PID-RS Ramp/Soak Controller Instruction Manual

1. Features:

1.1 Input Sensor Types: Can be connect the following sensors and signals to the universal input.

Thermocouple (temperature input): K, J, T, E, S, R

Resistance thermometer (temperature input): Pt100, CU50

1.2 Control Outputs: A control output can be a relay output, voltage output (for driving SSR), or linear current output, depending on the model.

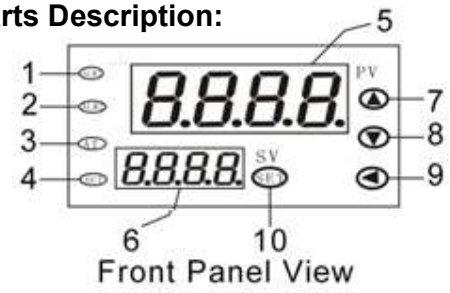
1.3 Adjusting PID Constants: Can be easily set the optimum PID constants by performing AT (auto-tuning) with the limit cycle method.

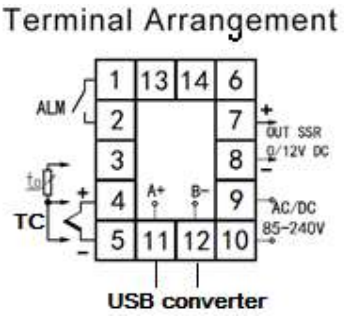
1.4 Standard Alarms: Can be output an alarm when the deviation, process value, set point, or manipulated value reaches a specified value.

1.5 Use this controller within the following allowable range: Allowable ambient temperature: −0 to +55 °C

Allowable ambient humidity: 5 to 85 % RH.

2. Parts Description:





1 ALM1: lamp Lights when Event occurs

2 ALM2 lamp: Lights when Event occurs

3 AT lamp: Flashes during the Program control waiting

lamp Lights during the Program control running

4 Output lamp: Lights when output is turned on

5 PV display: Displays Measured value (PV) or various Parameter symbols

6 SV display: Displays segment level, Set value (SV), Manipulated output value (MV) or various Parameter set values.

7 Up key:

−Ramp/Soak Controller Increase numerals.

− Press the Up key to start the Program control mode (RUN).

8 Down key:

−Decrease numerals

To scroll through numbers faster, and hold the Up key.

9Shift key: Shift digits when settings are changed.

