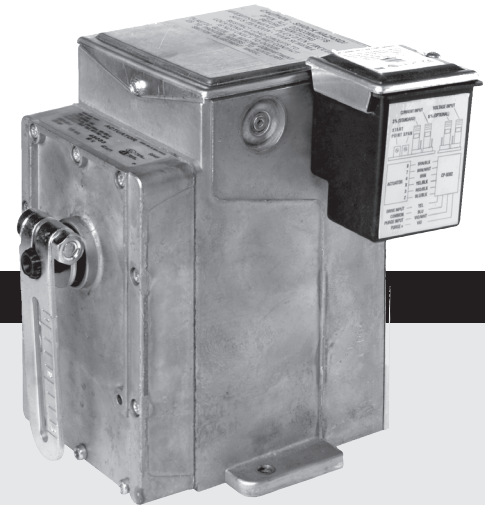


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Approvals



UL Listed: UL 873 and CSA C22.2 No. 24-93

Attention



The installation and maintenance of this product must be done under the supervision of an experienced and trained specialist. Never perform work if gas pressure or power is applied, or in the presence of an open flame.



On completion of installation on the EMP, perform a function test.



Please read the instruction before installing or operating. Keep the instruction in a safe place. You find the instruction also at www.dungs.com If these instructions are not heeded, the result may be personal injury or damage to property.



This product is intended to be used in combination with a control valve to modulate the flow of gas or air.



Any adjustment and application-specific adjustment values must be made in accordance with the equipment manufacturers instructions.

Explanation of symbols

- 1, 2, 3 ... = Action
- = Instruction

Specification

EMP-5 The EMP-5 series actuators provide damper control or valve control where it is desirable to move the crank arm in either direction, or to stop it at any point in the stroke with a voltage or current input. These actuators are NEMA Type 4.



Electrical Ratings

120 VAC (+10 % / -15 %); 60 Hz

Input Control

4 - 20 mA or 0 - 10 VDC

Power Consumption

78 VA; 0.65 A

Deadband Adjustability (Hysteresis)

Factory set at 3 %, adjustable to 5 %

Resolution

40 steps over 90° at factory setting. A minimum of about 0.4 mAdc is needed to drive actuator one step in same direction.

Auxiliary Switch Ratings

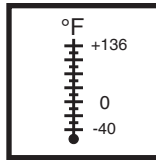
5.8 A Running; 34.8 A locked rotor

Grounded Input

Grounding either or both input wires will not cause.

Fuse

There is no internal fuse. The EMP is impedance protected.



Ambient Temperature

-40 °F to +136 °F (-40 °C to + 58 °C)

Note: Surface temperature during normal operation can reach 40 °F above ambient.

Open circuit Input

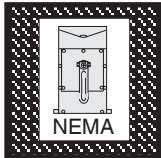
Drives actuator to low

Series Operation

No offset in control point when operated in tandem max. 3 slaving proportionating; current input 250 Ohm.

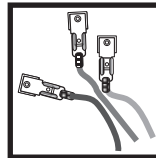
Overranging

No effect from 100 % overrange signal.



Environment and Mounting Position

NEMA Type 4; multipoised (best not to have shaft pointing downwards)



Electrical Connection

Terminal block with 1/2" NPT conduit knockout

Cycling Rate:

EMP is rated for 100% duty cycling & continuous cycling. Cycle life rating is 100,000 cycles (0-90°/cycle).

Model No.	Order No.	Travel	Description	Timing (seconds)	Torque (in.- lbs.)	Weight Lbs. (actual/shipping)
EMP-423-5	267229	90°	Fixed timing	12 s	60	9/10
EMP-424-5	269223	90°	Adjustable timing	12 s*	60	9/10
EMP-453-5	269224	90°	Fixed timing	40 s	220	9/10
EMP 454-5	269226	90°	Adjustable timing	40 s*	220	9/10

* up to approximately ten times the fixed timing.

Operation Description

The actuator's position is proportional to the input current from the primary controller. The current-to-position convertor is a solid state switching device attached to the side of the die cast housing and receives its feedback signal from the built in potentiometer in the actuator with a wiper arm driven by the output shaft.

