INSTRUCTION MANUAL FOR VT48/96/72… 26+ FUZZY PID

1. INTRODUCTION

This manual contains information for the installation, operation and tuning of your Vertex VT26+ series FUZZY ENHANCED auto-tuning microprocessor based controller. These controllers carry a two-year factory warranty. The VERTEX microprocessor controllers are FUZZY ENHANCED "proportional + integral + derivative" (PID) controllers that come in a variety of standard DIN sizes. The input is configurable and allows selection of inputs between thermocouples and RTD's. You can also have 4~20 and other linear inputs as an option to be specified when ordering the controller. When ordering your controller you can choose between Relay, SSR, Heat / Cool, 4~20 mA or other output signals. They have dual displays that show the input (measured temperature) in the top digital display and the required set point in the lower. They all come standard with 2 alarm relay outputs. The controller boasts a comprehensive range of other features that include a ramp, soft start with power limiting, auto/manual function and comes standard with two configurable alarms. The controllers can be switched to manual and can work as "time based ratio out-put controllers" in the event of thermocouple or input failures taking place. There are other options you can choose including "retransmission" of either the PV or SV or RS485 communications.

Features:

- **T/C, RTD selectable from front panel or as optional extra Linear Input.**
- **Heating output Relay, SSR or analog to be chosen when ordering**
- **Fuzzy enhanced PID Control.**
- **Auto / Manual Bumpless Transfer.**
- **Two alarm outputs.**
- **Standby and Latch mode can be combined with 8 different alarm functions.**
- **Ramp to set point and soak functions.**
- **Soft- start function.**
- **Universal power supply : 100~240VAC, 50/60Hz. Or as optional extra 24 Vdc/Vac**
- **PV or SV Retransmission (Cannot have retransmission and Cooling output together.**
- **RS-485 communication port as optional extra.(MODBUS RTU)**
- **Input sampling time 0.1 sec**

2. IN A HURRY

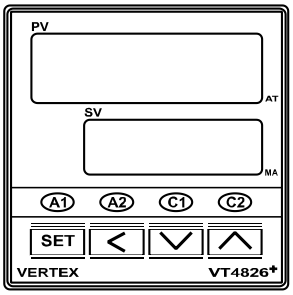
These Vertex temperature controllers, although quiet sophisticated, can be equally very simple to use. In its simplest form, all you need to do is install it and get the wiring right, (YOU MUST READ CONNECTIONS AND WIRING section) turn it on, check that the thermocouple type it is correct, (during the self test it will display the input type), make sure it is reading more or less the right temperature, that the heating elements actually get hot when the "C1" light is on and away you go. No need for laboriously reading this manual and changing and setting all the parameters….Just turn it on and when the system

it is controlling has reached it's operating temperature, do an "auto-tune" as explained in the section "Tuning your VERTEX VT26 series controller" You can also however explore all the parameters and set and use it in any way you may wish. If you are not sure please contact Vertex and ask, we are always happy to help.

To change the set point, first highlight the digit you wish to change using the sideways shift key and then use the up and down keys to make the change.

Please search in YouTube for "Vertex VT26 Series" for more info about these controllers

■ FRONT PANEL DESCRIPTION



(1) PV - Process Value

(2) SV - Setting Value

(3) AT - Auto tuning LED

(4) MA - Manual mode LED

(5) A1 - Alarm 1 LED

(6) A2 - Alarm 2 LED

(7) C1 - Control 1 LED

(8) C2 - Control 2 LED

(1) SET - SET KEY. Press once to access the next programmable parameter. Press this key for 5 seconds to reset alarm timer.

(2) ∧ - UP KEY. Press to increase the set point or parameter value.

(3) ∨ - DOWN KEY. Press to decrease the set point or parameter value.

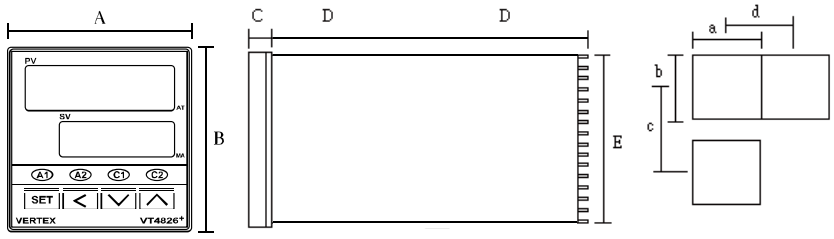
(4) < - SHIFT KEY. Press the shift key for 5 seconds to execute Auto Tune process (Yes. 1 mode)
To abort the Yes. 1 Auto Tune process, press the shift key for 5 seconds.