10 Set (SET) key: Used for Parameter calling up and set value registration.

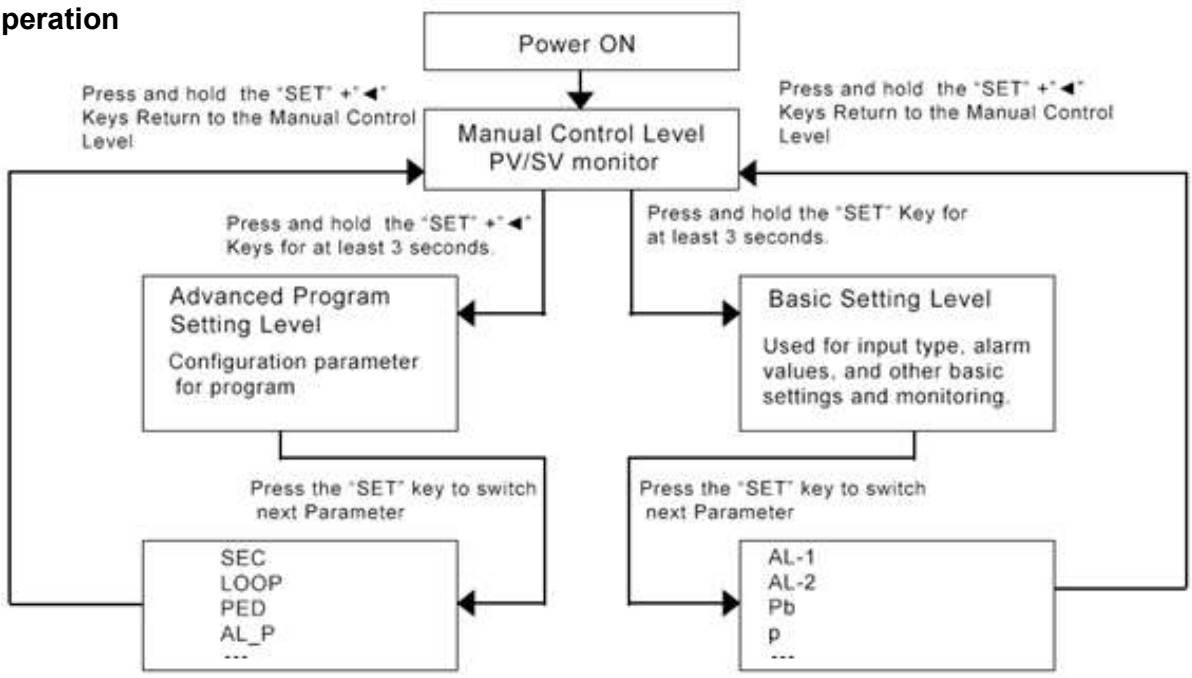
3. Parameters

Register Address	Code	Name	Manual	Setting range	Ex-Factory
0x00	SP	Setting value	When run = 0, no program segment controlling.	Determined by P-SL P-SH	100
The main Parameters (PART 1). Basic Setting Level					
0x01	AL-1	Alarm 1	Please refer to **ALP** for the alarm mode suitable.	Determined by P-SL, P-SH	300
0x02	AL-2	Alarm 2	Alarming when the program sections is breaking up.		100
0x03	Pb	PV Bias	The value set in the PV bias is added to the actual input value to correct the input value.	±20.0	0.0
0x04	P	Proportional Band	Set when PI or PID control is performance. For heating / cooling PID action. **When P=0,the controller is ON/OFF control**	1～9999	100
0x05	I	Calculus time	Eliminates offset occurring in proportional control.	0～3000	500
0x06	d	Differential time	Prevents overshoot and/or undershoot caused by integral action effect..	0～2000S	100S

0x07	T	PID control cycle.	Control response time	2～120	20S
0x08	FILT	Digital Filter	This is a 1st-order lay filter by software prepared in order to reduce fluctuations of measured value (PV) by noise.	0～99	20
0x09	Hy	Differential gap	When the control is ON/OFF control（P=0） Relay contact may repeat its turning ON and OFF due to input fluctuation if measured value (PV) is near the alarm set value. The differential gap setting can prevent the relay contact from ON or OFF repetition.	0.1～50.0	0.5
0x0A	dp	Decimal point position selection	Set the position of the decimal point for the measured value to be displayed.	0～3	0
0x0B	outH	Output limiter high	The min value and max value of output current.	outL～200	200
0x0C	outL	Output limiter low		0～outH	0
0x0D	AT	Auto tuning	1: Auto tuning (AT) with learning start 0: Auto tuning (AT) with learning stop Turns OFF automatically when the AT with learning function is completed.	0～1	0
0x0E	LocK	Set data lock	LOCK=0, Set value (SV) and Parameter can be set. LOCK=1, Only set value (SV) can be set. LOCK＞1, Set value (SV) and Parameter cannot be set.	0～50	0
0x0F	Sn	Input type	Cu50(Cu50)–50.0～150.0°C; Pt100(Pt1) –199.9～200.0°C; Pt100 (Pt2)–199.9～600.0°C; K(K) -30.0～1300°C; E(E) -30.0～700.0°C; J (J)-30.0～900.0°C; T(t) -199.9～400.0°C; S(S) -30～1600°C;	———	K
0x10	OP-A	Main output Opt.	0:no output 1:Relay output 2:Voltage output (for driving SSR) 3:Zero-cross output(for driving Triac) 4:PID linear current output(4-20mA /0-10v) (A single functional)	0～7	READ ONLY
0x11	OP-B	AUX output Opt.	0:no output; 1:RS232 or RS485; 2:contact the micro-printer; ‘ 3:transmitter 0～10mA 4:transmitter4～20mA	0～4	READ ONLY
0x12	ALP	Alarm output Opt.	0: Alarm function OFF; 1: Process high alarm; 2:Process low alarm; 3:Process high and low alarm.(H1 and L2) 4: Deviation High alarm ; 5: Deviation low alarm; 6:Deviation High and Low alarm.(H1 and L2) 7: Deviation high/low alarm; 8: Band alarm.	0～10	1
0x13	COOL	System function Opt.	‘0’:reverse control(heating) ‘1’:positive control(cooling)	0～1	0
0x14	P-SH	Range high	The control is displayed after the Input type and Input range.	P-SL～9999	1300
0x15	P-SL	Range low		-1999～P-SH	0
0x16	Addr	Address	Communication address can be set from 0 to 255	0～63	1
0x17	bAud	Communication speed	1200; 2400; 4800; 9600;	____	9600
0x18	m-A	Manual output			

