

## M9206 Series Electric Spring Return Actuators

### Installation

**IMPORTANT:** The M9206 Series actuator is intended to control equipment under normal operating conditions. Where failure or malfunction of an M9206 could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of or protect against failure or malfunction of an M9206 must be incorporated into and maintained as part of the control system.

### Parts Included

- M9206 actuator
- M9000-161 anti-rotation bracket
- two No. 12-24 sheet metal screws

### Special Tools Needed

- 5/16 in. (8 mm) nut driver
- 5/16 in. (8 mm) square socket or 3/8 in. (10 mm) 12-point socket
- drill with a 3/16 in. (No. 15, 4.57 mm) drill bit

### Spring Return Direction

#### **Counterclockwise (CCW) Operation**

For CCW spring return operation, install the actuator on the damper shaft so the CCW face of the actuator (shown in Figure 1) is away from the damper. The coupler is at the 0° position to drive CW and spring return CCW.

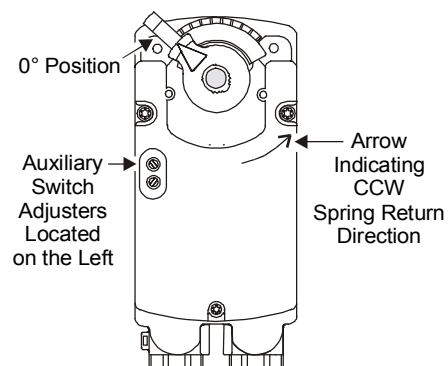


Figure 1: CCW Face of the Actuator

#### **Clockwise (CW) Operation**

To change the spring return direction to CW, install the actuator on the damper shaft so the CW face of the actuator (shown in Figure 2) is away from the damper. The actuator now drives CCW from the 0° position.

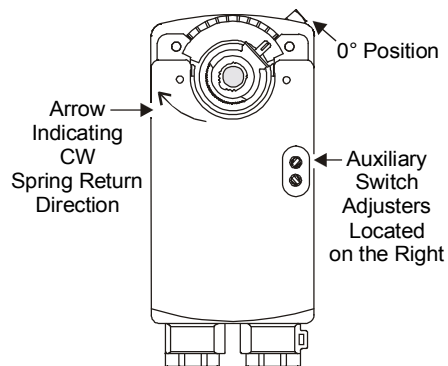


Figure 2: CW Face of the Actuator

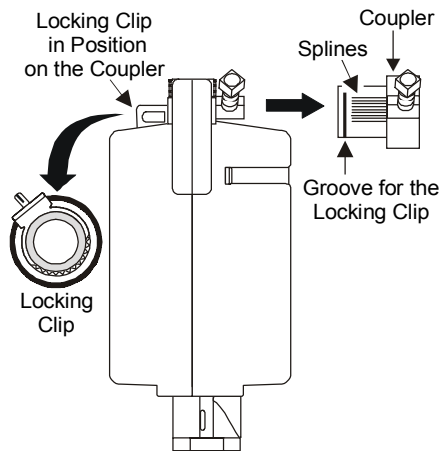
The coupler may be inserted in the CW face of the actuator for easier access to the coupler set screw. (Refer to the *Removable Coupler* section.)

### Removable Coupler

If the damper shaft is less than 3.2 in. (80 mm) long, the coupler must be inserted in the face of the actuator closest to the damper.

If the damper shaft is shorter than 1.7 in. (42 mm), a shaft extension is required to mount the actuator.

To change the coupler's position, refer to Figure 3 and proceed as follows:



**Figure 3: Changing the Position of the Coupler**

1. Pull the locking clip off the coupler, and remove the coupler from the actuator.

Proceed to the *Rotation Range* section for a rotation range of less than 90°.

2. Reinsert the coupler into either the CW or CCW face of the actuator (determined by the shaft length discussed earlier in this section).

The coupler splines (shown in Figure 3) are designed to prevent inserting the coupler at the wrong end of the rotation range.

**IMPORTANT:** For 0 to 93° rotation, the coupler must fit as closely as possible to, but not on top of, the metal plate at the spring return position.

