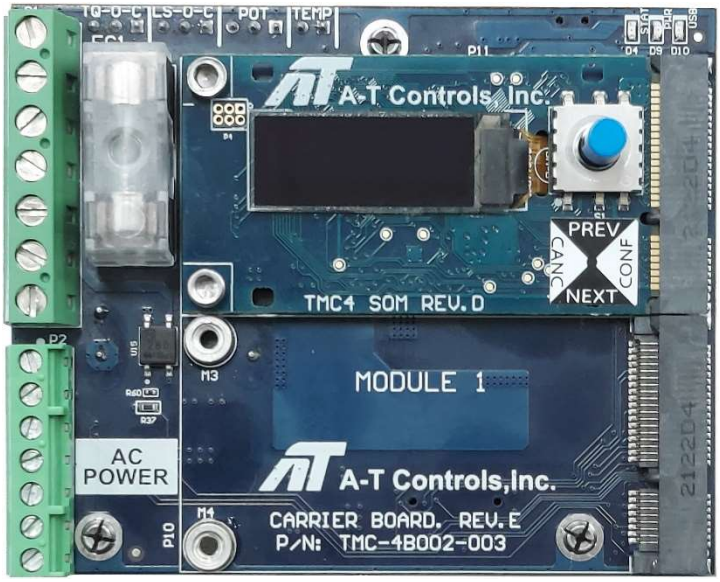
Installation and Operation Manual

TMC-4 Control Card (v3.05)

Features

- 4-20mA, 0-10VDC, 0-5VDC, Potentiometer, Open/Close, Digital Communication command inputs.
- 4-20mA or 0-10VDC self-powered transmitter.
- Programmable fail positions on loss of command signal: In Place, CW, CCW, % Value.
- LCD screen with 5-point joystick for menu navigation.
- Expansion module slot for added options.
- External brake control for spring return actuators.
- Motor temperature monitor by thermistor input.
- Sleep mode for extended screen life.
- 24V DC output for external sensor or transmitter power.



Overview

The Triac TMC4 control card is a motor controller intended to be used in electric actuators rated for running current loads up to 10 amps. The TMC4 control card is available in an AC version that can drive reversible AC motors with an 85-250VAC supply voltage, or a DC version can drive DC motors with a 24VDC supply voltage.

The LCD screen provides simple viewing of status and configuration settings, while a 5-point joystick allows easy navigation through the menus. An optional module slot permits expansion of the controller's capabilities to support various communication protocols or other control and interface options.

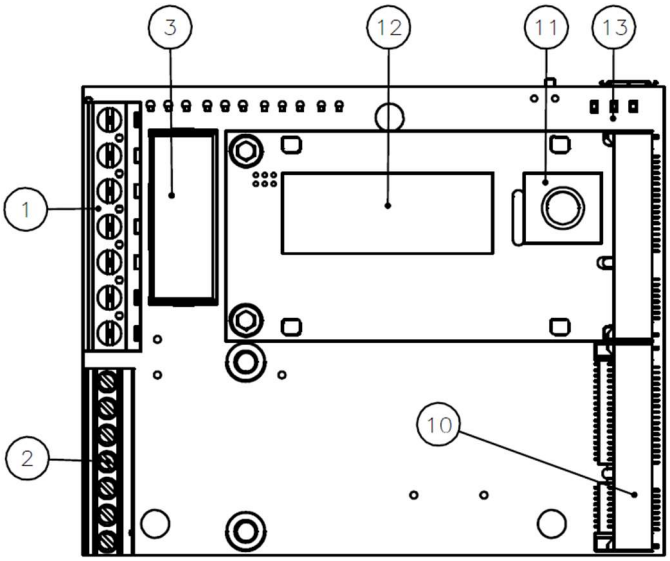
The TMC4 provides two main positioning options; proportional or two position. When operated as a proportional controller, the TMC4 compares an external command signal to a position feedback from a potentiometer connected to the output shaft of the actuator. When the two signals differ by a given magnitude, the TMC4 controller will energize the motor to operate either clockwise or counterclockwise to reduce the difference between the two signals. When operated as two-position controller, the TMC4 receives an open or close command, and drives the actuator clockwise or counterclockwise until activation of a position limit switch is detected.

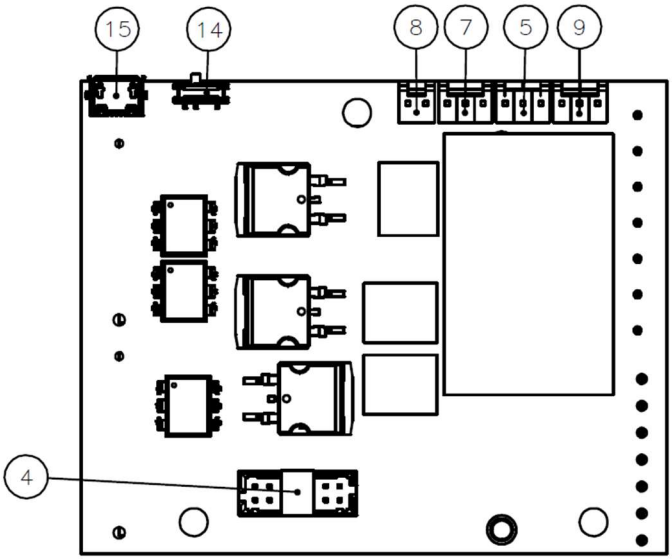
The TMC4 is designed to be mounted using PEM Snap-Top spacers for easy mounting and removal without the need for screws, while still providing a secure mount for most conditions.

> ⚠ The TMC4 must be installed in an appropriate enclosure to avoid electrical shocks. When operating, high voltages will be present on the controller, requiring caution during the installation process. Power should be deenergized before making wire connections to the TMC4. A heater and thermostat should be used when possible to prevent condensation.

Contents

1. Layout





1 – Power / Motor Terminals (P1)
Terminals for connecting supply power, motor connections, enclosure heater, and for external brake for spring return actuators. Refer to 2.1 for details.

2 – Signal Terminals (P2)
Terminals for connecting control signal, analog feedback signal, +24VDC output and Earth/chassis ground connection. Refer to 2.1 for details.

3 – Fuse
The fuse is a standard 5x20mm time delay fuse rated for 10A, 250V. Replacement fuses shall not exceed this maximum rating.

4 – Expansion Header (P4) (option)
14 point connection header for optional accessory interfaces.

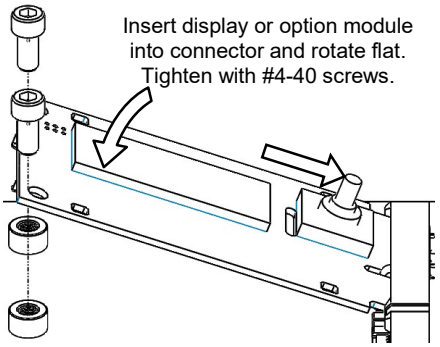
5 – Position Switches Header (P5)
3 point connection header for positioning limit switches when required for actuator control. Switches connected to this header provide position limits when operating as two-position actuator, and provide Open/Close status for the TMC4.

7 – Feedback Potentiometer Header (P7)
3 point connection header for feedback potentiometer when required for actuator control. This provides positioning feedback for when operating as a proportional control actuator.

8 – Thermistor Header (P8) (option)
2 point connection header for optional motor temperature monitor thermistor to prevent motor overheating.

9 – Stop (Torque) Switches Header (P9)
3 point connection header for motor stop limit switches when required for actuator control. Switches connected to this header will stop the motor when activated, without providing Open/Close status. These switches are useful when driving motor directly with the control card, rather than driving the motor through limit or torque switches. This would typically be for DC motor applications, where operating motor through limit switches is not practical.

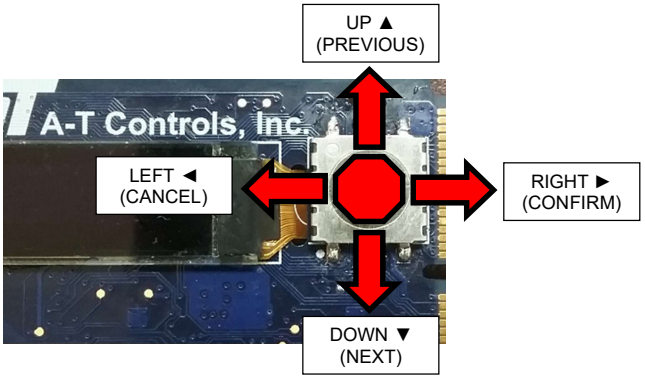
10 – Option Module Slot
mSATA / Mini PCI Express connection point for primary display and optional feature modules such as for serial communication or other control types. Option modules can be installed with (2) 4-40 screws, 3/16” to 1/4" in long.



WARNING!
The TMC4 must not be powered when installing display or optional modules. Failure to install display or module with TMC4 unpowered may result in damage to the display or module board.

11 – Joystick

5-way joystick (up, down, left, right, center) for menu navigation and adjustment of parameters and settings.



Direction	Function
UP ▲ [PREVIOUS]	• Navigate up in menus. • Choose previous setting selection or increase setting value. • Motor CCW in Manual Mode or **POSITION CONFIG** calibrate settings. If Feedback Type set for CMD Out, A2 = Command Span.
DOWN ▼ [NEXT]	• Navigate down in menus. • Choose next setting selection or decrease setting value. • Motor CW in Manual Mode or **POSITION CONFIG** calibrate settings. If Feedback type set for CMD Out, A2 = Command Zero.
LEFT ◄ [CANCEL]	• Navigate left in menus. • Return to previous menu screen or exit menu subgroup. • Cancel or exit setting without saving.
RIGHT ► [CONFIRM]	• Navigate right in menus. • Enter parameter screen to adjust setting. Parameter value will flash indicating it can be changed. • Confirm or save setting when finished changing.

NOTE: When incrementing/decrementing a setting value, the value step increases in value every 6 presses for more rapid adjustment. Reset the step back to +1 by pressing back in opposite direction.

12 – Display

OLED screen to show actuator status and menu options. Display will enter a sleep mode where the display is shut off if joystick has not been used for 5 minutes. Remote functionality is still enabled while in sleep mode. Status LED will flash while in sleep mode. Pressing any direction on joystick will wake up display.

13 – LEDs

Status:
- Blinks 1 second on when in Sleep Mode.
- 3x rapid flash to identify feedback potentiometer mid-range when configuring position.

Power: Solid to indicate the TMC4 is powered either by the supply terminals, or through the USB connector.

USB: Solid to indicate USB cable is connected to the USB connector.

14 – Run/Program Switch

Used by factory for programming and setup. Switch should be in off position (pointed away from USB connector) for normal operation.

15 – USB Connector

USB receptacle. Used by factory for programming and setup. Can be used to power board for configuration without having supply power connected.

2. Wiring and Operation

The supply voltage and motor should be connected as shown in the wiring section.

SUPPLY
Supply voltage is connected to terminals (P1-2) and (P1-3). Line/+ should be connected to (P1-2) and Neutral/- should be connected to (P1-3). The AC version can accept a single phase supply voltage of 85-250VAC, 50-60Hz, while the DC version can accept a supply voltage of 24VDC. An Earth ground connection is provided on terminal (P2-7).

MOTOR
For AC type motors, the winding that drives the actuator clockwise should be connected to the Motor CW terminal (P1-5), and the winding that drives the actuator counterclockwise should be connected to the Motor CCW terminal (P1-6). The motor neutral wire should be connected to the Motor N terminal (P1-7).

For DC type motors, the wires should be connected to the Motor CW (P1-5) and Motor CCW (P1-6) terminals only. When operating DC motors, the Motor CW and Motor CCW terminals switch polarity to the motor. A clockwise operation will apply the positive supply voltage to the Motor CW terminal (P1-5), and a counterclockwise operation will apply the positive supply voltage to the Motor CCW terminal (P1-6). The motor wires should be connected accordingly.

