



DTN

Multi-Loop Modular Temperature Controller

Operation Manual



Precautions

- ⚠ This device is an open-type installation. Therefore, when using this device, it must be installed in a dustproof, moisture-proof, and electric shock/impact-free distribution box. Additionally, protective measures (such as special tools or keys) must be in place to prevent non-maintenance personnel from operating or accidentally impacting the device, which could result in danger and damage.
 - ⚠ Attention! Please strictly follow the relevant precautions in the manual content below. Failure to comply may result in controller or peripheral product malfunctions, and could even lead to serious hazards such as fire, electric shock, and injury to personnel.
 - ⚠ Attention! Electrical hazards! When the power is turned on, do not touch the AC terminal to avoid electric shock. When checking the input power, make sure the power is turned off.
 - ⚠ This device is an open-type installation. Please avoid using it in hazardous applications to prevent serious injury to personnel and damage to other equipment. Also, ensure that it is installed on equipment with fault-safe protective devices.
 - ⚠ This device does not come equipped with a power switch or fuse internally. Therefore, in the product application system, there should be a switch or circuit breaker conveniently accessible to the operator, with clear markings indicating the disconnect position.
 - ⚠ To prevent danger from mixing different power sources, within the same I/O expansion module, when one channel is disconnected to high voltage, other channels must not be connected to a safe low-voltage circuit.
1. For crimp (European-style) terminals, please select the recommended specifications from this manual. Tighten the terminal screws according to the torque recommendation in this manual, avoiding excessive force, and ensure that the wiring is connected to the correct and appropriate port.
 2. If dust or metal residue falls into the device, it may cause incorrect operation. Install it in a dustproof, moisture-proof, and electric shock/impact-free external distribution box.
 3. Unauthorized modification or disassembly of this controller may result in unexpected errors or hazards. Also, avoid using unused terminals.
 4. During installation, stay away from high voltage, high-frequency noise, or areas with high current flow to prevent interference.
 5. Avoid using this device in the following conditions: (a) Excessive dust and the presence of corrosive or flammable gases. (b) High humidity with condensation, (c) Vibration and impacts, (d) High radiation environment.
 6. When implementing wiring or replacing temperature controllers, be sure to turn off the power.
 7. When extending thermocouple leads or dealing with wire connections, use compensation wires specific to the type of thermocouple.
 8. When using three-wire RTDs, ensure that all three wires have consistent gauge and length to minimize measurement errors. For extending platinum resistance thermometer (RTD) leads or handling wire connections, choose wires with the same length and impedance to avoid affecting displayed temperature values.
 9. When wiring from the sensor to the temperature controller, follow the principle of using the shortest distance. To avoid noise and induced effects, ensure that the wiring is separate from the power supply and load.
 10. Before applying power, verify that the power/signal assembly is correct; otherwise, it may cause severe damage.
 11. During power-up, avoid touching the terminal of the device or performing maintenance to prevent electric shock.
 12. If the power is disconnected within one minute and the circuit is not fully discharged, avoid touching the internal wiring and external terminals.
 13. When maintaining the temperature controller, please first turn off the power and use a dry cloth to clean the surface of the device. Do not open the casing to avoid contact with internal circuits, which could lead to circuit damage or malfunctions. Avoid using cleaning liquids containing acids or alkalis.
 14. For measurement expansion modules, install them on the right side of the main unit or other measurement

expansion modules. They can be installed consecutively, with a maximum of seven measurement expansion modules per main unit. IO expansion modules must also be installed on the right side of the main unit or other measurement expansion modules, but they cannot be installed consecutively. Only one I/O expansion module can be connected to the right side of each measurement unit (it is also acceptable not to connect any I/O expansion module). Connecting more than one I/O expansion module at the same time is not allowed (mechanical design prevents incorrect installation).

15. To prevent hazards due to different system voltages, ensure that the connection points on the same main unit, measurement expansion unit, or I/O expansion module have the same system voltage.
16. When purchasing measurement expansion units or IO expansion modules, they must be used in conjunction with the DTN main unit.
17. When adding or replacing measurement expansion units or IO expansion modules, be sure to disconnect the main unit's power, install the modules, and then restore power. Note that this product series does not support hot swapping, so avoid installing or removing modules without disconnecting the power.

Revision History

Version	Change Description	Release Date
V1.0	Initial Release.	2022/4/15
V1.1	<ol style="list-style-type: none"> 1. Modify figures. 2. Add sensor C-type and D-type support. And modify corresponding description. 3. Modify typo and sampling rate in specification table. 4. Modify section 1.6, add wiring diagrams. 	2024/8/21
V1.2	<ol style="list-style-type: none"> 1. Revised the sensor input wiring diagram in section 1.6. 2. Added terminal wiring precautions in section 1.7. 3. Corrected the temperature range description for C and D type sensors in section 2.2 and 3.1.2. 4. Modified section 4.1.3 and 4.3.3 to include an explanation of the heating and cooling registers. 5. Updated section 5.1 to include an explanation of the heating and cooling registers and added a note on the supported firmware version. 6. Added Section 5.1.4 to explain the ON-OFF switch control function. 7. Modified section 6.2 to include relevant heating and cooling register explanations and added a note on the supported firmware version. 8. Updated the register communication table in section 7.1. 	2025/3/13
V1.3	<ol style="list-style-type: none"> 1. Added to Sections 1.1 and 2.6 an explanation that DTN TC and DTN PT models cannot be used together. 2. Added to Sections 1.1 and 2.6 the installation method for the measurement unit and I/O expansion module. 	2025/5/7

DTN Multi-Loop Modular Temperature Controller

Operation Manual

Table of Content

Precautions	i
Revision History	iii
Table of Content	iv
Chapter 1 Product Overview	1-1
1.1 Product Description	1-1
1.2 Product Features.....	1-2
1.3 External Appearance of Product and Names of Parts	1-2
1.4 Purchase Information.....	1-4
1.5 Product Dimensions	1-5
1.6 Terminal Configuration Diagram.....	1-7
1.7 Installation Instructions.....	1-11
Chapter 2 Specifications and System Configuration	2-1
2.1 Electrical Specifications	2-1
2.2 Temperature Sensor Type and Temperature Range	2-3
2.3 Measurement Accuracy.....	2-4
2.4 Station Number Setting	2-4
2.5 RS485 Communication Protocol Settings.....	2-4
2.6 Expansion Module Installation Method	2-6
2.7 Initial Power On State	2-9
2.7.1 LED Display Status.....	2-9
2.8 Definitions of Commonly Used Terms	2-9
2.9 Restoring Default Settings	2-10
Chapter 3 Input Function Configuration	3-1

