MPC INSTRUCTION MANUAL

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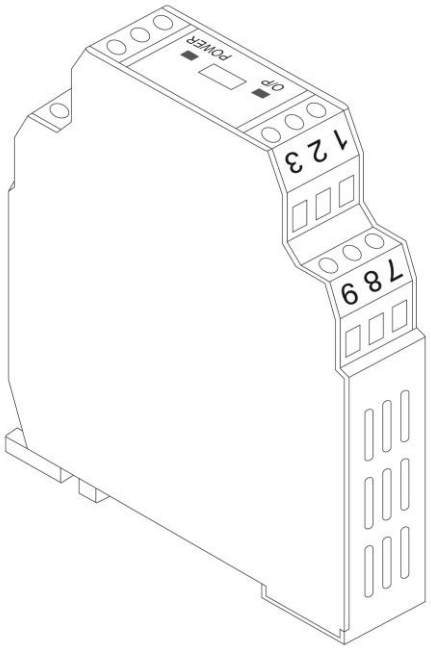


MPC DIN RAIL MOUNT PID CONTROLLER

1. Introduction

The MPC is compact size, space-saving modular type PID controller offering outstanding control performance.

Ideal as a slave PID loop to a programmable logic controller (PLC). The MPC offers a cost effective alternative to performing loops in a PLC while at the same time improving loop performance. All configurable parameters can be read/written directly over the Modbus communication interface by the supervisory host system or by the EzPro hand held programmer.

Key features

- DIN rail mounting
- Compact size
- Universal input / output selectable
- 100ms sampling rate
- 4 independent LEVEL PID
- Ramp/Soak profile (16 segments profile with loop / link / jump function)
- Power failure mode selectable for profile execution
- Soft-Start function
- Digital communication with MODBUS RTU Protocol
- All parameters can be easily configured by PC with URC-1020 interface cable or EzPro hand held programmer
- PV bias / PV ratio correction

2. Installation

2.1 Setting the Internal DIP Switch and Jumpers

Before installation, make sure the internal DIP switch and Jumpers are set properly. To set the internal DIP switch and jumpers, please open the cover of MPC as shown in figure 1.

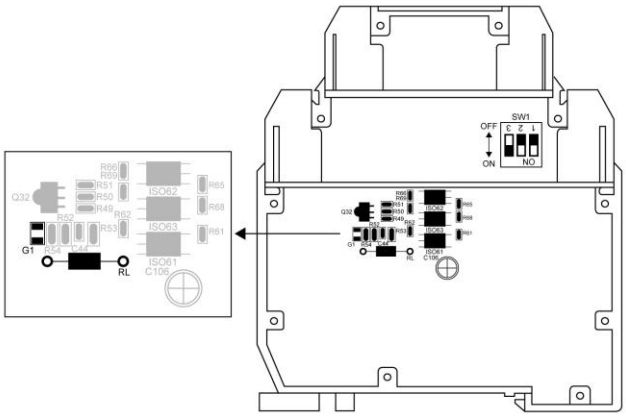


Figure 1 DIP switch and Jumpers setting

The various available input signals for MPC are divided into three groups.

1. TC/RTD/mV : Thermocouple type (J K T E B R S N C), RTD (Pt100 DIN and JIS) and -60~60mV analog input.
2. Current : 0 ~ 24mA
3. Voltage : -10 ~ 10 Vdc

For the three different groups of input signal type, the internal DIP switch SW1 should be set according to the table 1.

SW1	1	2	3
TC/RTD/mV	OFF	OFF	ON
0~24mA	ON	OFF	ON
-10~10V	OFF	ON	OFF

Table 1 internal DIP switch setting

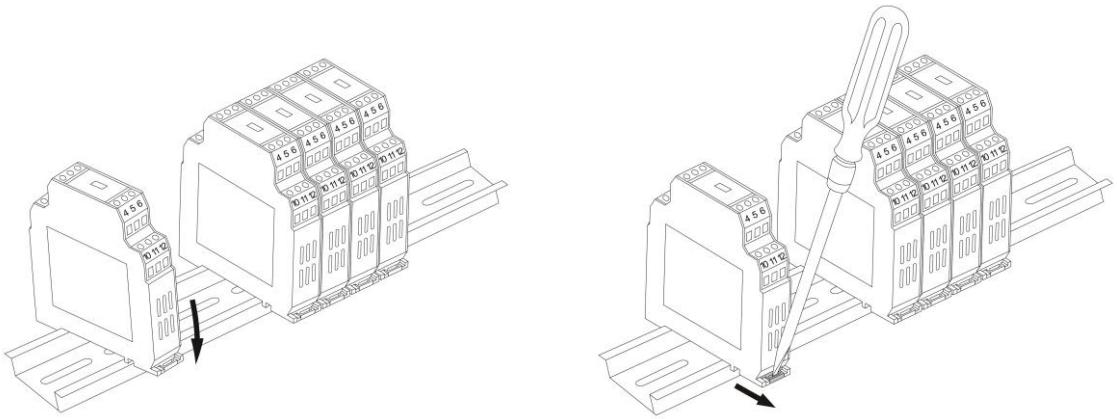
The MPC control output signal is also user selectable.

1. mA: 0 ~ 20mA or 4 ~ 20mA
2. mV,V : 0~10V or other
3. SSR : Pulsed voltage (DC 0/24V) to drive solid state relay (SSR) or relay.

For that different output signal, the internal jumpers should be set as figure 1.

2.2 Mounting

The MPC can be mounted on DIN rail in accordance with EN50 022 (35 x 7.5 mm or 35 x 15 mm) regulations as shown in figure 2.



Mount on DIN rail　　Remove from DIN rail

Figure 2

2.3 Electrical Connection

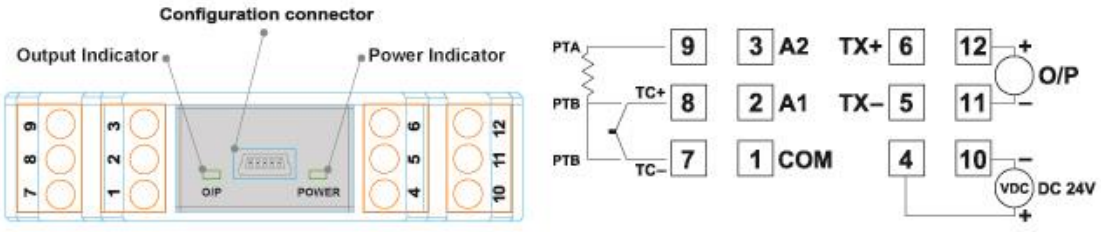
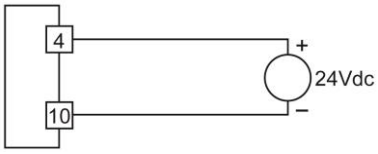
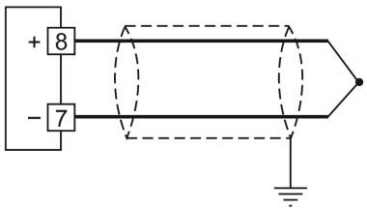


