

VA-3100 Series Electric Valve Actuators

Applications

VA-3100 Series Electric Valve Actuators use a synchronous motor to accurately position Johnson Controls® VG2000 Series Cast Iron Flanged Globe Valves in Heating, Ventilating, and Air Conditioning (HVAC) and industrial applications. These non-spring return electric actuators provide a 675 lb (3,000 N) force output for on/off (floating) or proportional control. Integral auxiliary switches are available for indicating end stop position or for performing switching functions. Position feedback is also available through an isolated 2,000 ohm potentiometer. All models feature a hand crank for manual positioning of the valve, independent of a power supply.

IMPORTANT: Use this VA-3100 Series Electric Valve Actuator only to control equipment under normal operating conditions. Where failure or malfunction of the VA-3100 Series Actuator could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices such as supervisory or alarm systems or safety or limit controls intended to warn of, or protect against, failure or malfunction of the VA-3100 Series Actuator.

Installation

Table 1: Special Tools Needed

Actuator/Valve Part	Recommended Actuator Mounting Tools
Packing Nut	3/4 in. Wrench for Valves with 3/8 in. Stem
	1 in. Wrench for Valves with 1/2 in. Stem
	1-1/4 in. Wrench to Remove Old Packing Nut
Yoke Adaptor	1-3/4 in. Wrench
Stem Extender	11/16 in. Wrench for Valves with 3/8 in. Stem
	7/8 in. Wrench for Valves with 1/2 in. Stem
Stem Nut	Two 9/16 in. Wrenches for Valves with 3/8 in. Stem
	3/4 in. Wrench for Valves with 1/2 in. Stem
Actuator and Valve Stem Coupling Assembly Screws	5 mm Allen Wrench
Yoke Nut	Adjustable-Face, Pin-Style Spanner Wrench with Circle Diameter to 3 in.

Pre-Installation Details

When installing a VA-3100 Series Electric Valve Actuator onto a VG2000 Series Cast Iron Flanged Globe Valve:

- install the actuator and valve assembly with the actuator at or above the centerline

IMPORTANT: Mount the actuator within 90° of the vertical position above the valve body. Failure to mount the actuator within 90° of the vertical position above the valve body may permit water or moisture to travel down the valve stem, damaging the actuator and voiding the warranty.

- mount the actuator and valve assembly in an upright position, in a conveniently accessible location. When mounting the assembly horizontally, orient the yoke so that the yoke supports are positioned vertically, one above the other (as illustrated in Figure 1).

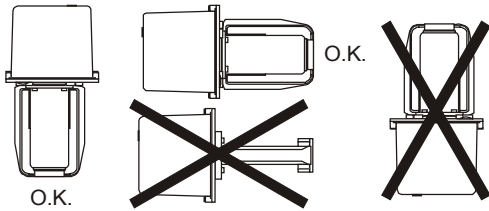


Figure 1: Proper Yoke Orientation

IMPORTANT: Protect the actuator from dripping water, condensation, and other moisture. Water or moisture could result in an electrical short, which may damage or affect the operation of the actuator.

- wire the actuator in accordance with applicable electrical code requirements



CAUTION: Risk of Electrical Shock.

Disconnect the power supply before making electrical connections to avoid electrical shock.

- wire the input lines to the electric actuator correctly, so that the valve moves in the proper direction



CAUTION: Risk of Property Damage.

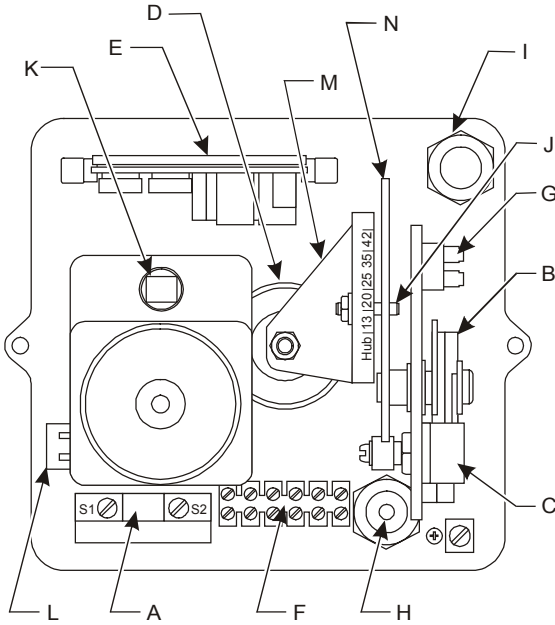
Do not apply power to the system before checking all wiring connections. Short circuited or improperly connected wires may result in permanent damage to the equipment.

