

# OpenAir™ GBB/GIB Series

## Electronic Damper Actuators

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### NSR Rotary, 24 Vac - Modulating Control




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**Description** The OpenAir direct coupled 24 Vac non-spring return (NSR) rotary electric actuator is designed for modulating control of building HVAC dampers.

- Features**
- Built-in feedback on modulating units
  - Unique self-centering shaft coupling
  - All metal housing
  - Two torque ranges available
  - Manual override
  - Offset and span adjustment models available
  - Independently adjustable dual auxiliary switches available
  - UL, cUL and CE listed

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**Product Numbers** Table 1.

24 Vac Operating Voltage						
Torque	Input Signal	Cabling	Standard	Span/Offset Adjustable	Dual Auxiliary Switches and Span/Offset Adjustable	Dual Auxiliary Switches only
221 lb-in (25 Nm)	0 to 10 Vdc	Standard	GBB161.1U	GBB163.1U	GBB164.1U	GBB166.1U
		Plenum Cable	GBB161.1P	GBB163.1P	GBB164.1P	GBB166.1P
310 lb-in (35 Nm)	0 to 10 Vdc	Standard	GIB161.1U	GIB163.1U	GIB164.1U	GIB166.1U
		Plenum Cable	GIB161.1P	GIB163.1P	GIB164.1P	GIB166.1P

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**Application** These actuators are used in constant or variable air volume installations for the control of supply return air, mixed air, exhaust, rooftop units, and face and bypass dampers requiring up to 221 lb-in (25 Nm) torque or 310 lb-in (35 Nm) torque.

## Warning/Caution Notations

<b>WARNING:</b>		Personal injury/loss of life may occur if you do perform a as specified.
<b>CAUTION:</b>		Equipment damage or loss of data may occur if you do not follow a procedure as specified.

<b>Specifications</b>	Operating voltage (G–G0)	24 Vac ±20%
	Frequency	50/60 Hz
<b>Power supply</b>	Power consumption	
	Running...	8 VA, 8W
	Holding...	1.1W
	For one tandem application of two actuators	12 VA
<b>Control Signal</b>	Input signal (Y–G0)	
	voltage-input	0 to 10 Vdc
	Input resistance	>100K ohms
<b>Feedback Signal</b>	Position output signal (U–G0)	
	Voltage-output	0 to 10 Vdc
	Maximum output current	DC 1 mA
<b>Equipment Rating</b>	Operating voltage, input signal and position output signal	Class 2, in accordance with UL/CSA
	Plenum type actuators as a whole device	Class 2 in accordance with UL/CSA
<b>Auxiliary Features</b>	<b>Dual auxiliary switches</b>	
	AC rating (standard cable)	24 to 250 Vac AC 6A resistive AC 2A general purpose
	AC rating (Plenum cable)	24 Vac AC 4A resistive AC 2A general purpose
	DC rating (Standard/Plenum cable)	12 to 30 Vdc DC 2A
	Switch Range	
	Switch A	0 to 90° with 5° intervals
	Recommended range usage	0 to 45°
	Factory setting	5°
	Switch B	0 to 90° with 5° intervals
	Recommended range usage	45 to 90°
Factory setting	85°	
Switching hysteresis	2°	



**WARNING:**

Apply only AC-line voltage from the same phase or only UL-Class 2 voltage (SELV for CE conformance) to the switching outputs of both auxiliary switches A and B. Mixed operation is not permissible.

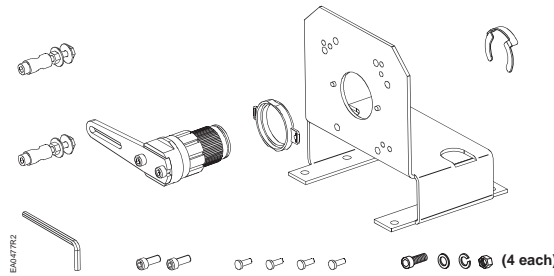
**NOTE:**

With plenum cables, only UL-Class 2 voltage (SELV for CE is permissible).