3.1	Input Functions.....	3-1
3.1.1	Hardware Configuration.....	3-1
3.1.2	Input Type, and Related Settings.....	3-4
3.1.3	Setpoint Value.....	3-5
3.1.4	Read Present Value.....	3-5
3.2	Temperature Filter and Input Temperature Deviation Setting.....	3-6
3.2.1	Temperature Filter Setting.....	3-6
3.2.2	Input Temperature Deviation Setting.....	3-6
3.3	Other Input Function Settings.....	3-7
3.3.1	Channel Disabled.....	3-7
3.3.2	Temperature Units.....	3-7
3.3.3	Cold Junction Compensation Selection.....	3-7
3.3.4	Input Channel Status.....	3-7
Chapter 4	Output and Alarm Function Configuration.....	4-1
4.1	Output Functions.....	4-1
4.1.1	Output Hardware Configuration.....	4-1
4.1.2	Output Functions Settings.....	4-3
4.1.3	Auxiliary Output Functions Settings.....	4-3
4.2	Alarm Settings.....	4-4
4.2.1	Alarm Function Modes.....	4-4
4.2.2	Alarm Function Settings.....	4-5
4.3	Other Output Function Settings.....	4-7
4.3.1	Input Sensor Error Output Value.....	4-7
4.3.2	Analog Output Compensation Adjustment.....	4-7
4.3.3	Retransmission Setting and Compensation Adjustment.....	4-8
Chapter 5	Control Functions and Operating Instructions.....	5-1
5.1	Control Functions.....	5-1
5.1.1	PID Control Function Settings.....	5-1
5.1.2	Slope Control Function Settings.....	5-3
5.1.3	Manual Control Function Settings.....	5-3
5.1.4	ON-OFF Control Function Setting.....	5-3

Chapter 6 Quick Start Guide	6-1
6.1 Communication Settings and Wiring	6-1
6.2 Basic Parameter Settings	6-3
6.3 Advanced Parameter Settings	6-8
Chapter 7 Appendix-Communication Registers	7-1
7.1 RS485 Communications	7-1
7.2 Communication Software	7-10

Chapter 1 Product Overview

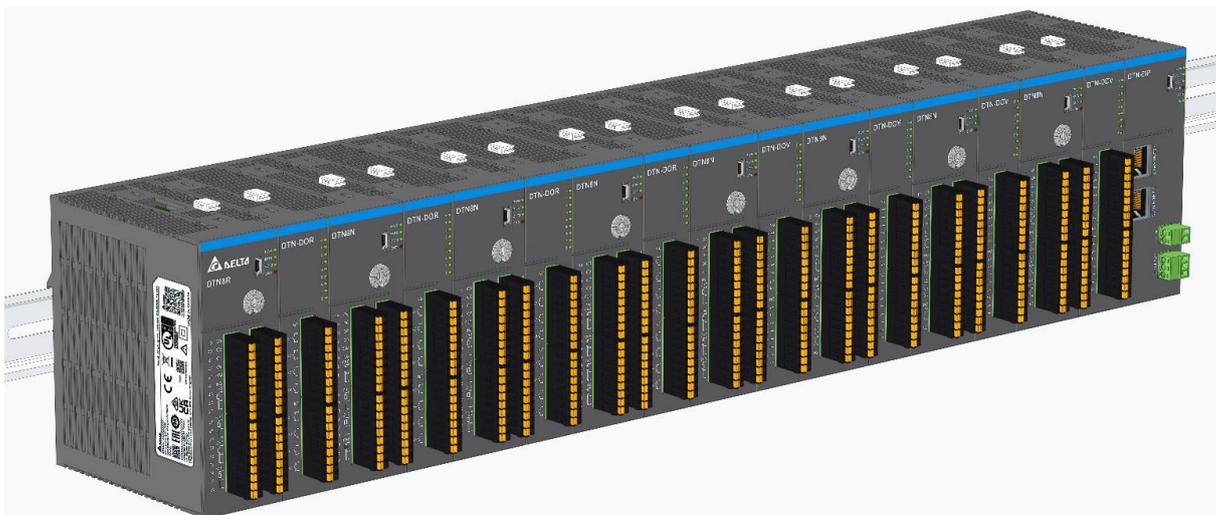
1.1 Product Description

The DTN series is a multi-channel modular temperature controller. It includes a measurement module, IO expansion output module, and communication module. One measurement module can provide up to 8 sets of PID control loops and the output module can be expanded.

The number of DTN measurement modules in the same group can be expanded to 8 units, providing up to 64 sets of PID control loops. Ethernet or RS-485 communications can be used to control the temperatures for more than 256 channels, which makes it suitable for use in rubber and plastics industry and electronics industry systems that require the simultaneous control of large numbers of temperature points.



Maximum 64-channel hardware configuration (including up to 64 points of I/O expansion alarm output):



Note:

1. DTN TC and DTN PT models cannot be used together. When the main unit is a TC model, the expansion units must also be TC models; when the main unit is a PT model, the expansion units must be PT models.

- Only one I/O expansion module can be connected to the right side of each measurement unit (it is also acceptable not to connect any I/O expansion module). Connecting more than one I/O expansion module simultaneously is not allowed (the mechanical structure is designed to prevent incorrect installation).

Example of correct installation:

[Measurement Main Unit + I/O Expansion Module] + [Measurement Expansion Module + I/O Expansion Module] + [Measurement Expansion Module + I/O Expansion Module] + Measurement Expansion Module + Measurement Expansion Module...

1.2 Product Features

The modular design of the DTN series makes it convenient for users to use and install. The DIN rail installation method can reduce wiring, allowing the various channel controllers to work independently at the same time.

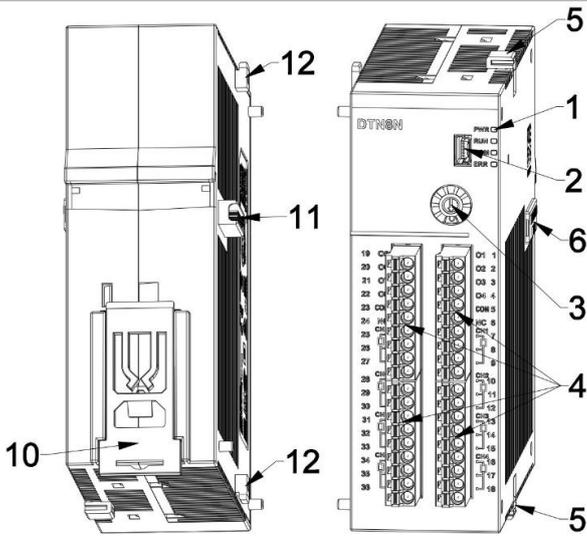
- ❖ A modular design simplifies wiring installation.
- ❖ IO expansion modules can meet the needs of different applications.
- ❖ RS-485 communication function.
- ❖ Ethernet communications function (requires DTN-EIP communications module).
- ❖ EtherCAT communication function (requires DTN-ECAT communication module).