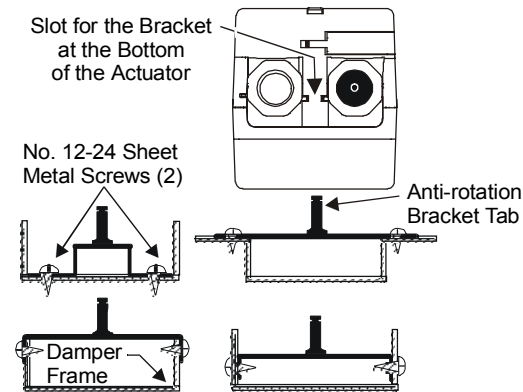
3. Snap the locking clip securely into the coupler groove to retain the coupler in the actuator.

### Mounting

The M9206 actuators may be mounted in any convenient orientation. They may be installed on a 3/8 to 1/2 in. (10 to 12.7 mm) round shaft and a 3/8 in. (10 mm) square shaft. If the shaft extends less than 3.2 in. (80 mm), refer to the *Removable Coupler* section.

To mount the actuator, proceed as follows:

1. Bend or cut the anti-rotation bracket to fit the damper frame or duct as shown in Figure 4. (The bracket may be bent to fit a round damper.)

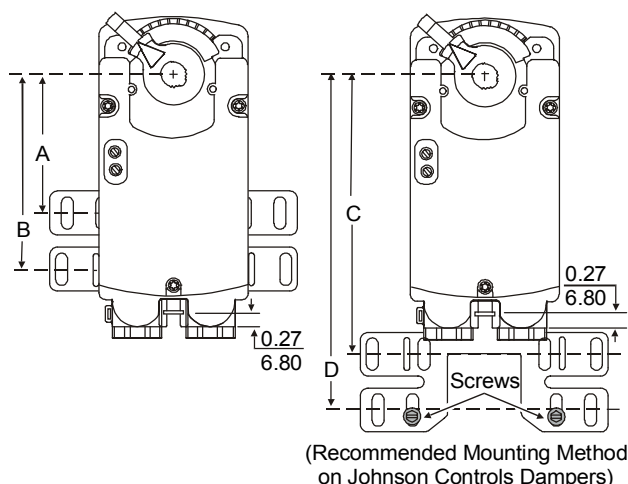


**Figure 4: Anti-rotation Bracket Positions**

2. Slide the actuator onto the damper shaft.
3. Position the anti-rotation bracket into the slot at the bottom of the actuator. (See Figure 4.)

**IMPORTANT:** The tab on the anti-rotation bracket must fit midpoint in the actuator slot. This prevents actuator binding and premature wear, and makes actuator removal easier.

4. Refer to the "A" through "D" dimensions in Figure 5 and Table 1 to ensure the anti-rotation bracket tab fits midway in the actuator slot.



**Figure 5: Mounting Positions, in./mm**

**Table 1: Shaft Sizes and Distances from the Anti-rotation Bracket to Shaft Center**

| Dimensions<br>in. (mm) | Shaft Diameter |              |
|------------------------|----------------|--------------|
|                        | 1/2 in. (mm)   | 3/8 in. (mm) |
| <b>A</b>               | 3.00 (76.3)    | 2.94 (74.7)  |
| <b>B</b>               | 4.23 (107.5)   | 4.17 (105.9) |
| <b>C</b>               | 6.11 (155.3)   | 6.05 (153.7) |
| <b>D</b>               | 7.35 (186.6)   | 7.30 (185.0) |

- Use the anti-rotation bracket as a guide, and drill the holes in the damper frame or duct for the bracket (based on the measurements obtained in Figure 5 and Table 1).

**Note:** When installing the actuator to a Johnson Controls CD-1300 damper, use the existing holes in the damper frame.

- Rotate the damper to the position desired when power is lost. If a tight seal is required, rotate the actuator 3° away from the spring return direction.
- Tighten the coupler set screw onto the damper shaft. Recommended torque for the set screw is 150 to 180 lb·in (17 to 20 N·m).
- Attach the anti-rotation bracket to the damper frame or duct with the two sheet-metal screws provided, using a 5/16 in. (8 mm) nut driver.

**IMPORTANT:** Do not overtighten the mounting screws to avoid stripping the threads. Make sure the anti-rotation bracket tab remains properly positioned in the actuator slot, and keep the actuator parallel to the mounting surface.