(5) SET ∧ - Press the SET and UP keys once to return the normal operation.

(6) SET < - LEVEL KEY. Press the SET and SHIFT keys simultaneously for 5 seconds to select programming level, then press SET key to enter this level.

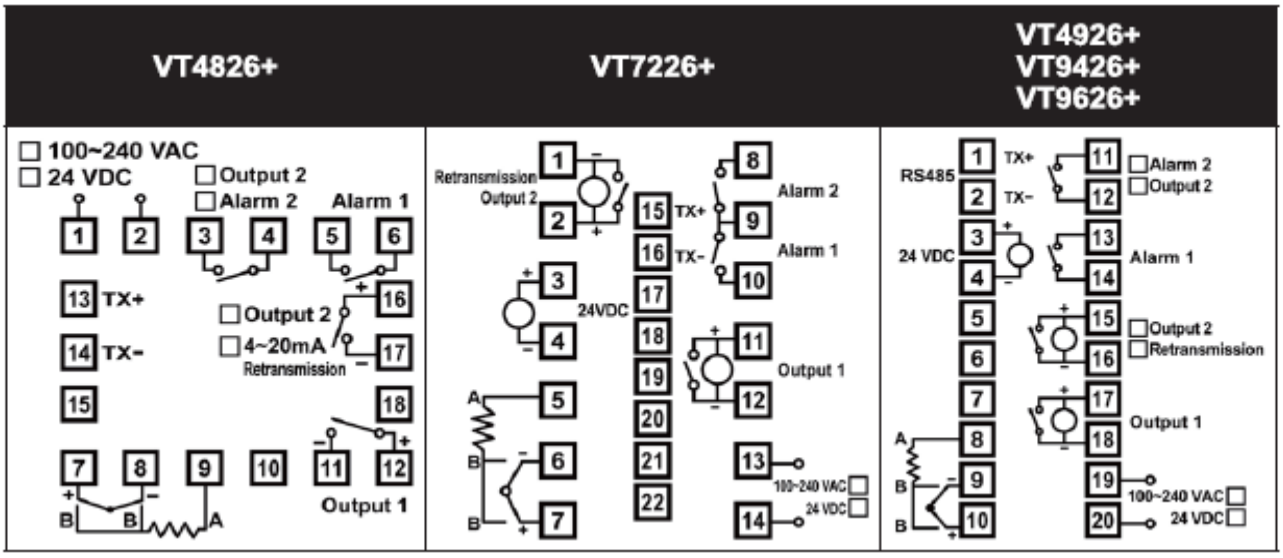
(7) ∧ ∨ - Press the UP and DOWN keys simultaneously for 5 seconds to access "LnLo" and "LnHi" parameters.

■ **PANEL CUTOUT**



Model	A	B	C	D	E	a	b	c	d
VT-4826+	48	48	6	100	45	45+0.5	45+0.5	60	48

(Unit:mm)

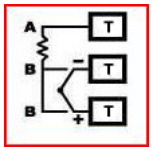


■ WIRING PRECAUTIONS

1. Before wiring, verify the controller label for correct model number and option.
2. For thermocouple input, use the appropriate compensation wire. And note the polarity of input signal.
3. To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.

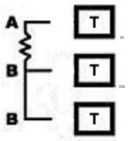
Connections Explained

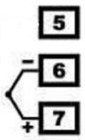
These are typical input connection drawing intended to explain the schematic symbols:

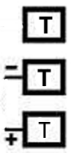


Now let's look at the detail included here……

RTD Input looks like this Thermocouple input like this mA or mV looks like this

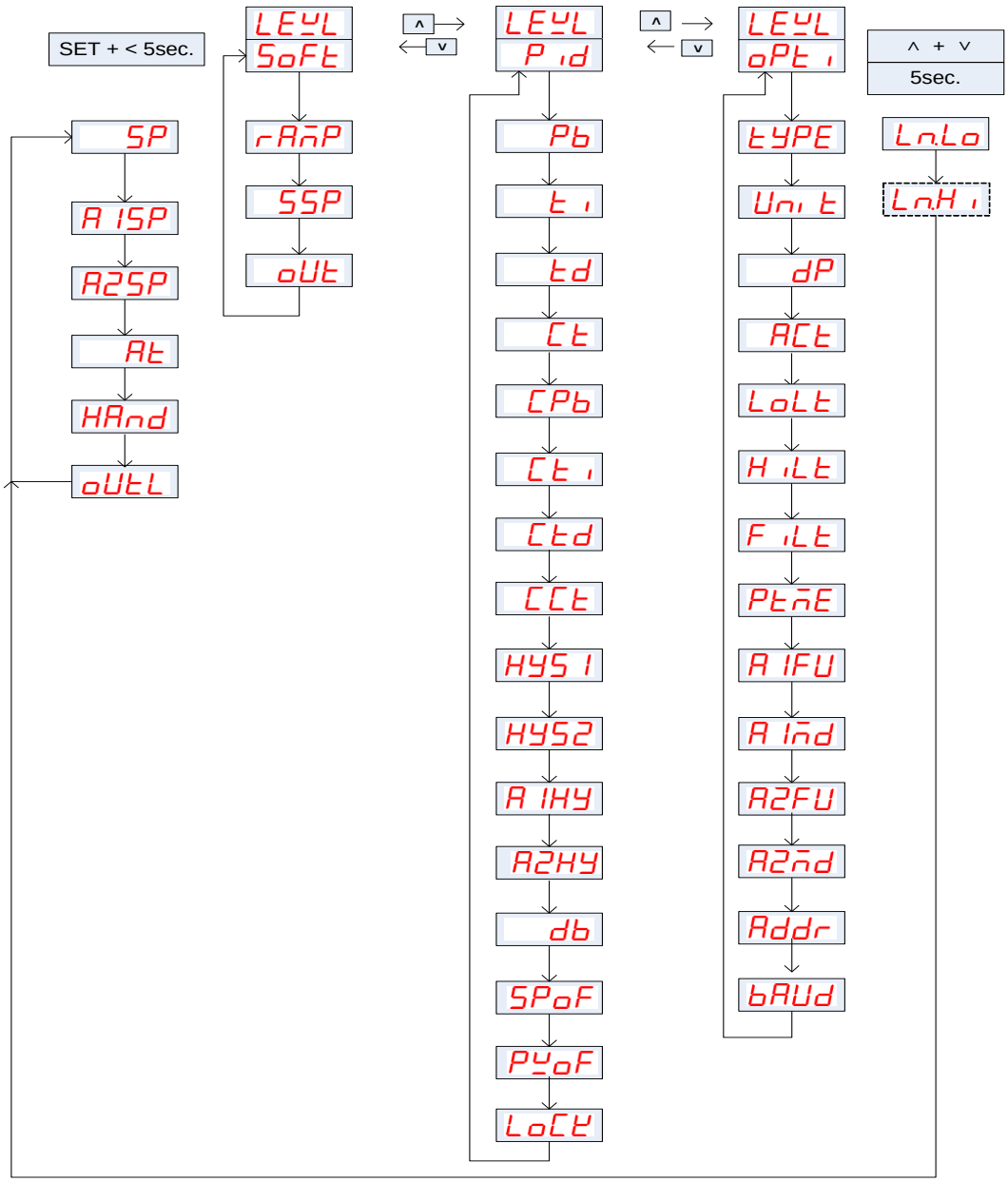






■ PROGRAMMING LEVEL PARAMETERS

lst. Prog. Level 2nd. Prog. Level 3rd. Prog. Level 4th Prog. Level 5th. Prog. Level



1. When 2nd Output (Cooling) is not selected, CPb、Cti、Ctd、HYS2 and db parameters are not available.
2. When Pb≠0.0， HYS1 will be skipped.
3. When CPb≠0.0，HYS2 will be skipped.
4. When Pb＝0.0，ti、td will be skipped.
5. When CPb＝0.0，Cti、Ctd will be skipped.