1.3 External Appearance of Product and Names of Parts

Main unit - DTN8R series

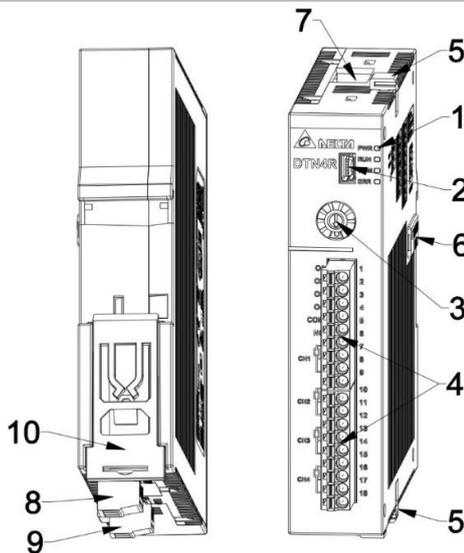
Serial No.	Name	Serial No.	Name
(1)	Status light	(7)	Communications protocol switch
(2)	Mini USB adapter*1	(8)	Power input terminal
(3)	Station ID knob	(9)	RS-485 communications terminal
(4)	Input/Output terminal	(10)	DIN RAIL fastener
(5)	Expansion fastener		
(6)	Expansion adapter/protective cover		

Measurement expansion module - DTN8N series



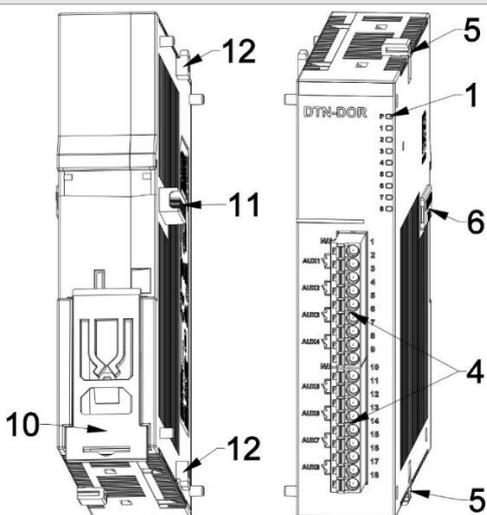
Serial No.	Name	Serial No.	Name
(1)	Status light	(7)	/
(2)	Mini USB adapter*1	(8)	/
(3)	Station ID knob	(9)	/
(4)	Input/Output terminal	(10)	DIN RAIL fastener
(5)	Expansion fastener	(11)	Expansion adapter
(6)	Expansion adapter/protective cover	(12)	Expansion fastening structure

Main unit - DTN2R / DTN4R series



Serial No.	Name	Serial No.	Name
(1)	Status light	(7)	Communications protocol switch
(2)	Mini USB adapter*1	(8)	Power input terminal
(3)	Station ID knob	(9)	RS-485 communications terminal
(4)	Input/Output terminal	(10)	DIN RAIL fastener
(5)	Expansion fastener		
(6)	Expansion adapter/protective cover		

I/O expansion unit



Serial No.	Name	Serial No.	Name
(1)	Status light	(7)	/
(2)	/	(8)	/
(3)	/	(9)	/
(4)	Output terminal	(10)	DIN RAIL fastener
(5)	Expansion fastener	(11)	Expansion adapter
(6)	Expansion adapter/protective cover	(12)	Expansion fastening structure

Note :

*1: The Mini USB adapter is a maintenance port, only for product maintenance used by Delta technicians.

1.4 Purchase Information

DTN 1 2 3 4

Series name	DTN: Delta DTN series temperature control measurement module
1 Type	2R = Two-channel main measurement unit 4R = Four-channel main measurement unit 8R = Eight-channel main measurement unit 8N = Eight-channel measurement expansion module
2 Input type*1	PT = Platinum resistance TC = Thermocouple
3 Output type	Code 1 = 2R: V = DC voltage pulse output (source type) Code 1 = 4R; 8R; 8N: V = DC voltage pulse output (source type) C = Linear current output (source type) L = linear voltage output
4 Special specifications	Blank = Standard products -x = x, x = A-Z Identified according to the customer ID/derivative device types

DTN - 1 2

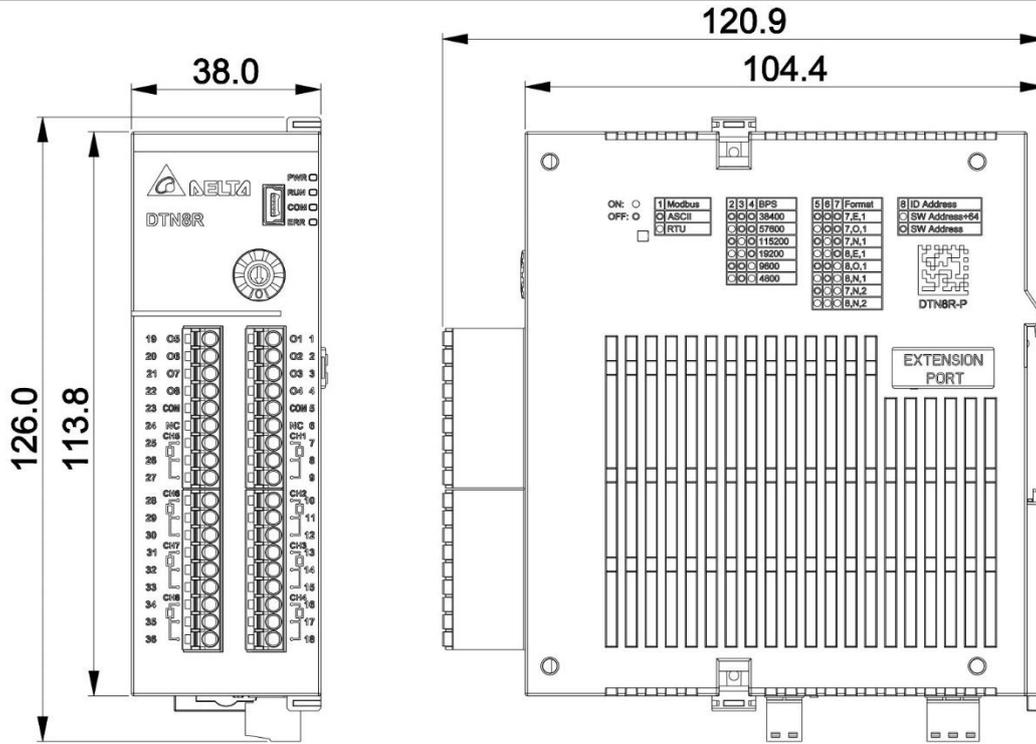
Series name	DTN: Delta DTN series temperature control accessories
1 Module type	DO = Output module EIP = Ethernet communication module
2 Optional functions	Blank = Standard products Code 1 = DO device type: R = Relay output V = DC voltage pulse output (source type)