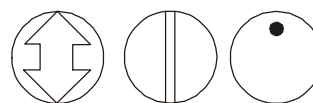
- Verify that the actuator rotates freely throughout the range by applying a full stroke control signal.

### Rotation Range

The actuator is factory set for 0 to 93° rotation. If the rotation range is reduced, the end-stop is reached with a reduced input signal. Refer to the *Setup and Adjustments, Direction of Action, Fixed or Auto Mode* section.

To reduce the rotation range, reposition the coupler as follows:

- Make sure that the damper blade is visually accessible or its position is permanently marked on the end of the damper shaft as shown in Figure 6.

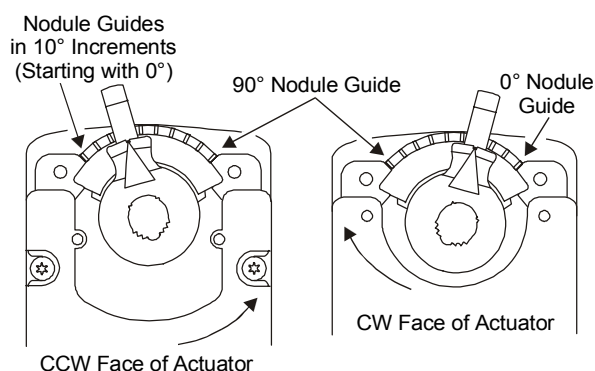


**Figure 6: Damper Position Icons**

- Determine the desired rotation range, and subtract this amount from 90°.
- Remove the locking clip from the coupler. (See Figure 3.)
- Manually reposition the coupler, so the coupler set screw aligns with the nodule guide that corresponds to the value determined in Step 2.

**Examples:**

- For a rotation range of 60°, move the coupler so the coupler set screw is at the 30° nodule guide (90° - 60° = 30°). Refer to Figure 7.



**Note:** Coupler set screw is shown at 30° in both applications.

**Figure 7: Actuator Set for 60° Rotation**

- For a rotation range of 45°, move the coupler so the coupler set screw is midway between the 40 and 50° nodule guides (90° - 45° = 45°).

Note: The minimum rotation range is 34.5°.

- Snap the locking clip securely into the coupler groove to retain the coupler in the actuator.

### Feedback Signal (GGx Models)

A change to the rotation range changes the feedback signal and the operating range proportionally in the fixed mode. (See Figure 8.) Refer to the *Setup and Adjustments, Direction of Action, Fixed or Auto Mode* section.

| Direction      | Feedback | Rotation Range |      |      |      |      |      |       |
|----------------|----------|----------------|------|------|------|------|------|-------|
|                |          | 0°*            | 15°  | 30°  | 45°  | 60°  | 75°  | 90°   |
| Direct Acting  | 0-10V    | 0.0V           | 1.7V | 3.3V | 5.0V | 6.7V | 8.3V | 10.0V |
|                | 2-10V    | 2.0V           | 3.3V | 4.7V | 6.0V | 7.3V | 8.7V | 10.0V |
|                | 6-9V     | 6.0V           | 6.5V | 7.0V | 7.5V | 8.0V | 8.5V | 9.0V  |
| Reverse Acting | 0-10V    | 10.0V          | 8.3V | 6.7V | 5.0V | 3.3V | 1.7V | 0.0V  |
|                | 2-10V    | 10.0V          | 8.7V | 7.3V | 6.0V | 4.7V | 3.3V | 2.0V  |
|                | 6-9V     | 9.0V           | 8.5V | 8.0V | 7.5V | 7.0V | 6.5V | 6.0V  |

\* 0° is the spring return position.

**Figure 8: Nominal Feedback Signal Relative to the Rotation Range**

### Wiring



#### **WARNING: Risk of Electrical Shock.**

Disconnect all power supplies before wiring connections are made or prior to performing maintenance. Make sure all unused wire leads are insulated to avoid the risk of electrical shock or damage to the equipment. More than one disconnect may be necessary to remove power from the actuator and both auxiliary switches.