Figure 3 Terminal connections

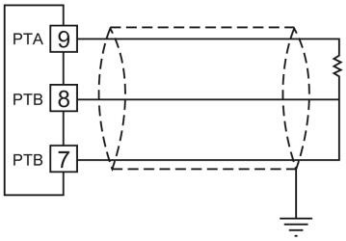
2.3.1 Power



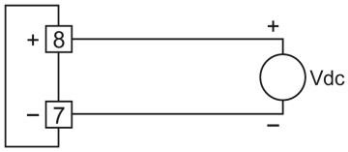
2.3.2 Input



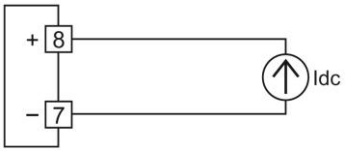
Thermocouple



PT100

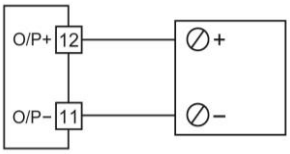


Linear Voltage(mV or V) input

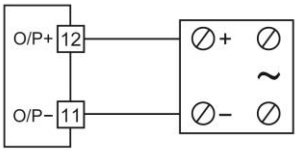


Linear current (0~24mA) input

2.3.3 Output

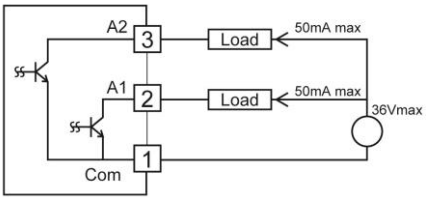


Linear output (4~20mA or 0~10Vdc)



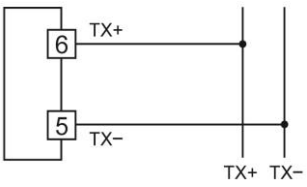
Pulsed Voltage to drive SSR or 24Vdc Relay Coil

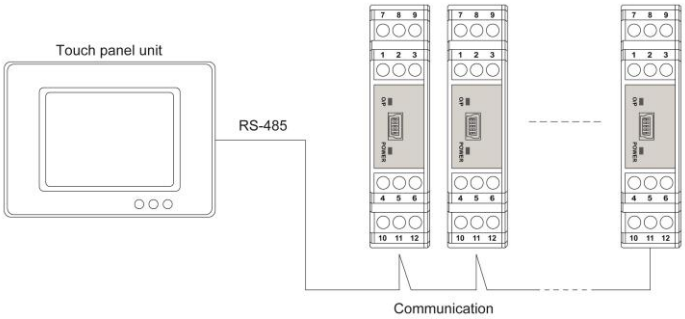
2.3.4 Alarm



Open collector alarm output

2.3.5 Communication





3. Communication

3.1 Specification

Item	Specification
Electrical specification	Based on EIA RS-485
Transmit system	2-wire, half-duplex
Synchronizing system	Asynchronous mode
Transmission distance	500m max
Transmission speed	Up to 19.2K BPS

Data format	Start bit	1 bit
	Data length bit	8 bits
	Parity bit	None
	Stop bit	2 bits
Transmission code	HEX value (MODBUS RTU mode)	
Error detection	CRC-16 bits	

A typical MODBUS protocol character is shown below:

1	2	3	4	5	6	7	8	9	10	11
1 Start bit	8 Data bits								2 Stop bits	

3.2 Communication Setting

In order that the master station and the ***MPC*** controller can communicate correctly, following settings are required.

- ✓ All communication settings of the master station such as baud rate and data format (1 start bit, 8 data bits and 2 stop bits) must be same as the ***MPC*** controller.
- ✓ Each ***MPC controller*** connected on line is set to a unique address (ID) which is different from each others by setting the ID parameter.

The communication settings to be set are shown in the following table.

Parameter	Item	Default	Setting range	Remarks
Baud Rate	Transmission speed	19200	2400/4800/9600 /19200(Note 1)	Set the same communication condition to the master station and all slave station.
ID	Slave address	247	1 to 247 (Note 1)	Set a different value to each MPC connected on the same communication bus.

Note 1: The MPC has no display to indicate its setting, if the baud rate and ID of a MPC has been set to other than the default and its setting are unknown, the "MPConsole" software is a useful tool to find them out by scan function or return its setting to default by initialize function (please refer to the on-line-help of MPConsole)

3.3 Communication wiring

- ✓ Use twisted pair cables with shield. Recommended cable: UL2464, UL2448, etc.
- ✓ The total extension length of the cable is up to 500m. A master station and up to 247 units of the ***MPC controllers*** can be connected per communication bus.
- ✓ Both ends of the cable should be connecting with terminate resistors 100Ω 1/2W.
- ✓ The shield wire of the cable should be grounded at one place on the master station unit side.

3.4 MODBUS Communication Protocol

3.4.1 General

The MODBUS serial line is a Master-Slaves protocol. Only one master (at the same time) is connected to the bus, and one or several ***MPCs*** (247 maximum) are also connected to the

same communication bus. A MODBUS communication is always initiated by the master. The ***MPC*** will never transmit data without receiving a request from the master. The ***MPC*** will never communicate with each other. The master initiates only one MODBUS transaction at the same time.

The master issues a MODBUS command message to the ***MPC*** in two modes:

1. Unicast Mode: the master addresses an individual ***MPC***. After receiving and processing the command message, the ***MPC*** returns a response message to the master. Each ***MPC*** must have an unique address (1 ~ 247) set by the ID parameter.
2. Broadcast mode: the master can send a command message to all ***MPCs***. No response is returned to a broadcast command sent by the master. The broadcast commands are necessarily writing commands. ALL ***MPCs*** must accept the broadcast for writing function. The address 0 is reserved to identify a broadcast exchange.

3.4.2 Composition of Command Message

Command message and response message consist of 4 fields: Slave Address (ID), Function code, Data and CRC check code. And these are sends in this order. The allowable character transmitted for all fields are hexadecimal 0-9, A-F.

RTU message framing

Slave Address	Function Code	Data	CRC
1 byte	1 byte	0 up to 252 byte(s)	2 bytes CRC Low, CRC Hi

In the following, each field is explained.

1. Slave Address (ID)

Address is the number specifying a ***MPC***. The individual addresses are set by the ID parameter in the range of 1~247 decimal. A master addresses a ***MPC*** by placing the ***MPC*** address in the address field of the message. When the ***MPC*** returns its response, it places its own address in this address field of the response to let the master know which ***MPC*** is responding.

Address 0 is used for the broadcast address, which all ***MPCs*** recognize.

When the broadcast address (address 0) is applied on the command message, no any response message will be sent from the ***MPC***

2. Function Code

This is a code to designate the function executed by ***MPC***. When a message is sent from a master to a ***MPC***, the function code field tells the ***MPC*** what kind of action to perform. When the ***MPC*** responds to the master, it uses the function code field to indicate either a normal response or that some kind of error occurred. For normal response, the ***MPC*** simply echoes the original function code. For an exception response, the ***MPC*** returns a code that is equivalent to the original function code with its most-signification bit set to logic 1.

The listing below shows the function codes supported by the ***MPC*** .

Function code		
Code	Function	Object Type
03	Read-out	16-bit word Read/Write Register

04	Read-out	16-bit word Read Only Register
06	Write-in	16-bit word Read/Write Register

3. Data

Data are the data required for executing function codes. The composition of data varies with function codes.

A data register is assigned to each parameter in the ***MPC***. For reading/writing parameter by communication, designate the data register. Refer to chapter 4 "**Parameters Description and Data Register Map**" for details.

4. CRC check

This is the code to detect message errors (change in bit) in the signal transmission.

On the MODBUS protocol (RTU mode), CRC-16 (Cyclical Redundancy Check) is applied.

CRC-16 is the 2-bytes (16-bits) error check code. From the first byte (address) of the message to the end of the data field are calculated.

