VT20 SERIES FUZZY ENHANCED PID CONTROLLERS INSTRUCTION MANUAL (VERSION 3.0)

VERTEX TECHNOLOGY CORP.

1. INSTALLATION

1.1 PANEL MOUNTING

a. Prepare a panel cutout. The cutout required is as show in table 1-1.

Table 1-1 Panel Cutout

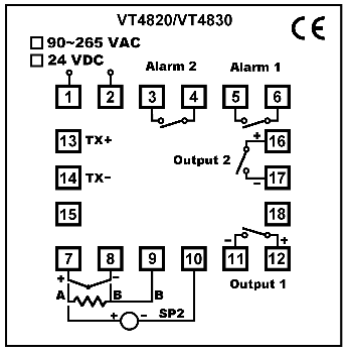
Model	High	Width
VT4820	45mm+ 0.5	45mm+ 0.5
VT4920	45mm+ 0.5	92mm+ 0.5
VT7220	68mm+ 0.5	68mm+ 0.5
VT9620	92mm+ 0.5	92mm+ 0.5

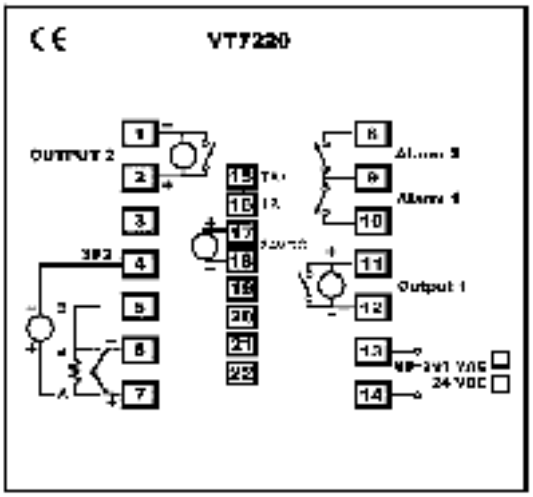
b. For VT4820, remove plastic panel clamp from controller. Slide the controller into the cutout. Replace panel clamp and press it firmly against the panel. Gently tighten the screws in the clamp till the controller front panel is fitted snugly in the cutout.

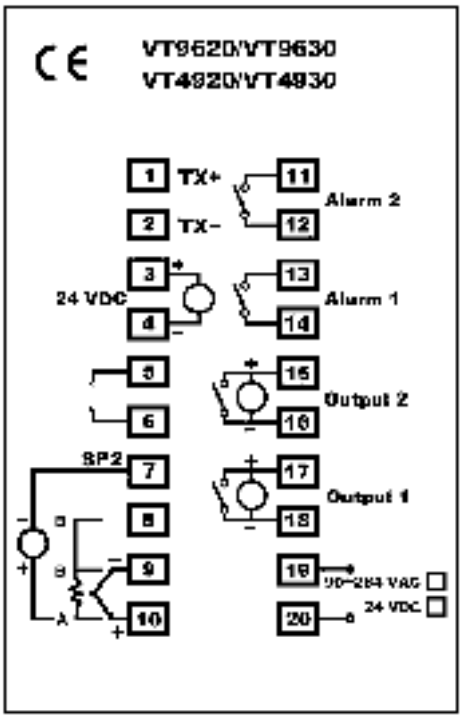
c. For other models, slide the controller into the cutout. Install the mounting clamp back. Gently tighten the screws in the clamp still the controller front panel is fitted snugly in the cutout.

1.2 CONNECTION AND WIRING

BEFORE WIRING, VERIFY THE LABLE FOR CORRECT MODEL AND OPTIONS.







a. Power input

The controller is supplied to operate on 90 ~ 264 VAC 50/60 Hz. power should be connected via a fuse with rate not exceeding 2 Amps.

b. 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. Ensuring the polarity of thermocouple/linear input is correct.

c. Control output

Different output module might be installed in the controller. Be sure that correct output device is select to meet your application. Available output modules are:

- ❑ 4 ~ 20 mA . Maximum load 600 ohms
- ❑ 1 ~ 50mV, 1 ~ 5V, 0 ~ 10V…..(Resistive 600 ohms Min)
- ❑ 0 / 24 VDC pulsed voltage to drive SSR..
- ❑ Relay contact. 10A/240VAC.