<b>Specifications, Continued</b>	Torque		
	GBB...	221 lb-in (25 Nm)	
	GIB...	310 lb-in (35 Nm)	
	<b>Function</b>	Runtime for 90° opening or closing	125 seconds at 60 Hz 150 seconds at 50 Hz
		Nominal angle of rotation	90°
	Maximum angular rotation	95°	
	Noise level	<45 dBA	
<b>Mounting</b>	Shaft size	3/8 to 1-inch (8 to 25.6 mm) diameter 1/4 to 5/8-inch (6 to 18 mm) square	
	Minimum shaft length	3/4-inches (20 mm)	
<b>Housing</b>	Enclosure	NEMA 2 in vertical position to 90° to the left and right of vertical See Figure 17 NEMA 3R rated when installed with ASK75.1U Weather Shield in the vertical position. See <i>Accessories</i> . IP54 according to EN60529	
	Material	Die cast aluminum alloy	
	Gear lubrication	Silicone-free	
<b>Ambient Conditions</b>	Ambient temperature		
	Operation	-25°F to 130°F (-32°C to 55°C)	
	Storage and transport	-40°F to 158°F (-40°C to 70°C)	
	Ambient humidity (non-condensing)	95% rh	
<b>Agency Approvals</b>		UL listed to UL873 cUL certified to Canadian Standard C22.2 No. 24-93 CE conformity: Electromagnetic compatibility 89/336/EEC Low-voltage directive 73/23/EEC	
	<b>Miscellaneous</b>	Pre-cabled connection	18 AWG
		Cable length	3 feet (0.9m)
	Life cycle	Designed for over 60,000 full strokes and a minimum of 1.5 million repositions at rated torque and temperature	
	Dimensions	See Figure 28	
	Weight	4.4 lbs (2 kg)	

**Accessories**

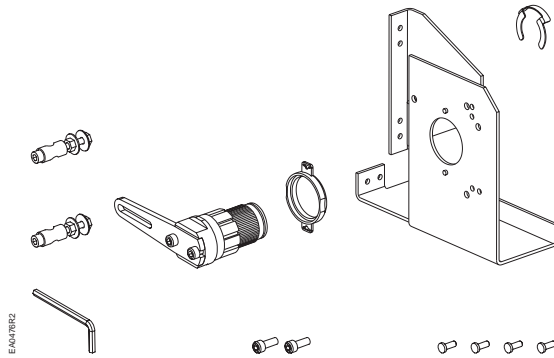
**NOTE:** Neither the control signal adjustments nor the auxiliary switches can be added in the field. Order the product numbers that include these options.



**Figure 1. Floor Mount Kit.**

**ASK71.1U:** Kit allows foot mounting of the OpenAir actuators. Kit should be used for in-the-air stream applications, and anywhere a foot-mounted actuator can be mounted. Kit contains:

- Crank arm that changes the angular rotation into a linear stroke
- Support bearing ring to minimize side loading on the actuator's output bearing
- Mounting bracket
- Required mounting fasteners

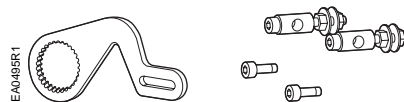


**Figure 2. Frame Mount Kit.**

**ASK71.2U:** Kit allows mounting of OpenAir actuators directly to a damper frame. Kit should be used with louvers and vents and in applications where use of the floor mount kit is not possible.

Kit contains:

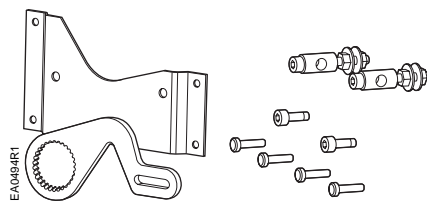
- Crank arm that changes the angular rotation into a linear stroke
- Support bearing ring to minimize side loading on the actuator's output bearing
- Mounting bracket
- Required mounting fasteners



**Figure 3. Crank Arm Kit.**

**ASK71.3:** Kit allows a direct-coupled actuator to provide an auxiliary linear drive. Crank arm kit can be used to simultaneously drive a set of opposing or adjacent dampers with a single actuator. Kit contains:

- Crank arm that attaches to the splined hub of the shaft adapter
- Other required mounting fasteners

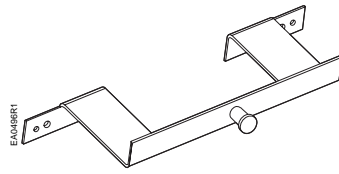


**Figure 4. Crank Arm Kit with Mounting Bracket.**

**ASK71.4:** Kit allows economical mounting of OpenAir actuators to a variety of surfaces. Kit should be used in applications where the actuator can be rigidly surface mounted and a linear stroke output is required. Kit contains:

- Crank arm that attaches to the splined hub of the shaft adapter
- Mounting bracket
- Required mounting fasteners

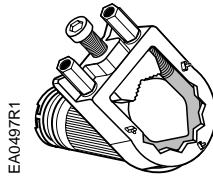
**Accessories,  
 Continued**



**Figure 5. Tandem Mounting Bracket.**

**ASK73.1U:** Provides an extended anti-rotation pin that allows two modulating GIB actuators to directly drive a single damper shaft. For any combination of GIB161x and GIB166x actuators.

Bracket must be ordered for tandem installation.