Partial Parameter of Program control (PART 2) Program Setting Level					
0x19	SEC	Set time unit	0:minute, 1:second.	0～1	0
0x1A	LOOP	Cycles	0:Stop the program at pattern end. 1:Repeat the program at pattern end	0～1	1
0x1B	PED	POWER DOWN	0: Power cut memorize, need operate manually (press ▲ 3 seconds) to continue the program. 1:Power cut return to the first segment, need operate manually(press▲3 seconds)to continue the program 2: Power cut memorize and automatic continue the program. 3: Power cut never memorize and perform from first segment of program.	0～3	
0x1C	AL_P	Wait zone	When Measured value (PV) does not follow the progress of the program (when difference between PV and SV remains) during the Program control operation, the program will be on standby state at Segment time endpoint until the Measured value (PV) reaches the Wait zone.	0～100.0	10.0
0x1D	run	Program control mode setting	0:No program control 1:stand-by: Program finish, control off. 2:Wait:Run with the current set value & pause timing 3 running: Program control running	0～3	0
0x1E	Pro	program segmentation	Currently run segment No.	0～64	0
0x1F	TE	Run time	Current segment performed time.		-
0x20	r1	Ramp Segment 1	Ramp Segment time. 0: Pattern end 2000: Skip to the beginning of the next segment.	0-2000 min	-
0x21	t1	Soak Time 1	Soaking time of Soak segment 1. 0:the Segment will be skipped to next section	0～9999 minute	
0x22	C1	Soak segment 1	The Setting value of Soak segment 1.	Determined by P-SL P-SH	-
	----------				
0x7D	r32	Ramp Segment 32	The same as above		___
0x7E	t32	Soak Time 32	The same as above		
0x7F	C32	Soak Segment 32	The same as above		___

4. Operation



4.1 Basic Setting Level:

Press the key SET 3S to enter into the main Parameters (PART 1), the controller will display the Parameter code(1～23)in the window at the upper tube, and display the Parameter data at the lower tube. Press Key ▲、▼ or ◀ to adjust the Parameters, and then press the Key SET to preserve.

It will be preserved of the data and withdrawal of the setting with no any operations automatically within 10 seconds.

Electronics Lock. All the Parameter can be revised when Lock=0; Only the "SP" can be revised when Lock=1.

4.2 Program Setting Level:

Segments' (Ramp/Soak Control) Data setting area. Press SET and ◀simultaneously for 3 Seconds to enter. The other operations is the same as above.

4.3 SV Setting Mode without program control operation(run=0):

Press Key ▲ 3 second to enter into the setting value amend area(SP), the other is the same as above.

4.4 reposition: press key ◀ +▼ 1 second, it will restore to segment 1,and then run according to the running state.

4.5 During the Program control operation ,Parameter switching display(Down key: ▼)

When program perform, press ▼ key PV window switching display: current sector set value; performed time, display as FXXX; Current sector No. display as P xx.

4.6 During the Program control operation ,Pause and restart function(Plus key: ▲)

A. State of Running status: press▲ key for 3 seconds program paused, A-T lamp shining, SV window alternately display "Hold" and set value of current sector, press ▲ again program resume running.

B. State of stand-by status: Press ▲ 3 seconds program will restart from the first segment.

5 Five States of the controller during the Program control

5.1 No program control(run=0):

when the controller is in the state of stop, the controller is used as the thermostatic control, the setting value is the basic setting value(SP),display in the window below, the running indicator light turn off.

