VT30 SERIES FUZZY ENHANCED PROGRAMMABLE CONTROLLERS INSTRUCTION MANUAL

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

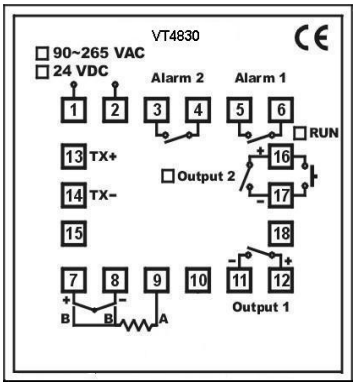
Model	High	Width
VT4830	45mm+ 0.5	45mm+ 0.5
VT4930	45mm+ 0.5	92mm+ 0.5
VT7230	68mm+ 0.5	68mm+ 0.5
VT9630	92mm+ 0.5	92mm+ 0.5

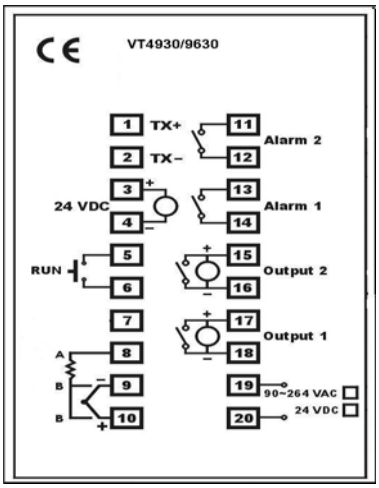
b. For VT4830, remove plastic panel clamp from controller. Slide the controller into the cutout. Replace panels clamp and press it firmly against the panel. Gently tighten the screws in the clamp till the controller front panel is fitted snugly in the cutout.

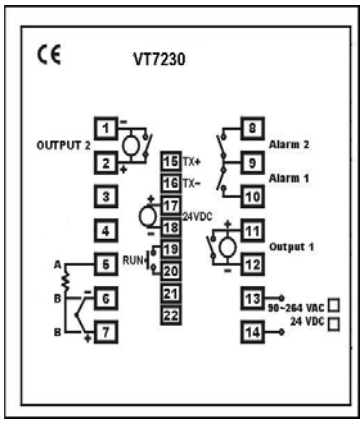
c. For other models, slide the controller into the cutout. Install the mounting clamp back. Gently tighten the screws in the clamp still the controller front panel is fitted snugly in the cutout.

1.2 CONNECTION AND WIRING

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







a. Power input

The controller can be operated on 90~264 VAC 50/60 Hz or 24VDC (option).

When controller is operated 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.

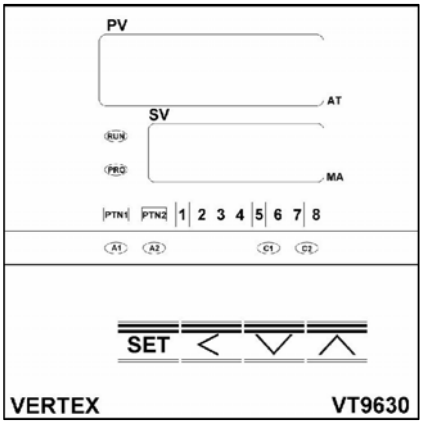
c. Control output

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

- ❑ 4 ~ 20 mA. Maximum load 600 ohms
- ❑ 0 ~ 5V, 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)

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. RUN status LED indicator.
Illuminates in red when the operation is executing.

f. PRO status LED indicator.
Illuminates in green when the program function is available.

g. PTN1 PTN2 LED indicators.
Illuminates in green when selected program pattern being executed or programmed.

h. Segment 1~8 LED indicators.
Illuminates in red when the segment number being executed or programmed.

i. 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.

j. 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.

Press the shift key for 5 seconds to execute Auto Tune process(Yes. 1 mode). To abort the Yes. 1 Auto Tune process, process the shift key for 5 seconds.

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.

Press the UP and DOWN keys simultaneously for 5 seconds to access “LnLo” and “LnHi” parameters.