The signal input is factory set from 4 - 20 mADC, (but is field adjustable). The deadband is also adjustable. Deadband is the difference between the input signal, which will drive the motor one way, and the level, which will drive it the opposite way.

Three adjustments are possible:

- 1) degree of counterclockwise travel.
- 2) the point of auxiliary switch actuation.
- 3) on the EMP 424-5 and EMP 454-5 models, the ability to slow the normal travel time by approximately 10 times.



All wiring must comply with local electrical codes, ordinances and regulations.

Installation

Inspect unit before installing, look for broken parts or leaks. Use NEMA Type 4 compatible type connectors.

Observe the barrier that separates the line voltage terminals from the low voltage which operates the actuator motor. All connections to the line voltage side of the barrier (L1 and L2, 1, 5 and 6 terminals) must be made with Class 1 wiring; connections to the remaining terminals can be Class 2 thermostat cable if desired.

Allow 6 inches (152 mm) clearance above the actuator wiring compartment.

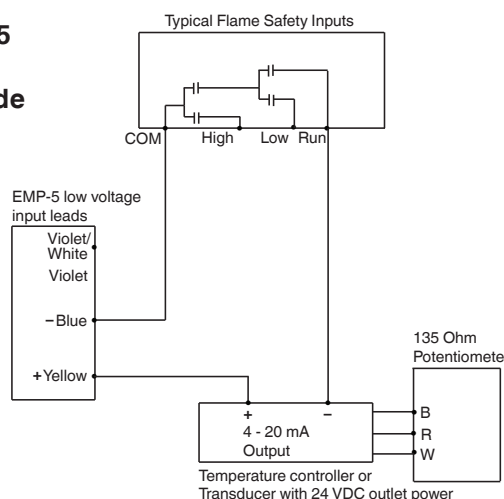
Do not adjust the limit switch beyond 90° unless the standard slidewire has been replaced with a 180° slidewire; do not adjust beyond 180° for proportioning control.

In some applications, a Flame Safeguard (FSG) may have one or two overriding circuits. One being a low fire purge start and the other a high fire pre-purge. The function of the violet/white and violet wires are to provide an electrical connection so that the FSG can override, the temperature controller and drive the air damper actuator without a 4 mA signal. If such connections are not needed in the application, simply tape them off, and safely stow away.

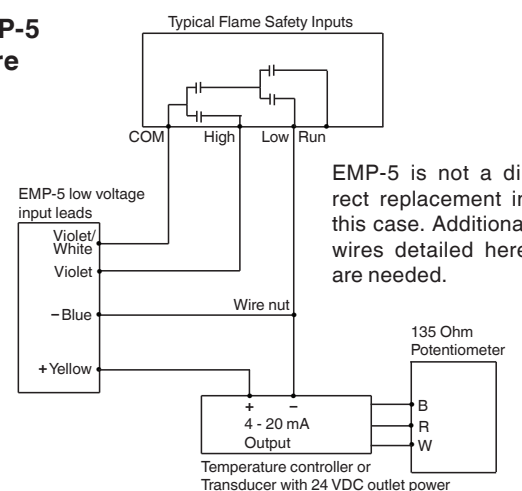
Replacing EMP-3 or EMP-4 with EMP-5

- When replacing an EMP-3 or EMP-4 with an EMP-5 and if the high fire override is not used, then follow the wiring schematic "EMP-4 to EMP-5 without using high fire override" for the low voltage input leads.
- When replacing an EMP-3 or EMP-4 with an EMP-5 and if the high fire override is used, then follow the wiring schematic "EMP-4 to EMP-5 using high fire override" for the low voltage input leads so that the EMP-5 drives closed with a low fire override input and open with a high fire override input from the flame safety.
- When replacing an EMP-3 with an EMP-5, there is no need to connect to the "run" terminal of the flame safety.
- Red wire on EMP-3 is replaced with violet/white wire on EMP-5, which must be connected to the LOW terminal on the flame safety and the - lead on the temperature controller. See schematic below.
- Blue wire on EMP-3 is replaced with blue wire on EMP-5.
- Orange wire on EMP-3 is replaced with yellow wire on EMP-5.
- When replacing an EMP-4 with an EMP-5, follow the wiring schematic below for the low voltage input leads so that the EMP-5 drives closed with a low fire override input and open with a high-fire override input from the flame safety.
- When replacing an EMP-4 with an EMP-5, there is no need to connect to the "run" terminal.
- White wire on EMP-4 is replaced with violet / white wire on EMP-5, which must be connected to the LOW terminal on the flame safety and the - lead on the temperature controller. See schematic below.
- Black wire on EMP-4 is replaced with blue wire on EMP-5.
- Red wire on EMP-4 is replaced with yellow wire on EMP-5.