The slave station calculates the CRC of the received message, and does not respond if the calculated CRC is different from the contents of the received CRC code.

The Cyclical Redundancy Checking (CRC) field is two bytes, containing a 16–bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The device that receives recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

The CRC is started by first preloading a 16–bit register to all 1's. Then a process begins of applying successive 8–bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits and the parity bit, do not apply to the CRC.

During generation of the CRC, each 8–bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8–bit character is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final content of the register, after all the characters of the message have been applied, is the CRC value.

A procedure for generating a CRC is:

1. Load a 16-bits register with FFFF hex (all 1's). Call this the CRC register.
2. Exclusive OR the first 8-bit byte of the message with the low-order byte of the 16-bit CRC registers, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), Zero-filling the MSB. Extract and examine the LSB.
4. If the LSB was 0: Repeat Step 3.
   If the LSB was 1: Exclusive OR the CRC registers with the polynomial value 0xA001 (1010 0000 0000 0001).
5. Repeat step 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit byte will have been processed.

6. Repeat step 2 through 5 for the next 8-bit byte of the message. Continue doing this until all bytes have been processed.
7. The final content of the CRC register is the CRC value.
8. When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

For example, if the CRC value is x1241H (0001 0010 0100 0001):

Addr	Func	Data Count	Data	Data	Data	Data	CRC Lo	CRC Hi
							0x41	0x12

3.4.3 Response Message of MPC

Once the command message has been processed by the MPC, a response message is built depending on the result of processing.

1. Normal Response

To a relevant command message, the MPC creates and sends back a response message, which corresponds to the command message. The composition of response message in this case is the same as command message. Content of the data field depend on the function code. For details, refer to Sec 3.5.

2. Exception Response

If contents of a command message have an abnormality (for example, non-actual function code is designated) other than transmission error, the slave station does not execute that command but creates and sends back a response message at error detection.
The composition of response message at error detection is shown on below; the value used for function code field is the function code of command message plus x80H.

Slave Address	Function code (Function code + x80H)	Error code	CRC check
8 BITS	8 BITS	8 BITS	16 BITS

Error Code	Contents	Description
01	Illegal function	The function code received is not an allowable action for the slave.
02	Illegal data address	The data address received is not an allowable address for the slave.
03	Illegal data value	A value contained in the data field is not an allowable value for the slave.

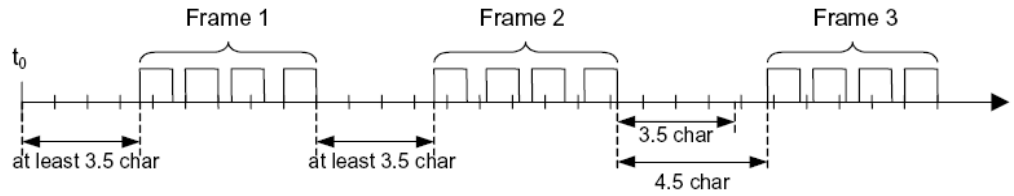
3.4.4 MODBUS Message RTU Framing

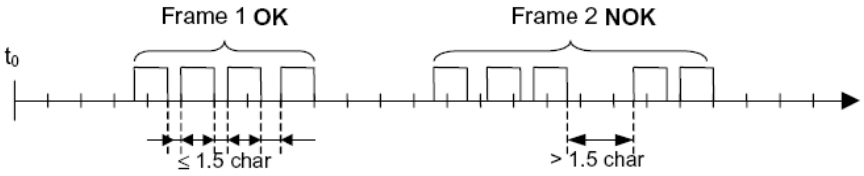
In RTU mode, message frame are separated by a silent interval of at least 3.5 character times. The entire message frame must be transmitted as a continuous stream of characters. If a silent interval of more than 1.5 character times occurs between two characters, the message frame is declared incomplete and will be discarded by the ***MPC***.

RTU Message Frame

MODBUS message

Start	Address	Function	Data	CRC Check	End
≥ 3.5 char	8 bits	8 bits	N x 8 bits	16 bits	≥ 3.5 char





1. Transmission procedure of master station

Since the communication system uses the 2-write RS-485 interface, there may be 2 statuses on a line below.
(a) Vacant status (no data on line)
(b) Communication status (data is existing)

The master station must proceed to a communication upon conforming to the following items.

1-1. Before sending a command message, at least 3.5 character times silent interval must be provided.
1-2. For sending, the interval between bytes of a command message must be below 1.5 character times.
1-3. Within 1.5 character times after sending a command message, the receiving status is posted.
1-4. Provide 3.5 character times vacant status between the end of response message reception and beginning of next command message sending (same as in 1-1).
1-5. For ensuring the safety, make a confirmation of the response message and make an arrangement so as to provide 3 or more retries in case of no response, error occurrence, etc.

2. Transaction of the MPC

(1). Detection of the command message frame

The ***MPCs*** connected on the line are initially at a receiving status and monitoring the line. When 1.5 character times or more vacant status has appeared on the line, the end of preceding frame is assumed and, within following 1.5 character times, a receiving status is posted. When data appears on the line, the ***MPCs*** receive it. While 1.5 character times more vacant status is detected again, the end of that frame is assumed. Data, which appeared on the line from the first 3.5 character times or more vacant status to the next 3.5 character times or more vacant status, is fetched as one frame.

(2). Response of ***MPC***

After frame detection, The ***MPC*** carries out that frame as a command message. If the command message is destined to the own station, a response message is returned. Its processing time is 1 to 10ms (depends on contents of command message). After sending a command message, therefore, the master station must observe the following.

1-1. Receiving status is posted within 1.5 character times after sending a command message.
1-2. 3.5 character times or more vacant status precedes the response message

sending.

1-3. Interval between bytes of response message must be smaller than 1.5 character times.

3.5 Function Code Description

3.5.1 Read Data Registers [Function Code: 03]

Read the contents of a contiguous block of data registers in the MPC.

Broadcast is not possible.

1. Message composition

Command message composition

Address	Function Code	Starting Register	Quantity of Registers	CRC-16	
x01~x09	x03	x0000~xFFFF	x0001~x007D	Low-order byte	High-order byte
1 byte	1 byte	2 byte	2 bytes	2 bytes	

Response message composition

Address	Function Code	Byte Count *	Register Value	CRC-16	
x01 ~ x09	x03	x02~xFA		Low-order byte	High-order byte
1 byte	1 byte	1 bytes	N x 2 bytes	2 bytes	

* N = Quantity of Registers; Byte Count = N × 2

2. Message transmission (example)

The following show an example of reading the set-point [data register x0000] from ID=1 MPC.

Command message composition

Address	Function Code	Starting Register	Quantity of Registers	CRC-16
x01	x03	x0000	x0001	x840A

Response message composition

Address	Function Code	Byte Count	Register Value	CRC-16
x01	x03	x02	x03E8	xB8FA

The response data show that the set-point of channel 1 is x03E8 (1000).

3.5.2 Read Input Registers [Function Code: 04]

Read the contents of a contiguous block of input registers (x1000~x1FFF) in the MPC.

Broadcast is not possible.

1. Message composition

Command message composition

Address	Function Code	Starting Register	Quantity of Registers	CRC-16	
x01~x09	x04	x1000~x1FFF	x0001~x007D	Low-order byte	High-order byte
1 byte	1 byte	2 bytes	2 bytes	2 bytes	

Response message composition

Address	Function Code	Byte Count *	Register Value	CRC-16	
x01 ~ x09	x04	x02~xFA		Low-order byte	High-order byte
1 byte	1 byte	1 byte	N x 2 bytes	2 bytes	

* N = Quantity of Registers; Byte Count = N × 2

2. Message transmission (example)

The following show an example of reading the Process Value (PV) [Input register x1000] from ID=1 MPC.

