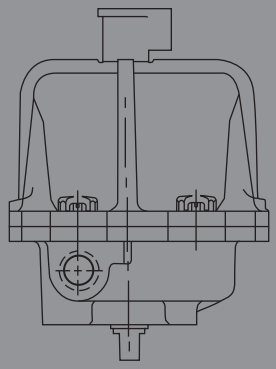

# DeviceNet Interface

## For Series 75 Electric Valve Actuators

FCD WCENIM2068-01 AQ (Part 14136)

## Installation, Operation and Maintenance

## 1 Description

Flowserve Worcester Controls Series 75 actuators are reversible electric quarter-turn actuators. Standard units can provide up to 1200 in-lb of torque and have capacitor-start, capacitor-run motors and permanently lubricated gear trains. These actuators are equipped with integral thermal overload protection with automatic reset and internal adjustable limit switches. In the event of electrical power failure, W, X and Z models feature manual override capabilities.

☠ **WARNING:** Series 75 actuators are electromechanical devices subject to normal wear and tear. Actuator life is dependent upon application and environmental conditions. If applied in hazardous services such as, but not limited to, media temperature extremes, toxins and flammables (or other services where improper or incomplete operation could produce a safety hazard), it is incumbent upon the system designer and the user to provide proper warning devices such as temperature sensors, oxygen sensors and flow sensors. At elevated temperatures the duty cycle has to be derated; consult factory. Flowserve also recommends that the optional auxiliary limit switches be used for monitoring and/or electrical interlock. A heater with thermostat as well as drain/breather fitting (V53 option) are recommended for humid environments when moisture may condense inside the housing. Please note that weatherproof enclosures will "breathe" over time and condensation within the housing will result.

⚠ **CAUTION:** Flowserve recommends that all product 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.

⚠ **CAUTION:** For wiring of actuator, please refer to wiring diagram(s) located inside of actuator cover. Wiring diagrams are also included in this manual for reference.

⚠ **CAUTION:** The PLC/Process Controller logic should **never** set bits 5 & 6 on (1) at the same time in output word 1. These bits control actuator CCW and CW rotation, and damage to the relay interface module and motors will result if these bits are set on (1) simultaneously. The output word 1 corresponds to an actuator at Address 1.

The DeviceNet Interface feature of this equipment permits simple DeviceNet bus connection and communication. Position indication is accomplished via the DeviceNet bus, and integral Light Emitting Diodes (LEDs) display the status of inputs and outputs.

The DeviceNet Board has two outputs and three inputs. Each output is used to control the CW or CCW direction of rotation of the actuator via integral interface relays. When a CW or CCW output is set to 1 or ON, the respective relay will be energized and the actuator will rotate in that direction. The actuator will rotate until that output is set to 0 or OFF, or until the actuator reaches the end of travel (0° or 90°) limit switch.

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Each input is used to monitor either a mechanical switch or an AC/DC two-wire NAMUR sensor. These switches have been factory set to indicate full CW and full CCW position.

The DeviceNet circuit board has six LEDs:

a. Two LEDs for DeviceNet MNS bus activity, as required by the ODVA (Open DeviceNet Vendors Association) Specification (see Supplement 2: N0457-14142) (green/red) D1 & D2

b. Red LED to monitor CW limit switch D3

c. Green LED to monitor CCW limit switch D5

d. Yellow LED to monitor coil power D4

e. Orange LED to monitor solenoid coil continuity D6

The motors are powered from a separate power source (not the DeviceNet cable).

The Access/DeviceNet Circuit Board meets the requirements of the ODVA Specification. It is a Group 2 slave device, which operates as a slave device on the DeviceNet network. It supports Explicit, Polled, Change of State and Cyclic I/O Messages of the predefined master/slave connection set. It does not support the Explicit Unconnected Message Manager (UCMM).

The Access/DeviceNet Circuit Board has one byte of input (consumed) data and eleven bytes of output (produced) data. In the input byte, bits 0–4 are not used, bit 5 is used to control the CW direction, bit 6 is used to control the CCW direction and bit 7 is used to reset the maintenance counter. Of the output bytes, byte 1 is used to monitor the switch and slave relays status of the unit, with bit 0 used to monitor switch 3 CW position, bit 1 used to monitor switch 4 CCW position, bit 2 used to monitor switch 3 (not used in this application), bit 3 used to monitor CCW slave relay and bit 4 used to monitor CW slave relay. Bits 5–7 are not used. Of the remaining bytes, bytes 2–5 make up the maintenance counter, bytes 6–9 make up the cumulative counter.

# 2 Installation to Worcester Controls/McCanna Valves

A. Attach mounting bracket to actuator using four cap screws and lockwashers, provided in mounting kit, and tighten securely. For small size top-mount style valves, attach bracket such that bracket nameplate is on the side of valve.