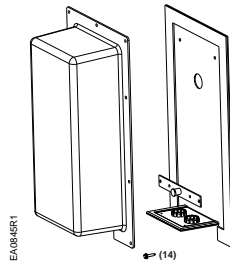


**Figure 6. Special Shaft Adapter.**

**ASK74.1U:** Shaft adapter attaches to a 1.05-inch (26.6 mm) diameter shaft; whereas, the standard self-centering adapter accepts up to a 1.00-inch (25 mm) diameter shaft. This special adapter can be used for coupling to 1-inch jackshafts that are slightly oversized.

Shaft adapter is 13/16-inches (20 mm) shorter than the height of the self-centering shaft adapter.

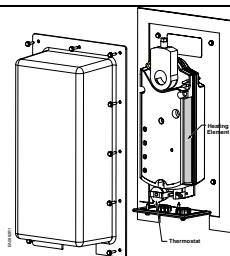
**985-052P20:** Small shaft insert (package of 20) when using the GIB actuator on a damper shaft less than 3/4-inch (20 mm) diameter.



**Figure 7. Weather Shield.**

**ASK75.1U:** The GBB/GIB actuators are UL listed to meet NEMA 3R requirements (a degree of protection against rain, sleet, and damage from external ice formation) when installed with this ASK75.1U weather shield and outdoor-rated conduit fittings in the vertical position.

For dimensions, see Figure 27.



**Figure 8. Heater/Weather Shield Assembly.**

**985-106:** Provides protection for GIB, GBB and GCA OpenAir actuators in an outside low temperature. Assembly includes:

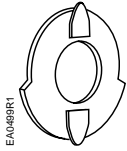
- Weather Shield (ASK75.1U)
- Heater Kit (985-105)S



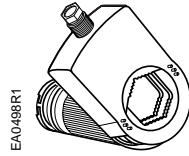
**Figure 9. Conduit Adapter.**

**985-008:** 1/2-inch (12 mm) for 1/2-inch NPT connector.

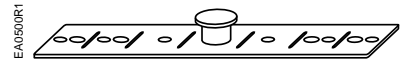
**Service Parts**



**Figure 10.**  
**Position Indicator.**  
 985-003  
 (package of 10)

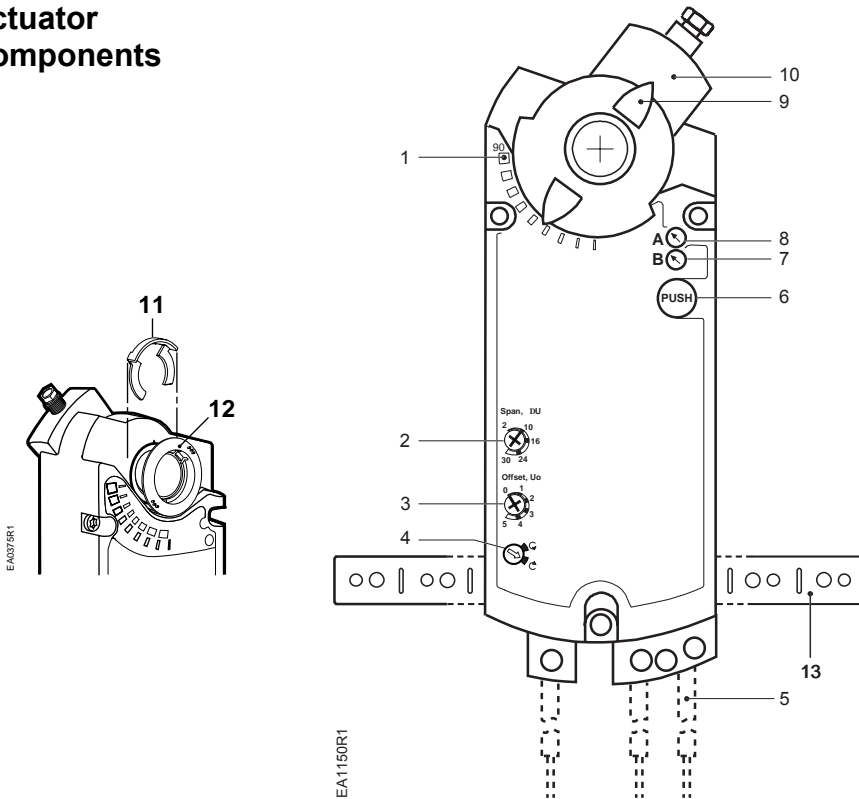


**Figure 11.**  
**Standard Shaft Adapter.**  
 985-004



**Figure 12.**  
**Anti-rotation (Mounting) Bracket.**  
 985-006

**Actuator Components**



**Figure 13. Components of the Modulating Actuator.**

**Legend**

1. Positioning scale for angle of rotation
2. Span adjustment
3. Offset (start point) adjustment
4. Direction of rotation arrow
5. Connection cables
6. Manual override
7. Auxiliary switch B
8. Auxiliary switch A
9. Position indicator
10. Self-centering shaft adapter
11. Shaft adapter locking clip
12. Position indicator adapter
13. Mounting bracket

**Operation**

A continuous 0 to 10 Vdc signal from a controller to wire Y operates the damper actuator. The angle of rotation is proportional to the control signal. A 0 to 10 Vdc position feedback output signal is available between wires U and G0 (system neutral) to monitor the position of the damper motor.