BRAKE
An external brake connection is provided on terminal (P1-4) to operate spring return type actuators that use a motor brake to hold the actuator in position. The output is the same voltage as the supply voltage. The maximum brake output rating of 300mW, 350V, 120mA continuous load must not be exceeded.

The AC version of the TMC4 keeps the external brake output energized until either of the motor outputs is activated, at which point, the external brake output deenergizes. The DC version of the TMC4 keeps the external brake output deenergized until the motor outputs are activated, at which point the external brake output energizes.

The brake setting is currently configured exclusively for use on Triac SRX series actuators and is not configurable. Care must be taken when using with other type of actuator motor brakes.

WARNING!
Using brake output on incorrect brake type may damage the TMC4 card, brake or actuator.

HEATER
The TMC4 also provides a dedicated terminal (P1-1) for a heater output that is internally connected directly to the Line/+ supply terminal (P1-2). An enclosure heater is strongly recommended to prevent moisture inside the actuator enclosure. The other heater connection should either be to motor neutral terminal (P1-7) or supply Neutral/- terminal (P1-3).

I/O
Standard analog control inputs for 4-20mA, 0-5V, 1-5V, 0-10V, 2-10V should be connected to signal input A1 terminals (P2-2) and (P2-3). 4-20mA and 0-10V analog feedback signals should be connected to A2 terminals (P2-4) and (P2-5). This feedback signal is self-powered by the TMC4 controller, so no loop power is required by the user.

The TMC4 can also be configured to operate by a variable resistor input, such as a slide wire or potentiometer by connecting the ends across the +24VDC (P2-1) and AGND (P2-3), and the wiper to the input A1 terminal (P2-2).

The +24VDC output across (P2-1) and (P2-6) is available to drive a single device up to 30mA or use with handheld loop calibrator set as 2-wire transmitter to locally control the actuator while conserving battery power. Refer to wiring diagrams in following section.

The input A1 and output A2 terminals also serve to operate as a two-position actuator when configured for ON-OFF command type using the internally supplied +24VDC output. In ON-OFF command type, A1 terminal (P2-2) functions as the Open/CCW input, and A2 terminal (P2-4) functions as the Close/CW input.

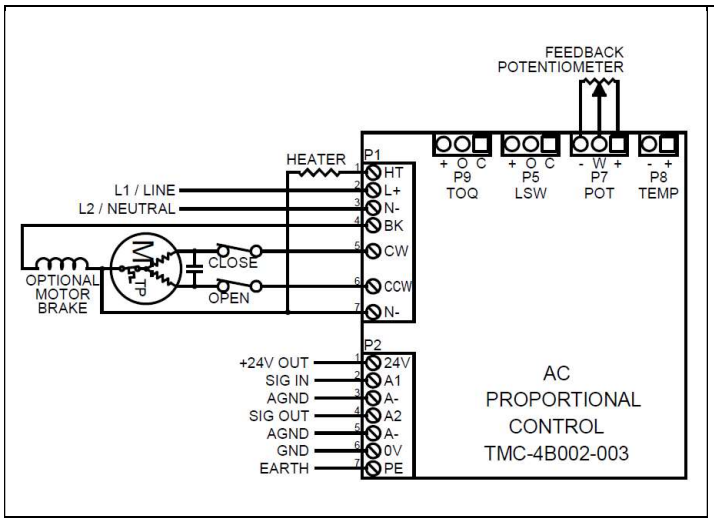
NOTE: If driving the motor through limit switches, the actuator can be operated like a standard on/off, but will not display end of position unless limit switches are wired to the on-board position limit switch connection header (P5).

2.1. Terminals

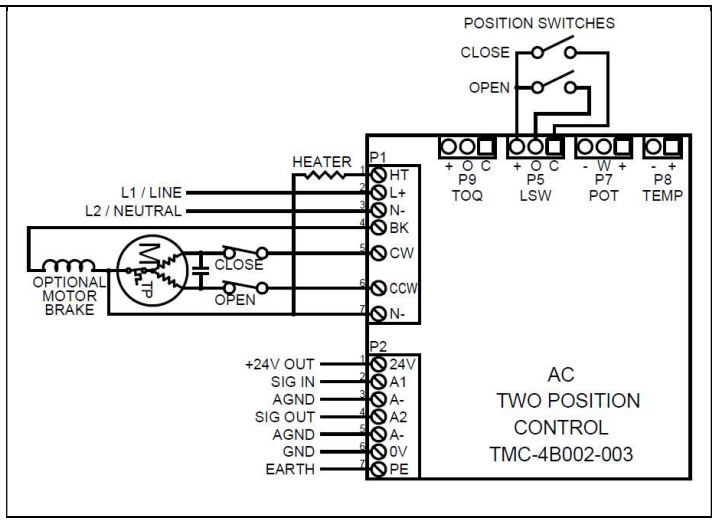
(P1) Power / Motor Terminals		Function
1	Heater (HT)	Supply power output for heater. Internally connected to Supply L/+ terminal.
2	Supply L/+ (L+)	Supply Power AC Line or DC +
3	Supply N/- (N-)	Supply Power AC Neutral or DC -
4	External Brake (BK)	Output for spring return electric actuator brakes. Switches supply power when motor outputs are energized. AC version: Switch off when motor on. DC version: Switch on when motor on.
5	Motor CW (CW)	AC version: Energize clockwise motor winding. DC version: Switch (+) supply voltage for clockwise operation.
6	Motor CCW (CCW)	AC version: Energize counterclockwise motor winding. DC version: Switch (+) supply voltage for counterclockwise operation.
7	Motor N (N-)	Internally connected to Supply N/- terminal. Can be used for second heater connection. AC version: Motor neutral DC version: No motor functionality

(P2) Signal / Comm Terminals		Function
1	+24V Out (24)	Auxiliary 24VDC output.
2	Signal In I/O (A1)	Analog command signal input. Open input when set for On/Off Command Type.
3	Signal GND (-)	Command signal reference.
4	Signal Out I/O (A2)	Analog feedback signal output. Close input when set for On/Off Command Type.
5	Signal GND (-)	Feedback signal reference.
6	0V Out (0V)	0V reference for +24V output.
7	Earth (E)	Connected to enclosure through TMC4 mounting bracket.

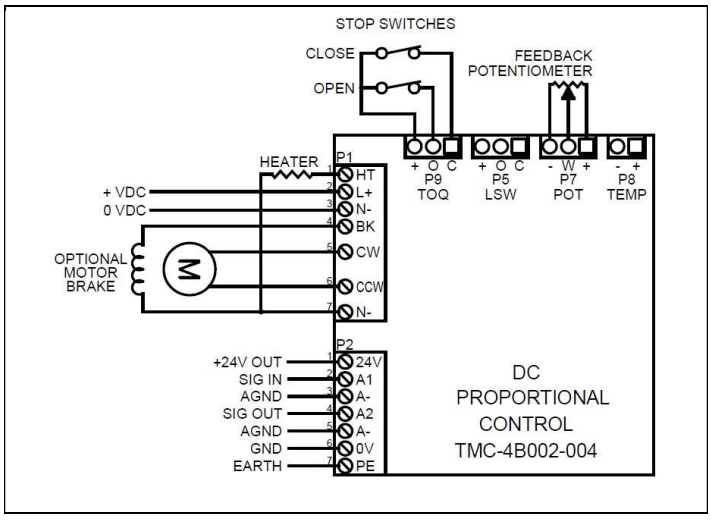
2.2. Wiring Diagrams



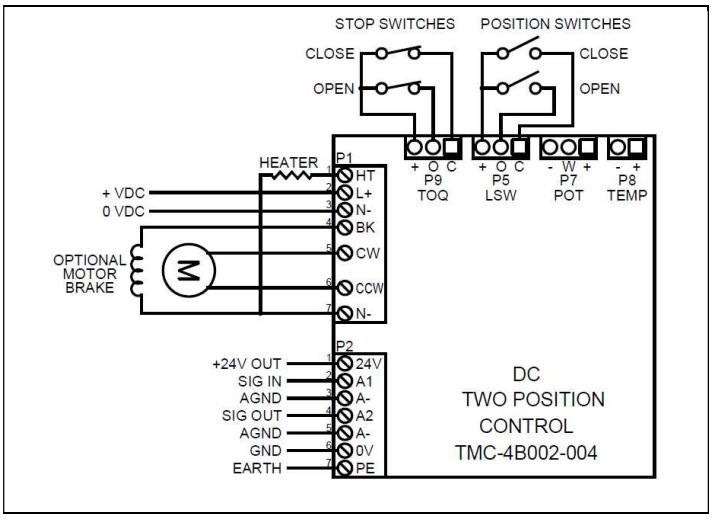
AC Proportional Control



AC Two Position Control

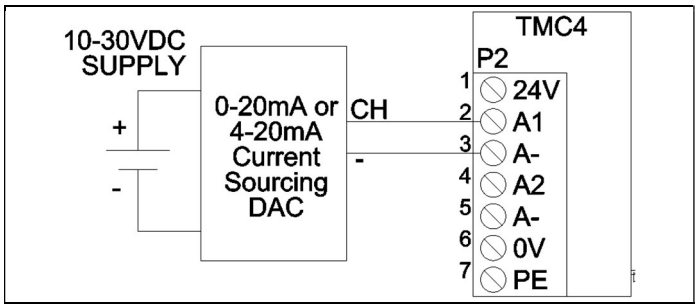


DC Proportional Control

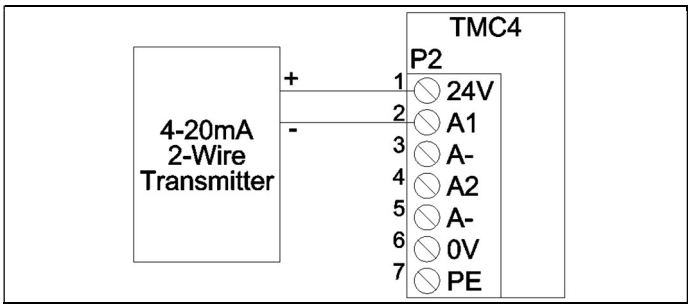


DC Two Position Control

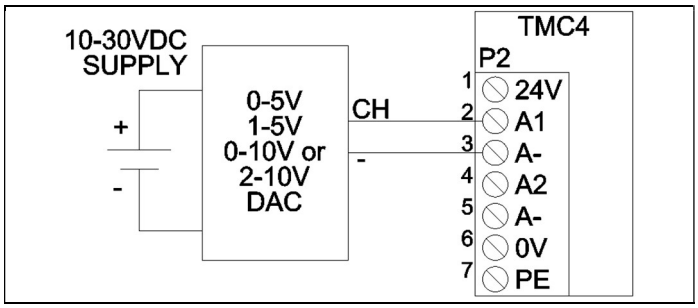
2.3. Input / Output Signal Configurations



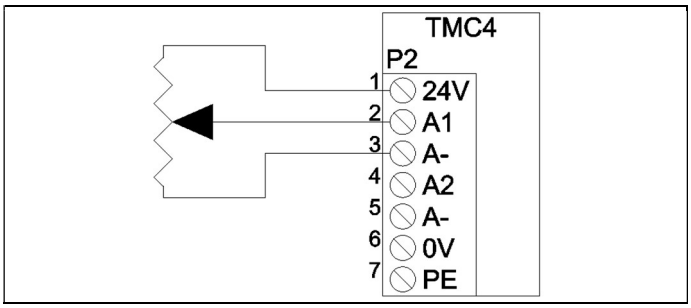
Command Type = mA Sinking
Externally Powered Loop Control