Command message composition

Address	Function Code	Starting Register	Quantity of Registers	CRC-16
x01	x04	x1000	x0001	x350A

Response message composition

Address	Function Code	Byte Number	Register Value	CRC-16
x01	x04	x02	x001B	xF93B

The response data show that the Process Value (PV) of channel 1 is x001B (27).

3.5.3 Write Single Register [Function Code: 06]

Write a single data register (x0000~xFFFF) in the MPC.

Broadcast is possible

1. Message composition

Command message composition

Address	Function	Register Address	Register Value	CRC-16	
x01 ~ x09	x06	x0000~xFFFF		Low-order byte	High-order byte
1 byte	1 byte	2 bytes	2 bytes	2 bytes	

Response message composition

Address	Function	Register Address	Register Value	CRC-16	
x01 ~ x09	x06	x0000~xFFFF		Low-order byte	High-order byte
1 byte	1 byte	2 bytes	2 bytes	2 bytes	

2. Message transmission (example)

The following show an example of setting the Input signal type [data register x0024] of ID=1 MPC to K type thermocouple.

Command message composition

Address	Function Code	Register Address	Register Value	CRC-16
x01	x06	x0024	X001B	x89CA

Response message composition

Address	Function Code	Register Address	Register Value	CRC-16
x01	x06	x0024	x001B	x89CA

4. Parameters Description and Data Register Map

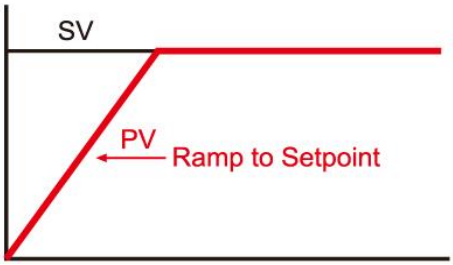
4.1 Parameters Description

4.1.1 SV (Set-point Value , data register=x0000)

Description: The set-point value is the target of controlled process.
Range: Low limit ~ High limit
Unit: °C, °F or Engineering unit

4.1.2 Ramp (Ramp Rate, data register=x0001)

Description: The controller can act as either a fixed set point controller or as a single ramp controller. If the ramp rate is set to a value other than zero, the process will increase or decrease at the setting rate during initial power up or with set point change.
Range: 0 ~ 30000
Unit: °C, °F or Engineering unit per Sec. or Min.



4.1.3 Soft (Soft Start Output limit, data register=x0002)

Description: Set the max. output limitation during soft-start. The control output will be limited at startup until the process value has reached the “SSV” set-point and the output will revert to full PID regulation.
Range: 0~100.0 (x0000 ~ x03E8)
Unit: %

4.1.4 SSV (Soft Start Set-point Value, data register=x0003)

Description: This is the set-point below which at startup, the output will be limited to the value set in the “Soft” parameter.
Range: Low limit ~ High limit
Unit: °C, °F or Engineering unit per Min.

4.1.5 A1SP/A2SP (Alarm 1/Alarm 2 Set-point, data register=x0004 / x0009)

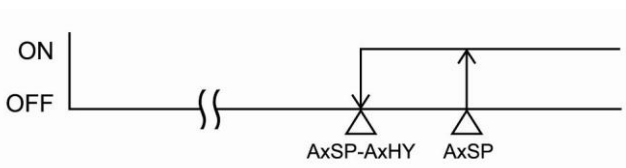
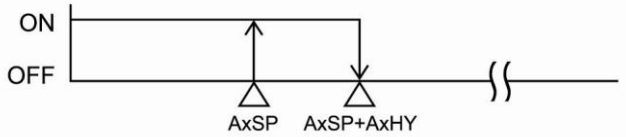
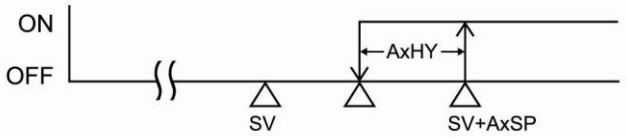
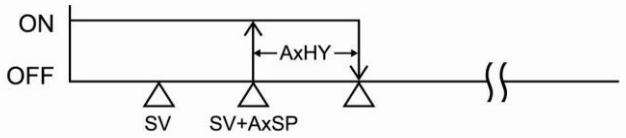
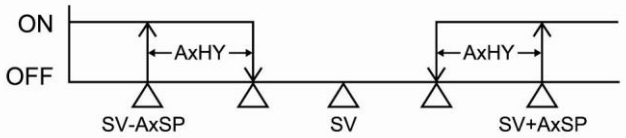
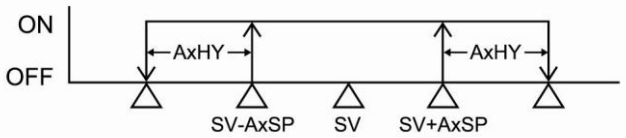
Description: The set-point of alarm even
Range: Low limit ~ High limit
Unit: °C, °F or Engineering unit

4.1.6 A1HY/A2HY (Alarm1/Alarm 2 Hysteresis, data register=x0005 / x000A)

Description: The hysteresis of alarm action
Range: 0 ~ 30000 (x0000 ~ x7530)
Unit: °C, °F or Engineering unit

4.1.7 A1FU/A2FU (Alarm 1/Alarm 2 Function, data register=x0006 / x000B)

Description: Select the alarm function
Range: x0000 ~ x0006
Unit: N/A

Setting	Alarm Function	Action
x0000	Alarm Disable	None
x0001	Process High Alarm	
x0002	Process Low Alarm	
x0003	Deviation High Alarm	
x0004	Deviation Low Alarm	
x0005	Deviation Band High Alarm	
x0006	Deviation Band Low Alarm	

4.1.8 A1MD/A2MD (Alarm Mode, data register=x0007 / x000C)

Description: Select the alarm mode.
Range: x000D ~ x0010
Unit: N/A

Setting	Alarm Mode	Action
x000D	Normal Mode	
x000E	Standby Mode	Prevents an alarm on power up. The alarm is active after alarm condition has been cleared and then alarm occurs again.
x000F	Latch Mode	The alarm output will be latched as the alarm

		occurs. The alarm output will not change its state even if the alarm condition has been cleared unless the power is off.
x0010	Standby & Latch mode	Both standby and Latch mode are applied.

The different alarm mode actions with alarm function set to Deviation Band High alarm is shown in figure 4.

