VT-4810 AUTO TUNE PID CONTROLLER

Microprocessor Based PID Controller with Ramp and Soak

FEATURES

- Single segment RAMP/SOAK function
- Selectable P,PI,PID control modes
- Selectable auto tune or manual PID
- Selectable display resolution for 1 or 0.1°
- Wide range power supply
- Selectable alarm relay modes

SPECIFICATIONS

1. INPUT

- **Thermocouple:** J,K,T,E,B,R,S,N (IPTS68/DIN 43710)
- **RTD**: RTD (DIN 43760/BS 1904 or JIS)
- **Linear Voltage**: -10 to 60 mV configurable with input attenuation
- **Linear Current**: 4 to 20 mA or 0 to 20 mA, 60 mV (max) voltage drop
- **Range**: User configurable
- **Accuracy**: ±2°C for T/C, ±0.2°C for RTD, ±0.05% for Linear input.
- **Cold Junction Compensation**: 0.1 % ambient typical.
- **Input Impedance**: 10M ohms for T/C, 100K ohms for Linear Voltage, 2.7 Ohms for 0 to 20 mA or 4 to 20 mA inputs.
- **Excitation Current for RTD**: 0.2mA Max.
- **Sample Rate**: 4 readings / sec.
- **Common Mode Rejection**: 120 dB
- **Normal Mode Rejection**: 60dB

2. Control

- **Proportional Band**: 0.0 ~ 100.0 % of full scale
- **Integral Time**: 0 ~ 3600 Sec.
- **Derivative Time**: 0 ~ 3600 Sec.
- **Anti Reset Windup**: Inhibit integral action outside Proportional Band
- **Manual reset**: 0 to 100% of proportional band
- **Hysteresis**: 0.0 to 25.5% of full scale
- **Ramp Rate**: 0.0 ~100.0°C /minute
- **Dwell**: 0 ~9999 minutes
- **On-Off**: With adjustable hysteresis
- **Cycle Time**: 0 ~ 99 Seconds
- **Control Action**: Configurable for direct (cooling) or reverse (heating) control

3. Output

- **Relay**: 5A/240 VAC resistive .
- **Pulsed Voltage**: Isolated 24 V DC 100 mA (max) for SSR drive. On voltage 24 V. Off voltage 3 V
- **Current**: Isolated 0 to 20 mA or 4 to 20 mA Maximum load 500 Ω. Voltage
- **Alarm**: Relay output, Form A contact (SPST) 10A/240 VAC resistive

4. Power

- **Rating**: 85 ~ 265 VAC 50/60 Hz.
- **Consumption**: 5 VA maximum.

5. Environmental

- **Operating Temperature**: -10 ~ 50°C
- **Humidity**: 0 ~ 90 %
- **Insulation**: 20M ohms minimum @ 500 V DC
- **EMC Emission**: EN 50081-1:1992, EN 55022:1994
- **EMC Immunity**: EN 50082-1:1992, IEC 801-2, IEC801-3, IEC 801-4:1988.
- **Weight**: 180g

This manual contains information for the installation and operation of Texmate VT4810 auto-tuning micro-processor based controller.

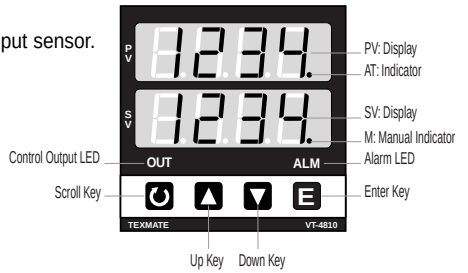
This controller is a “on off” or “proportional plus integral plus derivative” (PID) controller. The facilities include a wide range of inputs (T/C, RTD, LINEAR), auto/manual/PID, and ramp/soak function. The front panel is equipped with two 4-digit displays showing process and setpoint value at a glance. The sensor types, alarm modes, control parameter, unit, resolution, auto/manual mode, range all can be selected by the four touch keys on the front panel. The auto-tuning facility provides a fast method of setting up the control parameters with minimal overshoot.