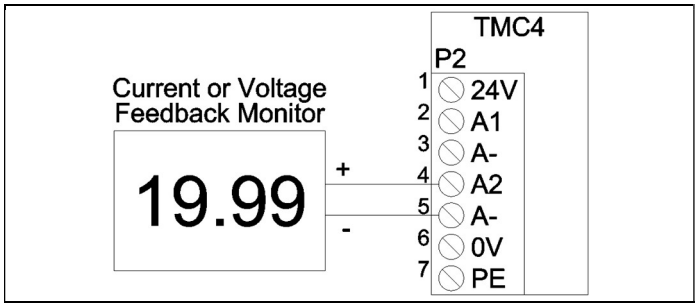
Command Type = mA Sinking
2-Wire Transmitter Control



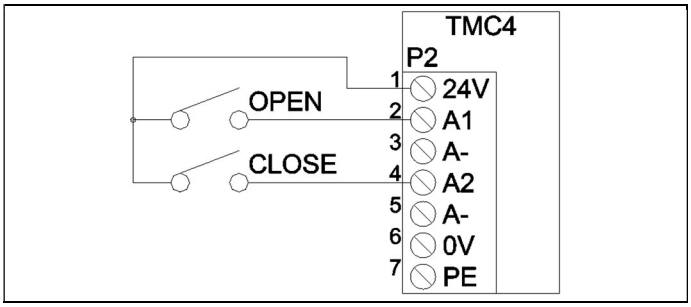
Command Type = 5V and 10V



Command Type = Ohms

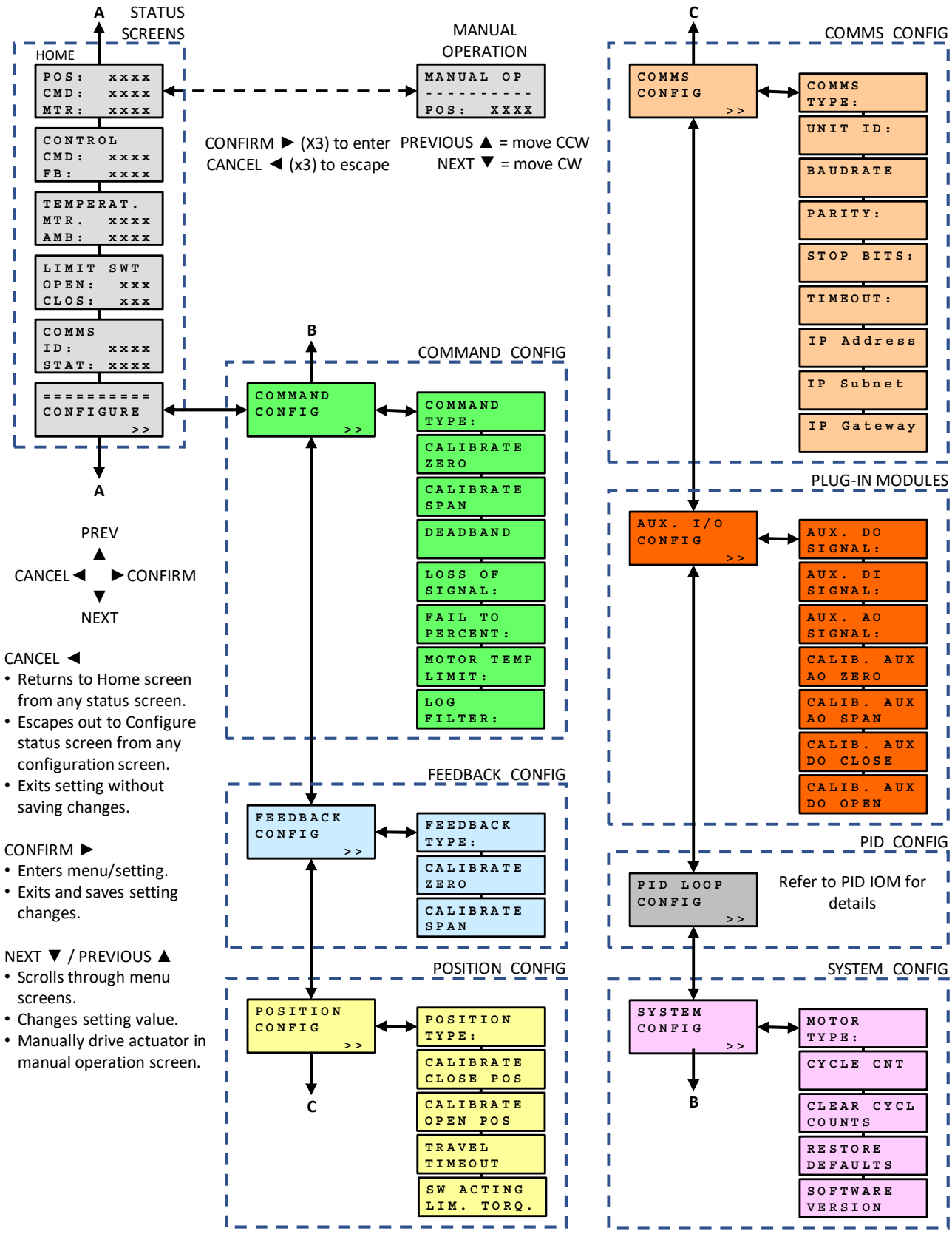


Feedback = mA or V
(Self-powered. Customer loop power not required.)



Command Type = On-Off
Using TMC-4 +24V Output

3. Menu



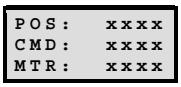
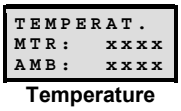
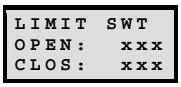
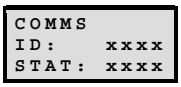
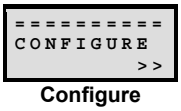
CANCEL ◀
- Returns to Home screen from any status screen.
- Escapes out to Configure status screen from any configuration screen.
- Exits setting without saving changes.

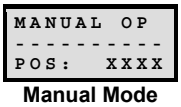
CONFIRM ▶
- Enters menu/setting.
- Exits and saves setting changes.

NEXT ▼ / PREVIOUS ▲
- Scrolls through menu screens.
- Changes setting value.
- Manually drive actuator in manual operation screen.

3.1. STATUS Screens / MANUAL Mode

The **STATUS** screen group contains various screens displaying functional information such as positioning values, motor status and control parameters. Pressing [CANCEL ◄] from any Status screen will return to the Home screen. Pressing [CONFIRM ►] three times from the Home screen will enter a manual control screen where the actuator can manually be controlled open or close with the joystick. Pressing [CANCEL ◄] three times from the manual control screen escapes back to the Home screen.

 **Home**	**POS:** Current travel position. Percentage with "Position Type" set to Potentiometer positioning in **POSITION CONFIG** submenu. If position exceeds 105% the display will change to ">100%" OPEN, N/A, or CLOSE with "Position Type" set to Limit Switch positioning in **POSITION CONFIG** submenu. **CMD:** Setpoint command position. Percentage with "Position Type" set to Potentiometer positioning in **POSITION CONFIG** submenu. 0.0%, 100.0% or STOP with "Position Type" set to Limit Switch positioning in **POSITION CONFIG** submenu. May show LOST if command signal is disconnected, or out of range, depending on command type. **MTR:** Motor status. OPEN, CLOSE, IDLE, HEAT DELAY, or SWITCH HEAT DELAY displays during forced motor off periods when motor temperature limit setting is enabled. SWITCH displays if operation is inhibited from the Position limit switches connected to (P5) or Stop/Torque switches connected to (P9).
 **Control**	**CMD:** Command signal type set in "Command Type" setting in **COMMAND CONFIG** submenu **FB:** Feedback signal type set in "Feedback Type" setting in **FEEDBACK CONFIG** submenu.
 **Temperature**	**MTR:** Motor temperature. Only displays with motor temperature monitoring option connected and enabled. **AMB:** Ambient temperature of TMC4 electronics. Note this may be slightly higher than internal ambient temperature of the installation enclosure.
 **Position & Stop Switches**	Alternates between showing state of Position limit switches connected to (P5) and Stop/Torque switches connected to (P9). Switch state is determined by N.O. or N.C. contact logic set in **POSITION CONFIG** submenu. **OPEN:** State of Open Position or Stop limit switch. ON if limit switch activated. OFF if limit switch is not activated. **CLOS:** State of Close Position or Stop limit switch. ON if limit switch activated. OFF if limit switch is not activated.
 **Communication**	**ID:** Value set in "Unit ID" setting in **COMMS CONFIG** submenu. **STAT:** Communication status. Indicates if communication is active, idle or lost. Shows time of last communication.
 **Configure**	Enters configuration submenus. Remote command signals will not operate actuator when entering configuration settings. If using CMD Out feedback type, terminal A2 will be forced to 0mA output.

 **Manual Mode**	Manually operate actuator with joystick. Remote command signals will not operate actuator when entering configuration settings. If using CMD Out feedback type, terminal A2 will be forced to 0mA output. Press [CONFIRM ►] 3x times to enter. Press [CANCEL ◄] 3x to escape back to Home screen. [PREVIOUS ▲] energizes CCW motor ouput. [NEXT ▼] energizes CW motor output.

3.2. COMMAND CONFIG submenu

The **COMMAND CONFIG** menu group contains various parameters associated with the control and response of the actuator. The command signal type and limits are set in this submenu, as are loss of signal behavior and deadband.

COMMAND TYPE: xxxx
Command Signal Type

Sets type of command signal used. Zero and Span should be recalibrated when changed.
DEFAULT = 4-20mA

10V: Terminal A1 is used as an analog voltage input to receive a 0-10V or 2-10V command signal. Signal range is configurable with the zero and span setting.

5V: Terminal A1 is used as an analog voltage input to receive a 0-5V or 1-5V command signal. Signal range is configurable with the zero and span setting.

4-20mA: Terminal A1 is used as an analog current input to receive a 0-20mA or 4-20mA command signal. Signal range is configurable with the zero and span settings.

Ohms: Terminal A1 is used as an analog resistance input for resistances between 0Ω and 5kΩ. The +24V output should be used to power the resistance input. Signal range is configurable with the zero and span setting.

ON-OFF: Terminal A1 and A2 are used as 24V digital inputs. A1 is the open input. A2 is the close input. The "Feedback Type" setting in the **FEEDBACK CONFIG** submenu is set to Disabled.

Comms: Control by a communication protocol (e.g. Modbus RTU). Specific protocol must be selected in the **COMMS CONFIG** submenu. Requires that an appropriate communication protocol module is installed in the options module slot.

NOTE: If command is set for signal range such as 0-5V, 0-10V, 0-20mA, Loss of Signal function will not be possible. The "zero" value must be greater than 0 for lost signal to be recognized.

Typical Command Signal Values									
	0mA	4mA	20mA		0V	1V	2V	5V	10V
5V Command	-	-	-		(2)*	755	1510	3780	-
10V Command	-	-	-		(2)*	380	760	1900	3800
4-20mA Command	(2)*	747	3732		-	-	-	-	-

* With no command wiring connected, count value will typically read some small value. If count value = 0, signal input wiring +/-may be reversed.

CALIBRATE ZERO xxxx
Calibrate Command Zero

Sets command signal zero digital count value. When selected, provide minimum command signal for direct action, and maximum control signal for reverse action. An input of this magnitude will drive actuator toward the programmed "Calibrate Close Pos" in the **POSITION CONFIG** menu.

Value is scaled between 12 bit count of 0 and 4095 for the selected command type range. Typical values can be found in Section **Error! Reference source not found.**.

CALIBRATE SPAN xxxx
Calibrate Command Span

Sets command signal span digital count value. When selected, provide maximum command signal for direct action, and minimum control signal for reverse action. An input of this magnitude will drive actuator toward the programmed "Calibrate Open Pos" in the **POSITION CONFIG** menu.