#### **CAUTION: Equipment Damage Hazard.**

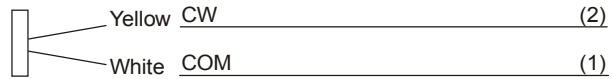
Check all wiring connections before applying power to the system. Short-circuited or improperly connected wires result in permanent damage to the equipment.

**IMPORTANT:** Make all wiring connections in accordance with the National Electrical Code and local regulations. Use proper Electrostatic Discharge (ESD) precautions during installation and servicing to avoid damaging the actuator's electronic circuits.

Refer to Figure 9 to wire the applicable M9206 model.

#### **On/Off Control\***

Models: BGA and BGC

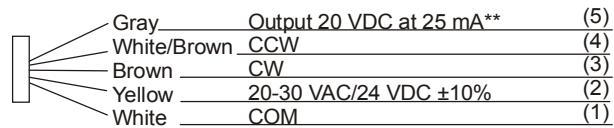


Models: AGA and AGC



#### **Floating Control\***

Models: AGA and AGC

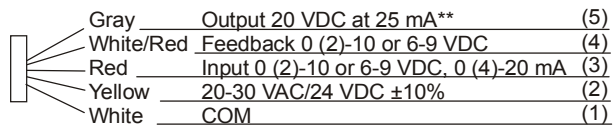


\* CW becomes CCW, and CCW becomes CW when the actuator is mounted for CW spring return operation for both on/off and floating control.

\*\* Only available on -2MP models.

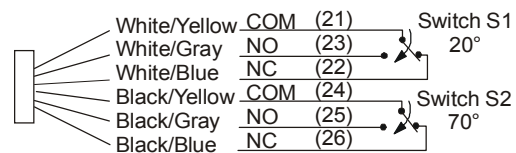
#### **Proportional Control**

Models: GGA and GGC



#### **Auxiliary Switches**

Models: BGC, AGC, and GGC  
(Shown Factory Set)



**Figure 9: Wiring Diagrams for M9206 Models**

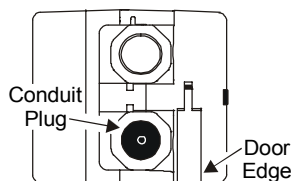
### Output (-2MP Models)

The -2MP models operate in response to a 6 to 9 VDC control signal and include a 20 VDC at 25 mA auxiliary power output used to power external devices, such as thermostats and controllers.

The -2MP models are compatible with a number of Barber-Colman® thermostat/controllers.

### Using Conduit

If it is necessary to use conduit or other electrical fittings for a specific actuator application, refer to Figure 10 and proceed as follows:



**Figure 10: Bottom of the Actuator**

1. Pry the plastic plug out of the wired conduit opening (if present) with a flat-blade screwdriver.
2. Slide the plug off the wiring cable and discard it.
3. Insert the conduit fitting (not provided) into the 1/2 in. conduit opening, and hand tighten in a CW direction.

**IMPORTANT:** Use flexible metallic conduit or its equivalent with the conduit fitting. To avoid stressing a mounted actuator, use a tool to grasp the conduit housing when installing the fitting. Do not overtighten the fitting into the actuator to avoid damaging the actuator housing.

4. Feed the wiring cable through the conduit assembly, and finish wiring.



#### **WARNING: Risk of Electrical Shock.**

Do not remove the conduit adaptor on xGC (auxiliary switch) models to avoid the risk of electrical shock and to maintain the double insulation and strain relief.

### Setup and Adjustments

The GGx models have mode selection switches to select the desired settings for operation. The AGx and BGx models are set up for operation with changes to the wiring.

### Direction of Action

The AGx models are factory set for DA operation. For RA operation, reverse the wiring between Terminals 3 and 4. (See Figure 9.)

The GGx models are factory set for DA operation with Switch 3 in the DA position. An increasing control signal drives the actuator away from the spring return position. For RA operation, move Switch 3 to the RA position. In this mode, an increasing control signal drives the actuator toward the spring return position.

The drive direction for the GGx models is dependent upon the position of Switch 3 and the spring return direction as shown in Table 2.