INSTALLATION

PANEL MOUNTING

- Prepare a cutout in your panel of 45 mm by 45 mm. The panel on which the controller will be mounted may be up to 10 mm thick.
- Remove plastic mounting bracket on VT4810. Slide meter into cutout. Replace mounting bracket, tighten screws. Do not tighten the mounting screws too tightly since this can bow the controller housing.

FRONT PANEL DESCRIPTION



PV: Process Variable

a) Displays the actual measurement of the input sensor.
b) Displays the parameter index code.
c) Displays Error messages.

SV: Setting Variable

a) Displays the set-point variable.
b) Displays the parameter data.

ALM: Alarm 1 LED

a) LED is lit when Alarm is energized.
b) LED flashes when timer is activated and counting down.

OUT: Control Output LED: LED is lit when Control Output 1 is on.

AT: Autotuning LED: Extreme right hand decimal of PV display flashes while the controller is autotuning.

M: Manual Indicator: Extreme right hand decimal of SV display flashes when controller is in manual mode.

Scroll Key: While programming the controller, you can move from one programmable parameter to the next by pressing the Scroll Key once. Also, to activate an autotuning session, press and hold down this key for 5 seconds.

▲ **Up Key**: Increases the setpoint value and changes the parameter data when programming.

▼ **Down Key**: Decreases the setpoint value and changes the parameter data when programming.

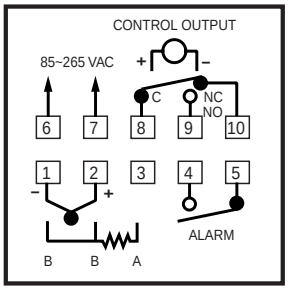
E **Enter Key**: During normal operation, pressing the Enter Key permits the user to view the controller output action in percentage (0~100). Pressing and holding this key for 5 seconds puts the controller into manual operation. Press this key from any other mode to return to the standard SV value.

Level key: The scroll and enter keys are often used together to move from one level to the next during programming. Both these keys should be pressed and held down for 5 seconds to move to the next level.

CONNECTION AND WIRING

BEFORE WIRING, VERIFY THE CONTROLLER LABEL FOR CORRECT MODEL NUMBER AND OPTION.

VT-4810 Rear View



1 **Main input:** The controller operates on 85~265 VAC 50/60 Hz. Power should be connected via a 2 Amp fuse.

2. **Sensor input:** Do not run sensor cable adjacent to power carrying conductors. The correct type of thermocouple extension lead wire or compensating cable must be used. Ensure that the polarity of the input is correct.

3. **Control output:** Different types of output may be installed in the controller. Be sure that the correct output device for your application is installed. Available output devices are:
   - 4~20 mA or 0~20mA, Maximum load 500 ohms.
   - 1~5 V, 0~5 V, 0~10 V.
   - Pulsed voltage 24 V DC at 100 mA max to drive SSR.
   - Relay 3A/240 VAC maximum, resistive load.

4. **Alarm output:** The alarm output is via a relay contact. Maximum contact rating is 10 Amps.

CONFIGURATION AND PARAMETER SETTING

All parameters are structured in four levels for easy programmability.

Level 1. Operation level
Level 2. Control parameter level
Level 3. Configuration level
Level 4. Calibration level

OPERATION LEVEL (LEVEL 1)

1. SP : Set-point Variable. This parameter is the desired target of the process. It can be adjusted within the range defined by Low Limit value and High Limit value.

2. rAnP : Ramp rate. This forces the process to warm up (or cool down) with a predetermined rate when power is applied. Set this parameter to zero if no ramp is needed. The process will then warm up (cool down) with maximum speed. Ramp rate can be set in the range of 0.0 to 100.0 °C/min.

3. oPoF : Output offset value for manual reset. For those systems, when it is desired to perform manual reset control by setting integral time (ti) to zero. This allows the user to compensate for the deviation between PV and SV.