5.2 Running(run=3)：

When the controller is in the state of running ,the controller constantly modify the setting value (SV) according to the setting curve，make the measured value(PV) changing according to the curve program, so as to achieve the purpose of curve program control, and the indicator light turn bright.

5.3 Stand-by(run=1)：

When the controller finish performing program (perform till parameter r=0), it will come into stand by status(Run=1), at this moment controlling output shut down, lamp A-T extinguish SV display "Stop",

Slightly press plus key ▲ or set Run as 3 user can restart program from the first Segment.

5.4 Wait (Zone wait function run=2)：

When Measured value (PV) does not follow the progress of the program (when difference between PV and SV remains) during the Program control operation, the program will be on standby state at Segment time end point until the Measured value (PV) reaches the Wait zone.

Controller automatic switch to state of wait, A-T lamp shining, timer stop work, SV value keep Constant. Once the absolute value of deviation between measuring value and set value(SV) less Than automatic interim (AL_P), |SV-PV|<AL_P Controller automatic resume running status.

5.5 Hold：

Progress of the program is suspended during the Program control operation

Press ▲ key 3 seconds program enter into hold state, at this moment A-T lamp shining and SV window Alternately display "HOLD" and the set value of current sector, press ▲ 3 seconds program resume running status.

6. Determining PID Constants(Auto-tuning)

When AT is executed, the optimum PID constants for the set point at that time are set automatically. A method (called the limit cycle method) for forcibly changing the manipulated variable and finding the characteristics of the control object is employed.

Set parameter run as 0, Set the HY as 0.5, if the output is relay set the t as 2, then set the AT as 1, the

lamp of AT will be flashed, in this time the controller enter into **Auto-tuning**. PV window will alternately

Display “AT” and set value, now meter’s control way is on-off mode, after 3 times vibrating(3 control period) automatic save P, I, D parameter, the self-adjusting procession finished.

Attentions：

when **Auto-tuning**, the controller should not change the set value.

When the power off during **Auto-tuning**, it will restart **Auto-tuning** next time.

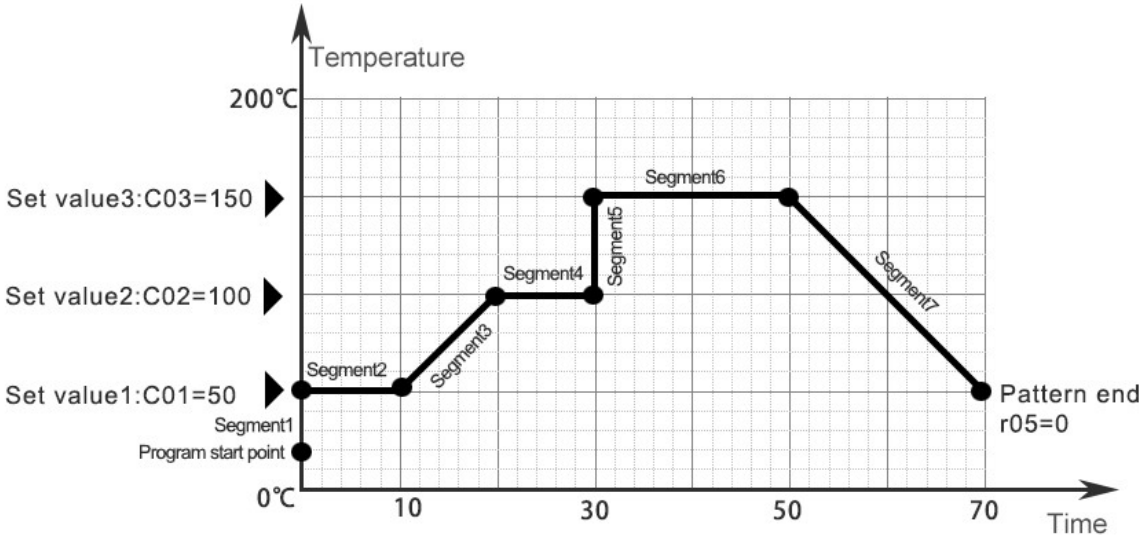
When it need artificially exit during **Auto-tuning**, set the Parameter(AT) to 0 so that can exit， but the setting result will not be valid.