Note:

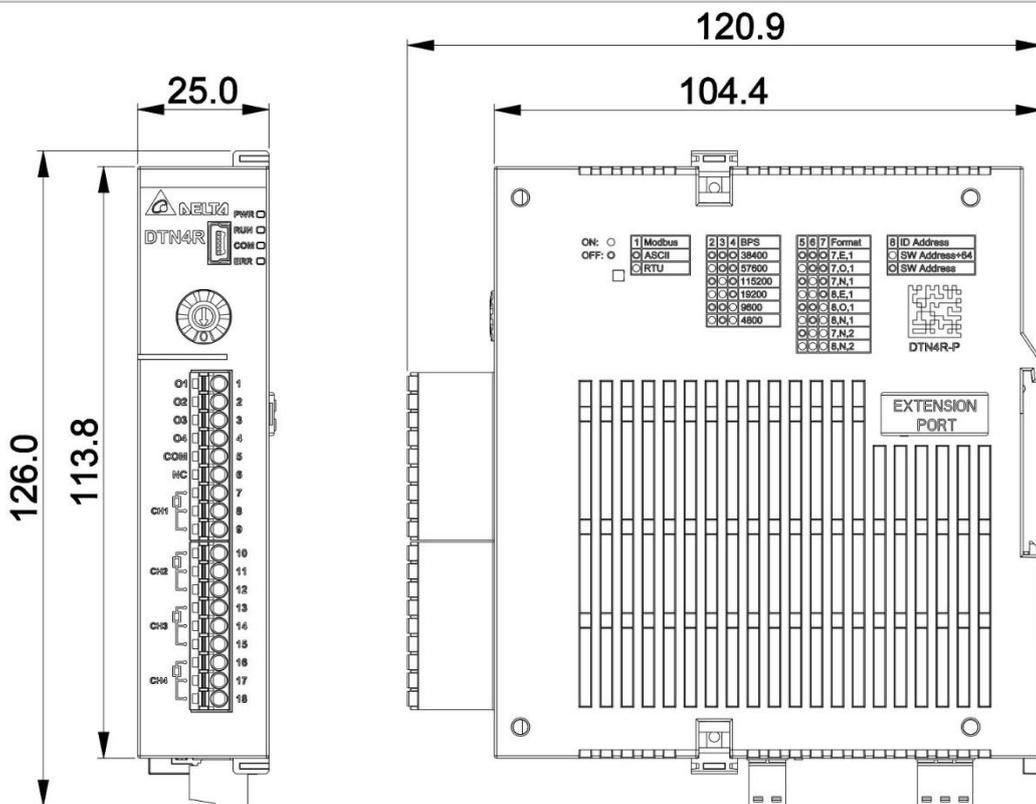
*1. The supported input sensors will vary according to the different input types. Please refer to the electrical specifications.

1.5 Product Dimensions

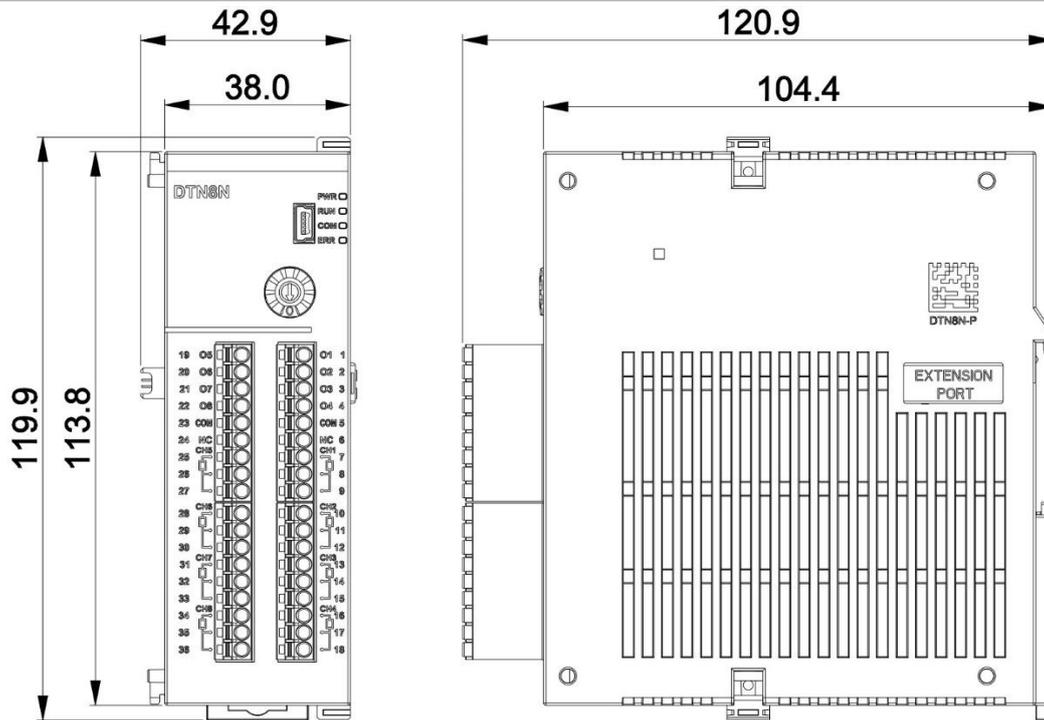
Main unit - DTN8R series (Unit: mm)