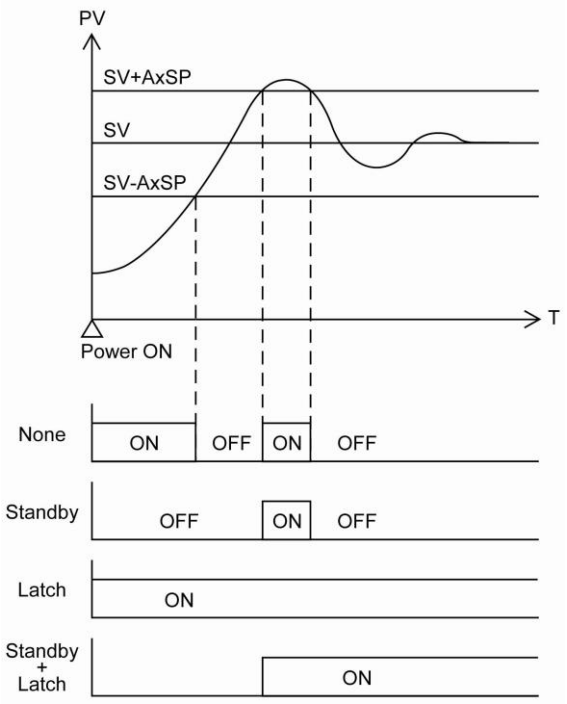


Figure 4 Alarm actions for different alarm mode with Deviation Band High alarm function

4.1.9 A1DT/A2DT (Alarm Delay Time, data register=x0008 / x000D)

Description: Alarm delay time is set to postpone the alarm action by the setting time.
Range: 0 ~ 30000 (x0000 ~ x7530)
Unit: Second or minute (depend on the setting of PTME)

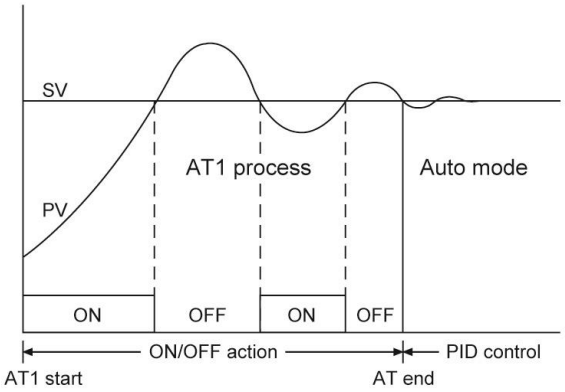
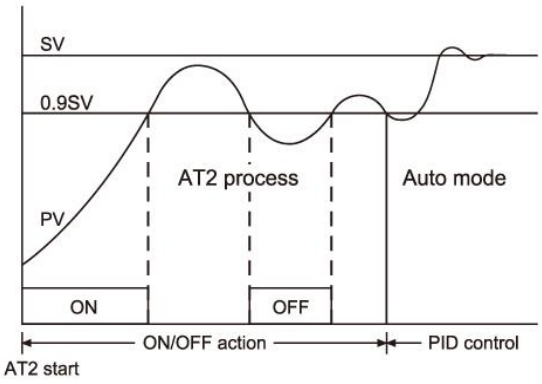
4.1.10 OUTL (Control Output Percentage, data register=x000E)

Description: Set the output percentage in manual mode.
Range: 0.0 ~ 100.0 (x0000 ~ x03E8)
Unit: %

4.1.11 RUN (Control mode selection, data register=x000F)

Description: Select the PID controller running mode.
Range: x0011 ~x0017
Unit: N/A

Setting	Mode	Action
x0011	Standby mode	Controlled output is turned off.
x0012	Auto-tuning mode 1	The controller will tune the PID parameters automatically at SV. The process will oscillate around

		the SV during AT1 process. Use AT2 mode if overshooting beyond the normal process is likely to cause damage. 
x0013	Auto-tuning mode 2	The controller will tune the PID parameters automatically at 90% of SV. The process will oscillate around (90%SV) during AT2 process. 
x0014	Manual mode (open loop control)	In this mode, the controlled output is set manually by "**OUTL**"
x0015	Auto mode (closed loop control)	Run the PID controller with fixed set-point. The control output is determined by PID algorithm or ON/OFF action.
x0016	Profile mode	Run the profile set in the program parameters.
x0017	Pause mode	The SV will be held at the moment the pause mode is set.

4.1.12 ACT (Control Action, data register=x0010)

Description: Set the controlled output to be heating or cooling action.
Range: x0018 or x0019
Unit: N/A

Setting	Action
x0018	Direct action (Cooling)
x0019	Reverse action (Heating)

4.1.13 PB1/PB2/PB3/PB4 (Proportional Band, data register=x0011 / x0017 / x001D / x0023)

Description: Proportional band. Set to 0.0 for ON/OFF control mode. This value can be automatically calculated by activating the auto tune function. It can also be set by the user if desired.

Range: 0.0 ~ 300.0 (x0000 ~ x0BB8)

Unit: %

4.1.14 Ti1/Ti2/Ti3/Ti4 (Integral Time, data register=x0012 / x0018 / x001E / x0024)

Description: Integral time (Reset). This value can be 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 (On/Off control mode), this parameter will be not available.

Range: 0.0 ~ 3000.0 (x0000 ~ x7530)

Unit: Second

4.1.15 Td1/Td2/Td3/Td4 (Derivative Time, data register=x0013 / x0019 / x001F / x0025)

Description: Derivative time (Rate). This value can be 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 (On/Off control mode), this parameter will be not available.

Range: 0.0 ~ 750.0 (x0000 ~ x1D4C)

Unit: Second

4.1.16 MR1/MR2/MR3/MR4 (Manual Reset, data register=x0014 / x001A / x0020 / x0026)

Description: For PID control, this value is set automatically after auto-tuning process. For P control, it is used to compensate the deviation between process value and set point.

Range: 0.0 ~ 51.0 (x0000 ~ x01FE)

Unit: %

4.1.17 AR1/AR2/AR3/AR4 (Anti-reset Windup, data register=x0015 / x001B / x0021 / x0027)

Description: The Anti-Reset windup (ARW) inhibits the integral action until the PV is within the ARW band thus reducing overshoot on start-up. It is set automatically by auto-tuning process. It is set in percentage of proportional band.

Range: 5.0 ~ 100.0 (x0032 ~ x03E8)

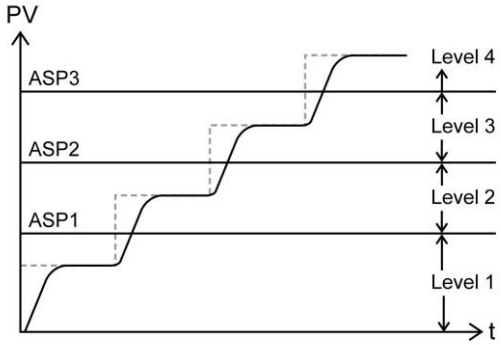
Unit: %

4.1.18 ASP1/ASP2/ASP3(Level PID boundary, data register=x0016 / x001C / x0022)

Description: Set the level PID boundary. The level 1 PID parameters (Pb1, Ti1, Td1, MR1, AR1 and CPb1) will be applied when the set-point is below ASP1. The level 2 PID parameters (Pb2, Ti2, Td2, MR2, AR2 and CPb2) are applied when the set-point is between ASP1 and ASP2. The level 3 PID parameters (Pb3, Ti3, Td3, MR3, AR3 and CPb3) are applied when the set-point is between ASP2 and ASP3. The level 4 PID parameters (Pb4, Ti4, Td4, MR4, AR4 and CPb4) are applied when the set-point is higher than ASP3.

Range: High limit ~ Low limit

Unit: °C, °F or Engineering unit.