**Table 2: Settings for Direction of Action**

| Position of Switch 3 and the Direction of Spring Return | Drive Direction with a Minimum Input Signal | Drive Direction with a Maximum Input Signal |
|---------------------------------------------------------|---------------------------------------------|---------------------------------------------|
| DA/CCW                                                  | CCW                                         | CW                                          |
| RA/CCW                                                  | CW                                          | CCW                                         |
| DA/CW                                                   | CW                                          | CCW                                         |
| RA/CW                                                   | CCW                                         | CW                                          |

Note: To change the spring return direction, see the *Installation, Spring Return Direction* section.

### Mode Switches (GGx Models)

The mode selection switches are located behind the door on the bottom of the actuator. To access these switches, insert a flat-blade screwdriver in the slot at the door edge to open the door. (See Figure 10.)

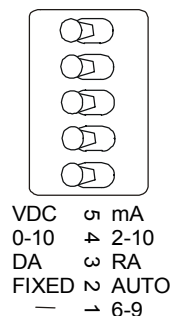
See Table 3 for the mode settings available.

**Table 3: Mode Selection Information**

| Mode Switches | Switch Functions                                           | Factory Settings |
|---------------|------------------------------------------------------------|------------------|
| 5             | VDC or mA                                                  | VDC              |
| 4             | 0-10 VDC (0-20 mA) or 2-10 VDC (4-20 mA)                   | 0-10             |
| 3             | Direct Acting (DA) or Reverse Acting (RA)                  | DA               |
| 2             | Fixed or Auto (See the <i>Fixed or Auto Mode</i> section.) | Fixed            |
| 1             | — or 6-9 VDC                                               | —                |

Note: The 6 to 9 VDC setting of Switch 1 overrides Switch 4.

The mode switches are factory set with all five switches positioned as shown in Figure 11:



**Figure 11: Position of the Mode Switches**

To change a factory setting, use a 1/8 in. (3 mm) flat-blade screwdriver to position the mode switch to the alternate setting. Close the door when finished.

### VDC or mA

The type of input control signal is determined by the position of Switch 5. When Switch 5 is in the VDC position (factory setting), the input signal is set for DC voltage. When Switch 5 is in the mA position, the input signal changes to current input. (See Figure 11 and Table 4.)

**Table 4: Available Input Control Signals**

| Control Signal      |      | Mode Switch 5 |    | Mode Switch 4 |      | Mode Switch 1 |     |
|---------------------|------|---------------|----|---------------|------|---------------|-----|
|                     |      | VDC           | mA | 0-10          | 2-10 | —             | 6-9 |
| Voltage Input (VDC) | 0-10 | X             |    | X             |      | X             |     |
|                     | 2-10 | X             |    |               | X    | X             |     |
|                     | 6-9  | X             |    | X             |      |               | X   |
| Current Input (mA)  | 0-20 |               | X  | X             |      | X             |     |
|                     | 4-20 |               | X  |               | X    | X             |     |

### Input Signal

The range of the input signal is determined by the position of Switches 1 and 4. (See Table 3.)

With Switch 5 in the mA position, the feedback signal varies within the 0 to 10 V, 2 to 10 V, or 6 to 9 V range.

### Fixed or Auto Mode

The M9206 actuators are factory set with Switch 2 in the fixed position, where a 0 to 10 VDC input signal (selected with Switches 1, 4, and 5) corresponds with a 0 to 93° rotation. If the rotation range is reduced, the end-stop is reached with a reduced input signal. For example, if a 0 to 10 VDC input signal is selected and the rotation range is limited to 75°, the end-stop is reached at 8 VDC.

The AUTO calibration or auto mode enables the actuator to redefine the selected input signal and feedback proportionally across a reduced rotation range. The actuator stores the reduced range in nonvolatile memory (retains data when power is lost or removed).

To activate the auto mode, move Switch 2 to the auto position, and leave it in this position. The actuator drives to the spring return position, then to the full stroke position, and stores these positions in nonvolatile memory. The actuator drives to the setpoint determined by the control signal applied after going through the auto mode.

During normal operation, if the actuator stroke increases in the auto mode due to seal or seat wear, the input is redefined to the increased rotation range in approximately 2° increments.

If the actuator's mounting position is changed or the linkage adjusted, reinitiate the auto mode by moving Switch 2 to "fixed" for 5 seconds and then back to "auto".

