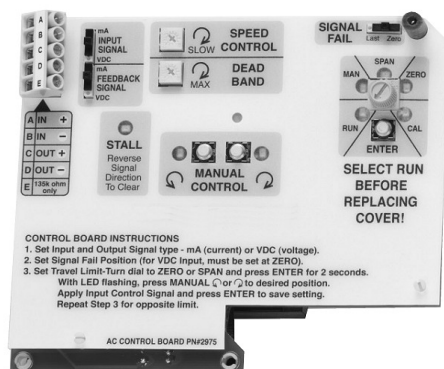


Installation, Maintenance and Operating Manual

VALVE CONTROL LTD
ELECTRIC & PNEUMATIC ACTUATORS + VALVE PACKAGES

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T Series Electric Actuators with Control Board

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READ THESE INSTRUCTIONS FIRST!

This instruction manual contains important information regarding the installation, operation, and troubleshooting of Valve Control Limited T-Series 115 VAC and 230 VAC Standard Electric Actuators with Option "C" Control Board installed. Please read these instructions carefully and save them for future reference.

1 General

1.1 Description for Control Board for Modulating Applications

The Control Board connects to the Motor Board with a 10 position plug-in connector and 3 mounting screws that are captured in the board.

The Control Board allows the actuator to modulate (change position) in response to a change in an analogue control signal.

The input control signal may be either current, such as 4-20 mA, or voltage such as 0-10VDC, or 2-10 VDC.

The control board also features analogue position feedback, signal fail options, speed control, locked rotor / stall protection, simple push button set-up, and auto calibration.

1.2 Operating Modes

The Control Board has five operating modes. Run, Manual, Set Span, Set Zero and CAL (calibrate). A rotary "Mode Selector Dial" on the Control Board allows the user to change the operating mode.

To change mode, turn the rotary selector knob with fingers or a small screwdriver.

Five LED indicators around the knob correspond to one of the five modes. When the Control Board mode dial is set to any mode, the corresponding LED turns on, indicating the mode is selected.

- **Run** mode is the basic operating mode. The actuator will respond to a command control signal which is supplied to terminal A and terminal B on the Control Board.

- **Manual** mode permits the user to override the control signal and drive the actuator by using the [CW] and [CCW] push buttons. In Manual mode the actuator will not travel beyond the saved settings for the Zero and Span stop positions.
- **Set Span** mode permits the user to precisely correlate the end of span travel stop with a corresponding control signal value. Typically, the Span position is the fully counter-clockwise position and maximum control signal value, but Span may be set at any position or signal value.
- **Set Zero** mode permits the user to precisely correlate the opposite end of travel stop position with a corresponding control signal value. The Zero position is typically the fully clockwise position and minimum control signal value, but Zero may be set at any position or signal value.
- **Cal** mode allows the user to automatically calibrate the position tracking potentiometer without the use of an ohmmeter or other electronic instruments.

1.2.1 Features, Settings and Controls

The control board is designed to be easy to use and hard to break. Set Up is push button simple and takes one minute! See (Figure 1) for callouts.

- **Enter** is located directly below the mode selector and permits the user to activate modes and confirm settings by pressing the [ENTER] button.

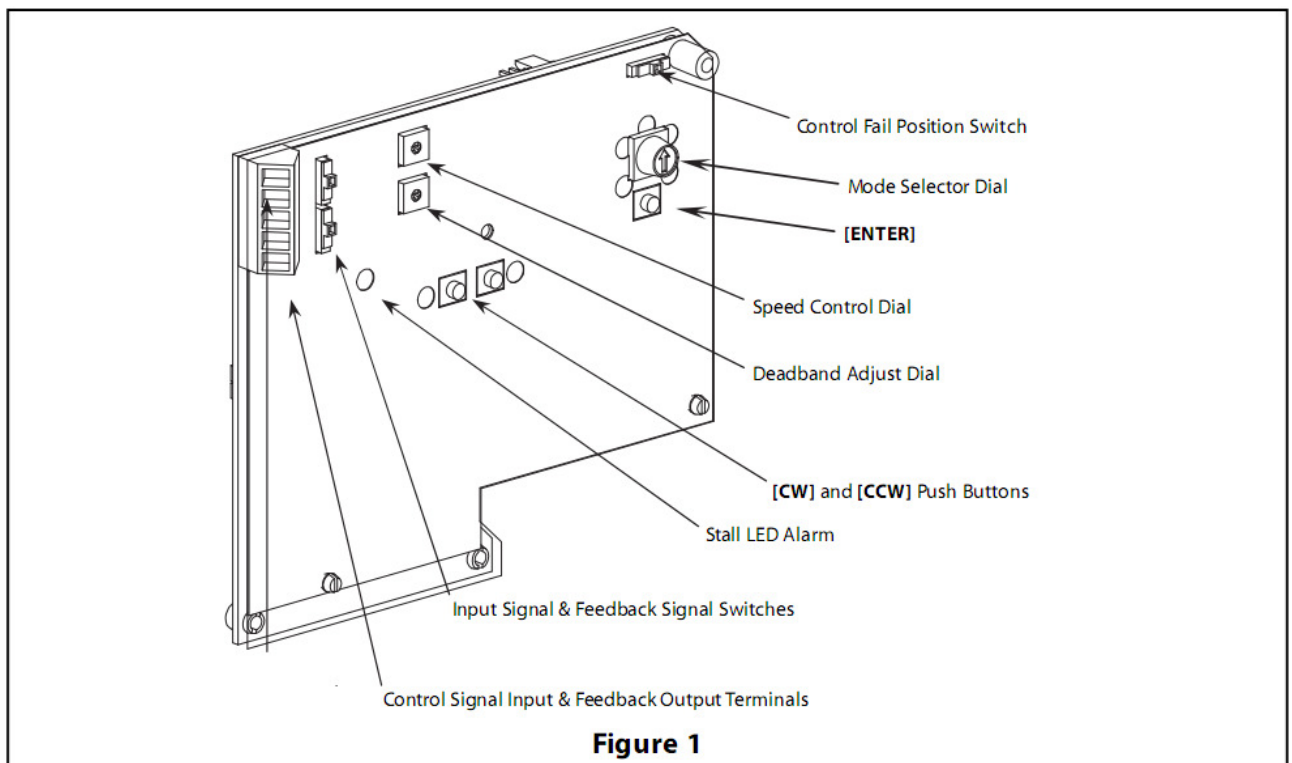


Figure 1

Control Signal Selection The board can accept either current or voltage control signals. Make sure the Signal Select switch is correctly positioned for the input control signal.

Feedback Signal Selection The board provides a feedback signal indicating actuator output position. This signal can be either current or voltage.

Make sure the Signal Select switch is correctly positioned for the desired feedback signal. If the feedback signal is not used, the switch may be left in either position.

