

TMC2 Triac Modulating Card Installation & Operating Instructions

1. GENERAL DESCRIPTION.

The Triac TMC2 is a proportional AC Motor Controller, intended for use with split phase AC actuator motors. The actuator is controlled by comparing an external command signal to a feedback signal from a potentiometer linked to the actuator. Depending on the magnitude of the two signals, the TMC2 controller will energize either the clockwise (cw) or the counterclockwise (ccw) motor output. This drives the actuator in the direction that will reduce the difference between the two signals. When the feedback signal equals the control signal, the controller will turn off the drive to the actuator.

The TMC2 controller can be used with a 4 to 20 mA command signal, a 1 to 5 mA command signal, a 0 to 10V command signal, a 1 to 5V command signal or a command signal potentiometer.

The TMC2 controller provides actuator calibration without the use of a command signal. Programming of the controller is accomplished by a combination of push button switches and a seven position DIP-switch.

The power line input is compatible with 115VAC power. Power line frequency may be either 50 or 60 Hz. When properly mounted, the controller is capable of providing an output motor running current of 3A.

2. MOUNTING.

In order to avoid electrical shock, it is important to install the TMC2 in an appropriate enclosure. When operating, high voltage is present on the controller, necessitating care and caution during the installation process. In particular, all AC power wiring must be de-energized before connecting any wires to the TMC2. Please refer to Figure 1 for an outline of the high voltage area

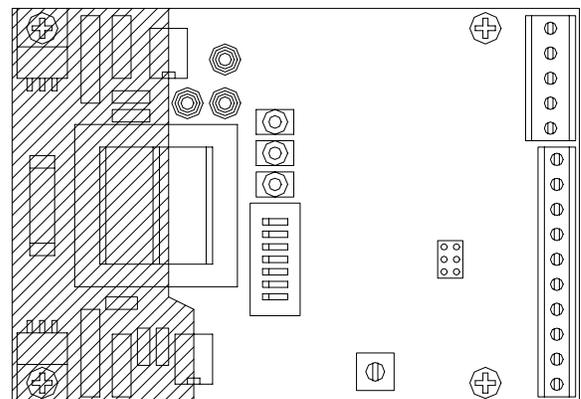


FIGURE 1. HIGH VOLTAGE IN SHADED AREA.

To take full advantage of the 3A output rating of the controller, the unit must be mounted to a suitable metal plate or bracket (aluminum is the preferred material) using 6-32 (or M3) screws in all four mounting holes. The mounting surface must be flat, without any burrs or roughness. If the TMC2 controller is to be used where condensation can be anticipated, a heater and thermostat must be used.

3. WIRING.

All TMC2 wiring is connected using terminal blocks. Terminal block TB1 is used for connections to 115 VAC power. Terminal block TB2 is used for signal connections. The location of the terminal blocks is shown in Figure 3.

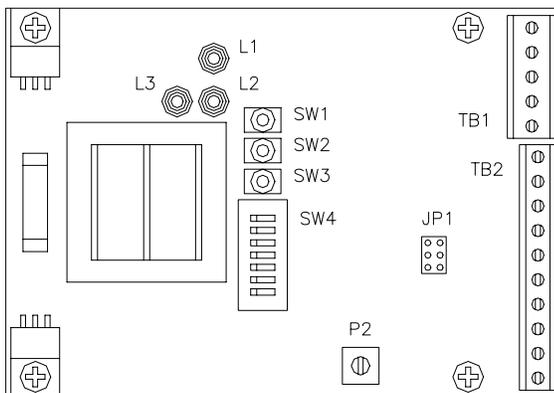


FIGURE 3. LOCATION OF INDICATORS AND CONTROLS.

3.1. ACTUATOR WIRING.

The actuator motor and feedback potentiometer are connected to the controller as shown in Figure 4.

Terminal 4 of TB1 is connected to the motor winding that drives the actuator ccw. Terminal 3 of TB1 is connected to the winding that drives the actuator cw. Terminal 5 of TB1 is connected to the neutral motor wire.

In most applications, limit switches will be used to set the maximum allowable range of the actuator. The switches should be wired to break the ccw and the cw motor connections. Set the switches so that motor power is interrupted at maximum travel in each direction.