In the event of a power failure, depending on load, the actuator may not hold the commanded (or new) position. In the event only the control signal is lost, the actuator returns to the "0" position.

In the event of a blockage in the damper, the actuator is overload protected over the full range to prevent damage to the actuator.

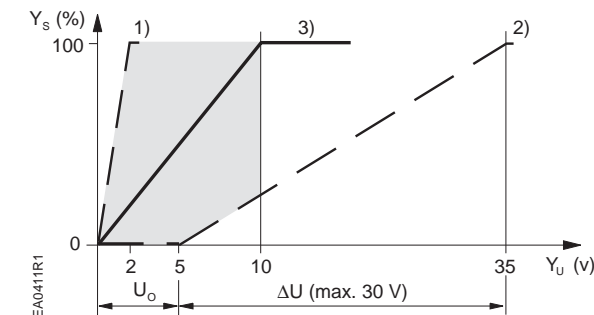
**Life Expectancy**

An improperly tuned loop will cause excessive repositioning that will shorten the life of the actuator.

**Control Signal Adjustment**

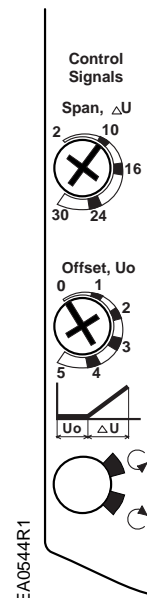
GBB/GIB 163x GBB/GIB 164x

The offset (start point) and span of the control signal can be adjusted. The offset point,  $U_0$ , (start point) can be adjusted between 0 to 5 Vdc. The span,  $\Delta U$ , can be adjusted between 2 to 30 Vdc.



- $Y_s$  Mechanical positioning range (100% = angle of rotation 90°)
- $Y_u$  Control signal
- $U_0$  Offset (start point)
- $\Delta U$  Span

1.  $U_0 = 0V, \Delta U = 2V$  Minimum working range for  $Y_s = 100\%$
2.  $U_0 = 5V, \Delta U = 30V$  Maximum working range for  $Y_s = 100\%$
3.  $U_0 = 0V, \Delta U \approx 10V$  Factory setting



Setting for 10V span 0 offset

**Figure 14. Minimum, Factory Setting, and Maximum Control Signal Adjustment.**

**Operation,  
 Continued**

**Control Signal  
 Adjustment Example**

Open the actuator from 0% to 50% (45°) using a control signal of  $U_{min} = 2V$  to  $U_{max} = 10V$ .  
 Calculating the value of  $\Delta U$ :

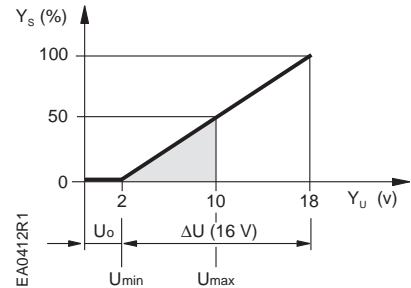
$$\Delta U = \frac{100 [\%] \times (U_{max} - U_{min})}{\text{Working angle of rotation} [\%]} = \frac{100\% \times (10V - 2V)}{50\%} = 16 V$$

Settings:

$U_0 = 2V$ ;  $\Delta U = 16V$

$U_{min}$  = minimum control signal

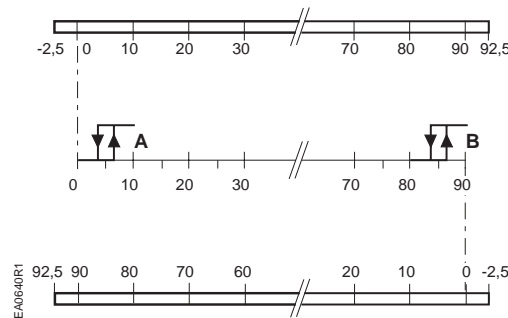
$U_{max}$  = maximum control signal



**Figure 15. Example.**

**Dual Auxiliary Switch**

**GBB/GIB 164x, and GBB/GIB 166x**



Actuator Scale:  
 clockwise

Adjustment range for Switches A and B  
 Setting interval: 5°  
 Switching hysteresis: 2°

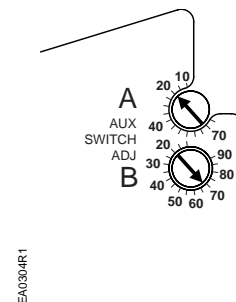
Actuator Scale:  
 counterclockwise

**NOTE:** The auxiliary switch setting shafts turn together with the actuator. The scales are valid only when the actuator is in the "0" position on clockwise motion.