Control Fail Position In the event that the control signal to the actuator is lost and power is still applied, the Fail Position Selector Switch on the Control Board provides for the actuator to remain at its LAST (current) position or drive the actuator to the "ZERO" position.

The actuator will maintain the LAST position or Zero position until a control signal returns to terminal A and terminal B. Note: If you use a 0-10 VDC control signal, the actuator will drive to the zero position regardless of the switch setting.

Manual Supervisory Control Selecting Manual (Man) Mode will override the connected control signal and allow driving the actuator to any position between Zero and Span, using the CW and CCW push buttons. There is no need to disconnect or handle live wires.

Deadband Deadband is the window of control signal change which the actuator will ignore. The sensitivity of the actuator to respond to changes in the control signal is adjustable.

Minimum deadband allows the actuator to respond to small control signal changes. Maximum deadband allows the actuator to ignore small control signal changes (such as noise on the control signal).

Deadband adjustment from Minimum to Maximum varies the dead band from small (1%) to large (3%) of input signal. The deadband should be set to the maximum amount which the process will allow.

Speed Control The Control Board will slow the actuator by pulsing the motor if the Speed Control feature is utilized.

The speed of the actuator can be regulated from 1:1 (normal) to 20:1 (1/20th of the normal cycle time) by adjusting the "Speed Control" dial on the Control Board.

Locked Rotor Protection Locked rotor protection prevents the overheating of the motor and possible premature failure.

The Control Board provides locked rotor protection and Stall LED Alarm in the event of a stall condition such as a jammed valve or damper.

Should the actuator stall before reaching the position commanded by the control signal, the actuator will remove power to the motor within 2-5 seconds.

The Stall LED on the Control Board will continue to flash until a reverse control signal clears the stall condition.

1.3 Control Board Wiring

To operate the actuator with the Control Board installed, the user must supply power to terminal 1 and terminal 2, only!

Power to terminal 3 and terminal 4 can cause damage to the Motor Board. See (Figure 2) for Diagram.

Power wiring to the Motor Board should be properly grounded in accordance with local electrical code.

Control signal wiring to the Control Board terminals should be properly shielded. To further prevent control signal noise, control signal wiring should be separated from the power wiring and should enter the actuator through a conduit opening separate from the entry used for the power wiring.

Terminal 5, counter-clockwise, and terminal 6, clockwise, position indication does not apply to actuators with the Control Board option.

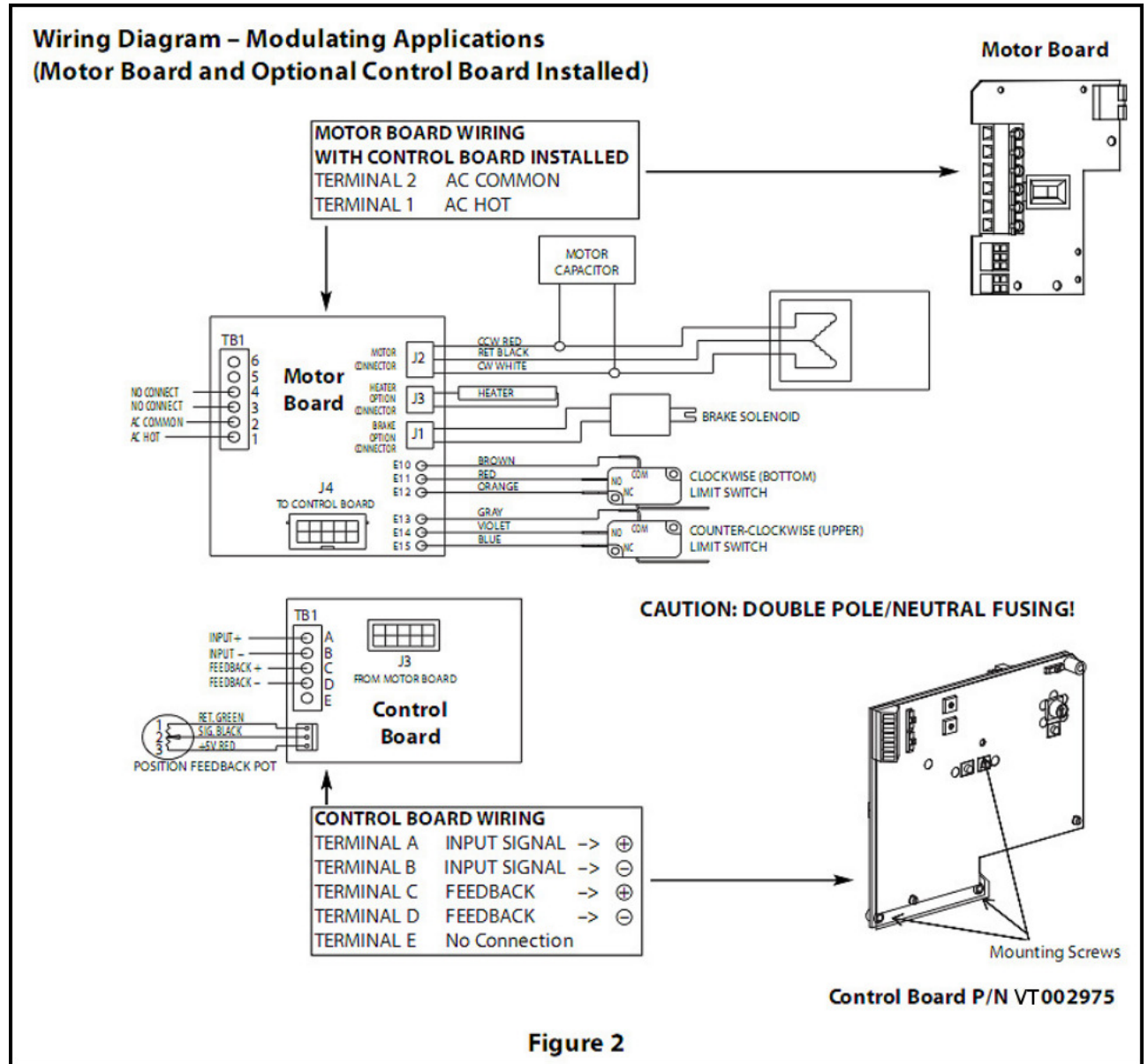
If status feedback is required with the Control Board option, install optional limit switches or use the standard readback feature provided with the Control Board. See (Section 2) for additional switches.

1.4 Operation for Modulating Applications (Motor Board and Control Board Installed) (90° Rotation)*

When Control Board is installed, power to terminal 3 or to terminal 4 will damage electronic circuit boards. Power terminals 1 and 2; Use [CW] Clockwise and [CCW] Counter-Clockwise buttons to drive actuator.

