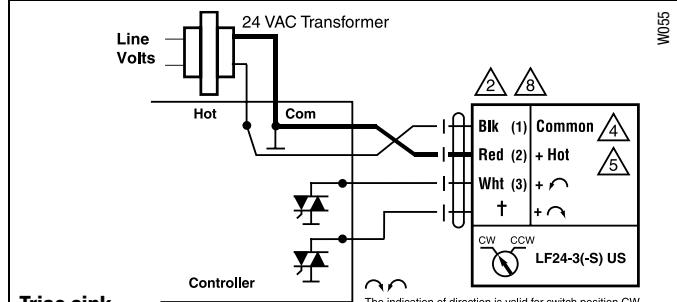
Floating Point wiring for LF24-3(-S) IIS



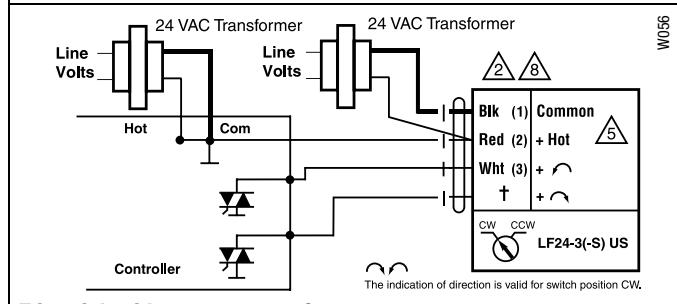
Auxiliary switch of LF24-3(-S) US



Triac source



Triac sink



Triac sink with separate transformers



Torque min. 35 in-lb, for control of air dampers

Application

For modulation or On/Off control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. The ZG-LFC114 universal mounting kit can be used with the LFC24-3-R US actuator for retrofit of the economizer section of the Trane Voyager unit.

Control is floating point from a triac or relay, or On/Off from an auxiliary contact from a fan motor contactor, controller, or manual switch.

Operation

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

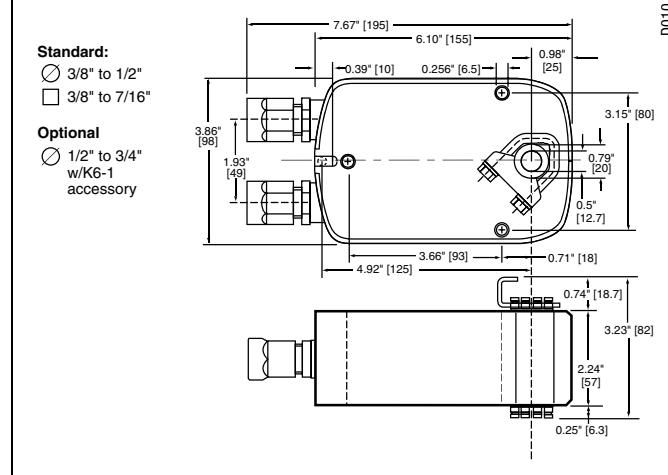
The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The LFC24-3-R (-S) US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

Power consumption is reduced in holding mode.

The LFC24-3-S US version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the LFC24-3-S US is double insulated so an electrical ground is not necessary.

Dimensions (Inches [mm])



Technical Data		LFC24-3-R(-S) US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection	LFC24-3-R US	3 ft, plenum rated cable 4 male spade connectors
	LFC24-3-S US	3 ft, 18 GA appliance cables (2) 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Input impedance		1000 Ω (0.6w) control inputs
Angle of rotation		max. 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm]
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Running time	motor	90 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 /IP54
Housing material		zinc coated metal
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running	< 30 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight	LFC24-3-R US	3.1 lbs (1.40 kg)
	LFC24-3-S US	3.6 lbs (1.45 kg)

LFC24-3-S US

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL Approved adjustable 0° to 95° (double insulated)
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Accessories

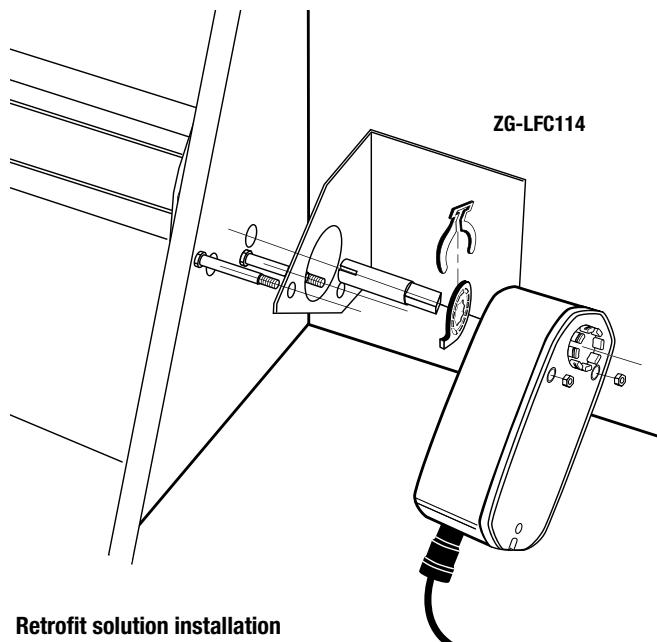
AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LFC114	Used with LFC24-3-R US, mounting bracket kit for Trane Voyager economizer actuator retrofit. Kit includes mounting bracket and installation hardware.
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing

NOTE: When using LFC24-3-R (-S) US actuators, only use accessories listed on this page.

NOTE: For On/Off control wiring please see LF24-3 US wiring diagram. "On/Off control of LF24-3(-S) US" page 71.

NOTE: For Floating point control wiring, Triac source, sink or wiring with separate power supplies please see page 71 for correct wiring.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.



Retrofit solution installation

Typical Specification

Floating point, On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have an external direction of rotation switch to reverse control logic. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Run time shall be constant and independent of torque. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel. Power consumption and input impedance must be observed.

3 No ground connection is required.

6 For end position indication, interlock control, fan startup, etc., LFC24-3-S US incorporates one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°. LFC24-3-S US has a white wire #5 instead of a green wire #4.

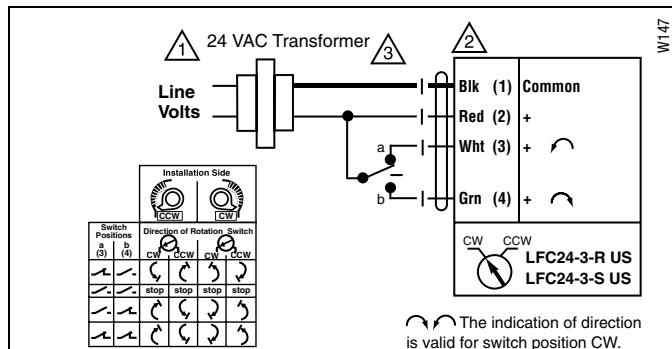
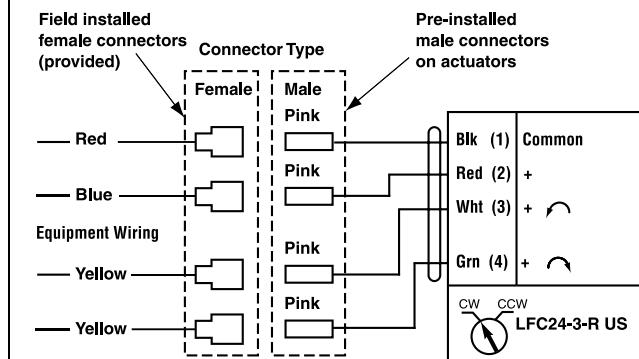
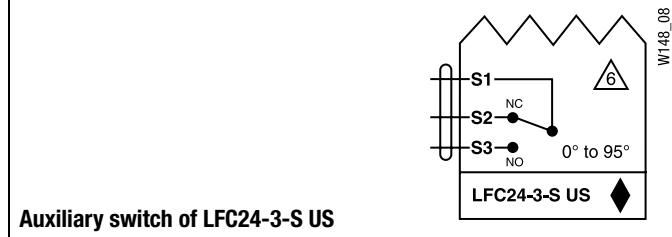
8 Actuators with plenum rated cable do not have numbers on wires; use color coded instead. Actuators with appliance rated cable use numbers.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**Floating point control of LFC24-3... US****Wiring LFC24-3-R US****Auxiliary switch of LFC24-3-S US**



Torque min. 35 in-lb, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500W resistor, a 4 to 20 mA control input from an electronic controller or positioner. A 2 to 10 VDC feedback signal is provided for position indication or master-slave applications.

Operation

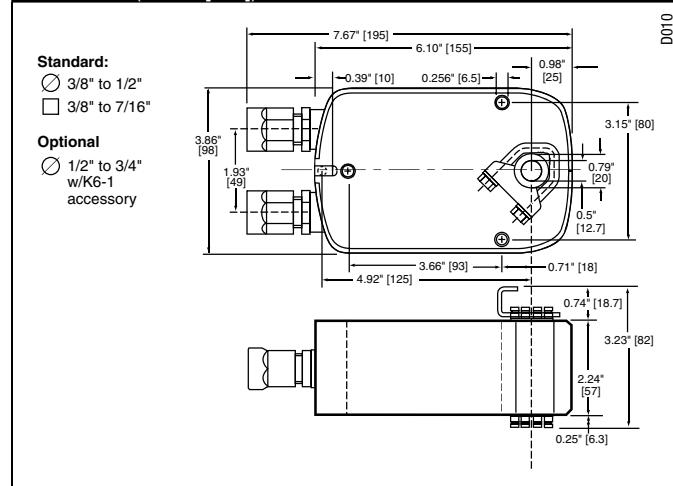
The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The LF24-SR (-S) US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The LF24-SR-S US version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the LF24-SR-S US is double insulated so an electrical ground is not necessary.

Dimensions (Inches [mm])



Technical Data		LF24-SR(-S) US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection	LF24-SR US	3 ft, plenum rated cable 1/2" conduit connector
	LF24-SR-S US	3 ft, 18 GA appliance cables (2) 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Input impedance		100 kΩ (0.1 mA), 500 Ω
Angle of rotation		max. 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm]
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Running time (nominal)	motor	150 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 /IP54
Housing material		zinc coated metal
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running	< 30 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight	LF24-SR US	3.1 lbs (1.40 kg)
	LF24-SR-S US	3.2 lbs (1.45 kg)

LF24-SR-S US

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL Approved adjustable 0° to 95° (double insulated)
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Accessories

AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
SGA24	Min. and/or man. positioner in NEMA 4 housing
SGF24	Min. and/or man. positioner for flush panel mounting
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for Honeywell Mod IV, M6415 type actuators, and new installations
ZG-R01	500 Ω resistor for 4 to 20 mA control signal
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)
ZS-260	Explosion-proof housing

NOTE: When using LF24-SR(-S) US actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo Wiring Guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position feedback or master-slave applications. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

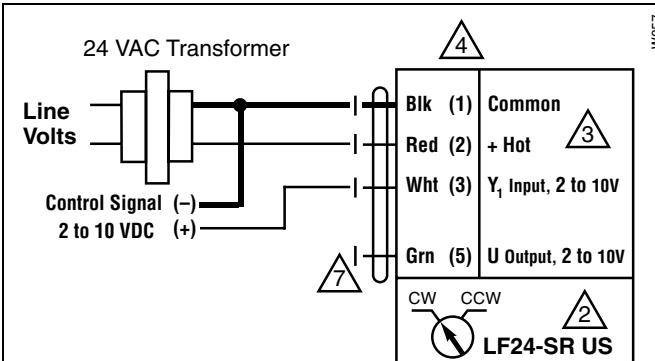
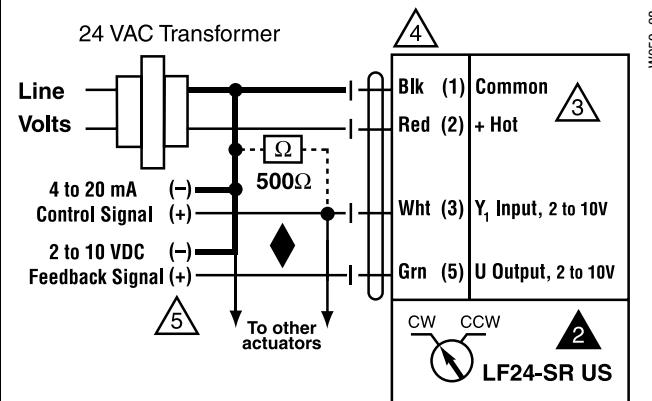
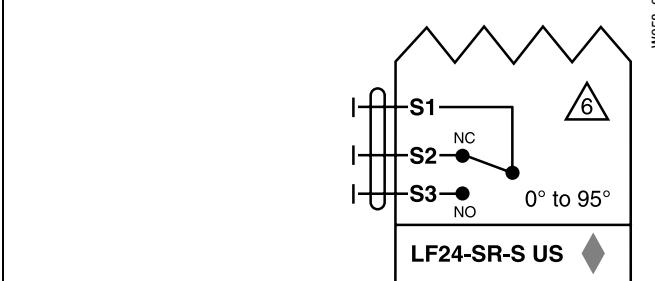
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor. Power consumption must be observed.
- 3 Actuator may also be powered by 24 VDC.
- 4 Actuators with plenum rated cable do not have numbers on wires; use color codes instead.
- 5 Only connect common to neg. (-) leg of control circuits
- 6 For end position indication, interlock control, fan startup, etc., LF24-SR-S US incorporates one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.
- 7 The LF24-SR-S US wire 5 is white.

APPLICATION NOTES

- ◆ Meets cULus requirements without the need of an electrical ground connection.
- ◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**2 to 10 VDC control of LF24-SR(-S) US****4 to 20 mA control of LF24-SR(-S) US with 2 to 10 VDC feedback output****Auxiliary switch of LF24-SR-S US**

W057

W059_08

W058_08

LF24-SR-E US

Proportional, Spring Return, 24 V, for 2 to 10 VDC, 4 to 20 mA Control Signal or 3-position On/Off Control with Minimum Position Potentiometer



Technical Data		LF24-SR-E US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection		3 ft, plenum rated cable 1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Control signal		Y 0 to 10 VDC, 0 to 20 mA, or 24 VAC for 3-position on/off control
Input impedance		100 kΩ
Operating range Y		2 to 10 VDC, 4 to 20mA between 0% and 100%
Feedback output U		2 to 10 VDC (max. 0.7 mA) for 95°
Angle of rotation		max. 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm]
Override function		Minimum, Open, Closed via spring Min-position adjusts on actuator cover between 0 and 100% (scaled 0 to 1)
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Running time (nominal)	motor	150 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 /IP54
Housing material		zinc coated metal
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running	< 30 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		3.2 lbs (1.45 kg)

- Torque min. 35 in-lb, for control of air dampers
- Built-in adjustable min-position for 3-position and proportional control

Application

For proportional control with minimum position setpoint, or three position control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to 24 VAC on wire 2 or 3, which allows the LF24-SR-E US to retrofit or replace Honeywell® M8405A actuators.

Operation

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The LF24-SR-E US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

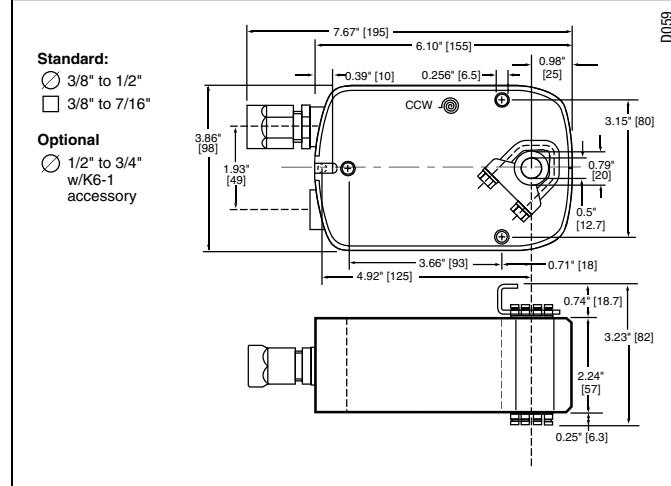
See wiring diagrams for LF24-SR-E US for more details on 3-position control.

Installation

Refer to LF Section of the Standard Actuation and Accessories, Technical Documentation.

Honeywell® is a trademark of Honeywell Inc.

Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for replacing Honeywell Mod IV, M6415 and M8405 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for replacing Honeywell Mod IV, M6415 and M8405 type actuators, and new installations
ZG-113	Mounting bracket kit for Honeywell W7459 logic module
ZG-ECON1	Mounting bracket kit for Honeywell M8405 economizer actuator retrofit and new installations
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using LF24-SR-E US actuators, only use accessories listed on this page.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. Actuator shall deliver a minimum output torque of 35 in-lbs. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500W resistor, a 4 to 20mA control input from an electronic controller. Actuator must have a built-in minimum position potentiometer. During 3-position control, the actuator shall drive to minimum position with 24 VAC on wire 2 and drive full open with 24 VAC on wire 3. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 feedback signal shall be provided for position feedback or master-slave applications. The actuator must be designed so that they may be used for either clockwise or counterclockwise failsafe operation. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Three-Position Control Signals

Switch A	Wire 2-Red (x)	Wire 3-White (D)	Position
Open**	Any	Any	Closed (via spring)
Closed	24 VAC	Open	Mid-position*
Closed	Open	24 Vac	Full Open*
Closed	24 VAC	24 VAC	Full Open*

*Desired position achieved by driving actuator with motor.

**An example would be to interlock the actuator power supply with the fan motor starter.

Wiring Diagrams

INSTALLATION NOTES

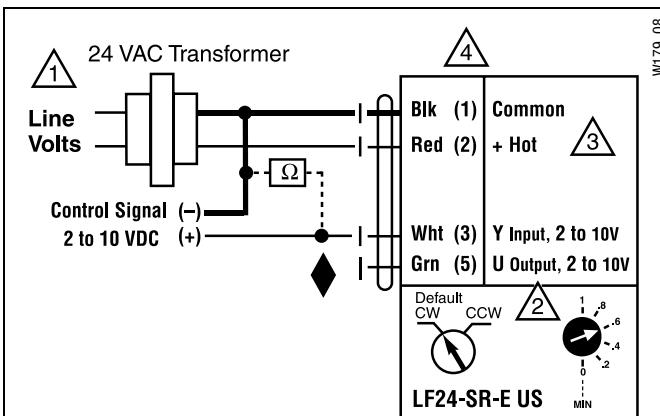
-  Provide overload protection and disconnect as required.
 -  ***CAUTION Equipment Damage!***
 - Actuators may be connected in parallel.
 - Power consumption and input impedance must be observed.
 -  Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.
 -  Actuator may also be powered by 24 VDC.
 -  Actuators with plenum rated cable do not have numbers on wires; use color codes instead.
 -  Switch A, actuator spring returns when open (e.g., fan interlock).

APPLICATION NOTES

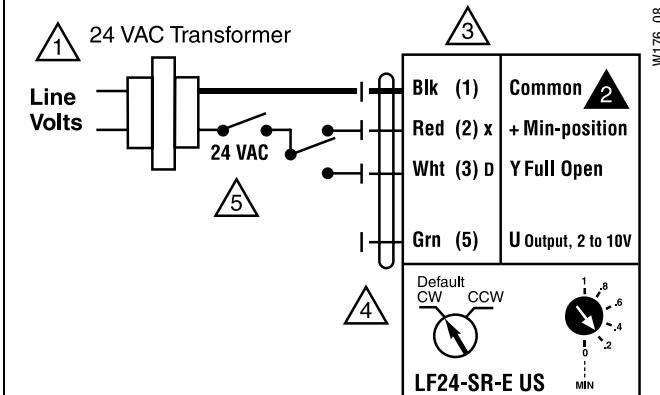
- The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

 **WARNING** Live Electrical Components!

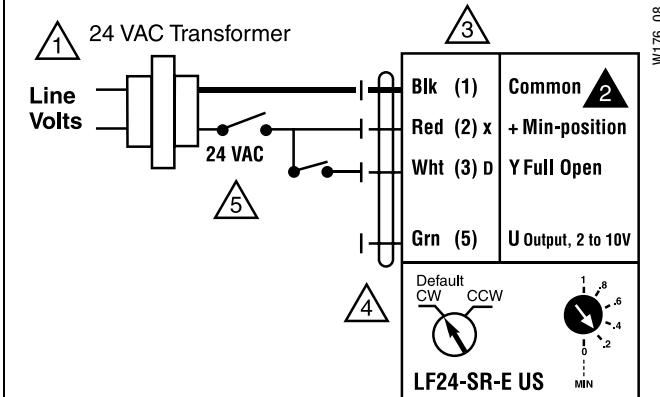
 During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



2 to 10 VDC control of LF24-SR-E US



**3-position control with a SPDT switch or two contact closures
(e.g. fan, cooling Y)**



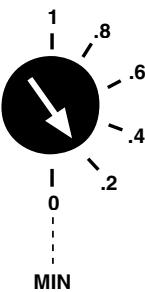
Min-position with Full Open override (with a single contact closure)

Application of the LF24-SR-E US with Minimum Position Potentiometer

The LF24-SR-E US is the newest addition to the LF-series product range featuring dual functionality. A minimum position potentiometer has been built into the actuator for cost effective proportional and three position applications, e.g. economizer dampers in rooftop units.