PARAMATER DESCRIPTION

LEVL	**LEVEL Selection** Press SET < keys for at least 5 seconds to access Soft Level. Use ▽ or △ key to select programming level. Then press SET key to enter this level. Level: SoFt — SoFt Level; Pid — PID Level; oPt1 — Option Level

USER LEVEL

Code	Description	Range	Default
SP	Set point value for control. To change press ◀button to highlight digit then use up and down buttons to change.	LoLt - HiLt	500
A1SP	Alarm 1 set point value or Timer set value if A1FU is set to T.on or T. off, the unit can be HH.MM or MM.SS. It depends on the "P.tnE" parameter.	-1999 - 9999/ 00.00~99.59	10
A2SP	Alarm 2 set point value or Timer set value if A2FU is set to T.on or T. off, the unit can be HH.MM or MM.SS. It depends on the "P.tnE" parameter.	-1999 - 9999/ 00.00~99.59	10
At	no : Auto-tuning is disable YES.1 : Auto-tuning at setpoint. YES.2 : Low PV type auto-tuning. This is done at 10% below SP during Auto-tuning.	no YES.1 YES.2	no
HAnd	no : Control is done by PID control automatically. YES : Output is manually adjusted by operator	no YES	no
oUtL	Output percentage. Adjustable when "Hand" is set to "Yes"	-100.0 - 100.0	100.0

SOFT LEVEL

Code	Description	Range	Default
rAnP	Ramp rate for the process value to limit an abrupt Change of process.(℃/min.)	0 – 9999 (0.0 - 999.9)	0.0
SSP	Set point value of soft-start	LoLt - HiLt	0
oUt	Output percentage of soft-start	0.0 - 100.0	100.0

PID LEVEL

Code	Description	Range	Default
Pb	Proportional band variable. Set to 0.0 for ON/OFF control mode.	0.0-300.0%	10.0
t1	Integral time (Reset). This value is automatically calculated by activating the Autotune function. If desired, the user can later adjust this parameter to	0-3600sec	240

	better suit the application. When PB=0.0, this parameter will be not available. When set to zero, Pb & td ≠ 0 for PD control.		
td	Derivative (Rate). This value is automatically calculated by activating the Auto tune function. If desired, the user can later adjust this parameter to better suit the application. When PB=0.0, this parameter will be not available. When set to zero, Pb & td ≠ 0 for PI control.	0-900sec	60
Ct	Proportional cycle time of output 1.	0-100sec	15
CPb	Proportional band variable for secondary control output (cooling). Set 0.0 for ON/OFF.	0.0-300.0%	10.0
Ct i	Integral time for secondary control output. When PB=0.0, this parameter will be not available. When set to zero, Pb & td ≠ 0 for PD control.	0-3600sec	240
Ctd	Derivative time for secondary control output. When Pb=0.0, this parameter will be not available. When set to zero, Pb & ti ≠ 0 for PI control.	0-900sec	60
CCt	Proportional cycle time of output 2.	0-100sec	15
HYS 1	Hysteresis for ON/OFF control on output 1.	0-2000 (0.0-200.0)	1
HYS2	Hysteresis for ON/OFF control on output 2.	0-2000 (0.0-200.0)	1
A 1HY	Hysteresis of alarm 1.	0-2000	1
A2HY	Hysteresis of alarm 2.	0-2000	1
db	Dead band value. This defines the area in which output 1 and output 2 are both active (negative value) or the area in which output 1 and output 2 are both inactive (positive value).	-1000-1000 (-100.0-100.0)	0
SPoF	Set point offset. This value will be added to SV to perform control. It mainly used to eliminate offset error during P control.	-1000-1000 (-100.0-100.0)	0
PVoF	Process value offset. Permits the user to offset the PV indication from the actual PV.	-1000-2000 (-100.0-200.0)	0
LoCK	Parameter lock. This security feature locks out selected levels or single parameters prohibiting tampering and inadvertent programming changes. 0000 — All parameters are locked out. 0001 — Only SP is adjustable 0010 — Only USER level is adjustable 0011 — USER and PID levels are adjustable. 0100 — USER,PID,OPTI levels are adjustable. 0101 — USER,SOFT,PID,OPTI levels are adjustable. 0101~0111 — All parameters in all levels are opened. 1000~1111 — 1000=0000,1001=0001, 1010=0010,1011=0011,1100=0100 but Output 2 is opened.		0100