1.4.1 Set Up for Operation

1. Remove actuator cover.
2. Select Input Control Signal type - "mA" or "VDC" (current or voltage), the actuator will accept 4-20 mA or 0-10 VDC. The unit will also accept a split range signal, i.e. 4-12 mA, 12-20 mA or a 2-10 VDC signal. Slide the [INPUT SIGNAL] switch up to select mA or down to select VDC.
3. Select Output Feedback Signal type - "mA" or "VDC" (current or voltage), the actuator will provide a 4-20 mA or 0-10 VDC feedback signal. Slide the [FEEDBACK SIGNAL] switch up to select mA or down to select VDC.
4. Select Signal Fail Position - "Zero" or "Last"- Slide the [SIGNAL FAIL] to the right to select Zero or to the left to select Last. Selecting Zero will drive the actuator to the minimum signal position upon loss of control signal. If Last is selected the actuator will remain in place upon loss of control signal. If using 0 VDC as the minimum signal, the actuator cannot differentiate between a commanded minimum signal or a loss of signal; therefore, Zero should be selected.



1.4.2 Potentiometer Calibration

Calibration Field installation of the Control Board option or replacement of the position tracking potentiometer requires calibration of the position tracking potentiometer prior to setting positions and values for Zero and Span.

Control Board options installed at the factory are fully calibrated at the factory and should not require further calibration.

To confirm proper potentiometer calibration:

1. Turn the Mode Selector Dial to [CAL] and press [ENTER] for 2 seconds.
2. Using the CW pushbutton, drive the actuator to the full clockwise position.

- If the [CAL] LED is flashing, potentiometer calibration is required; proceed to step 3 below.
 - If the [CAL] LED remains on, calibration is not required; proceed to Setting Zero and Span Positions section below.
3. Loosen the set screw in the larger Nylon gear with a 1/16" hex wrench.
 4. Rotate the gear until the LED remains on constantly; hold the gear in place and tighten the set screw. Ensure that the LED remains on after the set screw is tightened.
Note: The LED assists the user in locating the proper calibration window; it will flash faster as you approach the calibration window and slower as you move away from it.
 5. Press the [ENTER] button to save the potentiometer setting.

1.4.3 Setting ZERO and SPAN positions

- Setting Zero and Span Positions Once calibration has been confirmed, set the desired end of travel positions. Make certain that the limit switch cams are set beyond the desired range for the Zero and Span positions.

Zero and Span may be set at any position between 0 degrees and 94 degrees of travel. Zero or Span may be either clockwise or counter-clockwise and may be set to either a high value or low value control signal.

The Control Board features full reverse acting set up, requiring no wiring changes. See (Section 1.4.3) for simple Set Zero and Set Span procedures.

- For 180° Rotation order Option Kit P/N VT099180 to Replace 90° Potentiometer and Cam Gears
- For 270° Rotation order Option Kit P/N VT099270 to Replace 90° Potentiometer and Cam Gears

Caution: When Control Board is installed, power to terminal 3 or to terminal 4 will damage electronic circuit boards. Power terminals 1 and 2; Use [CW] Clockwise and [CCW] Counter-Clockwise buttons to drive actuator.

Set Zero:

1. Turn the Mode Selector Dial to [ZERO] and press [ENTER] for 2 seconds. The Zero LED will begin to flash.
2. Drive the actuator to desired minimum signal position using the CW or CCW pushbutton. If the "STALL" LED begins to flash; check to see if the limit switch cam is preventing actuator from reaching desired end-of-travel. If necessary back the cam off so that it will trip the switch slightly beyond the desired end-of-travel.
3. Apply input control signal, (i.e. 4 mA).
4. Press the [ENTER] button to save the Zero setting.

Set Span:

1. Turn the Mode Selector Dial to [SPAN] and press [ENTER] for 2 seconds. The Span LED will begin to flash.
2. Drive the actuator to desired maximum signal position using the CW or CCW pushbutton. If the "STALL" LED begins to flash; check to see if the limit switch cam is preventing actuator from reaching desired end-of-travel. If necessary back the cam off so that it will trip the switch slightly beyond the desired end-of-travel.
3. Apply input control signal, (i.e. 20 mA).
4. Press the [ENTER] button to save the Span setting.

Verify Zero and Span Settings:

1. Turn the Mode Selector Dial to [RUN].
2. Apply various control signals to verify operation.
3. Replace actuator cover.

2 Installation

2.1 Tools Required

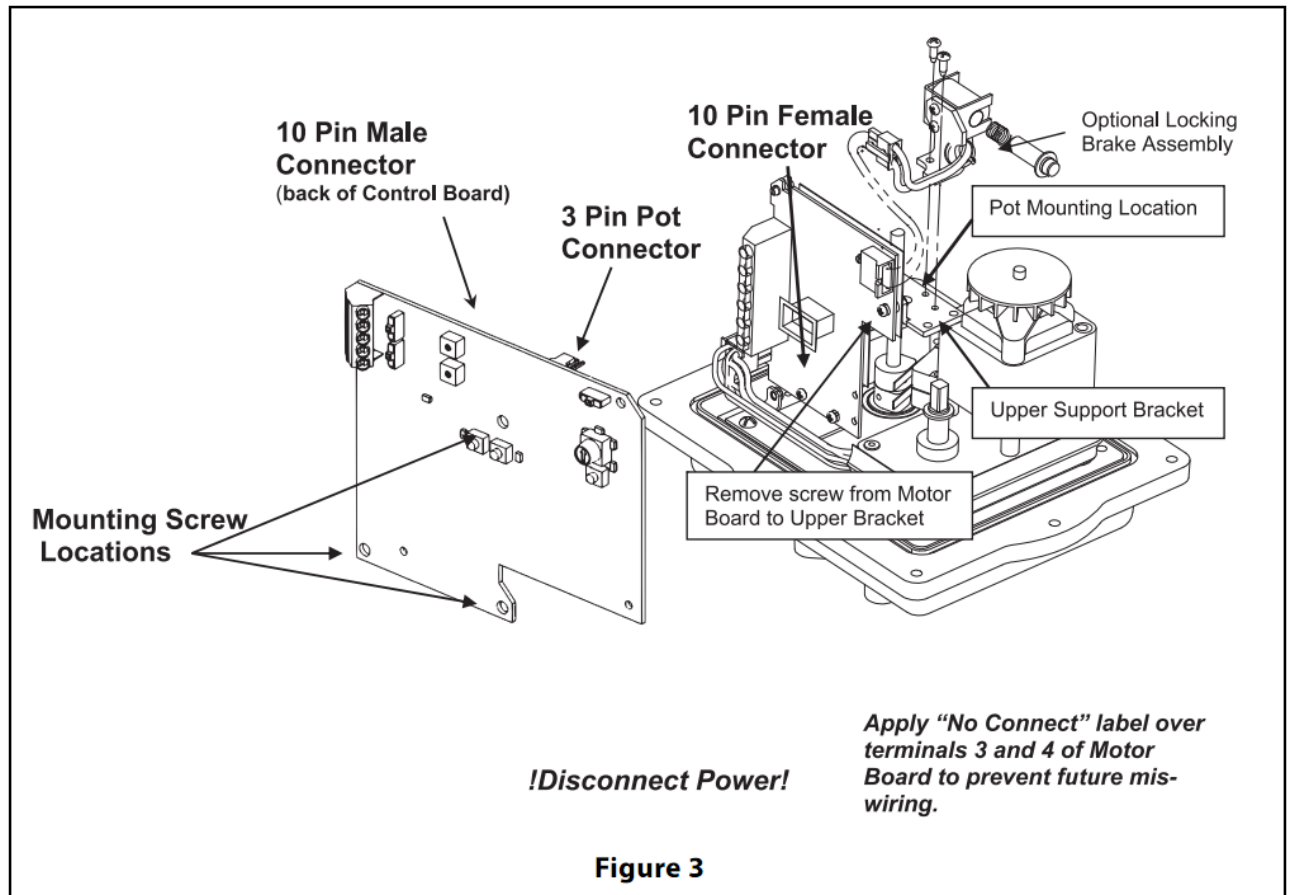
Philips Screwdriver Hex wrench, 0.035"(supplied with kit) Hex wrench, 1/16" (supplied with kit) • Wrench/Nut driver, 1/2"