4. A1SP : Alarm 1 setpoint value. This sets the level at which the alarm 1 will operate if A1Fu is selected for alarm function. If A1Fu is set to a value of 8,9,10 or 11 for the timer function, this parameter will be disabled.

5. tiME : Dwell time. The range is from 0 to 9999 minutes. This parameter is available only when the A1Fu is set to timer function.

CONTROL PARAMETER LEVEL (LEVEL 2)

1. [Pb] : Proportional band variable has a setting range from 0.0 to 100.0% of the controller's span. This value is automatically calculated by activating the Autotune function. If desired, the user can later adjust this parameter to better suit the application. Set to zero for ON/OFF control action.

2. [tI] : Integral time (Reset) has a setting range from 0 to 3600 seconds. This value is automatically calculated by activating the Autotune function. If desired, the user can later adjust this parameter to better suit the application. Set to zero if intergral action is not required.

3. [td] : Derivative (Rate) has a setting range from 0 to 3600 seconds. This value is automatically calabrated by activating the auto tune function. Set to zero, if desired the user can later adjust this perameter to better suit the application.

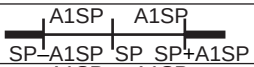
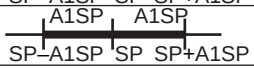
CONFIGURATION LEVEL (LEVEL 3)

1. [rEmo] : Remote/Local mode selection. Set to 0 for local mode or 1 for remote mode. In remote mode, the parameters can not be changed by the keypad on the front panel. Only a connected PC can change the controller's parameters. The VT-4810 can only be operated in local mode as it does not have a serial communication option.

2. [P-L] : Parameter Lock. Permits the user to lock-out level parameters that are not necessary or not used. See below, and page 10.

Parameter Lock Code #	Parameters that are adjustable in			
	Level 1	Level 2	Level 3	Level 4
1	SP1, ramp, A1SP (time)	All	All	All
0	SP1, A1SP (time)	All	All	All
2	SP1, oPoF, A1SP (time)	All	All	All
3	SP1, ramp, oPoF, A1SP (time)	All	All	All
4	SP1, A1SP (time)	All	All	None
5	SP1, ramp, A1SP (time)	All	All	None
6	SP1, oPoF, A1SP (time)	All	All	None
7	SP1, ramp, oPoF, A1SP (time)	All	All	None
8	SP1, A1SP (time)	All	None	None
9	SP1, ramp, A1SP (time)	All	None	None
10	SP1, oPoF, A1SP (time)	All	None	None
11	SP1, ramp, oPoF, A1SP (time)	All	None	None
12	SP1, A1SP (time)	None	None	None
13	SP1, ramp, A1SP (time)	None	None	None
14	SP1, oPoF, A1SP (time)	None	None	None
15	SP1, ramp, oPoF, A1SP (time)	None	None	None

3. A1Fu : Alarm 1 function. There are 16 modes for the alarm function, as per the table below.

0 *4	Deviation high alarm	
1 *5	Deviation low alarm	
2 *6	Process high alarm	
3 *7	Process low alarm	
8	On-timer	
9	Off-timer	
10	Event-On timer	
11	Event-Off timer	
12 14	Deviation band high alarm	
13 15	Deviation band low alarm	
Note: modes 4,5,6,7,14, and 15 are with standby sequence.		

4. A1HY : Hysteresis of alarm 1. Setting range 0.0 to 25.5% of controllers Span. This parameter is used to eliminate relay "chatter".

5. Act : Control output action. Set to 0 for cooling (direct) action or 1 for heating (reverse) action.

6. unit : Unit of process value. Select the correct unit for the process. Set to 0 for degree F, 1 for degree C and 2 for other linear process.

7. dP :

dp	Decimal
0	None
1	1XX•X
2	1X•XX
3	1•XXX

Decimal Point selection. This parameter defines the position of the decimal point on the process value and setpoint.