Value is scaled between 12 bit count of 0 and 4095 for the selected command type range. Typical values can be found in Section **Error! Reference source not found.**.

DEADBAND x.x%
Deadband

Sets deadband range by percent. This value determines the acceptable deviation from the command setpoint the controller will recognize as valid position. If set to 1.0%, when provided a 50.0% setpoint, the controller will position to between 49.0% and 51.0%. A setpoint outside a value in this range must be provided to move.
RANGE = 0.5% to 50.0% DEFAULT = 1.0%

When selected, use [PREVIOUS ▲] or [NEXT ▼] to adjust value.

LOSS OF SIGNAL: xxxx **Loss of Signal**	Sets behavior of actuator when command signal is lost, or out of range of the set zero and span. DEFAULT = Fail Close **In Place:** Remains in current position on loss of command signal. **Open:** Moves to programmed Open position on loss of command signal. **Close:** Moves to programmed Close position on loss of command signal. **Percent:** Moves to position specified in "Fail to Percent" setting. **Split:** Used for split range applications where signal outside of calibrated zero/span range can still be valid.
FAIL TO PERCENT: xxxx **Fail to Percent**	Sets percent position between 0% and 100% for actuator to control to on loss of command signal. Is only utilized if "Loss of Signal" type is set as "Position". DEFAULT = 50.0%.
MOTOR TEMP LIMIT: xxxx **Motor Temperature Monitor**	Sets temperature ranges for the motor temperature monitor connected to (P8). Below values indicate duty cycle restriction. See Section 5.1 for details. DEFAULT = Disabled **Disabled:** Ignores input to thermistor header (P8). **75C:** Below 75C = normal; 75C to 90C = 60%; 90C to 105C = 40%; Above 105C = 20% **90C:** Below 90C = normal; 90C to 105C = 60%; 105C to 120C = 40%; Above 120C = 20% **105C:** Below 105C = normal; 105C to 120C = 60%; 120C to 135C = 40%; Above 135C = 20%
LOG FILTER: xxxx **Log Rate Filter**	Sets time constant for the log rate filter to smooth out rapidly changing signals. The setting can be disabled to provide no signal filtering, or can provide 4, 8, 16, 32, or 64 second time constant for the filter. See Section 5.2 for details. DEFALUT = Disabled

3.3. FEEDBACK CONFIG submenu

The **FEEDBACK CONFIG** menu group contains parameters associated with the position feedback signal for the actuator. The analog feedback signal can be set and adjusted here.

FEEDBACK TYPE: xxxx **Feedback Signal Type**	Sets type of feedback signal. DEFAULT = 4-20mA **10V:** Terminal A2 is used as an analog voltage output to provide a 0 to 10 VDC signal based on the actuator position. Range is configurable with the zero and span setting. **4-20mA:** Terminal A2 is used as an analog current output to provide a 0 to 20 mA signal based on the actuator position. Range is configurable with the zero and span setting. **CMD Out:** Terminal A2 is used as an analog current output to repeat out a 4-20mA signal based on the command input. This setting can allow the TMC4 to operate a 4-20mA device using one of the available TMC4 communication protocol options, or simultaneously drive a second 4-20mA device with a single control signal. CAUTION! Because this setting repeats out the command signal, this setting should not be used to provide position feedback. CAUTION! A 0mA signal output is normal under certain operations. **Disabled:** Changes terminal A2 from an analog input to a 24V digital input for ON-OFF command type. This feedback type is automatically selected when command type is set for ON-OFF.

Typical Feedback Signal Values

	0mA	4mA	20mA		0V	1V	2V	5V	10V
10V Feedback	-	-	-		205	570	935	2028	3855
mA Feedback	275	928	3550		-	-	-	-	-

CALIBRATE ZERO xxxx **Calibrate Feedback Zero**	Sets feedback signal zero digital count value. When selected, use [PREVIOUS ▲] or [NEXT ▼] to adjust feedback until desired value is measured. Note, this feedback will correspond to the programmed “Calibrate Close Pos” position in the **POSITION CONFIG** menu. If command is set for reverse action, set this value accordingly. Value is scaled between 12 bit count of 0 and 4095 for the selected command type range. Typical values can be found in Section **Error! Reference source not found.**.
CALIBRATE SPAN xxxx **Calibrate Feedback Span**	Sets feedback signal span digital count value. When selected, use [PREVIOUS ▲] or [NEXT ▼] to adjust feedback until desired value is measured. Note, this feedback will correspond to the programmed “Calibrate Open Pos” position in the **POSITION CONFIG** menu. If command is set for reverse action, set this value accordingly. Value is scaled between 12 bit count of 0 and 4095 for the selected command type range. Typical values can be found in Section **Error! Reference source not found.**.

3.4. POSITION CONFIG submenu

The **POSITION CONFIG** menu group contains parameters associated with the positioning of the actuator. There are three types of positioning methods used. The first uses limit switches for two position operation. The second uses a feedback potentiometer for modulating or proportional control operation. The third determines position from a mA signal input to the A1 terminal, also for modulating or proportional control operation.

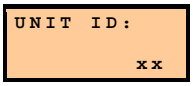
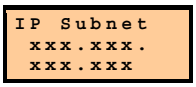
When using limit switches, the open and close limits are set using the mechanical cams and limit switches in the actuator. These switches should be connected to (P5) Limit Switch header. When using feedback potentiometer or A1 current input, the open and close limits are programmed in this submenu. The potentiometer should be connected to (P7) Feedback Potentiometer header.

POSITION TYPE: xxxx **Position Type**	Sets type of feedback used for positioning. DEFAULT = Potentiometer **Limit SW:** Uses position limit switches connected to (P5) header to detect end of travel position for two-position and on/off control. "Calibrate Close" and "Calibrate Open" position settings are not used. **Potent:** Uses potentiometer connected to (P7) header to detect position for modulating and proportional positioning control. Limits are determined by the "Calibrate Close" and "Calibrate Open" position settings. **mA In:** Uses 0 to 20mA signal on terminal A1 to detect position for modulating and proportional positioning control Limits are determined by the "Calibrate Close" and "Calibrate Open" position settings. CAUTION! This setting should only be used with "Comms" command type.
CALIBRATE CLOSE POS xxxx **Calibrate Close Position**	Only used with potentiometer feedback type to set position limit when the CW motor output is energized to move actuator in clockwise direction. This position will correspond to the "zero" value set in **COMMAND CONFIG** submenu. When selected, use [PREVIOUS ▲] or [NEXT ▼] to drive motor to desired close/clockwise position. If limit switch position type is selected, this value is not used during operation. Value is scaled between 12 bit count of 0 and 4095 based on the measured feedback potentiometer position. There is no "correct" value to set to, but it is recommended to fall within the range of 400-3700.
CALIBRATE OPEN POS xxxx **Calibrate Open Position**	Only used with potentiometer feedback type to set position limit when the CCW motor output is energized to move actuator in counterclockwise direction. This position will correspond to the "span" value set in **COMMAND CONFIG** submenu. When selected, use [PREVIOUS ▲] or [NEXT ▼] to drive motor to desired open/counterclockwise position. If limit switch position type is selected, this value is not used during operation. Value is scaled between 12 bit count of 0 and 4095 based on the measured feedback potentiometer position. There is no "correct" value to set to, but it is recommended to fall within the range of 400-3700.
TRAVEL TIMEOUT xxS **Travel Timeout**	Only used with communication bus options. Value should be greater than the normal actuator travel time. The TMC4 begins a timer when the motor outputs are energized to control the actuator to the commanded position. If the timer exceeds the timeout value before the command position is reached, the motor output is turned off. When selected, use [PREVIOUS ▲] or [NEXT ▼] to adjust value. Can also be configured via communication protocol. DEFALUT = 60 seconds
SW ACTING LIM. TORQ. xxxx xxxx **Switch Action**	Sets contact logic of the (P5) position limit switches and (P9) stop/torque switches. DEFAULT = N.O. / N.O. **(P5) Limits** / **(P9) Stop/Torque**: N.O. / N.O.; N.C. / N.C.; N.O. / N.C.; N.C. / N.O. N.O. indicates normally open action where input is activated when switch contact is closed. N.C. indicates normally closed action where input is activated when switch contact is opened.

NOTE: Calibrate Close and Calibrate Open value is scaled between 12 bit count of 0 and 4095 based on potentiometer reading. It may increase or decrease depending on how potentiometer is wired, but should never jump between 0 and 4095 extremes.

3.5. COMMS CONFIG submenu

The **COMMS CONFIG** menu group contains parameters associated with the various communication protocols supported by the TMC-4 control card. While some parameters in other menus are configurable via communication link, the communication parameters necessary to establish the link such as device ID or address must be set here first.

 **Communication Type**	Sets type of communication protocol when using one of the communication module options. Communication to the TMC4 is possible without controlling the actuator, but if using the communication link as the means to control the actuator, "Comms" command type must be selected in the **COMMAND CONFIG** submenu. **Modbus RTU** Modbus RTU **Modbus TCP** Modbus/TCP **Profibus** Profibus DP **EthernetIP** Ethernet/IP
 **Unit ID**	Actuator ID address. Selectable from 1 to 246. DEFAULT = 1
 **Baud Rate**	Communication channel data rate. 9600, 19200, 57600, 115200 bps DEFAULT = 9600
 **Parity**	Communication channel parity setting. None, Odd, Even DEFAULT = None
 **Stop Bits**	Communication channel stop bits setting. One, Two DEFAULT = One
 **Timeout**	Communication timeout. Determines duration of time which the actuator must receive communication before entering fault condition. DEFAULT = 10 seconds
 **IP Address**	Shows the IP address for the actuator. DEFAULT = 192.168.0.10
 **IP Subnet**	Shows the IP subnet mask for the actuator. Subnet mask is changed the same as the IP Address. DEFAULT = 255.255.255.0
 **IP Gateway**	Shows the IP gateway for the actuator. Gateway is changed the same as the IP Address. DEFAULT = 192.168.0.1

To change the IP address, subnet mask or gateway, press [CONFIRM ►] to enter an octet so the number is flashing. While number is flashing, use [PREVIOUS ▲] or [NEXT ▼] to adjust value, then press [CONFIRM ►] to save change. Press [CONFIRM ►] again to enter the next octet to change.

3.6. AUX. I/O CONFIG submenu

The **AUX. I/O CONFIG** menu group contains parameters associated with additional I/O modules that can be added with specific options.