EMP-4 to EMP-5 without using high fire override

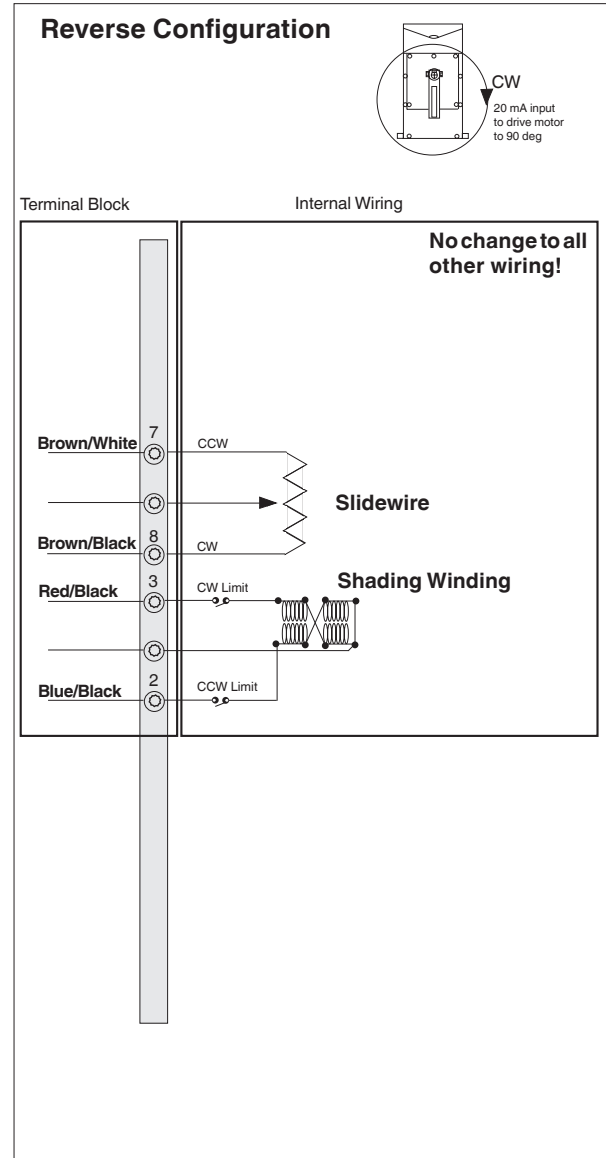
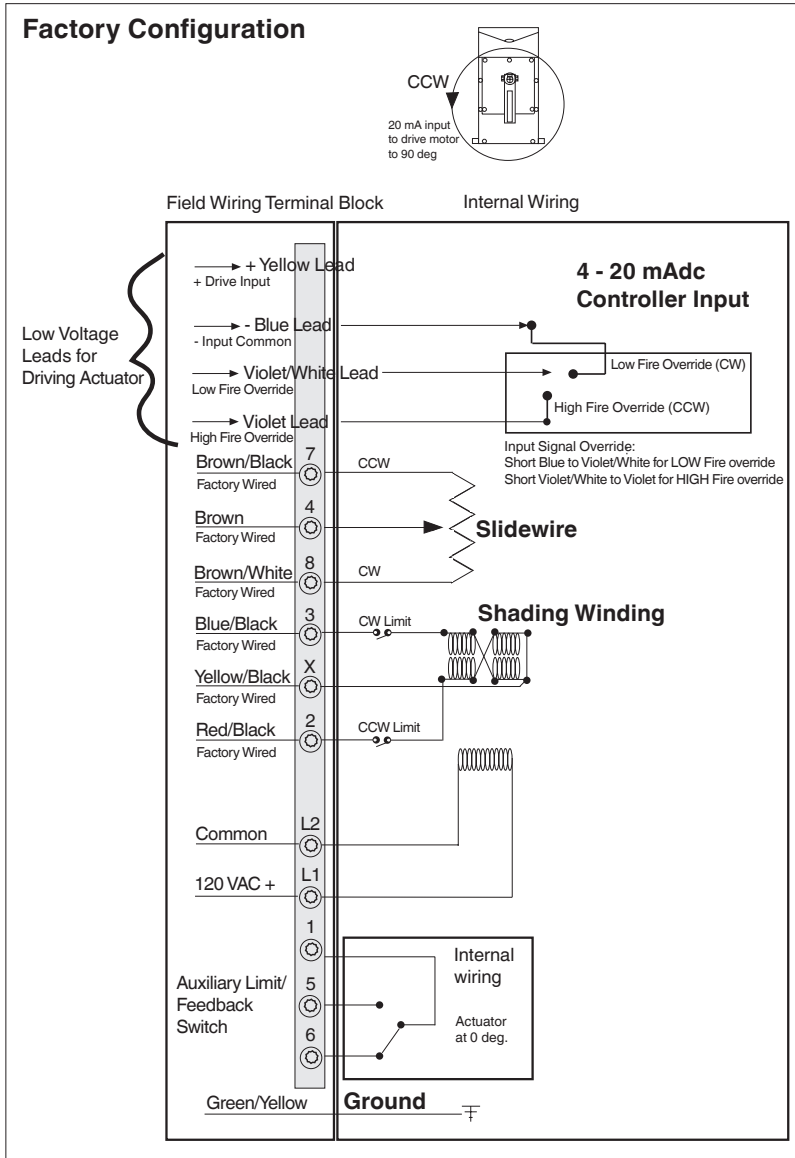