7. Example of Program pattern configuration

7.1 Example:

Temperature soared to 50 °C, keep 10 minutes at 50 °C; Raise temperature up to 100 °C in 10 minutes, keep 20 minutes at 100 °C; quickly raise temperature to 150 °C and Keep 20 minutes at 150 °C; reduce temperature to 50 °C in 20 minutes, shut down the control output stop heating.

7.2 Program pattern as the chart:



7.3 Parameter setting: Press SET+◀ enter into Program Setting Level

Segment	Parameter Setting	explanation
1	r01=2000 C01=50	Temperature soared to 50 °C(Skip the ramp segment)
2	t01=10	keep 10 minutes at 50 °C
3	r02=10 C02=100	Raise temperature up to 100 °C in 10 minutes
4	T02=20	keep 20 minutes for 100 °C
5	r03=2000 C03=150	temperature soared to 150 °C(Skip the ramp segment)
6	T03=20	keep 20 minutes for 150 °C
7	r04=20 C04=50 T04=0	reduce temperature to 50 °C in 20 minutes, skip soak segment (T04=0)
Other parameters	r05=0 LOOP=0 run=3 pro=1	r05=0 means program stopped, Loop=0 cancel cycle of program.

8. Example of Wait zone

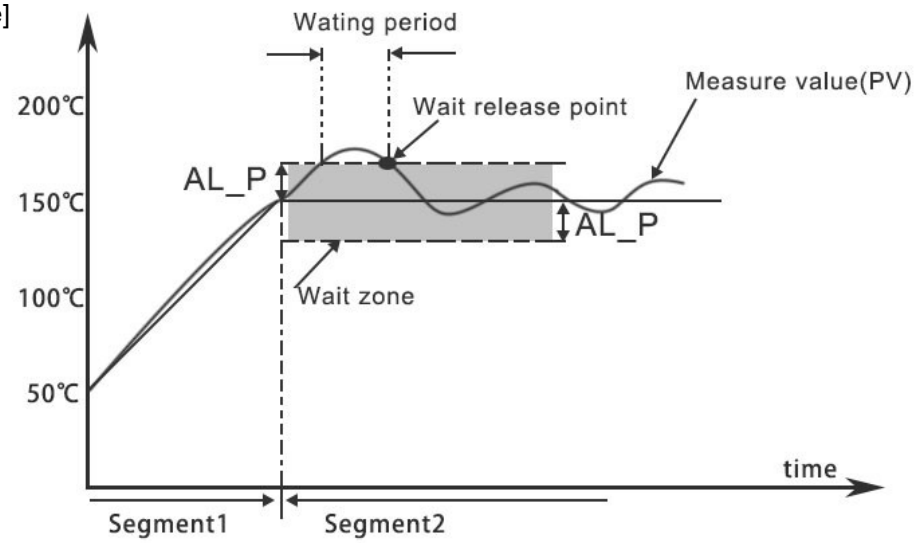
8.1Wait state release

Wait state will be released when the following condition is satisfied

Measured value (PV) reaches within the Wait zone

8.2 Wait state

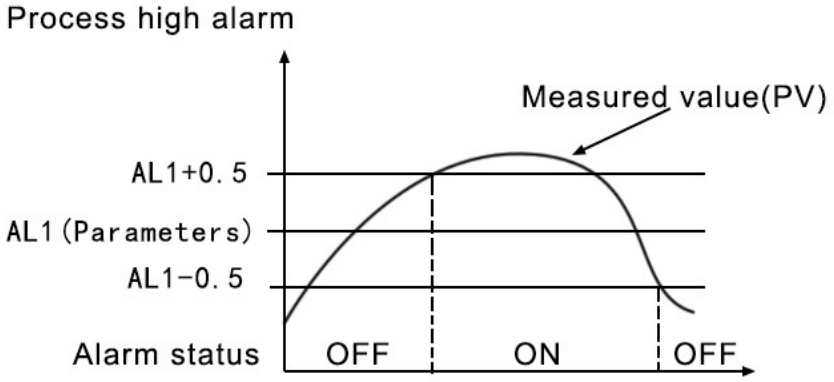
In the Program control operation, the Wait function switches the progress of segment into a standby state.
.Measured value (PV) reaches without the Wait zone
.run=2
8.3Description of function：
When Measured value (PV) does not follow the progress of the program (when difference between PV and SV remains) during the Program control operation, the program will be on standby state at Segment time end point until the Measured value (PV) reaches the Wait zone.
Wait releasing condition: Wait function is released when the Measured value (PV) reaches the Wait zone.
[Example: Wait zone]