4.1.19 TYPE (Input Signal Type, data register=x0028)

Description: Select the input signal type.
Range: x001A ~ x0027
Unit: N/A

Setting	Type	Max. measuring range
x001A	J	-50 ~ 1000°C
x001B	K	-50 ~ 1370°C
x001C	T	-270 ~ 400°C
x001D	E	-50 ~ 950°C
x001E	B	0 ~ 1800°C
x001F	R	-50 ~ 1750°C
x0020	S	-50 ~ 1750°C
x0021	N	-50 ~ 1300°C
x0022	C	-50 ~ 1800°C
x0023	PT100 (DIN)	-200 ~ 850°C
x0024	PT100 (JIS)	-200 ~ 600°C
x0025	mA	0 ~ 24mA
x0026	mV	-60 ~ 60 mV
x0027	V	-10 ~ 10 V

4.1.20 SCAL (Low Scale for Linear Input, data register=x0029)

Description: Set the low scale corresponding to low linear input signal (see the cut-off function for further detail). The default low limit of linear input signal (INL) for mA, mV and V is 4.00mA, 0.00mV and 0.00V separately. This parameter is effective only for linear input (mA, mV and V) type.
Range: -30000 ~ 30000 (x8AD0 ~ x7530)
Unit: Count

4.1.21 SCAH (High Scale for Linear Input, data register=x002A)

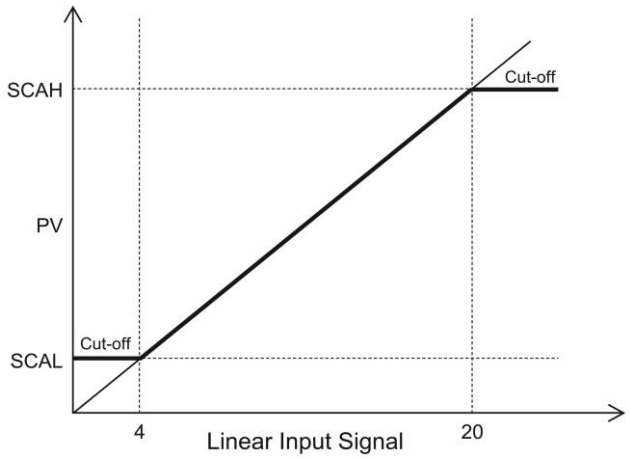
Description: Set the high scale corresponding to high linear input signal (see the cut-off function for further detail). The default high limit of linear input signal (INH) for mA, mV and V is 20.00mA, 50.00mV and 10.00V separately. This parameter is effective only for linear

input (mA, mV and V) type.
Range: -30000 ~ 30000 (x8AD0 ~ x7530)
Unit: Count

4.1.22 CUT (Cut-off Function, data register=x002B)

Description: The Cut-off function is used to limit the process value of linear input signal within the boundary whenever the input signal is out of the high/low limit range (set by HILT and LOLT). The cut-off function can be set to “Low”, “High” or “High/Low”, set to “None” disables the cut-off function. The cut-off function has no effect for input signal other than linear input.
Range: x0028 ~ x002B
Unit: N/A

Setting	Action
x0028	None
x0029	Low
x002A	High
x002B	High and Low



PV scale calculation: $PV = \frac{IN - INL}{INH - INL}(SCAH - SCAL) + SCAL$

Where
IN: the input signal.
INH: the high limit of linear input signal.
INL: the low limit of linear input signal.
Example:
For a 4~20mA input signal, the INL is 4.00mA and the INH is 20.00mA. Set SCAL=0.0 SCAH=100.0 (Of course, you may select other value for Decimal point to alter the resolution) and LOLT=0.0 HILT=100.0.
For a 12mA input, the PV will be 50.0.
For a 22mA input, the PV will be 112.5 with cut-off function set to “None” or 100.0 with

cut-off function set to “High” or “High/Low”.

For a 0mA input, the PV will be -25.0 with cut-off function set to “None” or 0.0 with cut-off function set to “Low” or “High/Low”

4.1.23 UNIT (Unit, data register=x002C)

Description: Select the process value indication in °C or °F when the input signal type is set to thermocouple or PT100. Select engineering unit for linear input (mA, mV or V).

Range: x002C ~ x002E

Unit: N/A

Setting	Unit
x002C	°C
x002D	°F
x002E	Engineering unit

4.1.24 DP (Decimal Point, data register=x002D)

Description: Select the decimal point position.

Range: x002F ~x0032.

Unit: N/A

Setting	Decimal Point
x002F	0000
x0030	000.0
x0031	00.00 (Linear input Only)
x0032	0.000 (Linear input Only)

4.1.25 LOLT (Low Limit, data register=x002E)

Description: Set the low limit of measuring range. When the PV goes below the low limit, an error flag set and the control outputs are set according to the EROP (Error Protection).

Range: Depend on the Max. measuring range of input signal type. Please refer to the “Type” description

Unit: °C, °F or Engineering unit

4.1.26 HILT (High Limit, data register=x002F)

Description: Set the high limit of measuring range. When the PV goes beyond the high limit, an error flag set and the control outputs are set according to the EROP (Error Protection).

Range: Depend on the Max. measuring range of input signal type. Please refer to the “Type” description

Unit: °C, °F or Engineering unit

4.1.27 PTME

Description: Set the time scale used for alarm delay time (AxDT), ramp rate (Ramp), ramp and

soak time (RTx and STx)
Range: x0033 ~ x0034
Unit: N/A

Setting	Action
x0033	The ramp rate (Ramp) is in per second. The alarm delay time, ramp and soak time of profile is in second.
x0034	The ramp rate (Ramp) is in per minute. The alarm delay time, ramp and soak time of profile is in minute.

4.1.28 EROP (Error Protection, data register=x0031)

Description: Set the control output status whenever an error occurred
Range: x0035 ~ x003C
Unit: N/A

Setting	Control output	Alarm2	Alarm1
x0035	OFF	OFF	OFF
x0036	OFF	OFF	ON
x0037	OFF	ON	OFF
x0038	OFF	ON	ON
x0039	ON	OFF	OFF
x003A	ON	OFF	ON
x003B	ON	ON	OFF
x003C	ON	ON	ON

4.1.29 SVOF (Set-Point offset, data register=x0032)

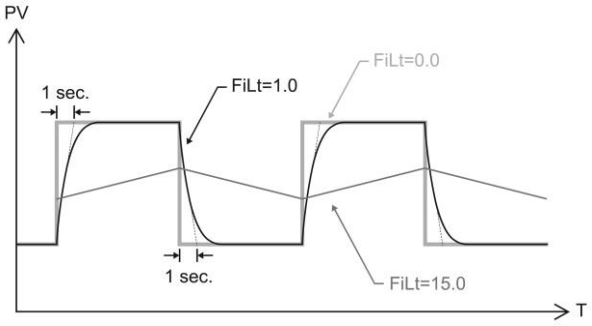
Description: Shift the set point value with an offset. The actual control target is shifted with this offset from set point value but not added to SV display.
Range: -30000 ~ 30000 (x8AD0 ~ x7530)
Unit: °C, °F or Engineering unit

4.1.30 PVOF (Process Value offset correction, data register=x0033)

Description: Shift the PV with an offset to correct the sensor offset error.
Range: -30000 ~ 30000 (x8AD0 ~ x7530)
Unit: °C, °F or Engineering unit

4.1.31 FILT (Digit Filter, data register=x0034)

Description: Set the time constant for digit filter (the first order filter). It is useful when the process value is too unstable to be read.
Range: 0.0 ~ 99.9 (x0000 ~ x03E7)
Unit: Second



4.1.32 BAUD (Baud Rate, data register=x0035)

Description: Set the communication baud rate.

Range: x003D ~ x0040

Unit: N/A

Setting	Baud Rate
x003D	2400
x003E	4800
x003F	9600
x0040	19200

4.1.33 ID (Address of communication, data register=x0036)

Description: Set the ID number for communication

Range: 1 ~ 247 (x0001 ~ x00F7)

Unit: N/A

4.1.34 CT (Cycle Time, data register=x0037)

Description: Set the control output cycle time. Set to 0 for linear output, 1 for pulsed voltage to drive SSR and 15 for driving relay.