8. Ct : Proportional cycle time of output 1. The value can be set from 0 to 100 seconds. Set to 1 second for pulse voltage output and 0 second for 4~20 mA output. Set the value to 30 seconds or longer is possible to help prolong the life of the relay contacts.

9. HYSt : Hysteresis (dead band) for ON/OFF control. User can set a range from 0.0 to 25.5% of SPAN. (used to avoid relay chatter)

10 . EroP :

EroP	Alarm 1	Output 1
0	Off	Off
1	Off	On
2	On	Off
3	On	On

Error protection. Defines protection mode for the status of control and alarm outputs to ensure a safe condition if the sensor fails.

11. Addr : Address of the controller for serial communication. This parameter provides an identity code for the RS-485 communication interface. Note that it is not allowable to set the same Address value for controllers communicating with the same computer to prevent line contention problems. If the controller does not have the RS-485 interface, this parameter can be neglected. Setting range is 0 to 31. The VT-4810 can only be operated in local mode as it does not have a serial communication option.

12. PvoF : Processes variable offset permits the user to offset the PV indication from the actual of measured PV. For example, if the thermocouple used is producing readings 2° higher than the actual temperature across the range, the user can eliminate the 2° difference by keying "–2". Overall range of the setting is –500 to +500. Default = 0.

13. tYPE : Input Type selection. Select a correct type in accordance with the input connection.

Type	Input Sensor Type	Range	
0	J	-50°C~1000°C	-58°F~1830°F
1	K	-50°C~1370°C	-58°F~2498°F
2	T	-270°C~400°C	-454°F~752°F
3	E	-500°C~750°C	-58°F~1380°F
4	B	0°C~1800°C	32°F~3272°F
5	R	0°C~1750°C	32°F~3182°F
6	S	0°C~1750°C	32°F~3182°F
7	N	-50°C~1300°C	-58°F~2372°F
8	PT 100 DIN	-200°C~500°C	-392°F~932°F
9	PT 100 JIS	-200°C~500°C	-392°F~932°F
10	LINEAR	-1999~9999	-1999~9999

14. LoLt : Low Limit of range. Set to a value lower than the SV and PV will ever display. Note that the low limit of the arange must be within the minimum limits specified for the type of input selected. For example: If, in the previous parameter setting ("tYPE"), you select a type J input, then the lowest possible limit of range would be –85°. Span is defined as the difference between HiLt and LoLt.

15. HiLt : High Limit of range. Set to a value higher than the SV and PV will ever display. Note that the high limit of the range must be within the maximum specified limits for the type of input selected. For example: If, in the previous parameter setting ("tYPE"), you select a type J input then the highest possible limit of range would be 1830 °F. Span is defined as the difference between HiLt and LoLt.

CALIBRATION LEVEL (LEVEL 4)

1. LoCA : Low calibration value.

2. HiCA : High calibration value.

WARNING!! NEVER ENTER THIS PROCEDURE UNLESS YOU HAVE APPROPRIATE CALIBRATION EQUIPMENT. THIS PROCEDURE SHOULD ONLY BE PERFORMED BY A TRAINED TECHNICIAN.

1. Press both scroll and enter key simultaneously for 5 seconds, then release. Repeat above operation until LoCA appear on the PV display.

2. Remove the sensor from the controller's input terminals and connect a Thermocouple of RTD simulation signal to the controller's input terminals. For a process DC input, use a 4 to 20 mA or 1 to 5 V DC signal, depending on the input type of controller.

3. Apply the low input signal to the controller which corresponds to the range you are using i.e., for thermocouple input, 0°C would be applied to the controller.

4. Use up and down key to adjust the SV display to match the input signal you have applied to the controller.

5. Press and hold the enter key for at least 5 seconds and the parameter on the PV display will changed form LoCA to HiCA. The low calibration value is now written into the controller's non-volatile memory.

6. Apply the high input signal to the controller which corresponds to the range you are using.

7. Use up and down key to adjust the SV display to match the input signal you have applied to the controller.

8. Press and hold the enter key for at least 5 seconds and parameter on the PV display will change from HiCA to SP. The low calibration value is now written into the controller's non-volatile memory.