OPTION LEVEL

<table>
<tr><th>Code</th><th>Description</th><th>Range</th><th>Default</th></tr>
<tr><td>tYPE</td><td>Input type selection.
<table>
<tr><th>TYPE</th><th>RANGE(℃)</th><th>RANGE(℉)</th></tr>
<tr><td>J</td><td>-50~1000</td><td>-58~1832</td></tr>
<tr><td>K</td><td>-50~1370</td><td>-58~2498</td></tr>
<tr><td>T</td><td>-270~400</td><td>-454~752</td></tr>
<tr><td>E</td><td>-50~950</td><td>-58~1742</td></tr>
<tr><td>B</td><td>0~1800</td><td>32~3272</td></tr>
<tr><td>R</td><td>-50~1750</td><td>-58~3182</td></tr>
<tr><td>S</td><td>-50~1750</td><td>-58~3182</td></tr>
<tr><td>N</td><td>-50~1300</td><td>-58~2372</td></tr>
<tr><td>C</td><td>-50~1800</td><td>-58~3272</td></tr>
<tr><td>D-PT</td><td>-200~850</td><td>-328~1562</td></tr>
<tr><td>J-PT</td><td>-200~600</td><td>-328~1112</td></tr>
<tr><td>LINE</td><td colspan="2">-1999~9999</td></tr>
</table></td><td>Refer to figure.</td><td>K</td></tr>
<tr><td>Unit</td><td>Unit of process value
oC : Degrees C.
oF : Degrees F.
EnG : Engineer unit for linear input.</td><td>oC
oF
EnG</td><td>℃</td></tr>
<tr><td>dP</td><td>Decimal point selection.
0000 : No decimal point.
000.0 : 0.1 resolution
00.00 : 0.01 resolution, used for linear input only.
0.000 : 0.001 resolution, used for linear input only.
After change decimal point, please reconfirm the parameter.</td><td>0000
000.0
00.00
0.000</td><td>0000</td></tr>
<tr><td>ACt</td><td>Output 1 control action.
rEV: Reverse action for heating.
dir : Direct action for cooling.</td><td>rEV
dir</td><td>rEV</td></tr>
<tr><td>LoLt</td><td>Low limit of span or range. Set the low limit lower than the lowest expected SV and PV display.</td><td>Full range</td><td>0</td></tr>
<tr><td>HiLt</td><td>High limit of span or range. Set the high limit higher than highest expected SV and PV display.</td><td>Full range</td><td>1000</td></tr>
<tr><td>FiLt</td><td>Software filter.</td><td>0.0-99.9</td><td>10.0</td></tr>
<tr><td>PtmE</td><td>Time scale for timer alarm.
HH.mm Hours:Minutes;
mm.SS Minutes:Seconds</td><td>00.00~99.59</td><td>00.00</td></tr>
<tr><td>A1FU</td><td>Alarm 1 function. Refer to alarm function section for detail.
If A1FU=None, it means alarm function is cancelled.</td><td>None, Hi, Lo, dif.H, dif.L, bd.Hi , bd.Lo t.on, t.oFF</td><td>difH</td></tr>
<tr><td>A1md</td><td>Alarm 1 mode. Refer to alarm mode section for detail..</td><td>none, Stdy, Lath, St.La</td><td>nonE</td></tr>
<tr><td>A2FU</td><td>Alarm 2 function. Refer to alarm function section for detail</td><td>none, Hi, Lo, dif.H, dif.L,</td><td>difL</td></tr>
</table>

	If A2FU=None, it means alarm function is cancelled.	bd.Hi, bd.Lo t.on, t.oFF	
A2nd	Alarm 2 mode. Refer to alarm mode section for detail.	none, Stdy, Lath, St.La	nonE
Addr	Address of controller when communication with master device.	0 - 255	1
bAUd	Communication baud rate. 2.4k=2400bps, 4.8k=4800 bps, 9.6k=9600 bps, 19.2k=19200 bps	2.4k, 4.8k 9.6k, 19.2k	9.6k

Code	Description	Range	Default
LnLo	Low Scale of Linear Input	-1999~9999(-199.9~999.9)	0.0
LnHi	High Scale of Linear Input	-1999~9999(-199.9~999.9)	100.0