- allow sufficient clearance to remove the actuator (as indicated in Figure 3)

IMPORTANT: Do not cover the actuator with thermal insulating material. High ambient temperatures may damage the actuator, and a hot water pipe, steam pipe, or other heat source may overheat it.

- pipe the valve with the flow in the direction of the arrow on the valve body, so that the plug seats against the flow

IMPORTANT: Take care to prevent foreign materials such as weld slag, thread burrs, metal chips, and scale from entering the piping system. This debris can damage or severely impede the operation of the valve by embedding itself in the seats, scoring the valve, and ultimately resulting in seat leakage. If the debris becomes imbedded in the seats, subsequent flushing and filtering of the piping system with the valve installed does not remedy the problem.



**Figure 2: VA-3100 Series
Electric Valve Actuator with Cover Removed
(View Looking Down)**

Table 2: Parts Included

Item	Part	Details
A	Motor Operation End-of-Travel Switches S1 and S2	Factory Set; Do Not Adjust
B	Auxiliary Switches S3 and S4	For Accessory Usage; Two Adjustable Switch Cams
C	Feedback Potentiometer	Position Indicator for On/Off (Floating) Control Models; Integrated Element of Resistance Balance Bridge for Proportional Control Models
D	Gear	Drives the Actuator Stem
E	Electronic Positioner	Plug-In Module for Proportional Control
F	Terminal Strip	For Connection of Motor and End-of-Travel Switches; Also Input Signal Connection on Proportional Control Models
G	Terminal Strip	For Auxiliary Switches S3 and S4; Also Feedback Potentiometer for On/Off (Floating) Control Models
H	Conduit Connector	For Motor Input
I	Conduit Connector	For Auxiliary Switches
J	Adjustment Transfer Bolt	To Feedback Potentiometer and Auxiliary Switches S3 and S4
K	Square Shaft	For Manual Crank
L	Switch S7	For Line Voltage Interruption
M	Transfer Arm	Must Remain Parallel to Feedback Arm
N	Feedback Arm	Transmits Transfer Bolt Position to Feedback Potentiometer

Note: On actuators featuring auxiliary switches, field adjust the switches to any position using the integral auxiliary switch cam adjusting wrench.

On actuators featuring a feedback potentiometer, the potentiometer provides position indication. Field adjust the potentiometer on its friction clutch shaft using a 3/16 in. blade screwdriver. Measure the nominal potentiometer resistance between Terminals 10 and 11 (as illustrated in Figure 6) when the actuator is positioned fully down.

