TC250D Universal Single Point PI Temperature Controller with Modbus

The TC250D is a universal, single point temperature controller with modbus communication. It is a direct replacement for the TA239W, adding modern micro processor control functions and a clear LED readout. The TC250D uses the same sensor as the TA239W.

The TC250D can be used in any heating or cooling system within the range of 40 to 205 ^{O}F (5-96 ^{O}C). It is designed to handle fast control loops with fluctuating loads. It works equally well in slow systems using actuators with long run times.

Features

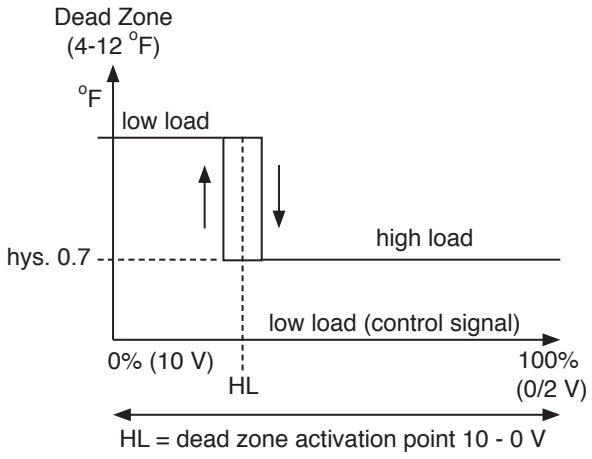
- Very easy to use
- Works with fast and slow control loops
- PI control algorithm
- Low load dead zone with adjustable activation point
- High temperature alarm function
- Fast sample rate of sensor input
- Reversible output for heating or cooling applications
- Works with any modulating valve or damper actuator or variable speed drive
- Modbus communication
- Option: Enclosure TC250D-EN with Mounting Plate TC250D-PL.

The TC250D is a proportional integral (PI) controller with an adjustable dead zone feature. The P action gives stability to the control loop but can result in some fluctuation around setpoint. The integral action (I) corrects the P error and brings the loop quickly back to setpoint.

The adjustable dead zone (4-12 ^{O}F) allows for stable control at low loads (high control signal). The activation point for the dead zone can be set between 0-10 V.

At high load, there is a fixed dead zone (hysteresis) of 0.7 ^{O}F.

The use of a dead zone reduces the wear on the actuator in systems with large fluctuations in load and with long periods at low load. The dead zone is not used in all applications.

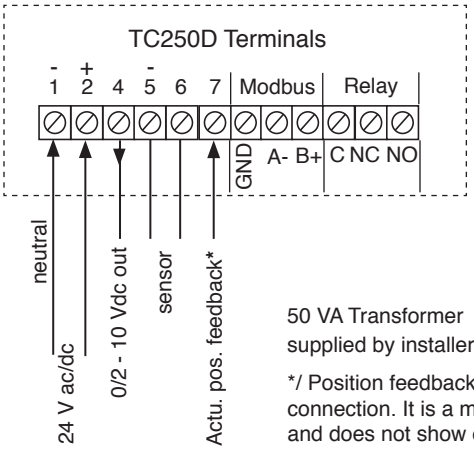


Technical Data

Part number	TC250D
Power supply *	24 V ac/dc
Power consumption	90 mA
Sensors (see page 2)	
Thermistor	NTC 1.8 K ohm
Sensor sample rate	10 / sec.
Analog output (AO)	0-10 or 2-10 Vdc
Alarm Relay SPDT	120 Vac 3 A max.
If sensor input is open or shorted:	
DA: Output goes to	10 Vdc
RA: Output goes to	0 Vdc
Enclosure size	6” (W), 6” (H), 3.5” (D)

The TC250D can be used in any single point heating or cooling application and will work with any modulating actuator or veriable speed drive that accepts 0/2 - 10 Vdc input.