9. Alarm (ALM1) function：

Alarm (ALM) function	Alarm status[ON]	Alarm status[OFF]
Process high alarm	Measured value(PV)>Alarm set value+0.5	PV<Alarm set value-0.5
Process low alarm	PV<Alarm set value-0.5	PV>Alarm set value+0.5
Deviation high alarm	PV>Alarm set value + Set value+0.5	PV>Alarm set value + Set value-0.5
Deviation low alarm	PV<Alarm set value - Set value-0.5	PV>Alarm set value - Set value+0.5
Band alarm	PV<Alarm set value + Set value-0.5 And PV>Alarm set value - Set value+0.5	PV>Alarm set value + Set value+0.5 Or PV<Alarm set value - Set value-0.5
Out of band alarm	PV>Alarm set value + Set value+0.5 Or PV<Alarm set value - Set value-0.5	PV<Alarm set value + Set value-0.5 And PV>Alarm set value - Set value+0.5

[Example: Process high alarm]



Character Symbols：This manual indicates 9-segment display characters as shown below.

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	t	U	Y	T			

10. Host communication based on MODBUS-RTU protocol [OPTIONAL for connecting to PC]

The software can be downloaded by using the following link. At the bottom of the description part there is the hyperlink to the software:

http://www.thermomart.com/PID-Temperature-controller-Ramp-Soak-USB-PC?keyword=ramp&category_id=0&description=1

The master controls communication between master and slave. A typical message consists of a request (query message) sent from the master followed by an answer (response message) from the slave. When master begins data transmission, a set of data is sent to the slave in a fixed sequence. When it is received, the slave decodes it, takes the necessary action, and returns data to the master.

10.1 Communication Mode:

Data bit length	Stop bits	Parity bit	Communication time interval
8-bit (Binary)	1,2	NONE	300ms

10.2 Message length of each function (Unit: byte):

Function code (Hexadecimal)	Function	Query message		Response message	
		Min	Max	Min	Max
03H	Read holding registers	8	8	7	7
06H	Preset single register	8	8	8	8

10.3 Message format

Slave address	The slave address is a number from 1 to 255 manually set at the front key panel of the controller.
Function code	Refer to **9.2. Message length of each function**
Data	The data to execute the function specified by the function code is sent to the slave and corresponding data returned to the master from the slave.
CRC-16	CRC-16: Cyclic Redundancy Check

10.4 Read holding registers [03H]

The query message specifies the starting register address and quantity of registers to be read.

Slave address	Function code 03H	Register address	Quantity The setting must be 1	CRC16
Example: The contents of the holding register 1001H are the read out from slave address 1. Query message: 01 03 10 01 00 01 D1 0A Response message: 01 03 02 **00 FD** 79 C5 Explain：00FD=253,is processed as 25.3				

10.5 Preset single register [06H]

The query message specifies data to be written into the designated holding register. Only R/W holding registers can be specified. The controller EEPROM had a life span of data written to the EEPROM less than 1000,000 times

Slave address	Function code	Register address	Write data	CRC16

Example: Data is written into the holding register 0001H(AL-1) of slave address 1.
Query message: 01 06 00 02 FF 38 68 28
Response message: 01 06 00 02 FF 38 68 28
When input ALM1 set value is -20.0,-20.0 is processed as -200,-200=0000H-00C8H=FF38H