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 keys for at least 5 seconds to access level selection. Use UP/DOWN key to select programming level.

1. Program level. (ProG)
2. Soft level.(SoFt)
3. Pid level. (P id)
4. Option level. (oPt i)

3.1 PROGRAM LEVEL

Ptn: Select the program pattern to be edited. There are two program patterns can be selected. PTN1 and PTN2.

bAnd: Set the wait zone. Setting range is from 0 to 1000 degree.

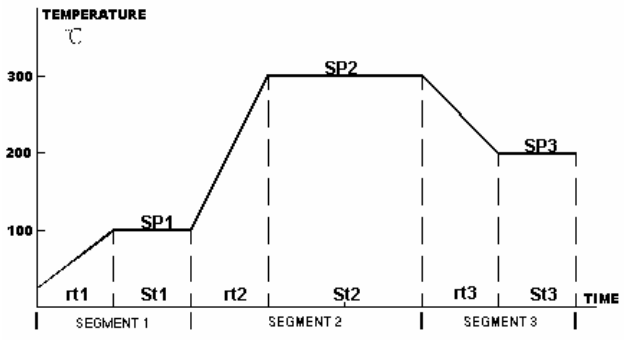
SPn: Set the set point of each segment. n=1~8.

rtn: Set the ramp time to reach the set point. The ramp time can be set from 00h00m to 99h59m or 00m00s to 99m59s. n=1~8.(Depend on PtmE setting)

Stn: Set the soak time in which the process value will remain at the set point. Setting range is from 00h00m to 99h59m 00m00s to 99m59s. n=1~8.(Depend on PtmE setting)

PROGRAMMING PROCEDURE

This section uses an example to explain how to edit the program pattern as show in the figure.



Segment	Set point	Ramp time	Soak time
1	100℃	30min.	30min
2	300℃	30min.	1hour
3	200℃	30min	30min
4	-	End	-

This example uses three segments in pattern 1 as

shown. the process value rise up from current value to 100℃ with the ramp time of 30 minutes and stay at 100℃ for 30 minutes. then again rise up to 300℃ with the ramp time of 30 minutes and stay at 300℃ for one hour. After one hour soak time is up. the process will cool down to 200℃ with the ramp time of 30 minutes and stay at 200℃ for 30 minutes.

The programming procedure is as follow.

1. Press the “BACK” key for more than 4 seconds to enter the program level. The Ptn will be shown on the PV display.
2. Use the “UP” and “DOWN” key to select “Ptn1” to be edited.
3. Press “SET” key once to get “bAnd” parameter and adjust the value as required. If don’t know, set the band value to zero.
4. Press “SET” key once to get “SP1”. Set the value to 100 by pressing “UP” and “DOWN” key.
5. Press “SET” key once and set the “rt1” to 0.30 by pressing “UP” and “DOWN” key.
6. Press “SET” key once and set the “St1” to 0.30 by pressing “UP” and “DOWN” key.
7. Press “SET” key once and set the “SP2” to 300 by pressing “UP” and “DOWN” key.
8. Press “SET” key once and set the “rt2” to 0.30 by pressing “UP” and “DOWN” key.
9. Press “SET” key once and set the “St2” to 1.00 by pressing “UP” and “DOWN” key.
10. Press “SET” key once and set the “SP3” to 200 by pressing “UP” and “DOWN” key.
11. Press “SET” key once and set the “rt3” to 0.30 by pressing “UP” and “DOWN” key.
12. Press “SET” key once and set the “St3” to 0.30 by pressing “UP” and “DOWN” key.
13. To terminate the pattern 1, Press “SET” key twice and set the “rt4” to “end” by using the “down” key.

3.2 USER LEVEL

<u>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.</u>

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.

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

rUn: Set the control output and alarm to active or to inactive.

- ☑ rUn: Active the control output and run the program.
- ☑ StoP: Inactive the control output and stops the program.
- ☑ HoLd: Active the control output and holds the program temporarily.

ProG: Select the program pattern to be executed with the end, loop or hold mode.