The wiper of the feedback potentiometer is connected to terminal 9 of TB2. One end of the potentiometer is connected to terminal 8 and the other end is connected to terminal 10. It is important to wire the potentiometer so that when the actuator moves toward the ccw position, the potentiometer resistance between terminals 9 and 10 of TB2 will increase.

A potentiometer that is wired in the wrong direction will drive the actuator to either the fully ccw or the fully cw position with no user control.

For proper operation, it is important to use a linear taper potentiometer with a value between 1000 ohms (1kohm) and 5000 ohms (5kohm). To ensure a stable and reliable feedback signal, the potentiometer must be securely mounted.

3.2. AC POWER WIRING.

Terminal block TB1 is used for AC power input to the TMC2 controller.

Connect 115 VAC (the "hot" wire) to terminal 2 and Neutral to terminal 1. Please study Figure 4 before wiring TB1.

3.3. SIGNAL WIRING.

As shown in Figure 4, all signal wiring is connected to terminal block TB2.

When using a 4 to 20 mA, 1 to 5 mA or 1 to 5 V command signal, connect the positive signal to terminal 2 and the common (negative) signal to terminal 4.

When using a 0 to 10 V command signal, connect the positive signal to terminal 3 and the common (ground) signal to terminal 4.

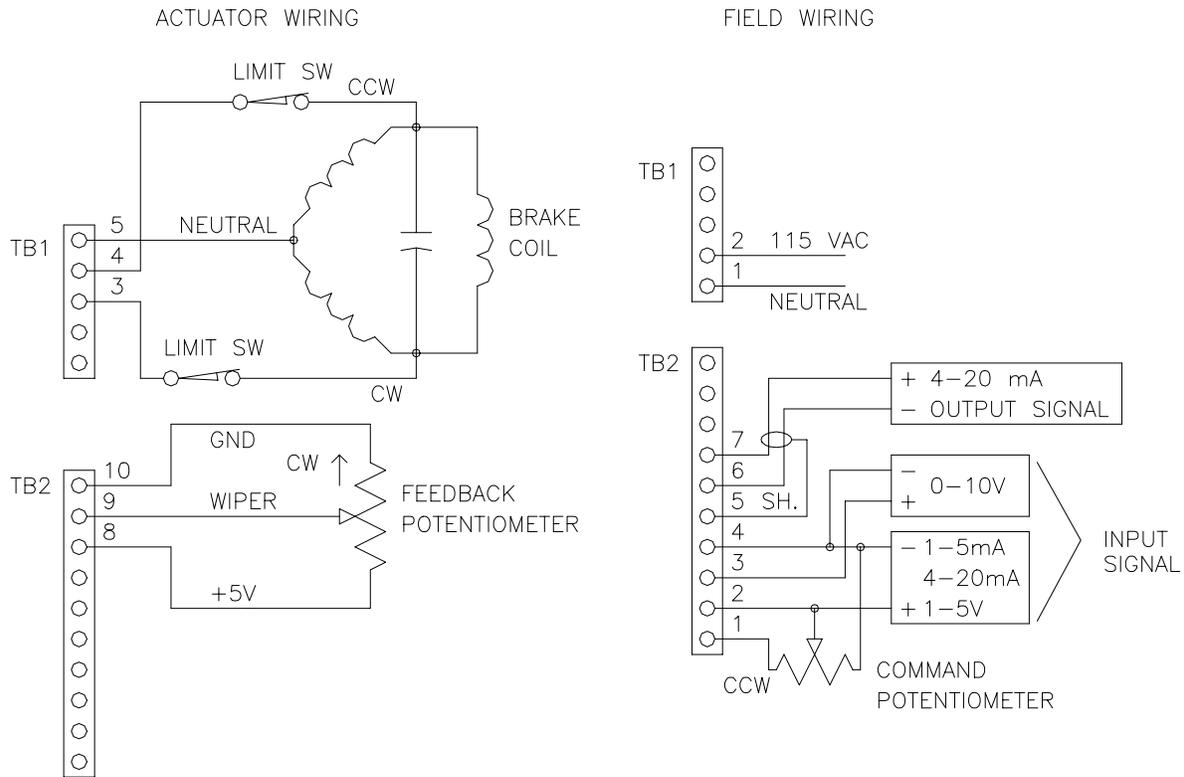


FIGURE 4. ACTUATOR AND FIELD WIRING.