2.2 Installation Instructions

Disconnect Power!

1. Remove and discard the screw that secures the Motor Board to the upper bracket.
2. Remove 1/2" locking nut from potentiometer (Pot) shaft and insert pot shaft up through hole in upper support bracket. Align locking tab and tighten the locking nut on pot shaft.
3. Plug Pot connector into the 3-Pin connector on the front of Control Board.
Plug Control Board into the Motor Board via the 10-pin connector. (Note that the pot wires should be between the two boards)
4. Secure Control Board to Upper and Lower Support Brackets with the 3 mounting screws. (Note that the 1" screw goes in the upper-most mounting hole)
5. Place small (20-tooth) gear on Pot shaft and tighten. Place spacer on Camshaft then place large (60-tooth) gear on Camshaft. Properly positioned, gears should mesh evenly.
6. Supply power to terminal 1 and terminal 2, only.

Refer to Section 1.4 for Set Up and Calibration Procedures



3 T-SERIES STANDARD OPTIONS

All T-Series options are designed to be easily installed in the field.

Options for all standard T-Series actuators are universal and completely interchangeable with each enclosure size.

For additional T-Series Options, see (Table 4). Voltage is not field changeable.

3.1 Option "H" - Tropical Heater and Thermostat

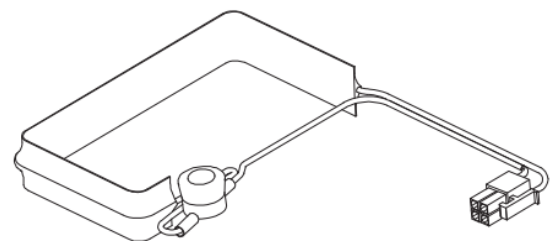
The tropical heater and thermostat option is a self-adhesive, resistance heater strip which is applied to the primary gearbox.

It installs with a plug-in connector and is recommended in high-humidity applications. The tropical heater option is also recommended in installations that experience wide temperature swings in order to evaporate any condensation.

Thermostat is pre-set to activate at or below 90°F and deactivate at or above 110°F. The tropical heater draws 15 watts @ 115 VAC; 40 watts @ 230 VAC.

This option can be installed in the field; for 115 VAC applications, order kit P/N VT099716 and for 230 VAC applications order kit P/N VT099723.

Option "H" Tropical Heater and Thermostat Option "T" Standard Heater and Thermostat



3.2 Option "I" - ISO 5211 Output

150 - 600 in-lb models are supplied with a 3/4" female square output coupling; when the "I" option is selected they are supplied with a 14 mm female square.

1000 - 3000 in-lb models are supplied with a 1" female square output coupling; when the "I" option is selected, 1000 in-lb models are supplied with a 19 mm female square and 1500 - 3000 in-lb models are supplied with a 22 mm female square.

This option is factory installed only.

3.3 Option "K" - Mechanical Brake

The highly efficient hardened steel spur gear system requires that the brake option be installed on all butterfly valve and damper applications. It is also recommended on PVC ball valves and resilient seated valves.

The brake will hold the valve in position against a force as great as the torque rating of the actuator. The brake option draws 4 watts and is universal to all standard T-Series actuators.

It is simple to install with a plug-in connector and two Phillips head mounting screws. No additional brackets are required.

This option can be installed in the field; order kit P/N VT099715.

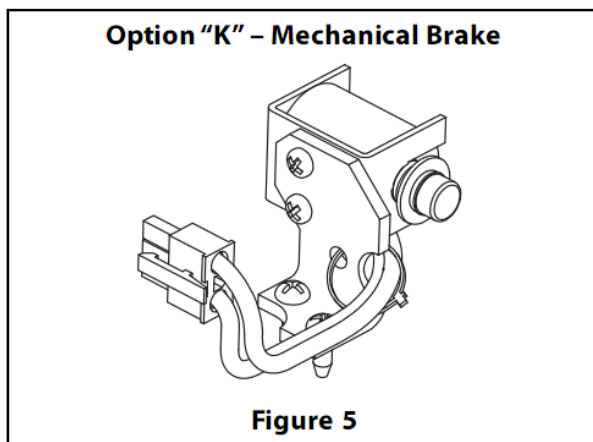


Figure 5

3.4 Option "P" - Feedback Potentiometer

The Feedback Potentiometer option provides 0 -1000 Ohm resistance feedback and includes a 12 position terminal block for internal wiring.

This option can be installed in the field; order kit P/N VT099200.

3.5 Option "S2" - Two Auxiliary Limit

The extra switches and stainless steel cams provide dry contacts and are fully adjustable to trip at any position. They are often used for position indication or to interlock other devices (such as in sequencing operations).

The switches are single pole, double throw switches rated for 1/2 HP, 15 amps @ 250 VAC.

Auxiliary switch kit P/N VT099000 is universal to all standard T-Series actuators and includes "flying wiring leads" for termination inside of the actuator enclosure using the supplied 6 position terminal block.

This option can be installed in the field; order kit P/N VT099000.

Option "S2" - Two Auxiliary Limit Switches

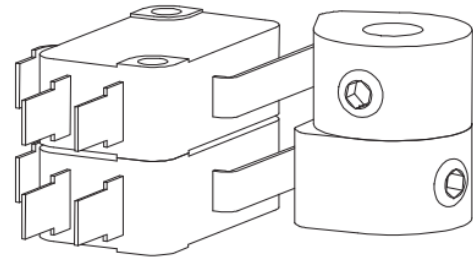


Figure 6

3.6 Option "T" - Heater and Thermostat

The heater and thermostat option is a self-adhesive, resistance heater strip which is applied to the primary gearbox.