2. FRONT PANEL DESCRIPTION

2.1 DISPLAY AND INDICATOR

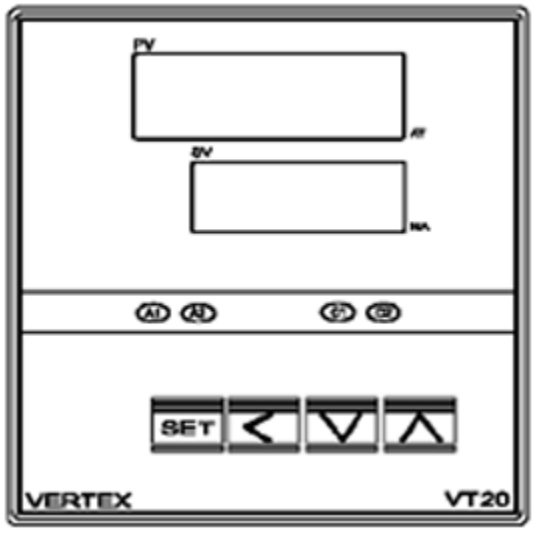
PV (Process Value) Display

- ➢ Displays the actual measurement of the input sensor.
- ➢ Displays the parameter index code.
- ➢ Displays the error message.

SV (Set Value) Display

- ➢ Displays the set value.
- ➢ Displays the parameter data.
- ➢ Displays the output percentage value.

Status indicators



a. A1 status LED indicator (Alarm 1 relay status LED)
This LED is lit in red when the alarm 1 relay is active.
b. A2 status LED indicator (Alarm 2 relay status LED)
This LED is lit in red when the alarm 2 relay is active
c. C1 status LED indicator (Control output 1 status LED)
Illuminates in green when the control output 1 is active.
d. C2 status LED indicator (Control output 2 status LED)
Illuminates in green when the control output 2 is active.
e. AT status indicator
When the controller is auto tuning. The rightmost decimal on the PV display will blink. When the tuning process is

finished or stopped, the decimal will cease blinking and disappear. Auto tuning may take from several minutes to several hours depending upon the process in question.

f. MA status indicator

When the manual control mode is selected. The rightmost decimal on SV display will blink.

2.2 KEY FUNCTION

SET key

Press once to access the next programmable parameter.

SHIFT key

Shift digits to be adjusted by up/down key.

DOWN key

Press to decrease the set point or parameter value.

UP key

Press to increase the set point or parameter value.

Press the SET and UP keys once to return the normal operation.

LEVEL key

Press the SET and SHIFT keys simultaneously for 5 seconds to select programming level, then press SET key to enter the level.

3. CONFIGURATION AND PARAMETERS SETTING

All programmable parameters are user friendly and clearly structured as three levels. To change level from one to the others, please press SET + SHIFT keys for at least 5 seconds to access level selection. Use UP/DOWN key to select programming level.

1. Pid level. (P id)
2. Option level. (oPt)

3.1 USER LEVEL

The following parameters are listed in a default sequence. However any unused parameter can be removed and the display sequence is configurable to simplify the operation.

SP: Set point value of control.

A1SP: Alarm 1 set point value.

A2SP: Alarm 2 set point value.

AT: Auto tune. Used to set Pb,ti,td parameters value automatically by auto tuning.

- ☑ no: Auto tuning is disable.
- ☑ YES.1: Standard type auto tuning. PV is compared with SV during auto tuning.
- ☑ YES.2: Low PV type auto tuning. PV is compared with SV-10%FS during auto tuning.

HAnd: Hand (manual) control. Used to enable or disable the manual mode.

- ☑ no: Disable the manual mode
- ☑ YES: Enable the manual mode.

oUt1: Output percentage. Adjustable when “Hand” is set to “YES” .

3.2 PID LEVEL

Pb: Proportional band value. Setting range from 0.0 to 300.0 % of controller‘s Span. set to 0.0 for on/off control action. This value is automatically calculated by activating the auto tune. If desired, the user can later adjust the value to better suit the application.

ti: Integral (reset) time. 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 PD control.

td: Derivative (rate) time. 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.

Ct: Cycle time of control output 1. Setting range is from 0 to 100 seconds. Set to 1 for pulsed voltage output, set to 0 for 4 ~ 20 mA analog output and set to 15 or longer possible to help

prolong the life of relay. The longer the time set. The less responsive the controller will be to process changes.

CPb: Proportional band value for secondary control output (cooling). Set 0.0 for ON/OFF.

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.

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.

CCt: Cycle time of secondary control output.

HYS1/HYS2: Hysteresis for on/off control on output 1and output 2. Users can create a dead band region from 0.0 to 200.0.

A1HY/A2HY: Hysteresis for alarm 1 and alarm 2.the setting range is 0.0 to 200.0.

db: Dead band value. Setting range is from -100.0 to 100.0. 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).