AUX. DO SIGNAL: xxxx **Auxiliary Digital Output Function**	Sets functionality of the auxiliary digital outputs. **O-C Out** Digital outputs provide programmable auxiliary limit switch outputs based on values set in the "Calibrate Aux. DO Close" and "Calibrate Aux. DO Open" settings. This setting can only be used with proportional control applications since it requires a percentage value based on using a feedback potentiometer. DO1 = Programmed Aux Open position DO2 = Programmed Aux Close position **Limit SW** Digital outputs mirror the position limits of the switches connected to position switch header (P5). DO1 = Open position limit DO2 = Close position limit **Motor Out** Digital outputs mirror the motor outputs. When specified motor output is energized, the corresponding digital output is activated. DO1 = CCW motor output DO2 = CW motor output
AUX. DI SIGNAL: xxxx **Auxiliary Digital Input Function**	Sets functionality of the auxiliary digital inputs. **Disable** Digital inputs are disabled. **Local Ctrl** Digital inputs are configured for local/remote inputs. DI1 = Local open switch input. Provides command to drive actuator to the calibrated open position if DI3 is active. DI2 = Local close switch input. Provides command to drive actuator to the calibrated close position if DI3 is active. DI3 = Local/remote switch input. Enters local control mode and disables normal remote signals allowing operation using DI1 and DI2. CMD will display as "LOCAL".
AUX. AO SIGNAL: xxxx **Auxiliary Analog Output Function**	Sets functionality of the auxiliary analog outputs. **Feedback** Provides auxiliary 4-20mA analog output independent of standard feedback signal based on calibrated auxiliary output zero and span. **4mA** Provides constant 4mA analog output based on calibrated auxiliary output zero and span. **20mA** Provides constant 20mA analog output based on calibrated auxiliary output zero and span.
CALIB. AUX AO ZERO xxxx **Calibrate Aux. Analog Out Zero**	Sets auxiliary analog output signal zero digital count value. When selected, use [PREVIOUS ▲] or [NEXT ▼] to adjust feedback until desired value is measured. Note, this feedback will correspond to the programmed "Calibrate Close Pos" position in the **POSITION CONFIG** menu. If command is set for reverse action, set this value accordingly. Value is scaled between 12 bit count of 0 and 4095 for the selected command type range.
CALIB. AUX AO SPAN xxxx **Calibrate Aux. Analog Out Span**	Sets auxiliary analog output signal span digital count value. When selected, use [PREVIOUS ▲] or [NEXT ▼] to adjust feedback until desired value is measured. Note, this feedback will correspond to the programmed "Calibrate Open Pos" position in the **POSITION CONFIG** menu. If command is set for reverse action, set this value accordingly. Value is scaled between 12 bit count of 0 and 4095 for the selected command type range.
CALIB. AUX DO CLOSE 5% **Calibrate Aux. Digital Out Close**	Sets percentage value for when DO1 is activated when Aux. DO Output set for "O-C Cmd" function. DO1 is activated between this set value and the close (0%) position set in the **POSITION CONFIG** submenu. Default value of 5% meaning between 0% and 5%, DO1 will remain activated.
CALIB. AUX DO OPEN 95% **Calibrate Aux. Digital Out Open**	Sets percentage value for when DO2 is activated when Aux. DO Output set for "O-C Cmd" function. DO2 is activated between this set value and the open (100%) position set in the **POSITION CONFIG** submenu. Default value of 95% meaning between 95% and 100%, DO2 will remain activated.

3.7. PID LOOP CONFIG submenu

The **PID LOOP CONFIG** menu group contains options for optional PID control when that feature is unlocked. The menu is inaccessible unless the PID control feature is unlocked. Refer to the TMC4 PID control supplemental document for further information.

3.8. SYSTEM CONFIG submenu

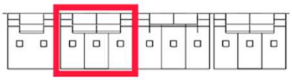
The **SYSTEM CONFIG** menu group contains information for the TMC-4 control card such as software version and cycle count as well as setting for selecting type of motor being operated and restoring factory defaults.

BRAKE TYPE: xx **Brake Type**	Displays type of motor braking based on if using AC TMC4, or DC TMC4. This option is not configurable and automatically detects correct braking type based on the TMC4 AC or DC construction. AC indicates motor brake output turns off when either motor output is energized. DC indicates motor brake output turns on when either motor output is energized. This option is designed for use with A-T Controls SRX series actuators and may not work correctly on other actuators if similar braking device operates opposite that which is described
CYCLE CNT OPEN: xxx CLOS: xxx **Cycle Count**	Displays count for open and close position since power supplied to controller.
CLEAR CYCL COUNTS >> **Clear Count**	Clears cycle count. Press [CONFIRM ►] to select, then press again to confirm and clear counts.
RESTORE DEFAULTS >> **Restore Defaults**	Restores all settings to their default value. Press [CONFIRM ►] to select, then press again to confirm and reset to default values. TMC4 will restart after confirming to restore default values.
SOFTWARE VERSION xx.xx **Software and Hardware Version**	Alternates between showing current software version number and current generation of circuit board. Gen 2 circuit board will display if AC version or DC version.

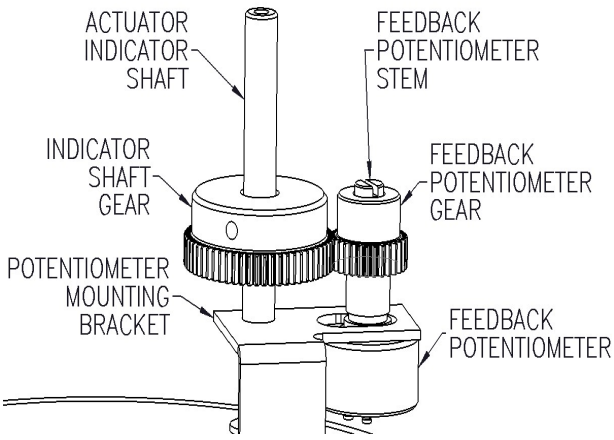
4. General Setup and Calibration

4.1. Positioning Devices

4.1.1. Feedback Potentiometer (P7)



A feedback potentiometer connected to header (P7) is used to measure the position of the actuator between the 0% to 100% limits for modulating and proportional control applications. The feedback potentiometer is coupled to the actuator output indicator shaft using a set of gears.



The feedback potentiometer must remain within its maximum and minimum resistance through the actuator operating range. This can be ensured by first moving the actuator the 50% position, then adjusting the feedback potentiometer to the midpoint of its resistance.

The potentiometer resistance is represented by a 12-bit value (0 to 4095) on the TMC4 display. The midpoint is represented by a value of 2048. When within a suitable range of the midpoint, the Status LED will flash.

NOTE: This midpoint range, 1900 to 2200, ensures the potentiometer does not jump between the minimum and maximum resistance within the operating range for a range of operating angles.

NOTE: It is not as critical to adjust the midpoint to some specific value when setting up the potentiometer as it is to ensure that the potentiometer resistance does not jump between the limits, shown as 12-bit values 0 and 4095, within the operating range. If this occurs, the TMC4 may not properly control the actuator.

The effective electrical angle of the potentiometer, actuator rotation angle, and ratio of the feedback gears determine the high and low 12-bit count values at the full open and full close positions. Typical 12-bit count values for the limits, and resulting range, are shown below for different gearing ratios or operating angles.

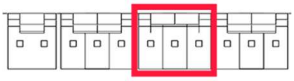
Gear Ratio / Actuator Rotation	Low	High	Range
1:1 / 90°	1506	2590	1084
1:1 / 180° or 2:1 / 90°	964	3132	2168
1:1 / 270° or 3:1 / 90°	422	3674	3252

Table 1: Position Calibration Example Values and Ranges

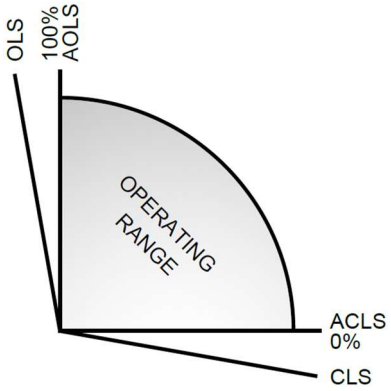
* Values assume 50% midpoint set exactly to 12-bit count of 2048. Actual values may differ.

NOTE: The 12-bit high and low values of the operating range may be swapped depending on rotation direction of the potentiometer in relation to the rotation direction of the actuator. The TMC4 will still correctly interpret the readings when the positions are calibrated.

4.1.2. Position Limit Switch (P5)

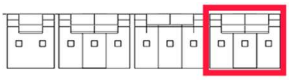


Position limit switches connected to header (P5) are used to set the operating range of the actuator for two position and on/off applications. These switches will stop the actuator at the limits and provide Open or Close status indication to the TMC4 when "Position Type" is set for Limit Switch in **POSITION CONFIG** submenu.

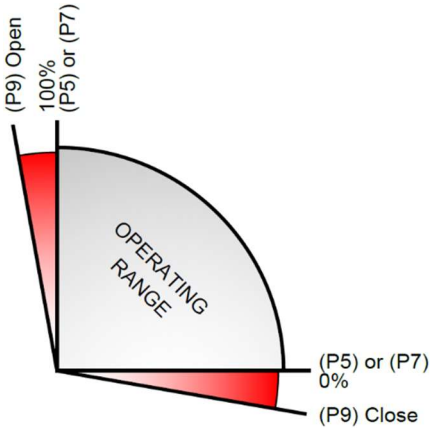


Typically, the auxiliary switches (AOLS and ACLS) in an actuator would be used, and the motor travel stop switches (OLS and CLS) would be set just outside of the operating range. The "Switch Action" setting in the **POSITION CONFIG** submenu must be set according to if using normally open contact (LIM = N.O.) or a normally closed contact (LIM = N.C.).

4.1.3. Stop/Torque Limit Switch (P9)



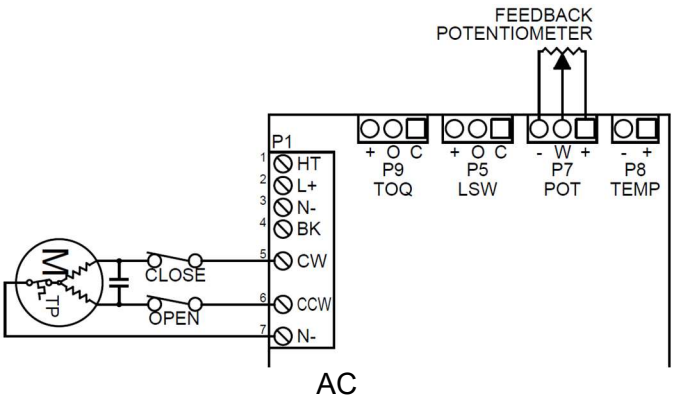
Normally the actuator motor is powered through travel limit switches to stop the actuator motor when the switches break the motor circuit. Sometimes torque switches can also be included to turn off the motor in an over torque condition. However, this is not always possible, such as for DC motors. In these cases, travel limit or torque switches connected to header (P9) can be used to stop the motor regardless of the operating range set using (P7) feedback potentiometer or (P5) position limit switches.



CAUTION!
Since the motor travel limit switches will stop the motor regardless of the operating range, care should be taken to ensure these switches are set outside of the operating range.

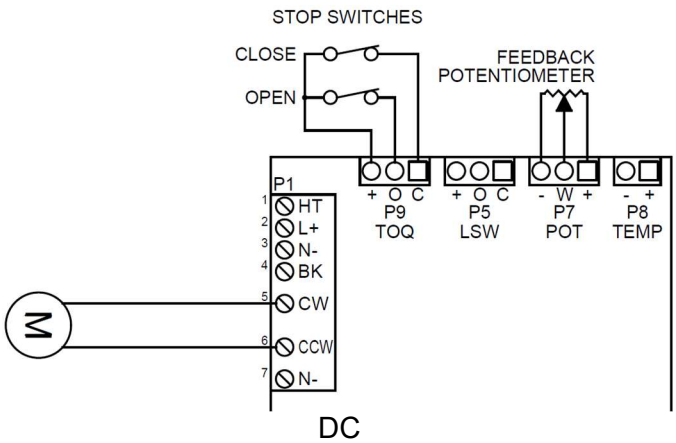
Note that the (P9) switch input provides no position indication for the TMC4. If it did, an over torque condition stopping the actuator may give a false Open or Close status indication. If position indication is required, such as for when using a communication protocol option, position limit switches should also be connected to (P5).

When the motor outputs are wired through travel limit or torque switches, they are typically connected through the N.C. contact. Therefore, it is recommended the switches connected to the Stop/Torque input (P9) also use a N.C. contact configuration. Ensure "Switch Action" setting in the **POSITION CONFIG** submenu is set for a normally closed contact (TORQ = N.C.).



AC

Motor outputs connected to motor through switches.
Stop/Torque switch input not required.



DC

Motor outputs connected directly to motor.
Stop/Torque switch input required.

4.2. Calibration

To change values or settings, press [CONFIRM ►/◙] so value or setting flashes. Change setting with [PREVIOUS ▲] or [NEXT ▼]. Press [CONFIRM ►] to save setting of value. Press [CANCEL ◄] to escape from setting without saving.

