TEMPERATURE CONTROL BOARD - Installation and Servicing Instructions

OPERATION

The TCB is a microprocessor-controlled device that will supply the proper step signal to most Sporlan electric valves to position, initialize or close the valve. The TCB can be used as an interface with an external controller; or, with the addition of a set point potentiometer and sensor, can be used as a standalone temperature control.

In the interface mode, the TCB will modulate a valve in response to a signal received from an external source. In addition to the 0 to 10 volt DC, or 4 to 20 milliamp signal commonly used on PID controllers, the TCB can be configured to modulate a valve in response to a TLL (5 volt) signal, or a 120 volt AC pulse of three to thirty seconds duration.

When used as a standalone temperature controller, the board will modulate a valve in response to a set point potentiometer and temperature sensor. The temperature sensor is a 2K, type B, NTC thermistor. This mode is used for the control of step motor evaporator control valves, discharge bypass valves or any other application suitable for single point temperature control. Since superheat control requires at least two sensors, **superheat control for electric expansion valves cannot be accomplished with the TCB in temperature control mode**.

The TCB is capable of powering and controlling two valves, connect in parallel. The TCB has an operational range of -40°F to 210°F.

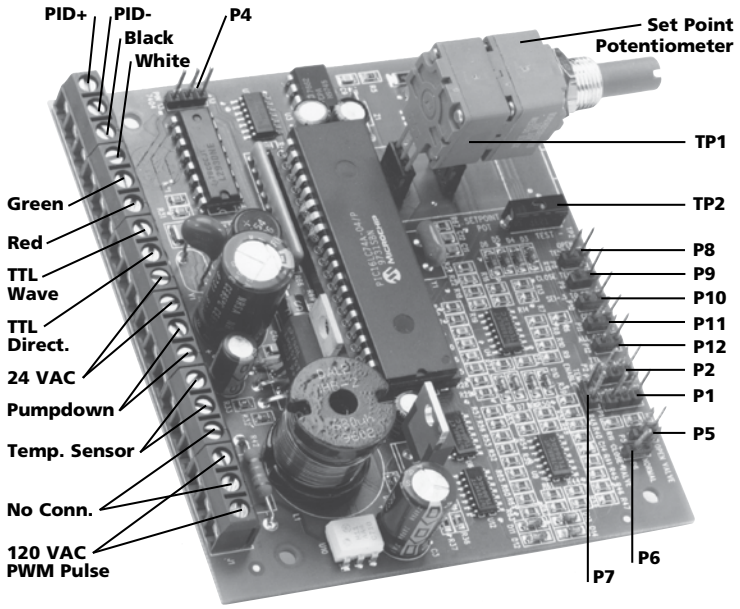


Figure 1

Table 1

Valve	Steps	P10	P11	P12
SEI .5 - 11, SER	1596	XXX	—	—
SEI-30	3193	—	—	XXX
SEH, SEI-50	6386	—	—	XXX
CDS-8	3193	—	XXX	—
CDS-9 & 16	6386	—	—	XXX
SDR-3, 3X	3193	—	XXX	—
SDR-4	6386	—	—	XXX
OTHERS	6386	—	—	XXX

NOTE: Only one jumper is used.

Table 2

Input	Source	P1	P2	P7
4-20 ma	External	L, C	—	—
0-10 VDC	External	C, R	—	—
TTL LOGIC	External	—	L, C	—
120 VAC PWM	External	—	C, R	—
TEMP. SENSOR	External	—	—	Top & Bottom

NOTE: L = left, R = right, C = center
When board is viewed as shown in Figure 1.

Table 3

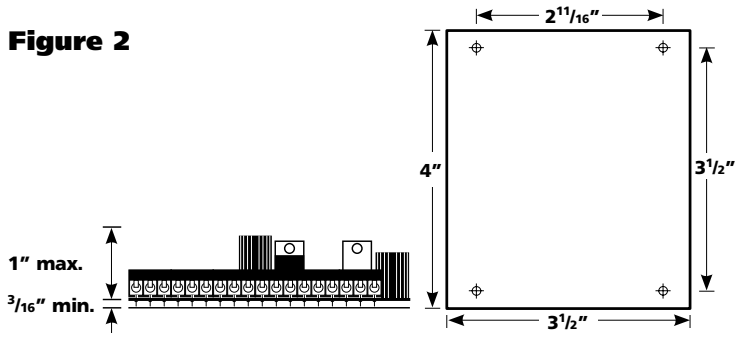
Item Number	Item Name	Use
952741	Set point potentiometer	Used to add temperature control to a TCB.
952669	Air sensor	Used with TCB in standalone mode for valve control via air temperature.
952662	Surface sensor	Used with TCB in standalone mode for valve control via refrigerant line temperature.
953276	SMA-12 Diagnostic Instrument	Used to test step motor operation.