Proportional Control with Minimum Position

Minimum position is adjustable using the built-in potentiometer on the cover of the LF24-SR-E US. The minimum position can be adjusted anywhere over the full 0 to 95° range of the actuator. A 2 to 10 VDC input proportionally controls the actuator to the set-point position. The actuator electronics see both the 2 to 10 VDC input and the input signal from the potentiometer (minimum position setting). The actuator's electronics select between the higher of these two signals. Therefore, the actuator moves to the position of the higher signal, which is the same operating characteristic the Belimo -SR actuators exhibit with the Belimo SGA24 and SGF24 positioners.



LF24-SR-E US Operates as Follows:

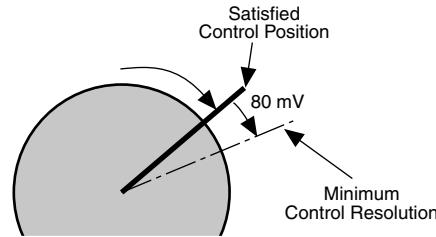
1. Set desired minimum position (Example 20%), while leaving the direction of rotation switch in the CW (default) position.
2. With power applied to wire 2 (red), the actuator will maintain the desired minimum position.
3. Applying a signal higher than that set by the minimum position potentiometer. In this example the input DC voltage must be greater than 3.6 VDC to move the actuator toward full open.
4. Changing the position of the direction of rotation switch to CCW will reverse the actuator's control logic. If only the position of the direction of rotation switch is changed, then the actuator will move from 20% to 80%. The scale is now reverse from the default (e.g. 10VDC moves the actuator to 0).
5. Typically, power to the actuator is interlocked with the fan relay, which causes the actuator to spring return closed if the fan de-energizes.

Control Accuracy and Stability

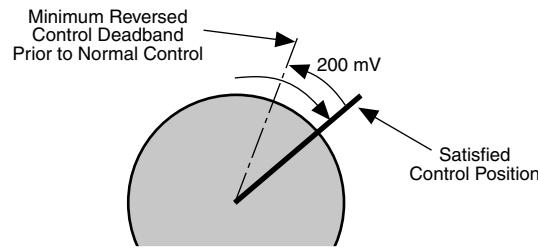
LF24-SR-E US actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The LF24-SR-E US actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 80 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 250 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

LF Actuator responds to a 80 mV signal when not changing direction from stop position.



LF Actuator responds to a 200 mV signal when reversing direction from stop position.



Three-Position Control Using the LF24-SR-E US

By applying the LF24-SR override functionality and the new minimum position potentiometer, it is possible to achieve simple three-position control with the LF24-SR-E US.

1. Set desired minimum position (Example 20%), while leaving the direction of rotation switch in the CW (default) position. The direction of rotation switch does not need to be changed for three-position control, because direction of rotation can be changed by flipping the actuator.
2. With 24 VAC power applied across wire 1 (black) and 2 (red), the actuator will maintain minimum position.
3. Applying 24 VAC power across wire 1 (black) and 3 (white) overrides the minimum position and moves the actuator to Full Open.
4. With no power applied to actuator, it will spring return (fail-safe) closed.
5. Typically, power to the actuator is interlocked with the fan relay, which causes the actuator to spring return closed if the fan de-energizes.

Features of the Belimo Three-Position Solution

The LF24-SR-E US will:

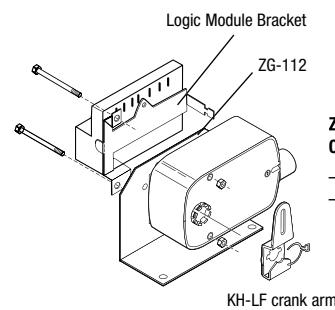
- Direct couple to the damper shaft between 3/8" and 3/4" diameter for reduced installation cost.
- Spring return in either CW or CCW direction depending on mounting orientation of the actuator. This feature eliminates the need to select a specific model with correct spring return direction.
- Spring returns in <25 seconds @ -4° to 122°F.
- Increase minimum torque output to 35 in-lbs for 40% more torque than other 3-position actuator solutions.
- Drive to the adjustable minimum position from either the fully Open or Closed position using its brushless DC motor for improved reliability. Spring returns only during power loss.
- Drive full stroke in 150 seconds.
- Output a 2 to 10 VDC signal for position feedback
- Control a damper proportionally between minimum position and full open (2 to 10 VDC input) for additional applications.
- Have dual (3-position and proportional control) wiring diagrams on actuator label for clear and easy wiring in the field.
- Consumes only 2.5 W driving to setpoint and 1 W to hold position, lower than actuators using AC motor technology.

Replacing an M8405 Actuator

The three-position control functionality of the LF24-SR-E US allows direct replacement of a Honeywell M8405A foot mounted economizer actuator.

Mounting

For non-direct coupled applications use the ZG-ECON1 accessory kit, which includes the KH-LF crank arm, ZG-112 bracket and logic module bracket (20477-00001). The ZG-112 aligns the plane of the crank arm with that of the Honeywell M8405A and has at least two mounting holes that match the M8405A foot pattern. The logic module bracket allows for attachment to the end of the LF24-SR-E US actuator. It provides for installation flexibility to place the module where space is available.



**ZG-LF112
Crank arm adaptor kit**

- Includes bracket and KH-LF crank arm.
- Bracket and crank arm for replacement of Honeywell M8405 actuators.

Wiring

For proper control logic wiring always refer to the controller manufacturer's documentation. See the Product Documentation Standard Actuation and Accessories for proper three position wiring diagram Belimo wiring diagram booklet.

LF24-ECON-R03(-R10) US

Proportional, Spring Return, 24 V, for Stand-Alone Economizer Damper Control Using 3 kΩ or 10 kΩ Mixed Air Sensor, Built-in Minimum Position Adjustment



Technical Data		LF24-ECON-R03(-R10) US
Power supply		24 VAC ± 20% 50/60 Hz 24 VDC ± 10%
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection		3 ft, plenum rated cable 1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Control signal, Y1 (LF24-ECON-R03 US)		3 kΩ NTC Type 10 thermistor, 3 kΩ @ 77°F (25°C) MA setpoint = 55°F
Input impedance		100 kΩ
Feedback output U		2 to 10 VDC (max. 0.7 mA) for 95°
Angle of rotation		max. 95°, adjust. with mechanical stop
Torque		35 in-lb [4 Nm]
Override function		See override control table on opposite page
Direction of rotation	spring motor	reversible with cw/ccw mounting reversible with built-in switch
Position indication		Visual indicator, 0° to 95° scaled as 0 to 1 (0° is spring return position)
Running time	motor spring	95 sec constant, independent of load < 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 /IP54
Housing material		zinc coated metal
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Noise level (max)	running spring return	< 30 db (A) 62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		3.2 lbs (1.45 kg)

LF24-ECON-R10 US

Control Signal, Y1	10 kΩ NTC Type 7 thermistor, 10 kΩ @ 77°F (25°C) MA setpoint = 55°F
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- Torque min. 35 in-lb, for control of air dampers
- Built-in adjustable min-position
- Integrated mixed air PI-control

Application

For proportional control of mixed air setpoint on economizer dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to 3 kΩ or 10 kΩ thermistor, which allows the LF24-ECON... to retrofit or replace Honeywell® M7415 actuators.

Operation

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides constant torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 90°.

The LF24-ECON-R03 (-R10) US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

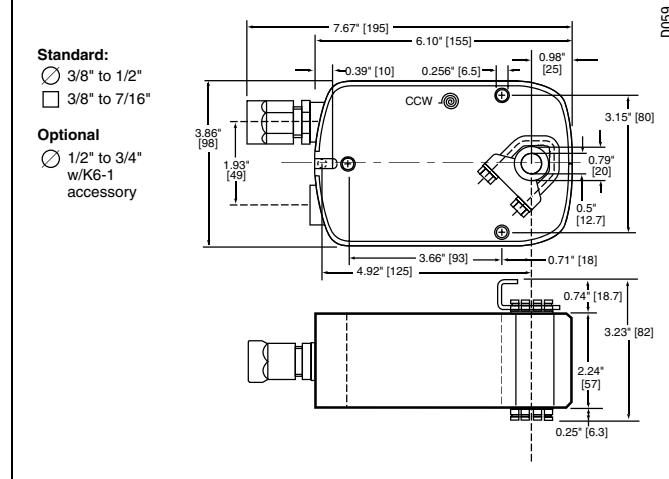
See wiring diagrams for LF24-ECON-R03 US for more details on 3-position control.

Installation

Refer to LF Section of the Standard Actuation and Accessories, Product Documentation.

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Dimensions (Inches [mm])



Accessories

AV 10-18	Shaft extension (K6-1 is required)
IND-LF	Damper position indicator
K6-1	Universal clamp for up to 3/4" diameter shafts
KH-LF	Crank arm for up to 1/2" round shaft
Tool-06	8mm and 10 mm wrench
ZG-LF2	Crank arm adaptor kit for LF
ZG-112	Mounting bracket for replacing Honeywell Mod IV, M7415 type actuators, and new installations
ZG-LF112	Crank arm adaptor kit for replacing Honeywell Mod IV, M7415 type actuators, and new installations
20477-00001	Mounting bracket for Honeywell W7459 logic module
ZG-ECON1	Mounting bracket kit for Honeywell M7415 economizer actuator retrofit and new installations
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using LF24-ECON-R03 (R10) US actuators, use accessories listed on this page.

Typical Specification

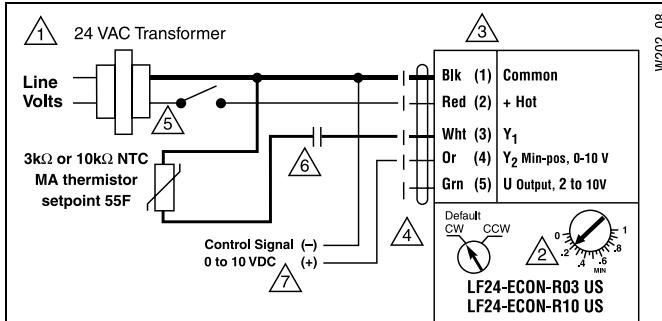
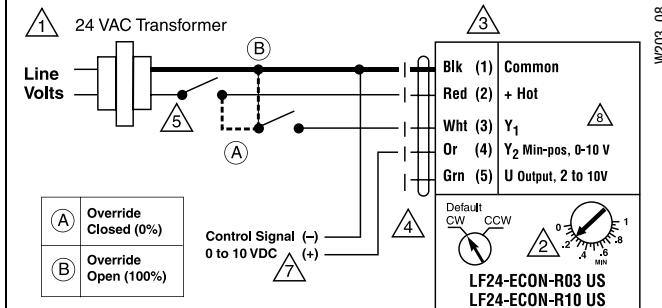
Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center a 1/2" shaft. Actuator shall deliver a minimum output torque of 35 in-lbs. The actuator must provide proportional damper control in response to a 3 kΩ or 10 kΩ NTC thermistor, 55°F setpoint. Actuator must have a built-in minimum position potentiometer. Actuator must have minimum position override via 0 to 10VDC on wire 4. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be independent of torque load. A 2 to 10VDC feedback signal shall be provided for position feedback or master-slave applications. The actuator must be designed so that they may be used for either clock-wise or counterclockwise fail safe operation. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo

Wiring Diagrams**✗ INSTALLATION NOTES**

- 1 Provide overload protection and disconnect as required.
- 2 Min-position is adjustable from 0 to 100% with a potentiometer on the actuator cover.
- 3 Actuators with plenum rated cable do not have numbers on wires; use color codes instead.
- 4 CW (default) indicates that motor drive starts at zero position.
- 5 A relay or switch can spring return the actuator when the RTU fan de-energizes, or if low ambient temperature is sensed.
- 6 A standard relay can be used to close the sensor circuit to engage economizer mode, e.g. outside air changeover device like a dry bulb or enthalpy limit switch. Honeywell® logic module W7459A and enthalpy sensor C7400 also provide terminals for this switching.
- 7 A remote CO2 sensor or DDC controller with a 0 to 10 VDC output can change the standard relay or can be used to open and close the sensor circuit. This device can be a relay or a dry bulb/enthalpy limit switch.
- 8 Override control for Y2 only accepts 0 to 10 VDC override control.

⚠ WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

**Standard Economizer Mode Wiring****Override****Override Control**

Wire	Input Signal	LF24-ECON... Position	Application
Y1	24 VAC	Drive closed (0%)	Morning warm-up cycle
Y1	Common	Drive open (100%)	Smoke Purge
Y1	Open wire	Drive to min position	Mechanical cooling in use, RTU thermostat calls for heat
Y2	0 VDC to 10 VDC	Min position of 0% to 100%	Override potentiometer via a remote CO2 sensor/controller or DDC controller

Operation LF24-ECON-R03(-R10) US

The LF24-ECON-R03(-R10) US provides a direct coupling solution for RoofTop Unit(RTU) economizer dampers.

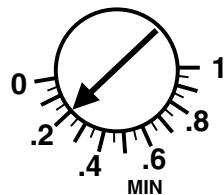
Control of Mixed Air in Typical Economizer Dampers

Occupied - Economizer Mode

The LF24-ECON-R03 (-R10) US enters Economizer Mode when either an external relay or controller (e.g. Honeywell® W7459A) completes the circuit between the actuator wire 3(Y1) and MA sensor. In this mode, the actuator moves proportionally to maintain a MA set-point of 55°F(fixed). A proportional band of 6°F modulates the actuator between 53 and 58°F. Also, a +/-1°F dead band eliminates hunting of the actuator, while maintaining suitable temperatures in the RTU mixed air chamber.

Occupied – Mechanical CH (Cooling or Heating) Mode

The LF24-ECON-R03(-R10) US enters Mechanical CH Mode when either an external relay or controller (e.g. Honeywell® W7459A) breaks the circuit between the actuator wire 3(Y1) and MA sensor. In this mode, the actuator drives to minimum position. Minimum position can be set on built-in potentiometer, or set remotely by sending a 0 to 10 VDC signal to wire 4(Y2) via a SGA24 or DDC controller.

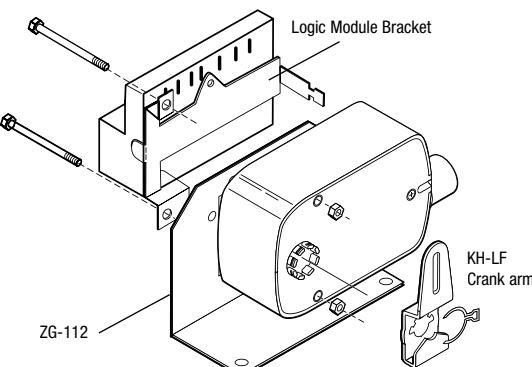


Unoccupied

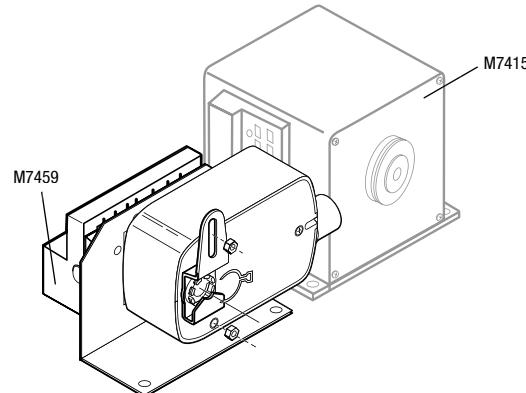
RTU Economizer damper actuators typically interlock actuator supply power with RTU fan motor starter/relay. This set-up ensures that the actuator spring returns the economizer damper closed during periods when the ventilation air is not required.

MA Dry Bulb Temperature	LF24-ECON... Position
< 53°F	Min. position
53°F < MAT < 58°F	Modulates between Min. Position and 100% open
> 58°F	100% open

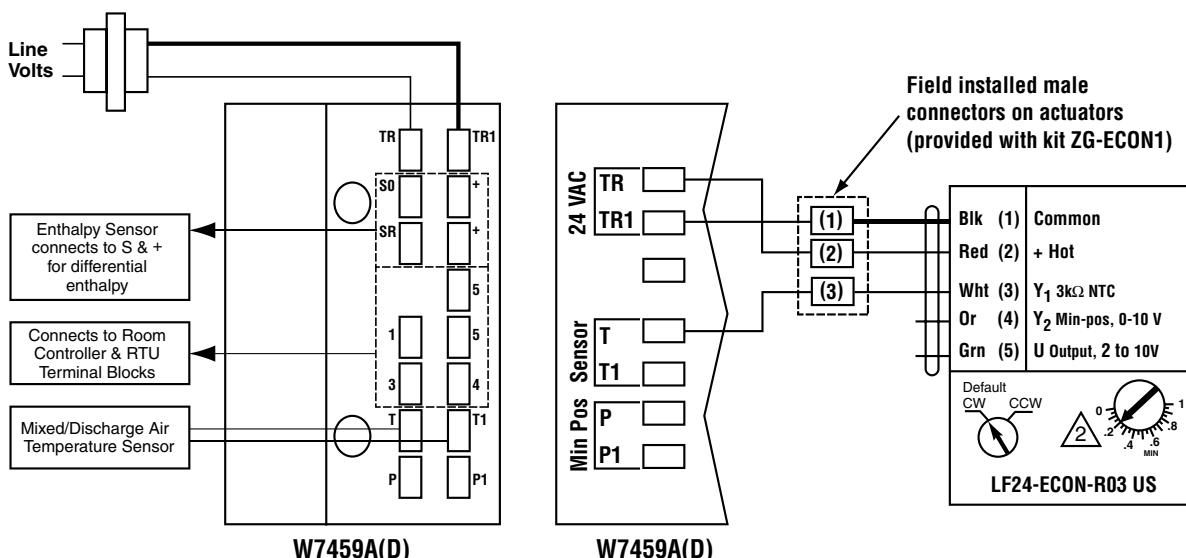
Mounting

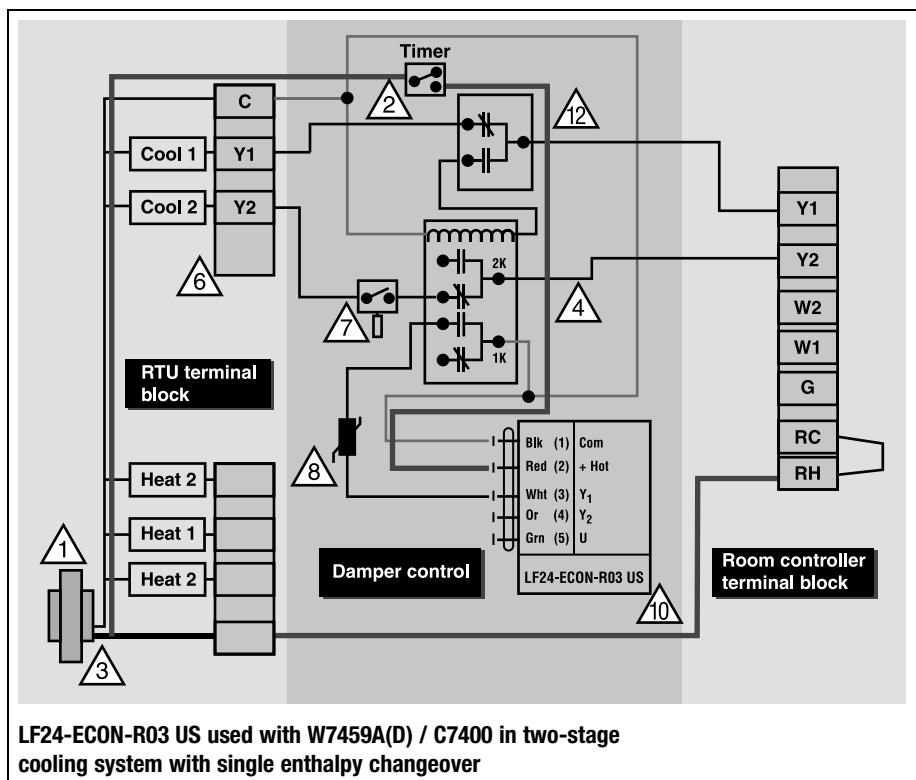


Replacing an Honeywell® M7415 actuator



Wiring Diagram for Installation of the LF24-ECON-R03 US





LF24-ECON-R03 US used with W7459A(D) / C7400 in two-stage cooling system with single enthalpy changeover