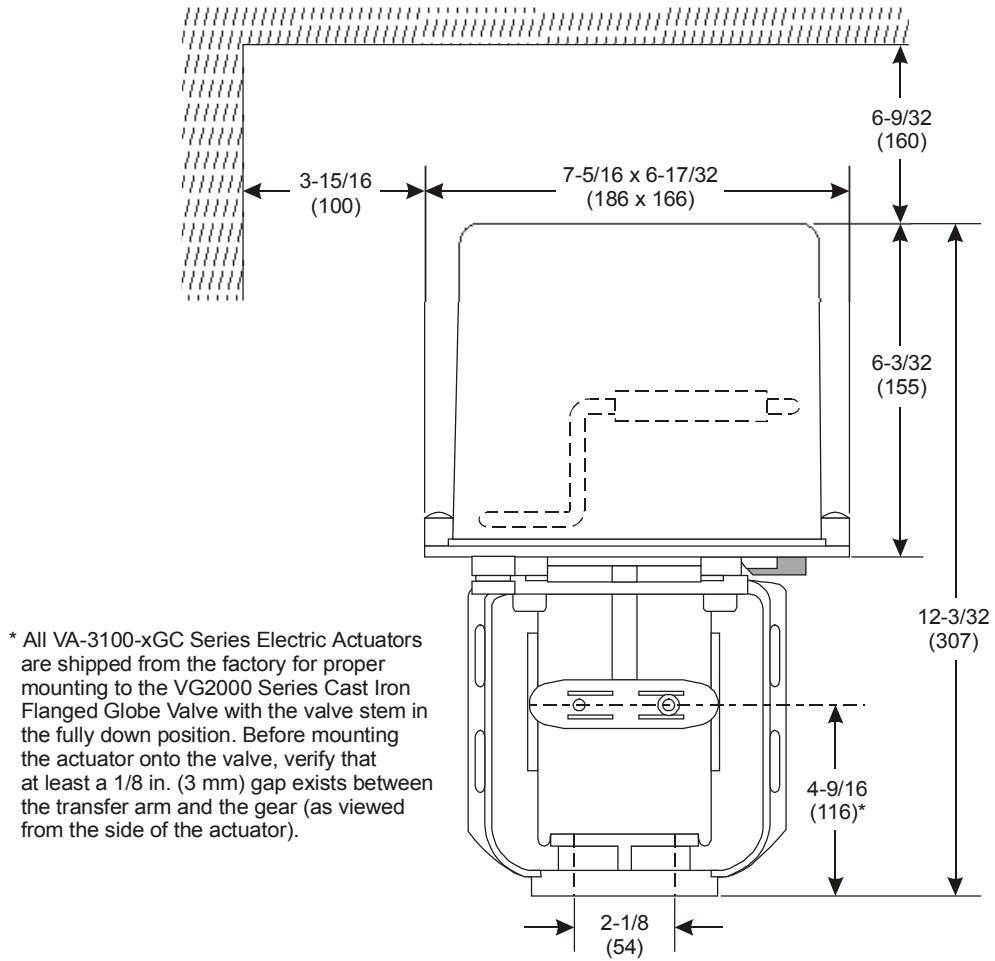


Figure 3: VA-3100 Series Electric Valve Actuator Dimensions, in. (mm)

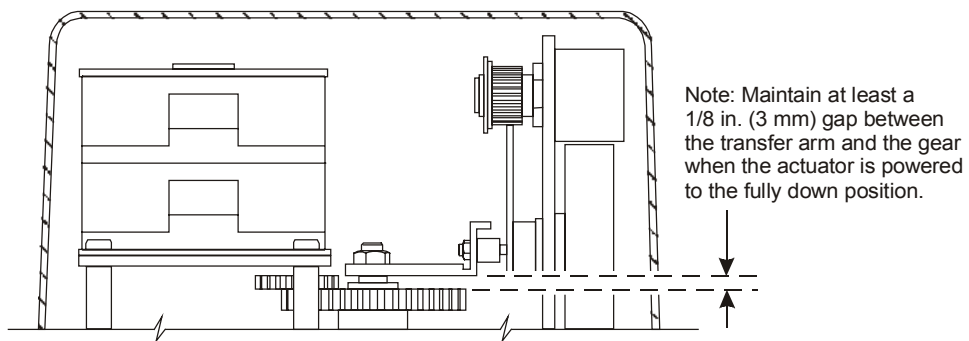


Figure 4: Location of the Gap Between the Transfer Arm and the Gear

Mounting

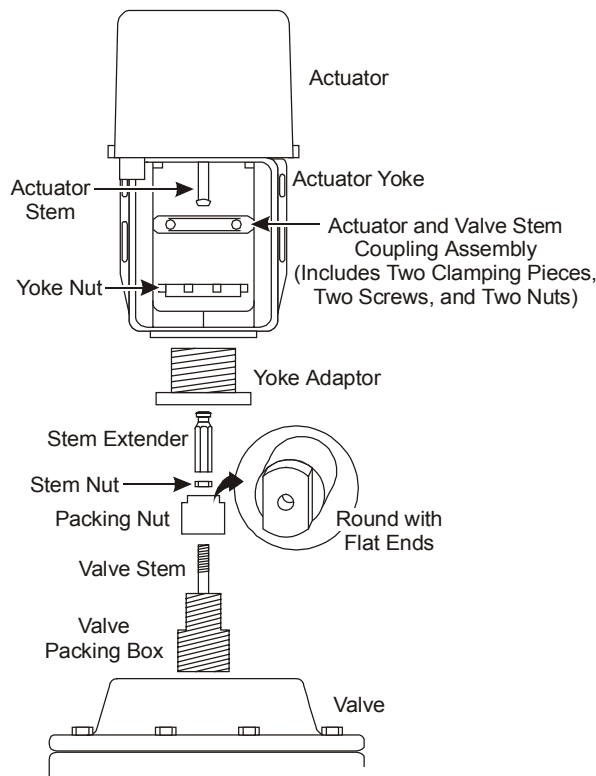


Figure 5: Exploded View of Actuator Mounting

To field mount a VA-3100 Series Electric Valve Actuator onto a VG2000 Series Cast Iron Flanged Globe Valve, refer to Figure 5 and proceed as follows:

1. Remove the hex packing nut from the valve and discard.

Note: The hex packing nut is found only on VG2000 Series Cast Iron Flanged Globe Valves that are ordered as valve bodies only, not as complete actuator and valve assemblies.
2. Thread the yoke adaptor onto the packing box, and tighten to a torque of 25 lb-ft (34 N·m).
3. Verify that the piping system is not pressurized.
4. Push the valve stem fully down into the valve body and verify that it is in the fully down position.
5. Thread the replacement packing nut (round with flat ends) included with the mounting kit onto the packing box, and tighten to a torque of 4 lb-ft (5.4 N·m).