LOCATION AND INSTALLATION

For proper operation, the signal type and valve model must be selected from Tables 1 and 2, and the TCB configured accordingly.

The TCB must be installed in a dry, protected environment. The board will operate properly in ambient conditions of -40°F to 140°F, with 90% relative humidity, non-condensing. The board should never be mounted in a corrosive atmosphere or in a location where frost buildup is likely. The TCB is provided with four 1/8" mounting holes as shown in Figure 2. Non-metallic standoffs are suggested but not required. Minimum clearance from the bottom of the TCB to a conductive substrate or mounting panel is 3/16".

Figure 2



WIRING and POWER SUPPLY REQUIREMENTS

Screw terminals suitable for up to 14 gauge wire are provided for all inputs and outputs. An **isolated secondary** 24 VAC 40 VA transformer must be used to power the board and valve. The transformer must not be used to supply power to any other device. External control signal wiring to the TCB should be kept as short as possible to prevent electrical noise and signal attenuation. The signal is polarized and care must be taken when connecting the wires to the (+) and (-) screw terminals. Terminals are arranged from top to bottom when the board is positioned with the component side up, and the terminal strip on the left as shown in Figure 1. Input signal requirements are shown in Table 3.

WIRING CONNECTIONS

PID+ - connect positive side of 4-20 ma or 0-10 VDC signal
INPUT - connect negative side of 4-20 ma or 0-10 VDC signal
BLACK - connect black valve lead
WHITE - connect white valve lead
GREEN - connect green valve lead
RED - connect red valve lead
SQUARE WAVE - connect TTL logic (5 VDC) step signal
DIRECTION - connect TTL logic direction signal. 5 VDC = OPEN, 0 VDC = CLOSE
24 VAC - 2 connections for 24 VAC @ 40 VA isolated power input
PUMPDOWN - 2 connections for pumpdown contacts. When "shorted" the valve will close and remain closed. When "open" the valve will control normally. If the pin jumpers are installed on both pins of P5 **and** P6, "shorting" the pumpdown terminals will cause the valve to open fully. "Opening" the pumpdown terminals will cause the valve to resume normal operation.
TEMP. SENSOR - 2 connections for supplied 2 k type B thermistor. Not polarized.
BLANK - no connection - for high voltage input isolation.
AC PULSE - for one leg of 120 VAC, 3-30 second Pulse Width Modulated signal.
BLANK - no connection - for high voltage input isolation.
AC PULSE - for the other leg of 120 VAC, 3-30 second Pulse Width Modulated signal.

NOTE: Not all inputs or pin jumpers will be used. See Configuration instructions.

INPUT SIGNAL REQUIREMENTS

4-20 MILLIAMP - source controller must supply 20 milliamps at 12 volts DC into a 600 Ohm load.
NOTE: 20 milliamps at 24 volt DC is not suitable.
0-10 VOLT - signal must be supplied with at least 20 milliamp current. Wiring between controller and TCB must be kept short to minimize electrical noise.
TTL - logical "1" must be a DC signal greater than 4.5 volts for 3 milliseconds. Logical "0" must be less than 0.5 volts DC for 3 milliseconds.
AC PULSE - Must be 120 volts AC ± 20% for a period of 3 to 30 seconds.

REPLACEMENT PARTS AND PARTS KITS

There are no user serviceable parts on the TCB, however, the accessories listed in Table 3 aid in the use and testing of the TCB/electric valve system.

TROUBLESHOOTING

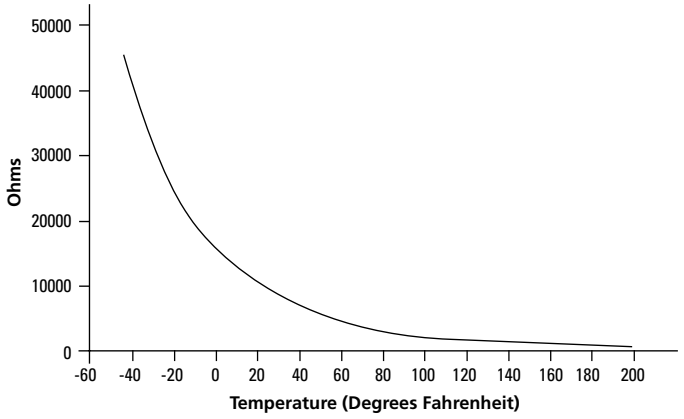
If a step motor is suspected to have failed, a simple resistance check may be made of the motor windings, however, actual winding failures are rare. Therefore Sporlan developed a diagnostic instrument, the SMA-12, to test our step motors. The SMA-12 is a step motor actuator that will operate all 12 volt DC bipolar step motor valves, as well as test the continuity of the valve wiring and motor. The step rate can be selected at 1, 50, 100 or 200 steps-per-second. At the one step-per-second rate the SMA-12 will test the continuity of the valve wiring and motor. The SMA-12 can also be used to manually open, position, or shut the valve should the controller fail. If contaminants are suspected, the SMA-12 can be used to drive the valve fully open to purge the foreign material.