Wiring Diagrams

INSTALLATION NOTES

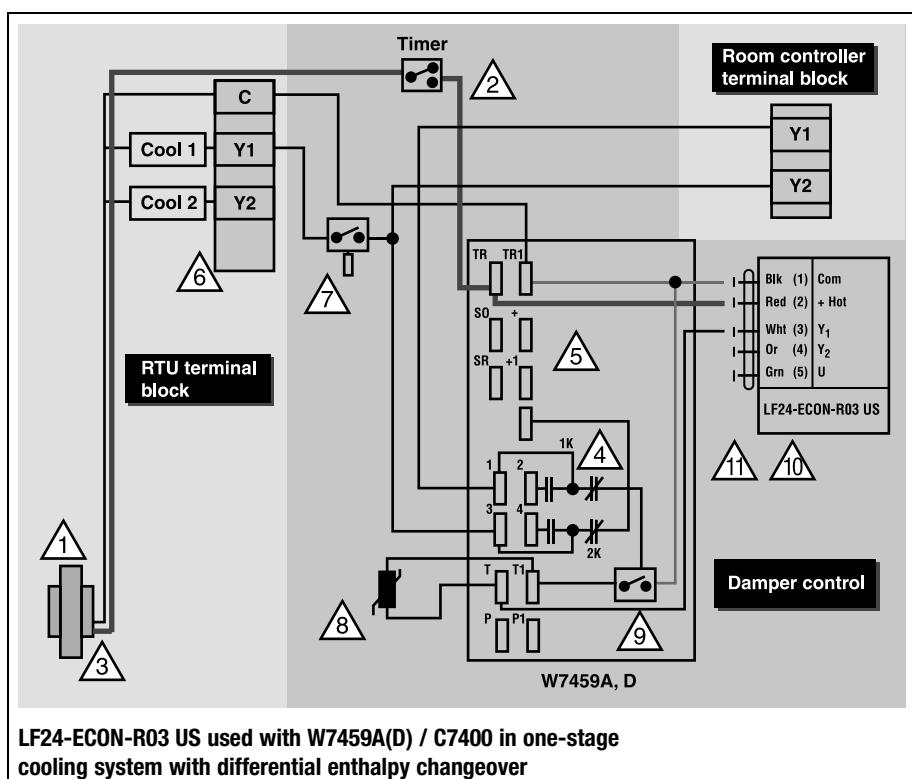
- (1) Power supply is 24VAC transformer. Provide overload protection and disconnect as required.
- (2) A fan delay relay should be interlocked with both fan and actuator power to ensure the actuator spring returns when the RTU fan de-energizes. A time clock for occupied or unoccupied mode is shown. The actuator spring returns in unoccupied mode.
- (3) Be sure the transformer is sized to accommodate the actuator, control module and other devices for economizer control.
- (4) Relays 1K and 2K actuate when the enthalpy sensed by the C7400 is higher than the enthalpy setpoint A-D..
- (5) Factory installed 620 OHM, 1 Watt 5% Resistor should be removed only if a C7400 enthalpy sensor is added to SR and + for differential enthalpy.
- (6) The heating, fan and power terminals of the RTU and room thermostat are not shown to simplify the wiring diagram. Typically there is a direct wiring connection between terminals W1, W2, G and R on both terminal strips. In addition the R terminal from the RTU connects to the RC or RH terminal on the thermostat. RH and RC are jumpered on the thermostat to ensure power gets to both the cooling and heating relays.

(7) The ambient lockout controller sets a low limit of 50 degrees F. This set-up ensures the compressors for mechanical cooling remain off at lower temperatures.

- (8) Mixed/Discharge air temperature sensor is used to regulate discharge air temperature by changing damper position of the LF24-ECON-R03(-R10) US. This switch contacts when 24V power is applied from the relays in note 4.
- (9) The LF24-ECON-R03(-R10) US provides a 2 to 10 VDC output indicating position.
- (10) A remote CO₂ sensor or DDC controller with a 0 to 10 VDC output can change the standard relay or can be used to open and close the sensor circuit. This device can be a relay or a dry bulb/enthalpy limit switch.
- (11) When conditions are met the dry bulb or enthalpy limit switch changes over the economizer from mechanical cooling to 100% outside air free cooling. This switch completes the circuit between the thermistor and the Y1 input on the actuator.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



LF24-ECON-R03 US used with W7459A(D) / C7400 in one-stage cooling system with differential enthalpy changeover



MFT

5
YEAR
WARRANTY

Technical Data		LF24-MFT(-S) US
Power supply		24 VAC, ± 20%, 50/60 Hz 24 VDC, ±10%
Power consumption	running	2.5 W
	holding	1.0 W
Transformer sizing		5 VA (Class 2 power source)
Electrical connection	(-S models have 2 cables)	3 ft, 18 GA, appliance cables 1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y*		2 to 10 VDC 4 to 20 mA (w/500 Ω, 1/4 Ω resistor) ZG-R01
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point and on/off control
Feedback output U*		2 to 10 VDC, 0.5 mA max
Torque		min 35 in-lb (4 Nm)
Direction of rotation*	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Mech. angle of rotation*		max 95°, adjust with mechanical stop
Running time	motor*	150 sec constant
	spring	<25 sec @ -4°F to 122°F [-20°C to 50°C] <60 sec @ -22°F [-30°C]
Angle of rotation adaptation*		off (default)
Override control*		Min. (Min. Position) = 0% - ZS (Mid. Position) = 50% - Max. (Max. Position) = 100%
Position indication		visual indicator, 0° to 95°
Humidity		5 to 95% RH, non-condensing
Ambient temperature		-22 to 122°F (-30 to 50°C)
Storage temperature		-40 to 176°F (-40 to 80°C)
Housing		NEMA 2, IP54
Housing material		zinc coated metal
Noise level		less than 45 dB (A)
Agency listings		CULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Quality standard		ISO 9001
Servicing		maintenance free
Weight		3.1 lbs [1.4 kg], 3.2 lbs [1.45 kg] with switch

* Variable when configured with MFT options

LF24-MFT-S US

Auxiliary switches	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95° (double insulated)
--------------------	--

- Torque min. 35 in-lb
- Control 2 to 10 VDC (DEFAULT)
- Feedback 2 to 10 VDC (DEFAULT)

Application

For proportional modulation of dampers and control valves in HVAC systems. The LF24-MFT US provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 2 to 10 VDC applications of the LF24-MFT US actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool software application.

Operation

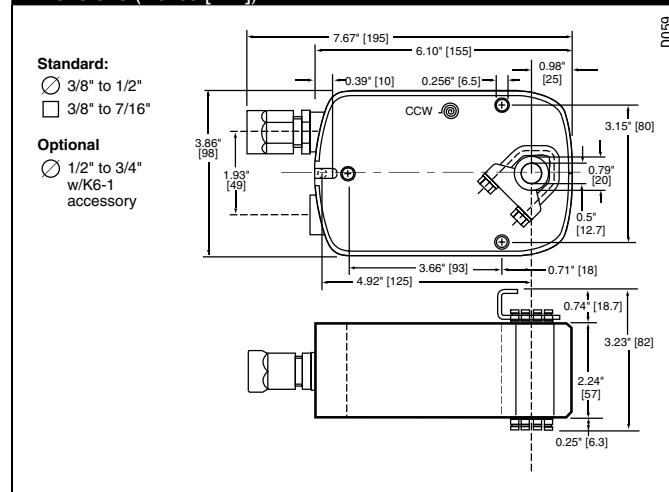
The LF24-MFT US actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the damper or valves mechanical stop and use this point for its zero position during normal control operations.

The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The LF24-MFT US is mounted directly to control shafts up to 3/4" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption. The LF24-MFT US actuator is shipped in the zero position, compression against seats or gaskets for tight shut-off is accomplished manually.

NOTE: Please see documentation on Multi-Function Technology.

Dimensions (Inches [mm])



Wiring Diagrams**INSTALLATION NOTES**

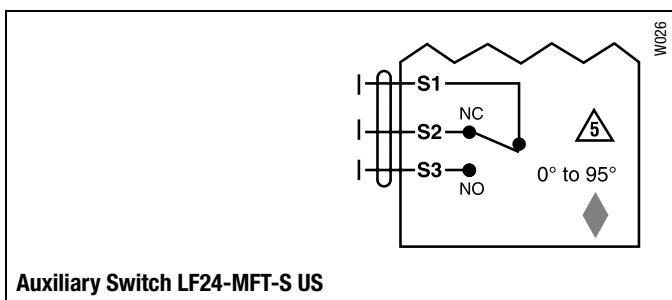
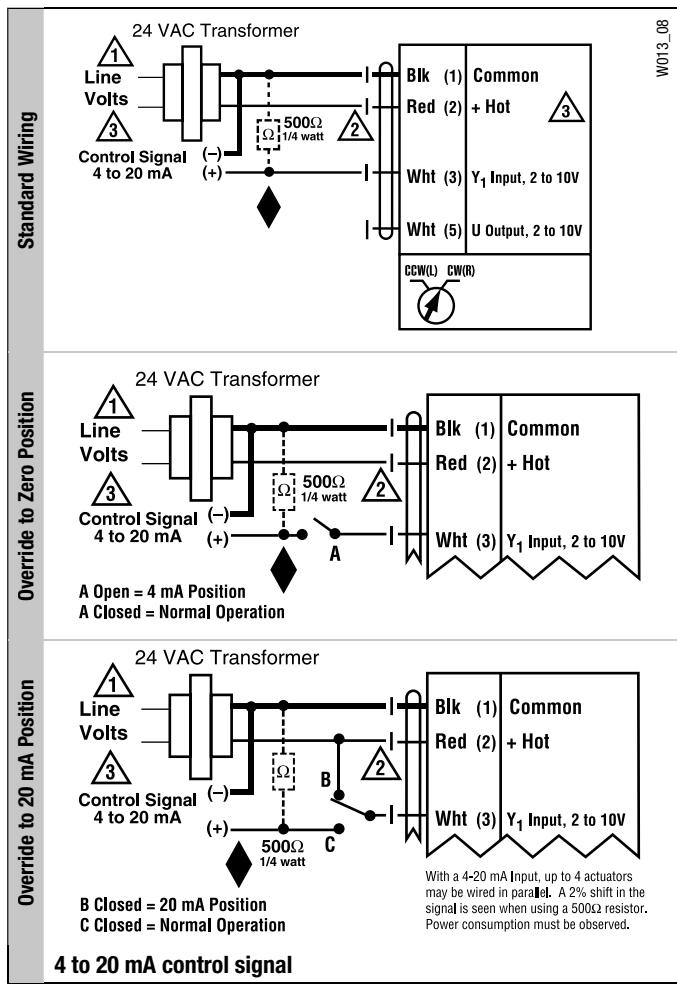
- 1** Provide overload protection and disconnect as required.
- 2** **CAUTION Equipment Damage!** Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3** Actuators may also be powered by 24 VDC.
- 4** The Common connection from the actuator must be connected to the Hot connection of the controller.
- 5** For end position indication, interlock control, fan startup, etc., LF24-MFT-S US incorporates one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

APPLICATION NOTES

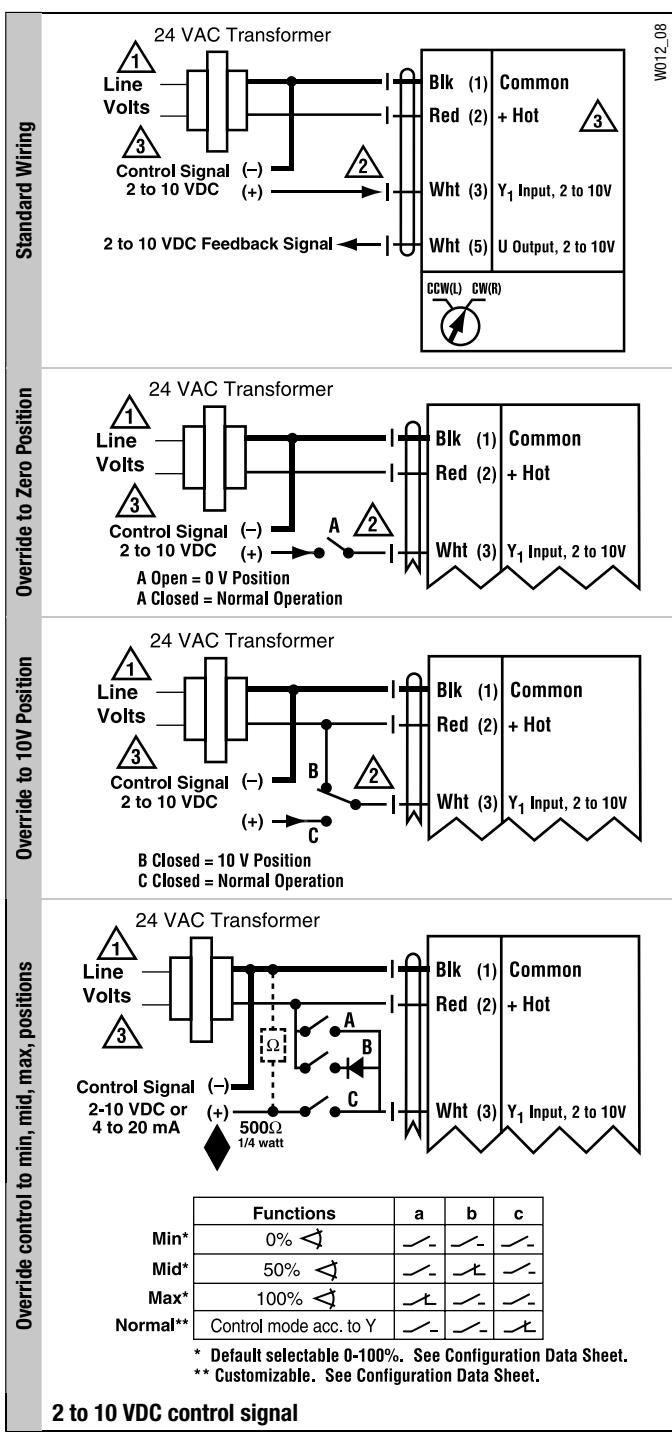
- ◆ Meets cULus requirements without the need of an electrical ground connection.
- ◆ The ZG-R01 500 Ω resistor may be used.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



Auxiliary Switch LF24-MFT-S US



2 to 10 VDC control signal

LF24-MFT(-S)-20 US

Proportional, Spring Return, 24 V, for 6 to 9 VDC

Output Power Supply 20 VDC Provides Power to Controllers



MFT



Technical Data		LF24-MFT(-S) -20 US
Power supply		24 VAC, ± 20%, 50/60 Hz 24 VDC, ±10%
Power consumption	running	3 W
	holding	1.5 W
Transformer sizing		6 VA (Class 2 power source)
Electrical connection	(-S models have 2 cables)	3 ft, 18 GA, appliance cable 1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y*		6 to 9 VDC (Default), P-10005
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point and on/off control
Feedback output U*		2 to 10 VDC, 0.5 mA max
Torque		35 in-lb (4 Nm)
Direction of rotation*	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Angle of rotation*		max 95°, adjustable with mechanical stop
Mechanical angle of rotation*		limited to 95°
Running time	motor*	150 sec constant
	spring	<25 sec @-4°F to 122°F [-20°C to 50°C] <60 sec @-22°F [-30°C]
Angle of rotation adaptation*		off (default)
Override control*		Min. (Min. Position) = 0% - ZS (Mid. Position) = 50% - Max. (Max. Position) = 100%
Position indication		visual indicator, 0° to 95° (0° is spring return position)
Humidity		5 to 95% RH, non-condensing
Ambient temperature		-22 to 122°F (-30 to 50°C)
Storage temperature		-40 to 176°F (-40 to 80°C)
Housing		NEMA 2, IP54
Housing material		zinc coated metal
Noise level	running	< 30 db (A)
	spring return	62 dB (A)
Agency listings		cULus acc. to UL 873 and CAN/CSA C22.2 No. 24-93
Quality standard		ISO 9001
Servicing		maintenance free
Weight	LF24-MFT-20 US	3.1 lbs (1.40 kg)
	LF24-MFT-S-20 US	3.2 lbs (1.45 kg)

* Variable when configured with MFT options

LF24-MFT-S-20 US

Auxiliary switches	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95° (double insulated)
--------------------	--

- Torque min. 35 in-lb
- Control 6 to 9 VDC (DEFAULT)
- Feedback 2 to 10 VDC (DEFAULT)
- 20 VDC power output

Application

For proportional modulation of dampers and control valves in HVAC systems. The LF24-MFT(-S)-20 US provides mechanical spring return operation for reliable fail-safe application.

Default/Configuration

Default parameters for 6 to 9 VDC applications of the LF24-MFT(-S)-20 US actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool software application.

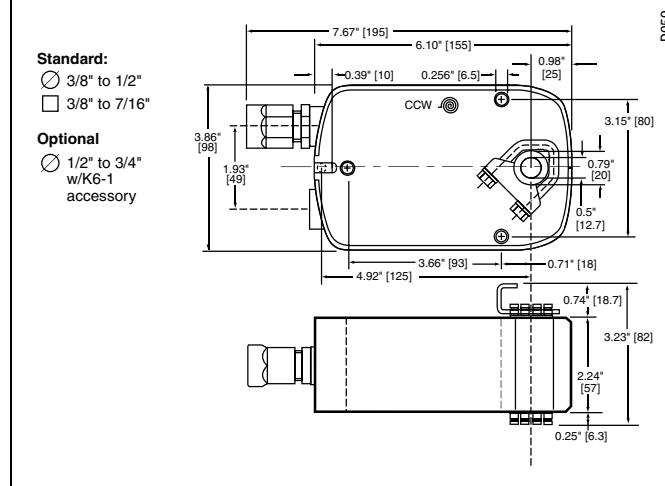
Operation

The LF24-MFT(-S)-20 US actuator provides 95° of rotation and is provided with a graduated position indicator showing 0° to 95°. The actuator will synchronize the 0° mechanical stop or the damper or valves mechanical stop and use this point for its zero position during normal control operations.

The actuator uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact position. The ASIC monitors and controls the brushless DC motor's rotation and provides a Digital Rotation Sensing (DRS) function to prevent damage to the actuator in a stall condition. The position feedback signal is generated without the need for mechanical feedback potentiometers using DRS. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

The LF24-MFT(-S)-20 US is mounted directly to control shafts up to 3/4" diameter by means of its universal clamp and anti-rotation bracket. A crank arm and several mounting brackets are available for damper applications where the actuator cannot be direct coupled to the damper shaft. The spring return system provides minimum specified torque to the application during a power interruption. The LF24-MFT(-S)-20 US actuator is shipped in the zero position, compression against seats or gaskets for tight shut-off is accomplished manually.

Dimensions (Inches [mm])



Wiring Diagrams**INSTALLATION NOTES**

- 1** Provide overload protection and disconnect as required.
- 2** **CAUTION Equipment Damage!**
Actuators may be connected in parallel.
Power consumption and input impedance must be observed.
- 3** Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.

- 4** Actuator may also be powered by 24 VDC.
- 5** For end position indication, interlock control, fan startup, etc., LF24-MFT(-S)-20 US incorporates one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.
- A** 24 VAC: Black/Blue
120 VAC: White
240 VAC: White/Black
Belimo modulating actuators are 24 VAC/DC, if 120 or 240 is available an external transformer is required.

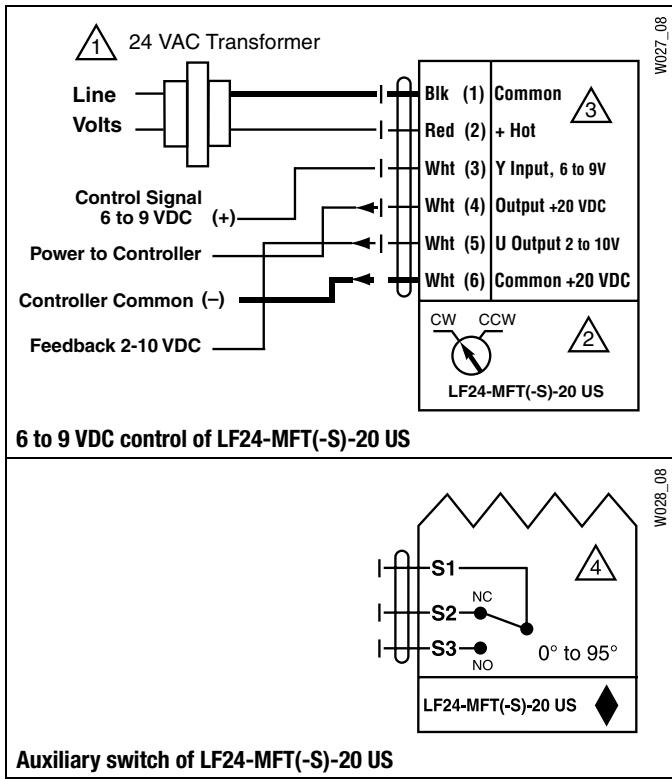
- B** Maximum of 2
- C** MP-52XX-500 models include internal SPDT auxiliary switch.