EMP-4 to EMP-5 using high fire override



Standard Wiring of EMP-5

- Disconnect all power to the valves before wiring to prevent electrical shock and equipment damage.
- Do not exceed the electrical ratings given in the specifications and on the actuator.
- Attach a flexible 1/2" NPT conduit to the actuator.
- Route the wires through the conduit.
- Use 14 or 16 guage 2 or 4 conductor shielded cable for at least 105 °C (221 °F).
- Connect the wiring to the appropriate terminals.
- For "reverse configuration", change only the wires designated in bold.



⚠ Overriding the input signal will drive the actuator to the mechanical end of travel.

⚠ Applying line voltage to terminals input leads or to X, 2, 3, 4, 7 or 8 will permanently damage the motor.

Adjustment

Limit Switch

The counterclockwise limit switch is factory set to stop the actuator after 90° of travel. This setting can be changed in the field. To adjust the limit switch, removing the top metal cover, and locate the small opening next to the terminal block and positioned **between terminals 3 and 4**. Insert a flathead screwdriver through this opening and turn the cam clockwise as seen from the shaft end of the actuator to increase the degree of actuator rotation up to a maximum of 320°. Each click of the cam represents about 3° change in actuator rotation. Attempting to adjust for more than 320° rotation will result in both limit switches opening in the clockwise end of the actuator rotation, and the unit will no longer operate. The clockwise limit switch is fixed and cannot be field adjusted.

Auxiliary Switch

An adjustable cam operated SPDT switch is built into each actuator. The switch is factory set to operate at the clockwise end of the actuator rotation, making terminal 1 to terminal 6. As the cam turns counterclockwise from this point, the cam follower drops, breaking 1 to 6 and making 1 to 5. To adjust the auxiliary switch, removing the top metal cover, and locate the small opening next to the terminal block and positioned **next to terminal 1**. Insert a flathead screwdriver through this opening and turning the disc clockwise as seen from shaft end of the actuator causes the switch to operate nearer the counterclockwise end of actuator rotation. Each click of the cam represents about 3° change in operating point. **NOTE:** After turning the disc, remove back plate and reposition the wiper; it will need to be repositioned back to zero.

Speed Adjustment

Actuator timing is varied by a slotted adjustment screw on the lower left side of the shaft (Models 424 & 454 only) housing. Turning the screw clockwise decreases the speed. If the adjustment screw is turned too far clockwise, the motor will stall but will not be damaged. If stalling occurs, turn the screw counterclockwise until the motor resumes operation. Total adjustment is normally 3 - 1/2 turns.

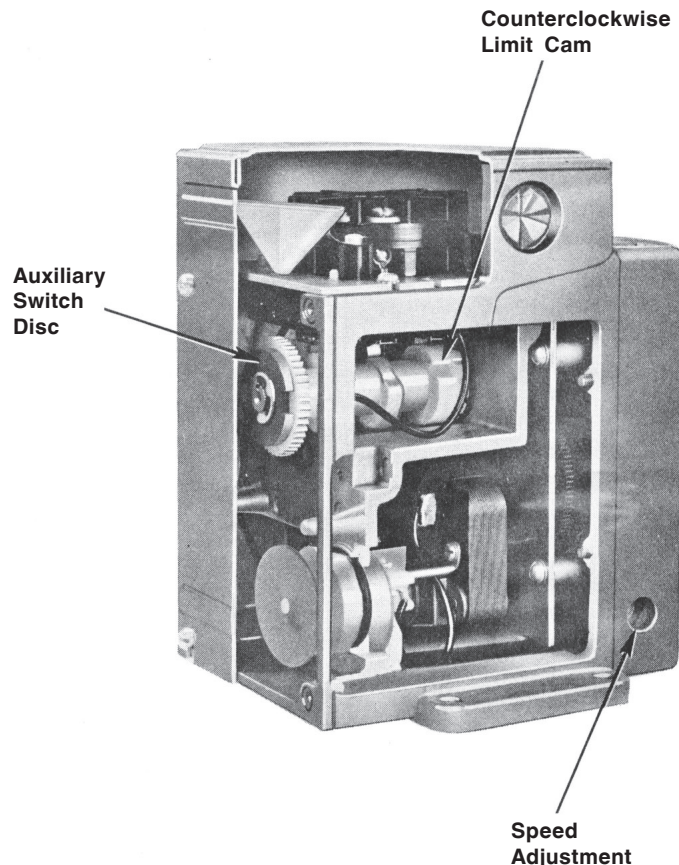
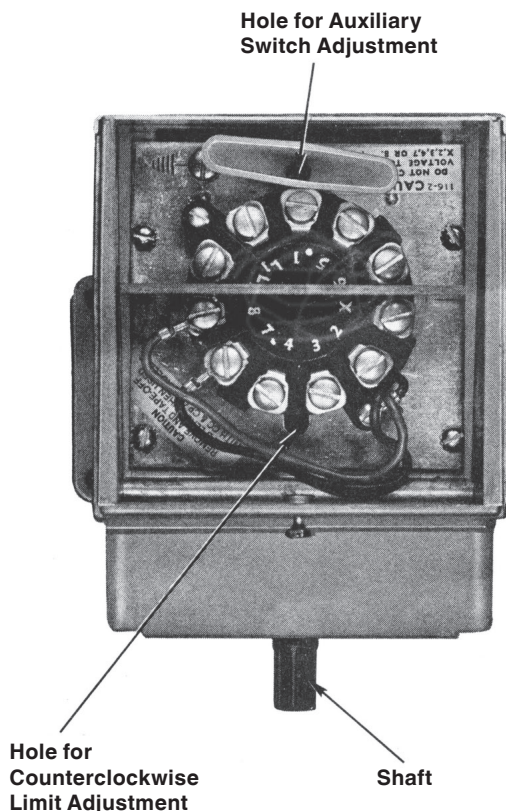
CP-9302-702 (Black Box) Adjustment (Preparation) From the factory, the actuator is calibrated such that it drives to 90 degrees with 20 mA applied and 0 degrees with 4 mA applied. To reduce the 90 degree position or increase 0 degree position, following the procedure below.

Initial Setup

1. Turn off all power and input signals to the actuator.
2. Remove the metal cover. This allows access to the potentiometers and the input/deadband jumpers.
3. Disconnect the drive's yellow and blue leads from the controller.
4. Connect the drive's leads to the corresponding lead on an instrument capable of producing 4 - 20mA +/- 0.1 mA (current calibrator).

Minimum Position Calibration

1. Apply power to the actuator, then turn on the "current calibrator".
 2. Adjust the "current calibrator" until the mA input equals the desired zero point current. This is typically 4 mA.
- See page 6 "Potentiometer Adjustment" for location of pots.



Adjustment

NOTE: The minimum position current input (zero point) potentiometer and maximum position current input (span) potentiometer can be physically turned indefinitely; but they have an effective limit of 25 turns. Relative to the start point (4 mA / 0 degrees), rotating the post CW causes the actuator to drive toward 90 degrees. Conversely rotating the pots CCW causes the actuator to drive back toward zero. This is true of both the START POINT and SPAN adjustments.

NOTE: There is a slight delay (approx. 3 seconds) in actuator movement when a potentiometer is adjusted. Make final adjustments slowly to prevent over adjusting. If adjusted properly, when the unit just begins to drive it should stop within 5 degrees. Over adjusting will lower the actual start point.

3. With the desired current input for the minimum position applied (typically 4 mA), adjust the zero point potentiometer so the actuator shaft drives to its zero point (minimum position). It is best to adjust the start point potentiometer until the actuator shaft just starts to move off its zero point.

Maximum Position Calibration

1. Apply power to the actuator, then turn on the "current calibrator".
2. Adjust the "current calibrator" until the mA input equals the desired finish point (maximum position). This is typically 20 mA.



Do not apply a voltage source input to a CP-9302 actuator drive that is configured for current input. Doing so may damage the drive.

NOTE: After adjusting for deadband or input, the drive will need to be re-calibrated. Please follow procedure on page 5 and page 6.



Static charges produce voltages high enough to damage the electronic components. Follow static electricity precautions when servicing the device (s).

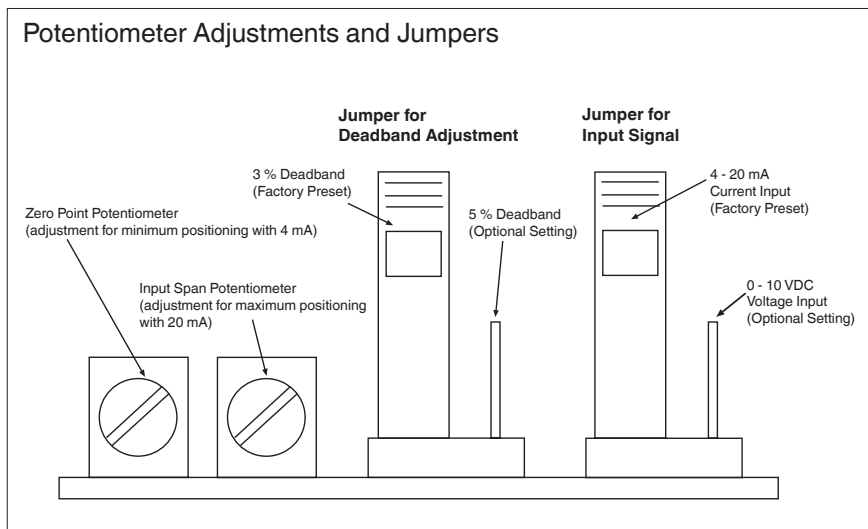
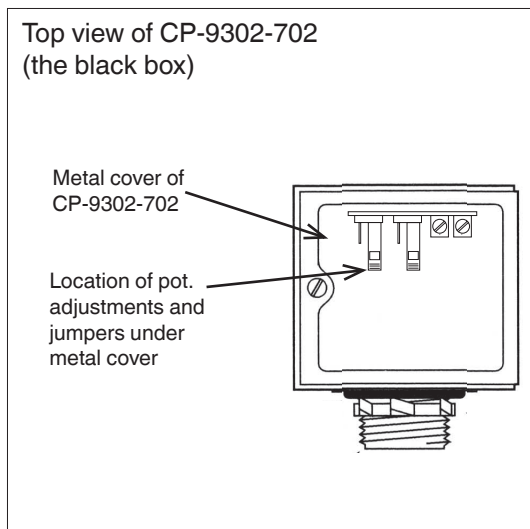
NOTE: Occasionally, an adjustment to the input span setting results in a change to the start point setting, due to a small interaction between these two settings. After adjusting the input span potentiometer, ensure that both settings meet requirements by repeating steps 7 - 9.

NOTE: When setting the potentiometers; only move the actuator shaft in one direction. If the shaft is moved in opposite direction, deadband will effect the setting.

3. With the desired current input for maximum position (typically 20mA), the actuator will drive towards 90 degrees. Once the actuator stops, adjust the span potentiometer so the actuator shaft drives to the maximum position. It is best to adjust the span potentiometer until the actuator shaft just moves to its finish point.
4. Remove the current calibrator and turn off power to the actuator. Then, reconnect the drive's leads to the controller.
5. Reinstall the cover.
6. Reapply power to the actuator and turn on the controller.

Potentiometer Adjustment and Jumpers

The potentiometer adjustments and the jumpers are located under the metal cover of the CP-9302-702 (the black box).



Testing

Side Box Test #1: Connect the drive's leads to the corresponding lead of a suitable current signal source (current calibrator). Apply power to the actuator, then turn on the current signal source (current calibrator). Adjust the current signal source (current calibrator) until the mA meter reading equals the desired zero point current (2 to 16 mA). Adjust the current signal source (current calibrator) until the mA meter reading equals the finish point current. With the desired finish point current applied, the actuator shaft should drive to the finish point. If the actuator fails this test, repeat the CP-9302-702 adjustment on page 4. Short the Violet/White wire to the Violet wire; the actuator shaft should turn counterclockwise. Short the Violet/White wire to the Bluewire; the actuator shaft should turn clockwise. When you break the connection between the Violet/White and Violet wires, the shaft should return fully clockwise. If the side box fails this test, perform Test 2.

Actuator Test #2: If the side box test passes, then the actuator can be tested. Disconnect the wires at terminals X, 2 and 3. Jumper actuator terminal "X" to terminal 2; the actuator shaft should turn clockwise (CCW for reverse configuration). When the connection between terminals "X" and 2 is broken, the shaft should remain stationary. Then jumper terminal "X" to terminal 3; the shaft should turn counterclockwise (CW for reverse configuration).

Conclusion:

- 1) If the side box test #1 fails but the actuator test #2 passes, then the side box is defective.
- 2) If the actuator test #2 fails, then the actuator is defective.
- 3) If both tests fail, then the actuator is defective. The side box must be tested on a functional actuator in order to determine whether or not it is defective.

Technical Tips and Data

Tech Tip #1: There is no rectified circuit in the actuator's shading windings. The voltage on the shading windings is about 30 VAC, and the voltage on the main windings is 120 VAC.

Tech Tip #2: Maximum voltage to terminals 7 and 8 is 24 VAC. During operation, the voltage at these terminals is about 12 VAC.

Tech Tip #3: For 0 - 10 VDC input control, the resistance across + and - leads is 10,000 ohms.

Tech Tip #4: For 4 - 20 mA input control, the resistance across + and - leads is 250 ohms.

Tech Tip #5: For 4 - 20 mA input control, the input control voltage on the + and - leads should be 1.0 VDC at 4 mA, 2.5 VDC at 12 mA, and 5 VDC at 20 mA.

Tech Tip #6: Across terminals 2 to X and 3 to X, the voltage should be 24 - 30 VAC and about 0.9 amps when actuator is powered.

Tech Tip #7: The black converter (side box) operates on 24 VDC, and pulls its voltage from the shading windings.

Tech Tip #8: The EMP has internal impedance protection. There is no need to electrically protect it with a fuse.

Tech Tip #9: The amperage draw under locked rotor is the same.

Tech Tip #10: The torque is the same at low temperatures, but the timing might be longer.

Troubleshooting

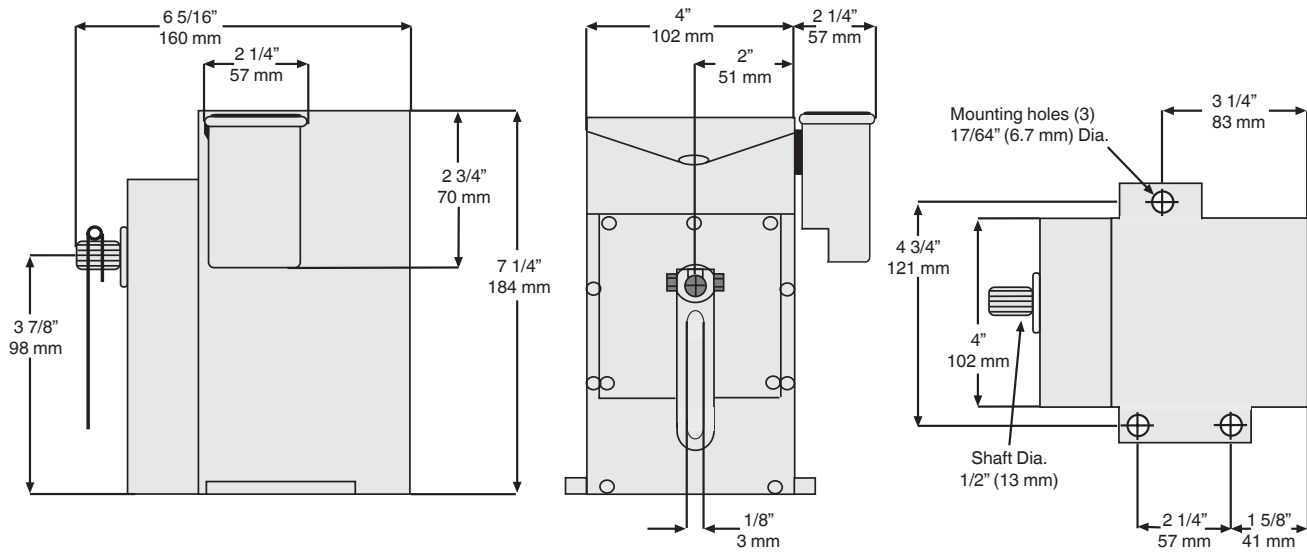
Problem

- #1:** The actuator will not modulate; it will only remain at 0 deg, and then at some input the actuator will drive completely to 90 deg.
- #2:** The actuator will not modulate, or modulation will be erratic.
- #3:** The actuator will actuate on the opposite direction; with 4 mA in, the actuator goes to high fire, and with 20 mA, it goes to low fire. Or, when the designated wires for HIGH fire override are made, it drives to LOW fire.

Possible Solution

- #1:** This problem can occur if the factory configuration (CCW rotation for 0 - 90 deg) is switched to REVERSE configuration (CW rotation for 0 - 90 deg), but only one set, rather than both sets, of terminals were not changed. Terminals 7 and 8 AND 2 and 3 need to be reversed.
- #2:** Verify that the low voltage input wires are not in the same conduit at the high voltage wires. Check jumper under side box and adjust pots if needed.
- #3:** Verify that the input wires (the - and the +) are not reversed at the meter, the side box, or at the temperature controller.

Dimensions



Accessories & Replacement

Model #	Description	Order No.	
CP-9302-702	4 - 20 mA current to position converter (black box) (comes standard)	269229	
AM-321-0-2	Auxiliary feedback switch. Two independent SPDT snap switches for position feedback	269234	
ADDA-259-010	135 ohm slidewire; 90 deg	267194	
ADDA-274-010	1000 ohm slidewire; 90 deg Note: Actuator will not operate in the same way	269221	
ADDA-38-010	100 ohm slidewire; 180 deg	269241	
ADDA-902-5	100 ohm 90 deg slidewire and wiper arm kit	269220	
AM 332-102-1	100 Slidewire potentiometer for position indicating or paralleling (same housing as AM 321-0-2)	269236	
AM 301	90 deg mounting bracket	267191	
AE 504	Paralleling Relay for driving up to 3 actuators with one input signal	269237	
AM 132	5/16" hole; ball joint linkage-swivel connector for non-parallel linking	269232	
AM 122	5/16" hole; straight linkage connector for parallel linking	269233	
AM 113	1/2" crank arm (comes standard)	267224	
AM 116	1/2" splined crank arm (not shown)	267242	
AM 125	5/16" diameter rod (20"long)	267223	
AM 363	NEMA 4 Cover (comes standard)	269239	

We reserve the right to make modifications in the course of technical development.