Wiring Diagram

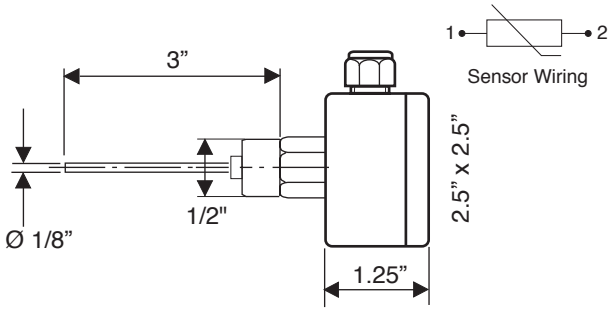


50 VA Transformer
supplied by installer

*/ Position feedback is an optional connection. It is a modbus function and does not show on the display.

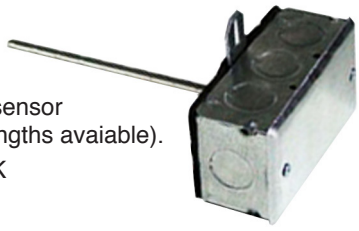
Sensors for the TC250D

STP120-70 fast immersion sensor. Stainless steel probe. Reaction time = 1.5 sec. Connection 1/2" NPS. No well needed. Use for domestic hot water and other fast control loops. Thermistor NTC 1.8 K



TS-ETS100 surface mounted pipe sensor.
Thermistor NTC 1.8K

TS-ETD100-6 Duct sensor
Lengths: 6" (other lengths avaiable).
Thermistor NTC 1.8K



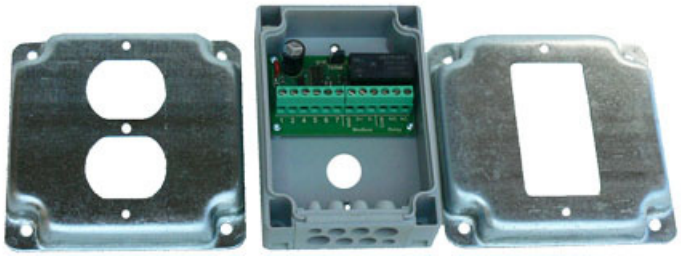
TS-STX140 Slab / Ground sensor
Four thermistors NTC 1.8K are placed equal distance over the 6 ft length of the 3/8" polythene tube.
Comes with 6 ft connecting cable.
When used in the ground, place the sensor portion inside a 1/2" pipe.

Installation of controller:

The TC250D cover has four tabs, one at each corner. Hold down the two upper or lower tabs and carefully pry off the lid.

Screw the controller to a wall or back plate or fasten to a 2"x4" or 4"x4" electrical box. Use any of the 4"x4" covers shown.

Enter wires through the 5/8" bottom hole or the grommets. Finish the wiring and snap the lid back in place.



Or use the optional NEMA 4 enclosure TC250EN, with mounting plate.

With the simple 3 button interface, select temperature scale and change control parameters to match system requirements. The factory defaults are typicall for a tempering valve system.

Display	Functions & Adjustments	Default
F C	Temperature scale ^{O}F or ^{O}C	^{O}F
120F	Setpoint 40 - 205 ^{O}F (5 - 96 ^{O}C)	120 ^{O}F
P50	P-band 9 - 360 ^{O}F (5 - 200 ^{O}C)	50 ^{O}F
I12	I-Time OFF or 1 - 480 seconds	12 sec
HL9	Dead zone activation point 0 - 10 Vdc	9 Vdc (To eliminate the dead zone, set function HL to 10)
d24	Dead zone 4 - 12 ^{O}F (2 - 9 ^{O}C)	4 ^{O}F
Fb	Actu. pos. feedback **0** = 0-10 V, **2** = 2-10 V	2 (Modbus function only. Does not display on controller)
Ao	Analog output 0 - 10 or 2 - 10 Vdc	0-10 Vdc
dA	Direct acting output	Dir. Acting
t30	Actuator run time 15, 30, 60, 120, 180	30 sec
LOFF	Limit, OFF or 15-40 ^{O}F over setpoint	OFF
d10	Limit time delay 3 -300 seconds	10 sec
HLA	High temperature limit alarm (blinking)	
SE	Sensor Error (open or shorted sensor)	
dEF	Reset to default values Yes or No	To reset to default values, go to function dEF select **Yes** and press ↵

Operator Interface

The simple 3 key operator interface performs all the functions needed to adjust and set the operating parameters for the control loop.