It is also possible to use a potentiometer for the command signal. Connect the cw terminal of the potentiometer to terminal 1 of TB2, the wiper to terminal 2 of TB2 and the ccw terminal of the potentiometer to terminal 4 of TB2 (ground). For best results, the potentiometer resistance should be 1000 ohms (1 kohm).

The TMC2 controller can be equipped with an on-board 4 to 20 mA transmitter. The positive output signal will be available at terminal 7 and the common (negative) signal is connected to terminal 6.

Please note that the current output does not need an external loop power supply and must not be connected to such a loop. The external load should be resistive without any

excitation voltage present.

If a shielded cable is used for the signal input wiring or the current output wiring, the shield can be connected to terminal 5. This terminal is connected to the actuator enclosure through the mounting bracket.

4. PROGRAMMING JUMPER.

Before using the TMC2 controller, it is important to set the on-board programming jumper for the proper type of command signal.

The type of command signal used is programmed using the "INP CONF" jumper (JP1 in Figure 3). The jumper should be installed in the "4-20MA" position when using a 4 to 20 mA command signal. The jumper should be installed in the "1-5MA" position when using a 1 to 5 mA command signal. The jumper is installed in the 0-10V position when using a 0 to 10 V command signal or when using a local command potentiometer. If a 1 to 5 V command signal is used, the jumper must be removed from JP1.

5. OUTPUT INDICATORS.

The TMC2 controller makes use of two LED's to indicate the status of the actuator motor outputs. When the ccw output is on, the green LED (L1 in Figure 3) is active. The red LED (L2 in Figure 3) indicates an active cw output.

6. CALIBRATION MODE.

Information regarding the location of the various controls used in the calibration process can be found in Figure 3.

Begin the calibration process by wiring the actuator as described in section 3.1. Next, wire the AC power input as described in section 3.2. Do not apply power at this stage.

Switch SW4-1 (see Figure 3) to the ON

position (this will select the calibration mode).

6.1. FEEDBACK SIGNAL.

Before proceeding with the calibration, it is very important to center the travel of the feedback potentiometer. The following steps will ensure that the potentiometer is properly centered:

Switch SW4-7 to the ON position. Using caution, turn on AC power. Position the actuator half way between the desired travel limits. To move the actuator in the ccw direction, use SW1. The green LED will light. To move the actuator in the cw direction, use SW2. The red LED will light.

Loosen the set screw on the feedback potentiometer. Slowly turn the potentiometer while observing the yellow LED (L3 in Figure 3). At some potentiometer position, the yellow LED will light. This indicates the center position of the feedback potentiometer. The indicator is very sensitive, so care is necessary in order not to miss the center position of the potentiometer. Without moving the potentiometer, re-tighten the set screw. Turn OFF SW4-7.

6.2. FULLY CW/CCW POSITION.

Setting the fully ccw and fully cw positions of the actuator can be accomplished with or without a command signal. Both methods will be covered.

First, make sure that all switches on SW4 are OFF except SW4-1 that should be in the ON position. For information regarding the use of the DIP-switches (SW4) in the run mode, please refer to Figure 5. Using caution, turn on AC power.

If using a command signal, proceed to section 6.2.2.

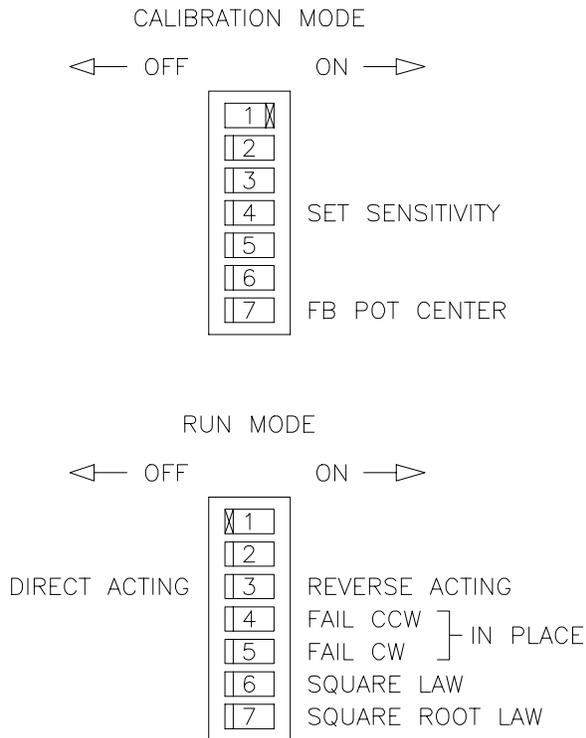


FIGURE 5. SW4 SETTINGS.