TEST POINTS and PIN JUMPERS

TP1 - Test Point 1 - positive connection point to millivolt voltmeter to read set point temperature
TP2 - Test Point 2 - negative connection point as above
P1 - Pin Jumper 1 - voltage or current input selector
P2 - Pin Jumper 2 - TTL logic or 120 VAC Pulse Width Modulated signal input selector
P4 - Pin Jumper 4 - internal power selector - DO NOT CHANGE
P5 - Pin Jumper 5 - force valve open switch - valve will open and will remain open as long as jumper is installed. See **Pumpdown** above.
P6 - Pin Jumper 6 - force valve closes switch - valve will close and remain closed while jumper is installed. See **Pumpdown** above.
P7 - Pin Jumper 7 - temperature sensor enable selector
P8 - Pin Jumper 8 - "open on rise" logic selector
P9 - Pin Jumper 9 - "close on rise" logic selector
P10 - Pin Jumper 10 - SEI .5 to SEI-11, and SER valve selector (1596 step stroke)
P11 - Pin Jumper 11 - CDS-8 or SDR-3, 3X and SEI-30 valve selector (3193 step stroke)
P12 - Pin Jumper 12 - all other valves selector (6386 step stroke)

NOTE: Pin 8 causes valve to open on temperature rise above set point.
Pin 9 causes valve to close on temperature rise above set point.

Figure 3
TEMPERATURE SENSOR RESISTANCE



When a system component does fail, it is important to first determine whether the failure is the valve, the TCB, or the external controller (if used).

TEST THE VALVE

The resistance of the motor winding may be tested without opening the system.
1. Remove power from the external controller and/or TCB.
2. Remove the valve leads from TCB.
3. Measure the resistance between the black and white leads of the valve. The resistance should be 75 Ohms for brass housed valves with the valve at room temperature or about 65 Ohms if the valve is at -40ºF. The resistance for stainless steel housed valves should be 100 Ohms with the valve at room temperature.
4. Measure the resistance between the green and red leads. This value should be within ± 5% of the resistance between the black and white leads.
5. Measure the resistance from any lead to valve body. Resistance should be infinite, that is to say, open.

TEST THE TCB

The flow charts that follow are designed to assist in diagnosing a possible TCB failure. All measurements should be made with a **Digital Multimeter**.

TROUBLE SHOOTING GUIDE – TCB Operating on External Signal (4-20 ma or 0-10 VDC)*

Note: Before testing the TCB, make certain the valve is operating. See "Test the Valve" instructions.

1. Is there 24V AC at terminals 9 & 10?
   - NO → Repair or replace power supply or power supply wiring.
   - YES ↓
2. Is the 24V transformer of the isolated secondary type?
   - NO → Replace the transformer with an isolated secondary type.
   - YES ↓
3. Is the valve connected to terminals 3-6 with wire colors correct?
   - NO → Shut off power to TCB and correct wiring.
   - YES ↓
4. Connect voltmeter to the Black and White valve terminals. Interrupt and restore power to the TCB. Does the meter read 12 volts AC ± 1?
   - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
   - YES ↓
5. Repeat above test using Red and Green terminals. Does the meter read 12 volts AC ± 1?
   - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
   - YES ↓
6. Are wires for external signal connected to terminals 1 & 2?
   - NO → Shut off power to TCB and external controller. Correct input signal observing polarity.
   - YES ↓
7. Is external signal present? Signal should be 4-20 MA at (2.5-12.5 VDC) or 0-10 VDC.
   - NO → Test or replace external controller.
   - YES ↓
8. Is polarity of signal correct? (+) to term 1 and (-) to term 2.
   - NO → Shut off power to TCB and external controller and correct wiring.

Look at the date on the serial number label in the center of the board. If the date is prior to March 1, 2000, continue with steps 9 through 13. If the date is March 1, 2000 or later, go to step 14 and continue.

9. Is pin jumper for input signal selection (P1 & P2) on the correct pins? See Table 2.
   - NO → Shut off power to TCB and external controller and move pin jumper to correct location.
   - YES ↓
10. If present, remove wires from pumpdown terminals 11 & 12. Did the valve open?
    - NO → First make sure input at terminal 1 & 2 is greater than 4 ma @ 12 VDC. If so, repair wiring or replace pumpdown relay.
    - YES ↓
11. Put a jumper across terminals 11 & 12. Did the valve close?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
12. **Remove the jumper from terminals 11 & 12 and reconnect the wires!**
    - YES ↓
13. Move the pin jumper from its storage position between P5 & P6 to P5. Did the valve open?
    - NO → Move the jumper to P6. Did the valve close?
      - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
      - YES ↓
    - YES ↓

TCB is functional, test external controller.