Press and hold the ↵ enter key for 3 seconds to place the interface in adjust mode.

Use the ▼ ▲ keys to move between functions.

Select a function with ↵ and then make changes with ▼ ▲

When finished, confirm the change with ↵ then select the next function with the up or down arrow key and make that adjustment.

When all changes have been made, hold down ↵ for 3 seconds to exit adjust mode.

High Limit Alarm Function (Works in D. A. mode only). Function is OFF by default (LOFF in Display)

This is a high limit function that is activated if the temperature goes above setpoint by an adjustable number of degrees, for a certain length of time. This is set with **L** (temperature) and **Lt** (time). **L** is the number of degrees over setpoint and **Lt** is the delay in minutes before the function is activated.

Example: Setpoint = 125^{O}F, L = 15^{O}F, d = 10 seconds. The alarm is triggered at 140^{O}F after 10 seconds.

The output for this function is a SPDT relay that can be wired to a N.C. solenoid valve and/or a remote alarm unit.

Alarm Reset: Press down both ▼ ▲ keys for one second to reset a high temperature alarm.

Note: To turn off the alarm function, increase the limit temperature (**L**) one step beyond maximimum, to **OFF**.

Modbus: To reach modbus programming, press and hold all 3 keys for 1 second. To exit, step to **'end'** and press Enter. See separate page for the modbus register.

TC250D / TVS43 Modbus

Protocolversion: 1.0
2017-06-14

Communication (RTU)

RS-485 2-wire interface

Baud Rate:	9600/19200/38400/57600
Word Length:	8 bits
Parity:	None/Odd/Even
Stop Bits:	1 or 2*

* 2 stop bits with no parity

Modbus pgm mode:	**Push all 3 keys for 1 second**
A. 1	Unit address
b. 9.6 / 19.2 / 38.4 / 57.6	Baud rate (thousands)
P. no / P.odd / P.evn	Parity
def	Defaults: A. 1 / b. 9.6 / P. no
end	**Exit pgm mode**

Modbus functions

Function Code	Description
3	Read Holding Register
6	Preset Single Register

Jumper: ON/OFF Default = OFF. When ON it connects a 120 ohm resistor on the last unit in the chain.

Modbus exceptions

Exception Code	Description
2	Illegal Data Address

Holding Registers (40001-49999)

Register	R/W	Description	Unit	Default	Min	Max	Notes
4x0001	R	Program version (32 bits)					Major version
4x0002	R						Minor version
4x0003	R	Unit address	1-127	1	1	127	
4x0004	R	Actual temperature	F				
4x0005	R	Control signal output	%		0	100	
4x0006	R	Actuator position feedback	%		0	100	
4x0007	R	Sensor Error	0-1		0	1	0 = OK, 1 = open or shorted sensor
4x0008	R	High temperature alarm	0-1		0	1	0 = No alarm, 1 = Alarm
4x0009	R/W	Temperature display unit	0-1	F	C	F	0 = F, 1 = C
4x0010	R/W	Setpoint temperature	F	125	40	205	
4x0011	R/W	P-band	F	50	9	360	
4x0012	R/W	I-time	seconds	12	1	480	0 = OFF
4x0013	R/W	Dead zone activation point	Vdc	9	0	10	
4x0014	R/W	Dead zone temperature	F	4	4	12	
4x0015	R/W	Position feedback range	Vdc	0-10	0-10	2-10	0 = 0-10V, 2 = 2-10V
4x0016	R/W	Output action	0-1	Direct	Direct	Reverse	0 = direct, 1 = reverse
4x0017	R/W	Actuator run time	0-4	1	0	4	0=15s, 1=30s, 2=60s, 3=120s, 4=180s
4x0018	R/W	Limit over setpoint	F	OFF	14	40	14 = OFF
4x0019	R/W	Limit time delay	seconds	10	3	300	
4x0020	W	Alarm Reset	1				1 = Reset alarm
4x0049	R	Auto Discovery					Returns the value 1499

Note: Register 4x0049 is an “Auto-Discovery” function. When queried,
it returns the number “1449” and will show all other TC250D within this system.