To change the settings of A and B, use a flat-blade screwdriver to turn the switch adjustment dials to the desired setting at which a signal is to be given.

Factory setting

- Switch A      5°
- Switch B      85°



**Figure 16. Dual Auxiliary Switch Dials.**



## Sizing

The number of actuators required depends on several factors. To determine the quantity of actuators required for the installation, do the following:

1. Obtain damper torque ratings (ft-lb/ft<sup>2</sup> or Nm/m<sup>2</sup>) from the damper manufacturer.
2. Determine the area of the damper.
3. Calculate the total torque required to move the damper:

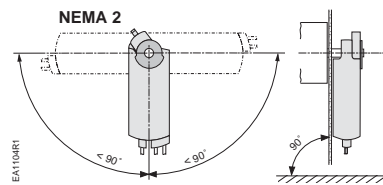
$$\text{Total Torque} = \text{Torque Rating} \times \text{Damper Area}$$

4. Select the total quantity of actuators required:

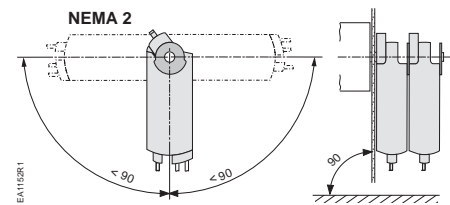
$$\text{Number of actuators} = \frac{\text{Total Damper Torque required}}{\text{SF}^1 \times \text{Actuator Torque (Refer to Specifications)}}$$

- <sup>1</sup> Safety Factor: When calculating the number of actuators required, a safety factor should be included for unaccountable variables such as slight misalignments, aging of the damper, etc. A suggested safety factor is 0.80 (or 80% of the rated torque).

## Mounting and Installation



**Figure 17. Acceptable NEMA 2 Positions.**



**Figure 18. Acceptable NEMA 2 Position for Tandem Applications.**

- The direction of rotation switch must be set to match the clockwise or counterclockwise rotation of the damper shaft. The factory setting is clockwise. See Figure 13 for location on the actuator.



**Figure 19. Direction of Rotation Switch.**

- The minimum damper drive shaft length is 3/4-inches (20 mm). The shaft length determines whether the shaft adapter will be mounted on the front or back side of the actuator.
- See *Specifications* for minimum and maximum damper shaft dimensions.
- The shaft adapter can be mounted on either side of the actuator. The direction of rotation and shaft length determine how the shaft adapter will be mounted on the actuator.
- The position indicator can be mounted to show either the clockwise or counterclockwise 0 to 90 scale.
- The actuator is shipped from the factory with a 5° pre-load to ensure tight close off of the damper.
- The shaft adapter and mounting parts are shipped in a separate container with the actuator.
- Detailed mounting instructions are included with each actuator.

## Mounting and Installation, continued

### Tandem Applications

- The direction of rotation switches must be set identically on both actuators according to the clockwise or counterclockwise rotation of the damper shaft. The factory setting is clockwise. See Figure 13 for location on the actuators.
- The tandem actuator pair is intended for use on the same mechanical load.
- Minimum damper drive shaft length is 4-inches (100 mm).



**CAUTION:**

No more than three actuators are to be used in tandem applications.

### Manual override

To move the damper blades when power is not present:

1. Hold down the **PUSH** button.
2. Make adjustments to the damper position.
3. Release the **PUSH** button.

**NOTE:** If there is no load, the actuator will hold the new damper position. If load conditions exist, the actuator might not be able to hold.

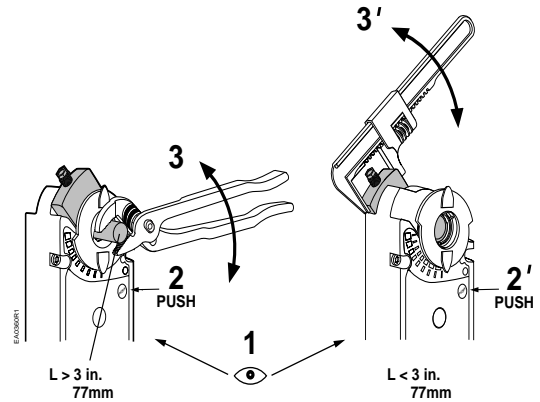


Figure 20. Manual Override.

Once power is restored, the actuator returns to automated control.

### Mechanical Range Adjustment

The angular rotation is adjustable between 0 and 90° at 5-degree intervals. The range of shaft movement is limited by mounting the shaft adapter:

1. Loosen the shaft adapter from the damper shaft and remove the actuator from the damper shaft.
2. Remove the clip and shaft adapter from the actuator.