SPOF: Set point offset. Setting range is from -100.0 to 100.0 or –1000 to 1000. This value will be added to SV to perform control. It mainly used to eliminate offset error during P control.Set point offset.

PVoF: Process value offset. Setting range form -100.0 to 200.0 or –1000 to 2000 permits the user to offset the PV indication from the actual PV.

LoCK: Parameter lock. This security feature locks out selected levels or single parameters prohibiting tampering and inadvertent programming changes.

Table 3-1 Parameter lock selection

Setting	Description
0000	All parameters are locked out.
0001	Only SP is adjustable.
0010	Only USER level is adjustable
0011	USER and PID level are adjustable.
0100	USER, PID, OPT1 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 Output2 is opened.

3.3 OPTION LEVEL

TYPE: Sensor input selection.

Table 3-2 Input and range

TYPE	DISPLAY	RANGE	
J	J	-50℃ ~1000℃	-58℉~ 1832℉
K	K	-50℃ ~1370℃	-58℉~2498℉
T	t	-270℃~400℃	-454℉~752℉
E	E	-50℃ ~1000℃	-58℉~1832℉
B	b	0℃~1800℃	32℉~3272℉
R	r	-50℃ ~1750℃	-58℉~3182℉
S	S	-50℃ ~1750℃	-58℉~3182℉
N	n	-50℃ ~1300℃	-58℉~2372℉
C	C	-50℃ ~1800℃	-58℉~3272℉
DPT	d-Pt	-200℃~850℃	-328℉~1652℉
JPT	J-Pt	-200℃~600℃	-328℉~1112℉
LINEAR	LinE	-1999~9999	

Unit: Unit of measure selection.

- ☑ °C: Degrees C.
- ☑ °F: Degrees F.
- ☑ EnG: Engineering unit. Only for linear input.

dP: Decimal point selection.

- ☑ 0000: No decimal point.
- ☑ 000.0: 0.1 resolution.
- ☑ 00.00: 0.01 resolution. Only for linear input.
- ☑ 0.000: 0.001 resolution. Only for linear input.

After change decimal point, please reconfirm the parameter.

Act: Output 1 control action.

- ☑ rEV: Reverse action. Used for heating control.
- ☑ dir: Direct action. Used for cooling control.

LoLt: Low limit of span or range. Set the low limit lower than the lowest expected SV and PV display.

HiLt: High limit of span or range. Set the high limit higher than highest expected SV and PV display.

F iLt: Software filter.

A1Fu/A2Fu: Alarm function selection. See section 5.1 for detail.

A1md/A2md: Alarm mode selection. See section 5.2 for detail.

Addr: Address of the controller when communicate with a master device. This parameter provides an identity code for the RS485 communication interface.

bAud: Communication baud rate. 2.4k=2400 bps, 4.8k=4800 bps, 9.6k=9600 bps, 19.2k=19200 bps

4. OPERATION

4.1 AUTO TUNE

The auto tune is mainly to "teach" the controller the main characteristics of the process. It "learns" by cycling the output on and off. The results are measure and used to calculate optimum Pb, ti, td values, which are automatically entered into nonvolatile memory.

The auto tune program is applied during

- Initial set-up
- The set point is changed substantially from previous auto tune.
- The control result is unsatisfactory.

The auto tune procedure:

- In order to automatically set the PID parameters; first adjust the controller's set point (SV) to a value, which closely approximates your application.
- Make sure that the value of Pb is not zero (zero initialize on/off control).
- Set the " AtE" parameter to "YES. 1" for standard type auto tune or "YES.2" for low PV type auto tune.
- The rightmost decimal (**AT**) on the PV display will blink during tuning process.
- After two oscillatory cycle of on/off control action. The controller performs PID control with the "learned" PID value to verify the results. Finally the PID values will be entered into the memory and then start the fuzzy enhanced PID control.
- To abort an auto tune process. Simply set the " AtE" parameter to " no".

4.2 TUNING THE CONTROLLER MANUALLY

- To ensure that all parameters are configured correctly.
- Set " Pb" to zero. Set "HYS 1" to smallest.
- Set the controller's set point (SV) to a value, which closely approximates your application.
- The controller will perform the on/off control action. So the process value will oscillate about the set point.
- The following parameters should be noted:

a. The peak-to-peak variation (P) in ℃/℉ (i.e. the difference between the highest value of the overshoot and the lowest value of the undershoot).

b. The cycle time of the oscillation in seconds.

- The control setting should be then calculated as follows:

Pb= (P×100)÷Span (%)

ti = T

td = T/4

Note: The span is the difference between the "H iLt" high limit value and "LoLt" low limit value.