APPLICATION NOTES

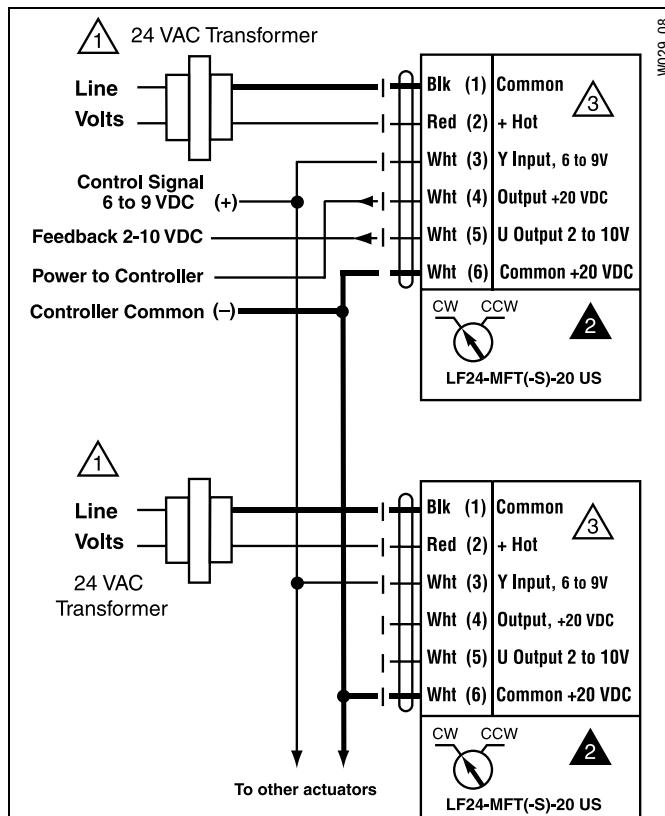
- ◆** Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

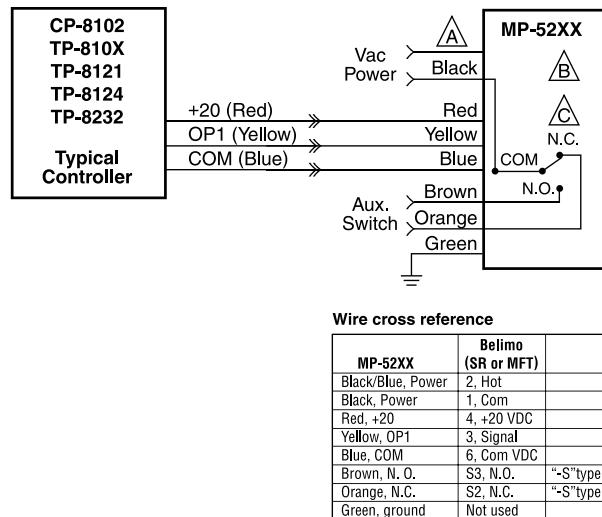
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



Auxiliary switch of LF24-MFT(-S)-20 US



Multiple LF24-MFT(-S)-20 US actuators from one controller



Typical Control Wiring for MP-52XX Series Actuators to Controllers Requiring External 20 VDC Power Supply.

Installation Instructions

Quick-Mount Visual Instructions for Mechanical Installation

BELIMO

Quick-Mount Visual Instructions

1. Rotate the damper to its failsafe position. If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out. If it rotates clockwise, mount the actuator with the "CW" side out.
2. If the universal clamp is not on the correct side of the actuator, move it to the correct side.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

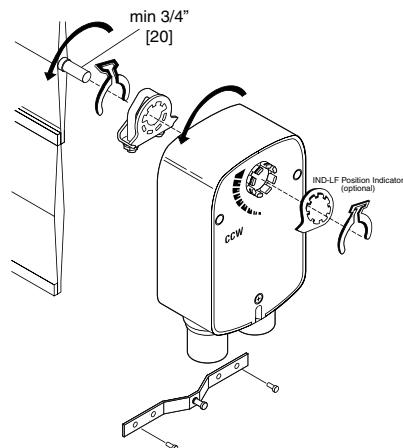
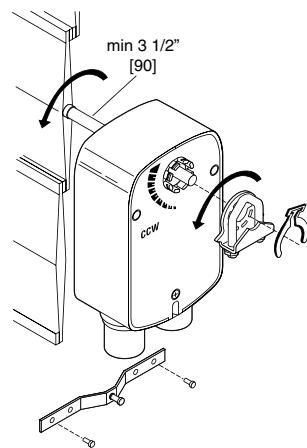
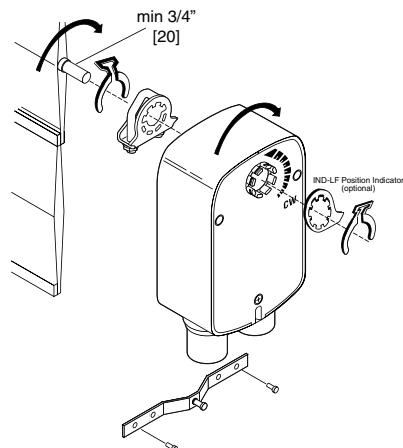
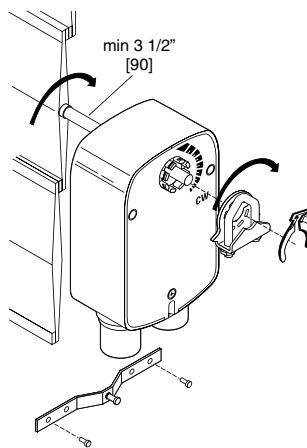
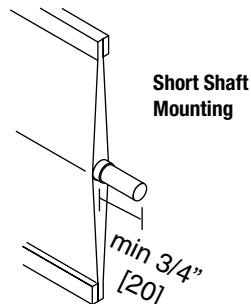
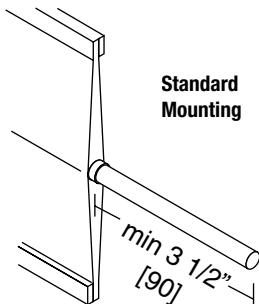
NOTE: Read the "Standard Mounting" instructions, on the next page, for more detailed information.

Preliminary Steps

1. Belimo actuators should be mounted indoors in dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator (See *Belimo Mechanical Accessories*).
2. For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft.
3. For standard mounting, the damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3 1/2", the actuator may be mounted in its short shaft configuration. If an obstruction blocks access, the shaft can be extended with the AV 10-18 shaft extension. (K6-1 is required)



Dimensions (Inches [mm])



Mechanical Operation

The actuator is mounted directly to a damper shaft up to 1/2" in diameter by means of its universal clamp, or up to a 3/4" shaft with the optional K6-1 clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The LF...-S versions are provided with 1 built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

Standard Mounting / Airtight Damper Procedure

- See **Figure B**. Manually move the damper to the fail-safe position (a) (usually closed). If the shaft rotated counterclockwise (↖), this is a CCW installation. If the shaft rotated clockwise (↗), this is a CW installation. In a Left Hand installation, the actuator side marked "CW" faces out, while in a CW installation, the side marked "CCW" faces out. All other steps are identical.
- The actuator is usually shipped with the universal clamp mounted to the "CW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CW" (or the "CCW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
- If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out, position the clamp so that the pointer section of the tab is pointing to 0° (see **Figure C**) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.)
- Lock the clamp to the actuator using the retaining clip.
- Verify that the damper is still in its full fail-safe position (a).
- Mount the spring return actuator to the shaft. Tighten the universal clamp, finger tight only.
- Mount the anti-rotation strap at the base of the actuator. Do not tighten the screws.
- Remove the screw from one end of the mounting bracket and pivot it away from the actuator.
- Loosen the universal clamp and, making sure not to move the damper shaft, rotate the actuator approximately 5° in the direction which would open the damper.
- Tighten the universal clamp to the shaft.
- Rotate the actuator to apply pressure to the damper seals (b) and re-engage the anti-rotation strap (c).
- Tighten all fasteners.

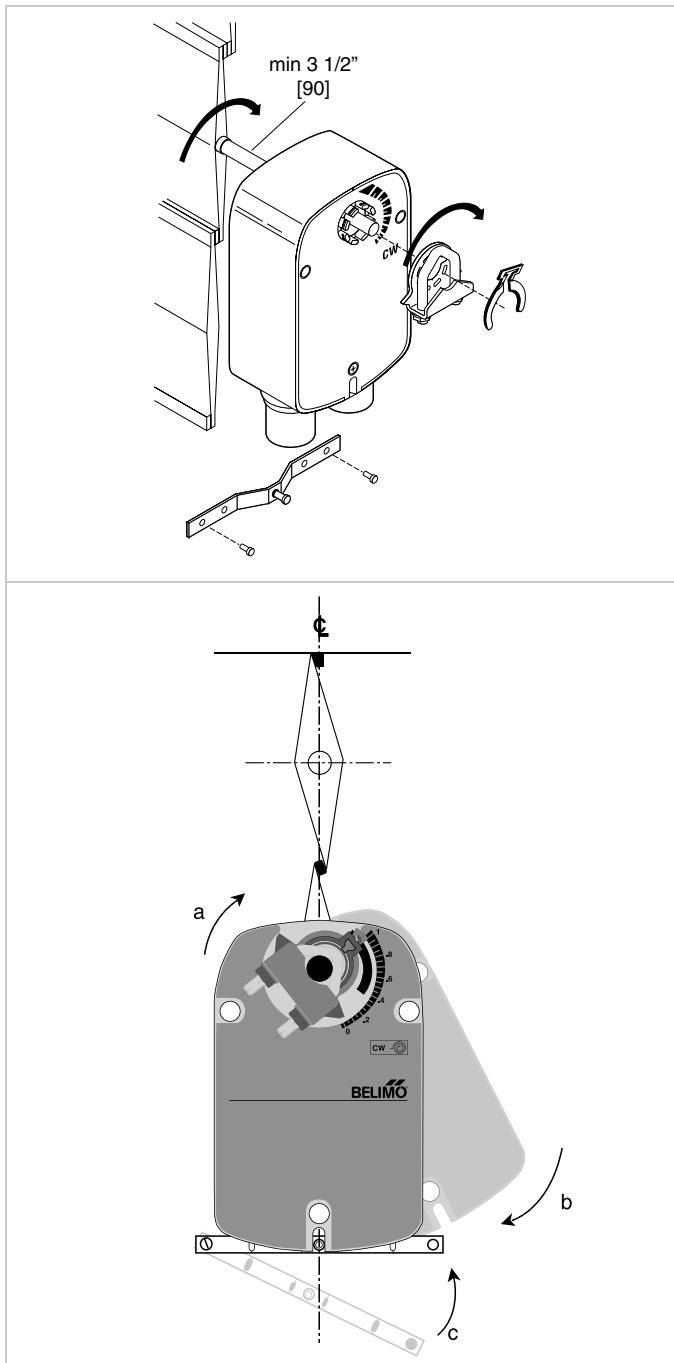


FIGURE B – Standard Mounting (Dimensions in Inches [mm])

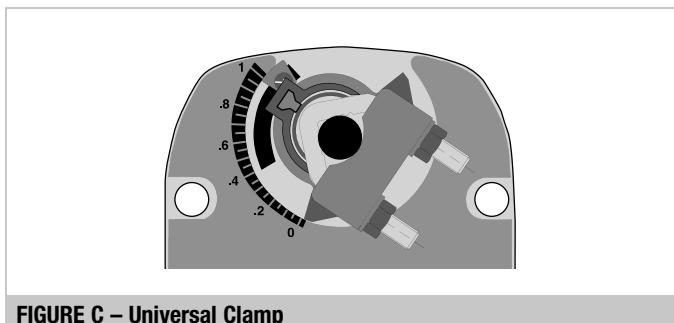


FIGURE C – Universal Clamp

Installation Instructions

Mechanical Installation

BELIMO®

Short Shaft Mounting with IND-LF Position Indicator / Airtight Damper Procedure

If the shaft extends at least 3/4" from the duct, follow these steps:

1. (See **Figure D**) Move damper blades to the fail-safe position (a).
2. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
3. Engage the clamp to the actuator as close as possible to the determined location.
4. Lock the clamp to the actuator using the retainer clip.
5. Mount the spring return actuator to the shaft. Tighten the universal clamp, finger tight only.
6. Mount the anti-rotation strap at the base of the actuator. Do not tighten the screws.
7. Remove the screw from one end of the mounting bracket and pivot it away from the actuator.
8. Loosen the universal clamp and, making sure not to move the damper shaft, rotate the actuator approximately 5° in the direction which would open the damper.
9. Verify that the damper is still in its full fail-safe position.
10. Tighten the universal clamp to the shaft.
11. Rotate the actuator to apply pressure to the damper seals (b) and re-engage the anti-rotation strap (c).
12. Tighten all fasteners.
13. Use IND-LF accessory if position indication is needed.

Operational Information for LF24-SR US and LF24-MFT... US Actuators

Initialization of the LF24-SR US and LF24-MFT... US

When power is applied, the internal microprocessor recognizes that the actuator is at its full fail-safe position and uses this position as the base for all of its position calculations. This procedure takes approximately 15 seconds. During this time you will see no response at the actuator. The microprocessor will retain the initialized zero during short power failures of up to 25 seconds. When power is applied during this period, the actuator will return to normal operation and proceed to the position corresponding to the input signal provided. For power failures over 25 seconds, the actuator will be at its fail-safe position and will go through the start up initialization again.

Motor position detection

Belimo brushless DC motors eliminate the need for potentiometers for positioning. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Overload protection

The LF, On/Off actuators are electronically protected against overload. The LF, On/Off actuators have an internal current limiter which maintains the current at a safe level which will not damage the actuator while providing adequate holding torque.

The LF24, modulating actuators (LF24-SR US, LF24-3 US, LF24-MFT US) are protected against overload by digital technology located in the ASIC. The ASIC circuitry constantly monitors the rotation of the brushless DC motor inside the actuator and stops the pulsing to the motor when it senses a stall condition. The motor remains energized and produces full rated torque during stall conditions. The actuator will try to move in the direction of the stall every 2 minutes, for a period of 32 minutes. After this, the actuator will try again every 2 hours.

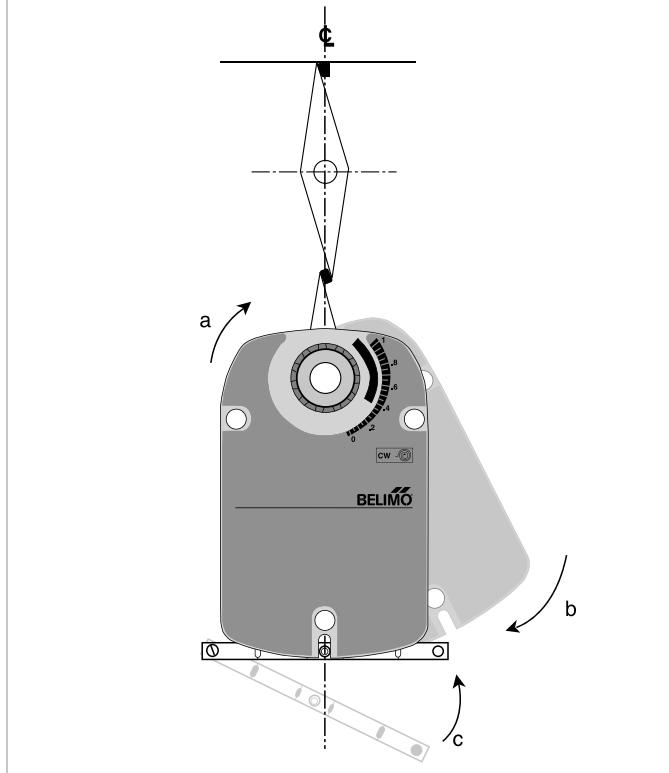
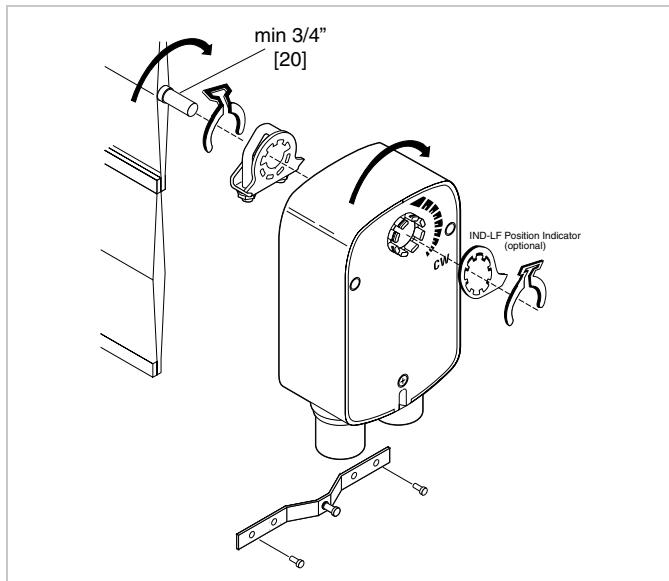


FIGURE D – Standard Mounting (Dimensions in Inches [mm])

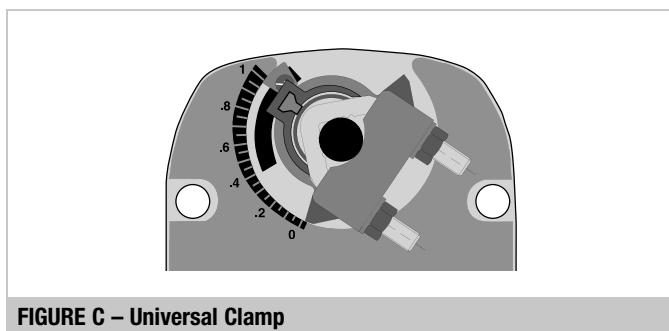
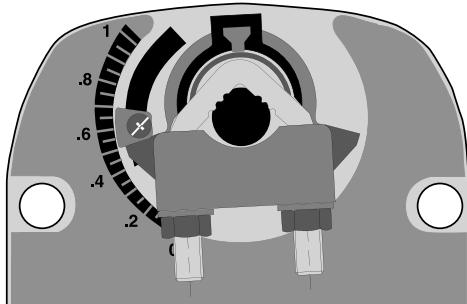


FIGURE C – Universal Clamp

Mechanical Angle of Rotation Limiting

The LF actuators are provided with an adjustable stop to limit the rotation of the actuator. This function works in conjunction with the universal clamp or the optional position indicator. The adjustable stop is needed when rotation of less than 95° is required. The LF actuator can be indefinitely stalled, in any position, without harming the actuator.

**Using the Universal Clamp**

1. Loosen the end stop fastening screw using a #2 Phillips screwdriver.
2. Move the stop block so the bottom edge of the block lines up with the number corresponding to the desired degrees of rotation. (example: 45 degrees of rotation = .5)
3. Lock the block in place with the fastening screw.
4. Check the actuator for proper rotation.

Using the IND-LF Position Indicator with Adjustable Stop

NOTE: preferred method if short shaft mounting is used.

1. With the actuator in its fail-safe position, place the IND-LF Position Indicator so that it points to the 0 degree position.
2. Loosen the end stop fastening screw using a #2 Phillips screwdriver.
3. Move the stop block so the bottom edge of the block lines up with the number corresponding to the desired degrees of rotation (example: 45 degrees of rotation = .5).
4. Lock the block in place with the fastening screw.
5. Check the actuator for proper rotation.

Direction of Rotation Switch

LF24-3(-S) US and LF24-SR(-S) US actuators have a direction of rotation switch on the cover labeled "CW-CCW". Switch position indicates start point. For the LF24-SR, with the switch in position "CW", the actuator rotates clockwise with a decrease in voltage or current. With the switch in position "CCW", the actuator rotates counter-clockwise with a decrease in voltage or current.

The LF24-3(-S) US and LF24-SR(-S) US actuators rotate clockwise when the switch is in the "CW" position and power is applied to wire #3. When power is applied to wire #4 the actuator rotates counter clockwise.

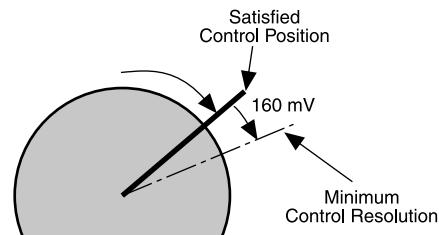
Rotating the direction of rotation switch to "CCW" reverses the control logic. During checkout, the switch position can be temporarily reversed and the actuator will reverse its direction. This allows the technician a fast and easy way to check the actuator operation without having to switch wires or change settings on the controller. When the check-out is complete, make sure the switch is placed back to its original position.