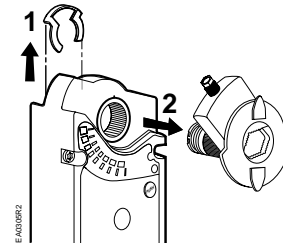


Figure 21.

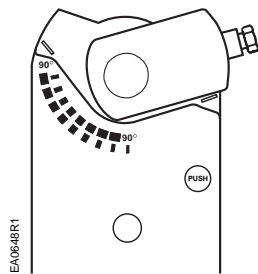


Figure 22.

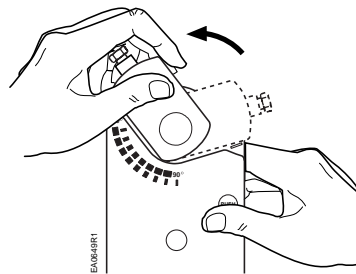


Figure 23.

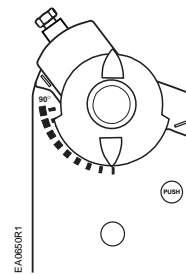


Figure 24.

**Mechanical Range Adjustment, Continued**

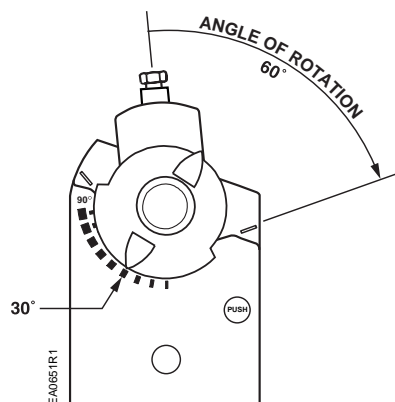
3. Return the actuator gear train to the "0" position using the steps that follow for the clockwise or counterclockwise damper shaft rotation.

**Clockwise-to-open:**

- a. Insert the shaft adapter to the right as close as possible to the raised stop. See Figure 22.
- b. Hold down the **PUSH** button and rotate the shaft adapter to the left until it stops. See Figure 23.
- c. Release the **PUSH** button.
- d. If the shaft adapter is not resting against the left raised stop, remove the adapter and insert it against the left stop.
- e. Place the position indicator to the "0" position on the outside scale. See Figure 24.

**Counterclockwise-to-open:**

- a. Insert the shaft adapter to the left as close as possible to the raised stop.
  - b. Hold down the **PUSH** button and rotate the shaft adapter to the right until it stops.
  - c. Release the **PUSH** button.
  - d. If the shaft adapter is not resting against the right raised stop, remove the adapter and insert it against the right stop.
  - e. Place the position indicator to "0" on the inside scale.
4. Determine the angle of rotation for the damper blade shaft. Subtract that amount from 90°.
  5. Remove the shaft adapter and insert it with the position indicator pointing to mark on the scale calculated in the previous step. See Figure 25.
  6. Attach the clip.
  7. Rotate the damper blade shaft to its "0" position.
  8. Return the actuator to the damper shaft and tighten the shaft adapter to the damper shaft.



**Figure 25. Mechanical Range Adjustment.**

## Reversing the Position Indicator

Reverse the position indicator so that the counterclockwise 0 to 90 scale is visible. See Figure 26.

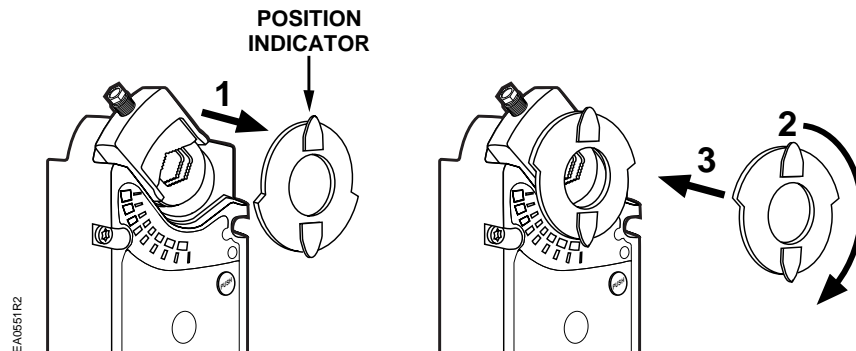


Figure 26. Position Indicator.

## Wiring

All wiring must conform to NEC and local codes and regulations.

Use earth ground isolating step-down Class 2 transformers. Do not use autotransformers.

The maximum rating for a Class 2 step-down transformer is 100 VA. Determine the supply transformer rating by summing the VA ratings of all actuators and all other components used. It is recommended that one transformer power no more than 10 actuators (or 80% of its VA).



### WARNINGS:

- Mixed switch operation is not permitted to the switching outputs of both auxiliary switches (A and B).
- Either AC line voltage from the same phase must be applied to all six outputs of the dual auxiliary switches, or UL-Class 2 voltage must be applied to all six output.