6.2.1. NO COMMAND SIGNAL.

When using a 1 to 5 mA command signal, the basic accuracy of the controller is compromised if the fully ccw and cw positions are set without a command signal present. The accuracy that can be achieved without a command signal is approximately 1%. If the input is a 1 to 5 mA signal and maximum accuracy is desired, please proceed to section 6.3.

The first step is to make sure that there is no signal present on the command input. Any

signal present may interfere with actuator accuracy.

Next, move the actuator to the desired fully cw position by using SW2 (the cw output is active) or SW1 (the ccw output is active). If the actuator stops short, check the setting of the limit switch. It is very important that the fully cw position is located on the cw side of the actuator center position.

When the actuator is properly positioned, push SW3 (the red push button) to save the fully cw position to memory. The yellow LED and the red LED should light for about one second indicating a successful save. The red LED indicates that the position saved is the cw position (the position is on the cw side of center).

Move the actuator to the desired fully ccw position by using SW1 (the ccw output is active). If the actuator stops short, check the setting of the limit switch. It is very important that the fully ccw position is located on the ccw side of the actuator center position.

When the actuator is properly positioned, push SW3 (the green push button) to save the fully ccw position to memory. The yellow LED and the green LED should light for about one second indicating a successful save. The green LED indicates that the position saved is the ccw position (the position is on the ccw side of center).

Proceed to section 6.3.

6.2.2. WITH COMMAND SIGNAL.

The fully ccw and fully cw positions can also be set with a command signal present. If a 1 to 5 mA command signal is used, calibration with a signal is necessary to obtain the highest accuracy.

Normally, there is no need to supply a command signal (see section 6.2.1), but there are some situations when it may improve the actuator accuracy. This is particularly true if the command signal source shows poor accuracy, supplying a signal that is not exactly 4mA to 20mA or 0V to 10V.

The first step in the calibration-with-command signal procedure is to make sure that there is an appropriate low command signal present on the command input. If the controller is using a 4 to 20 mA or a 1 to 5 mA signal, the low signal (typically 4 mA or 1 mA) must be present. If the controller is using a 0 to 10V signal, the low signal (typically 0V) must be present.

Move the actuator to the desired fully cw position (see section 6.2.1). It is very important that the fully cw position is located on the cw side of the actuator center position. When the actuator is properly positioned, push SW3 to store the fully cw position together with the low command signal in memory. The yellow LED and the red LED should light for about one second indicating a successful save. The red LED indicates that the position saved is the cw position (the position is on the cw side of center).

Change the command signal to 20mA/5mA or 10V.

Move the actuator to the desired fully ccw position (see section 6.2.1). It is very important that the fully ccw position is located on the ccw side of center. When the actuator is properly positioned, push SW3 to store the fully ccw position together with the high command signal in memory. The yellow LED and green LED should light for about one

second indicating a successful save. The green LED indicates that the position saved is the ccw position (the position is on the ccw side of center).

The TMC2 controller will use the stored values for low and high command signals until re-calibrated (with or without a command signal).

6.3. COMMAND SENSITIVITY.

When in the run mode, the outputs of the TMC2 controller are activated by a change in the command signal. The magnitude of change necessary to activate the outputs is under user control and is set by potentiometer P2. The potentiometer setting is stored in memory and, once stored, is not affected by the setting of the potentiometer.

To calibrate the sensitivity, set SW4-1 and SW4-4 to the ON position with all other switches set to the OFF position. Apply AC power. Adjust potentiometer P1 for the desired sensitivity (see Figure 7). If P1 is set fully ccw, the controller is set for maximum sensitivity (this is the factory setting). If set fully cw, the controller is set for minimum sensitivity. Push SW3 to store the sensitivity in memory. The yellow LED should light for about one second indicating a successful save.