9. Input a signal midway between the low and high calibration signals previously applied and verify that the display matches the input signal. Repeat the above procedure if necessary.

3. tunE : Autotuning selection.

AUTOTUNE

The autotune program may be initiated

- During initial set-up
- When the setpoint is changed substantially from the previous autotune result
- When the control result is unsatisfactory

Autotuning the controller: In order to automatically set the values for Proportional Band (PB), Integral (Reset) time (ti), and Derivative (Rate) time (td), first adjust the controller's setpoint (SV) to the desired value. Make sure that the value for Proportional Band (PB) is NOT zero (zero initializes ON/OFF control). Also, check that the following parameters are set correctly for your application: Cycle Time (Ct), input sensor (typE), and low/high limit (loIT and HiIT).

To initiate the autotune, press and hold the SCROLL key for at least 5 seconds until the right-most decimal point on the PV display begins flashing.

When autotune is complete, the right-most decimal will cease flashing. The new P, I, and D values will-now be stored in nonvolatile memory. Adjustments can now be made manually if desired.

To abort an autotune process, simply press and hold the SCROLL key again for 5 seconds until the decimal stops flashing.

Autotune teaches the controller the main characteristics of the process. It learns by cycling the output on and off. The result are measured and used to calculate optimums PID values which are automatically entered into nonvolatile memory. After two oscillatory cycle of ON/OFF control, the controller performs PID control to verify the results.

To ensure satisfactory autotune operation, it is important that the span (the difference between LoLt and HiLt) be set carefully since 10% of this difference will determine the autotune position in 0, 2, and 4 below.

1. The controller will autotune at 10% of span below setpoint. After the autotune cycle is complete, the process value will then rise to setpoint.

2. The controller will autotune at the setpoint. Note: The temperature will rise above the setpoint during the autotune cycle in this mode.

3. For the first time only, when the controller is switched on, the controller will autotune at 10% of span below setpoint. After the autotune cycle is complete, the process value will then rise to setpoint.
4. For the first time only, when the controller is switched on, the controller will autotune at the setpoint. Note: The temperature will rise above the setpoint during the autotune cycle in this mode.

5. Every time the controller is switched on, the controller will autotune at 10% of span below setpoint. After the autotune cycle is complete, the process value will then rise to setpoint.

6. Every time the controller is switched on, the controller will autotune at set- point value. Note: The temperature will rise above setpoint during the autotune cycle in this model

AUTO/MANUAL CONTROL MODES

AUTOMATIC CONTROL

In auto mode, which is the default mode, the controller automatically adjusts the output variable in accordance with the PID algorithm to reach and maintain the desired setpoint. Auto mode is the normal mode of operation, and may be set for P, PI, PD, PID or ON/OFF control.

MANUAL CONTROL

Manual control is usually used for testing purposes and allows the user to drive the outputs manually between 0.0 to 100%. To access the manual mode, press and hold the ENTER key for 4 seconds until either the right-most decimal point on the SV display begins flashing. The controller's output percent will now appear on the SV display.

To return to AUTO mode from MANUAL mode, press and hold the ENTER key for 4 seconds again until the decimal point turns off. The setpoint again appears on the SV display.

RAMP/SOAK DWELL

The VTR Series controller can operate as a fixed setpoint controller or as a single stage Ramp and Soak Controller upon power-up. Ramp and Soak permits the user to limit the rate at which the controller travels from starting point to setpoint. Also, the Alarm 1 relay can be configured to perform a "Dwell" function. Ramp, Soak, and Dwell will be explained further below.

RAMP FUNCTION

If the parameter "rAmP" is set to a value other than "0", the controller will perform a programmed ramp. The process will travel twards the setpoint at a programmed rate. Rate settings range between 0.0 and 100.0 degrees per minute.

RAMP and SOAK FUNCTION

If the "AlFu" parameter is set to a "10", the alarm 1 relay contact will be de-energized at start-up and will become energized after the elapsed time, which the user programs, has timed-out.