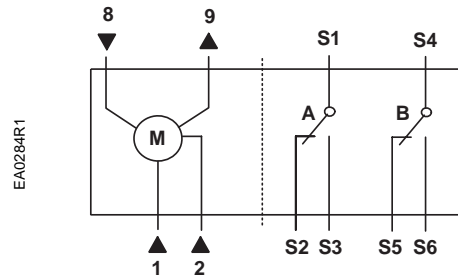
**NOTE:** With plenum cables, only UL-Class 2 voltage is permitted.



### CAUTION:

Do not parallel wire GBB/GIB with any other type of actuator, including GBB/GIB actuators with date codes earlier than 501.

**Wire Designations** Each wire has the standard symbol printed on it. See Table 2.



**Table 2. Wire Designations.**

Standard Symbol	Function	Terminal Designations	Color
1	Supply (SP)	G	Red
2	Neutral (SN)	G0	Black
8	0 to 10 Vdc	Y	Gray
9	Output for 0 to 10 Vdc position indication	U	Pink
S1	Switch A – Common	Q11	Gray/red
S2	Switch A – Normally Closed	Q12	Gray/blue
S3	Switch A – Normally Open	Q14	Gray/pink
S4	Switch B – Common	Q21	Black/red
S5	Switch B – Normally Closed	Q22	Black/blue
S6	Switch B – Normally Open	Q24	Black/pink

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## **Start-Up/ Commissioning**

1. Check that offset (start point) and span are set correctly, if used.
  2. Check that the direction of the rotation switch matches the rotation of the damper shaft.
  3. Check the operation:
    - a. Connect wires 1 (red) and 2 (black) to the actuator.
    - b. Set the DMM dial to Vdc.
    - c. Connect wires 2 (black) and 8 (gray) to a Digital Multimeter (DMM).
    - d. Apply a full-scale input signal (10 Vdc) to wire 8 (gray).
    - e. Allow the actuator shaft coupling to rotate from 0 to 90.
    - f. Disconnect wire 8 (gray) and the shaft coupling returns to the "0" position.
  4. Check the Feedback:
    - a. Set the DMM dial to Vdc.
    - b. Attach wires 2 (black) and 9 (pink) to the DMM.
    - c. Apply a full-scale input signal to wire 8 (gray).  
The reading at the DMM should increase.
    - e. Remove the signal from wire 8 (gray). The reading at the DMM should decrease and the actuator shaft coupling returns to the "0" position.
  5. Check the Auxiliary Switch A:
    - a. Set the DMM dial to ohms (resistance) or continuity check.
    - b. Connect wires S1 and S3 to the DMM. The DMM should indicate open circuit or no resistance.
    - c. Apply a full-scale input signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
    - d. Connect wires S1 and S2 to the DMM. The DMM should indicate open circuit or no resistance.
    - e. Stop the signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch A.
  6. Check the Auxiliary Switch B:
    - a. Set the DMM dial to ohms (resistance) or continuity check.
    - b. Connect wires S4 and S6 to the DMM. The DMM should indicate open circuit or no resistance.
    - c. Apply a full-scale input signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
    - d. Connect wires S4 and S5 to the DMM. The DMM should indicate open circuit or no resistance.
    - e. Stop the signal to wire 8 (gray).  
The DMM should indicate contact closure as the actuator shaft coupling reaches the setting of switch B.
-

**Service**



**WARNING:**

Do not open the actuator.  
 If the actuator is inoperative, replace the unit.

**Troubleshooting**

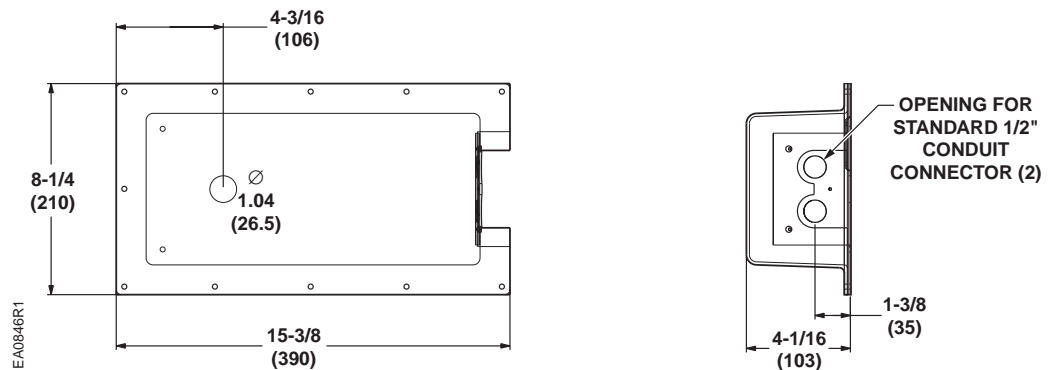


**WARNING:**

To avoid injury or loss of life, pay attention to any hazardous voltage (for example, 120 Vac) when performing checks.