6. Thread the stem nut and the appropriate stem extender onto the valve stem and down to the packing nut, without tightening either securely in place. (In the VA-3100-500 Mounting Kit, the 2-1/4 in. length stem extender is for 2-1/2 in. valves, and the 2-1/2 in. length stem extender is for 3 and 4 in. valves.)
7. Remove the actuator cover on VA-3100-AGC and VA-3100-HGC models only, and verify that the actuator stem is positioned at the 4-9/16 in. (116 mm) dimension as illustrated in Figure 3.
8. Adjust the valve stem as necessary using the manual hand crank furnished with the actuator to obtain the 4-9/16 in. (116 mm) dimension.
9. Verify that at least a 1/8 in. (3 mm) gap exists between the transfer arm and the gear (as viewed from the side of the actuator). Refer to Figure 2 for parts identification.
10. Remove the actuator and valve stem coupling assembly from the actuator without rotating the actuator stem.
11. Mount the actuator and yoke nut onto the yoke adaptor, making sure that the side of the yoke nut with the small lip and standoff is facing downward.
12. Thread the yoke nut onto the yoke adaptor, and tighten to a torque of 20 lb-ft (27.2 N·m).
13. Unscrew the stem extender to the point where it barely touches the actuator stem, being careful not to apply any force to the actuator stem.
14. Secure the position of the stem extender by tightening the stem nut. Tighten the stem nut to a torque of 16 lb-ft (21.8 N·m) for a 3/8 in. stem, and 25 lb-ft (34.0 N·m) for a 1/2 in. stem.
15. Secure the actuator stem to the stem extender using the two clamping pieces, two screws, and two nuts of the actuator and valve stem coupling assembly. Position the actuator stem so that its flats are parallel to the actuator yoke. The clamping assembly is designed to securely hold the actuator stem without rotating.

When properly aligned, the actuator stem and stem extender fit perfectly into the cutouts on the inside of the clamping pieces. The clamping assembly straddles the actuator yoke and rides along the yoke without rotating. Tighten the two clamping assembly screws to a torque of 7 lb-ft (9.5 N·m). When properly installed, the clamping assembly prevents any rotation of the actuator stem when the valve is at the end of its stroke.

16. Drive the valve to the fully down position using the manual hand crank (refer to the *Manual Operation* section for more details).
17. Verify that at least a 1/8 in. (3 mm) gap exists between the transfer arm and the gear (as viewed from the side of the actuator) for VA-3100-AGC and VA-3100-HGC models. Refer to Figure 2 for parts identification.

IMPORTANT: Do not allow the transfer arm to bottom out on the top of the gear when the actuator is powered to the fully down position, or the actuator may become damaged.

18. If at least a 1/8 in. (3 mm) gap exists, proceed directly to the *Setup and Adjustments* section. If the gap is less than 1/8 in. (3 mm), refer to Figure 5 and proceed as follows:
 - a. Raise the actuator stem using the manual hand crank, until a 3/16 in. (5 mm) gap exists between the transfer arm and the gear.
 - b. Remove the actuator and valve stem coupling assembly.
 - c. Push the valve stem fully down.
 - d. Loosen the stem nut and adjust the stem extender until it just touches the actuator stem.
 - e. Repeat Steps 14 and 15.