Range: 0 ~ 60 (x000 ~ x003C)

Unit: Second

4.1.35 O1FU (Control output function, data register=x0038)

Description: Set the control output function. The MPC control output can also be set as a PV or SV retransmission output when a 4 ~ 20 mA output signal is selected.

Range: x0041 ~ x0043

Unit: N/A

Setting	Control Output Function
x0041	PV retransmission
x0042	SV retransmission
x0043	Control output

4.1.36 O1CH

Description: Linear output high scale adjustment. For a 4 ~ 20mA output, adjust O1CH count until the output signal is read 20mA.

Range: 0 ~ 12000

Unit: count

4.1.37 O1CL

Description: Linear output low scale adjustment. For a 4 ~ 20mA output, adjust O1CL count until the output signal is read 4mA.

Range: 0 ~ 12000

Unit: count

4.1.38 State (Memory Backup, data register=x003B)

Description: The state of power failure for profile execution. Set to x0044, the profile will be started from segment 1 while the power is recovered. Set to x0045, the profile will be continued from where the profile had been interrupted by power failure while the power is recovered.

Range: x0044 or x0045

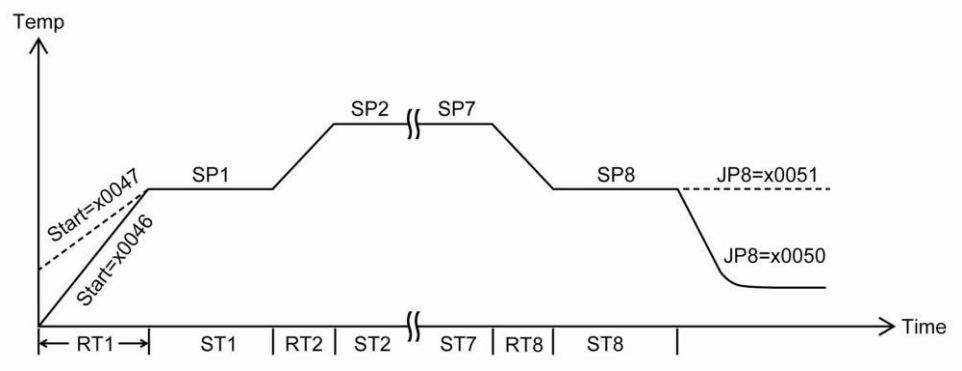
Unit: N/A

4.1.39 Start (Star from, data register=x003C)

Description: Define the segment 1 of profile starting from. Set to x0046, the segment 1 will start from 0. Set to x0047, it will start from the PV of the instant that profile is execution.

Range: x0046 or x0047

Unit: N/A



4.1.40 Band (Band, data register=x003D)

Description: Set a tolerance band. The soak time start to count down when the PV reaches the band.

Range: 0 ~ 30000 (x0000 ~ x7530)

Unit: °C, °F or Engineering unit

4.1.41 RT1~RT8 (Ramp time, data register=x003E/x0043/x0048/x004D/x0052/x0057/x005C/x0061)

Description: Set the time that the process will take to ramp up/down to next segment set-point.

Range: 0 ~ 30000 (x0000 ~ x7530)

Unit: Second

4.1.42 SP1~SP8 (Set-point of segment, data register=x003F/x0044/x0049/x004E/x0053/x0058/x005D/x0062)

Description: Segment set-point.

Range: Low limit ~ High limit

Unit: °C, °F or Engineering unit

4.1.43 ST1~ST8 (Soak time, data register=x0040/x0045/x004A/x004F/x0054/x0059/x005E/x0063)

Description: Set the soak time that the PV will remain at the segment set-point.

Range: 0 ~ 30000 (x0000 ~ x7530)

Unit: Second

4.1.44 JP1~JP8 (Jump Function, data register=x0041/x0046/x004B/x0050/x0055/x005A/x005F/x0064)

Description: Select which segment will be jump to after soak time is up or set the end of the profile.

Range: x0048 ~ x0052. x0052 is not available for JP8

Unit: N/A

Setting	Action
x0048	**Jump to Segment 8**
x0049	**Jump to Segment 7**
x004A	**Jump to Segment 6**
x004B	**Jump to Segment 5**
x004C	**Jump to Segment 4**
x004D	**Jump to Segment 3**
x004E	**Jump to Segment 2**
x004F	**Jump to Segment 1**
x0050	**End of the profile**
x0051	**Hold. PV will be hold at the segment set-point**
x0052	**Next. Link to next segment**

4.1.45 LN1~LN8(Loop Number, data register=x0042/x0047/x004C/x0051/x0056/x005B/x0060/x0065)

Description: In coordinate with jump function. Set the cycle number that the profile loop will be executed.

Range: 0 ~ 30001 (x0000 ~ x7531). 30001 will have unlimited cycles.

Unit: N/A

An example is shown in figure x below. Here the JP3 is set to x0042 and LN3 is set to 0. When the segment 3 is completed, the profile will jump to segment 2, and proceed to segment 3

again. Because the LN3 is set to 0, after the second time that segment 3 is completed, the profile will proceed to segment 4.

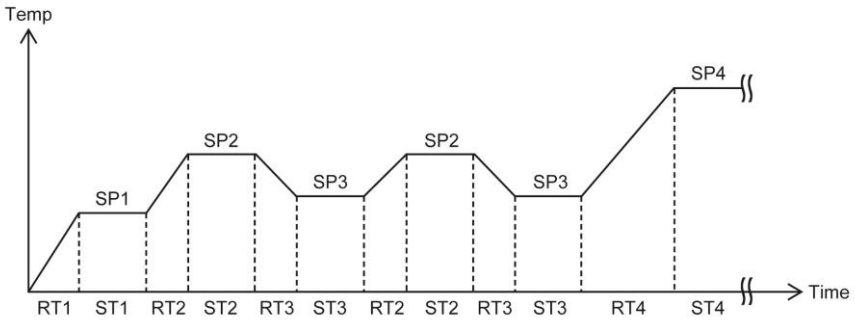


Figure x JP3=2 and LN3=0

Another example is shown in figure x below. Here the JP3 is set to x0042 and LN3 is set to 1. When the segment 3 is completed, the profile will jump to segment 2, and proceed to segment 3 again. Because the LN3 is set to 1, so the profile will execute the loop once again until the third time that segment 3 is completed, the profile proceed to segment 4.