If the power supply or control output of the controller is connected to the Aloarm 1 contacts, the controller will operate as "guaranteed" soak controller. In other words, the controller will pause the timer if the controller deviates from setpoint (after the SV has been initially reached); once the setpoint is again matched, the timer resumes. This ensures that the controller will soak at the desired temperature for the programmed amount of time.

DWELL FUNCTION

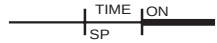
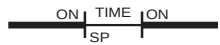
If the "AlFu" parameter is set to a "9", the Alarm 1 relay contact will be deenergized at start-up and de-energized after trhe elapsed time, which the user programs, has timed-out.

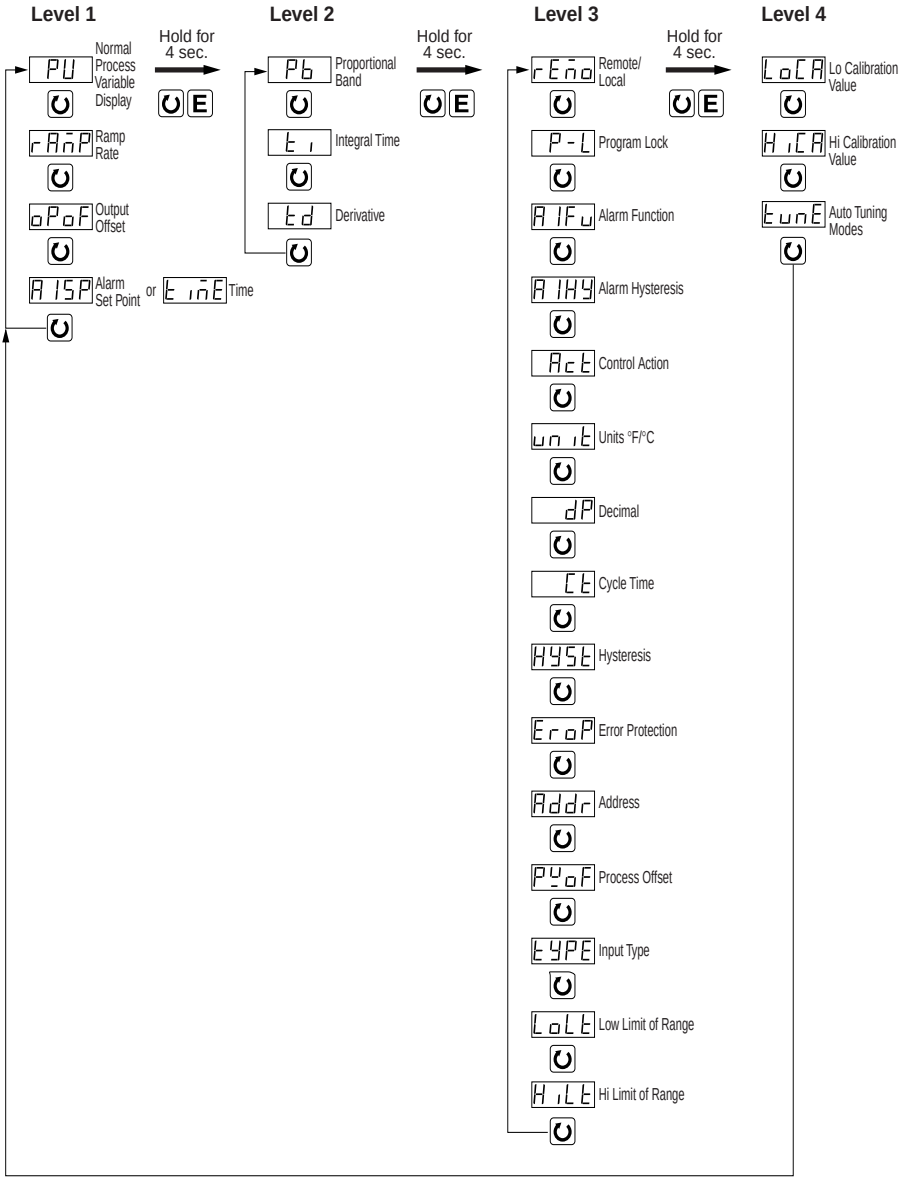
NOTE: The difference between DWELL and SOAK is that DWELL does NOT stop the timer clock when the PV devates from the SV (after the SV has initially been reached) but the SOAK function does stop the clock ensuring or "guaranteeing" a soak right at the desired temperature for the entire programmed time.