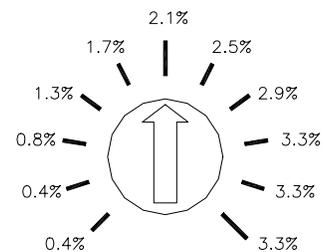


FIGURE 7. SENSITIVITY SETTINGS (% OF FULL SCALE).

7. RUN MODE.

To enter the run mode, set SW4-1 to the OFF position. For information regarding the use of the DIP-switches (SW4) in the run mode, please refer to Figure 5. When in this mode, the TMC2 controller moves the actuator to a position which is calculated using the command input together with the stored fully ccw and cw positions. When using a 4 to 20 mA, 1 to 5 mA or 1 to 5 V command signal, it is also important to configure the signal loss mode.

7.1. COMMAND SIGNAL LOSS.

If a 4 to 20 mA, 1 to 5 mA or 1 to 5 V command signal is lost, the TMC2 controller can be programmed to act in a predictable manner. The setting of switches SW4-4 and SW4-5 controls the failure mode. The switches have no effect if JP1 is configured for a 0 to 10 V input. A lost command signal is defined as a signal that is less than 75% of the low signal level (nominally 3mA, 0.75mA or 0.75V).

If SW4-4 and SW4-5 are both in the ON position, the actuator will fail in place when the command signal is lost. If the actuator is moving when the signal is lost, it will stop when the command signal falls below the signal loss threshold.

If SW4-4 is in the ON position and SW4-5 is in the OFF position, the actuator will fail in the fully ccw position. This is true whether the controller is set for direct acting or reverse acting.

If SW4-5 is in the ON position and SW4-4 is in the OFF position, the actuator will fail in the fully cw position. This is true whether the controller is set for direct acting or reverse acting.

If SW4-4 and SW4-5 are both in the OFF position, the controller will use the low (below 4mA or 1V) command signal as is. If the controller is set for direct acting drive, the actuator will move to the fully cw position. If the controller is set for reverse acting drive, the actuator will move to the fully ccw position.

7.2. DIRECT/REVERSE ACTING.

Normally, the actuator will move to the fully cw position when the command signal is low (4 mA, 1 mA or 0 V). This mode of operation is referred to as direct acting.

Sometimes it is desirable to have the actuator move to the fully cw position when the command signal is high (20 mA, 5 mA or 10 V) and to the fully ccw position when the command signal is low (4 mA, 1 mA or 0 V). This mode of operation is referred to as reverse acting.

To set the controller to the direct acting mode, switch SW4-3 to the OFF position. To change to the reverse acting mode, switch SW4-3 to the ON position. No other changes are necessary.

Please note that the controller is wired exactly the same for both direct and reverse acting mode. The calibration procedure for the fully ccw and fully cw positions is not affected by the choice of direct or reverse acting mode.

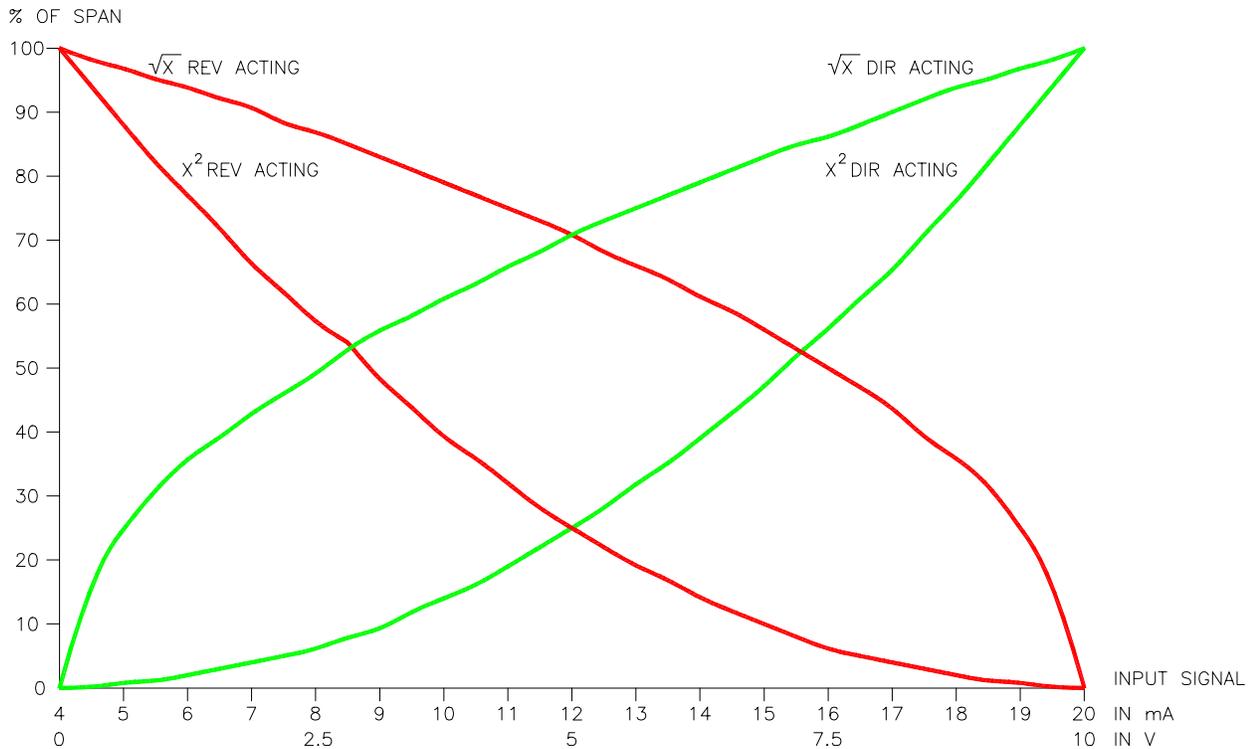


FIGURE 6. ACTUATOR POSITION VS. COMMAND INPUT.

7.3 NON-LINEAR OUTPUT.

The TMC2 controller has the ability to use a non-linear relationship between the actuator position and the command signal. Two non-linear relationships are available.

If SW4-6 is in the ON position, the actuator position is proportional to the square of the command signal.

If SW4-7 is in the ON position, the actuator position is proportional to the square root of the command signal.

The relationship between the command input and the actuator position is shown in Figure 6.

7.4. 4 TO 20 mA OUTPUT.

The 4 to 20 mA output (TB2-6 and TB2-7) will track the position of the feedback potentiometer.

When the controller is operating in the direct acting mode, the output will be 4 mA at the fully cw position and 20 mA at the fully ccw position.

When the controller is operating in the reverse acting mode, the output will be 20 mA at the fully cw position and 4 mA at the fully ccw position.

8. SPECIFICATIONS.

8.1. AC POWER.

115VAC \pm 10%, 50 or 60 Hz.

8.2. SIGNAL INPUTS.

The inputs have a basic 8 bit accuracy.

0-10 VDC Command Input: 200 kohm input impedance.

Command Potentiometer Input: 5.25 VDC nominal voltage. 100 kohm input impedance. Use with 1 kohm potentiometer.

1-5 VDC Command Input: 100 kohm input impedance. Loss of signal threshold is 75% of low signal.

4-20 mA Command Input: 250 ohm input impedance. Loss of signal threshold is 75% of low signal.

1-5 mA Command Input: 1 kohm input impedance. Loss of signal threshold is 75% of low signal.

Feedback Input: 5.25 VDC excitation voltage (nominal value). 1 Mohm input impedance. Use with 1000 to 5000 ohm potentiometer.

8.3. 4 TO 20 mA OUTPUT.

500 ohm maximum load impedance. 8 bit (1 in 255) basic accuracy.

8.4. AC MOTOR OUTPUTS.

When properly mounted, the outputs will supply a load current of 3A with less than 5 mA of leakage current.

8.5. FUSING.

The TMC2 AC power is fuse protected. The fuse should be tailored to the demands of the actuator motor used. The rating of the fuse should not exceed 5A.

8.6. ENVIRONMENTAL.

Operating temperature: 0°C to 70°C.

Storage temperature: -40°C to 85°C.

Relative humidity: 0 to 90% non-condensing.