The PID parameters determined by the above procedures are just rough values. If the control results are unsatisfactory. The following rules may be used to further adjust the PID parameters.

Adjustment sequence	Symptom	Solution
1. Proportional Band	Slow response.	Decrease PB.
	High overshoot or Oscillations	Increase PB.
2. Integral Time	Slow response	Decrease ti.
	Instability or Oscillations	Increase ti.
3. Derivative Time	Slow response or Oscillations	Decrease td.
	High overshoot	Increase td.

4.3 MANUAL CONTROL

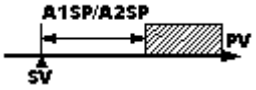
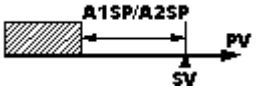
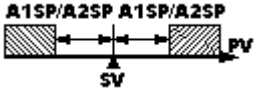
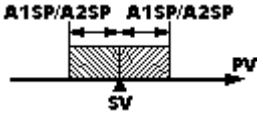
Manual control allows the user to manually drive the output percentage from 0.0 through 100.0% (usually used for testing purposes). To access the manual control mode, set the "HAnd" parameter to "yes", the rightmost decimal (**MA**) on SV display will flash. Then

the " oUtL " parameter will display alternately "oUtL" and process value. The output percentage then can be adjusted by using up or down key. To abort the manual control just simply set the "HAnd" to " no ".

5. ALARM

5.1 ALARM FUNCTION

There are two independent alarm outputs available in VT20 series controllers. Each alarm can be set to be one of six alarm function (process high, process low, deviation high, deviation low, band high and band low) from A1FU or A2FU. When the alarm output is not used, set to "nonE" to prevent alarm action.

A1FU A2FU	ACTION	ACTION DIAGRAM
nonE	**No alarm action**	
H i	**Process high alarm**	
Lo	**Process low alarm**	
d iF.H	**Deviation high alarm**	
d iF.L	**Deviation low alarm**	
bdH i	**Band high alarm**	
bdLo	**Band low alarm**	

5.2 ALARM MODE

A special alarm mode can be set from A1nd and A2nd.

nonE: No special mode

StdY: Standby mode

When selected, in any alarm function, prevents an alarm on power on. The alarm is enabled only when the process value reaches 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.

StLA: Standby and Latch mode

6. ERROR MESSAGE AND TROUBLESHOOTING

Symptom	Probable	Solution
uuuu	-Input signal below the low limit -Incorrect input sensor selection	-Set a higher value to high limit. -Check connect input sensor selection.
nnnn	-Input signal below the low limit -Incorrect input sensor selection	-Set al lower value to low limit. -Check correct input sensor selection
oPEn	-Sensor break error -Sensor not connected	-Replace sensor -Check the sensor is connected correctly
AtEr	-A/D converter damage	-Unit must be repaired or replaced. -Check for outside source of damage such as transient voltage spikes.
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(Refer to 4.1) -Set Pb, Ti, Td manually(Refer to 4.2)
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

7. SPECIFICATION

INPUT

Thermocouple	J, K, T, E, B, R, S, N, C TYPE
RTD	DIN PT-100; JIS PT-100
Linear	4~20mA; 0~50mV; 1~5V; 0~10V…..
Range	User configurable
Accuracy	±1°C for thermocouple, ±0.2°C for RTD, ±3mA for Linear
Cold Junction Compensation	0.1°C/°C ambient
Sampling Time	0.5 sec.
Normal Mode Rejection	60 dB
Common Mode Rejection	120 dB

CONTROL FUNCTION

Proportional Band	0.0 ~ 300.0 %
Integral Time	0 ~ 3600 sec.
Derivative Time	0 ~ 900 sec.
Hysteresis	0.0 ~ 200.0/ 0 ~ 2000
Cycle Time	0 ~ 100 sec.
Control Action	Direct (for cooling) or Reverse (for heating)

OUTPUT

Relay Contact Output	10A/240 VAC (Resistive Load)
Pulsed Voltage Output	0 or 24 VDC (Resistive 250 ohms Min.)
Current Output	4 ~ 20mA (Resistive 600 ohms Max.)
Continuous Voltage Output	0 ~ 50mA, 1 ~ 5V, 0 ~ 10V…… (Resistive 600 ohms Min.)

GENERAL

Rated Voltage	90 ~ 264 VAC 50/60 Hz
Consumption	Less than 5 VA
Memory Backup	EEPROM and non-volatile memory (Approx. 10 years)
Ambient Temperature	0 ~ 50°C
Ambient Humidity	0 ~ 90% RH (Non-condensing)

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