Wiring

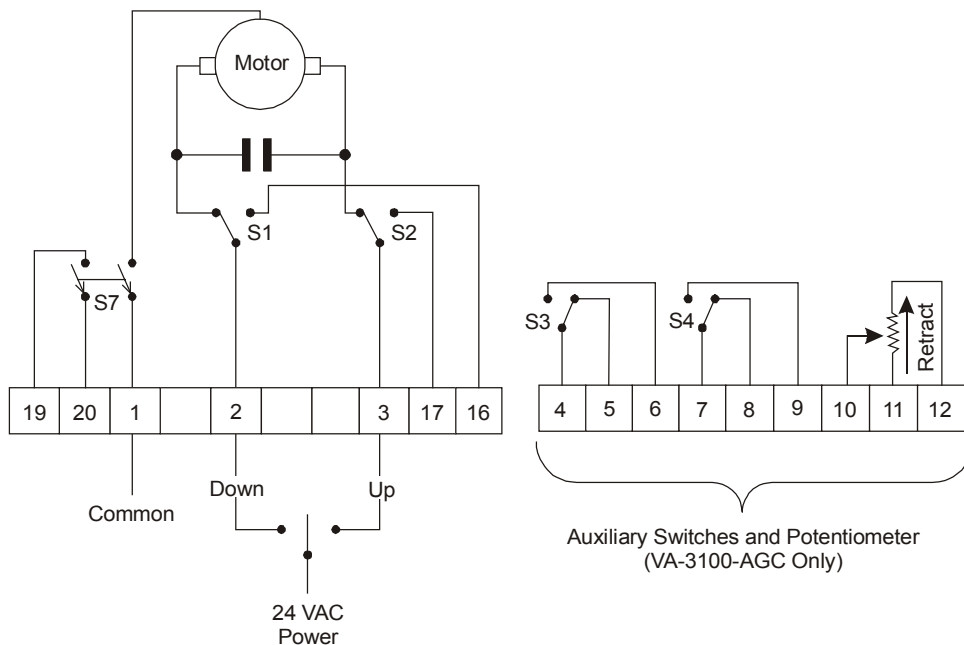


Figure 6: VA-3100-AGx Wiring Diagram for On/Off (Floating) Control

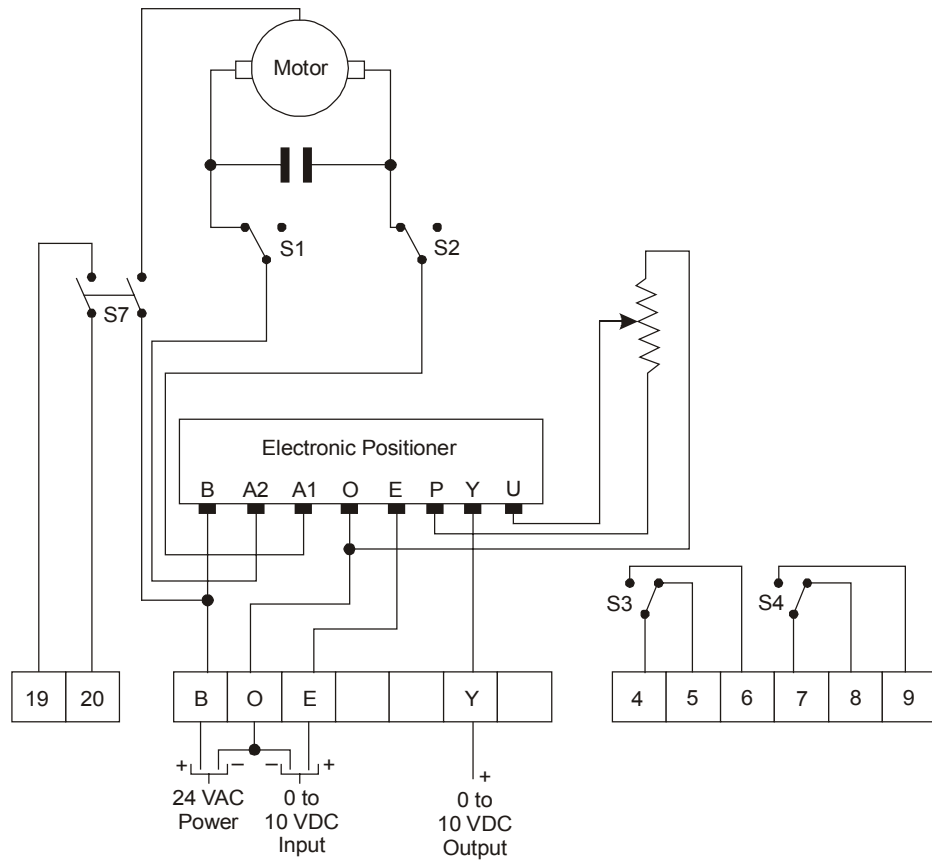


Figure 7: VA-3100-HGC Wiring Diagram for Proportional Control

Setup and Adjustments

Power Disconnect

Manually disconnect the electrical supply using the black power rocker switch located on the underside of the actuator. Depress the side of the rocker switch marked with the symbol (O) to disconnect the power.

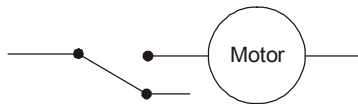


Figure 8: Power is Off when the Motor Common is Interrupted

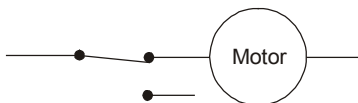


Figure 9: Power is On when the Motor Common is Connected



CAUTION: Risk of Electrical Shock.
Disconnect the power supply before making electrical connections to avoid electrical shock.



CAUTION: Risk of Property Damage.
Do not apply power to the system before checking all wiring connections. Short circuited or improperly connected wires may result in permanent damage to the equipment.

Manual Operation

Manually operate the VA-3100 Series Electric Valve Actuator as follows:

1. Manually disconnect the electrical supply using the black power rocker switch located on the underside of the actuator. Depress the side of the rocker switch marked with the symbol (O) to disconnect the power to the actuator.
2. Locate the manual hand crank that is stored on the outside of the actuator cover.
3. Remove the plastic plug from the top of the actuator cover.
4. Insert the end of the manual hand crank with the square socket, and gently press the crank inward to engage the friction clutch.