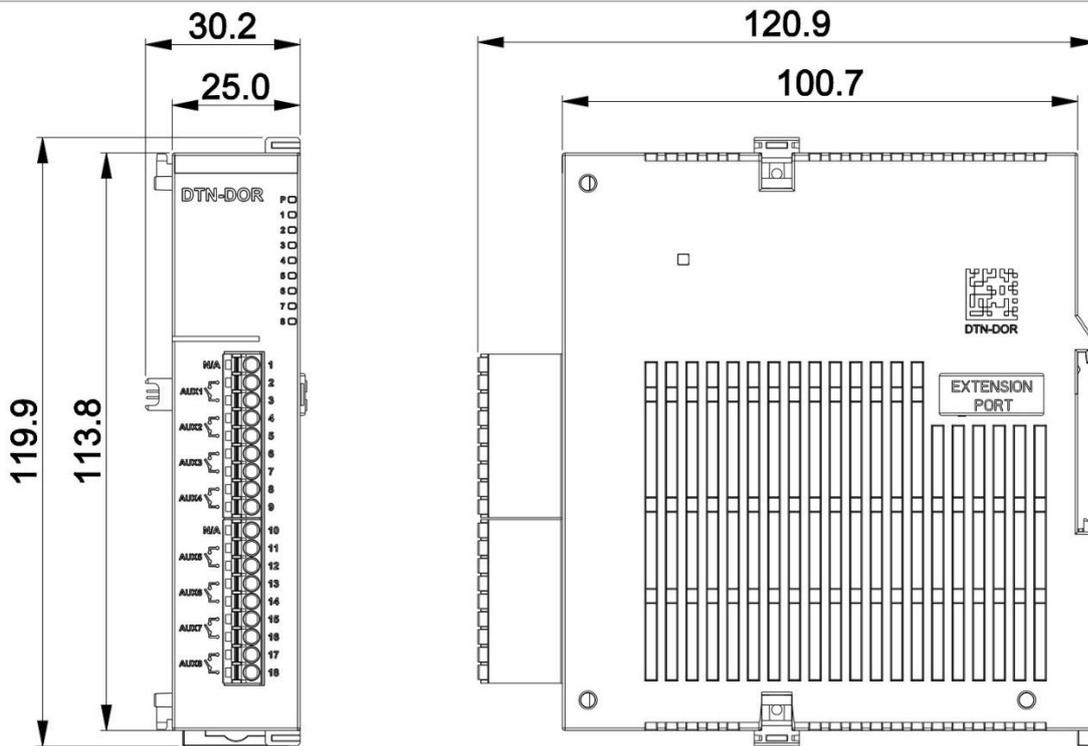
Main unit - DTN2R / DTN4R series (Unit: mm)



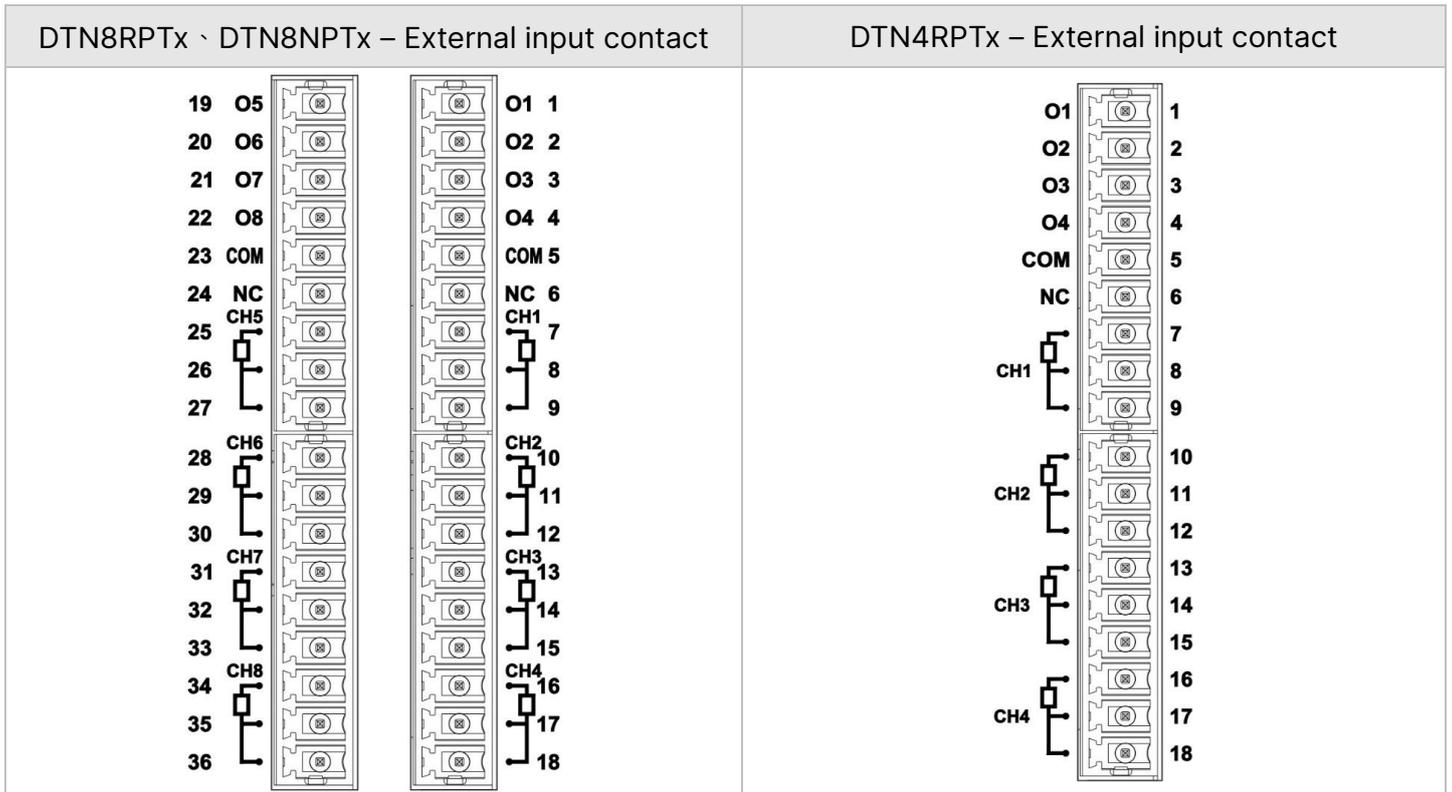
Measurement expansion unit - DTN8N series (Unit: mm)



I/O expansion unit (Unit: mm)