ERROR MESSAGE

AdEr	A/D converter damage
oPEn	Sensor break error
AtEr	Incorrect operation of autotune procedure
CSEr	Checksum error, value in memory may have changed accidentally

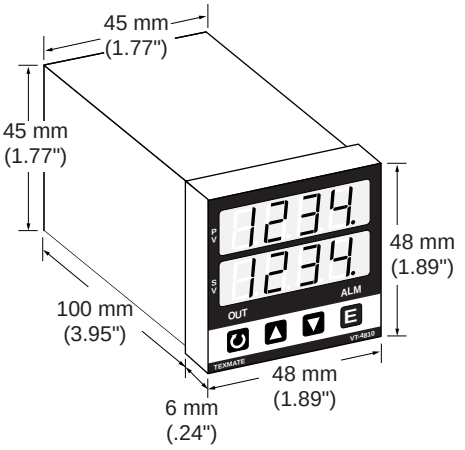
ALARM FUNCTION

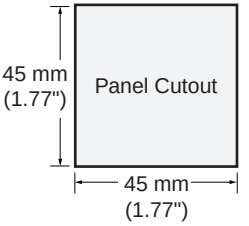
8	On-timer	
9	Off-timer	
10	Event-On timer	
11	Event-Off timer	
Note: modes 4,5,6,7,14 and 15 are with standby sequence.		


Level 1
Level 2
Level 3
Level 4
Hold for 4 sec.
Hold for 4 sec.
Hold for 4 sec.
PU Normal Process Variable Display
rAnP Ramp Rate
oPoF Output Offset
AISP Alarm Set Point
or
tInE Time
Pb Proportional Band
ti Integral Time
td Derivative
rEmo Remote/ Local
P-L Program Lock
AIFu Alarm Function
AIHY Alarm Hysteresis
Act Control Action
unit Units °F/°C
dP Decimal
Ct Cycle Time
HYSt Hysteresis
ErrP Error Protection
Addr Address
PVoF Process Offset
tYPE Input Type
LoLt Low Limit of Range
HiLt Hi Limit of Range
LoCA Lo Calibration Value
HiCA Hi Calibration Value
tunE Auto Tuning Modes

Parameter	Default Setting	Programmed Setting	User Setting	User Setting
rAnP	0.0			
oPoF	0.0			
AISP	10			
Pb	0.0			
ti	240			
td	40			
rEno	0			
P-L	3			
AIFu	1			
AIHY	0.1			
Act	1			
unit	1			
dP	0			
Ct	0			
HYSt	0.1			
ErrP	2			
Addr	0			
PYoF	0			
tYPE	1			
LoLt	-50			
HiLt	1370			
LoCA	0			
HiCA	1000			
tunE	1			

CASE DIMENSIONS





ORDERING INFORMATION

VT-4810 / ___ ___

T= Thermocouple input
D= RTD input
L= Linear 4 to 20 mA input
C= Custom linear input

R= Control output is relay 5 A / 240 V resistive load
P= Control output is pulsed 24 VDC (100 mA max)
X= Control output is 4 to 20 mA (max load 500 Ω)
Y= Control output is 0 to 20 mA (max load 500 Ω)
V= Voltage output 0 to 5 / 1 to 5 / 0 to 10 VDC
C= Custom voltage or current output

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Texmate has facilities in Japan, New Zealand, Taiwan, and Thailand. We also have authorized distributors throughout the USA and in 28 other countries.

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