### Auxiliary Switches (xGC Models)



#### **WARNING: Risk of Electrical Shock.**

Make sure all unused auxiliary switch leads are insulated to avoid the risk of electrical shock or damage to the equipment.

The M9206-xGC models have two built-in auxiliary switches with switch adjusters accessible on either face of the actuator. (See Figures 1 and 2.) Factory settings are 20° for Auxiliary Switch 1 (SW #1) and 70° for Auxiliary Switch 2 (SW #2), both nominal. Refer to *Auxiliary Switch Rating* in the *Technical Data* section.

**IMPORTANT:** Do not force the switch adjuster out of the allowable range, or damage to the switch may occur.

Switch points are independently and continuously adjustable from 0 to 70° for SW #1 and 20 to 90° for SW #2. For the most accurate positioning of the switches, refer to Figure 12 and use the following method that serves as an example.

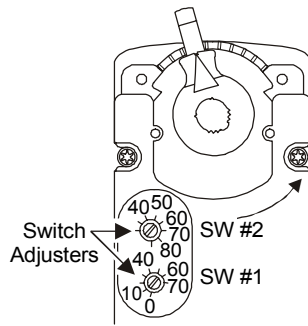
### **Auxiliary Switch 1**

To change the trip point of SW #1 to 30°:

1. Connect SW #1 to a power source or an ohmmeter, and apply a 3.3 VDC input signal to the actuator. (An actuator set for 0 to 10 VDC input drives to the 30° position.)

SW #1 trips when the actuator reaches the 20° factory setting.

2. When the actuator reaches 30°, use a 1/8 in. (3 mm) flat-blade screwdriver to turn the SW #1 adjuster until SW #1 trips again.



**Figure 12: Switch Trip Point Settings**

Note: The normally open contact opens, and the normally closed contact closes. (See the Auxiliary Switches in Figure 9.)

### **Auxiliary Switch 2**

To change the trip point of SW #2 to 60°:

1. Connect SW #2 to a power source or an ohmmeter, and apply a 6.6 VDC input signal to the actuator. (An actuator set for 0 to 10 VDC input drives to the 60° position.)
2. When the actuator reaches 60°, turn the SW #2 adjuster with the screwdriver until SW #2 trips.

Note: The normally open contact closes, and the normally closed contact opens. (See the Auxiliary Switches in Figure 9.)

### **Repairs and Replacement**

Field repairs must not be made. For a replacement or an accessory, refer to the *Ordering Information* section in the *M9206 Series Electric Spring Return Actuators Product Bulletin (LIT-2681118)*.