Note: The square shaft lies approximately 1/2 in. (13 mm) below the surface of the actuator cover. When inserting the manual hand crank, insert it straight down (not at an angle).

5. Observe the position indicator on the side of the actuator yoke while turning the manual hand crank clockwise or counterclockwise to achieve the desired valve position.
6. Remove the manual hand crank and return it to its storage location on the actuator cover.
7. Restore the electrical supply using the black power rocker switch located on the underside of the actuator. Depress the side of the rocker switch marked with the symbol (—) to restore the power to the actuator.

VA-3100-AGA Electric Valve Actuator

No adjustments are required on the VA-3100-AGA Electric Valve Actuator.

VA-3100-AGC Electric Valve Actuator

To adjust the **potentiometer** on the VA-3100-AGC Electric Valve Actuator, proceed as follows:

1. Depress the side of the black power rocker switch marked with the symbol (—) and apply power to Terminals 1 and 2 (as illustrated in Figure 6) to drive the valve stem fully down.

IMPORTANT: There must be at least a 1/8 in. (3 mm) gap between the transfer arm and the gear (as viewed from the side of the actuator) when the valve stem is powered to the fully down position, or the actuator may become damaged.

IMPORTANT: Do not drive the actuator unless it is mounted on a valve, or the actuator may become damaged.

2. Adjust the transfer bolt (as illustrated in Figure 10). The transfer bolt position at its center should correspond to the following values: for a 2-1/2 in. valve, set the transfer bolt to 23 mm; for a 3 or 4 in. valve, set the transfer bolt to 33 mm; for a 5 in. valve, set the transfer bolt to 39 mm; and for a 6 in. valve, set the transfer bolt to 42 mm.
3. Connect an ohmmeter to Terminals 10 and 12 (as illustrated in Figure 6) and read the resistance. Adjust the potentiometer for 50 to 150 ohms using a 3/16 in. blade screwdriver.
4. Apply 24 VAC power to Terminals 1 and 3 (as illustrated in Figure 6) to drive the valve stem fully up.

Note: When the valve reaches the end of stroke, the ohmmeter should read a nominal end resistance of 1,850 to 1,950 ohms. If the resistance is too low or if the maximum resistance occurs before the valve reaches the end of stroke, adjust the transfer bolt (as illustrated in Figure 10).

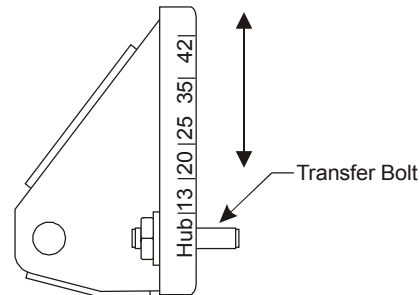


Figure 10: Adjusting the Transfer Bolt (Scaled in Millimeters)

5. Repeat Steps 1 through 4 until the required ohmmeter readings are obtained.

To adjust the **auxiliary switches** on the VA-3100-AGC Electric Valve Actuator, proceed as follows:

1. Refer to Figure 2 to locate the auxiliary switches.
2. Locate the auxiliary switch cam adjusting wrench that is stored on the inside of the actuator cover.
3. Loosen the cam holding screw using a 3/16 in. blade screwdriver.
4. Adjust the actuator to the desired down position where the inner auxiliary switch is to be tripped.

5. Adjust the inner cam using the auxiliary switch cam adjusting wrench, so that it just trips the inner auxiliary switch.
6. Adjust the actuator to the desired up position where the outer auxiliary switch is to be tripped.
7. Adjust the outer cam using the auxiliary switch cam adjusting wrench, so that it just trips the outer auxiliary switch.
8. Tighten the cam holding screw using a 3/16 in. blade screwdriver after the desired position is obtained.
9. Reinstall the actuator cover, making sure that the access hole for the manual hand crank aligns with the square drive.