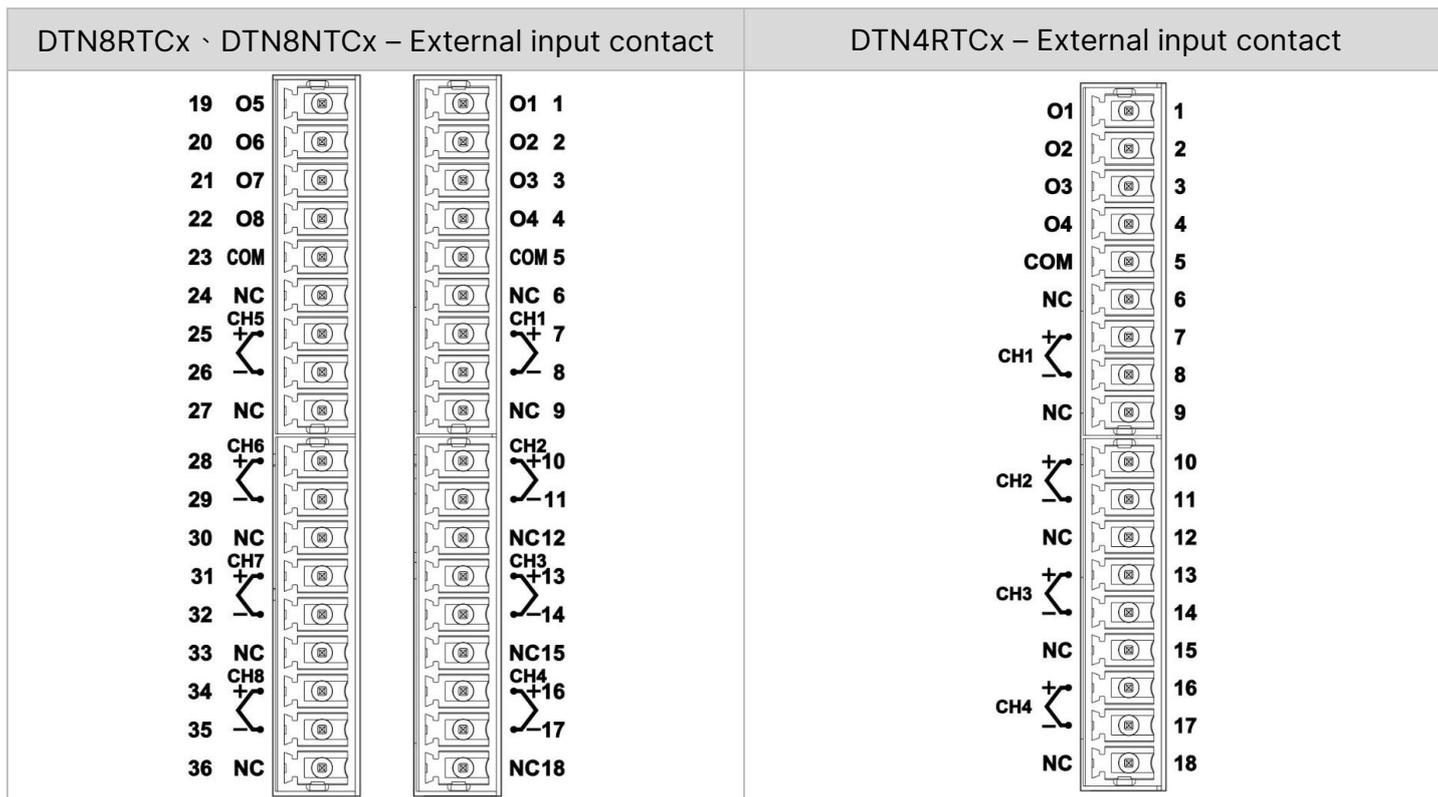


1.6 Terminal Configuration Diagram



Description		Output type		
		DC voltage pulse output, 12V Pulse	DC current output, 4~20mA	DC voltage output, 0~10V
Terminals	O1~O8	12VDC pulse positive (+)	Current output positive terminal (+)	Voltage output positive terminal (+)
	COM	0V (-)	Current output negative terminal (-)	Voltage output negative terminal (-)
Wiring diagram				

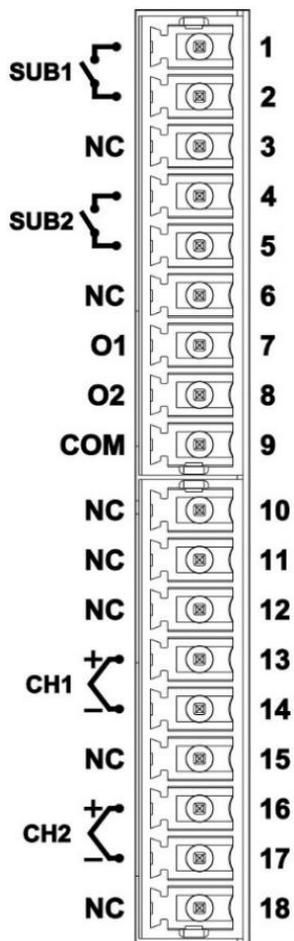
Description	Temperature sensor input: RTD
<p>Wiring diagram</p>	<p>CH1 ~ CH8</p> <p>3-wire RTD sensor</p>



Description		Output type		
		DC voltage pulse output, 12V Pulse	DC current output, 4~20mA	DC voltage output, 0~10V
Terminals	O1~O8	12VDC pulse positive (+)	Current output positive terminal (+)	Voltage output positive terminal (+)
	COM	0V (-)	Current output negative terminal (-)	Voltage output negative terminal (-)
Wiring diagram				

Description	Temperature sensor input: Thermocouple
<p style="text-align: center;">Wiring diagram</p> <div style="display: flex; align-items: center; justify-content: center;"> </div>	<p>CH1 ~ CH8</p>

DTN2RTCx – External input contact

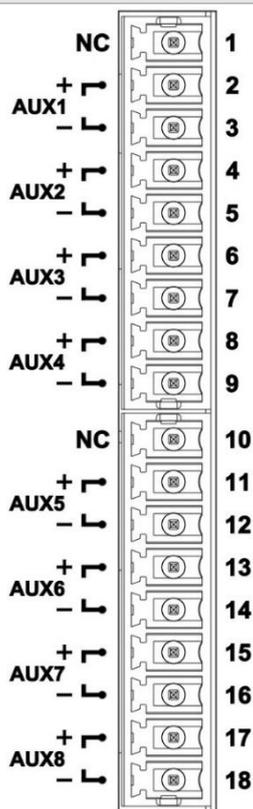


Description	Output: Relay
SUB1, SUB2 Wiring diagram	<p>SUB1, SUB2</p>

Description		Output: DC voltage output, 12V Pulse
Terminal	O1, O2	12VDC voltage pulse positive (+)
	COM	0V (-)
Wiring diagram		