Scaling for Linear Input

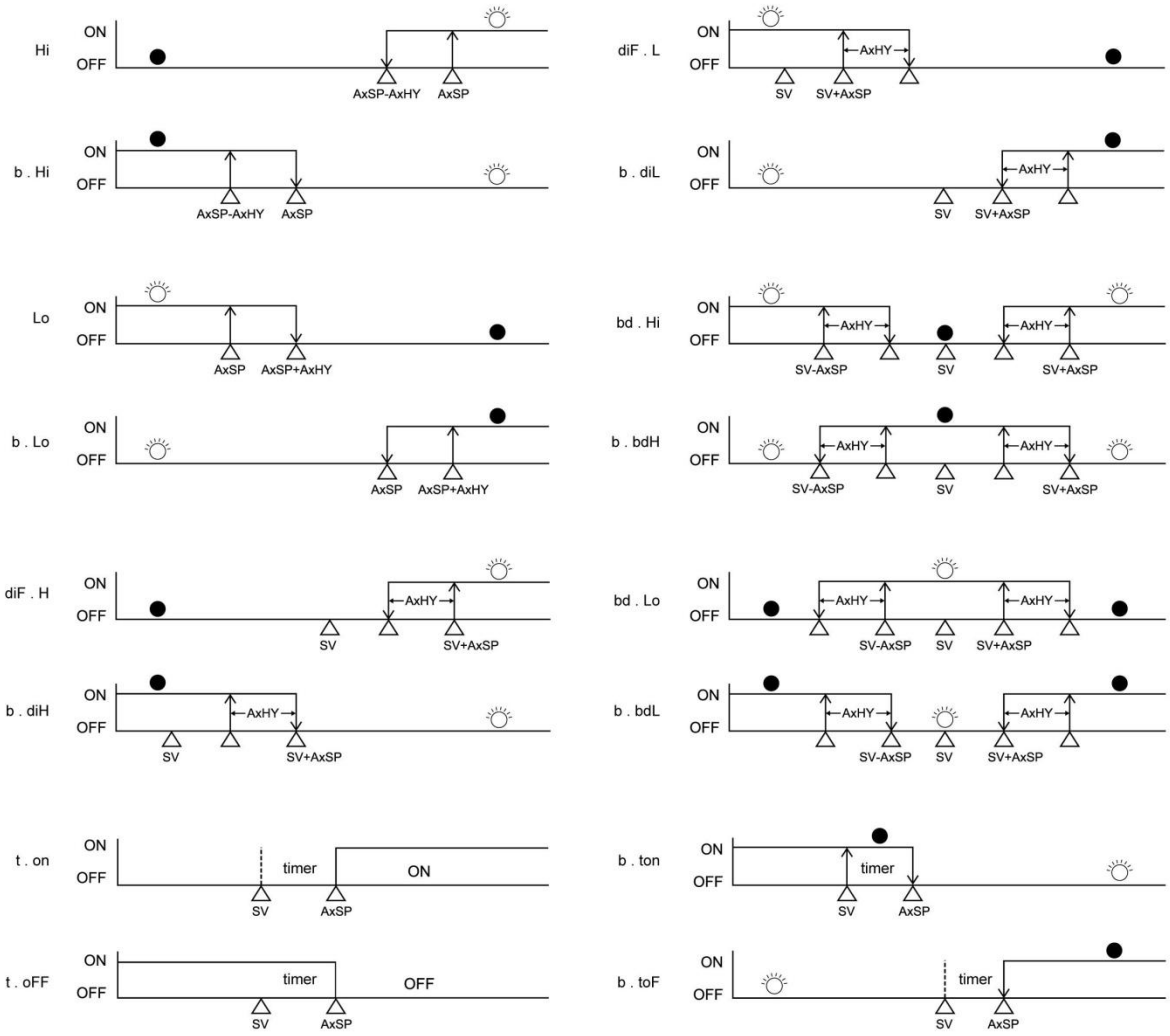
1. Press the UP and DOWN keys simultaneously for 5 seconds to access “LnLo” parameter.
2. Adjust “LnLo” setting to correspond the low scale and after adjustment press SET key once to access “LnHi” parameter.
3. Adjust “LnHi” setting to correspond the high scale and after adjustment press SET key once for normal operation.

■ ALARM FUNCTION

Select the alarm function

nonE – Alarm action off.
Hi – Process high alarm with Form A contact
Lo – Process low alarm with Form A contact
diF.H – Deviation high alarm with Form A contact
diF.L – Deviation low alarm with Form A contact
bd.Hi – Deviation band high alarm with Form A contact
bd.Lo – Deviation band low alarm with Form A contact
t.on – On-timer with Form A contact
t.oFF –Off-timer with Form A contact

b noE – Alarm action off
b.Hi – Process high alarm with Form B contact
b.Lo – Process low alarm with Form B contact
b.diH – Deviation high alarm with Form B contact
b.diL – Deviation low alarm with Form B contact
b.bdH – Deviation band high alarm with Form B contact
b.bdL – Deviation band low alarm with Form B contact
b.ton – On-timer with Form B contact
b.toF –Off-timer with Form B contact