Control Accuracy and Stability

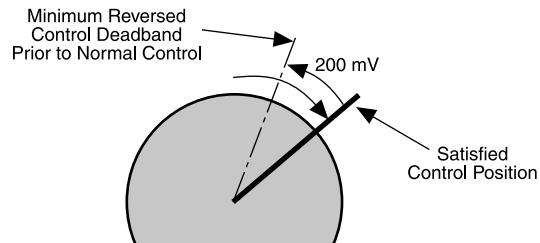
LF24-SR US actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The LF24-SR US actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 160 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

LF Actuator responds to a 160 mV signal when not changing direction from stop position.



LF Actuator responds to a 200 mV signal when reversing direction from stop position.



The LF24-MFT(-S) US control accuracy and stability can be found in the MFT technical documentation.

Installation Instructions

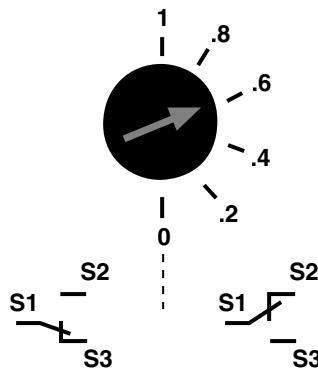
Auxiliary Switches and Non-Direct Mounting Methods

BELIMO®

Auxiliary Switches

The ...-S model actuators are equipped with an adjustable auxiliary switch used to indicate damper position or to interface additional controls or equipment. Switching positions can be set over the full 0 to 95° rotation simply by setting a switch on the actuator.

1. Set desired switch position.
(Example 60%)
2. As the actuator rotates, the switch indicator moves from .6 (60%) toward 0 (0%). When the indicator passes 0 the switch contact between S1 and S2 is broken and the contact between S1 and S3 is made.



Switch Rating

Voltage	Resistive load	Inductive load
120 VAC	3 A	1.03 A
250 VAC	3 A	0.5 A

Non-Direct Mounting Methods

KH-LF Crank arm

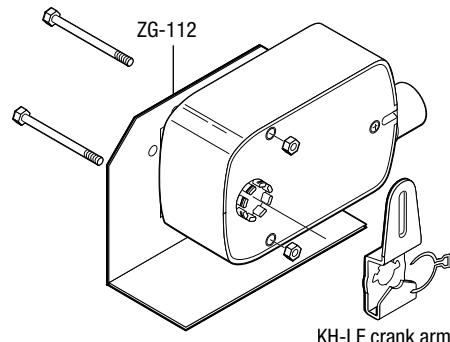
Including Retaining Ring



KH-LF

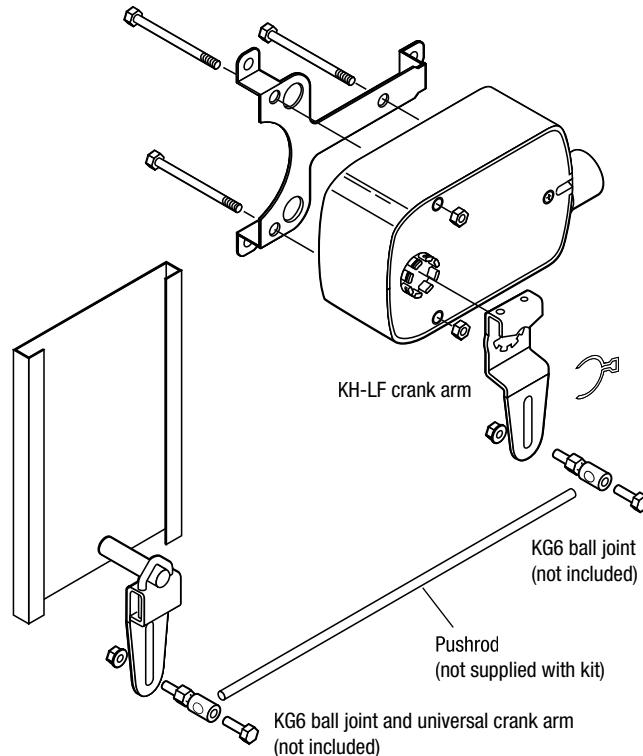
For round shafts up to 1/2"

ZG-LF112 Crank arm Adaptor Kit



KH-LF crank arm

ZG-LF2 Crank arm Adaptor Kit



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The LF24 . . actuator requires a 24 VAC class 2 transformer and draws a maximum of 7 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 2004/108/EC
- Software class A: Mode of operation type 1
- Low voltage directive: 2006/95/EC

CAUTION It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg. Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for LF... Actuators

Keep power wire runs below the lengths listed in the table in **Figure A**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example for LF24-SR US: 3 actuators, 16 Ga wire
 $550 \text{ Ft} \div 3 \text{ Actuators} = 183 \text{ Ft. Maximum wire run}$

LF24(-S) US Maximum Wire Length

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	1100 Ft.	18 Ga	260 Ft.
14 Ga	700 Ft.	20 Ga	140 Ft.
16 Ga	440 Ft.	22 Ga	75 Ft.

LF120(-S) US / LF230(-S) Maximum Wire Length

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	1250 Ft.	18 Ga	320 Ft.
14 Ga	800 Ft.	20 Ga	160 Ft.
16 Ga	500 Ft.	22 Ga	85 Ft.

LF24-SR(-S) US / LF24-3(-S) US

LFC24-3-R(-S) US / LF24-MFT... US

Maximum Wire Length

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	1500 Ft.	18 Ga	375 Ft.
14 Ga	925 Ft.	20 Ga	200 Ft.
16 Ga	550 Ft.	22 Ga	100 Ft.

FIGURE A

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the LF24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The LF24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. Do not connect it to the actuator common.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside rotating permanent magnets. The electromagnetic poles are switched by a microprocessor and a special ASIC (Application Specific Integrated Circuit) developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Startup and Checkout

Instructions For LF24-SR (-S) US and LF24-MFT...US + P100



LF24-SR (-S) US and LF24-MFT...US + P100 Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step...	Does Not Give Expected Response Go To Step...
1.	Remove power to reset actuator. Re-apply power. Apply control signal to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 8.	No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4.
2.	Check power wiring. Correct any problems. See Note 1.	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive Step 1.	Power wiring corrected, actuator still does not drive Step 4.
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 8.	Does not drive toward "Control Signal Position" Step 4.
4.	Make sure the control signal positive (+) is connected to Wire No 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position	Actuator operates properly Step 8.	Step 5.
5.	Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. For LF24-SR US this is 2 to 10 VDC or 4 to 20 mA. Note: The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicate.	Controller output (actuator input) is correct. Input Polarity Correct Step 6.	Reprogram, adjust repair or replace controller as needed Step 1.
6.	Loosen the nuts on the V-bolt and move the damper by hand from fully closed to fully open.	Damper will go from fully closed to fully open.	Damper moves properly Step 7.	Find cause of damper jam and repair. Move damper back to the fully closed position and tighten the nuts Step 1.
7.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator. - See Note 2.	Recalculate actuator requirement and correct installation.
8.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original installation date, notify Belimo and give details of the application.



N40103 - 09/11 - Subject to change. © Belimo Aircontrols (USA) Inc.

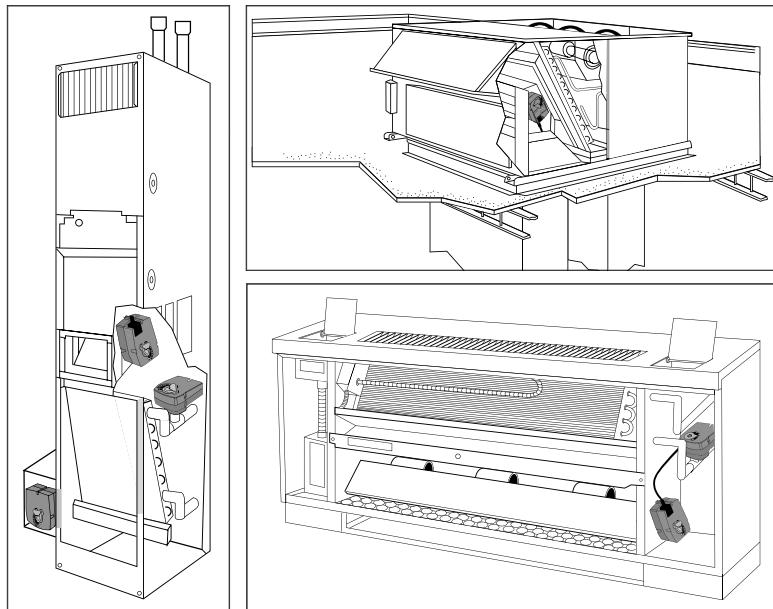
Minimum 22 in-lbs Torque

- For damper areas up to 5.5 sq-ft*

Applications

Cost effective quality and performance for a range of applications including:

- Classroom Unit Ventilators
- Fan/Coil Units
- Economizer Units
- Airhandlers
- Control Dampers
- VAV Terminal Units



Actuators in bold have BDCM

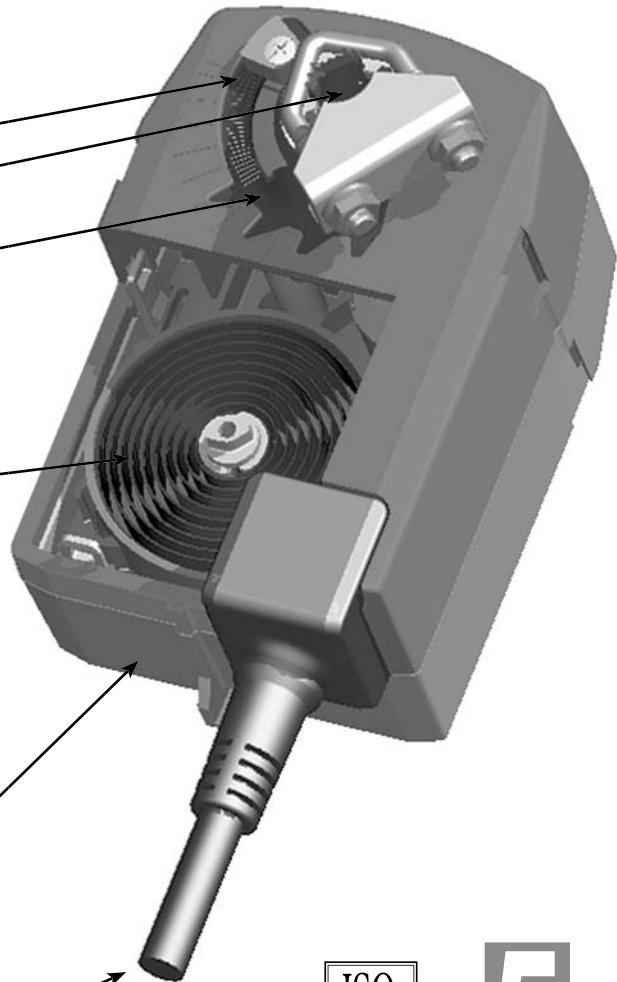
TFB, TFX Series - At A Glance

	TFB24, TFX24 (pg. 165)	TFLB24 (pg. 167)	TFB24-S, TFX24-S (pg. 165)	TFB120, TFX120 (pg. 169)	TFLB120 (pg. 171)	TFB120-S, TFX120-S (pg. 169)	TFCB120-S, TFCX120-S (pg. 173)	TFB24-3, TFX24-3 (pg. 175)	TFB24-3-S, TFX24-3-S (pg. 175)	TFB24-SR, TFX24-SR (pg. 177)	TFB120-SR (pg. 179)	TFB24-SR-S, TFX24-SR-S (pg. 177)	TFB24-MFT, TFX24-MFT (pg. 181)	TFB24-MFT-S, TFX24-MFT-S (pg. 181)
Torque:	22 in-lbs	●	●	●	●	●	●	●	●	●	●	●	●	●
Power supply:	24 VAC/DC**	●	●	●	●	●	●	●	●	●	●	●	●	●
	120 VAC			●	●	●	●			●			●	●
	230 VAC			●	●	●	●			●			●	●
Control signal:	on/off	●	●	●	●	●	●							
	floating point							●	●					
	proportional 2 to 10 VDC									●	●	●		
	multi-function										●			●
Running time motor:	<75 seconds	●	●	●	●	●	●							
	< 30 seconds							●						
	95 seconds constant							●	●	●	●			
	Adj. 75 to 300 seconds***							●	●	●	●			
spring:	<25 seconds	●		●	●	●	●	●	●	●	●	●	●	●
	<75 seconds		●		●		●			●	●	●	●	●
External direction of rotation switch								●	●	●	●	●	●	●
Plenum rated cable, 18 GA								●	●	●	●	●	●	●
Appliance cable, 18 GA	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Conduit fitting	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Built-in auxiliary switch			●			●	●	●	●	●	●	●	●	●
General wiring	(p. 182)													
Installation instructions		(p. 177-181)												
Start-up and checkout		(p. 183)												

*Based on 4 in-lb/ft² damper torque loading. Parallel blade. No edge seals. **Note: TFB24-3(-S) is only 24 VAC. ***Default 150 seconds

A CLOSER LOOK...

- Easy-to-adjust mechanical stop to limit damper rotation.
- Cut labor costs with simple direct coupling. Actuator Centers on 1/2" shaft.
- Clockwise or counterclockwise fail-safe mounting for fail-safe.
- Compact size with the shortest shaft-center to edge distance in the industry - 0.77".
- True mechanical spring return – the most reliable fail-safe.
- Single line voltage model for on/off application has 100 to 240V (-15/+10%), 50/60 Hz supply power.
- Check damper position easily with clear position indicator.
- Don't worry about actuator burn-out. Belimo is overload-proof throughout rotation.
- Need to change control direction? Do it easily with a simple switch (modulating actuators).
- Built-in auxiliary switch is easy to use, offers feedback or signal for additional device.
- Microprocessor-controlled brushless DC motor increases actuator life span and reliability, provides constant running time (modulating actuators).
- Rugged housing withstands rough handling in the mechanical room.
- 3 ft. standard cable and conduit connector (not shown) eases installation.



ISO
9001

5
YEAR
WARRANTY



LISTED
94 D5
TEMP. IND. &
REG. EQUIP. C UL us



The Belimo Difference

- *Customer Commitment.*
Extensive product range. Application assistance.
Same-day shipments. Free technical support. Five year warranty.
- *Low Installation and Life-Cycle Cost.*
Easy installation. Accuracy and repeatability.
Low power consumption. No maintenance.
- *Long Service Life.*
Components tested before assembly. Every product tested before shipment.
30 years direct coupled actuator design.



Technical Data		TFB24(-S), TFX24(-S)
Power supply		24VAC ± 20%, 50/60Hz 24VDC ± 10%
Power consumption	running	2 W
	holding	1.3 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection	TFB24...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
TFX24...		3 ft [1m], 10 ft [3m], or 16 ft [5m], 18 GA appliance or plenum cables, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time (nominal)	motor	< 75 sec
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listings†		CULUS acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC (and 2006/95/EC for -S versions)
Noise level (max)	running	< 50 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg), 1.5 lbs (0.7 kg) with switch

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

TFB24-S, TFX24-S

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95°
------------------	--

Torque min. 22 in-lbs, for control of air dampers

Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is on/off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 90°.

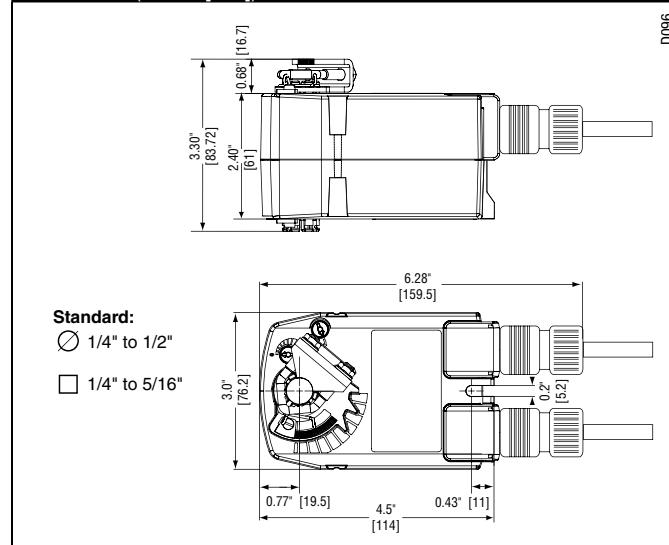
The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The TF-S versions are provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFB24(-S), TFX24(-S) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, please see Belimo wiring guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption must be observed.

3 Actuators may also be powered by 24 VDC.

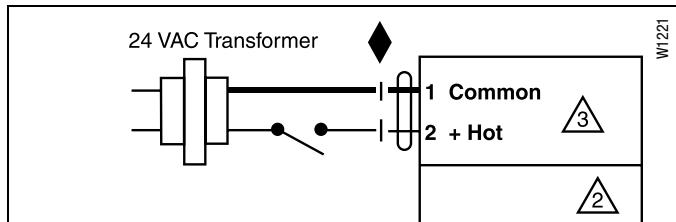
4 For end position indication, interlock control, fan startup, etc., TFB24-S, TFX24-S incorporates a built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0 to 95.

APPLICATION NOTES

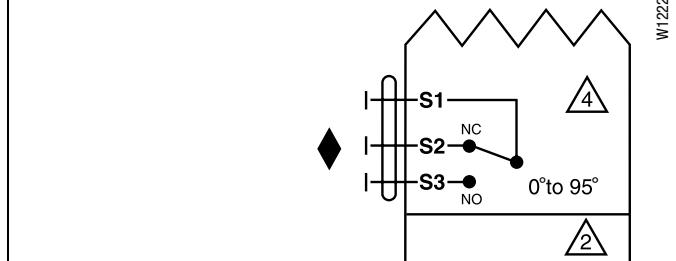
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for TFB24, TFX24



On/Off wiring for TFB24-S, TFX24-S



Technical Data		TFLB24
Power supply		24VAC ± 20%, 50/60Hz 24VDC ± 10%
Power consumption	running	2 W
	holding	1.3 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection		3 ft, 18 GA appliance cable
(-S models have 2 cables)		1/2" conduit connector
Overload protection		electronic throughout 0 to 95° rotation
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 90° (0° spring return position)
Running time	motor	< 75 sec
(nominal)	spring	< 75 sec @ -4°F to 122°F [-20°C to 50°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listings†		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC (and 2006/95/EC for -S versions)
Noise level (max)	running	< 40 dB(A)
	spring return	< 40 dB(A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg)

† Rated Impulse Voltage 800V, Type of action 1.AA, Control Pollution Degree 3.

Torque min. 22 in-lbs, for control of air dampers

Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is on/off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

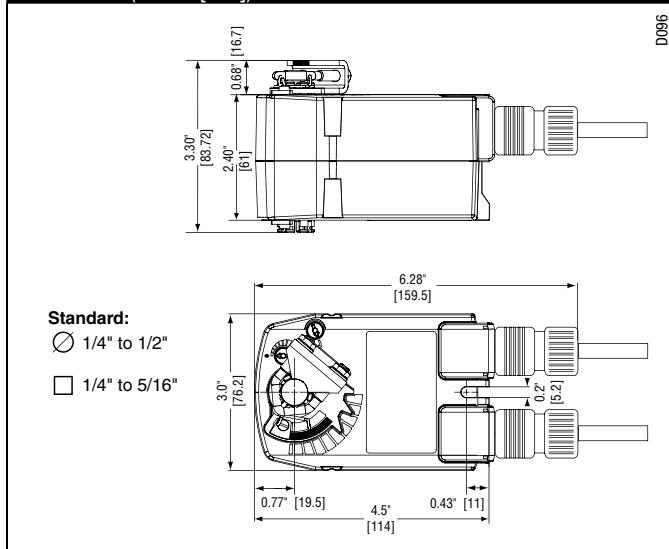
The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 90°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFLB24 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, Please See Belimo wiring guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption must be observed.

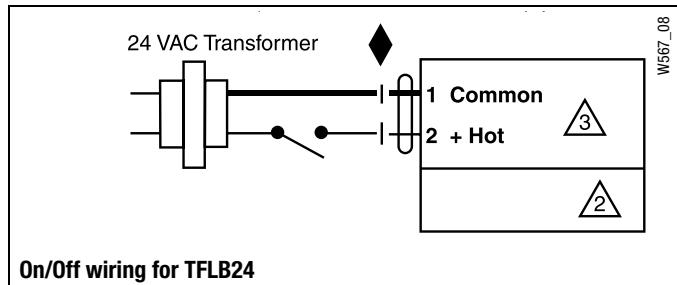
3 Actuators may also be powered by 24 VDC.

APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

! During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



TFB120(-S), TFX120(-S)

On/Off, Spring Return, 100 to 240 VAC

BELIMO



Technical Data		TFB120(-S), TFX120(-S)
Power supply	nominal tolerance	100 to 240 VAC, 50/60 Hz 85 to 265 VAC, 50/60 Hz
Power consumption	running holding	2.5 W 1.3 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection	TFB120...	3 ft, 18 GA appliance cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	TFX120...	3 ft [1m], 10 ft [3m], or 16 ft [5m], 18 GA appliance cable, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Electrical protection		actuators are double insulated
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time	motor spring	< 75 sec < 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listings†		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC (and 2006/95/EC for -S versions)
Noise level (max)	running	< 50 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg), 1.5 lbs (0.7 kg) with switch

† Rated Impulse Voltage 4kV, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

TFB120-S, TFX120-S

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95°
------------------	--

Torque min. 22 in-lbs, for control of air dampers

Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is on/off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 90°.

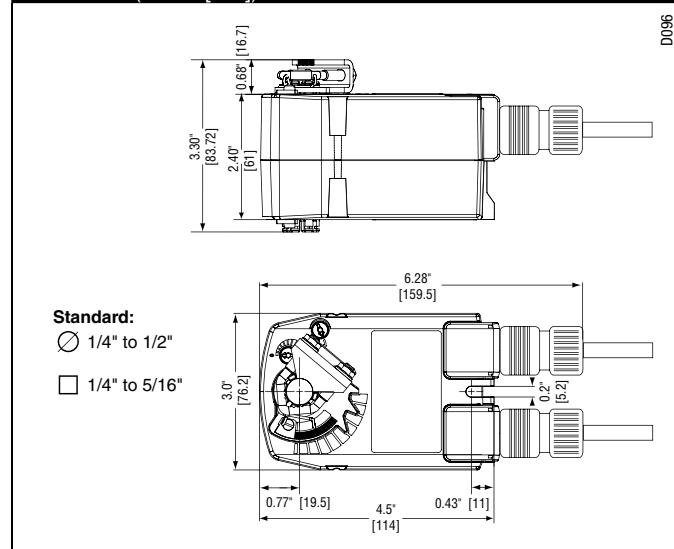
The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode. The actuator is double insulated so an electrical ground connection is not necessary.

The TF-S versions are provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFB120(-S) and TFX120(-S) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

2 Actuators may be connected in parallel.
Power consumption must be observed.

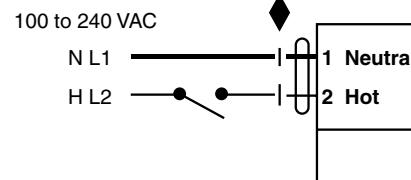
4 For end position indication, interlock control, fan startup, etc., TFB120-S, TFX120-S incorporate one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

APPLICATION NOTES

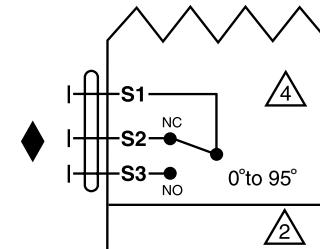
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

! During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



On/Off wiring for TFB120, TFX120



On/Off wiring for TFB120-S, TFX120-S



Technical Data		TFLB120
Power supply	nominal	100 to 240 VAC, 50/60 Hz
	tolerance	85 to 265 VAC, 50/60 Hz
Power consumption	running	2.5 W
	holding	1.3 W
Transformer sizing		5 VA (class 2 power source)
Electrical connection		3 ft, 18 GA appliance cable 1/2" conduit connector
(-S models have 2 cables)		
Overload protection		electronic throughout 0 to 95° rotation
Electrical protection		actuators are double insulated
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation		reversible with cw/ccw mounting
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time	motor	< 75 sec
	spring	< 75 sec @ -4°F to 122°F [-20°C to 50°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listing†		CULUs acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC (and 2006/95/EC for -S versions)
Noise level (max)	running	< 40 dB(A)
	spring return	< 40 dB(A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg)

† Rated Impulse Voltage 4kV, Type of action 1.AA, Control Pollution Degree 3.

Torque min. 22 in-lbs, for control of air dampers

Application

For on/off, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is on/off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

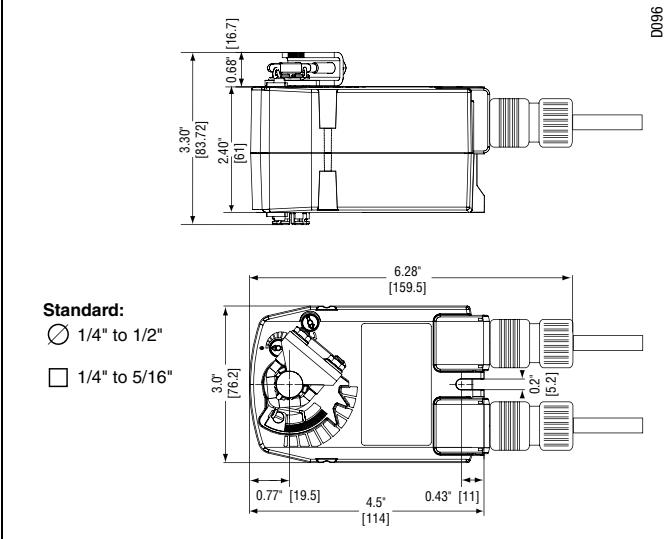
The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 90°.

The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode. The actuator is double insulated so an electrical ground connection is not necessary.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFLB120 actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. Actuators must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES****CAUTION Equipment Damage!**

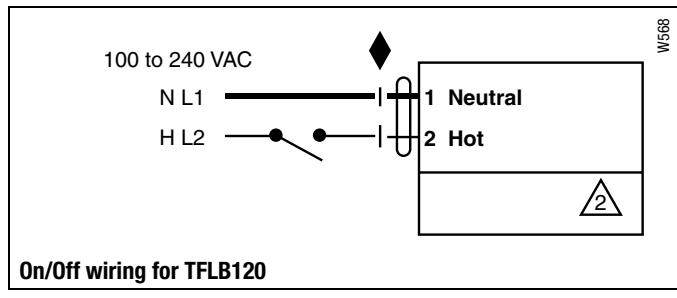
Actuators may be connected in parallel. Power consumption must be observed.

APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.





Technical Data		TFCB120-S, TFCX120-S
Power supply	nominal tolerance	100 to 240 VAC, 50/60 Hz 85 to 265 VAC, 50/60 Hz
Power consumption	running holding	3 W 1.5 W
Transformer sizing	6 VA (class 2 power source)	
Electrical connection	TFCB120...	two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	TFCX120...	two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection	electronic throughout 0 to 95° rotation	
Electrical protection	actuators are double insulated	
Angle of rotation	max 95°, adjust. with mechanical stop	
Torque	22 in-lbs [2.5 Nm] minimum	
Direction of rotation	reversible with cw/ccw mounting	
Position indication	visual indicator, 0° to 95° (0° spring return position)	
Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95°	
Running time	motor spring	< 30 sec < 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity	5 to 95% RH non-condensing	
Ambient temperature	-22°F to 122°F [-30°C to 50°C]	
Storage temperature	-40°F to 176°F [-40°C to 80°C]	
Housing	NEMA type 2 / IP42, UL enclosure type 2	
Housing material	UL94-5VA	
Agency listings†	cULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC, and 2006/95/EC	
Noise level (max)	running	< 56 db (A)
	spring return	63 dB (A)
Servicing	maintenance free	
Quality standard	ISO 9001	
Weight	1.5 lbs (0.7 kg)	

† Rated Impulse Voltage 4kV, Type of action 1.AA.B, Control Pollution Degree 3.

Torque min. 22 in-lbs, for control of air dampers

Application

For on/off fast running, fail-safe control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. Control is on/off from an auxiliary contact, or a manual switch.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0° to 90°.

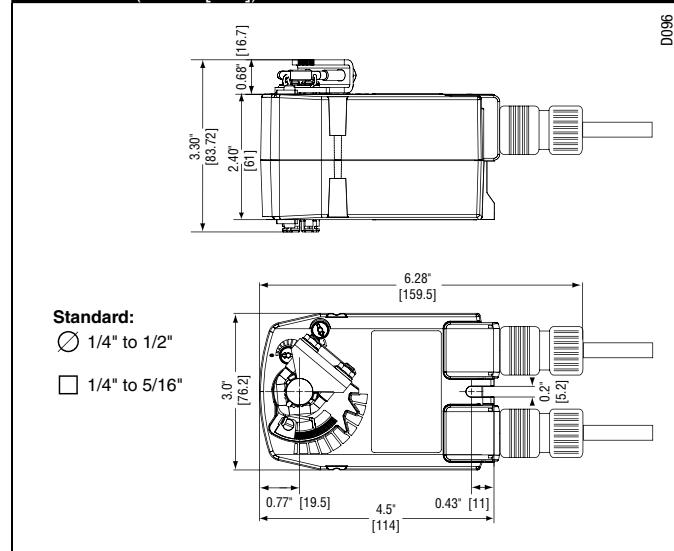
The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode. The actuator is double insulated so an electrical ground connection is not necessary.

The TFCB120-S version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



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Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZG-TF113	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFCB120-S, TFCX120-S actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators must be constructed to meet the requirements for Double Insulation so an electrical ground connection is not required to meet agency listings. Actuators shall be cULus listed and have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagram**INSTALLATION NOTES**

1 Provide overload protection and disconnect as required.

CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption must be observed.

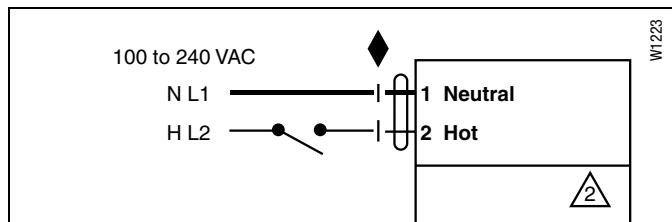
4 For end position indication, interlock control, fan startup, etc., TFCB120-S, TFCX120-S incorporate one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

APPLICATION NOTES

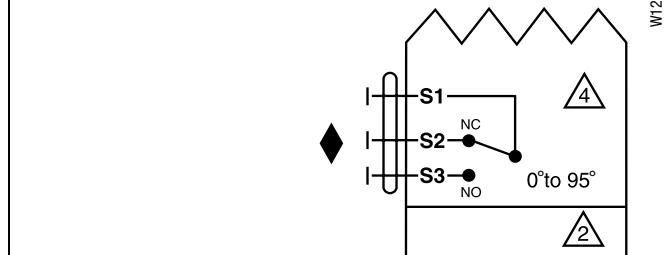
◆ Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

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On/Off wiring for TFCB120-S, TFCX120-S



On/Off wiring for TFCB120-S, TFCX120-S

TFB24-3(-S), TFX24-3(-S)

On/Off, Floating Point, Spring Return, 24V

BELIMO



Technical Data		TFB24-3(-S), TFX24-3(-S)
Power supply		24 VAC ± 20%, 50/60 Hz
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		4 VA (class 2 power source)
Electrical connection	TFB...	3 ft, 18 GA plenum cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
	TFX...	3 ft [1m], 10 ft [3m], or 16 ft [5m], 18 GA appliance or plenum cable, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Input impedance		1000 Ω (0.6w) control inputs
Electrical protection		actuators are double insulated
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time	motor	95 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listing†		cULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC, (and 2006/95/EC for -S versions)
Noise level (max)	running	< 35 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg), 1.5 lbs (0.5 kg) with switch

†Rated Impulse Voltage 800V, Type of action 1 AA (1.AA.B for -S version), Control Pollution Degree 3.

TFB24-3-S, TFX24-3-S

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95° (double insulated)
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Torque min. 22 in-lbs, for control of air dampers

Application

For modulation or on/off control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

Control is floating point from a triac or relay, or on/off from an auxiliary contact on a fan motor contactor, controller, or manual switch.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The TF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches.

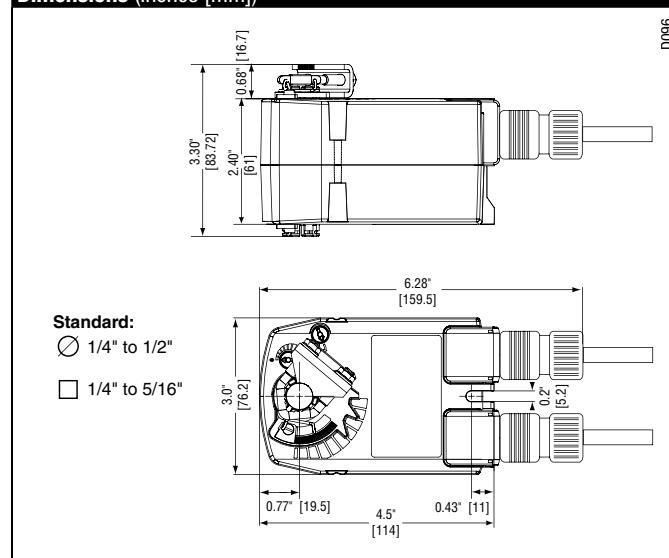
Power consumption is reduced in holding mode.

The TF-S version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the TF-S is double insulated so an electrical ground is not necessary.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFB24-3(-S), TFX24-3(-S) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

Floating point, On/Off spring return damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have an external direction of rotation switch to reverse control logic. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Run time shall be constant and independent of torque. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams
INSTALLATION NOTES
CAUTION Equipment Damage!

Actuators may be connected in parallel.
Power consumption must be observed.

The Common connection from the actuator must be connected to the Hot connection of the controller.

The actuator Hot must be connected to the control board Common.

For end position indication, interlock control, fan startup, etc., TFB24-3-S, TFX24-3-S incorporates one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

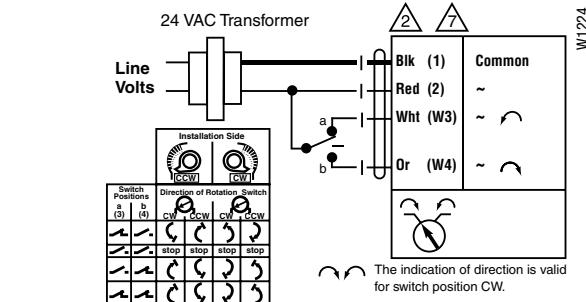
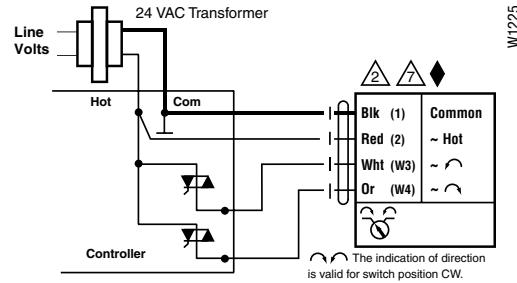
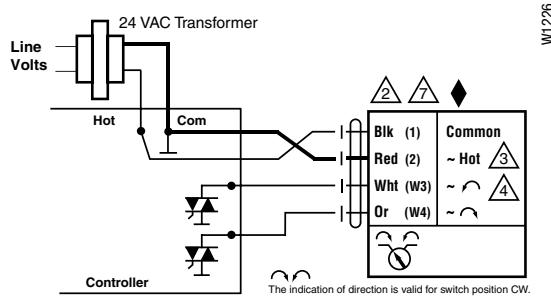
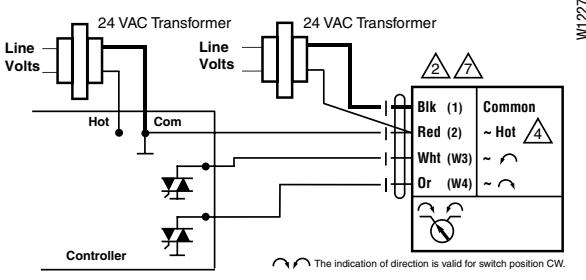
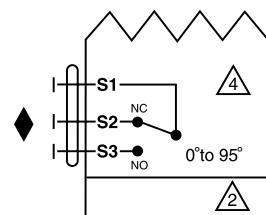
Actuators with plenum rated cable do not have numbers on wires; use color coded instead. Actuators with appliance rated cable use numbers.
TF-S has an Orange wire #5 instead of #4.

APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

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Floating Point control for TFB24-3(-S), TFX24-3(-S)

Triac source

Triac sink

Triac sink with separate transformers

Auxiliary switch of TFB24-3(-S), TFX24-3(-S)

TFB24-SR(-S), TFX24-SR(-S)

Proportional, Spring Return, 24 V, for 2 to 10 VDC or 4 to 20 mA Control Signal



Technical Data		TFB24-SR(-S), TFX24-SR(-S)
Power supply		24 VAC \pm 20% 50/60 Hz 24 VDC \pm 10%
Power consumption	running	2 W
	holding	1 W
Transformer sizing		4 VA (class 2 power source)
Electrical connection	TFB...	3 ft, 18 GA plenum cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
TFX		3 ft [1m], 10 ft [3m], or 16 ft [5m], 18 GA appliance or plenum cable, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ (0.1 mA), 500 Ω
Feedback output U		2 to 10 VDC, 0.5 mA max
Angle of rotation		max 95°, adjust with mechanical stop
Torque		22 in-lbs [2.5 Nm]
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time	motor	95 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listings†		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC (and 2006/95/EC for -S versions)
Noise level (max)	running	< 35 db (A)
	spring return	62 dB (A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.4 lbs (0.6 kg), 1.5 lbs (0.7 kg) with switch

† Rated Impulse Voltage 800V, Type of action 1.AA (1.AA.B for -S version), Control Pollution Degree 3.

TFB24-SR-S, TFX24-SR-S

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95° (double insulated)
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Torque min. 22 in-lbs, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

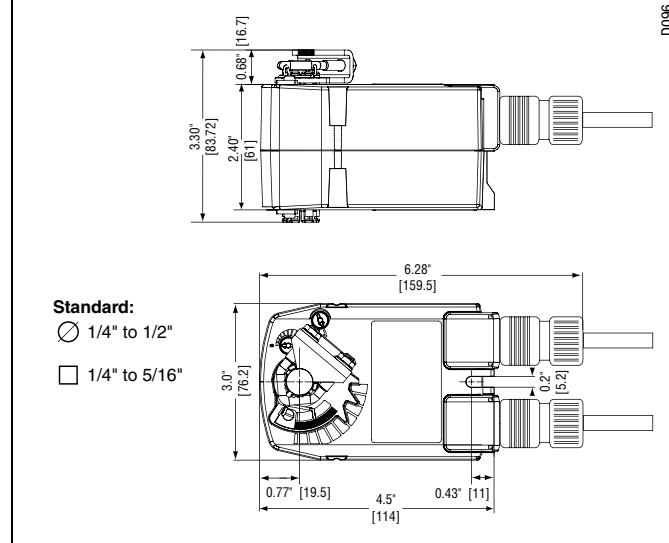
The TF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The TF-S version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the TF-S is double insulated so an electrical ground is not necessary.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFB24-SR (-S), TFX24-SR (-S) actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES****CAUTION Equipment Damage!**

Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor, a +2% shift of control signal may be required. Power consumption must be observed.

Actuator may also be powered by 24 VDC.

Only connect common to neg. (-) leg of control circuits.

Actuators with plenum rated cable do not have numbers on wires; use color codes instead.

For end position indication, interlock control, fan startup, etc., TFB24-SR-S, TFX24-SR-S incorporates one built-in auxiliary switch: 1 x SPDT, 3A (0.5A) @250 VAC, UL Approved, adjustable 0° to 95°.

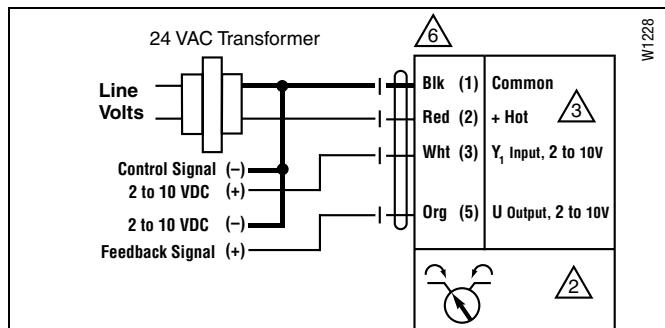
APPLICATION NOTES

Meets cULus requirements without the need of an electrical ground connection.