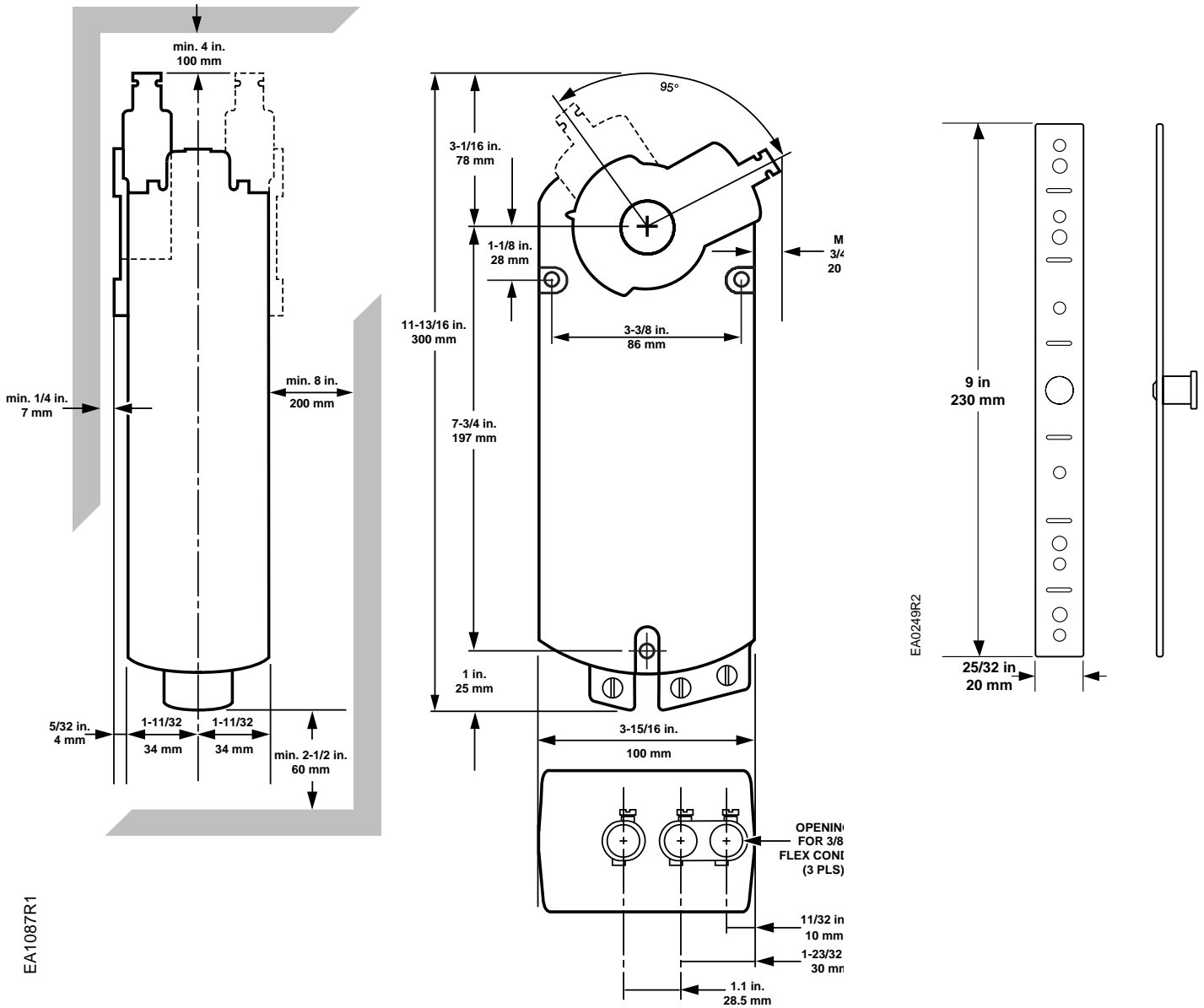
- Check that the wires are connected correctly.
- Check that offset (start point) and span are set correctly, if used.
- Check that the direction of rotation switch matches the rotation of the damper shaft.
- Connect wires 1 (red) and 2 (black) to a Digital Multimeter (DMM) with the dial set at Vac to verify that the operating voltage is within range.
- If the actuator is not working, check the damper for blockage. If blocked, remove the obstacle and cycle the actuator power off and on. The actuator should resume normal operating mode.

**Dimensions**



**Figure 27. Dimensions of the ASK75.1U Weather Shield in Inches (Millimeters).**

**Dimensions, Continued**



**Figure 28. Dimensions of the GBB/GIB Actuator and Mounting Bracket in Inches (mm).**