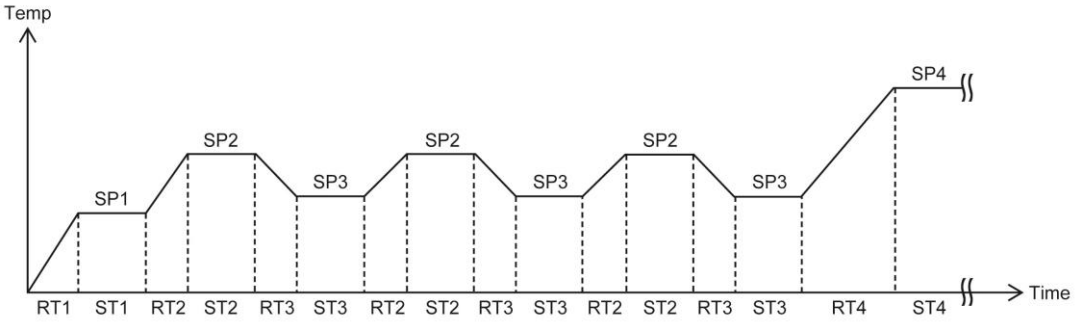


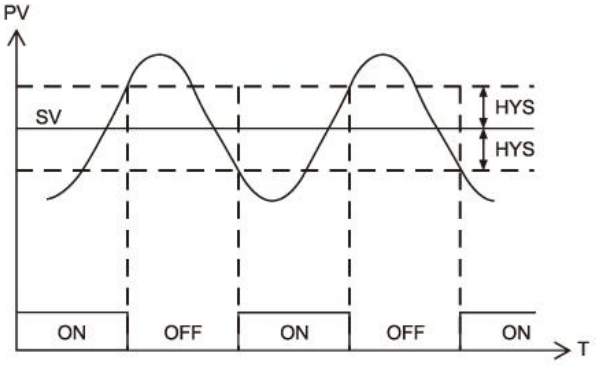
Figure x JP3=2 and LN3=1

4.1.46 HYST (Hysteresis of control output, data register=x0066)

Description: With ON/OFF control, the control output turns On/Off with respect to the set point. Therefore, the control output would change frequently in response to a slight change in process value. This might shorten the service life of the output device. To prevent this, a hysteresis is provided in the ON/OFF control.

Range: 0 ~ 30000 (x0000 ~ x7530)

Unit: °C, °F or Engineering unit



4.1.47 O1HL (Control Output High Limit, data register=x0067)

Description: Set the Max. Output. The default setting is 100.0%.

Range: 0.0 ~ 100.0 (x0000 ~ x03E8)

Unit: %

4.1.48 O1LL (Control Output Low Limit, data register=x0068)

Description: Set the Min. Output. The default setting is 0.0%.

Range: 0.0 ~ 100.0 (x0000 ~ x03E8)

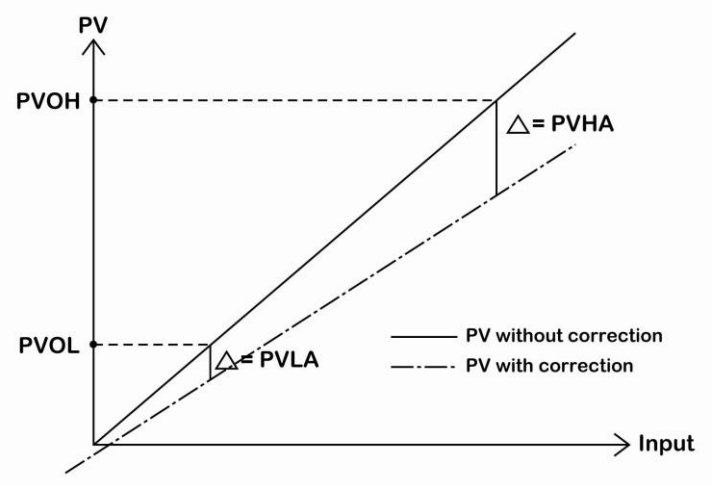
Unit: %

4.1.49 PVOH

Description: High scale of PV correction.

Range: -30000 ~ 30000 (x8AD0 ~ x7530)

Unit: °C, °F or Engineering unit



4.1.50 PVHA

Description: High scale offset of PV correction.

Range: -30000 ~ 30000 (x8AD0 ~ x7530)

Unit: °C, °F or Engineering unit

4.1.51 PVOL

Description: Low scale of PV correction.

Range: -30000 ~ 30000 (x8AD0 ~ x7530)

Unit: °C, °F or Engineering unit

4.1.52 PVLA

Description: Low scale offset of PV correction.

Range: -30000 ~ 30000 (x8AD0 ~ x7530)

Unit: °C, °F or Engineering unit

4.2 Data Registers Map

Parameter	Register	Read/Write	Setting
SV	x0000	R/W	
RAMP	x0001	R/W	
SOFT	x0002	R/W	
SSV	x0003	R/W	
A1SP	x0004	R/W	
A1HY	x0005	R/W	
A1FU	x0006	R/W	
A1MD	x0007	R/W	
A1DT	x0008	R/W	
A2SP	x0009	R/W	
A2HY	x000A	R/W	
A2FU	x000B	R/W	
A2MD	x000C	R/W	
A2DT	x000D	R/W	
OUTL	x000E	R/W	
ENAB	x000F	R/W	
ACT	x0010	R/W	
PB1	x0011	R/W	
TI1	x0012	R/W	
TD1	x0013	R/W	
MR1	x0014	R/W	
AR1	x0015	R/W	
ASP1	x0016	R/W	
PB2	x0017	R/W	
TI2	x0018	R/W	
TD2	x0019	R/W	
MR2	x001A	R/W	
AR2	x001B	R/W	
ASP2	x001C	R/W	
PB3	x001D	R/W	
TI3	x001E	R/W	
TD3	x001F	R/W	
MR3	x0020	R/W	
AR3	x0021	R/W	
ASP3	x0022	R/W	
PB4	x0023	R/W	
TI4	x0024	R/W	
TD4	x0025	R/W	

MR4	x0026	R/W	
AR4	x0027	R/W	
TYPE	x0028	R/W	
SCAL	x0029	R/W	
SCAH	x002A	R/W	
CUT-OFF	x002B	R/W	
UNIT	x002C	R/W	
DP	x002D	R/W	
LOLT	x002E	R/W	
HILT	x002F	R/W	
PTME	x0030	R/W	
EROP	x0031	R/W	
SPOF	x0032	R/W	
PVOF	x0033	R/W	
FILT	x0034	R/W	
BAUD	x0035	R/W	
ID	x0036	R/W	
CT	x0037	R/W	
O1FU	x0038	R/W	
O1CH	x0039	R/W	
O1CL	x003A	R/W	
STAT	x003B	R/W	
STAR	x003C	R/W	
BAND	x003D	R/W	
RT1	x003E	R/W	
SP1	x003F	R/W	
ST1	x0040	R/W	
SF1	x0041	R/W	
LN1	x0042	R/W	
RT2	x0043	R/W	
SP2	x0044	R/W	
ST2	x0045	R/W	
SF2	x0046	R/W	
LN2	x0047	R/W	
RT3	x0048	R/W	
SP3	x0049	R/W	
ST3	x004A	R/W	
SF3	x004B	R/W	
LN3	x004C	R/W	
RT4	x004D	R/W	
SP4	x004E	R/W	

ST4	x004F	R/W	
SF4	x0050	R/W	
LN4	x0051	R/W	
RT5	x0052	R/W	
SP5	x0053	R/W	
ST5	x0054	R/W	
SF5	x0055	R/W	
LN5	x0056	R/W	
RT6	x0057	R/W	
SP6	x0058	R/W	
ST6	x0059	R/W	
SF6	x005A	R/W	
LN6	x005B	R/W	
RT7	x005C	R/W	
SP7	x005D	R/W	
ST7	x005E	R/W	
SF7	x005F	R/W	
LN7	x0060	R/W	
RT8	x0061	R/W	
SP8	x0062	R/W	
ST8	x0063	R/W	
SF8	x0064	R/W	
LN8	x0065	R/W	
HYST	x0066	R/W	
OUCH	x0067	R/W	
OUCL	x0068	R/W	
PVOH	x0069	R/W	
PVHA	x006A	R/W	
PVOL	x006B	R/W	
PVLA	x006C	R/W	
reserved	x006D	R/W	
reserved	x006E	R/W	
reserved	x006F	R/W	

Parameter	Register	Read/Write	
PV	x1000	Read Only	
SV	x1001	Read Only	
OUTL	x1002	Read Only	