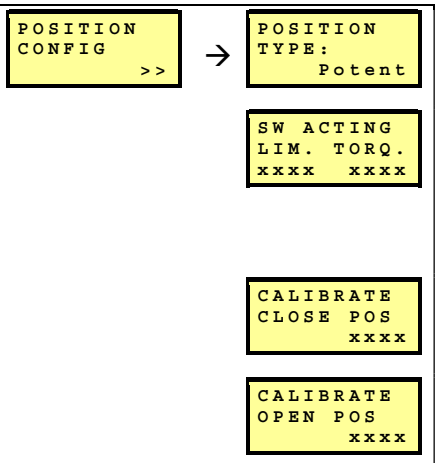
4.2.1. Proportional Control Calibration

For when operating with a 0-100% analog control input signal. This control method scales the analog control signal on the A1 terminal between the calibrated open and close positions based on the potentiometer feedback connected to header (P7). An analog feedback signal of the present position is provided on terminal A2. The calibrated Close (clockwise) position corresponds to the zero command and feedback value, while the calibrated Open (counterclockwise) position corresponds to the span command and feedback value.

1) Set position limits and switch action.
   a) Enter **POSITION CONFIG** submenu.
   b) Set to "Potent" in "Position Type" setting.
   c) Ensure "Switch Action" setting is correct for the actuator configuration. Typical configuration is:

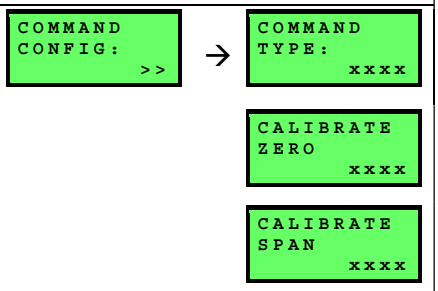
Actuator	Limit	Torque
AC	N.O.	N.O.
DC	N.O.	N.C.

   d) Adjust feedback potentiometer to center at 50% position.
      i) In "Calibrate Close Pos" or "Calibrate Open Pos", hold [PREVIOUS ▲] or [NEXT ▼] to drive actuator to 50% position.
      ii) Rotate feedback potentiometer until display reads between 1900-2200 and Status LED signals mid-range, then tighten gears.
   e) In "Calibrate Close Pos", hold [PREVIOUS ▲] or [NEXT ▼] to drive actuator to desired clockwise position and confirm.
   f) In "Calibrate Open Pos", hold [PREVIOUS ▲] or [NEXT ▼] to drive actuator to desired counterclockwise position and confirm.



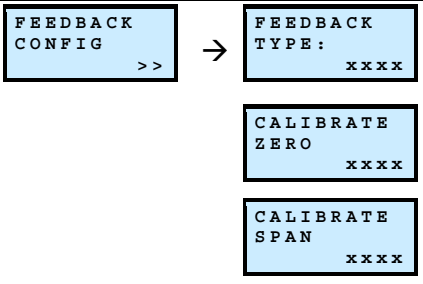
- If actuator does not drive when holding the joystick direction, confirm switch action setting.
- If actuator does not drive to the full open or full close position, confirm limit switches or mechanical stops are not preventing movement.

2) Select and calibrate input command signal (optional).
   a) Enter **COMMAND CONFIG** submenu.
   b) Select desired command signal type in "Command Type" setting and confirm.
   c) Connect command signal source to input terminals per appropriate wiring diagram.
   d) Enter "Calibrate Zero" setting, send 0% command signal and confirm.
   e) Enter "Calibrate Span" setting, send 100% command signal and confirm.



- Typical command signal values are given in table in *3.2 COMMAND CONFIG submenu*.
- Swap 0% and 100% signals for zero and span if setting for reverse action.

3) Select and calibrate output feedback signal (optional).
   a) Enter **FEEDBACK CONFIG** submenu.
   b) Select desired feedback signal type in "Feedback Type" setting and confirm.
   c) Connect feedback signal monitor to output terminals per appropriate wiring diagram.
   d) Enter "Calibrate Zero" setting and adjust feedback signal using [PREVIOUS ▲] or [NEXT ▼] until desired 0% feedback is achieved and confirm.
   e) Enter "Calibrate Span" setting and adjust feedback signal using [PREVIOUS ▲] or [NEXT ▼] until desired 100% feedback is achieved and confirm

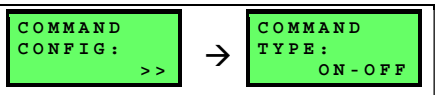


- Typical feedback signal values are given in table in *3.3 FEEDBACK CONFIG submenu*.
- Swap 0% and 100% signals for zero and span if setting for reverse action.

4.2.2. Two-Position Control Calibration

For when operating as two position on/off actuator. This control method uses discrete 24V Open and Close inputs to drive the actuator open or close. Position limits are set using external limit switches. In order for the TMC4 to read the position limits, there must be switch contacts connected to header (P5).

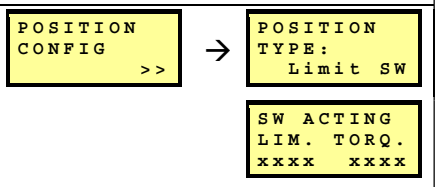
1) Select On-Off input command type.
   a) Enter **COMMAND CONFIG** submenu.
   b) Select “On-OFF” command in “Command Type” setting.



2) Set position limits and switch action.
   a) Enter **POSITION CONFIG** submenu.
   b) Set to “Limit SW” in “Position Type” setting.
   c) Ensure “Switch Action” setting is correct for the actuator configuration. Typical configuration is:

Actuator	Limit	Torque
AC	N.O.	N.O.
DC	N.O.	N.C.

   d) Set position limit switch cams in the actuator.



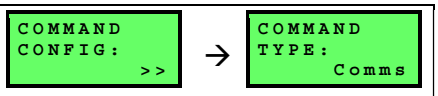
- If actuator does not drive when holding the joystick direction, confirm switch action setting.
- The Manual Operation screen can be used to drive the actuator to set the limit switch cams and will display “Open” or “Close” if switches are connected to header (P5).

4.2.3. Communication Bus Control Calibration

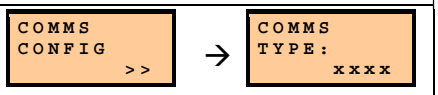
For when operating with one of the optional communication protocol add-on modules. This control method operates the actuator over a supported communication protocol bus. Refer to specific communication option module manual for specific details. The actuator can be operated in either two-position control or proportional control.

When operated with two-position control, positioning is based on external limit switch settings connected to header (P5). When operated with proportional control, positioning is based on the potentiometer feedback connected to header (P7). The calibrated Close (clockwise) position corresponds to the zero command and feedback value, while the calibrated Open (counterclockwise) position corresponds to the span command and feedback value.

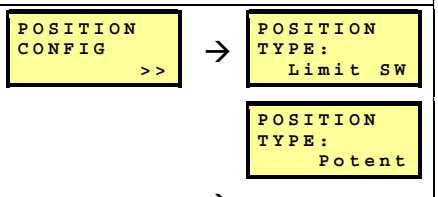
1) Select communication input command type.
   a) Enter **COMMAND CONFIG** submenu.
   b) Select “Comms” command in “Command Type” setting.



2) Configure communication setting.
   a) Enter **COMMS CONFIG** submenu.
   b) Select communication protocol in “Communication Type” setting.
   c) Set address and other communication parameters in appropriate setting within the **COMMS CONFIG** submenu as needed.



3) Set position limits.
   a) Enter **POSITION CONFIG** submenu.
   b) If using actuator for two-position control, see position limits and switch action setup in *4.2.2 Two-Position Control Calibration*.
   c) If using actuator for proportional control, see position limits and switch action setup in *0*
   d)
   e)
   f) *Proportional* Control Calibration.



4.2.4. Communication Bus Control Calibration (with Triac Semi-Integral Control)

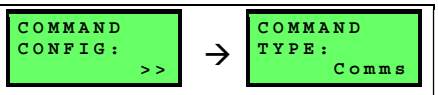
Command Out Feedback Type 4-20mA Converter/Repeater.

For when operating Triac Semi-Integral control module with a communication bus protocol. The control method operates a Triac Semi-Integral control module with a 4-20mA command signal output from the TMC4 A2 terminal, based on the command signal issued over the communication bus.

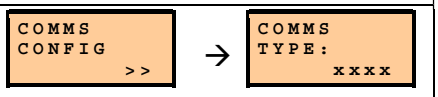
For both two-position control and proportional control, the positioning is accomplished by the Semi-Integral control module, however position is communicated in one of two ways depending on positioning type. When set for “Limit Switch” Position Type, open and close position is detected based on external limit switches connected to header (P5). When set for “Potent” Position Type, 0-100% position is detected based on the Semi-Integral 4-20mA output wired into the A1 analog input terminal.

NOTE: The signal from the A2 terminal is the command signal to the actuator and not a position feedback when using this setting.

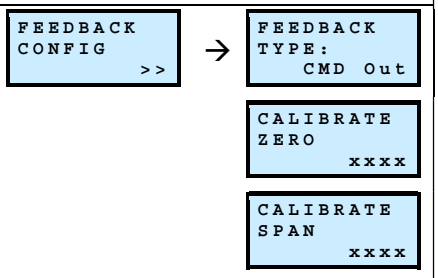
1) Select communication input command type.
   a) Enter **COMMAND CONFIG** submenu.
   b) Select “Comms” command in “Command Type” setting.



2) Configure communication setting.
   a) Enter **COMMS CONFIG** submenu.
   b) Select communication protocol in “Communication Type” setting.
   c) Set address and other communication parameters in appropriate setting within the **COMMS CONFIG** submenu as needed.

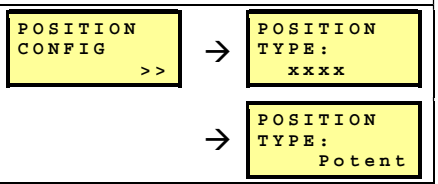


3) Select and calibrate mA output signal.
   a) Enter **FEEDBACK CONFIG** submenu.
   b) Select “CMD Out” in the “Feedback Type” setting and confirm.
   c) Connect feedback signal monitor, or 4-20mA device, to output terminals per appropriate wiring diagram, .
   d) Enter “Calibrate Zero” setting and adjust feedback signal using [PREVIOUS ▲] or [NEXT ▼] until desired 0% output is achieved and confirm.
   e) Enter “Calibrate Span” setting and adjust feedback signal using [PREVIOUS ▲] or [NEXT ▼] until desired 100% output is achieved and confirm.



- Swap 0% and 100% output signals for zero and span if setting for reverse action.
- Typical feedback signal values are given in table in *3.3 FEEDBACK CONFIG submenu*.
- Zero and span adjustment may affect positioning of the 4-20mA device being controlled.

4) Set position limits.
   a) If using actuator for two-position control, see *4.2.2 Two-Position Control Calibration*.
   b) Select communication protocol in “Communication Type” setting.



4.3. Reverse Action / Direct Action

The TMC4 can be configured for reverse or direct action depending on the signal given when setting the command and feedback zero and span. For direct action, set the zero value to the 0% signal and the span value to the 100% signal. For reverse action, set the zero value to the 100% signal and the span value to the 0% command signal.

The calibrated zero command or feedback value will correspond to the calibrated Close (CW) position in the **POSITION CONFIG** submenu, and the calibrated span command or feedback value will correspond to the calibrated Open (CCW) position in the **POSITION CONFIG** submenu.