Boards manufactured after March 1, 2000 will have a pin jumper on both P5 and P6. The boards are shipped with the jumpers on one post of P5 & P6. With the pin jumpers in this position, the valve will close when the pumpdown relay is energized. If both P5 & P6 are enabled, the valve will open when the pumpdown relay is energized.

For testing purposes, make sure the pin jumpers are on both posts of pins P5 & P6.

14. Remove the wires from pumpdown terminals 11 & 12 and put a jumper across them. Did the valve open?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
15. Remove the pin jumper from P5 and leave the pin jumper on P6. Did the valve close?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
16. Remove the pin jumper from P6 and put it on P5. Did the valve open?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
17. **Remove the jumper from terminals 11 & 12 and reconnect the wires! Put the pin jumpers back in their proper location on P5 & P6.**
    - YES ↓

TCB is functional, test external controller.

* If external signal is TLL or 120 volt pulse, contact Sporlan Division of Parker for troubleshooting instructions.

TROUBLE SHOOTING GUIDE – TCB Operating as Standalone Controller

Note: Before testing the TCB, make certain the valve is operating. See "Test the Valve" instructions.

1. Is there 24V AC at terminals 9 & 10?
   - NO → Repair or replace power supply or power supply wiring.
   - YES ↓
2. Is the 24V transformer of the isolated secondary type?
   - NO → Replace the transformer with an isolated secondary type.
   - YES ↓
3. Is the valve connected to terminals 3-6 with wire colors correct?
   - NO → Shut off power to TCB and correct wiring.
   - YES ↓
4. Connect voltmeter to the Black and White valve terminals. Interrupt and restore power to the TCB. Does the meter read 12 volts AC ± 1?
   - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
   - YES ↓
5. Repeat above test using Red and Green terminals. Does the meter read 12 volts AC ± 1?
   - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
   - YES ↓
6. Is pin jumper on "Temp Enable" P7?
   - NO → Shut off power to TCB and external controller. Correct pin jumper location and restore power.
   - YES ↓
7. Connect voltmeter to test points. Does reading vary between -40 and 210 millivolts when potentiometer shaft is turned?
   - NO → Remove potentiometer and measure resistance between the center pin and either side pin. The resistance should change as the shaft of the potentiometer is turned. If not, replace the potentiometer.
   - YES ↓
8. Disconnect the temperature sensor from terminals 13 & 14. Measure the resistance through the sensor from terminals 13 & 14. Measure the resistance through the sensor and compare the reading to the chart in Figure 2. Does it match?
   - NO → Replace the sensor.

Look at the date on the serial number label in the center of the board. If the date is prior to March 1, 2000, continue with steps 9 through 12. If the date is March 1, 2000 or later, go to step 13 and continue.

9. If present, remove wires from pumpdown terminals 11 & 12. Did the valve open?
   - NO → First make sure input at terminal 1 & 2 is greater than 4 ma @ 12 VDC. If so, repair wiring or replace pumpdown relay.
   - YES ↓
10. Put a jumper across terminals 11 & 12. Did the valve close?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
11. **Remove the jumper from terminals 11 & 12!**
    - YES ↓
12. Move the pin jumper from its storage position between P5 & P6 to P5. Did the valve open?
    - NO → Move the jumper to P6. Did the valve close?
      - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
      - YES ↓
    - YES ↓

Replace the TCB.

Boards manufactured after March 1, 2000 will have a pin jumper on both P5 and P6. The boards are shipped with the jumpers on one post of P5 & P6. With the pin jumpers in this position, the valve will close when the pumpdown relay is energized. If both P5 & P6 are enabled, the valve will open when the pumpdown relay is energized.

For testing purposes, make sure the pin jumpers are on both posts of pins P5 & P6.

13. Remove the wires from pumpdown terminals 11 & 12 and put a jumper across them. Did the valve open?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
14. Remove the pin jumper from P5 and leave the pin jumper on P6. Did the valve close?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
15. Remove the pin jumper from P6 and put it on P5. Did the valve open?
    - NO → Using an SMA-12 test instrument, test the step motor. If operational, replace the TCB.
    - YES ↓
16. **Remove the jumper from terminals 11 & 12 and reconnect the wires! Put the pin jumpers back in their proper location on P5 & P6.**
    - YES ↓

Replace the TCB.

Sporlan Division, Parker Hannifin Corporation
206 Lange Drive, Washington, Missouri 63090 USA