- ☑ oFF: Turn the program off, the controller will act as a normal controller.
- ☑ End 1: The program pattern 1 will be executed and the control output will be turn off after all the segments being executed.
- ☑ End2: The program pattern 2 will be executed and the control output will be turn off after all the segments being executed.
- ☑ EndA: The program pattern 1 and pattern 2 are linked to be executed and the control output will be turn off after all the segments being executed.
- ☑ Hod 1: The program pattern 1 will be executed and the process value will be remained at the last set point of the program pattern 1 after all the segments being executed.
- ☑ Hod2: The program pattern 2 will be executed and the process value will be remained at the last set point of the program pattern 2 after all the segments being executed.
- ☑ HodA: The program pattern 1 and pattern 2 are

linked to be executed and the process value will be remained at the last set point of the program pattern 2 after all the segments being executed.

- ☑ LoP1: The program pattern 1 is executed repeatedly.
- ☑ LoP2: The program pattern 2 is executed repeatedly.
- ☑ LoPA: The pattern 1 and pattern 2 are linked and be executed repeatedly.

3.3 SOFT LEVEL

rAnP: Ramp refer the process value to limit an abrupt change of process.(℃/min)

SSP: Set point value of soft-start.

oUt: Output percentage of soft-start.

3.4 PID 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.

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.

t_i: 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.

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	USER,SOFT,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.

3.5 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℃~750℃	-58℉~1382℉
B	b	0℃~1800℃	32℉~ 3272℉
R	r	0℃~1750℃	32℉~3182℉
S	S	0℃~1750℃	32℉~3182℉
N	n	-50℃~1300℃	-58℉~2372℉
C	C	-50℃~1800℃	-58℉~3272℉
DPT	d-Pt	-200℃~850℃	-328℉~1652℉
JPT	J-Pt	-200℃~650℃	-328℉~1202℉
LINEAR	L inE	-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.

PtmE: Time scale of ramp / soak time.

FiLt: 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

3.6 SCARLING FOR LINEAR INPUT

LnLo: Low Scale of Linear Input

LnHi : High Scale of Linear Input

1. Press the “UP” and “DOWN” key 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 “LnLo” setting to correspond the high scale and after adjustment press SET key once for normal operation.

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).
- Make sure the Program(User Level) have to be

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.

shut down as following steps :

1. SET run = stop
2. SET parameter PROG = OFF
3. SET run = GO

Finally, set Auto Tune.

- Set the " AT" 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 " AT" 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

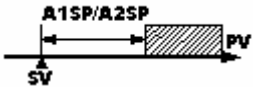
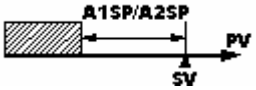
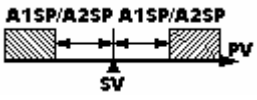
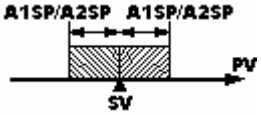
4.3 MANUAL CONTROL

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	
t.SnL	Time Signal Output	

5.2 ALARM MODE

A special alarm mode can be set from A1md and A2md.

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. TIME SIGNALS AND PROGRAM END ALARM

6.1 TIME SIGNAL

The alarm output 1 and alarm output 2 can also be used as a time signal outputs. When a time signal output function is selected by setting the A1FU and A2FU to be t.SnL. The alarm output is produced for a certain period during program execution.

When the t.SnL is selected. The parameters A1SP, A1HY and A2SP, A2HY will be replaced by A1on, A1oF and A2on, A2oF respectively. A1on and A2on set the time signal start segment. A1oF and A2oF set the time signal end segment.

The first two characters of the setting for time signal parameter stand for pattern, which is P1 to P2. The last two characters stand for ramp section or soak section which is r1 ~ r8 or S1 ~ S8.

6.2 PROGRAM END ALARM

A special alarm mode can also be set in the A1md and A2md which is used to active the alarm output when a program has completed.

To select this function just simply set the A1md or A2md to t.End

7. ERROR MESSAGE AND TROUBLESHOOTING

Symptom	Probable	Solution
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

8. 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, ±3μA 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	Ambient Humidity