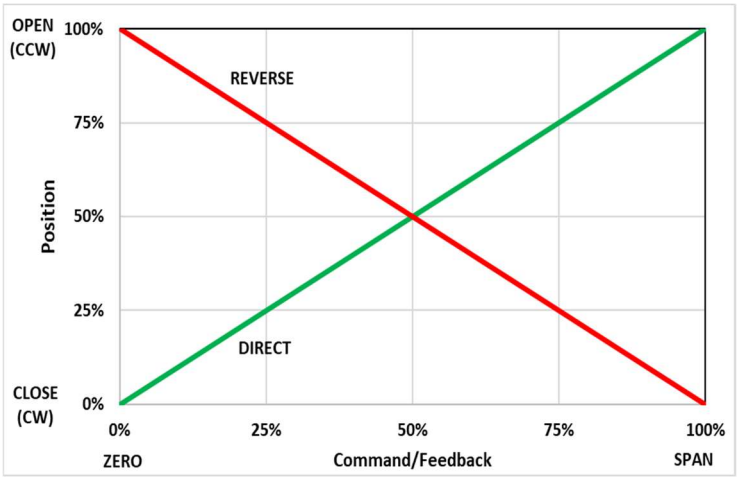


Figure 1: Direct Action vs. Reverse Action

Direct Action	Signal	Command	Feedback	Position
	0%	Zero	Zero	Close/CW
	100%	Span	Span	Open/CCW

Reverse Action	Signal	Command	Feedback	Position
	0%	Span	Span	Open/CCW
	100%	Zero	Zero	Close/CW

Table 2: Direct and Reverse Action Zero/Span Configuration

4.4. Loss of Signal / Out of Range Signal

The TMC4 will detect when a command signal is lost or out of range. For analog command signals such as 1-5V, 2-10V or 4-20mA, a lost command signal would be if the command signal falls below the calibrated 0% value, such as from a disconnected signal input. An out of range signal would be if the command signal exceeds the calibrated 100% value.

Analog command signals where a signal zero value is used (e.g., 0-5V, 0-10V, 0-20mA), cannot reliably detect a lost command signal due to a disconnected input still being considered a valid command signal. An out of range condition can still be detected.

Ohm command signals cannot determine either loss of signal or out of range conditions when using a variable resistance to the full resistance range. To detect a loss of signal or out of range condition, avoid using the full resistance range when calibrating the command zero and span, or add series biasing resistors to the input.

On-off command type does not recognize a lost or out of range signal. 0-10V is considered “Off” and 10-24V is considered “On”. Communication protocols only recognize lost signal if the communication is interrupted. Refer to specific communication module for additional details.

The TMC4 can be set to operate on a loss of signal or out or range condition in one of several modes. Fail “In Place” will remain in the current position. Fail “Open” will move actuator to programmed open (CCW) position. Fail “Close” will move actuator to programmed close (CW) position. Fail to “Percent” will move actuator to the percentage position specified in the “Fail to Percent” setting. Fail “Split” ignores a loss of signal or out of range condition, and simply operates the actuator to the 0% or 100% if the input signal is below or above the calibrated command signal range. Signal fail modes are illustrated below.

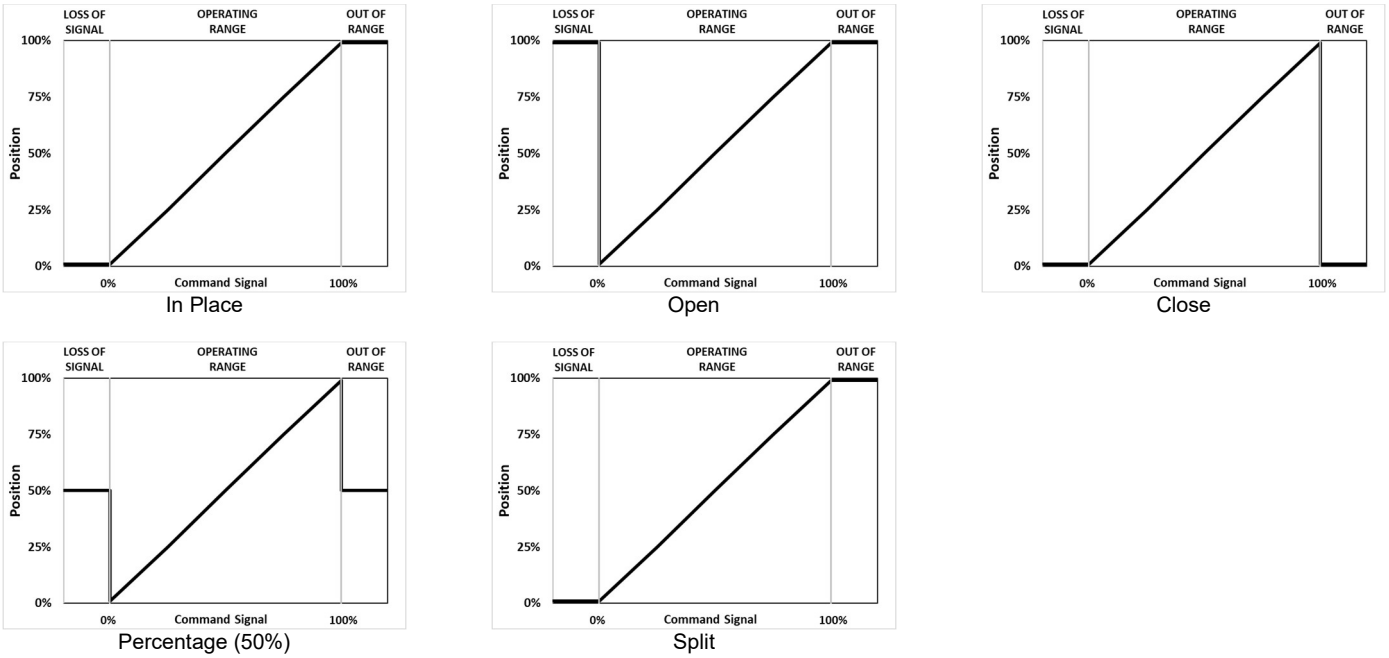


Figure 2: Lost / Out of Range Signal Modes

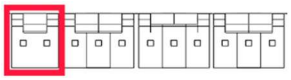
4.4.1. Split Range

The “Split” loss of signal setting allows the TMC4 to be used with some segment of a typical analog signal range. Often, this would be a 4-20mA signal divided into separate 4-12mA and 12-20mA input ranges, but could also be any user defined signal range (e.g., 3-7V input operating from a 0-10V signal). In these cases, an acceptable signal outside the calibrated 0-100% input range may be present, but should not be considered a fault.

A signal outside of the 0-100% input signal range would normally create lost signal, or out of range condition. This may operate the actuator to an undesirable position, or may not operate the actuator as needed. The “Split” loss of signal setting will operate the actuator to the 100% position for any signal equal to or above 100% command, and operate the actuator to the 0% position for any signal equal to or less than 0% command, which includes a disconnected input signal.

5. Options and Advanced Settings

5.1. Motor Temperature Monitor (P8)



The TMC4 provides an optional motor temperature monitor using a thermistor connected to header (P8) to monitor the case temperature of the actuator motor. This helps prevent excessive motor heating that may cause premature failure in high cycle applications. The thermistor bead should be attached to the motor where the case temperature is likely to become the hottest.

The thermistor provides a temperature-dependent resistance that the TMC4 inputs into an algorithm to establish a defined duty cycle limit depending on the measured temperature. As the temperature increases, the duty cycle is decreased to allow more time for the motor temperature to be reduced.

The default setting for the TMC4 is for the monitor to be disabled. The three temperature levels allow for higher insulation class motors to operate before the need to limit the motor movement, but it is recommended to use the lowest level.

Temp. Level	Temp. Limit 1	Temp. Limit 2	Temp. Limit 3	Minimum Insulation Class
Disabled	n/a	n/a	n/a	
1	75°C	90°C	105°C	B
2	90°C	105°C	120°C	F
3	105°C	120°C	135°C	H

	1	2	3
Normal	60%	40%	20%

Table 3: Duty Cycles by Temperature Limit Levels

CAUTION!
The motor temperature monitor is intended to only serve as a backup to prevent motor overheating. The user should still ensure their controls are adjusted so the recommended duty cycle of the actuator is not exceeded and not solely rely on the motor temperature monitor.

5.2. Log Rate Filter

The log rate filter setting imitates a first order filter to smooth out rapidly changing input signals such as with boiler feed tank level controls. When disabled, there is no input signal filtering performed.

The number selected sets the time constant for the filtered response following an exponential smoothing algorithm. Available time constants are 4, 8, 16, 32 or 64 seconds. A higher time constant provides a slower reaction to a change in input signal.

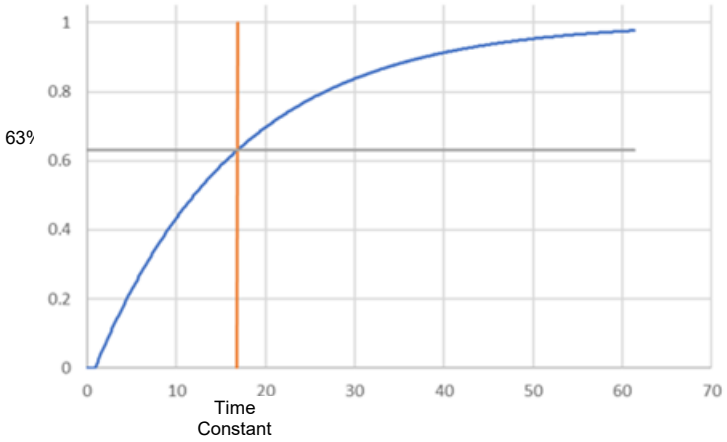


Figure 3: Log Rate Filter Plot

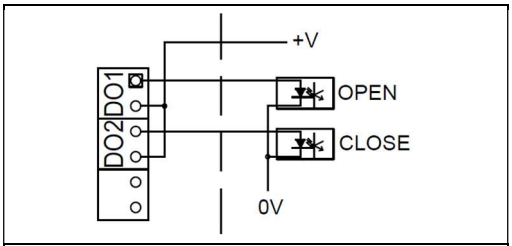
The time constant determines the time it will take to reach 63% of the change in input signal. For example, using the 16 second time constant there is a 10% change in input signal, the actuator will move the first 6.3% of the change in 16 seconds, and then gradually change the remaining 3.7% until reaching the command input. Note that the CMD value on the screen will show the filtered command signal rather than the actual input command signal.

5.3. Auxiliary I/O

The TMC4 can support auxiliary inputs and outputs using modules plugged into the Options Module slot. These inputs and outputs can be configured to provide additional position feedback or control options in the **AUX. I/O CONFIG** submenu. The standard auxiliary I/O module provide (3) DI digital inputs, (2) DO digital outputs, and (1) AO analog 4-20mA current output.

5.3.1. Aux. DO

The TMC4 auxiliary I/O module currently supports three digital output configurations. Each of these configurations provides two solid state relay outputs, DO1 and DO2, with a normally open contact rated up to 250VAC, 140mA continuous, 550mW.



DO Outputs to PLC or Actuator Inputs

1. O-C Out

The “O-C Out” configuration uses relay outputs, DO1 and DO2, to provide a programmable open and close position output. These outputs can be set anywhere between the calibrated Open and Close positions with the “Calibrate Aux DO Open” and “Calibrate Aux DO Close” settings. This configuration is only usable if operating with a feedback potentiometer connected to (P7) header to monitor position of the actuator.

Output DO1	Auxiliary open output. This output is made if the actuator position is between the programmed open position and the auxiliary open position. By default, this is between 95% - 100%.
Output DO2	Auxiliary close output. This output is made if the actuator position is between the programmed close position and the auxiliary close position. By default, this is between 0% - 5%.

2. Limit Switch

The “Limit Switch” configuration uses relay outputs, DO1 and DO2, to provide open and close position outputs that correspond to position limit switches connected to (P5) position switch header. These position switches may normally be available to the user but are instead required for control by the TMC4.

Output DO1	(P5) Position open limit switch.
Output DO2	(P5) Position close limit switch.

3. Motor Out

The “Motor Out” configuration uses relay outputs, DO1 and DO2, to provide outputs that are active whenever the CCW or CW motor outputs on the TMC4 are energized. This configuration can be used if the actuator must operate using relays or contact inputs, or if indication that actuator is moving is required.

Output DO1	TMC4 motor CCW counterclockwise output energized.
Output DO2	TMC4 motor CW clockwise output energized.

5.3.2. Aux. DI

The TMC4 auxiliary I/O module currently supports one digital input configuration. This configuration uses three 24V digital inputs, DI1, DI2 and DI3.

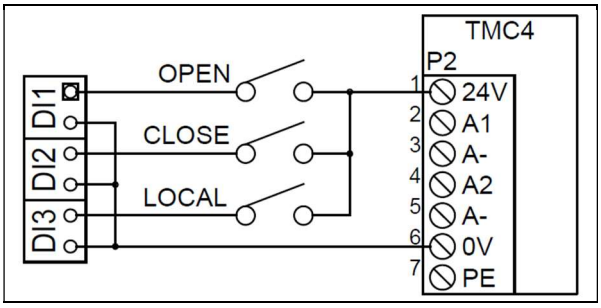
1. Disable

Digital inputs DI1, DI2 and DI3 are disabled and serve no function.

2. Local Control

Digital inputs DI1, DI2 and DI3 are used to interface with a local control station. If control station indicator lamps are required, use the digital output connections DO1 and DO2.

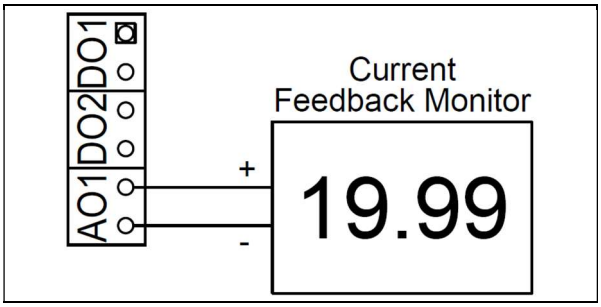
Input DI1	Local open input. If Input DI3 is powered, indicating local control mode, powering Input DI1 will operate the actuator to the close position. Actuator will only move while Input DI1 and DI3 are powered, or it has not yet reached its close position.
Input DI2	Local close input. If Input DI3 is powered, indicating local control mode, powering Input DI2 will operate the actuator to the open position. Actuator will only move while Input DI2 and DI3 are powered, or it has not yet reached its open position.
Input DI3	Local/remote switch input. If Input DI3 is powered, the TMC4 enters local control mode and all remote control signals are ignored. The CMD status in the main Home screen will show as “LOCAL”. While in local control mode, the actuator can be operated by activating inputs DI1 or DI2.



DI Inputs to Local Control Station Switches

5.3.3. Aux. AO

The TMC4 auxiliary I/O module currently supports three analog output options using output AO1. These options provide a constant 4mA output, constant 20mA output, or secondary 4-20mA output in addition to the standard TMC4 transmitter feedback. The auxiliary analog output is calibrated just like the standard transmitter with the auxiliary “AO Zero” and “AO Span” settings.



AO Output for Auxiliary 4-20mA Feedback

6. Troubleshooting

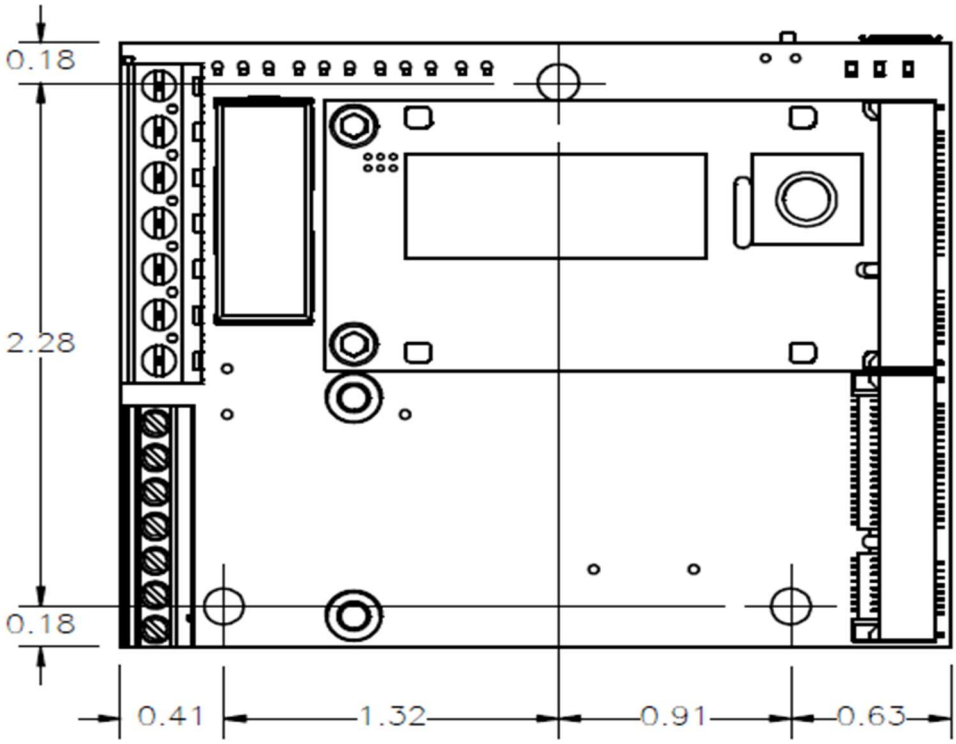
Problem	Cause	Solution
No Display	In Sleep mode (Status LED flashing).	Press joystick in any direction.
	Run/Program switch in wrong position (Power LED on).	Ensure switch is pointed away from USB connector.
	No power.	Confirm supply voltage connected.
	Blown fuse.	Replace fuse.
Not responding to command signal	Incorrect wiring.	Check wiring. Note, if Command Zero or Span shows as “0”, signal input wiring may be reversed.
	Incorrect command signal type.	Change command type.
	Incorrect command signal calibration.	Recalibrate command zero and span.
	Incorrect position calibration.	Recalibrate Open and Close position. Calibrated Open must equal CCW position and calibrated Close must CW position.
	Position feedback potentiometer gears loose.	Check potentiometer gears are tight. If loose, tighten and repeat position calibration.
	Position feedback potentiometer not set correctly.	Confirm potentiometer is at midrange at 50% position. Status LED should flash near 50% position.
	Position exceeding 105% calibrated range. Used manual handwheel to operate too far past 100% position.	Manually operate actuator so position shows 105% or less. Readjust mechanical stops so actuator cannot be manually operated as far.
	Incorrect switch action setting.	Change switch action setting.
	Limit or torque switches tripping.	Adjust limit switch cams outside of operating range according to actuator instructions. Check actuator mechanical stops are not adjusted too far in. Check there is no valve obstruction or valve seats are not damaged.
No feedback or feedback is not correct	Incorrect wiring.	Check wiring.
	Incorrect feedback type.	Change feedback type.
	Incorrect feedback calibration.	Recalibrate feedback zero and span.
	External loop power being provided.	Remove external loop power.
Actuator is hunting	Noisy command signal.	Check command signal.
	Deadband setting too low.	Increase deadband setting.
	Command signal changing too quickly.	Slow down change in command signal or enable log filter setting.
Not moving to setpoint position correctly	Mechanical stops adjusted in too far.	Adjust mechanical stops outside of operating range according to actuator instructions.
	Limit switches tripping.	Adjust limit switch cams outside of operating range according to actuator instructions.
	Torque switches tripping.	Check actuator mechanical stops are not adjusted too far in. Check there is no valve obstruction or valve seats are not damaged.
	Position feedback potentiometer gears loose.	Check potentiometer gears are tight. If loose, tighten and repeat position calibration.
	Log rate filter enabled.	Disable log rate filter.
	Position Type setting incorrect.	Set Position Type for Potentiometer.
Motor is pulsing when moving	Motor temperature too high. (if using motor temperature monitor option)	Slow operation to allow motor to cool.
Actuator moving in wrong direction	Open and close position set incorrectly.	Check open and close position calibration.
	CW / CCW wiring reversed.	Check wiring.
	Command zero and span set reverse.	Check zero and span settings.
CMD = LOST	Incorrect Command Type.	Confirm Command Type setting is correct.
	Disconnected or reversed signal wires.	For voltage or mA command, disconnected input wires will read ~1-3. Reversed input wires will read 0.
MTR flashes “HEAT DELAY”	Motor temperature limit is enabled, and thermistor input (P8) is detecting motor temperature above selectable threshold.	Check control loop to reduce excessive movement.
MTR = SWITCH	Incorrect switch action setting.	Change switch action setting.

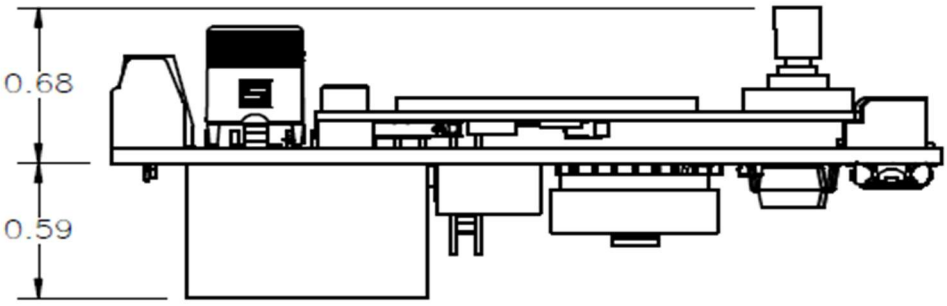
7. Specifications

7.1. Electrical Specifications

Power	
Supply:	AC: 85 – 250 VAC, 50/60Hz, 1 Phase DC: 24 VDC
Fuse:	10A, 250V, Time Delay, 5 x 20mm
Command Signal In	
Voltage:	0 to 10.8 VDC, 130kΩ input impedance 0 to 5.4 VDC, 65kΩ input impedance
Current:	0 to 22 mA, 380 Ω input impedance
Resistance:	100 – 10kΩ, @ maximum 24VDC
On-Off:	24 VDC maximum, <0.3mA @ 24VDC ≤ 12V = Off > 12V = On
Resolution:	12 bit (4096 points)
Feedback Signal Out	
Voltage:	0 to 10.6 VDC, min 500Ω load
Current:	0 to 23.4 mA, max 750Ω load
Resolution:	12 bit (4096 points)
Potentiometer / Switch Connection P5/P7/P9	
Voltage:	0 to 3.3 VDC
Potentiometer:	100 – 10kΩ
Limit Switches:	Normally Open or Normally Closed
Outputs	
+24V Out:	24VDC, 30mA maximum
Ext. Brake:	300mW, 350V, 120mA continuous load
Environmental	
Operating:	0°C to 60°C (32°F to 140°F)
Storage:	-40°C to 85°C (-40°F to 185°F)
Relative Humidity:	0 to 90% non-condensing
Connections	
Terminals:	(P2) Power/Motor: 0.2” pitch (5.08mm), 16 – 30 AWG (0.05 – 1.3 mm^2) (P1) Signal: 0.15” pitch (3.81mm), 16 – 30 AWG (0.05 – 1.3 mm^2)
Headers:	0.1” pitch, 2pos and 3pos
Expansion Header:	2x7 pos, 2mm pitch
Optional Auxiliary I/O Module	
Digital Inputs:	10-24V DC or AC, 8.5mA @ 24VDC
Digital Outputs:	250VAC, 140mA max continuous, 550mW max
Analog Outputs:	0-21 mA, max 750Ω load

7.2. Dimensions





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