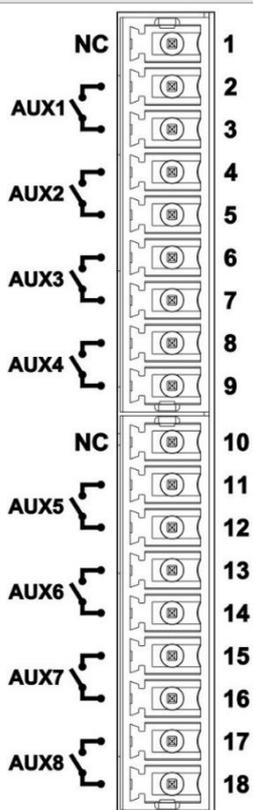
Description	Temperature sensor input: Thermocouple
Wiring diagram	<p>CH1, CH2</p>

I/O expansion DTN-DOV : DC voltage pulse output (source type)



Description		Output: DC voltage output, 12V Pulse
Terminal	AUX[1..8]+	12VDC pulse positive (+)
	AUX[1..8]-	0V (-)
AUX1~AUX8 Wiring diagram		

I/O expansion DTN-DOR : relay output



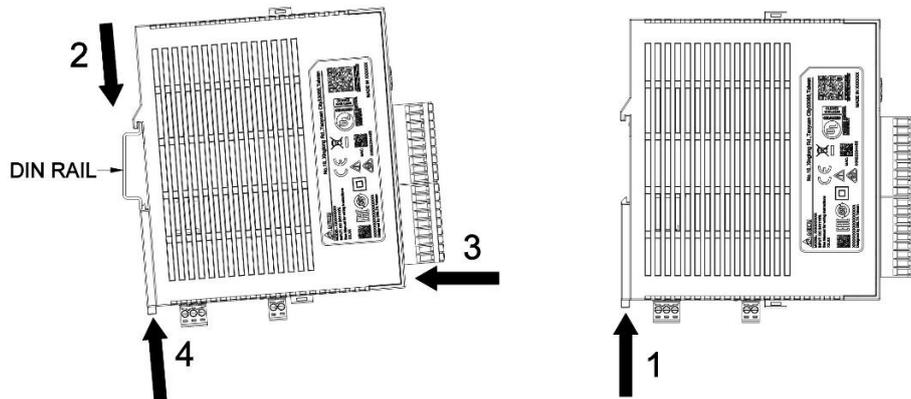
Description	Output: Relay
AUX1~AUX8 Wiring diagram	<p>SUB1, SUB2</p>

1.7 Installation Instructions

Installation and removal:

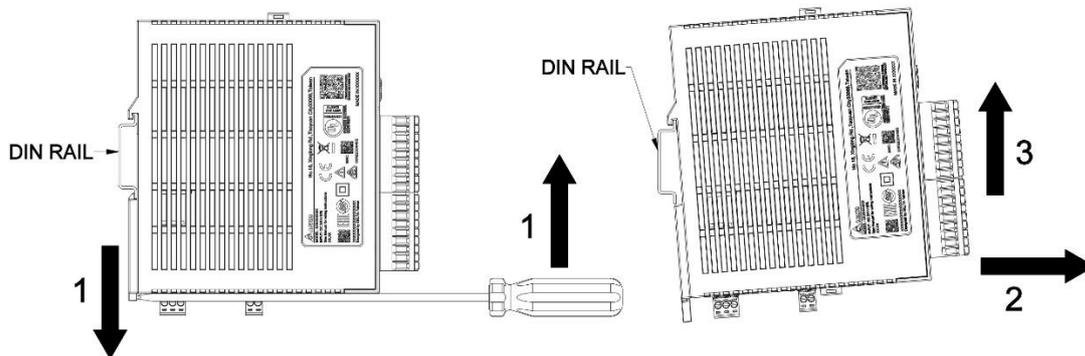
Installation

- 1) Attach with DIN RAIL fastener
- 2) Hang the DIN RAIL fastener on top of the controller diagonally on the DIN RAIL
- 3) Press down on the DIN RAIL fastener at the bottom of the controller to lock it
- 4) Ensure the DIN RAIL fastener is attached to the DIN RAIL



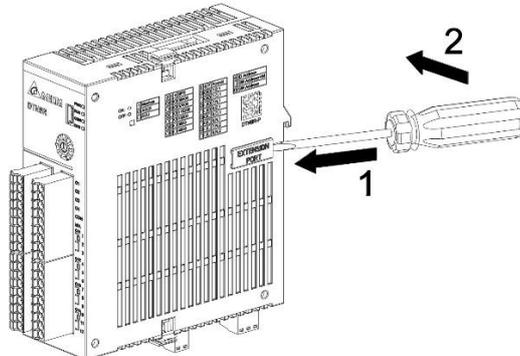
Remove the controller

- 1) Insert a flat head screwdriver into the DIN RAIL fastener's square hole. Apply pressure in the direction of the arrow to loosen the DIN RAIL fastener.
- 2) Open the controller according to Step 2.
- 3) Lift up the controller and remove.