B. Attaching bracket/actuator assembly to valve:

**NOTE:** If cross-line mounting of actuator is desired, note the following:

Mount the actuator with conduit hole perpendicular to the flow axis (centerline) of the valve and reverse the open/close decals.

For diverter and 3-way valves with V1 porting, and for CPT valves, also see Section 3, paragraph D, for cam and limit switch adjustments to facilitate cross-line mounting operation.

⚠ **CAUTION:** Ball valves can trap pressurized media in the cavity. If it is necessary either to remove any valve body bolts or stem nuts, or to remove valve from the line, and if the valve is or has been in operation, make sure there is *no* pressure to or in the valve and operate the valve one full cycle.

1. Valve Models Top Mount 44 (¼"–2"), 45 (2½"–6"), 51/52 (½"–10"), 151/301 (3"–6"), Top Mount 59 (¼"–4"), WK70 & H71 (½"–2"), 818/828 (2"–8"), 82/83 (½"–10"), and 94 (1½"–6"):

   **NOTE:** For above-listed valves, it is not necessary to remove any valve body bolts or remove valve from line in order to mount actuator.

   a. Close valve. For valves ¼"–2", the valve is closed when flats on valve stem are perpendicular to the line of flow; for valves 3" and larger, where the valve stem is square, the indicator line on top of stem will be perpendicular to the line of flow or check ball position for closure.

   b. If any valve information is marked on stop plate or handle, it will be necessary to transfer this information to the bracket nameplate.

      For Series Top Mount style valves 44 (¼"–2"), WK70 (¼"–2"), 59 (¼"–1½"), H71 (½"–1½"), and for valves with high cycle stem packing as standard (51/52 (½"–2") and 82/83 (½"–1½"): Remove handle nut, lockwasher, handle, separate stop plate (if any), retaining nut and stop pin(s). Add the two additional Belleville washers with their larger diameter sides touching each other. Add the self-locking nut to the stem and tighten while holding the stem flats with wrench. Tighten until Belleville washers are flat; the nut will "bottom," and then back nut off ⅓ of a turn. The two additional Belleville washers and the self-locking nut are included in the mounting kit.

      ⚠ **CAUTION:** The self-locking stem nut is difficult to tighten, and *must* fully flatten Belleville washers before backing off.

      For 2" 59, H71,82/83, and 2½" 45, 82/83 Series valves and valves 3" and larger with square stem, remove handle assembly (if any), retaining nut, stop and stop screws. Replace with valve stem spacer, or, if valve has graphite stem packing, with two Belleville washers—except 8", 10" 82/83 and 10" 51/52—and replace retaining nut.

**NOTE:** Belleville washers are installed with larger diameters touching each other. Using a wrench to prevent stem from turning, tighten retaining nut until stem packing is fully compressed (or until Bellevilles, if used, are fully flattened), then back off nut

⅛ turn. Excessive tightening causes higher torque and shorter seal life.

**NOTE:** For both large valves with V51 high cycle stem packing option installed (identified by two Belleville washers installed and handle assembly, stop and stop screws removed), and 818/828 Series valves, no stem area disassembly is required.

For ½"–2" 94 valves, remove handle (if any). For 3"–6" 94 and 2"–8" E818/828 valves, remove handle assembly, stop and spacer (if any). Do not remove gland plate or gland bolts.

For 2"–8" 818/828 valves, remove handle assembly, locking plates and hardware, and stop screw (if any). Do not remove stop plate (2"–6" Sizes) or spacer (8" Size).

c. Center coupling on valve stem.

d. Lower mounting bracket/actuator assembly over coupling and onto valve, making sure that male actuator shaft engages slot in coupling.

e. Secure bracket to valve using cap screws and lockwashers, or bolts and nuts provided in mounting kit. Tighten securely. For small size top mount style valves, bracket nameplate is on the side of valve.

f. Install set screws (if any) in the coupling and tighten securely.

# 3 Electrical Installation and Adjustment

A. To gain access to terminal strip, it is necessary to remove the actuator cover.

General Purpose: Loosen cover screws and lift cover from unit.

W, X and Z: Remove declutch knob screw and lift knob from shaft. Remove the two cover screws from cover (the other six screws are in an envelope and inside the cover) and lift cover from unit.

B. Make conduit connection to NPT fitting on actuator base. Connect power supply to actuator terminal strip, as shown on electrical schematic diagram(s) located inside actuator cover and also in this manual.

The actuator should be electrically grounded in accordance with standard procedures.

For W, X and Z actuators, connect a CSA-certified 18 AWG green-colored grounding wire to the green-colored grounding screw on actuator base.

See Table 1 for minimum fuse rating when overcurrent protection is used in motor power circuit.

⚠ **CAUTION:** In cases where the conduit connected to the actuator may be partially or completely run underground, or through which moisture may contact energized live parts, or where the actuator and/or conduit is exposed to temperature differences, the power and DeviceNet conduits should be sealed within 18" of the actuator in accordance with the National Electrical Code.

*Table 1*

| Actuator Size | Voltage | Fuse Rating |
|---|---|---|
| 10–23 | 120 VAC | 5 A |
| | 240 VAC | 3 A |

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

C. Connections to the 75 Actuator/DeviceNet Circuit Board

The customer's field connections to the circuit board take place on terminal block P3 as follows:

Terminal 1: Bus negative from 24 VDC supply (next to the P3 label)

Terminal 2: CanL signal

Terminal 3: Bus Shield

Terminal 4: CanH signal

Terminal 5: Bus positive from 24 VDC supply

The switch/sensor connections are made to the terminal block labeled as P2. Terminal 1 is located next to the P2 label.

The switches/sensors are wired to the terminals such that terminals 1 and 2 are for SW3 CW direction and terminals 3 and 4 are for SW4 CCW direction.

The CCW slave relay connects to terminal block P4 terminals 3 and 4. Positive 24 VDC is supplied to the relay coil from terminal 3, and the relay coil return is connected to terminal 4. The relay is energized by turning on a transistor, which connects the return to ground. When the relay is energized, the normally open contact closes and then switches the hot side of the power supply to the motor(s) to rotate the actuator in the CCW direction.

The CW slave relay connects to terminal block P4 terminals 1 and 2. Positive 24 VDC is supplied to the relay coil from terminal 2, and the relay coil return is connected to terminal 1. The relay is energized by turning on a transistor, which connects the return to ground. When the relay is energized, the normally open contact closes and then switches the hot side of the power supply to the motor(s) to rotate the actuator in the CW direction.

The circuit board has three 10-position rotary switches on board (SW1, SW2 and SW3). SW1 and SW2 are used to set the MACID of the board (i.e., address), with SW2 used for the most significant bit and SW1 used for the least significant bit (e.g., in

a MACID of 25, SW2 would be set to 2 and SW1 would be set to 5). Valid MACID values range from 00 to 63. A nonvalid MACID setting on the switches allows the MACID to be set through software.

SW3 is used to set the DeviceNet baud rate. Valid baud rate selections are 125k, 250k and 500k. SW3 position 0 represents 125k, SW3 position 1 represents 250k and SW3 position 2 represents 500k. If the SW3 position is set to an invalid setting, it permits the baud rate to be set through software.

**NOTE:** Whenever the baud rate and/or MACID is changed via the switches, the DeviceNet board power must be cycled in order for the change to take effect.

D. Switch Cam Settings:

Switch configuration is as follows (when viewed from the terminal strip side of the actuator):

Actuator shown at 0° position (all the way CW).

Cam settings are as follows:

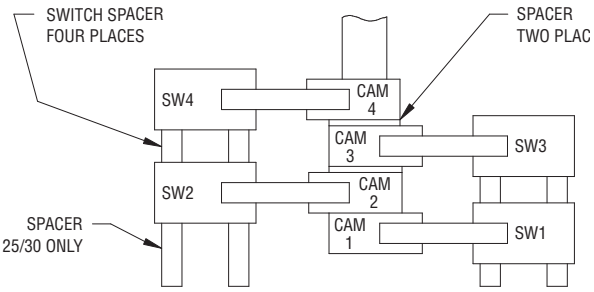
Switch 1: Trips at 0°. Full CW.

Switch 2: Trips at 90°. Full CCW.

Switch 3: Trips at 2°.

Switch 4: Trips at 88°.

*Figure 1*

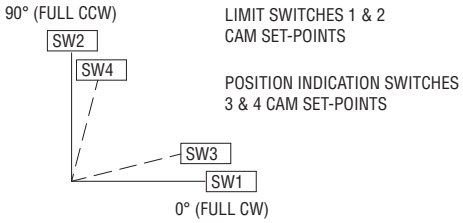



The positioner employs a total of four cams, two for the end of stroke limit switches and two for the position indication switches.

Figure 2 shows actuator shaft location as viewed looking down on the shaft.

1. Adjust the CW limit switch 1 cam so that the valve shaft has a position of 0° when movement stops.
2. Adjust the CCW limit switch 2 cam so that the valve shaft has a position of 90° when movement stops.
3. Adjust the CW position indication switch 3 cam 2° to 3° before the CW end of travel (i.e., +2° to +3°). If the cam is properly adjusted, the CW LED (SW3) will be closed when the valve is in the full CW position.
4. Adjust the CCW position indication switch 4 cam 2° to 3° before the CCW end of travel (i.e., +87° to +88°). If the cam is properly adjusted, the CCW LED (SW4) will be closed when the valve is in the full CCW position.

*Figure 2*




E. Replacing Actuator Cover

**NOTE:** For W and Z models, make sure flange gasket/seal is properly installed. Tighten all cap screws securely.

*For X and Z models only:*

After placing the cover on the actuator, tighten the cover bolts in a crisscross fashion to a torque of 70–80 in-lb.

A feeler gage, ⅛" to ½" wide and .0015" thick, shall be used to check the clearance between the base and cover flange. This feeler gage shall *not* penetrate the base/cover flange gap any more than ⅛".

Replace declutching knob, taking care that knob set screw engages milled flat on clutch shaft and indicates proper position on labeled cover.

# 4 Options (Factory-Installed)

A. Mechanical Brake

**NOTE:** Mechanical brake should require no adjusting.

1. Testing and Troubleshooting:
   a. Energize actuator for rotation in both open and closed directions. At the rated actuator voltage, the brake coil is energized and moves the plunger to release brake arm. Clearance of .020" to .030" must exist between the brake arm and the brake disc when power is applied to the actuator.
   b. If the brake arm is too close to the brake disc, realign the coil housing so that coil plunger can move farther toward the center of the actuator, permitting more movement of the brake arm.
   c. Plunger chattering indicates a low supply voltage. If actuator voltage is at the rated conditions, realign coil housing so that coil moves away from the center of the actuator to reduce plunger movement.

d. All coil adjustment is done in small increments of .015" or less.

e. Additional adjustment may be done by moving mounting plate toward/away from actuator shaft.

B. Heater and Thermostat

**NOTE:** Heater and thermostat option requires no adjusting. If defects are found, notify factory.

The thermostat will close its contacts at 80°F (power on) and open its contacts at 95°F (power off).

C. Drain/Breather (V53) Option

If actuator is equipped with drain/breather at bottom of base, actuator must be installed in an upright position for drain to operate properly.

# 5 Manual Operation

⚠ **CAUTION:** Disconnect actuator from power supply. If power is not off, motor may start when cam moves from limit switch.

Pull the declutching knob all the way up and hold. Apply wrench to exposed flats on actuator shaft and rotate to desired position. To reengage, return shaft to original position of disengagement and release declutch knob.

**NOTE:** Actuator should be manually operated only over the range for which it is set up to operate electrically. Operation beyond this range will totally disrupt indexing.

# 6 Maintenance and Troubleshooting

⚠ **CAUTION:** The PLC/Process Controller logic *should never* set bits 5 and 6 on (1) at the same time in output word 1. These bits control actuator CCW and CW rotation, and damage to the relay interface module and motors will result if these bits are set on (1) simultaneously. The output word 1 corresponds to an actuator at Address 1.

The Series 75 DeviceNet electric valve actuator requires no regular maintenance. Should the unit fail to operate, however, the following are hints for troubleshooting. If the unit still fails to operate, consult the factory.

## 6.1 General

If the actuator does not operate, check that:

1. The valve is free to move. This can be done as described in Section 5.
2. The actuator is correct size.
3. Correct voltage is supplied to terminals 1 and 2.
4. Correct voltage is supplied to the DeviceNet bus (24 VDC).
5. The DeviceNet bus is properly terminated with a 120 ohm resistor between CanL and CanH.
6. The proper communication baud rate and MACID (address) has been selected.
7. LEDs D1 & D2 on the DeviceNet board are both on and green.
8. The actuator is wired correctly, per Figures 3, 4 and 5.

**NOTE:** If the above checklist is OK, proceed to Section 6.2.

## 6.2 Isolate the Problem

1. Determine if the problem is with the Switch/Cam settings (Section 6.3).
2. Determine if the problem is with the Motor(s)/Cam Settings (Section 6.4).
3. Determine if the problem is with the DeviceNet board (Section 6.5).

The actuator, when received from factory, will be in the full CCW (open) 90° position and should only respond to a CW (close) DeviceNet command. If a new actuator does not respond to a CW or CCW command, the problem could be with the cam adjustments, defective motor(s) or defective DeviceNet board. Ensure that Switch 1 is not being tripped when a CW command is given and that Switch 2 is not tripped when a CCW command is given. If the actuator does not rotate CW or CCW when a respective command is given, proceed to Section 6.4.

## 6.3 Switch/Cam settings

Refer to Figures 1 and 2

Switch/cams 1 & 2 control the CW and CCW, respectively, end of travel of the actuator.

The cams have been factory set for:

Switch/cam 1 CW: 0° (stops actuator CW rotation)

Switch/cam 2 CCW: 90° (stops actuator CCW rotation)

Switch/cam 3: 2-3° (CW indication to DeviceNet board)

Switch/cam 4: 87-88° (CCW indication to DeviceNet board)

The switches can only be adjusted by operating the actuator motor(s) and setting the cams per above settings. If the switches and cams require adjusting, go to Section 6.4.

## 6.4 Motor, Cam and Switch Troubleshooting

1. Remove power from the actuator at terminals 1 and 2.
2. Remove the red and black wires from terminals 3 and 4, and tape these wires. (This isolates the DeviceNet Board from the circuit.)
3. Apply power to the actuator at terminals 1 and 2.
4. Using a jumper wire connect terminal 2 to terminal 3. The actuator should rotate in the CCW direction until it is stopped by switch 2. If switch 2 is tripped, remove the jumper from terminal 3 and connect from terminal 2 to terminal 4. The actuator should rotate in the CW direction. When rotating the actuator, check to see that the cams trip the switches per settings in Section 6.3. If the cams are set properly, the switches are not tripped, and the actuator does not rotate in either direction when commanded, the motor/gearbox housing is defective and requires replacement.

   ⚠ **CAUTION:** Do not jumper 3 and 4 to terminal 2 simultaneously. Jumper one terminal at a time.

5. If the actuator rotates in both directions and stops at the 0° and 90° positions, remove power from the actuator, reconnect the red and black wires to terminals 3 and 4, and proceed to Section 6.5.

## 6.5 DeviceNet Board Troubleshooting

Check to make sure that:

1. The board is wired correctly per Figures 3 and 4.
2. The correct voltage is supplied to terminals 1 and 2.
3. The DeviceNet bus is properly terminated with a 120 ohm resistor between CanL and CanH.
4. The proper communication baud rate and MACID (address) have been selected.
5. The correct voltage is supplied to the DeviceNet bus (24 VDC).
6. LED 1 is on steady green and LED 2 is flashing green. If LED 2 is red, then there is an address conflict (two nodes have the same address).
7. LED 3 is on red (indicating CW position) or that LED 5 is green (indicating CCW position). If none of the LEDs are on and 24 VDC can be measured at terminal strip P3 terminals 1(-) and 5(+), the board is defective and requires replacing.
8. If the LEDs are, on per Steps 6 and 7:

   When a CCW command is given to the DeviceNet board from the Processor/Controller, LEDs 2, 4 and 6 should go on steady, and the actuator should rotate in a CCW direction. When a CW command is given to the DeviceNet board, LED 2 should go on steady, and the actuator should rotate in a CW direction.

   If the actuator does not respond to either command, and after verifying that the Controlling Processor/PLC is configured properly, the board is defective and requires replacing.

## 6.6 Limit Switches 1 and 2

If both switches 1 and 2 are actuated simultaneously, the unit will not operate.

## 6.7 Capacitor

The AC motors are operated with a capacitor. If the capacitor is defective, it will prevent the motor from starting and/or running. Replace if necessary.

## 6.8 Motor

If one of the motor windings is open or short-circuited, the unit will not operate. If motor is hot, allow it to cool down so that the stator is at room temperature. Apply voltage to motor. If motor still fails to operate, replace the entire motor module.

## 6.9 Gear Train

Remove the motor module from the actuator. Rotate the motor by hand. Spinning the motor shaft should rotate the module output pinion. If module output pinion fails to rotate, replace the entire motor module. Also, check the bull gear for missing or broken teeth. Replace if necessary.

## 6.10 Valve

The problem may lie with the valve instead of with the actuator. Check the operation of the valve by removing the actuator and operating the valve by hand.

# 7 Spare Parts

The following are recommended spare parts that should be kept on hand for Series 75 electric actuators:

1 Limit Switch Kit

1 Capacitor (AC Units only)

When ordering spare parts, please specify actuator size, voltage and cycle time.

# 8 Electrical Requirements

Table 2 represents approximate current draw (at rated stall torque) in amperes at various voltages for each motor.

Actual values depend on several variables. For exact values, test the unit at a particular load.

*Table 2: Approximate Current Draw (amps)*

| Suffix Code | Duty Cycle | Voltage | Actuator Size | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 10 | 12 | 15 | 20 | 22 | 23 |
| Blank | 20% | 120 AC | — | — | 0.7 | — | — | — |
| Blank | 25% | 120 AC | 0.7 | 0.7 | — | 1.5 | 1.5 | — |
| 2 | 10% | 120 AC | 1.5 | 1.5 | — | 2.9 | 2.9 | — |
| 4 | 75% | 120 AC | 0.3 | 0.3 | — | 0.7 | 0.7 | 0.7 |
| 5 | 100% | 120 AC | 0.25 | 0.25 | — | 0.5 | — | — |
| Blank | 25% | 240 AC | 0.4 | 0.4 | — | 0.9 | 0.9 | — |
| 2 | 10% | 240 AC | 0.6 | 0.6 | — | 1.3 | 1.3 | — |
| 4 | 75% | 240 AC | 0.15 | 0.15 | — | 0.3 | 0.3 | 0.3 |
| 5 | 100% | 240 AC | — | — | — | — | — | — |

*Table 3: Cycle Time (Sec.)*

| Actuator Size | | | | | | |
|---|---|---|---|---|---|---|
| Suffix Code | 10 | 12 | 15 | 20 | 22 | 23 |
| Blank | 5 | 8 | 5 | 5 | 8 | — |
| 2 | 2.5 | 4 | — | 2.5 | 4 | — |
| 4 | 17, 15 | 27, 25 | — | 17, 15 | 27, 25 | 25 |
| 5 | 17 | 27 | — | 27 | — | — |

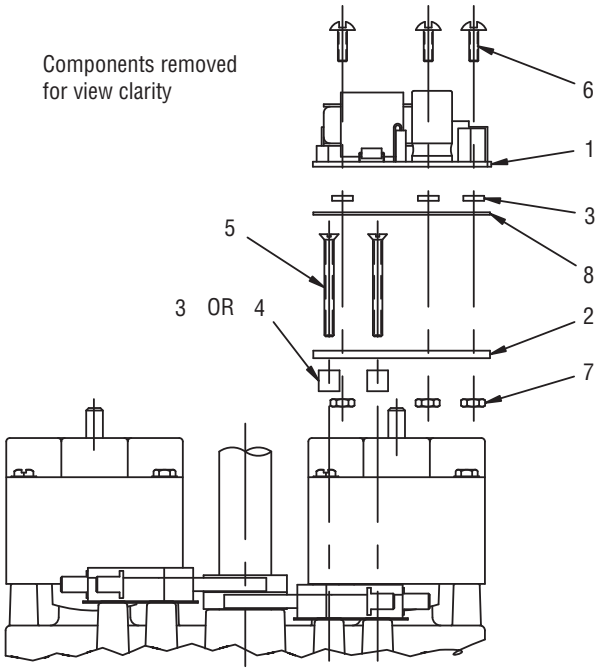
# 9 Illustrations

## 9.1 DeviceNet Board Assembly Installation

*Table 4*

| Item | Qty | Description |
|---|---|---|
| 1 | 1 | DeviceNet Circuit Board |
| 2 | 2 | 6-32 Socket Head Cap Screw (1.00") |
| 3 | 2 | Hex Spacers (.50") |
| 4 | 1 | 4-40 Round Head Screw (1.50") |
| 5 | 2 | 6 Lockwasher |
| 6 | 2 | 6-32 Round Head Screw (.25") |
| 7 | 3 | 4-40 Round Head Screws (.38") |
| 8 | 1 | Relay Board |
| 9 | 1 | Round Head Screw (1.00") – Reused from switch mounting |

*Figure 3: DeviceNet Board Assembly*



## 9.2 Electrical Schematics and Wiring Diagrams For Options (Series 75)

**NOTE:** For installation of options, refer to installation instructions and wiring diagram(s) contained in respective kit.

Electrical Schematic (Series 75):

Actuator is shown in counterclockwise extreme of travel, or “open” position.

Motors have a “thermal protector,” as shown by —(M)T— in diagram.

See Table 2 for minimum fuse rating when overcurrent protection is used in motor power circuit.

*Figure 4*

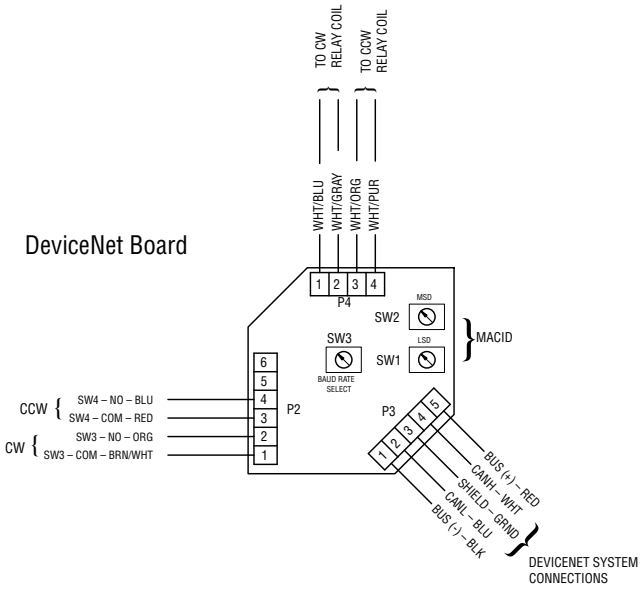



*Figure 5*

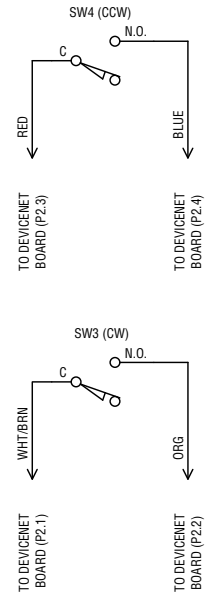



*Figure 6*

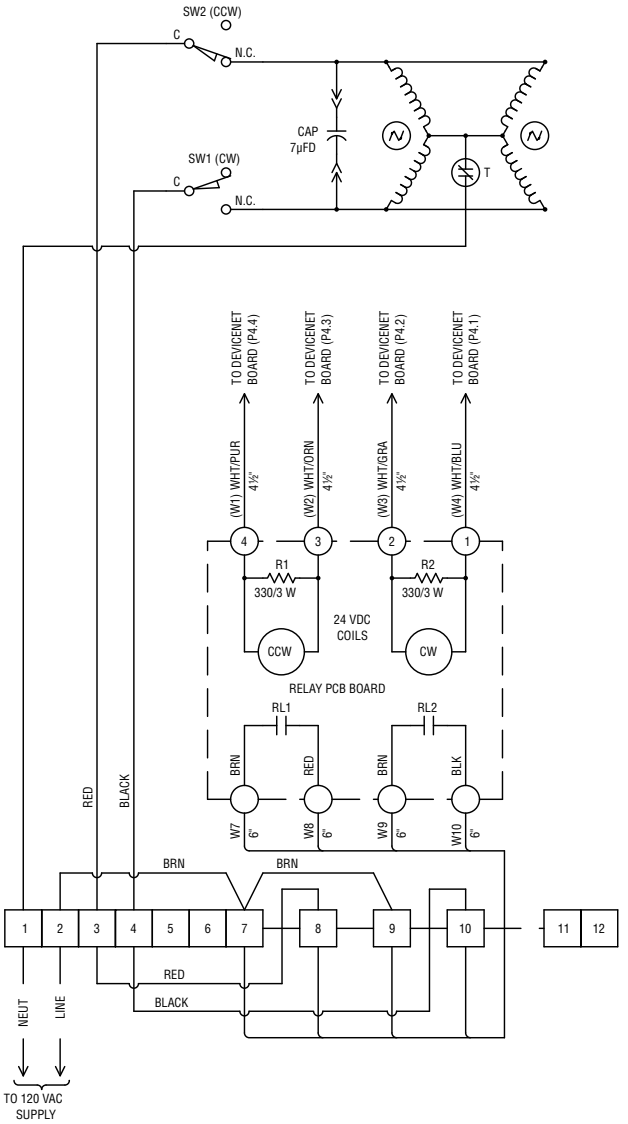
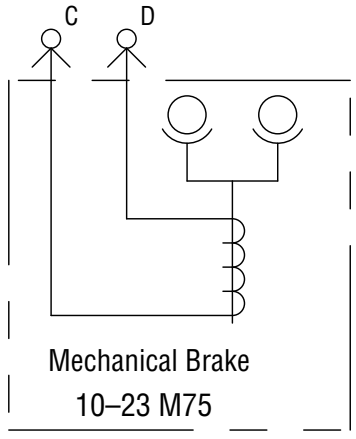
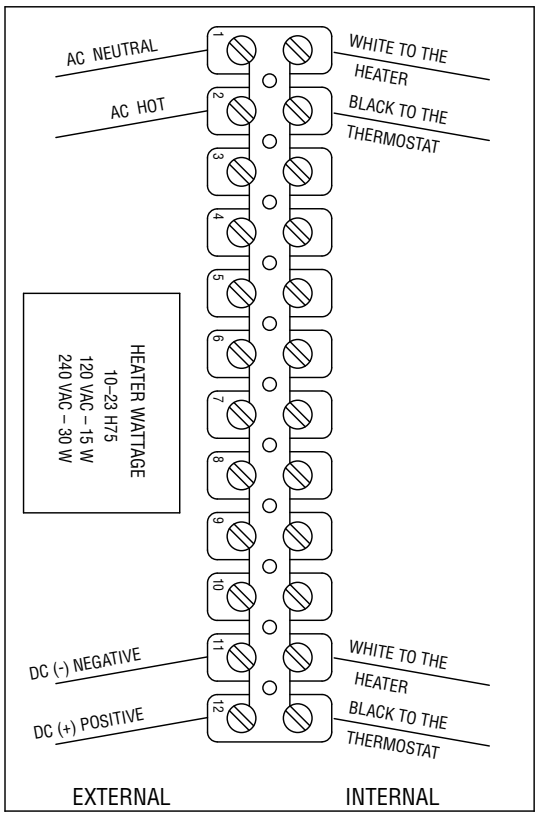



*Figure 7*




Wiring of MB 75 Option

*Figure 8*



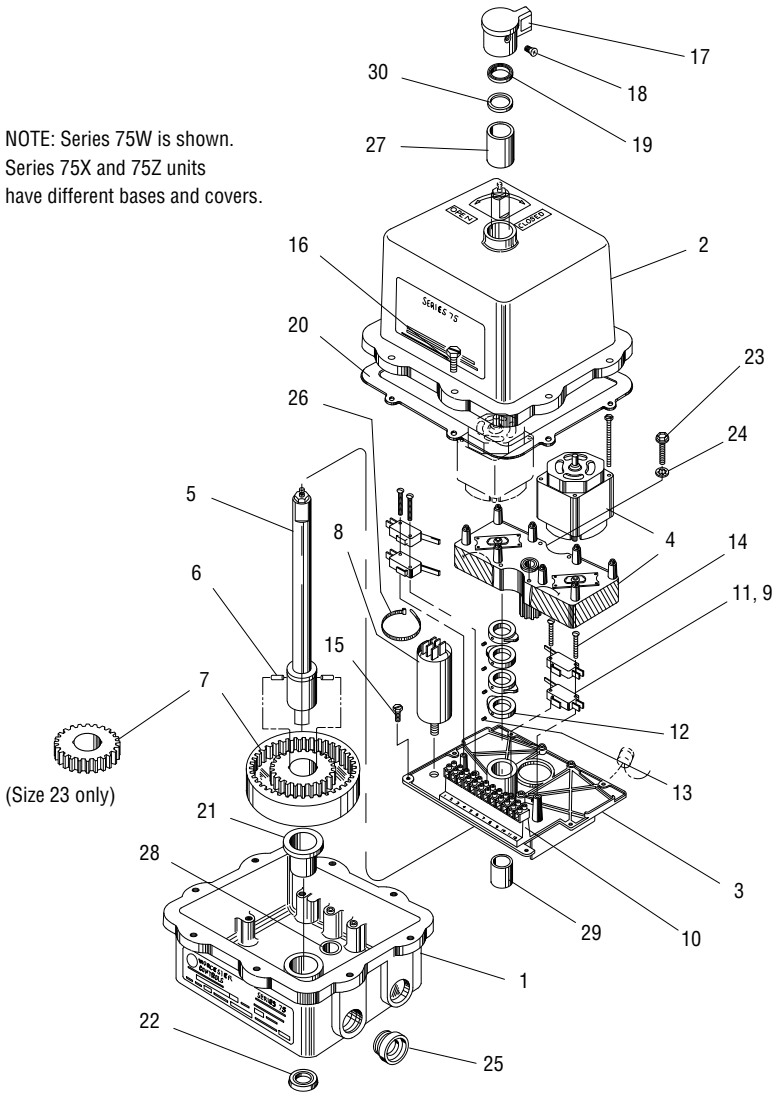

HEATER VOLTAGE SHOULD BE SAME AS ACTUATOR
OR SPECIFY IF DIFFERENT.

## 8.3 General Assembly

| Item | Qty | Description | Material |
|---|---|---|---|
| 1 | 1 | Base | Aluminum Casting |
| 2 | 1 | Cover | Aluminum Casting |
| 3 | 1 | Base Plate | Zinc Casting |
| 4 | 1 | Motor Module | Zinc Casting |
| 5 | 1 | Output Shaft | Steel |
| 6 | 2 | Gear Drive Pin | Steel |
| 7 | 1 | Bull Gear | Steel |
| 8 | 1 | Capacitor (rectangular or round type) | Phenolic Encapsulated |
| 9 | 2 | Switch Insulator (not shown) | Nylon |
| 10 | 1 | Terminal Strip | Polyethylene-Based Material |
| 11 | 4 | Limit Switch | Phenolic Encapsulated |
| 12 | 4 | Limit Switch Cam | Zinc Casting |
| 13 | 1/Cam | Cam Set Screw | Steel |
| 14 | 4 | Limit Switch Screw | Steel |
| 15 | 6 | Base Plate Screw | Steel |

| Item | Qty | Description | Material |
|---|---|---|---|
| 16 | 8 | Hex Screw (W,X,Z) | Stainless Steel |
| 17 | 1 | Position Indicator (W,X,Z) | Lexan |
| 18 | 1 | Indicator Set Screw (W,X,Z) | Steel |
| 19 | 1 | Seal (W,X,Z) | Reinforced Rubber |
| 20 | 1 | Gasket (W only) | Neoprene |
| 20 | 1 | Flange Seal (Z only) | Buna N |
| 21 | 1 | Bearing | Bronze |
| 22 | 1 | Seal | Reinforced Nitrile |
| 23 | 4 | Screw | Steel |
| 24 | 4 | Lockwasher | Steel |
| 25 | 1 | Conduit Plug | Polyethylene |
| 26 | 1 | Capacitor Tie | Plastic |
| 27 | 1 | Bearing (W,X,Z) | Bronze |
| 28 | 1 | Roller Bearing (Size 23 only) | Steel |
| 29 | 1 | Bearing, Base Plate | Nylon |
| 30 | 1 | O-ring (W,X,Z) | Buna |

*Figure 9*



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*Worcester Actuation Systems*

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