ALARM MODE

A1MD/A2MD	DESCRIPTION
nonE	Normal alarm mode/ When timer function is selected, PV<SV timer function is not available.
StdY	Standby mode When selected, in any alarm function, prevents an alarm on power on. The alarm is enabled only when the process value reach alarm set point. Also known as “Startup inhibit” and is useful for avoiding alarm trips during startup.
LAtH	Latch mode. When selected, the alarm output and indicator latch as the alarm occurs. The alarm output and indicator will be energized even if the alarm condition has been cleared unless the power is shut off. When Timer function is selected, PV< SV timer function is available.
StLA	*Standby and latch mode*

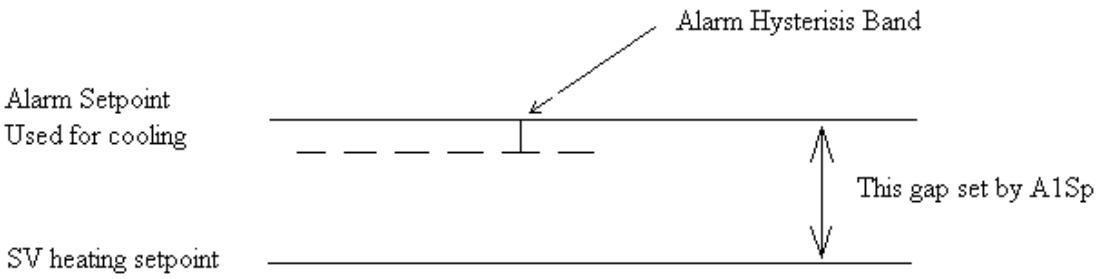
AUTOMATIC AND MANUAL OUTPUT CONTROL

Automatic control is the normal mode of controller operation. In automatic control mode the controller automatically adjust the control output percentage by PID algorithm so that the PV=SV. The PID parameter Pb, Ti and Td can be also calculated by Auto Tune

procedure.
Manual control allows the user to manually drive the output percentage from 0.0 to 100.0%. To access the manual mode, set the "HAnd"parameter to " YES", the rightmost decimal (MA) on SV display will flash. Then the "oUtL " parameter will display alternately " oUtL " and process value. The output percentage then can be adjusted by pressing UP or DOWN key. To abort the manual control just simply set the "HAnd" to " no".

2.1. HEAT / COOL USING THE ALARM

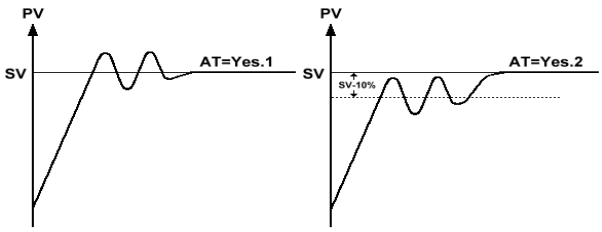
1. When it is required to have "Heat" and "Cooling" as for example on an extrusion barrel, you can use the alarm setting as the "cooling setpoint".
2. The alarm based cooling will be on/off and not proportional.
3. This in itself is not bad, as if you are cooling using a fan, or in other applications you may have compressor cooling, you cannot use proportional control, as switching a fan motor or compressor "on and off" rapidly will burn it out in any case.
4. In the case of liquid cooling (solenoid) on extrusion barrel zones, this method works just as well as proportional.
5. You can however have a second output (optional extra) that will provide full PID control on a second output and use it on a solenoid liquid cooling system should you so require.
6. When using the "alarm" for cooling, you can set the gap between the heating and cooling setpoints, and also specify how long the cooling must stay on each time it switches on using the "hysteresis" adjustment.
7. When using the alarm for cooling, the first thing to do is select the "Alarm Function" that links the alarm to the setpoint by a fixed "Gap". You will find on your unit that the factory default is set to this so it is not necessary to change anything. That is Alarm Function "diF.H" (Deviation alarm high) selected in "oPt 1" level. The VT26 series controllers are supplied with this as a default setting.
8. This means that the Alarm setpoint will be linked to the main (Heating) setpoint by a gap as shown below.
9. When you move the main setpoint (Heating Setpoint) the Alarm (Cooling Setpoint) will follow, always offset by the gap.
10. Once you have selected this function you now set the gap.
11. This is done in Level 1 using the "A1Sp" setting. This will be the amount of degrees C that the Alarm Setpoint (Cooling Setpoint) will be above the Main Setpoint (Heating Setpoint)
12. You can now set the 'Hysterisis" band attached to the alarm setpoint that will determine how long the cooling stays on each time it is switched on.
13. The temperature must rise to the alarm setpoint which in this case will be the main setpoint + the alarm 1 setpoint before the alarm (cooling) will switch on.
14. It will now stay on until the temperature has dropped below the lower limit of the hysteresis band before the cooling will switch off.
15. This setting is set in degrees C