VA-3100-HGC Electric Valve Actuator

To adjust the **span and starting point potentiometers** on the VA-3100-HGC Electric Valve Actuator, proceed as follows:

1. Refer to Figure 2 to locate the electronic positioner and feedback potentiometer.
 2. Refer to Figure 11 to locate the action mode switch and compensating potentiometer on the inward side of the electronic positioner circuit board. Also, locate the span and starting point potentiometers on the outward side of the electronic positioner circuit board. During the adjustment procedure, it may be necessary to lift the electronic positioner circuit board out of its holder to access the action mode switch and the compensating potentiometer.
3. Move the action mode switch to Position II for Reverse Acting (RA) mode. In the RA mode, the actuator travels up as the input signal increases.
 4. Turn the span potentiometer to 100% using a 3/16 in. blade screwdriver.
 5. Turn the starting point potentiometer to 0% using a 3/16 in. blade screwdriver.
 6. Adjust the transfer bolt (as illustrated in Figure 10). The transfer bolt position at its center should correspond to the following values: for a 2-1/2 in. valve, set the transfer bolt to 23 mm; for a 3 or 4 in. valve, set the transfer bolt to 33 mm; for a 5 in. valve, set the transfer bolt to 39 mm; and for a 6 in. valve, set the transfer bolt to 42 mm.
 7. Depress the side of the black power rocker switch marked with the symbol (—) and apply power to Terminals B and O (as illustrated in Figure 7) to drive the valve stem fully down.
 8. Connect a voltmeter to Terminals Y and O (as illustrated in Figure 7) to monitor feedback voltage. The voltmeter should be on the 10 V range or set for auto.
 9. Apply a 0 VDC input signal to Terminals E and O (as illustrated in Figure 7). The valve stem should travel to the fully down position.
 10. Adjust the compensating potentiometer (located on the inward side of the circuit board as illustrated in Figure 11) to the center of its rotation range.
 11. Turn the feedback potentiometer clockwise to its stop using a 3/16 in. blade screwdriver. Then turn the feedback potentiometer counterclockwise until the feedback output voltage at Terminals Y and O (as illustrated in Figure 7) is 0.75 to 1.0 VDC.

IMPORTANT: Take hold of the electronic positioner circuit board by its edges when removing and handling it during adjustment. Do not allow the circuit board components to touch the actuator enclosure, or the actuator may become damaged.

IMPORTANT: There must be at least a 1/8 in. (3 mm) gap between the transfer arm and the gear (as viewed from the side of the actuator) when the valve stem is powered to the fully down position, or the actuator may become damaged.

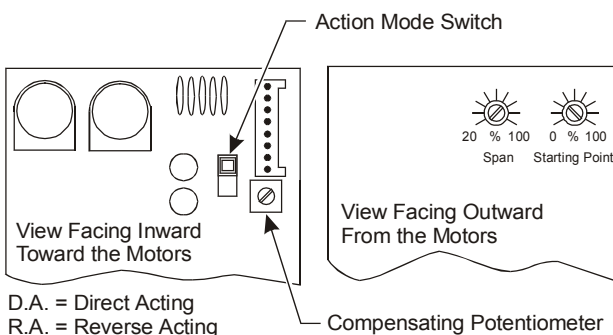


Figure 11: Electronic Positioner Circuit Board

12. Increase the actuator input voltage to 10 VDC; the input signal is on Terminal E and the input signal common is on Terminal O (as illustrated in Figure 7). The valve stem should travel to the fully up position.

13. Check the feedback output voltage at Terminals Y and O (as illustrated in Figure 7). Adjust the compensating potentiometer until the feedback output voltage just equals 9 to 9.25 VDC.

Note: If the compensating potentiometer cannot be adjusted for 9 to 9.25 VDC, then the transfer bolt needs to be adjusted.

14. Repeat Steps 10 through 13 until the required voltages are obtained.

15. Decrease the actuator input voltage to 0 VDC; the input signal is on Terminal E and the input signal common is on Terminal O (as illustrated in Figure 7). The valve stem should travel to the fully down position. Check that the feedback output voltage is still 0.75 to 1.0 VDC.

16. Adjust the transfer bolt (as illustrated in Figure 10) if the adjustment range is not sufficient. If the voltage span is too high, move the transfer bolt in the direction of larger strokes. If the voltage span is too low, move the transfer bolt in the direction of smaller strokes. The transfer arm must remain parallel to the feedback arm.

17. Set the action mode switch (as illustrated in Figure 11) to the desired direction. In the direct acting mode, the actuator extends down as the control signal increases; in the reverse acting mode, the actuator retracts up as the control signal increases. For both settings, the feedback voltage is maximum when the valve stem is in the fully up position and minimum when the valve stem is in the fully down position.

Note: Use calibration values that are somewhat less than application values for the controller to have sufficient overtravel (to account for valve seat wear over time). Recommended calibration values are as follows:

Application Value	Calibration Value
0 to 10 VDC	1 to 9 VDC
0 to 5 VDC	1 to 4 VDC
5 to 10 VDC	6 to 9 VDC

18. Input the desired minimum control signal to the actuator. Once the valve stops, slowly adjust the starting point potentiometer (as illustrated in Figure 11) in small increments until the actuator no longer strokes and the motor end-of-travel switches turn the motor off. The valve should be in the fully minimum position.