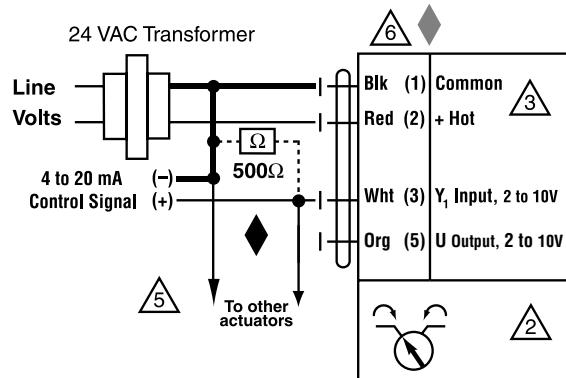
The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

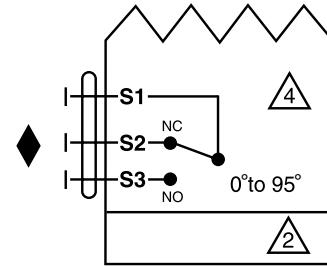
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



2 to 10 VDC control of TFX24-SR(-S)



4 to 20 mA control of TFB24-SR(-S), TFX24-SR(-S)



Auxiliary switch of TFB24-SR-S, TFX24-SR-S



Technical Data		TFB120-SR
Power supply		100...240 VAC + 10% / -15%, 50/60 Hz
Power consumption	running	2.5 W
	holding	2 W
Transformer sizing		5.5 VA
Electrical connection		two 3 ft, 18 GA appliance cables 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y		2 to 10 VDC, 4 to 20mA
Input impedance		100 kΩ (0.1 mA), 500 Ω
Feedback output U		2 to 10 VDC (max. 0.5 mA) for 95°
Angle of rotation		max 95°, adjust. with mechanical stop
Torque		22 in-lbs [2.5 Nm] minimum
Direction of rotation	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Position indication		visual indicator, 0° to 95° (0° spring return position)
Running time	motor	95 sec constant, independent of load
	spring	< 25 sec @ -4°F to 122°F [-20°C to 50°C] < 60 sec @ -22°F [-30°C]
Humidity		5 to 95% RH non-condensing
Ambient temperature		-22°F to 122°F [-30°C to 50°C]
Storage temperature		-40°F to 176°F [-40°C to 80°C]
Housing		NEMA type 2 / IP42, UL enclosure type 2
Housing material		UL94-5VA
Agency listings†		CULus acc. to UL60730-1A/-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC
Noise level (max)	running	≤ 35 dB(A)
	spring return	≤ 62 dB(A)
Servicing		maintenance free
Quality standard		ISO 9001
Weight		1.5 lbs (0.7 kg)

† Rated Impulse Voltage 4kV, Type of action 1-AA, Control Pollution Degree 3.

Torque min. 22 in-lbs, for control of air dampers

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

The actuator is mounted directly to a damper shaft from 1/4" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The actuator operates in response to a 2 to 10 VDC, or with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner.

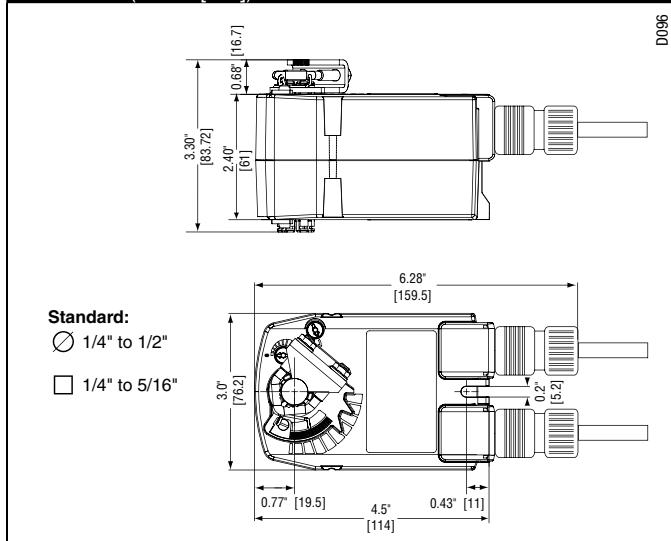
Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The TFB120-SR uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFB120-SR actuators, only use accessories listed on this page.

For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams**INSTALLATION NOTES****CAUTION Equipment Damage!**

2 Up to 4 actuators may be connected in parallel. With 4 actuators wired to one 500 Ω resistor, a +2% shift of control signal may be required. Power consumption must be observed.

5 Only connect common to neg. (-) leg of control circuits.

6 Actuators with plenum rated cable do not have numbers on wires; use color codes instead.

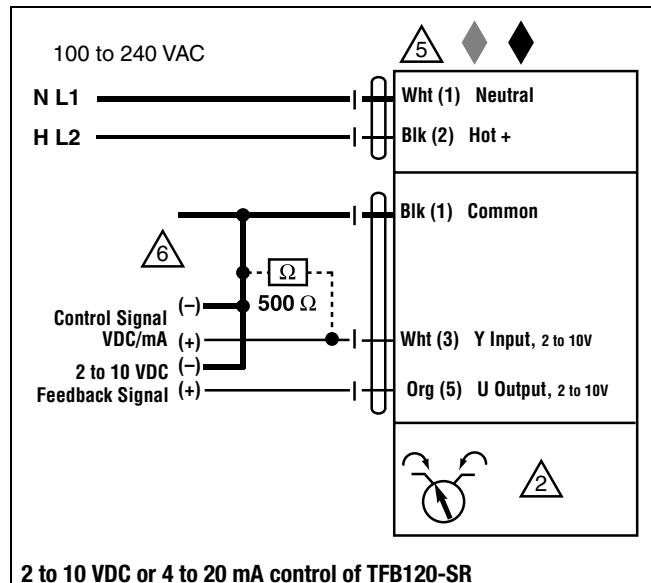
APPLICATION NOTES

◆ Meets cULus requirements without the need of an electrical ground connection.

◆ The ZG-R01 500 Ω resistor converts the 4 to 20 mA control signal to 2 to 10 VDC.

WARNING Live Electrical Components!

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2 to 10 VDC or 4 to 20 mA control of TFB120-SR

TFB24-MFT(-S), TFX24-MFT(-S)

Proportional, Spring Return, Multi-Function Technology®

BELIMO



MFT



Technical Data		TFB24-MFT(-S), TFX24-MFT(-S)
Power supply		24 VAC, ± 20%, 50/60 Hz 24 VDC, ±10%
Power consumption	running	2.5 W
	holding	1 W
Transformer sizing		4 VA (Class 2 power source)
Electrical connection	TFB...	3 ft, 18 GA plenum cable, 1/2" conduit connector -S models: two 3 ft, 18 gauge appliance cables with 1/2" conduit connectors
TFX...		3 ft [1m], 10 ft [3m], or 16 ft [5m], 18 GA appliance or plenum cable, with or without 1/2" conduit connector -S models: two 3 ft [1m], 10 ft [3m] or 16 ft [5m] appliance cables with or without 1/2" conduit connectors
Overload protection		electronic throughout 0 to 95° rotation
Operating range Y*		2 to 10 VDC 4 to 20 mA (w/500 Ω, 1/4 Ω resistor) ZG-R01
Input impedance		100 kΩ for 2 to 10 VDC (0.1 mA) 500 Ω for 4 to 20 mA 1500 Ω for PWM, floating point and on/off control
Feedback output U*		2 to 10 VDC, 0.5 mA max
Torque		22 in-lbs (2.5 Nm) minimum
Direction of rotation*	spring	reversible with cw/ccw mounting
	motor	reversible with built-in switch
Mech. angle of rotation*		max 95°, adjust with mechanical stop
Running time	motor*	150 sec constant independent of load
	spring	<25 sec @ -4°F to 122°F [-20°C to 50°C] <60 sec @ -22°F [-30°C]
Angle of rotation adaptation*		off (default)
Override control*		Min. (Min Position) = 0% - ZS (Mid. Position) = 50% - Max. (Max. Position) = 100%
Position indication		visual indicator, 0° to 95°
Humidity		5 to 95% RH, non-condensing
Ambient temperature		-22 to 122°F (-30 to 50°C)
Storage temperature		-40 to 176°F (-40 to 80°C)
Housing		NEMA 2, IP42, UL enclosure type 2
Housing material		UL 94-5VA
Noise level (max)		<35 dB (A)
	spring return	<65 dB (A)
Agency listings		CULus acc. to UL60730-1/A-2-14, CAN/CSA E60730-1:02, CE acc. to 2004/108/EC
Quality standard		ISO 9001
Servicing		maintenance free
Weight		1.4 lbs. (0.6 kg), 1.5 lbs (0.7 kg) with switch

* Variable when configured with MFT options

† Rated Impulse Voltage 800V, Type of action 1.AA, Control Pollution Degree 3.

TFB24-MFT-S, TFX24-MFT-S

Auxiliary switch	1 x SPDT 3A (0.5A) @ 250 VAC, UL approved adjustable 0° to 95° (double insulated)
------------------	--

- Torque min. 22 in-lb.
- Control 2 to 10 VDC (Default)
- Feedback 2 to 10 VDC (Default)

Application

For proportional modulation of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications.

Default/Configuration

Default parameters for 2 to 10 VDC applications of the TF-MFT actuator are assigned during manufacturing. If required, custom versions of the actuator can be ordered. The parameters noted in the Technical Data table are variable.

These parameters can be changed by three means:

- Pre-set configurations from Belimo
- Custom configurations from Belimo
- Configurations set by the customer using the MFT PC tool software application.

Operation

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

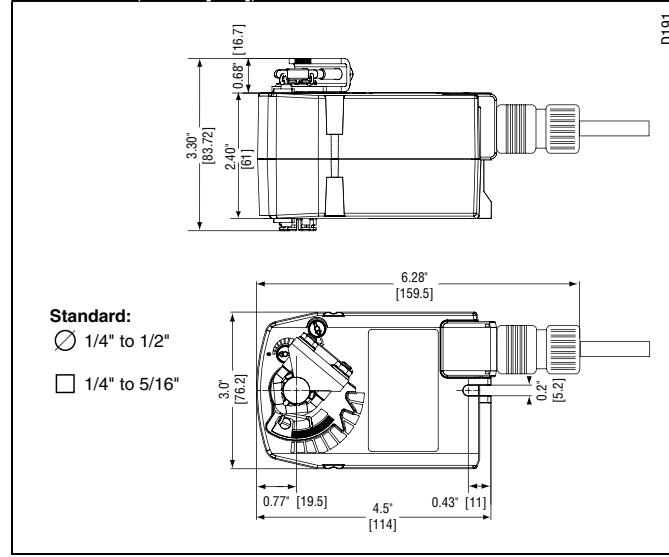
The TF uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode.

The TF-S version is provided with one built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°. The auxiliary switch in the TF-S is double insulated so an electrical ground is not necessary.

SAFETY NOTE

Screw a conduit fitting into the actuator's bushing. Jacket the actuator's input and output wiring with suitable flexible conduit. Properly terminate the conduit in a suitable junction box.

Dimensions (Inches [mm])



Accessories

Tool-06	8mm and 10 mm wrench
KH-TF	Crank arm for up to 1/2" round shaft
ZG-TF2	Crank arm adaptor kit for TF
ZG-TF112	Mounting bracket, kit for TF
ZS-100	Weather shield (metal)
ZS-150	Weather shield (polycarbonate)

NOTE: When using TFB24-MFT (-S), TFX24-MFT (-S) actuators, only use accessories listed on this page.
For actuator wiring information and diagrams, refer to Belimo wiring guide.

Typical Specification

Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 1/2" diameter and center a 1/2" shaft. The actuator must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500 Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. If required, one SPDT auxiliary switch shall be provided having the capability of being adjustable. Actuators with auxiliary switch must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Actuators shall be cULus listed certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo.

Wiring Diagrams
INSTALLATION NOTES

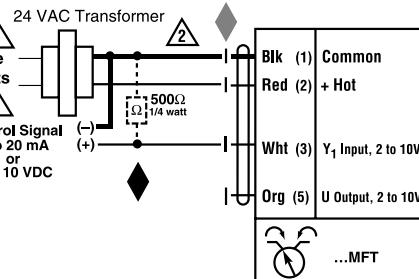
- 1 Provide overload protection and disconnect as required.
- 2 **CAUTION Equipment Damage!**
Actuators may be connected in parallel if not mechanically mounted to the same shaft. Power consumption and input impedance must be observed.
- 3 Actuators may also be powered by 24 VDC.
- 4 Position feedback cannot be used with Triac sink controller. The actuator internal common reference is not compatible.
- 5 Control signal may be pulsed from either the Hot (source) or the Common (sink) 24 VAC line.
- 6 Contact closures A & B also can be triacs. A & B should both be closed for triac source and open for triac sink.
- 7 For Triac sink the common connection from the actuator must be connected to the hot connection of the controller.

APPLICATION NOTES

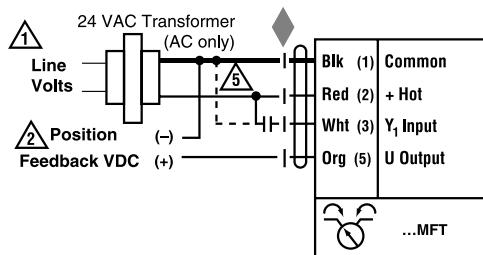
- The ZG-R01 500 Ω resistor may be used.
- Meets UL requirements without the need of an electrical ground connection.

WARNING Live Electrical Components!

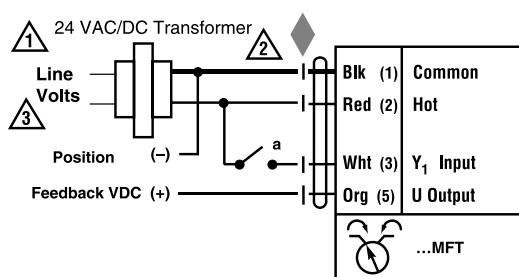
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



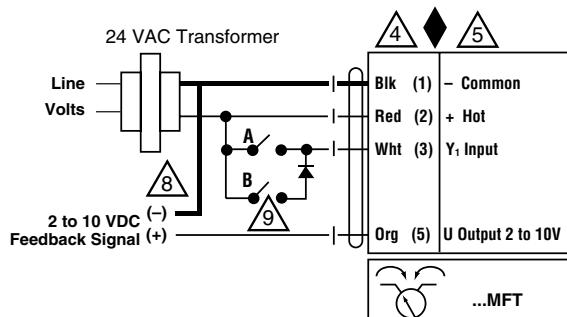
W399_01

VDC/ 4-20 mA


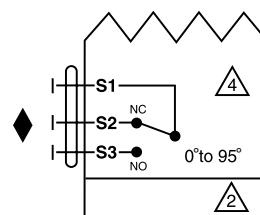
W399_02

PWM


W399_03

On/Off Control


W1235

Floating Point Control


W1222

Auxiliary switch of TFB24-MFT(-S), TFX24-MFT(-S)

Installation Instructions

Quick-Mount Visual Instructions for Mechanical Installation

BELIMO

Quick-Mount Visual Instructions

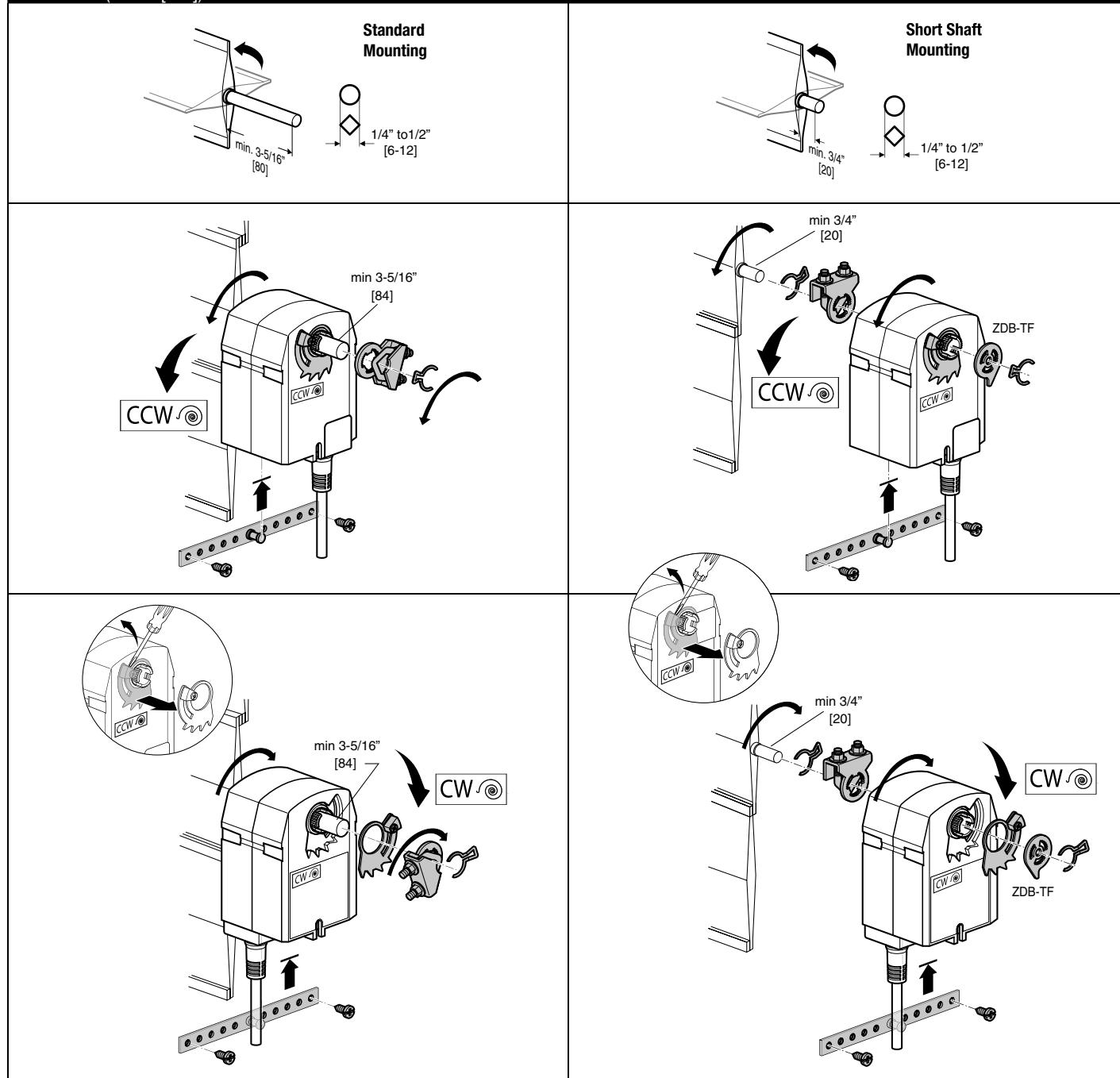
1. Rotate the damper to its failsafe position. If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out. If it rotates clockwise, mount the actuator with the "CW" side out.
2. If the universal clamp is not on the correct side of the actuator, move it to the correct side.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with an 8mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

NOTE: Read the "Standard Mounting" instructions, for more detailed information.

Preliminary Steps

1. Belimo actuators should be mounted indoors in dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator. (See Mechanical Accessories Section)
2. For new construction work, order dampers with extended shafts. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft.
3. For standard mounting, the damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3 1/2", the actuator may be mounted in its short shaft configuration.

Dimensions (Inches [mm])



Mechanical Operation

The actuator is mounted directly to a damper shaft up to 1/2" in diameter by means of its universal clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The TF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The TF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The TF...-S versions are provided with 1 built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

Standard Mounting / Airtight Damper Procedure

1. See **Figure B**. Manually move the damper to the fail-safe position (a) (usually closed). If the shaft rotated counterclockwise (↷), this is a CCW installation. If the shaft rotated clockwise (↶), this is a CW installation. In a Left Hand installation, the actuator side marked "CW" faces out, while in a CW installation, the side marked "CCW" faces out. All other steps are identical.
2. The actuator is usually shipped with the universal clamp mounted to the "CW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CW" (or the "CCW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the Short Shaft Installation section.
3. If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out, position the clamp so that the pointer section of the tab is pointing to 0° (see Fig. C) and the spline pattern of the clamp mates with spline of the actuator. Remount the stroke limiter to this side then slip the clamp over the spline. (Use the same procedure if the "CW" side is out.)
4. See Remounting the Stroke Limiter after the section Short Shaft Mounting with IND-TF Position Indicator.
5. Lock the clamp to the actuator using the retaining clip.
6. Verify that the damper is still in its full fail-safe position. (a)
7. Mount the spring return actuator to the shaft. Tighten the universal clamp, finger tight only.
8. Mount the anti-rotation strap at the base of the actuator. Do not tighten the screws.
9. Remove the screw from one end of the mounting bracket and pivot it away from the actuator.
10. Loosen the universal clamp and, making sure not to move the damper shaft, rotate the actuator approximately 5° in the direction which would open the damper.
11. Tighten the universal clamp to the shaft.
12. Rotate the actuator to apply pressure to the damper seals (b) and re-engage the anti-rotation strap (c).
13. Tighten all fasteners.