10.6 No response

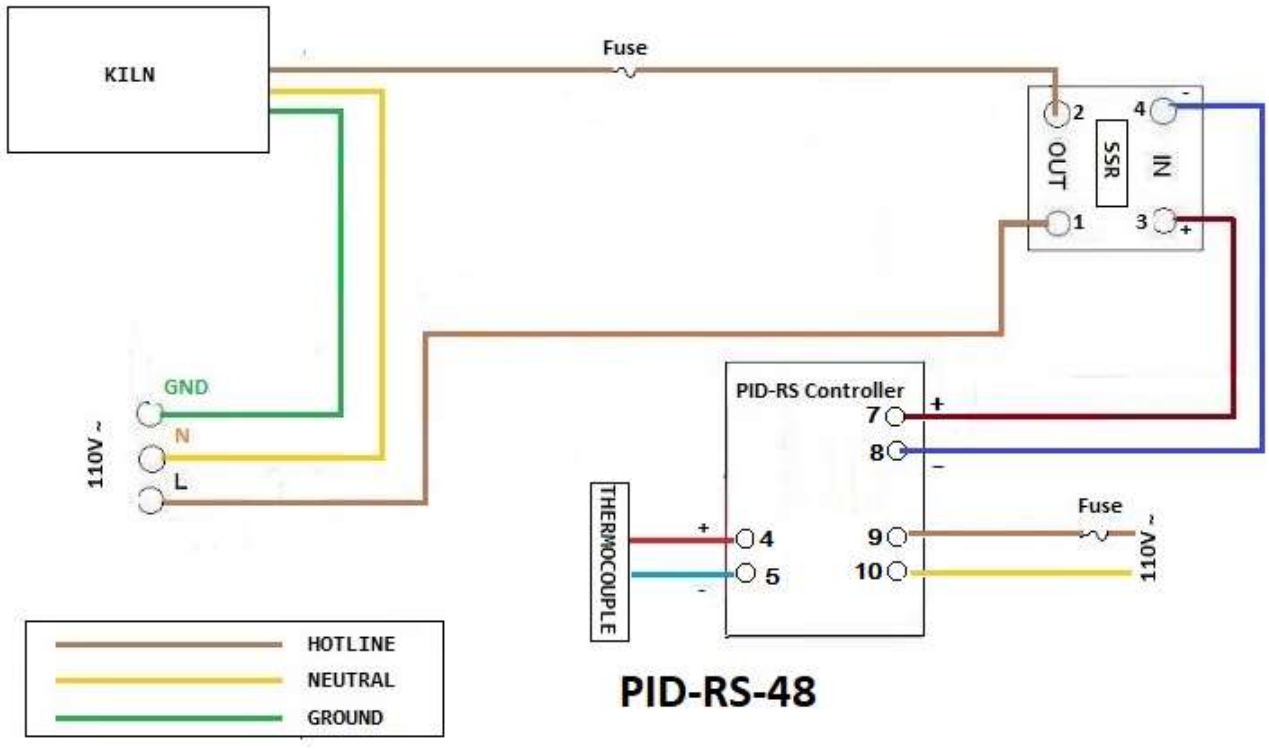
The slave ignores the query message and does not respond when:

- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity and etc., is found in the query message.
- The Communication time interval less than 300ms.

10.7 Register address list:

Symbol	Decimal point	Real Register	Holding Register
Measured value(PV)	YES	1001H	44098
Manipulated output (MV):	NO	1101H	44354
Alarm output	NO	1200H	44609
Controller parameters *(Refer to 3. Parameters)*			
SP	YES	0000H	40001
AL-1	YES	0001H	40002
AL-2	YES	0002H	40003
Pb	NO	0003H	40004
... And so on			
r32	NO	007DH	40126
t32	NO	007EH	40127
C32	YES	007FH	40128

Wiring diagram for SSR output controller



PID-RS Ramp-and-Soak USB Temperature Controller Manual

For current product information, availability, and compatible options, use the verified ThermoMart links below. The preceding pages remain the original manual content.

PRODUCTS USING THIS DOCUMENT

Models: PID-RS-USB-485, RS-P&P-USB, RS-P&P20-USB

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