It installs with a plug-in connector and is required in installations where the ambient temperatures drop below 32° F.

The heater option is also recommended in installations that experience wide temperature swings in order to evaporate any condensation. Thermostat is pre-set to activate at or below 40°F and deactivate at or above 60° F.

The heater draws 15 watts @ 115 VAC; 40 watts @ 230 VAC. This option can be installed in the field; for 115 VAC applications, order kit P/N VT099515 and for 230 VAC applications order kit P/N VT099523. (see Figure 4)

3.7 Option "Z" - Handwheel Override

All T-Series actuators are supplied with a wrench-operated manual override shaft.

If the Handwheel Override option is selected the shaft is replaced by a declutchable shaft and a six-inch handwheel.

This option can also be installed in the field; for 150 - 600 in-lb models order kit P/N VT009097 and for 1000 - 3000 in-lb models order kit P/N VT009098.

3.8 Certification

Certification is standard on all standard T-Series actuators for applications in either Hazardous (WX) or non-Hazardous (W) locations.

3.9 Voltage

115 VAC or 230 VAC. T-Series actuators are rated for full torque at +/-10% of the nominal voltage at 50 Hz or 60 Hz. At 50 Hz operation, the duty cycle decreases proportionally and the cycle time increase.

T-Series actuators are rated for a minimum of 75%* duty cycle @ 60 Hz @ 104° F. They provide a 75% duty cycle and are rated for 50 Hz or 60 Hz as a standard feature.

*55% duty cycle for 3000 in-lb actuators

4 General Operating Information

For enclosure specifications and dimensions, see (Tables 1-3 and Figure 8)

4.1 NEMA Ratings and Certification

Valve Control Limited manufactures two styles of T-Series actuator enclosures: the "W" enclosure is weather tight and designed to NEMA 4/4X standards the "WX" enclosure is "explosion-proof" and designed to NEMA 4/4X/7&9 (Class 1, Division 1, Groups C and D, Class 2, Division 1, Groups E, F and G and Class 3) standards.

Actuators are certified to meet Canadian and U.S. standards for applications in both Hazardous and Non-Hazardous locations. The "WX" option must specified at the time of ordering and can only be installed at the factory.

Ensure that the actuator's ratings are appropriate for the application environment prior to installation. Use extreme care when removing the cover. Scratches or nicks on the flanges may cause the enclosure not to meet NEMA specifications.

4.2 Wiring

The AC voltage actuators use reversing induction motors which cause high voltages. Devices connected to terminal 3 and to terminal 4 must be rated for minimum 250 VAC (440 VAC for 230 VAC applications). Controllers with solid state outputs must be rated for more than 250 VAC.

We strongly recommend that relay outputs be used on connected devices. Due to the induction feedback voltage, multiple actuators can not be wired in parallel. Separate (isolated contacts) must be provided for each actuator. If the actuator is driven by contacts on a PC or PLC, make sure the contacts have the proper ratings.

4.3 Duty Cycle and Motor Protection

T-Series actuators can operate continuously for up to 15 minutes at 104° F. After 15 minutes of continuous operation they are rated for 75% duty cycle operation at 104° F and for 30 starts per minute.

Duty cycles decrease at temperatures in excess of 104°F. Duty cycle is the maximum proportion of "on" time and the minimum required "off" time to prevent thermal overloading. Actuators with cycle times of 30 seconds must rest at least 10 seconds between cycles. Higher temperature applications decrease duty cycle.

The AC motors contain thermal overload protection. Exceeding the rated duty cycle may cause the thermal overload switch to temporarily remove power to the motor and cause it to stall. After the motor cools, the actuator will resume normal operation.

The thermal protector is a safety device, designed for infrequent use. Constant tripping of the thermal overload protector may cause premature motor failure.

4.4 Operating Temperature Limits

T-Series actuators are designed to operate in ambient environments between 32° F and 150°F. If the ambient temperature may drop below 32°F, the heater and thermostat option must be installed. The actuator is rated to operate at -40° F with the heater and thermostat option installed.

In outdoor applications where ambient temperatures exceed 80°F, actuators should be shielded from direct sunlight. In applications with high media temperatures, insulating blankets, heat shields and/or extended mounting shafts should be used to maintain ambient temperatures at the actuator within normal operating limits.

Heaters and thermostats are required for all outdoor applications and may also be used to dry condensation in high humidity environments.

4.5 Actuator Mounting

The actuator may be mounted in any position including upside-down. It must be firmly secured to a direct mount flange or sturdy mounting bracket. A minimum of four bolts with lock washers should be used to secure the actuator to the bracket.

Flexibility in the bracket is not allowed, and backlash, or "play", in the coupling should be minimized. The actuator output shaft must be in line (centred) with the valve shaft to avoid side-loading the shaft. See (Figure 8) for output drive dimensions and mounting hardware specifications.

4.6 Manual Override

To use the manual override, push the override shaft down approximately 1/4 inch to disengage the motor from the gear train. Failure to disengage motor prior to turning override will cause damage to the actuator.

While holding the shaft down, turn the shaft with a wrench or handle to the desired position. The override shaft on actuators below 1000 in-lb must be rotated in the opposite direction of the desired direction of the output shaft. In actuators 1000 in-lb and above, the override and the output shaft turn in the same direction.

Do not drive the actuator beyond the limit switch settings; it is possible to damage installed options such as a feedback potentiometer. The manual override shaft must be returned to its fully upward position before the motor is re-engaged.

Rotate the shaft slightly to align the spur gears until the shaft "springs" back to its re-engaged position. Note: The rotation direction of the output may not be the same as the rotation of the override shaft!

4.7 Lubrication

All rotating power train components are permanently lubricated with multi-purpose Lithium grease suitable for the operating temperature range of the actuator. Additional lubrication is not required in normal operation.

4.8 Problem Prevention

Most actuator problems result from improper installation.

- **Incorrect Wiring and Set Up** Make certain the actuator is wired correctly and travel stops are properly set before power is applied.
- **Coupling, Alignment, and Mounting** Do not add extra torque! Make certain that the mounting arrangement is sturdy, centred, properly aligned, and that all mounting hardware is secure and properly tightened.
- **Moisture** Replace the cover tightly and make certain conduit entry holes are sealed properly to prevent moisture infiltration.

4.9 Warranty

All T-Series actuators are backed by a 1 year warranty that covers materials and workmanship.

4.10 Technical Assistance, Replacement Parts, Options and Repairs

All replacement parts, plug-in options, accessories, and repair services for T Series actuators are available from Valve Control Limited. For further technical information please contact Valve Control Limited.

5 Specifications & Technical Information

Table 1 - Torque & VA Ratings								
Torque @ breakaway	Speed (seconds per 90° rotation)	Duty Cycle	VA Rating		Max Running Current at Full Load (True MS)		Max Effective Peak Inrush Current (= .66 x) Peak rush	
			115 VAC	230 VAC	115VAC	230 VAC	115 VAC	230 VAC
150 in·lb	8	75%	70 vA	115 vA	.6 amps	.5 amps	1.25 amps	.924 amps
300 in·lb	15	75%	70 vA	115 vA	.6 amps	.5 amps	1.25 amps	.924 amps
600 in·lb	30	75%	70 vA	115 vA	.6 amps	.5 amps	1.25 amps	.924 amps
1000 in·lb	25	75%	92 vA	161 vA	.8 amps	.7 amps	1.66 amps	1.29 amps
1500 in·lb	40	75%	92 vA	161 vA	.8 amps	.7 amps	1.66 amps	1.29 amps
2000 in·lb	55	75%	92 vA	161 vA	.8 amps	.7 amps	1.66 amps	1.29 amps
2500 in·lb	70	75%	92 vA	161 vA	.8 amps	.7 amps	1.66 amps	1.29 amps
3000 in·lb	75	55%	92 vA	161 vA	.8 amps	.7 amps	1.66 amps	1.29 amps

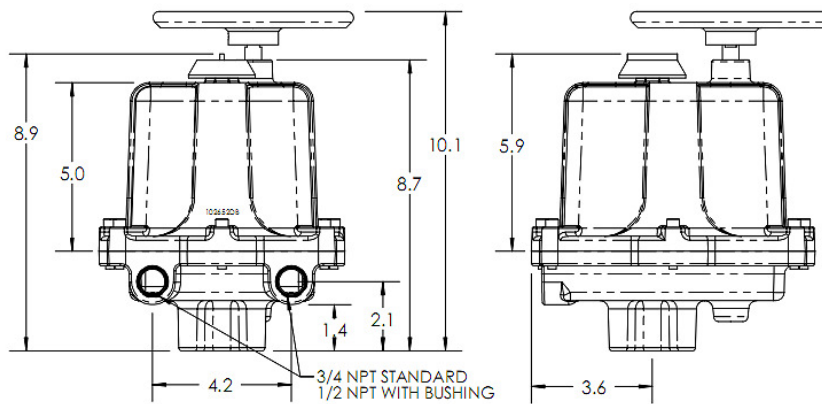
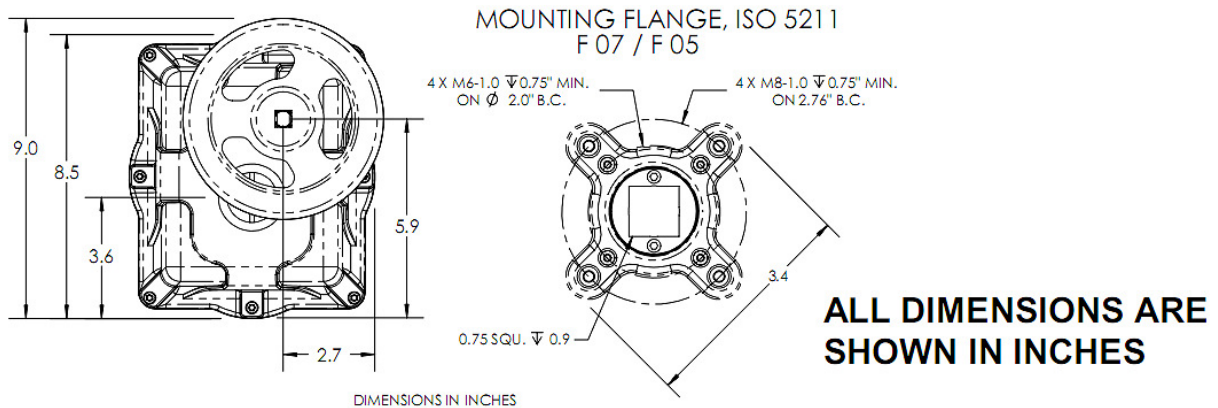
Table 2 - Specifications	
Temperature Range	32°F to 150°F (without heater and thermostat) -40°F to 150°F (with heater and thermostat)
Conduit Connections	(2) 3/4" NPT in sizes up to 600 in·lb (3/4" to 1/2" reducing bushings included) (2) 3/4" NPT in sizes 1000 in·lb and above (3/4" to 1/2" reducing bushings included)
Output	150 to 600 in·lb: ISO 5211 F05 and F07 bolt circles, 3/4" inch female square (14 mm w/"I" Option) 1000 in·lb and above: ISO 5211 F07 and F10 bolt circles, with 1" inch female square (19 mm 1000 in·lb, 22 mm 1500 – 3000 in·lb w/"I" Option)
Duty Cycle	The actuator may run continuously at temperatures below 104° F for up to 15 minutes. After that 15 minutes, the actuators may run up to 75% duty cycle (between each full cycle), the actuator must rest for 1/3 of the 90 degree cycle time. NOTE: At 50 Hz, the duty cycle is 60% @ 104° F.
Voltage	115 VAC: 103.5 to 126.5 VAC, 50 or 60 Hz 230 VAC: 207 to 253 VAC, 50 or 60 Hz
Limit Switches	(2) Single pole, double throw switches rated for 1/2 HP, 15 amps @ 250 VAC, CSA certified, fuse protected. Two standard switches are used for end of travel control, and for pilot or position indication at terminal 5 and terminal 6. Indication outputs are protected by 0.25 AMP permanent auto reset polyfuses – reset time approximately 3 mins.
Motor	Split phase, capacitor driven motor with Class B or better insulation; sub-fractional horsepower
Lubrication	Permanently lubricated gear train and bearings
Gear Train	Hardened steel spur gears
Approximate Weight	17 lbs for sizes up to 600 in·lb 31 lbs for sizes 1000 in·lb and above
Enclosure	Die cast aluminum

Table 3 - Analog Control (Positioning) - Control Board Option	
Input Impedance	Voltage Input: 35K ohms. Current Input: 200 ohms
Control Signal	May be either 4-20mA or 0-10VDC (selectable via on-board slide switch) Fully compatible with ISA-550.1 as a type 4, class L, power isolated device. Input minus (-) and transmit minus (-) are tied together and isolated from power and earth ground.
Position Readback Signal	May be either 4-20mA or 0-10VDC (selectable via on-board slide switch) Minimum resistive load for voltage output: 1K ohm. Maximum resistive load for current output: 500 ohm
Locked Rotor Protection	If the actuator cannot achieve the position commanded by the control signal, this feature will remove all power to the motor after 5 seconds. The actuator will not restore power to the motor until the control signal commands the actuator to drive in the opposite direction.
Control Fail Position	In the event of a loss of control signal (with power still supplied), user can choose either the Zero position or the Last position via slide switch. NOTE: If the minimum control signal = 0, the fail position must be Last
Position Potentiometer	360° Rotation, 0"K" ohms to 1"K" ohms.
Local Supervisory Control	User can select manual (MAN) to override control signal and drive actuator by pushing the CW or CCW buttons. Actuator may be manually positioned to any location between the existing Zero and Span settings. For additional range, reset the ZERO and Span locations.
Speed Control - Cycle Rate	User can choose 90 degree rotation times of: normal, 2X normal, 3X normal, 5X normal, 10X normal & 20X normal.
Split Range Control	Actuator will accept split range control signal (i.e. 4-12 mA or 12-20mA; 0-5 V or 5-10 V) with no wiring changes.
Reverse Acting	With no wiring changes required, the actuator may be calibrated to drive clockwise upon an increasing control signal, and counter-clockwise upon a decreasing signal.
Dead Band	The amount of change in control signal that the actuator will ignore before the output shaft begins to move. Adjustable from 1% to 3%.

Caution: When Control Board is installed, power to terminal 3 or to terminal 4 will damage electronic circuit boards. Power terminals 1 and 2; Use [CW] Clockwise and [CCW] Counter-Clockwise buttons to drive actuator.

5.1 Dimensions

Small: 12 - 50 lb-ft (16.3 - 68 Nm)



Large: 83 - 250 lb-ft (113 - 339 Nm)

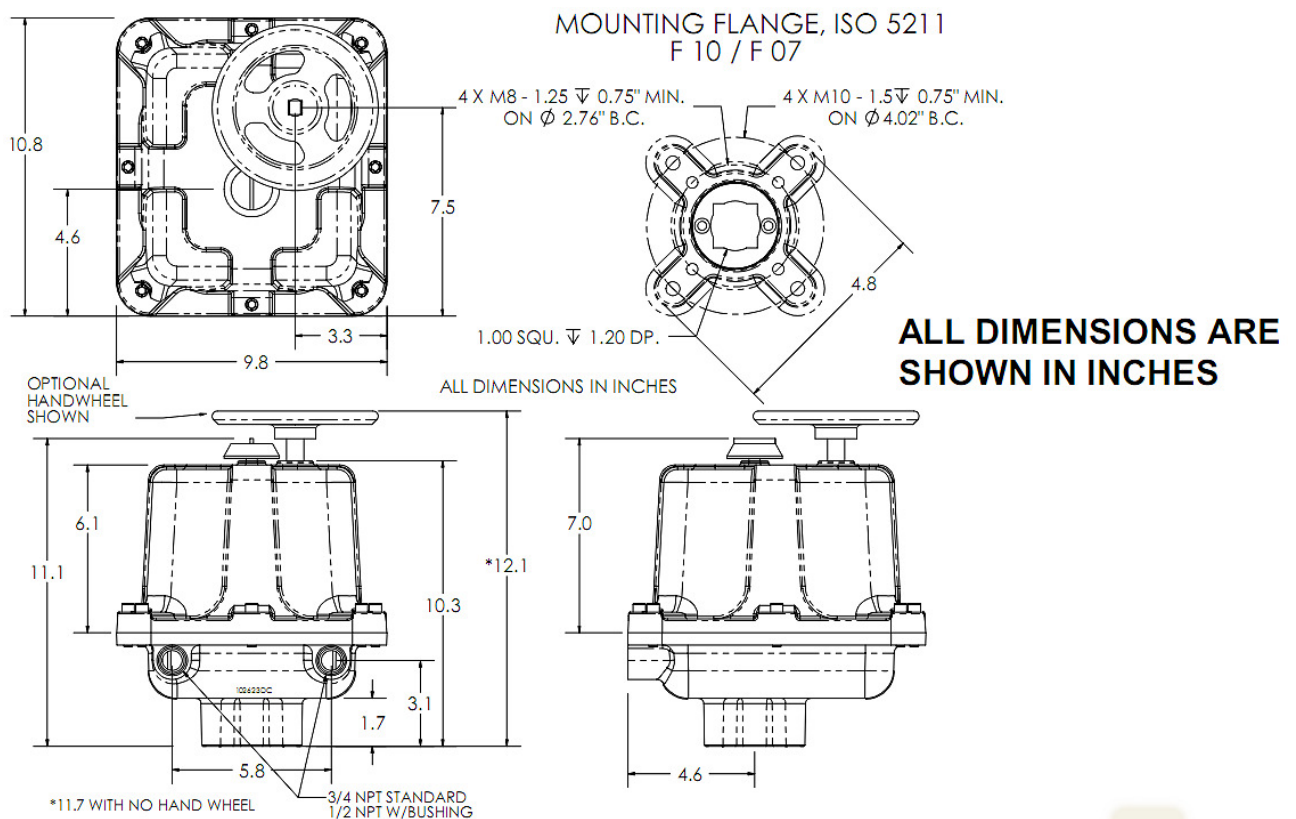
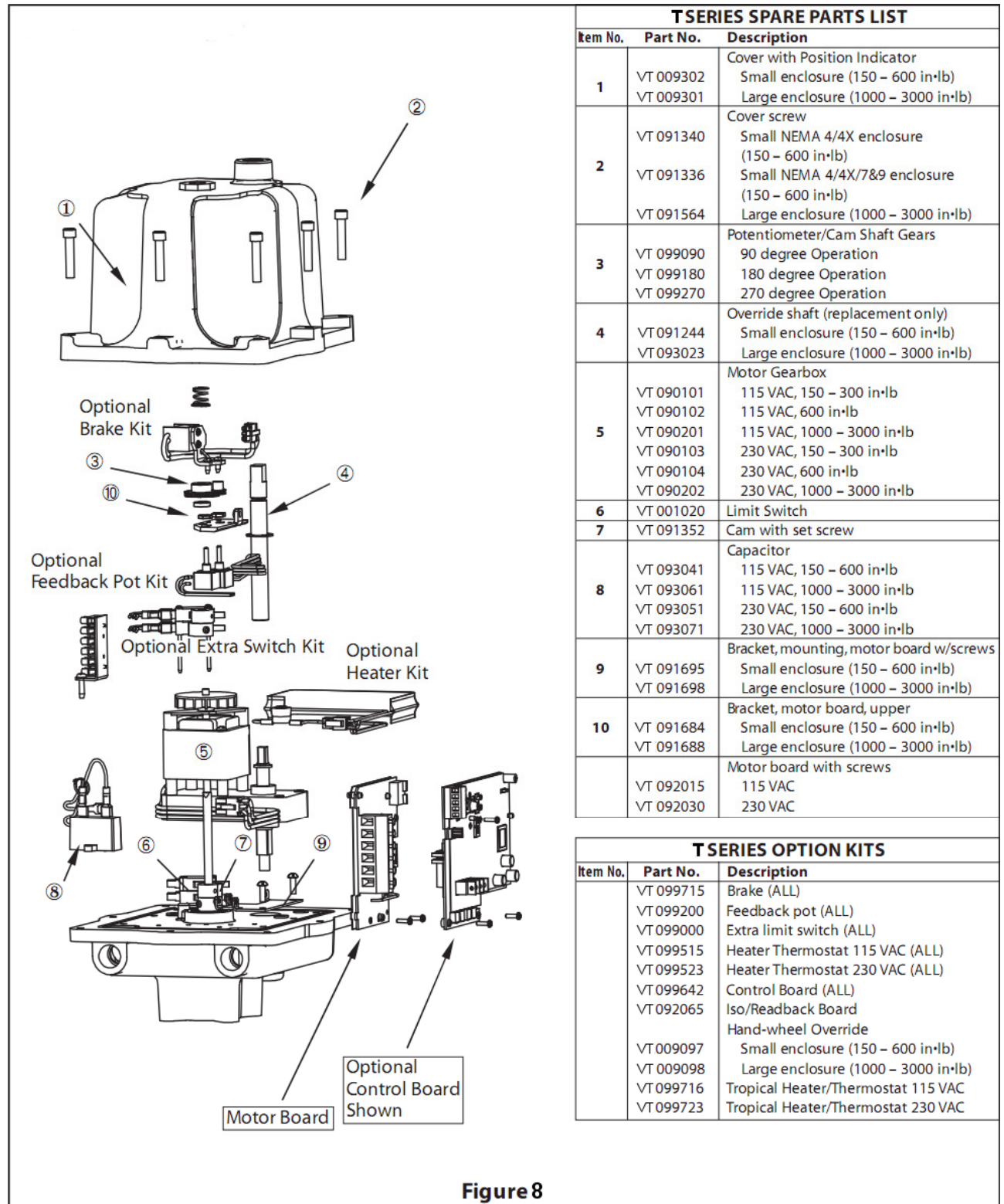


Figure 7

5.2 Exploded View



6. T Series Actuators by Part Numbers

Table 4										
Standard T-Series Actuators (with "N" in model number before the voltage code)										
Series	Enclosure Type		Torque		Board Options ¹		Other Options		Operating Voltage	
	Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
T	W	Weathertight NEMA 4/4X	150	150 in·lb	C	Control Board	H ²	Tropical Heater/Thermostat	N115AC	115 VAC
			300	300 in·lb	J	Speed Control/Timer Board	I ^{3a}	ISO 5211 Output	N230AC	230 VAC
			600	600 in·lb	U	Iso/Readback Board	K	Brake		
	WX	Weathertight & Explosionproof NEMA 4/4X/7&9					P	Feedback Potentiometer		
							S2	Two Auxiliary Limit Switches		
							T ⁴	Heater/Thermostat		
							Z	Handwheel		
LT	W	Weathertight NEMA 4/4X	1000	1000 in·lb	C	Control Board	H ²	Tropical Heater/Thermostat	N115AC	115 VAC
			1500	1500 in·lb	J	Speed Control/Timer Board	I ^{3b}	ISO 5211 Output	N230AC	230 VAC
			2000	2000 in·lb	U	Iso/Readback Board	K	Brake		
	WX	Weathertight & Explosionproof NEMA 4/4X/7&9	2500	2500 in·lb			P	Feedback Potentiometer		
			3000	3000 in·lb			S2	Two Auxiliary Limit Switches		
							T ⁴	Heater/Thermostat		
							Z	Handwheel		

Notes:

- Select only one board option, as needed.
- This heater option activates at or below 90°F and deactivates at 110°F; it is recommended in high-humidity applications.
- 3a. 150 - 600 in·lb models with "I" option are supplied with a 14 mm female square (note that without option "I" the female square is 3/4")
- 3b. 1000 in·lb models with "I" option are supplied with a 19 mm female square and 1500 - 3000 in·lb models are supplied with a 22 mm female square (Note that without option "I" the female square is 1")
- This heater option activates at or below 40°F and deactivates at 60°F; it is recommended in applications where the temperature may drop below 32°F.

For enclosure specifications and dimensions see (Tables 1-3 and Figure 6).

Enclosure "W" (weather tight) is certified to meet specifications for NEMA 4/4X for weather tight and dust tight, environments. It is intended for non-hazardous locations in indoor or outdoor use and provides a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation. It is not designed to be submersible.

Enclosure "WX" (explosion proof & weather tight) is certified to meet specifications for NEMA 7&9, explosion proof environments as well as to meet NEMA 4/4X specifications. Explosion proof means that an internal explosion will be contained, with no sparking that could ignite external atmospheric gases. The enclosure is rated for the following environments:

- NEMA Class I, Division 1, Group C (Ethyl-ether vapours, ethylene or cyclopropane)
- NEMA Class I, Division 1, Group D (Gasoline, hexane, naphtha, benzene, butane, propane, alcohol, acetone, benzol, lacquer, solvent, vapours or natural gas)
- NEMA Class II, Division 1, Group E (Metal dust, including aluminium, magnesium, their commercial alloys, and other metals of similarly hazardous characteristics)
- NEMA Class II, Division 1, Group F (Carbon black, coal or coke dust)
- NEMA Class II, Division 1, Group G (Flour, starch or grain dust)
- NEMA Class III

Sample Model Code: TW153CHIKS2

Actuator Series	T
Enclosure Type	W
Torque	1500
Operating Voltage	N230v
Board Option	C
Other Options (if applicable)	H
	I
	K
	S2

Torque = Breakaway Torque Valve Control Limited actuators are rated at breakaway torque; the amount of torque the actuator will provide from a fully loaded stop upon immediate power-up.

With running momentum and inertia, the amount of torque supplied by the actuator at full speed (running torque) or upon entering a stall condition (stall torque) always exceeds the minimum rated breakaway torque.

Since valves require most torque at breakaway, only breakaway torque should be considered when sizing actuators.

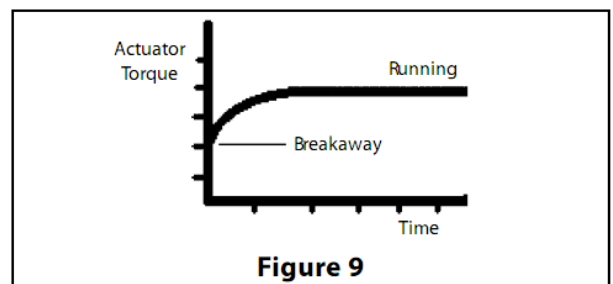


Figure 9