AUTO TUNE

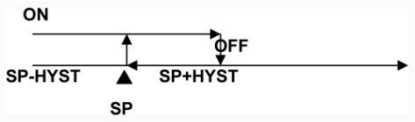
In order to automatically set the PID parameter in PID level ("Pb" proportional band, "ti: integral time or reset and "td" derivative time or rate), first adjust the controller's set point to a value, which closely approximates your application. Allow te system to warm up and settle down at that operating temperature before attempting an auto-tune process. Set the " AT " parameter to "YES.1" for standard type auto tune at and around the setpoint or "YES.2" for auto-tune 10% below the current setpoint. The right-most decimal point (AT) on the PV display begins flashing. The auto tune procedure will take two cycle oscillations. After that, the controller performs PID control with the "learned" PID value to verify the results. Finally the PID values will be entered into the nonvolatile memory and then start the Fuzzy enhanced PID control. The auto tune process can last from several minutes up to two hours, depending on the system's parameter. A time out error will occur if the auto tune process cannot be completed within two hours, in this case, try to set the PID parameters manually.

Under normal circumstances if it does not complete within say 10 minutes something is wrong. To abort an auto tune process, simply set the " AT " parameter to " no".

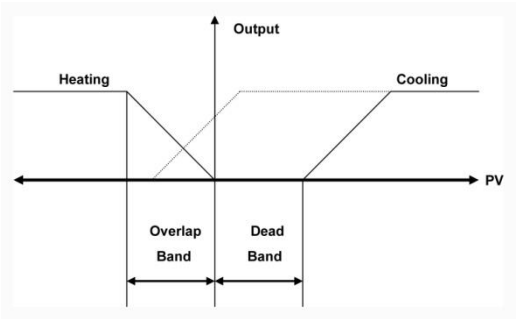


On/Off control

The controller can also be set to ON/OFF, PI, PD and P control mode. Set Pb = 0 for ON/OFF control mode. Set ti = 0 for PD control mode. Set td = 0 fro PI control mode and ti, td = 0 fro P control mode. The Hysteresis (dead band) 0f ON/OFF control can be set as follow:



When the second control output (output 2) is equipped the proportional band of output 2 and dead band are defined as follow:



Parameter Retransmission

As an optional extra you can have a retransmission of either the process value or setpoint value re-transmission. However you can only have either Output 2 or Re-transmission but not both.

Auxiliary Power Source

A 24 Vdc 40 mA auxiliary power source is available to drive 4 wire input devices

■ ERROR MESSAGE AND TROUBLESHOOTING

Symptom	Probable	Solution
oPEn	-Sensor break error -Sensor not connected	-Replace sensor -Check the sensor is connected correctly
AdEr	-A/D converter damage	-Unit must be repaired or replaced. -Check for outside source of damage such as transient voltage spikes. -If the wires are connected back to front, at first you will simply get a negative reading then when it goes out of range the ader error.
AtEr	-Auto tune time out error	Set Pb, ti, td manually.
Keypad no function	-Keypads are locked -Keypads defective	-Set" LoCK "to a proper value -Replace keypads
Process value unstable	-Improper setting of Pb, Ti, Td and CT	-Start AT process to set Pb, Ti, Td automatically -Set Pb, Ti, Td manually
No heat or output	-No heater power or fuse open -Output device defective or incorrect output used	-Check output wiring and fuse -Replace output device
All LED's and display not light	-No power to controller -SMPS failure	-Check power lines connection -Replace SMPS
Process Value changed abnormally	-Electromagnetic Interference (EMI) or Radio Frequency Interference (RFI)	-Suppress arcing contacts in system to eliminate high voltage spike sources. Separate sensor and controller wiring from "dirty" power lines. Ground heaters
Entered data lost	-Fail to enter data to EEPROM	-Replace EEPROM

VERTEX 10/2016

VERTEX is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual