



Worcester Controls

WCAIM2031

# ***AF-17 Electronic Positioner***

## ***Installation, Operation and Maintenance Instructions***

### **MODELS**

20 – For AF-17 Boards Mounted Inside 10-23 75 Actuator.

30 – For AF-17 Boards Mounted Inside 25-30 75 Actuator.

AF-17-1K, 120A or 240A, 1000 ohm Resistance Input

AF-17-13, 120A or 240A, 135 ohm Resistance Input

AF-17-1, 120A or 240A, 1 to 5 Milliamp Input

AF-17-4, 120A or 240A, 4 to 20 Milliamp Input

AF-17-10, 120A or 240A, 10 to 50 Milliamp Input

AF-17-5V, 120A or 240A, 0 to 5 VDC Input

AF-17-XV, 120A or 240A, 0 to 10 VDC Input

R – Reverse Action Option

120A-120 VAC Power Circuits

240A-240 VAC Power Circuits

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# 1.0 GENERAL

## 1.1 Basic Design

The Worcester AF-17 Electronic Positioner was designed for use with the Worcester Series 75 actuators. However, it may also be used with other actuators or electrically operated rotary devices, provided the specified load parameters as given in Part 6.3 are not exceeded.

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**CAUTION: This positioner is sensitive to electrical noise; please see part 1.2.**

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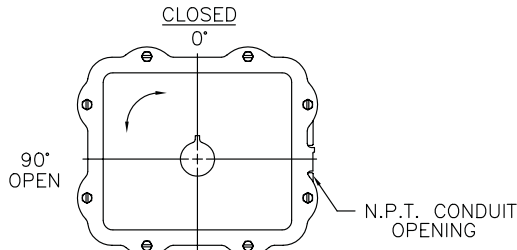
**PLEASE READ THIS SECTION**

- A. The AC AF-17 board 4-20 mA signal input circuit is protected with a 62 mA fuse (F1). The fuse is used to protect the input circuit from an excessively high voltage. The fuse used in the input circuit is a Littlefuse PICO II very fast-acting fuse rated at 62 mA. There is a spare fuse located on the circuit board in the area of the large power resistors.
- B. The AF-17 board is designed to receive a floating current input signal. This allows several pieces of equipment to be operated from the same current loop while at the same time remaining electrically independent of each other.
- C. The AF-17 board can be set up in several ways for normal operation. The board is designed to control in 90° quadrants only. The number of quadrants over which the board will control is determined by the number of teeth on the feedback pot pinion gear. The adjustment trimpots on the board were not set up to reduce actuator travel for a 4-20 mA input span. For example, trying to adjust the board such that 4 mA is closed and 20 mA is only 60% open is not possible with the standard set up.

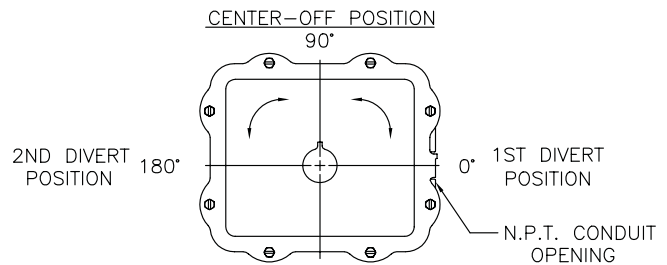
The standard setups are:

- 1. 4 mA for full clockwise rotation, i.e., 0°, and 20 mA for full counter-clockwise rotation, i.e., 90° or 180°.
- 2. Split range where 4 mA would be full clockwise and 12 mA would be full counter-clockwise or 12 mA would be full clockwise and 20 mA would be full counter-clockwise.
- 3. Each of the above standard setups can also be made reverse-acting.

**Quadrants of Operation**



**Standard 90° Actuator**  
Series 75W, X, and Z Shown



**180° Center-Off Actuator**  
Series 75W, X, and Z Shown typical

- D. Quite often when we receive an actuator for repair at Flowserve we find that the only thing wrong with the unit is that the feedback potentiometer is out of calibration. It is very important that the feedback pot be properly calibrated for correct operation of the positioner board. It is also very important that the actuator shaft not be rotated out of the quadrant for which the feedback pot has been calibrated. Whenever you have a problem with the positioner calibration, always check the feedback pot calibration first. This must be done with no power applied to the circuit board. If the actuator is in the full clockwise position, check the resistance between the purple and white/black potentiometer leads. The reading should be 80-90 ohms. If it is not, rotate the face gear until the proper reading is achieved. If the actuator happens to be in the full counter-clockwise position then check the resistance between the green and white/black potentiometer leads. If necessary, adjust the face gear for an 80-90 ohm reading. NOTE: It is not necessary to loosen or remove face gear snap ring(s) to rotate gear; it is a friction fit.

## 1.2 Environmental Considerations

**CAUTION:** The AF-17 Electronic Positioner is sensitive to electrical noise on signal or supply lines and in the environment. For maximum sensitivity, the electrical noise level should not exceed 10mV. Follow installation, calibration and adjustment guidelines carefully and use shielded wire as stated in paragraph 1.2.4.

Flowserve recommends that all products that must be stored prior to installation be stored indoors, in an environment suitable for human occupancy. Do not store product in areas where exposure to relative humidity above 85%, acid or alkali fumes, radiation above normal background, ultraviolet light, or temperatures above 120°F or below 40°F may occur. Do not store within 50 feet of any source of ozone.

Temperature and humidity are the two most important factors that determine the usefulness and life of electronic equipment.

### 1.2.1 Temperature

Operating solid-state electronic equipment near or beyond its high temperature ratings is the primary cause for most failures. It is, therefore, very important that the user be aware of and take into consideration, factors that affect the temperature at which the electronic circuits will operate.

Operating an electronic device at or below its low temperature rating generally results in a unit operating poorly or not at all, but it will usually resume normal operation as soon as rated operating temperatures are reached. Low temperature problems can be easily cured by addition of a thermostatically controlled heater to the unit's housing.

At high temperatures, some components will destruct completely when their maximum temperature is exceeded; others will cease operation at temperatures above ratings and will return to operation at normal ratings, but may have been permanently changed in one or another parameter, causing a device to operate poorly, and may also cause greatly reduced component life.

### 1.2.2 Positioner Temperature Considerations

The Worcester AF-17 Electronic Positioner is rated for operation between -40°F and 160°F. When using the positioner inside the Worcester 75 Series actuators, a maximum ambient temperature of 115°F is required to ensure the circuit board maximum temperature of 160°F is not exceeded.

### 1.2.3 Humidity

Most electronic equipment has a reasonable degree of inherent humidity protection and additional protection is supplied by the manufacturer, in the form of moisture proofing and fungicidal coatings.

Such protection, and the 3 to 4 watts of heat generated by the circuit board assembly will generally suffice for environments where the average relative humidity is in the area of 80% or less and ambient temperatures are in the order of 70°F average with only occasional short term exposure to temperatures up to 90°F. Where relative humidity is consistently 80 to 90% and the ambient temperature is high or subject to large variations, consideration should be given to installing a heater and thermostat option in the enclosure. The heater should not increase the enclosure temperature to the point where the circuit board assembly's temperature rating of 160°F is exceeded.

In those instances where the internal heater would bring the circuit board's operating temperature near or above its maximum rating, the user might consider purging the enclosure with a cool, dry gas. The initial costs can usually be paid off quickly in the form of greatly extended equipment life, low maintenance needs, and much less process downtime.

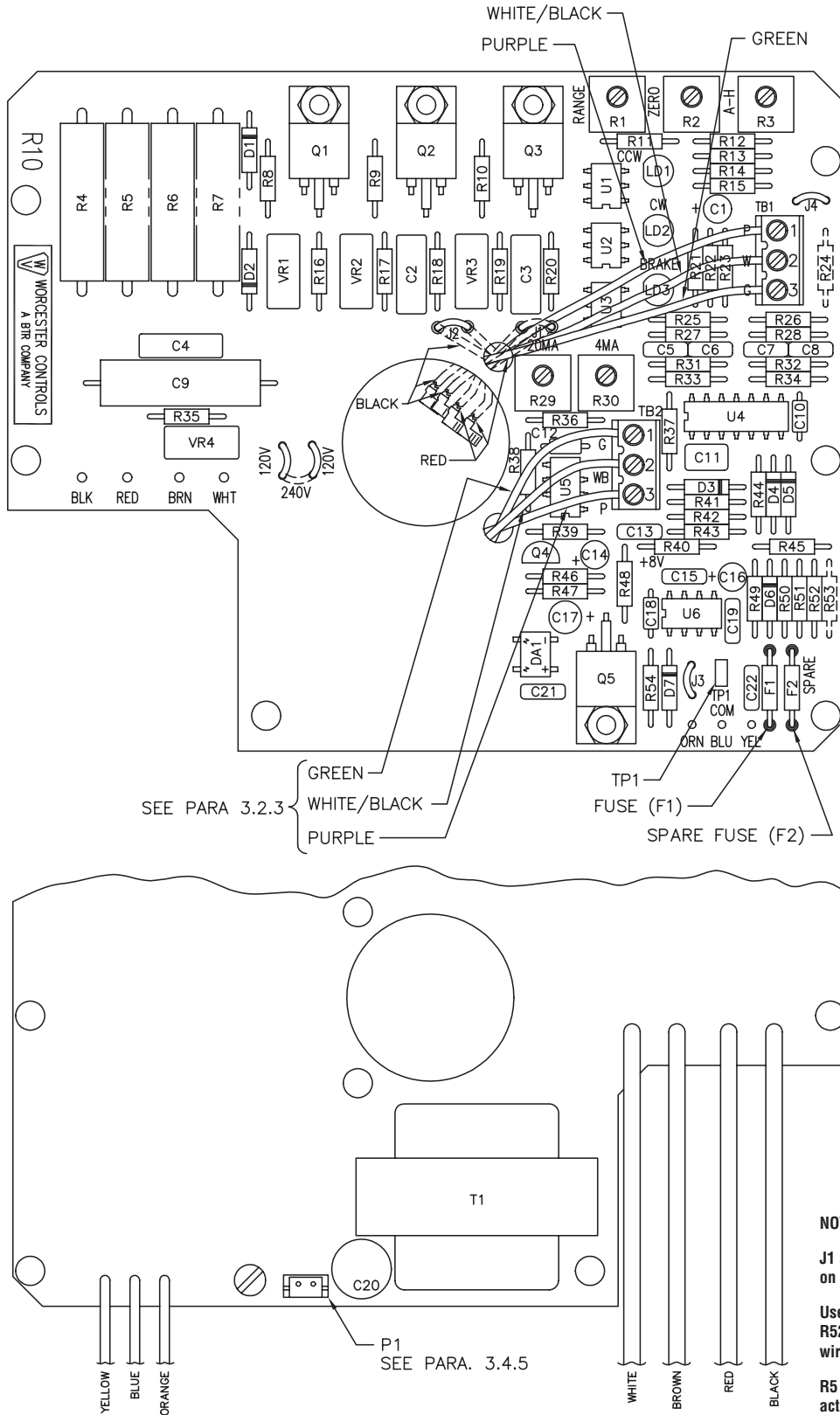
### 1.2.4 Input Circuit Noise Protection

Shielded wiring should be used for all signal input circuit wiring regardless of length.

With separately housed positioners, the wiring from the feedback potentiometer to remote positioner, would be considered as signal input wiring and should also be shielded wire.

The shields should never be used in place of one of the input wires, and the shields normally should be grounded to equipment housings at one end of the wiring run only. Grounding both ends of shielding can eliminate the shielding benefits because of current ground loops. If two or more shielded cables come to the positioner from different locations, ground the shields at the positioner.

Figure 1 – 120 VAC AND 240 VAC POSITIONER CIRCUIT BOARD



**NOTES:**

- J1 and J2 with red and black wires are on 240 VAC board only.
- Use or values of components R13, R24, R52, R53, R54, C22, J3, J4 and orange wire will vary depending on input signal.
- R5 and R7 used only for 25 and 30 size actuators.

## 2.0 ELECTRONIC CIRCUIT BOARD (120/240 VAC)

### 2.1 General

Figure 1 defines the location of major components and wires from the positioner to terminal strip connections. The #18 gauge white wire is the AC power unit “neutral” (or common) in the case of DC input wire. The #20 gauge white/black wire is one of the connections between the feedback pot and the terminal block (TB-1) on the circuit board.

### 2.2 Circuit Board Configurations

The positioner board is factory supplied for one of the seven input signal options.

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**NOTE: Field changes to the positioner board are not advised. Consult Flowserve before attempting any modification.**

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### 2.3 LED Indicators

Light emitting diodes (LED) marked LD1, LD2 and LD3 are in the output circuits of amplifier U4. LD1 is tied to pin #13, LD2 to pin #14, and LD3 to pin #1, and they are each associated with their respective opto-coupler U1, U2 and U3 and indicate when the input side of the opto-coupler is energized.

### 2.4 Controls

Three adjustment potentiometers are provided, located on the top side of the board and marked “Range”, “Zero”, and “AH”. See Figure 1.

#### 2.4.1 Range

The “Range” Control adjusts the positioner’s feedback circuit to cover the same span of voltage as generated by the input signal.

#### 2.4.2 Zero

The “Zero” adjustment is basically an offset adjustment in that essentially all input signals start at other than a zero signal condition, i.e., 1, 4 or 12 milliamps.

#### 2.4.3 A-H

The “AH” Control is used primarily to balance the positioner to the dynamic characteristics of the device and media being controlled. Functionally, it varies the amount of input signal that must be applied to the positioner to cause the actuator to reverse its direction of rotation. In effect it varies the deadband of the positioner on a reversing signal condition only. The deadband — the percent change in input signal change that must be applied to initiate a movement of the actuator — on a signal that is constantly increasing or decreasing, is relatively unaffected by the “AH” control.

The “AH” control can vary the balance point deadband from approximately .3% to 4.0% of signal span. It can therefore be used to help decrease the effects of signal noise, with a tradeoff in accuracy/sensitivity.

### 2.5 AC Power Control

The AC output circuits are controlled by solid-state switches (triacs Q1, Q2, Q3), which will provide trouble-free operation for the life of the equipment they are used with, AS LONG AS THEY ARE OPERATED WITHIN THEIR RATINGS.

The ratings for the solid-state switches used in the Worcester AF-17 Positioner are listed in Part 6.3.

## 3.0 INSTALLATION OF AF-17 INTO SERIES 75 ELECTRIC ACTUATOR

### 3.1 General

If the actuator was purchased with the AF-17 positioner board factory installed, proceed to section 4.0.

If a 4-20 mA Position Output option is also used with the AF-17 positioner, refer to paragraph 3.3.3 for installation (if not already installed), and paragraph 3.4.5 for wiring.

#### 3.1.1 Check Kit For Parts

##### A. Common Parts For Sizes 10-30 Actuators

Quantity	Name
1	Circuit Board Subassembly
1	Insulating Board
5 or 6	Washers (Nylon)
5 or 6	Grommets (Rubber)
5 or 6	Mounting Screws (Circuit Board)
1	Nameplate – Circuit Board
1	Nameplate – Base
1	Wiring Label – Cover
1	Instruction Manual
5	Cable Ties
2	Closed End Splice
1	Wire – White

##### Additional Parts For 10-23 Actuators:

Quantity	Name
1	Pot Kit Subassembly
1	Bracket – Right (Long)
1	Bracket – Left (Short)
2	Spacer (Bracket)
2	Mounting Screw (Bracket/Spacer)
1	Support Bracket – Transformer
1	Spacer – Transformer Support Bracket (for 23 Size Only)

##### Additional Parts For 25 and 30 Actuators:

Quantity	Name
1	Pot Kit Subassembly
1	Mounting Bracket
2	Mounting Screw (Bracket)

**3.1.2. Tools Needed**

- ¼" nut driver, ⅝" screwdriver, needle nose pliers, ⅛" Allen wrench (cams and spur gear).
- Volt/ohm meter (checking feedback potentiometer resistance, voltages – incoming process signal).
- Milliamp source (to check calibration of positioner on actuator).
- VAC line cord (to power basic actuator).

**3.1.3. Operation Check of Basic Actuator**

Set cams for about 1° to 3° of over travel in each direction (full open and full closed). That is, for 0° to 90° operation set at minus 3° and plus 93°. Power terminals 1 and 3 for CCW rotation, terminals 1 and 4 for CW rotation (reference paragraph 4.7.6.).

**3.2 Mounting Potentiometer**

**3.2.1 Mounting Single Potentiometer Into Series 75 Actuator**

See Figure 2.

A. With the potentiometer mounted to the potentiometer bracket and the spur gear loosely fitted to the potentiometer shaft, mount the potentiometer bracket (if not already mounted) as follows:

10-23 75 Actuator:

Remove the motor module mounting screws on the side of the module furthest away from the actuator shaft. Position potentiometer assembly bracket holes over screw holes and line up potentiometer shaft with center of actuator shaft, replace and tighten screws.

25/3075 Actuator:

Attach potentiometer bracket to motor support plate between the terminal strip and actuator shaft with mounting screws as shown.

**3.2.2 Mounting Dual Potentiometer Into Series 75 Electric Actuator**

A dual potentiometer is also available and is required with the AF-17 when external resistance indication is also desired, or when the 4-20 Position Output option is also used.

Each potentiometer can serve only one function. Remote resistance monitoring and an AF-17, for instance, cannot share a potentiometer.

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**Note: Voltage limit of "B" potentiometer is 30 volts maximum.**

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Mount potentiometer per paragraph A of 3.2.1.

**3.2.3 Potentiometer Wiring**

A. The feedback potentiometer leads are connected to the terminal block (TB-1) on the AF-17 board. Run the three leads up through the hole next to potentiometer R29. See Figure 1.

B. Connect the potentiometer leads to the terminal block as follows:

TB-1	
Terminal	Wire Color
1	Purple
2	White/Black
3	Green
(DO NOT CUT POTENTIOMETER WIRES!)	

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**NOTE 1:** In the case of a dual potentiometer, "A" (front, close to the bracket) potentiometer wires are wired to the AF-17 board terminal block (TB-1) as stated above, "B" (rear, far from the bracket) potentiometer wires may be wired to terminals 7 (green), 8 (white/black), and 9 (purple) if available and the potentiometer will be used for resistive feedback, or they may be wired to TB-2 if 4-20 mA position output option is used. The wires are run up through the hole next to Q4 then connected to TB-2 as follows:

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TB-2	
Terminal	Wire Color
1	Green
2	White/Black
3	Purple
(DO NOT CUT POTENTIOMETER WIRES!)	

### 3.2.4 Adjusting Potentiometer

A. Reference paragraph 4.7.6 for moving the actuator shaft electrically.

B. 10-30 75 Actuator:

Place the large face gear (12) over the actuator shaft with the gear teeth down and secure with snap ring (16).

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**NOTE: The face gear utilizes a friction fit to the shaft. For best results, wipe off any lubricant that may be on the shaft before sliding on the face gear.**

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**CAUTION: Do not overstretch the snap ring — use the minimum opening to allow them to slip over the gear.**

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C. Adjust the potentiometer spur gear until there is approximately 1/8" engagement with the large face gear. Ensure there is minimum backlash between the gears. Tighten the spur gear set screw.

D. Rotate the face gear back and forth to ensure smooth and easy operation of the potentiometer.

E. **IMPORTANT:** For 90° Valves:

Depending on whether the AF-17 board is installed and wired, either measure the resistance directly at the potentiometer wires if not installed or at the AF-17 terminal block (TB-1) if installed and wired. With the actuator either in the OPEN (full CCW) or CLOSED (full CW) position, and power off, rotate the face gear, thus turning the potentiometer shaft, until the resistance between the white/black lead (AF-17 terminal 2) and the green lead (AF-17 terminal 3) or the white/black lead (AF-17 terminal 2) and the purple lead (AF-17 terminal 1) respectively, as measured by ohmmeter, is between 80 ohms and 90 ohms.

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**NOTE: It is not necessary to loosen or remove face gear snap ring(s) to rotate gear.**

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F. Power the actuator to the opposite position from where resistance was measured. Reference paragraph 4.7.6 for moving actuator shaft electrically.

G. At this position, with power off, measure the resistance at the same terminals as stated above. The resistance reading should be greater than 700 ohms. If not, then power actuator back to original position and adjust potentiometer again, if necessary, as stated in paragraph E above. If unsuccessful in getting proper resistance readings, potentiometer is defective and should be replaced.

H. The feedback potentiometer is now adjusted for use in the 75 actuator. Add the potentiometer caution label to the outside of the actuator cover.

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**CAUTION: If the actuator shaft is manually rotated a multiple of 360° from its original position, the feedback potentiometer will no longer be in calibration. It must be recalibrated per paragraphs E-G above, in order for the AF-17 board to operate properly.**

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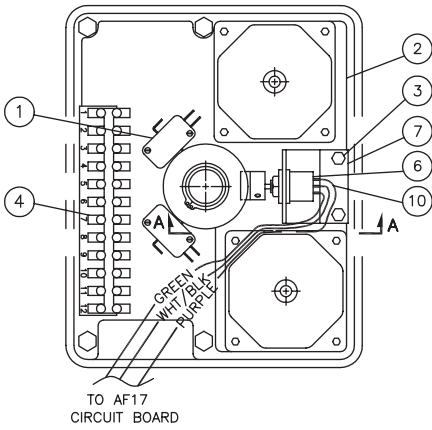
### 3.2.5 Important Note

The feedback potentiometer is calibrated for only one 90-degree quadrant of valve operation.

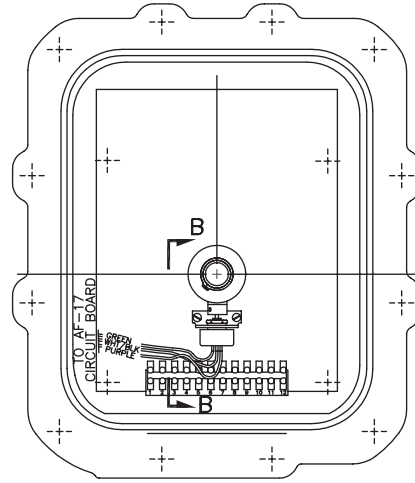
If the valve and actuator output shaft is repositioned to another 90-degree quadrant the feedback potentiometer must be recalibrated as per Section 3.2.4.

The Series 75 actuators offer a manual override feature. Whenever repositioning the valve using the manual override capability on these actuators, move the valve only within the 90 degrees for which the feedback potentiometer has been calibrated.

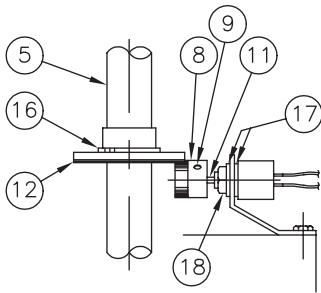
Figure 2 – NOTE: Illustrations show single potentiometer only.



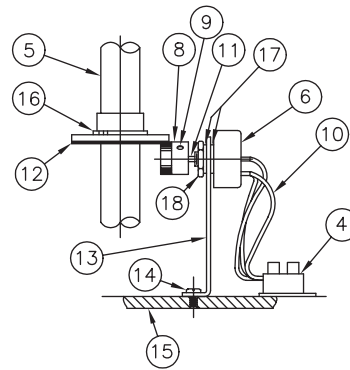
10-2375  
PLAN VIEW



25/3075  
PLAN VIEW



VIEW A-A



VIEW B-B

Item	Description
1	Limit Switches
2	Motor Module
3	Motor Module Mounting Screws (2)
4	Terminal Strip
5	Actuator Shaft
6	Potentiometer
7	Potentiometer Bracket
8	Spur Gear
9	Spur Gear Set Screw
10	Potentiometer Leads
11	Potentiometer Shaft
12	Face Gear
13	Potentiometer Bracket
14	Mounting Screws (2)
15	Motor Support Plate
16	Snap Ring
17	Lockwashers (2)
18	Nut

Illustrations Show Single Potentiometer Only

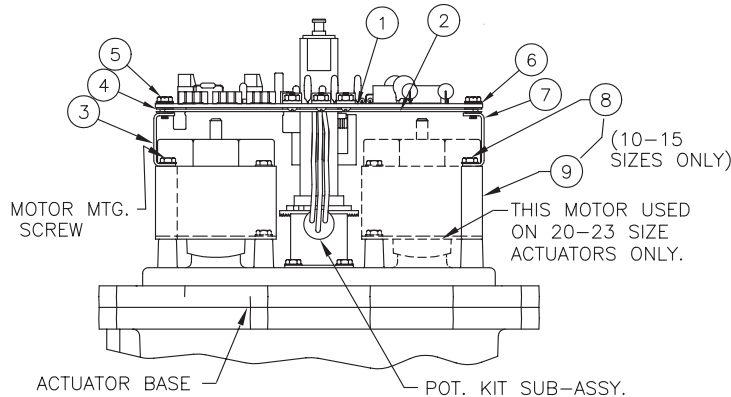
### 3.3 Mounting Circuit Board

#### 3.3.1 For 120/240 VAC 10-23 Size Electric Actuators

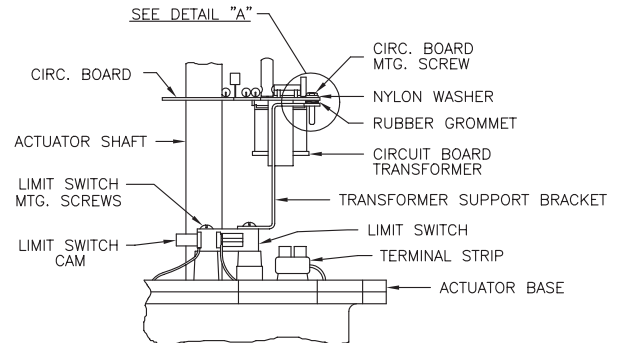
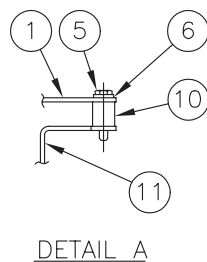
See Figure 3.

- A. Mount these brackets to the actuator motors or spacers as provided. The longer bracket is mounted to the right side of the actuator when facing the terminal strip using the motor mounting screws. Mount transformer support bracket to limit switch using existing switch screw.
- B. Remove and replace motor screws carefully to avoid stripping the threads of these self-tapping screws.
- C. Once these motor screws and brackets are firmly secured, firmly tap the motor stator to force realignment of the top motor bearing.
- D. Loosen all actuator terminal strip screws necessary to connect the circuit board's wiring to the terminal strip. See manual Part 3.4 for proper wiring of circuit board to the actuator's terminal strip. Wire routing is important. Ensure that wiring is not pinched and is not near cams or mechanical brake.
- E. Assemble circuit board into actuator. Slide rubber grommets onto insulating board. Put nylon washers under heads of self-tapping screws. (Six screws will be used to install the circuit board onto the brackets).
- F. Place circuit board over brackets. Feed the three feedback potentiometer wires up through the hole in the circuit board near potentiometer R29. See Figure 3 below and Figure 1 on page 6. Loosely fasten board to brackets using mounting screws. Use a nylon washer and a rubber grommet on the self-tapping screw securing the left front corner of board to transformer support bracket when facing terminal strip. NOTE: For 23 size only, use spacer (10) in place of grommet. Wire potentiometer to the AF-17 board per paragraph 3.2.3.
- G. The circuit board is wired to the terminal strip as shown in Part 3.4.
- H. Snug down the circuit board and secure mounting screws such that grommets are about half compressed.

Figure 3



10-23 Size 75 Actuators	
Item	Description
1	Circuit Board Sub-Assembly
2	Insulating Board
3	Bracket-Right (Long)
4	Grommet-Rubber
5	Mtg. Screws (Circuit. Board)
6	Washer - Nylon
7	Bracket - Left (Short)
8	Mtg. Screws (Bracket)
9	Spacer (Bracket)
10	Spacer (2375 AC Only)
11	Transformer Support Bracket



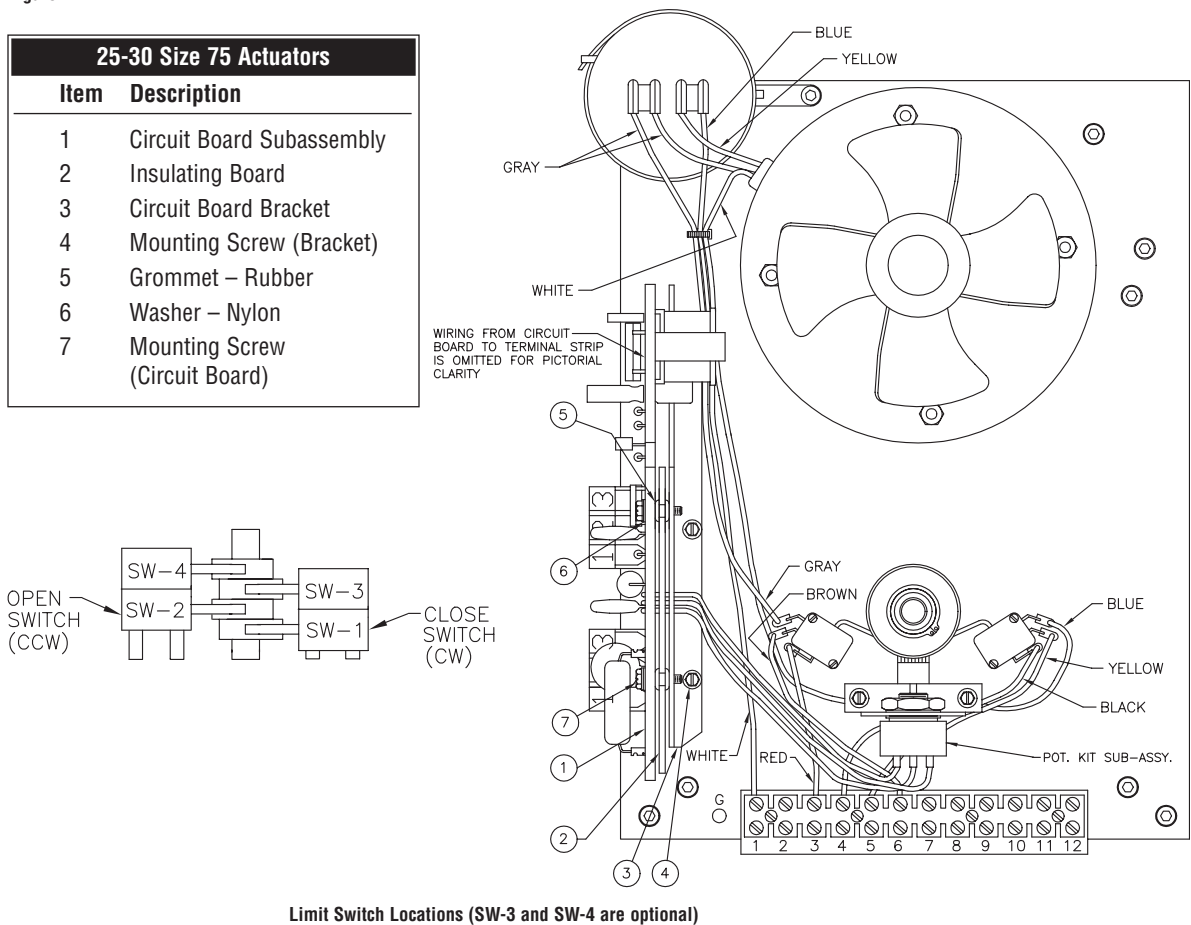
View Shown from the capacitor end of the 75 actuator (Capacitor not shown for pictorial clarity)

**3.3.2 For 120/240 VAC 25 and 30 Size Electric Actuators**

See Figure 4.

- A. Assemble circuit board to bracket as shown.
- B. Place four of the five rubber grommets onto the insulating board. Put nylon washers on the self-tapping screws and place screws through the circuit board and insulating board. Start screws into the bracket. Use a nylon washer and a rubber grommet on the self-tapping screw, securing the lower left corner of circuit board.
- C. If no insulating board is used, place a rubber grommet between the board and the bracket. Tighten all screws such that the grommets are about half compressed.
- D. Use two screws to fasten circuit board bracket to the motor mounting plate, component side of the board is facing out.
- E. The circuit board is wired to the terminal strip as shown in Part 3.4.

Figure 4



**NOTE:** Standard wiring for switches and capacitor as shown in Figure 4 is the same for 10-23 75 actuators and is for 120 VAC Positioner only. For 240 VAC Positioner, see paragraph 3.4.4.

**3.3.3 Installation of Optional 4-20 Position Output (if used and not factory installed)**

A. The output of the position output option is suited for a 4-20 mA DC meter with 0-100% scale (such as General Electric type GE185), which is not part of the package. If properly calibrated, it indicates actuator shaft position from closed (0°, 0%) to open (90°, 100%).

A dual potentiometer has to be used with the AF-17 to achieve the 4-20 mA output. Each potentiometer can serve only one function. See Part 3.2 for potentiometer installation and wiring procedures.

B. Parts Available for Assembly

Item	Qty	Description
1	3	Cable Ties
2	1	Potentiometer Kit (Not Shown)
3	1	Connector Assembly (Not Shown)

### 3.4 Wiring of AF-17 Board to Actuator

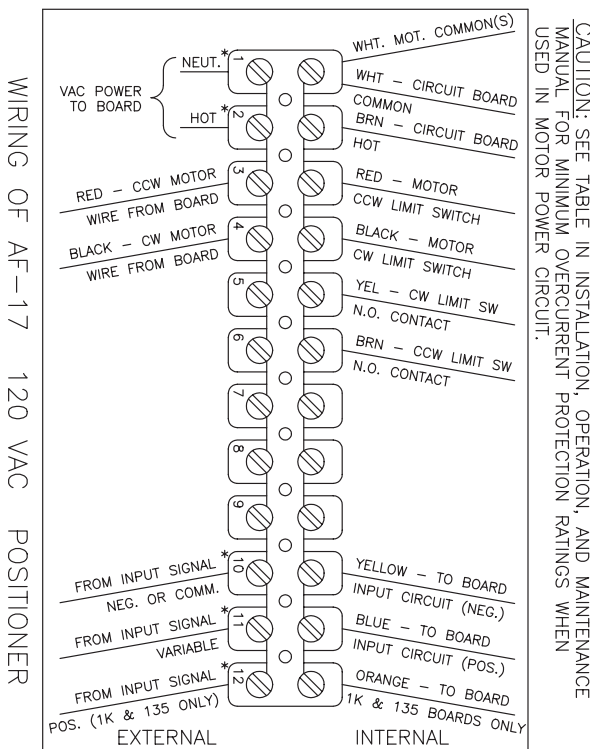
**NOTE:** When there are multiple wires going to terminal 1, use short white wire provided. Connect it to terminal 1 and then splice it to the other white wires (common) using the closed end splice provided.

#### 3.4.1 Terminal Strip

The AF-17 positioner board is wired to the terminal strip per Figure 5 for 120 VAC or Figure 6 for 240 VAC.

**CAUTION:** Wiring should be inserted only to mid-point of terminal strip.

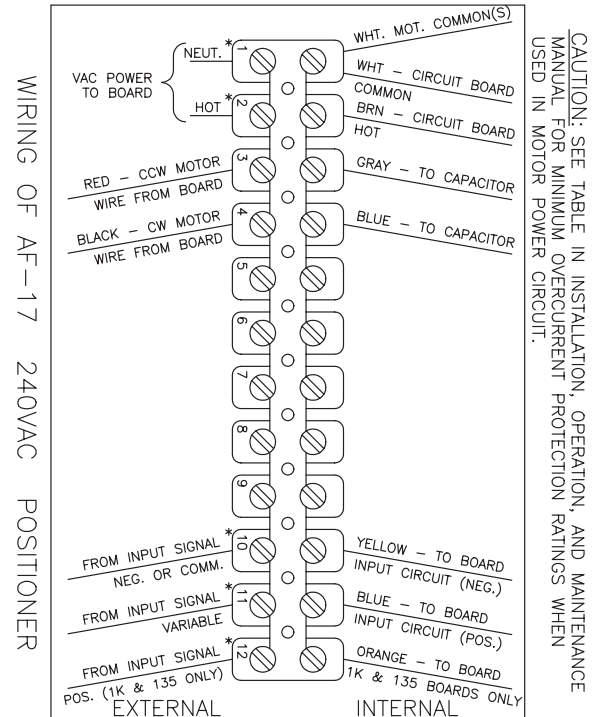
Figure 5



\*TERMINALS 1 & 2 (POWER) AND 10,11, & 12 (SIGNAL) ON EXTERNAL SIDE ARE FOR USER'S FIELD CONNECTIONS

Figure 6

TWO BLACK AND TWO RED WIRES FROM CIRCUIT BOARD ASS'Y. WIRE TO COMM. AND N.C. CONTACTS OF SWITCHES NO. 1 AND 2 RESPECTIVELY.



\*TERMINALS 1 & 2 (POWER) AND 10,11 & 12 (SIGNAL) ON EXTERNAL SIDE ARE FOR USER'S FIELD CONNECTIONS

**NOTE:** For all input signal circuit wiring, regardless of length, shielded wiring should be used. See Paragraph 1.2.

### 3.4.2 Feedback Connections

Actuators shipped with the positioner circuit board installed will have the feedback potentiometer also installed and connected to the AF-17 terminal block (TB-1) numbers 1, 2 and 3, green wire to 3, white/black wire to 2, and purple wire to 1. (Reference Figure 2.) If not already done, connect the three feedback potentiometer leads as listed above. See Figure 1.

### 3.4.3 Output Connections

The AC power switching circuits on the circuit board connect to actuator terminals 3 and 4. The circuit board's CCW power control circuit connects to terminal 3 via the positioner's red wire and the CW power control circuit connects to terminal 4 via the positioner's black wire. (Reference Figures 5 and 6). The actuator's motor "Common" must connect to the positioner board's white wire and AC "neutral" for correct actuator operation.

### 3.4.4 For 10-30 AF-17 240 VAC Positioner Wiring

For this voltage only, the two limit switches are used to switch off the opto-coupler (U1, U2, U3) outputs at the end of CW and CCW strokes instead of directly switching off the motor. This protects the triacs (Q1, Q2, Q3) by ensuring that they are switched off via their gate circuit and do not shut off on full power.

Replace the original gray and blue actuator wires (make a note of which color wire is on which capacitor terminal and then discard them) with those provided. Connect them to the capacitor as originally wired and to terminals 3 and 4 (gray to no. 3, blue to no. 4) Reference Figure 6.

The two black wires (#20 gauge) from the positioner board connect to the common and normally closed contacts of switch no. 1 (lower right hand switch), and the two red wires (#20 gauge) from the positioner board connect to the common and normally closed contacts of switch no. 2 (lower left hand switch). Route the wires so they will not interfere with switch or feedback potentiometer operation.

The cams, which operate these switches, are adjusted as referenced in paragraphs 3.1.3, 4.1, 4.2, 4.3 and 4.7.1.

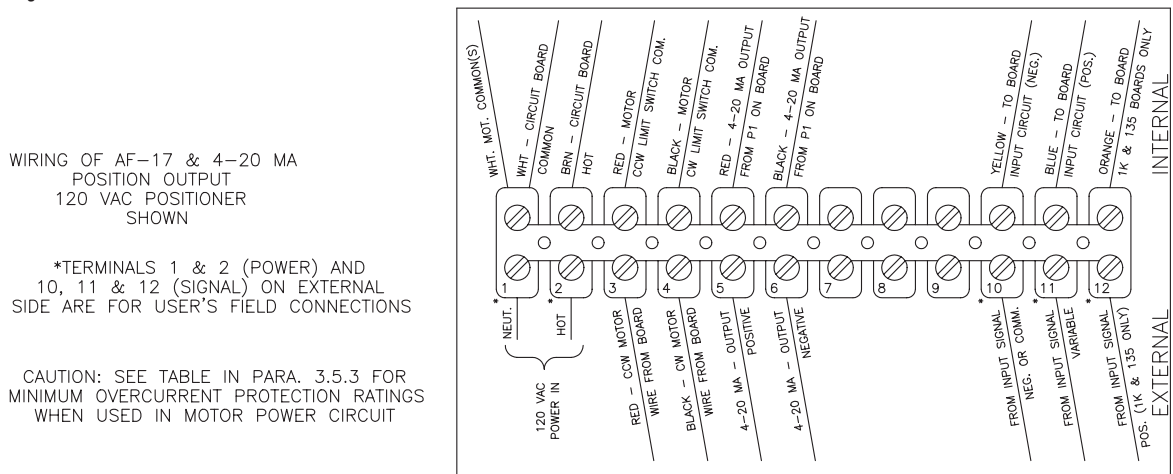
**NOTE: Securely tighten all terminal screws. Keep wiring away from all rotating parts and ensure it will not be pinched when the actuator cover is installed.**

### 3.4.5 Wiring for AF-17 with 4-20 mA Output

See Figure 7.

A. The white wire (common) from the AF-17 PC board is wired to terminal no. 1 on internal side; the brown wire (hot) from the AF-17 PC board is wired to terminal no. 2 on internal side. Feedback potentiometer wires from the "B" section of the dual potentiometer are wired directly to the AF-17 circuit board terminal block TB-2 (green to terminal 1, white/black to terminal 2, and purple to terminal 3).

Figure 7



WIRING OF AF-17 & 4-20 MA POSITION OUTPUT 120 VAC POSITIONER SHOWN

\*TERMINALS 1 & 2 (POWER) AND 10, 11 & 12 (SIGNAL) ON EXTERNAL SIDE ARE FOR USER'S FIELD CONNECTIONS

CAUTION: SEE TABLE IN PARA. 3.5.3 FOR MINIMUM OVERCURRENT PROTECTION RATINGS WHEN USED IN MOTOR POWER CIRCUIT

WIRING OF AF-17 & 4-20 MA POSITION OUTPUT 120 VAC POSITIONER

- B. For 120 VAC board only, remove yellow wire from terminal 5 and brown wire from terminal 6, disconnect them from N.O. contacts of switches 1 and 2 and discard them. For all AC boards, connect wires of output signal connector assembly from AF-17 board connector (P1) such that red wire (+) is wired to terminal 5 and black wire (-) is wired to terminal 6 on internal side of terminal strip.

**NOTE: Check for wiring diagram label inside of cover, if it doesn't have the 4-20 mA output option wiring shown, mark label for terminals 5 and 6 according to Figure 7.**

- C. External wiring is between actuator terminal strip and outside power supply and various controls. Common wire of the power supply is wired to terminal 1 and hot wire of the power supply to terminal 2. An outside position indicator meter is wired with positive connection to terminal 5 and negative connection to terminal 6.
- D. Securely tighten all terminal screws. Secure all wires neatly with the cable ties. Keep wiring away from all rotating parts and ensure wiring is not pinched when actuator cover is installed.
- E. The feedback potentiometer has to be adjusted to obtain the proper resistance range. See paragraph 3.2.4. To obtain proper 4-20 mA output, the AF-17 board 4-20 mA output has to be calibrated. Using an ammeter connected to actuator terminals 5 (positive) and 6 (negative) adjust the two potentiometers R29 and R30 on the board. Locate the actuator in the closed position (0%) and adjust R30 potentiometer (closest to TB-2) to obtain 4 mA on the ammeter. Move the actuator to the open position (100%) and adjust R29 potentiometer (closest to the shaft hole) to obtain 20 mA. Because adjustment of one potentiometer affects the other, repeat the procedure several times to obtain proper values.

**IMPORTANT:** The feedback potentiometer is calibrated for only one 90° quadrant of valve operation. If the output shaft is repositioned to another 90° quadrant or if the output shaft is rotated a multiple of 360° from its original position, or if the 4-20 mA position output option is disconnected from the AF-17 board, the feedback potentiometer will no longer be in calibration and must be recalibrated. See paragraph C of part 1.1 and paragraph 3.2.4.

### 3.5 Actuator Power

#### 3.5.1 Wire Size

AC power to the positioner and from the positioner to the actuator should be with wire no smaller than #18 gauge and with insulation rated for the particular application. The #18 gauge wire size is sufficient for all Worcester Series 75 actuators. When using the positioner with other makes of actuators, check the manufacturer's current rating to determine the correct wire size.

#### 3.5.2 Terminations and Voltage

AC power connections are made to terminals 1 and 2 of the terminal strip. The AC neutral, or common, wire should be connected to terminal #1 and the AC "Hot" wire to terminal #2. Note that the positioner requires a minimum of 110 VAC, and a maximum of 130 VAC for the 120 VAC version and a 220 VAC minimum, 250 VAC maximum for the 240 VAC version.

Grounding wires should be connected to green colored grounding screw (if present) on actuator base or to any base plate mounting screw in the actuator.

#### 3.5.3 Minimum Fuse Ratings

See table below for minimum fuse rating when overcurrent protection is used in motor power circuit.

Minimum Fuse Rating for Overcurrent Protection		
Actuator Size	Voltage	Fuse Rating
10-23	120 VAC	5A
25/30	120 VAC	10A
10-23	240 VAC	3A
25/30	240 VAC	5A
10-23	12 VDC	10A
10-23	24 VDC	5A

**NOTE: This table shows the minimum rating to prevent inrush current from blowing the fuse.**

### 3.6 Input Signal Connections

**NOTE: The 120/240 VAC AF-17 positioner board signal input circuit is protected by a 1/6 amp fuse, F1. See Figure 1 and Paragraph A of Part 1.1.**

#### 3.6.1 AF-17-1, AF-17-4, AF-17-10 (Milliamp Input Signal for AF-17)

For a milliampere signal input, the more positive or “High” signal lead should connect to terminal 11. The less positive or “Common” lead should connect to terminal 10. Terminal 10 is (-), Terminal 11 is (+).

This positioner is available for use with the standard milliamp signals: 1 to 5, 4 to 20, and 10 to 50 milliamps. The positioner board is factory calibrated for one of the three milliamp signal ranges, and field changes are not advised. A label on the circuit board indicates the positioner’s signal range.

Paragraph 6.4.1 gives the nominal resistance load, which the positioner presents to the control circuit for the three signal ranges.

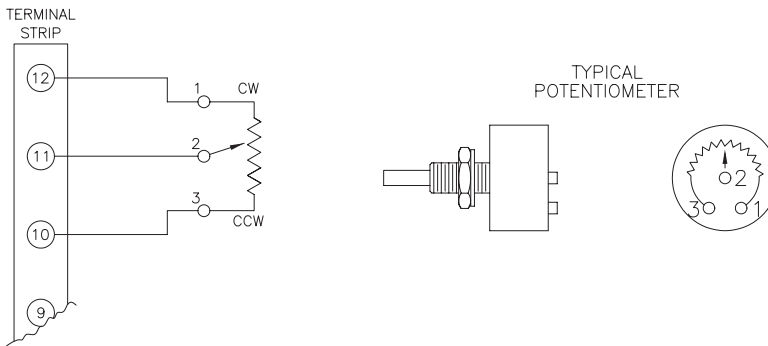
Comparison of resistance measurements made at terminals 10 and 11 (on the yellow and blue wires from the circuit board) against the resistances shown in paragraph 6.4.1 provides a quick way to determine the milliamp range for which a particular board is calibrated.

**NOTE: If the circuit board has an orange wire (See Figure 1) attached to it, the board is for a Resistive Input. See Paragraph 3.6.2 and Figure 8.**

#### 3.6.2 AF-17-13, AF-17-1K (Resistive Input for AF-17)

**NOTE: The Resistive Input Potentiometer is not the Feedback Potentiometer, but is an additional Potentiometer provided and externally located by user.**

Figure 8



For a resistance input signal, the usual connections will be similar to that shown in Figure 8 with a “Close” command being generated where the potentiometer of Figure 8 is rotated to its full CCW position and an “Open” command when it is in the full CW position.

If the command signal is derived from other than a rotary potentiometer, it is only necessary to keep in mind that a “Closed” (full CW) valve is called for when the command potentiometer presents the least resistance between terminals 10 and 11 and the most resistance between terminals 11 and 12. A full “Open” (full CCW) valve would be the reverse condition; the least resistance between terminals 11 and 12 and the most resistance between terminals 10 and 11.

If the “Command” potentiometer is reasonably linear, the actuator/valve will be approximately 50% open when the resistances between terminals 10 to 11 and 11 to 12 are equal.

Resistive input circuit boards are made in two versions, one for high resistance command circuits – 1000 ohms nominal, and one for low resistance command circuits – 135 ohms nominal.



### 3.6.3 AF-17-5V, AF-17-XV (Direct Voltage Input Signal for AF-17)

For a voltage input signal, the more positive or “High” signal lead should connect to terminal 11. The less positive or “Common” lead should connect to terminal 10. Terminal 10 is (-), Terminal 11 is (+).

This positioner is available for use with the standard direct voltage signals: 0 to 5 VDC and 0 to 10 VDC. The positioner board is factory calibrated for one of these two signal ranges and field changes are not advised.

Paragraph 6.4.1 gives the nominal resistance load that the positioner presents to the control circuit for the two signal ranges.

## 4.0 CALIBRATION AND ADJUSTMENT

### 4.1 Initial Set-Up and Adjustment (Applies To All Models)

When properly adjusted, the actuator will stop at the full open and full closed points as a result of having reached one of the limits of the input signal span, and the actuator’s limit switches will be used in a back-up mode to stop the actuator, should an out-of-range input signal occur.

In case of Series 75, 240 VAC Actuator with AF-17 240 VAC positioner, the two limit switches do not limit actuator travel. Exercise caution not to override limit switches. Reference paragraph 3.4.4.

Actuators with factory-mounted positioners will be shipped with their limit switches properly adjusted. When the positioner, whether internally or externally mounted, is installed to an actuator in the field, the actuator limit switches should be initially adjusted to trip at 1 to 3 degrees AFTER the positioner would normally have shut the actuator off upon reaching the upper or lower input signal limit. Reference parts 4.2, 4.3 and paragraph 4.7.1. CAUTION: If either the valve or the actuator have mechanical end of travel stops, the limit switches should be set to trip JUST before a mechanical stop is reached even if this point is coincident with one of the limits of the input signal.

---

**NOTE: Prior to starting potentiometer adjustment procedure set the AF-17 adjustment potentiometers as follows: “Range” and “Zero” potentiometers full clockwise, “AH” full clockwise then ¼ turn counter-clockwise.**

---

### 4.2 “Zero” Adjustment [“Zero” Potentiometer Initially Full Clockwise (CW)]

Apply a “full closed” signal to the positioners input, i.e., 4 mA. The actuator should rotate in the CW direction and come to a stop at or near the CW limit of rotation. Adjust the “Zero” adjustment until the actuator stops in the fully closed position AND the indicator LD2 is “OFF”. If LD2 is “ON”, this indicates that the “Closed” (SW-1) limit switch has tripped. The “Closed” limit switch should be adjusted such that it will trip 1° to 3° beyond the full closed position of the actuator. Readjust the “Closed” limit switch if necessary.

### 4.3 “Range” Adjustment [“Range” Potentiometer Initially Full Clockwise (CW)]

Apply a “full open” signal to the positioners input, i.e., 20 mA. The actuator should rotate in the CCW direction and come to a stop at or near the CCW limit of rotation. Adjust the “Range” adjustment until the actuator stops in the fully open position AND the indicator LD1 is “OFF”. If LD1 is “ON”, this indicates that the “Open” (SW-2) limit switch has tripped. The “Open” limit switch should be adjusted such that it will trip 1° to 3° beyond the full “Open” position of the actuator. Readjust the “Open” limit switch if necessary. When 4.2 and 4.3 are complete, ensure that limit switches are set 1° to 3° beyond the electronic travel limits. Reference CAUTION in 4.1.

### 4.4 “AH” Adjustment (Anti-Hunt) (“AH” Potentiometer – turn fully clockwise (CW), then ¼ turn CCW)

This adjustment can be made only after installation is complete and actuator is operational. Apply sufficient input signal to turn the actuator shaft an amount that would open the valve approximately 10%. If the actuator hunts, adjust the “AH” control in a CCW direction until the hunting stops. If no hunting occurs, adjust the control towards the CW direction. Increase the input signal in steps of approximately 10% and reset the “AH” adjustment until no hunting occurs over the entire input signal range.

## 4.5 Adjustment Recheck

There is some interaction between adjustments of the “Zero” and “Range” controls, therefore if an adjustment is made at one end of travel, the opposite end should be rechecked.

Although the “Range” and “Zero” settings are relatively unaffected by fairly large temperature changes, it is suggested that positioners be checked during a users routine maintenance schedule.

## 4.6 Operational Check

Once the AF-17’s circuit board zero and span potentiometers are set for the minimum and maximum process signal values, typically a 4-20 mA signal, do the following checks:

### 4.6.1 Increasing Signal

Reduce process input signal below the minimum value so that actuator stops on its closed limit switch and closed LD2 is on. Increasing the input signal in small increments should allow the actuator to move in angular increments proportional to these small incremental increases in the incoming signal.

### 4.6.2 Decreasing Signal

Continually adjust the signal until the maximum signal value is reached and actuator is in fully open position. With a signal over 20 mA, when the positioner is calibrated for 4 to 20 mA, the actuator will operate until the proper cam has actuated the open limit switch. Note that the open LD1 will be “on” when actuator stops at limit switch.

In similar fashion, decrease the process signal in small values. The actuator should move closed in small steps until the fully closed position is reached at the minimum signal value, typically 4 mA for a 4-20 mA calibration.

### 4.6.3 Attaching Label

Attach label to board.

## 4.7 If Problems Occur

If problems occur while trying to obtain the desired positioner action, check the following:

### 4.7.1 Cam Adjustment

The actuator cams should actuate the limit switches 1° to 3° after the actuator stops at either the fully open or fully closed position.

If the actuator is closed at 0 degrees, the limit switch must actuate by the time the actuator is at the minus 1 to 3 degree position. Similarly, at the open or 90-degree position, the limit switch must actuate by the time the actuator is at the 91 to 93 degree position.

---

**NOTE: See CAUTION in part 4.1.**

---

### 4.7.2 Feedback Potentiometer Calibration

Check the feedback potentiometer calibration per paragraph 3.2.4 of the manual. At either the full open or the full closed position, stopping at either limit switch, the potentiometer must still be within its electrical travel. To verify this, check the resistance at either the full open or full closed position. The resistance measured between terminals 2 and 3 or 2 and 1 on the AF-17 terminal block, with the power off, must be between 80 ohms and 90 ohms.

Readjust the feedback potentiometer as necessary and check as in the previous steps for proper incremental movement of the valve actuator from limit switch to limit switch; full closed to full open; -1° to -3°, +91° to +93°.

### 4.7.3 Reverse-Acting

For a reverse-acting actuator, read part 5.4 in the manual. Simply follow the instructions of part 5.4 and readjust the circuit board “zero” and “range” potentiometers as needed.

### 4.7.4 Adjustment to Loop Process

Once the actuator and positioner are installed in the system, further adjustments may be necessary to trim the AF-17 circuit board/actuator action to the process controller’s action in the process loop. The AH potentiometer on the circuit board may require adjustment counterclockwise to stop the AF-17 circuitry from reacting to spurious electrical noise signals.

#### 4.7.5 Check Fuse F1

For AC boards, check fuse F1 to see if it is blown. If it is, replace with spare fuse F2 attached to PC Board and order another fuse for spare (Newark part number 94F2146). **IMPORTANT:** To check fuse - remove it from circuit and test with ohmmeter. Resistance should be about 6 ohms.

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**NOTE: If fuse F1 is blown, excessive voltage (possibly 120 VAC) was applied to the signal input circuit. If so, correct this condition before changing fuse. See Paragraph A of Part 1.1.**

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For DC boards, check fuse F1 to see if it is blown. If it is, replace it with a 1 1/2", 250 volt, 3 amp fuse, available through any electrical supplier. See Part 2.2 in DCAF17 IOM supplement.

#### 4.7.6 Check basic actuator for proper operation using the proper AC voltage

- A. Remove red and black leads coming from circuit board at terminals 3 and 4 (if already installed). Tape stripped ends of these wires.
- B. Alternately energize, with the appropriate AC voltage, terminals 1 and 3 and 1 and 4. The actuator should move clockwise when energizing terminals 1 and 4, stopping only at the clockwise limit switch. The actuator should move counter-clockwise when energizing terminals 1 and 3, stopping only at the counter-clockwise limit switch.

---

**NOTE: For AF-17 240 VAC Positioner only, limit switches do not directly control motor. Therefore, the actuator will not stop when the limit switches trip. Use care not to drive the actuator past its normal limits. Run the actuator to its limits in each direction, to assure proper operation of the actuator.**

---

#### 4.7.7 Check for Noise Problems

If the circuit board's light emitting diodes (LEDs) blink or seem to continuously glow, electrical noise is interfering with the positioner's input process signal. (Always use shielded cable for the process signal coming to the AF-17 board. Ground the shield at only one end.) Adjust AF-17 positioner as necessary. See Section 4.0.

#### 4.7.8 Replace Circuit Board

If problems still occur after taking these remedial steps, replace circuit board in the actuator.

## 5.0 OPERATIONAL VARIABLES

### 5.1 Sensitivity

The Worcester AF-17 Electronic Positioner has been designed to a standard sensitivity equivalent to approximately 240 positions for a 15 second 90 degree shaft movement.

### 5.2 Reduced Travel Operation

A small amount of travel reduction can be achieved (4-6 degrees). This can be accomplished by applying maximum and minimum input signals and adjusting the "Range" and "Zero" controls to determine the new rotation end limits. (Limit switch cams should also be reset. See parts 4.1 and 4.4.)

### 5.3 Split Range

With AF-17 Positioner circuit board revisions (Revision R10 and later) split range adjustment capability is available with standard board and may be obtained using the standard calibration procedures.

### 5.4 Reverse Action

The usual mode of operation of an actuator is to use an increasing signal for the open direction of travel and a decreasing signal for the close direction of travel. For use in certain types of applications, it may be desirable to operate using a decreasing signal for the open direction and an increasing signal for the close direction. For some valves this can be done by cross-line mounting the actuator (mounting the actuator to the valve such that it is rotated 90° from the normal mounting position. This has the effect of rotating the valve ball 90° with the actuator at its 4 mA position. As the signal is increased toward 20 mA the valve ball will travel toward its closed position but in a counter-clockwise direction. Therefore, this method will work only with valves with round seats, not with characterized seats). No positioner wiring changes would be required using this method. If cross-line mounting is not feasible, the reversal can be accomplished at the positioner as follows:

**5.4.1 Input Reversing – (AF-17-1, AF-17-4, AF-17-10) (mA Input); 120 VAC**

Reverse the black and red wires from the positioner board; the red goes to terminal 4 and the black to terminal 3. Change the feedback potentiometer wires on the board at TB-1 terminals 1 and 3; the purple wire goes to terminal 3 and the green wire to terminal 1. The positioner will now operate in reverse of the usual manner and the controls “Range” and “Zero” will also be reversed. The “Range” control should now be used to adjust the closed end of travel and the “Zero” control used to adjust the open end of travel. Always adjust the “Zero” control first!

---

**NOTE: If the 4-20 mA signal output (if installed) is to be reversed also, then the wires at TB-2 terminals 1 and 3 must also be reversed. The AF-17 board must be recalibrated after switching the wires at TB-2 and/or TB-1.**

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**5.4.2 Input Reversing – (AF-17-1K, AF-17-13) (Resistance Input); 120 VAC**

Make the same changes as in 5.4.1. If the input is from a manual control station and it is desired that the direction for “Closed” and “Open” also be reversed at the “Command” potentiometer, change additionally the wires from the circuit board to terminals 10 and 12. Connect the orange wire to terminal 10 and the yellow wire to terminal 12. The operation of adjustments “Range” and “Zero” will be reversed, as in paragraph 5.4.1. Recalibrate the AF-17 board.

**5.4.3 Input Reversing – (AF-17-5V, AF-17-XV) (Direct Voltage Input); 120 VAC**

Follow same procedure as paragraph 5.4.1.

**5.4.4 Input Reversing, 240 VAC Only**

In addition to performing the steps in paragraphs 5.4.1, 5.4.2, or 5.4.3, it is also necessary to swap the two black wires from limit switch 1 to limit switch 2 and the two red wires from limit switch 2 to limit switch 1.

## 6.0 TECHNICAL DATA

### 6.1 AC Input Voltage:

All voltages ..... ±10%  
 Power Consumption (Circuit Board Only).....2.5 watts

### 6.2 Input Circuit Specifications

Maximum Noise Level at Maximum Positions.....Approx. 7mV

Resistance Input  
 AF-17-1K.....Nominal 1000 ohms  
 AF-17-13.....Nominal 135 ohms

Current Input  
 AF-17-1 ..... 1 to 5 milliamps  
 AF-17-4 ..... 4 to 20 milliamps  
 AF-17-10.....10 to 50 milliamps

Voltage Input  
 AF-17-5V.....0 to 5 VDC  
 AF-17-XV.....0 to 10 VDC

### 6.3 Output Circuits Specifications

**All Models**

- Maximum Surge Current .....100 amps for 1 cycle
  - Maximum Normal Starting or In-Rush Current .....10 amps for 1 second
  - Maximum Stall Current .....8 amps for 1 minute
  - Maximum Running Current – Resistive Load .....5 amps  
90% Duty Cycle
  - Maximum Running Current – Inductive Load .....3 amps  
90% Duty Cycle
  - Maximum Peak Voltage on Load Circuit .....800 VAC  
All 120 VAC and 240 VAC
- 4-20 mA output will drive 20 mA into a 600 ohm maximum load.

### 6.4 Input Circuit Characteristics

**6.4.1 Input Circuit Load Resistances**

	<b>Approximate</b>
1 to 5 milliamp Models .....	1000 ohms
4 to 20 milliamp Models .....	220 ohms
10 to 50 milliamp Models .....	100 ohms
0 to 5 VDC Models.....	800 ohms
0 to 10 VDC Models.....	1100 ohms

**6.4.2 Nominal Useable Input Signal Deadband**

1000 ohm Input .....	.5.5 ohms
135 ohm Input.....	.75 ohms
1 to 5 milliamp Input.....	.20 microamperes
4 to 20 milliamp Input.....	.80 microamperes
10 to 50 milliamp Input.....	.200 microamperes
0 to 5 VDC Input.....	.25 millivolts
0 to 10 VDC Input.....	.50 millivolts

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**NOTE: Above “Useable” deadband figures are “NORMS” determined by multiple tests of various actuator/valve combinations. All actuators used a permanent split phase motor, with an output shaft speed of 1 RPM (15-second cycle time). Electronic braking was employed on all tests. Results may differ in applications where different shaft speeds are used.**

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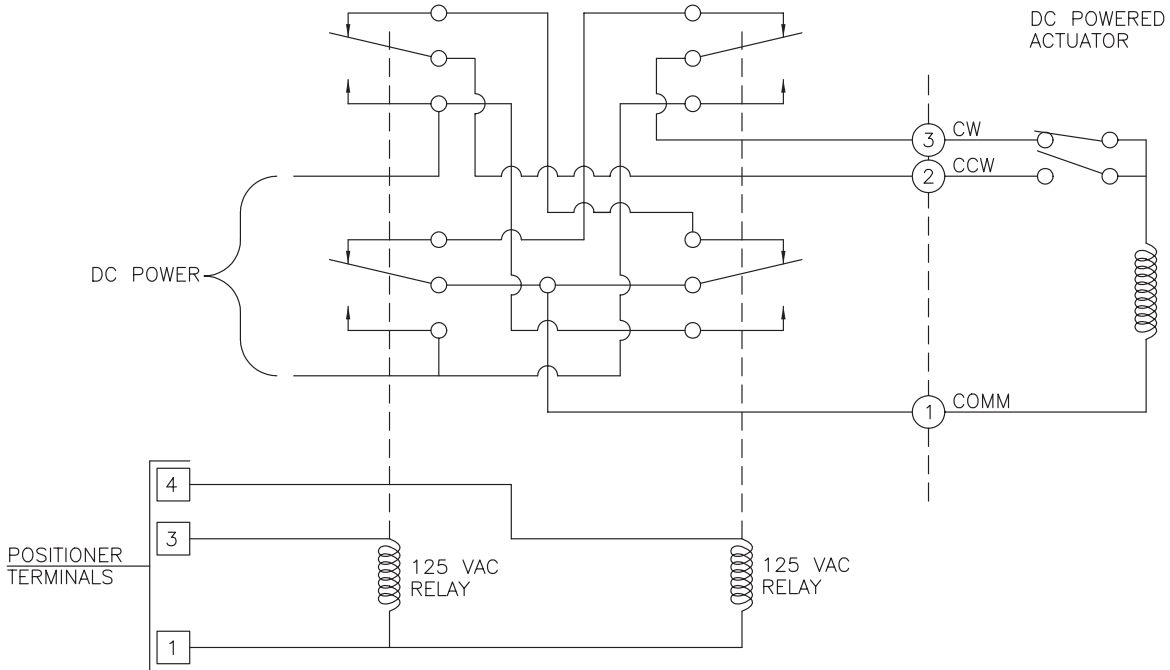
### 6.5 Controls – All Models

- Zero – Adjustment for Low End of Control Signal +60% Span
- Range – Adjustment for High End of Control Signal -60% Span
- AH – Adjustment for Hysteresis (Anti-Hunt) 0.3% to 4.0% of full scale
- 4 mA – Adjust 4 mA Output
- 20 mA – Adjust 20 mA Output

## 7.0 APPLICATION NOTES

### 7.1 DC Motor Actuator

Figure 9



Typical wiring to operate DC motor actuators from Worcester AF-17 120 VAC electronic positioner. Terminal numbers in schematic are for Worcester 75 actuators, but wiring arrangement is applicable to other makes. Relay contact ratings should be based on switching a highly inductive load at the actuator's maximum current rating (stalled current).

Motor is automatically braked when either relay goes from the "on" to the "off" position.

**NOTE: The electronic brake on the positioner board should be made inoperative for this application (clip out U3 from circuit board – See Figure 1 for location).**

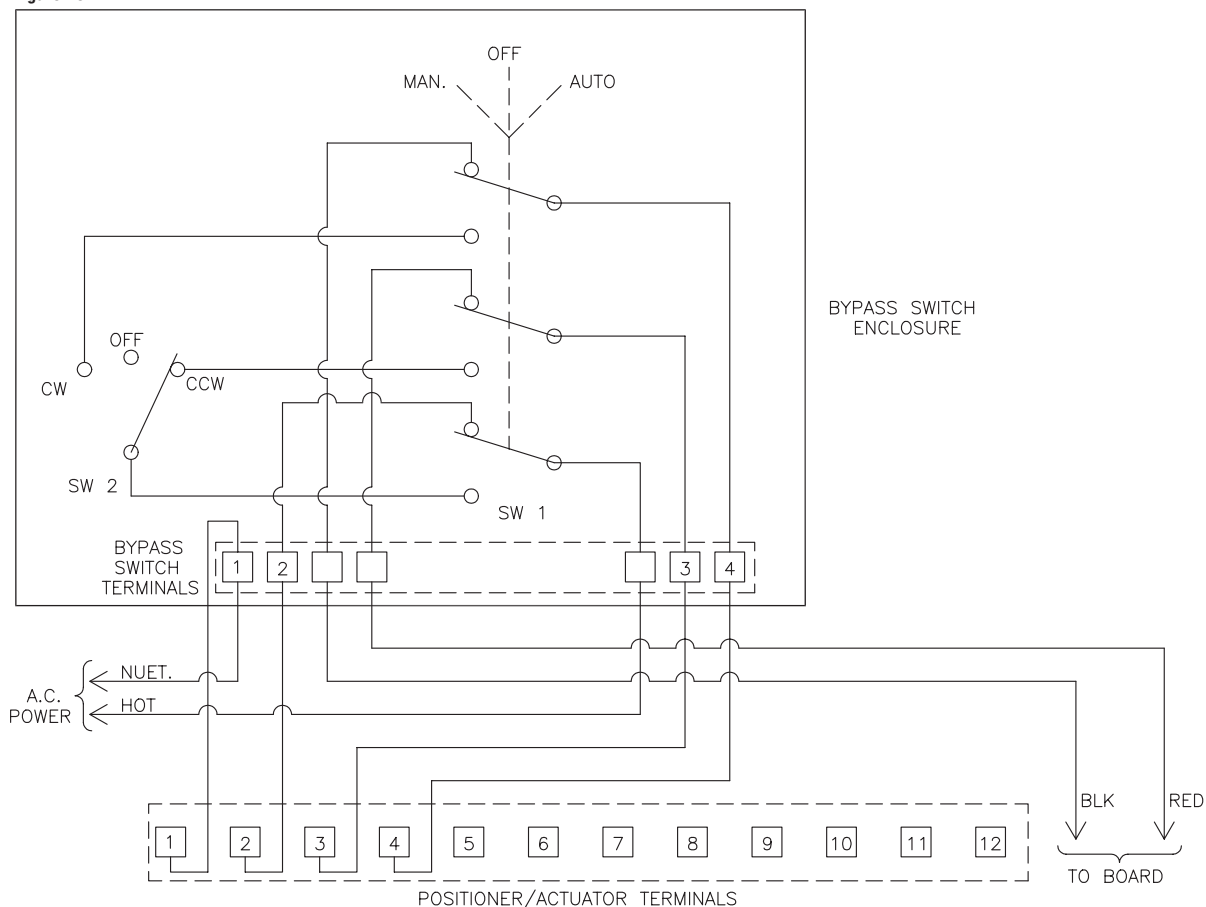
### 7.2 Bypass Switch for Manual Control (For 120 VAC Only)

This application is offered as a non-standard option through Flowserve's Custom Products Department or may be altered by end user. Figure 10 on the next page shows a schematic diagram of two switches for controlling the following functions:

One triple-pole, double-throw (TPDT) switch with center-off, switching from automatic to manual operation.

One single-pole, double-throw (SPDT) switch with center-off position for manually controlling clockwise (CW), counter-clockwise (CCW) directions of actuator.

Figure 10



## 8.0 TROUBLESHOOTING

### 8.1 General

The following charts are a troubleshooting guide for servicing the positioner, should a malfunction occur. If the problem cannot be solved, the unit should be returned to the factory for service.

The first thing to be checked, before proceeding to the troubleshooting guide, is to determine if the malfunction is in the positioner, or in the actuator. To do this, remove the red and black positioner leads from terminals 3 and 4 of the actuator, and the AC line connections from terminals 1 and 2. Tape these leads. Using a test cable, apply power to actuator terminals 1 and 3. The actuator should rotate CCW until stopped by the CCW limit switch. Then apply power to terminals 1 and 4 to check CW actuation and the CW limit switch.

For AF-17-240 VAC positioner only, switches do not directly limit travel. Exercise caution not to override limit switches. Operate the unit to its limits in each direction, to assure that the basic actuator is functional.

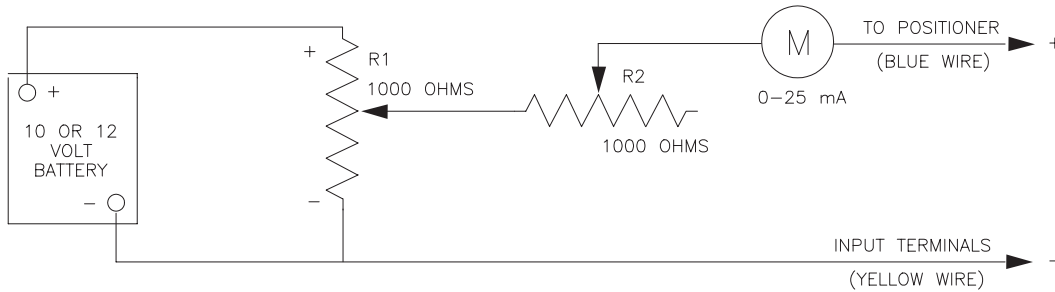
If the actuator does not operate, check wiring from the terminal strip, through the limit switches to the motor and capacitor. For 240 VAC actuator with AF-17 positioner, check wiring from the terminal strip to the capacitor and to the motor. Check switch continuity. Check for an open motor winding, and check for a shorted capacitor. If the problem in the actuator still cannot be determined, return the unit for service. If the actuator functions properly, then proceed to the troubleshooting guide.

To facilitate troubleshooting a positioner, it would be advantageous on resistive input units to connect a potentiometer directly to the signal input terminals in place of the standard process input. Use a 150 ohm or 1000 ohm potentiometer depending on which model is used. Figure 11 on next page shows a schematic of a simple test unit that can be connected to the input terminals to stimulate the process signal for a milliamp rating.

## 8.2 Symptom Table

Symptom	Guidelines to Follow
8.2.1 Actuator will not operate in either direction [no sound from motor(s)].	8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.3.6, 8.3.7, 8.3.10
8.2.2 Actuator will not operate in either direction [humming or buzzing sound from motor(s)].	8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.3.6, 8.3.9, 8.3.10, 8.3.11, 8.3.12
8.2.3 Actuator slowly moves in one direction on its own.	8.3.4
8.2.4 Actuator runs normally for 7° to 8° while coming off limit switch, then slows down or stops [motor(s) hum or buzz].	8.3.4, 8.3.15
8.2.5 Actuator oscillates intermittently or upon reaching a new position.	8.3.2, 8.3.8, 8.3.13
8.2.6 Actuator runs slowly in one or both directions, but otherwise operates normally	8.3.2, 8.3.4, 8.3.9, 8.3.10, 8.3.11, 8.3.12
8.2.7 Actuator works intermittently.	8.3.2, 8.3.10, 8.3.12
8.2.8 Actuator runs normally in one direction but will not operate in the other direction [no hum or buzz from motor(s)].	8.3.2, 8.3.4, 8.3.7
8.2.9 Actuator will not move valve after a stop when signaled to travel in same direction as previous command.	8.3.14

Figure 11



Test Unit for Milliamp Input Positioner – Set R1 all the way toward the plus end. Adjust R2 for a 20 mA reading. Varying R1 will now provide input signals between 4 and 20 milliamps.



### 8.3 Use the following troubleshooting guidelines to isolate problems/bad components

Prior to beginning any procedure, read all of Check, Action, and Notes and Cautions sections.

Check	Action	Notes and Cautions
8.3.1 Check for proper AC/DC power to actuator and circuit board. See Figures 5 or 6 for AC or Figure 3 in DCAF17 IOM supplement for DC.	Correct as necessary.	
8.3.2 With power off, check for broken wires and/or loose connections.	Repair broken wires and tighten loose connections.	
8.3.3 With power off, check to see if fuse F1 is blown.	Remove F1 from socket pins or fuse clips. For AC boards only, check for continuity through fuse with an ohmmeter. If F1 is bad, replace it. AC boards have a spare fuse (F2) located on board.	Before restoring power, try to determine what caused F1 to blow and correct problem. See part 3.6 and paragraph 4.7.5 Notes and Paragraph A of Part 1.1 for AC boards. See part 2.2 in DCAF17 IOM supplement for DC boards.
8.3.4 Check operation of basic actuator per Part 8.1.	See Part 8.1.	This check will isolate the problem to either the actuator or the circuit board.
8.3.5 Check for proper range of input signal.	Use ammeter, voltmeter or ohmmeter to verify input signal range.	See models listed at beginning of IOM for ranges. 4-20 mA is standard.
8.3.6 With power off, check calibration of feedback potentiometer per Paragraph 3.2.4.	A quick check to see if this is the problem is to declutch the actuator shaft and reposition the shaft to about 45° (if valve torque permits). If the actuator now runs normally in each direction (after clutch re-engages), recalibrate the feedback potentiometer.	When trying to move the valve manually with the clutch disengaged, be certain that the wrench fits properly on the flats of the actuator shaft. Improper fit can cause shaft damage with consequent damage to cover bearing surface. Stay within the preset quadrant of operation. See Paragraph C of Part 1.1.
8.3.7 Check to see that varying input signal from 4-20 mA causes the light emitting diodes (LEDs) to turn on and off individually.	If LEDs do not turn on and off, replace board.	The turning on and off of the LEDs is indicative that the input side of the circuit board is OK.
8.3.8 Check the operation of the positioner with a portable, battery-operated signal source.	If intermittent or jittery operation stops, it is indicative of a noisy on-line signal input. To avoid damaging the actuator, it is necessary to "clean up" the signal. Also, follow the shielding guidelines of Paragraphs 1.2 and 1.2.4.	Turning the A-H control CCW may help to alleviate the problem.
8.3.9 Check the motor run capacitor for a short, excessively high leakage and low capacitance. Use a capacitance meter to check. (AC boards only) terminals	Replace as necessary.	Disconnect all leads from capacitor (power off) prior to testing. Do not exceed rated voltage of capacitor. Make certain that capacitor is discharged before reconnecting.

Check	Action	Notes and Cautions
8.3.10	Check temperature of motor(s). Each AC motor has a thermal cutout switch built in that opens at about 210°F (winding temperature). If the thermal cutout in one motor has opened, the other motor by itself may not be strong enough to move the valve (20-2375 sizes).	Allow the motor(s) to cool so that the thermal switches can reset. Normally the thermal switches will not open unless the motor's rated duty cycle is exceeded and/or the ambient temperature is very high. Correct the problem.
8.3.11	Check the operating torque of the valve. If necessary, remove the actuator from the valve. Measure valve torque with an accurate torque wrench. Check torque under actual operating conditions if possible.	Duty cycle is specified at an ambient temperature of 70°F, 60 Hz.
8.3.12	Check ambient temperature.	If operating torque of valve exceeds the specified torque for the seats used and the DP across the valve, determine cause and correct. If torque falls within normal range, it is possible that the actuator is undersized.
8.3.13	Check to see that mechanical brake is operating correctly.	Higher ambient derates duty cycle.
8.3.14	Check to see if actuator can move a high torque valve from a stop under load when moving in the same direction as last command (mechanical brake does not allow motor(s) to unwind).	Replace defective mechanical brake. If one was never installed, order a kit and install it in actuator.
8.3.15	Check to see which direction of travel causes problem. If actuator is coming off open limit switch (traveling CW) when it slows down or stops, then either Q1 or U1 is bad. If actuator is coming off closed limit switch (traveling CCW), then either Q2 or U2 is bad. (AC boards only)	All 2" CPT valves with positioner boards in actuator must have mechanical brake installed to prevent oscillation.
		Replace circuit board.

## 9.0 SUGGESTED SPARE PARTS

It is suggested that where 10 or more units are in service, one or more complete circuit boards be stocked as spares for ease of maintenance and minimum downtime. All circuit boards are wired directly to screw type terminal strips (no solder connections) and can be easily changed on location.

Fuse F2 is a spare fuse attached to AC circuit boards but not wired in the circuit. See Figure 1. If fuse F2 is used to replace fuse F1, it is recommended that another be purchased and attached to circuit board as a spare.

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