## Technical Data

|                                 |                                                                                                                                                                                                                                                               |                                                                                                                                                                                                  |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>                  | M9206 Series Electric Spring Return Actuators                                                                                                                                                                                                                 |                                                                                                                                                                                                  |
| <b>Power Requirements</b>       | 20 to 30 VAC at 50/60 Hz or 24 VDC $\pm 10\%$ , Class 2,<br>16 VA supply at 32 to 140°F (0 to 60°C)<br>22 VA supply at -22 to 32°F (-30 to 0°C)<br>25 VA supply at -40 to -22°F (-40 to -30°C)                                                                |                                                                                                                                                                                                  |
| <b>Input Signal</b>             | AGx (Floating):                                                                                                                                                                                                                                               | 20 to 30 VAC at 50/60 Hz or 24 VDC $\pm 10\%$ , 4.8 mA                                                                                                                                           |
|                                 | AGx (On/Off) and BGx:                                                                                                                                                                                                                                         | 20 to 30 VAC at 50/60 Hz or 24 VDC $\pm 10\%$ ,<br>533 mA at 32 to 140°F (0 to 60°C)<br>733 mA at -22 to 32°F (-30 to 0°C)<br>833 mA at -40 to -22°F (-40 to -30°C)                              |
|                                 | GGx:                                                                                                                                                                                                                                                          | 0 (2) to 10 VDC, 6 to 9 VDC, or 0 (4) to 20 mA                                                                                                                                                   |
| <b>Input Signal Adjustments</b> | GGx (Voltage Input or Current Input):<br>Factory Setting: 0 to 10 VDC, CW rotation with signal increase<br>Switch Selectable: 0 (2) to 10 VDC, 6 to 9 VDC, or 0 (4) to 20 mA<br>Direction of Action: Switch selectable direct or reverse with signal increase |                                                                                                                                                                                                  |
| <b>Input Impedance</b>          | GGx:                                                                                                                                                                                                                                                          | Voltage Input, 200,000 ohms; Current Input, 500 ohms                                                                                                                                             |
| <b>Feedback Signal</b>          | GGx:                                                                                                                                                                                                                                                          | 0 (2) to 10 VDC for 90° (10 VDC at 2 mA) or 6 to 9 VDC<br>Corresponds to input signal selection and also rotation limits.                                                                        |
| <b>Power Supply Output</b>      | 17 to 22 VDC at 25 mA (-2MP models)                                                                                                                                                                                                                           |                                                                                                                                                                                                  |
| <b>Auxiliary Switch Rating</b>  | xGC Models:<br>Rating per Switch:                                                                                                                                                                                                                             | Two Single-Pole, Double-Throw (SPDT), double insulated<br>24 VAC, 50 VA pilot duty<br>120 VAC, 5.8 A resistive, 1/4 hp, 275 VA pilot duty<br>240 VAC, 2.9 A resistive, 1/4 hp, 275 VA pilot duty |
| <b>Spring Return</b>            | Direction is selectable with the mounting position of the actuator:<br>CCW actuator face away from the damper for CCW spring return;<br>CW actuator face away from the damper for CW spring return                                                            |                                                                                                                                                                                                  |
| <b>Mechanical Output</b>        | Running Torque:                                                                                                                                                                                                                                               | 53 lb·in (6 N·m)                                                                                                                                                                                 |
| <b>Rotation Range</b>           | Adjustable from 34.5 to 90°, mechanically limited to 93°                                                                                                                                                                                                      |                                                                                                                                                                                                  |
| <b>Rotation Time</b>            | 90 seconds for 93° with 0 to 53 lb·in (0 to 6 N·m)                                                                                                                                                                                                            |                                                                                                                                                                                                  |
| <b>Cycles</b>                   | 60,000 full stroke cycles; 1,500,000 repositions rated at 53 lb·in (6 N·m)                                                                                                                                                                                    |                                                                                                                                                                                                  |
| <b>Electrical Connection</b>    | Actuator:                                                                                                                                                                                                                                                     | 48 in. (1.2 m) cable with 20 AWG wire leads                                                                                                                                                      |
|                                 | Auxiliary Switches:                                                                                                                                                                                                                                           | 48 in. (1.2 m) cable with 18 AWG wire leads                                                                                                                                                      |
| <b>Mechanical Connection</b>    | 3/8 to 1/2 in. (10 to 12.7 mm) diameter round shaft<br>3/8 in. (10 mm) square shaft                                                                                                                                                                           |                                                                                                                                                                                                  |
| <b>Enclosure</b>                | NEMA 2, IP42                                                                                                                                                                                                                                                  |                                                                                                                                                                                                  |
| <b>Ambient Conditions</b>       | Operating:                                                                                                                                                                                                                                                    | -40 to 140°F (-40 to 60°C); 10 to 90% RH, non-condensing                                                                                                                                         |
|                                 | Storage:                                                                                                                                                                                                                                                      | -85 to 185°F (-65 to 85°C); 5 to 95% RH, non-condensing                                                                                                                                          |
| <b>Dimensions (H x W x D)</b>   | xGC Models:                                                                                                                                                                                                                                                   | 8.32 x 3.25 x 3.58 in. (211.3 x 82.6 x 91.0 mm) with conduit adaptor                                                                                                                             |
|                                 | All Other Models:                                                                                                                                                                                                                                             | 6.98 x 3.25 x 3.58 in. (177.3 x 82.6 x 91.0 mm)                                                                                                                                                  |
| <b>Shipping Weight</b>          | 3.45 lb (1.56 kg)                                                                                                                                                                                                                                             |                                                                                                                                                                                                  |
| <b>Agency Compliance</b>        | UL 873 Listed, File E27734, CCN XAPX<br>CSA C22.2 No. 139 Certified, File LR85083, Class 3221 02<br>CE Mark: EMC Directive 89/336/EEC; Low Voltage Directive 73/23/EEC                                                                                        |                                                                                                                                                                                                  |

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.



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