19. Input the desired maximum control signal to the actuator. Once the valve stops, slowly adjust the span potentiometer (as illustrated in Figure 11) in small increments until the actuator no longer strokes and the motor end-of-travel switches turn the motor off. The valve should be in the fully maximum position.

20. Reapply the minimum control signal and the maximum control signal, and check the valve for proper operation.

To adjust the **auxiliary switches** on the VA-3100-HGC Electric Valve Actuator, proceed as follows:

1. Refer to Figure 2 to locate the auxiliary switches.
2. Locate the auxiliary switch cam adjusting wrench that is stored on the inside of the actuator cover.
3. Loosen the cam holding screw using a 3/16 in. blade screwdriver.
4. Adjust the actuator to the desired down position where the inner auxiliary switch is to be tripped.
5. Adjust the inner cam using the auxiliary switch cam adjusting wrench, so that it just trips the inner auxiliary switch.
6. Adjust the actuator to the desired up position where the outer auxiliary switch is to be tripped.
7. Adjust the outer cam using the auxiliary switch cam adjusting wrench, so that it just trips the outer auxiliary switch.
8. Tighten the cam holding screw using a 3/16 in. blade screwdriver after the desired position is obtained.
9. Reinstall the actuator cover, making sure that the access hole for the manual hand crank aligns with the square drive.

Repairs and Replacement

If the VA-3100 Series Electric Valve Actuator fails to operate within its specifications, unit replacement is required. For a replacement VA-3100 Actuator, contact the nearest Johnson Controls representative.

Troubleshooting

Table 3: Symptoms and Suggested Remedies

Symptom	Suggested Remedy
Actuator does not drive.	Confirm that a 24 VAC power source is available at the actuator.
	Confirm that the side of the black power rocker switch with the symbol (—) is depressed to apply power to the actuator.
Transfer bolt has come out of the feedback arm.	Drive the valve to the fully down position using the manual hand crank, and verify that at least a 1/8 in. (3 mm) gap exists between the transfer arm and the gear (as viewed from the side of the actuator). Refer to Steps 16 and 17 in the <i>Mounting</i> section for more details.
	Install the actuator onto the valve body before operating the actuator. Verify that the actuator stem is positioned at the 4-9/16 in. (116 mm) dimension as illustrated in Figure 3. Refer to the <i>Installation</i> section for more details. Also verify that the piping system is not pressurized, and that the valve stem is in the fully down position.
	Reinstall the actuator and valve stem coupling assembly properly. Refer to Step 15 in the <i>Mounting</i> section for more details. Make certain that the internal standoffs in both halves of the clamping assembly are positioned toward the valve body.
	Properly reposition the transfer plate if it has bottomed out on the top gear and spun out of place, and secure the top nut to a torque of 40 lb·in (4.5 N·m).
Feedback voltage at the bottom position shifts after feedback voltage at the top position is set (VA-3100-HGC only).	Increase the transfer bolt setting and recalibrate the actuator as outlined in the <i>Setup and Adjustments</i> section.
Actuator does not drive in the proper direction.	Move the action mode switch (as illustrated in Figure 11) to Position I for Direct Acting (DA) mode or Position II for Reverse Acting (RA) mode.

Technical Specifications

Product	VA-3100 Series Electric Valve Actuators	
Force Output	675 lb (3,000 N)	
Power Requirements	On/Off (Floating) Control Models	20 to 28 VAC, 60 Hz; 16 VA Minimum
	Proportional Control Models	20 to 28 VAC, 60 Hz; 18 VA Minimum
Input Signal	On/Off (Floating) Control Models	20 to 28 VAC, 60 Hz
	Proportional Control Models	0 to 10 VDC
Input Impedance	Proportional Control Models Only	5,600 ohms
Feedback Signal	VA-3100-AGC Only	0 to 2,000 ohms
	VA-3100-HGC Only	Approximately 8 VDC Span (1.0 VDC with Valve Stem Fully Down; 9.0 VDC with Valve Stem Fully Up)
Switch Contact Rating	100 VA, 30 VAC Maximum	
Maximum Stroke	1-21/32 in. (42 mm)	
Nominal Timing for 1 in. Stroke	92 Seconds	
Ambient Operating Temperature Limits (Limited by the Actuator)	On/Off (Floating) Control Models	14 to 140°F (-10 to 60°C)
	Proportional Control Models	14 to 122°F (-10 to 50°C)
Agency Compliance	UL 873 Listed, File E27734, CCN XAPX; cUL C22.2 No. 24-93 Listed, File E27734, CCN XAPX7	
Enclosure Rating	NEMA 3/3R, IP 54	
Shipping Weight	9.7 lb (4.4 kg)	

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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