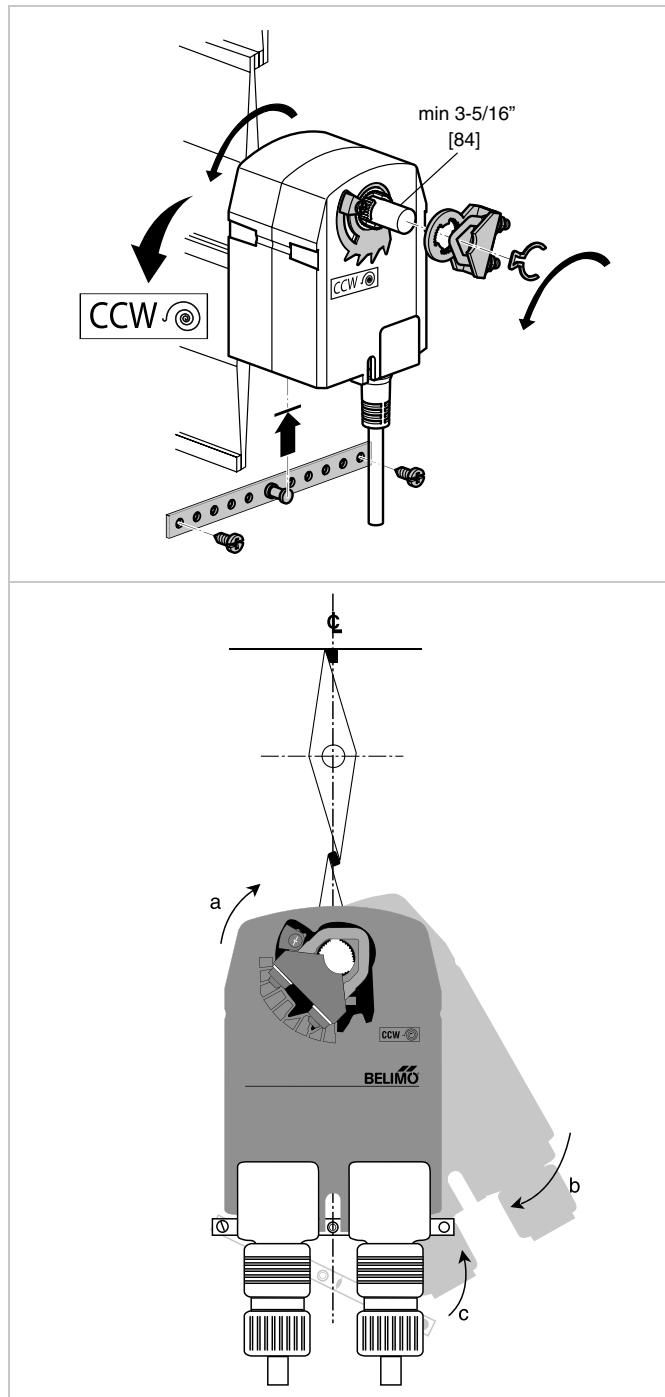


FIGURE B – Standard Mounting (Dimensions in Inches [mm])

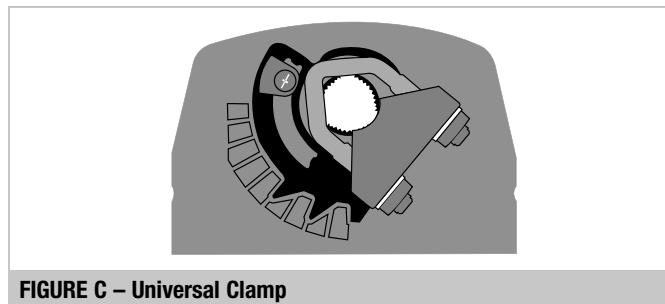


FIGURE C – Universal Clamp

Installation Instructions

Mechanical Installation

BELIMO

Short Shaft Mounting with IND-TF Position Indicator / Airtight Damper Procedure

If the shaft extends at least 3/4" from the duct, follow these steps:

1. (See **Figure D**) Move damper blades to the fail-safe position (a).
2. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
3. Engage the clamp to the actuator as close as possible to the determined location.
4. Lock the clamp to the actuator using the retainer clip.
5. Mount the spring return actuator to the shaft. Tighten the universal clamp, finger tight only.
6. Mount the anti-rotation strap at the base of the actuator. Do not tighten the screws.
7. Remove the screw from one end of the mounting bracket and pivot it away from the actuator.
8. Loosen the universal clamp and, making sure not to move the damper shaft, rotate the actuator approximately 5° in the direction which would open the damper.
9. Verify that the damper is still in its full fail-safe position.
10. Tighten the universal clamp to the shaft.
11. Rotate the actuator to apply pressure to the damper seals (b) and re-engage the anti-rotation strap (c).
12. Tighten all fasteners.
13. Use IND-TF accessory if position indication is needed.

Remounting the Stroke Limiter

1. Remove the stroke limiter by inserting a small screwdriver, like the one shown, and gently prying upward. This procedure takes very little force. See **Figure 1**.
2. While holding the back eye-let, unscrew the end-stop so that eye-let separates from the end-stop.
3. Flip the limiter over, so the teeth point the other direction. Replace the eye-let and end-stop.
4. Flip the actuator over to the opposite side (this reverses the spring return direction of the actuator). Replace the stroke limiter assembly by inserting the first two teeth as shown in the orange circle. Then press the stroke limiter into place by pushing downward on the adjustable stop.
5. Replace clamp and retaining clip.

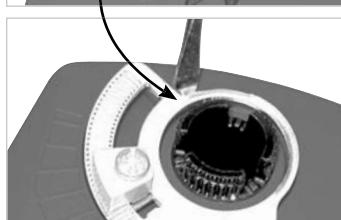
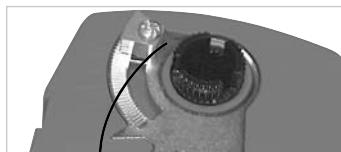


FIGURE 1

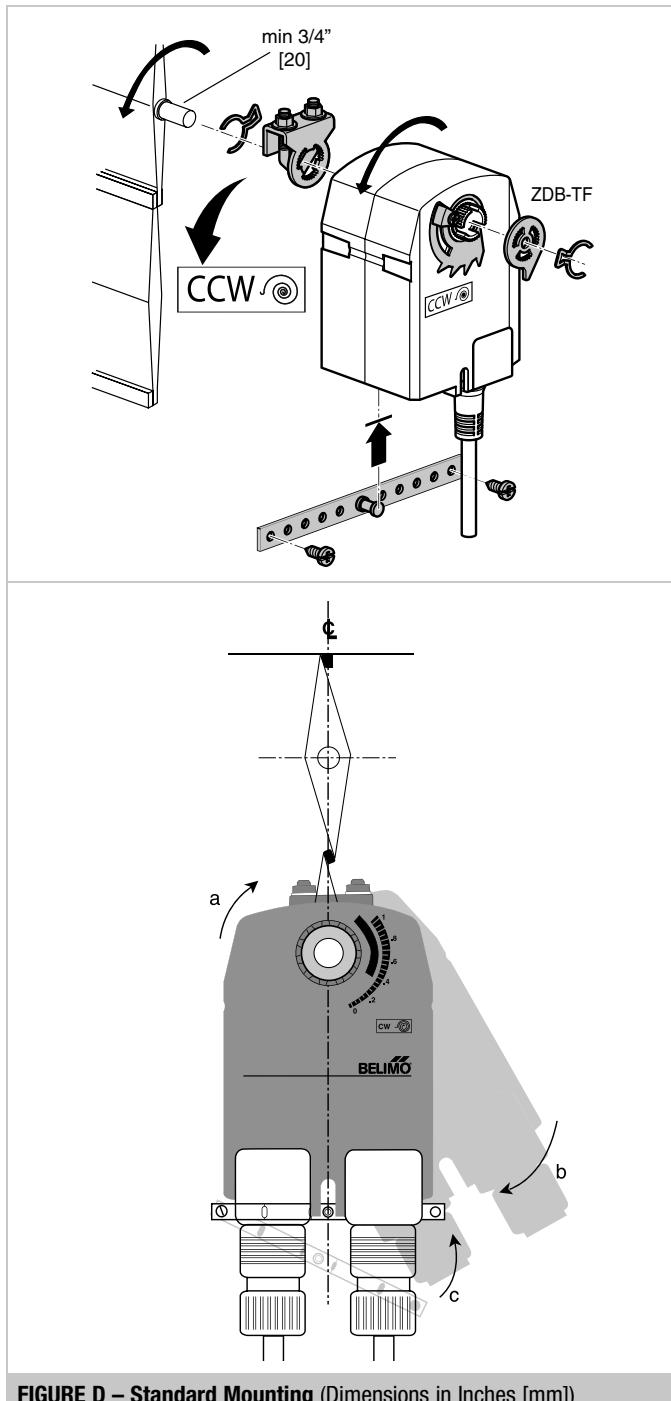
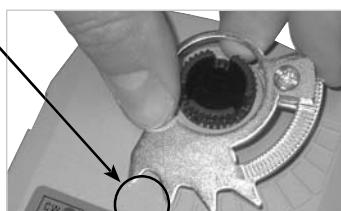


FIGURE D – Standard Mounting (Dimensions in Inches [mm])

Operational Information for TF Actuators**Initialization of the TFB24-SR(-S)**

When power is applied, the internal microprocessor recognizes that the actuator is at its full fail-safe position and uses this position as the base for all of its position calculations. This procedure takes approximately 15 seconds. During this time you will see no response at the actuator. The microprocessor will retain the initialized zero during short power failures of up to 25 seconds. When power is applied during this period, the actuator will return to normal operation and proceed to the position corresponding to the input signal provided. For power failures over 25 seconds, the actuator will be at its fail-safe position and will go through the start up initialization again.

Motor position detection TFB24-SR(-S)

Belimo brushless DC motors eliminate the need for potentiometers for positioning. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

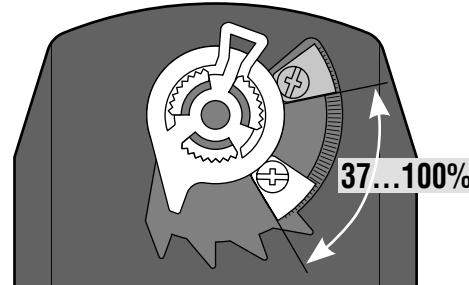
Overload protection

The TF on/off actuators are electronically protected against overload. The TF, on/off actuator have an internal current limiter which maintains the current at a safe level which will not damage the actuator while providing adequate holding torque.

The TF modulating actuators (TFB24-SR(-S), TFB24-3(-S), TFB120-SR) are protected against overload by digital technology located in the ASIC. The ASIC circuitry constantly monitors the rotation of the brushless DC motor inside the actuator and stops the pulsing to the motor when it senses a stall condition. The motor remains energized and produces full rated torque during stall conditions. The actuator will try to move in the direction of the stall every 2 minutes, for a period of 32 minutes. After this, the actuator will try again every 2 hours.

Mechanical Angle of Rotation Limiting

The TF actuators are provided with an adjustable stop to limit the rotation of the actuator. This function works in conjunction with the universal clamp or the optional position indicator. The adjustable stop is needed when rotation of less than 95° is required. The TF actuator can be indefinitely stalled, in any position, without harming the actuator.

**Using the Universal Clamp**

1. Loosen the end stop fastening screw using a #2 Phillips screwdriver.
2. Move the stop block so the bottom edge of the block lines up with the number corresponding to the desired degrees of rotation. (example: 45 degrees of rotation = 0.5)
3. Lock the block in place with the fastening screw.
4. Check the actuator for proper rotation.

Using the IND-TF Position Indicator with Adjustable Stop

NOTE: preferred method if short shaft mounting is used.

1. With the actuator in its fail-safe position, place the IND-TF Position Indicator so that it points to the 0 degree position.
2. Loosen the end stop fastening screw using a #2 Phillips screwdriver.
3. Move the stop block so the bottom edge of the block lines up with the number corresponding to the desired degrees of rotation (example: 45 degrees of rotation = 0.5).
4. Lock the block in place with the fastening screw.
5. Check the actuator for proper rotation.

Direction of Rotation Switch

TFB24-3(-S), TFB24-SR(-S), and TFB120-SR actuators have a direction of rotation switch on the cover marked "CCW" for CCW or "CW" for CW respectively. Switch position indicates start point. For the TFB24-SR, with the switch in position "CW", the actuator rotates clockwise with a decrease in voltage or current. With the switch in position "CCW", the actuator rotates counterclockwise with a decrease in voltage or current.

The TFB24-3(-S) actuator rotates clockwise when the switch is in the "CW" position and power is applied to wire #3. When power is applied to wire #4 the actuator rotates counter clockwise.

Rotating the direction of rotation switch to "CCW" reverses the control logic.

During checkout, the switch position can be temporarily reversed and the actuator will reverse its direction. This allows the technician a fast and easy way to check the actuator operation without having to switch wires or change settings on the controller. **When the check-out is complete, make sure the switch is placed back to its original position.**

Installation Instructions

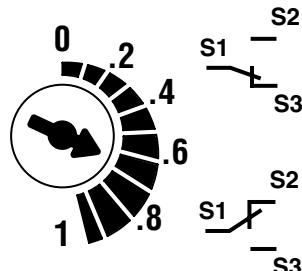
Mechanical Installation

BELIMO®

Auxiliary Switches

The ...-S model actuators are equipped with an adjustable auxiliary switch used to indicate damper position or to interface additional controls or equipment. Switching positions can be set over the full 0 to 95° rotation simply by setting a switch on the actuator.

1. Set desired switch position.
(Example 60%)
2. As the actuator rotates, the switch indicator moves from .6 (60%) toward 0 (0%).



Switch Rating

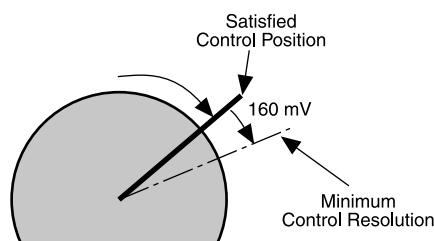
Voltage	Resistive load	Inductive load
250 VAC	3 A	0.5 A

Control Accuracy and Stability

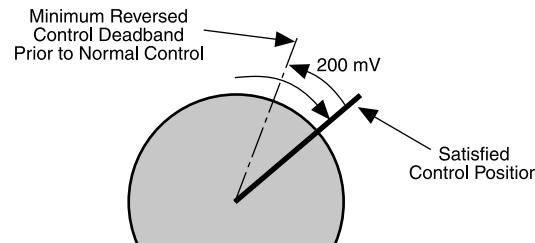
-SR and MFT TF actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The -SR and MFT TF actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 160 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

TF Actuator responds to a 160 mV signal when not changing direction from stop position.

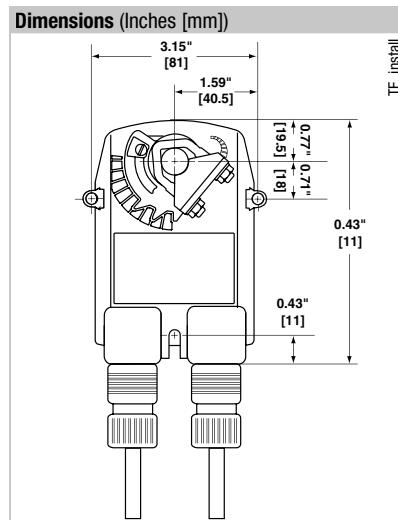
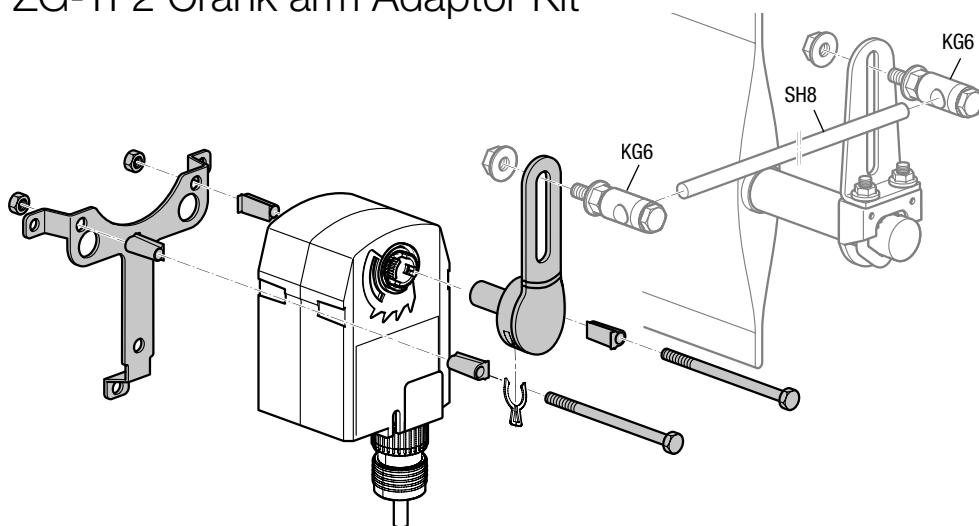


TF Actuator responds to a 200 mV signal when reversing direction from stop position.



Non-Direct Mounting Methods

ZG-TF2 Crank arm Adaptor Kit



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The TF24 . . actuator requires a 24 VAC class 2 transformer and draws a maximum of 5 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 2004/108/EC
- Software class A: Mode of operation type 1
- Low voltage directive: 2006/95/EC

CAUTION It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. *This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg.* Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for TF... Actuators

Keep power wire runs below the lengths listed in the table in **Figure A**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example for TFB24-SR: 3 actuators, 16 Ga wire
 $550 \text{ Ft} \div 3 \text{ Actuators} = 183 \text{ Ft. Maximum wire run}$

TFB24(-S) / TFB120(-S) Maximum Wire Length

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	1300 Ft.	18 Ga	575 Ft.
14 Ga	1175 Ft.	20 Ga	300 Ft.
16 Ga	900 Ft.	22 Ga	150 Ft.

TFB24-3(-S) Maximum Wire Length

Wire Size	Max. Feet.	Wire Size	Max. Feet
16 Ga	1125 Ft.	20 Ga	400 Ft.
18 Ga	725 Ft.	22 Ga	200 Ft.

TFB24-SR(-S), TFB24-MFT Maximum Wire Length

Wire Size	Max. Feet.	Wire Size	Max. Feet
12 Ga	1800 Ft.	18 Ga	450 Ft.
14 Ga	1100 Ft.	20 Ga	275 Ft.
16 Ga	700 Ft.	22 Ga	125 Ft.

FIGURE A

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the TFB24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unsPLICED from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The TFB24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. Do not connect it to the actuator common.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside rotating permanent magnets. The electromagnetic poles are switched by a microprocessor and a special ASIC (Application Specific Integrated Circuit) developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Startup and Checkout

Instructions For TFB24-SR(-S)



TFB24-SR(-S) Electrical Check-Out Procedure

STEP	Procedure	Expected Response	Gives Expected Response Go To Step...	Does Not Give Expected Response Go To Step...
1.	Remove power to reset actuator. Re-apply power. Apply control signal to actuator.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 8.	No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4.
2.	Check power wiring. Correct any problems. See Note 1.	Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC.	Power wiring corrected, actuator begins to drive Step 1.	Power wiring corrected, actuator still does not drive Step 4.
3.	Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right.	Actuator will move to its "Control Signal" position.	Actuator operates properly Step 8.	Does not drive toward "Control Signal Position" Step 4.
4.	Make sure the control signal positive (+) is connected to Wire No 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW.	Drives to "Control Signal" position.	Actuator operates properly Step 8.	Step 5.
5.	Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. For TFB24-SR this is 2 to 10 VDC or 4 to 20 mA. Note: The input signal must be above the 2 VDC or 4 mA to have the actuator move.	Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicate.	Controller output (actuator input) is correct. Input Polarity Correct Step 6.	Reprogram, adjust repair or replace controller as needed Step 1.
6.	Loosen the nuts on the V-bolt and move the damper by hand from fully closed to fully open.	Damper will go from fully closed to fully open.	Damper moves properly Step 7.	Find cause of damper jam and repair. Move damper back to the fully closed position and tighten the nuts Step 1.
7.	Check damper torque requirement.	Torque requirement is actuator's minimum torque.	Defective Actuator. Replace Actuator - See Note 2.	Recalculate actuator requirement and correct installation.
8.	Actuator works properly. Test controller by following controller manufacturer's instructions.			

NOTE 1 Check that the transformer(s) are sized properly.

- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original installation date, notify Belimo and give details of the application.