Removal of protective cover

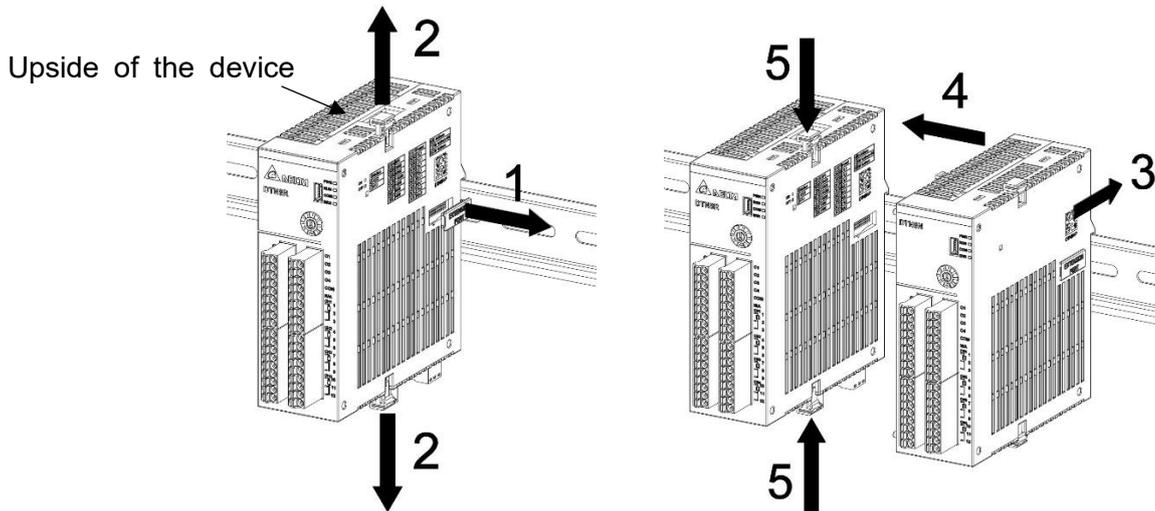
- 1) Insert a flat head screwdriver into the removal hole of the protective cover.
- 2) Apply force in the direction of the arrow to remove the protective cover.



Expansion Method:

Expansion controller

- 1) Use a flat head screwdriver to remove the expansion adapter protective cover on the master computer.
- 2) Pull the two ends of the expansion fastener apart in the directions of the arrows.
- 3) Install the controller to be expanded on the aluminum rail.
- 4) Connect the controller to be expanded with the master computer along the aluminum rail until it is completely attached to the master computer.
- 5) Attach the expansion fastener to complete the expansion.

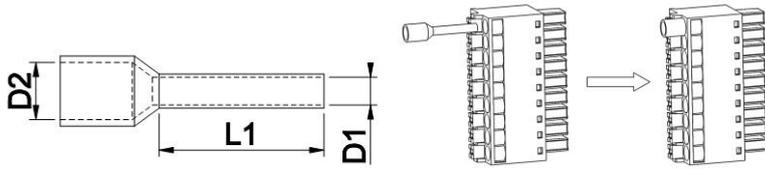


⚠ Note:

1. When adding/replacing an expansion controller, make sure power has been shut off to the system, and power up the system after installation. The products in this series do not support hot swapping. Please perform expansions only after the power has been turned off.
2. When installing the temperature controller, it should be mounted with the top facing up. Ensure there is sufficient space around it: 100mm of clearance on the top and bottom, and 100mm on the left and right sides to ensure proper heat dissipation and to facilitate the installation and removal of mounting accessories.
3. The tightening torque for the input power and RS-485 interface screws should be 2kg-cm (1.7 lb-in).
4. To avoid signal interference, make sure to route the power and load lines separately from the measurement signal lines in different cable ducts.
5. For the temperature controller input power, use 16AWG~24AWG single-core bare wire or multi-core wire with a voltage rating of 300V and a temperature rating of 60/70°C.
6. The symbol marked on the casing indicates the input power. Connecting the input power to other terminals may damage the controller, potentially causing injury or fire.
7. When crimping terminal wires (Euroblock), use dedicated crimping tools.
8. Recommended specification for terminals (Euroblock):
 - For power input/RS-485 connectors: As shown in the figure below, please use crimp terminals with an inner diameter equal to or less than 1.4mm.



- For input/output terminals: Please select crimp terminals with specifications indicated (or close to) in the figure and table below. When using, insert the crimp terminal into the input/output terminal to the deepest point, ensuring that the insulating plastic or plastic guide on the crimp terminal enters the hole of the input/output terminal and makes close contact with the hole wall to achieve a secure fit (please refer to the terminal assembly diagram below).



AWG	D1 (I.D.)	D2 (I.D.)	L1
18	1.4 mm	3.0 mm	10 mm

Chapter 2 Specifications and System Configuration

2.1 Electrical Specifications

Input power	DC24V with isolated power switch	
Operation voltage	90%–110% of rated voltage	
Power consumption (Max.)	Measurement Main Unit = 5W; Measurement Expansion Module = 5W; IO Expansion Module = 4W Maximum Number of Modules = [Measurement Main Unit + IO Expansion Module] * 1 + [Measurement Expansion Unit + IO Expansion Module] * 7 = (5 + 4)W * 1 + (5 + 4)W * 7 = 72W	
Installation method of the machine	The measurement expansion module and I/O expansion module cannot be powered independently. The main unit is the power source. The measurement expansion module should be installed on the main unit or the right side of other measurement expansion modules. It cannot be installed consecutively. Up to 7 modules can be installed only. The I/O expansion module should be installed on the main unit or the right side of other measurement expansion modules. It cannot be installed consecutively. Up to 8 modules can be installed only. Maximum number of modules = [Main measurement unit + IO expansion module]*1 + [Measurement expansion + IO expansion module]*7	
Input sensor support	Input type = DTNxxTCx Thermocouple pair: K, J, T, E, N, R, S, B, L, U, TXK, C, D	
	Input type = DTNxxPTx Platinum measurement resistance: Pt100, JPt100, Ni120, Cu50	
Sampling period	DTN2RTC model: 0.4 seconds; Other models: 1 second	
Control mode	PID, ON/OFF	
Output accessory types	Main measurement unit Measurement expansion module	Voltage pulse output: DC 12V±10%, maximum output current of 20mA
		Analog current output: DC 4–20mA output (load resistance must be less than 500 ohms)
		Analog voltage output: DC 0–10V (load resistance must be greater than 1000 ohms)
	I/O expansion module	Relay output: Single pole single throw switch, maximum load of AC 250, 2A resistive load Voltage pulse output: DC 12V±10%, maximum output current of 20mA
Output functions (optional)	Optional control output, alarm output, or retransmission output	
Alarm function (optional)	8 alarm modes to choose from.	
Communications functions	RS-485 communication supports 4,800bps to 115,200bps transmission speeds.	
Communication protocol	Employs the Modbus communications protocol and supports RTU/ASCII communications format	
Internal connection functions	Provides internal connection terminals; 24V power and communications signal are provided via the terminals.	

Chapter 2 Specifications and System Configuration

Vibration resistance	10–55Hz @ 10 m/s ² in 3-axis for 10 min
Shock resistance	Max 300m/s ² in 3-axis and 6-orientation for 3-repetition
Operating temperature	0°C–+50°C
Storage temperature	-20°C–+65°C
Operating altitude	Lower than 2,000 m
Operating humidity	35% to 85% RH (no dew)
Pollution level	2

2.2 Temperature Sensor Type and Temperature Range

The supported sensor types are as follows

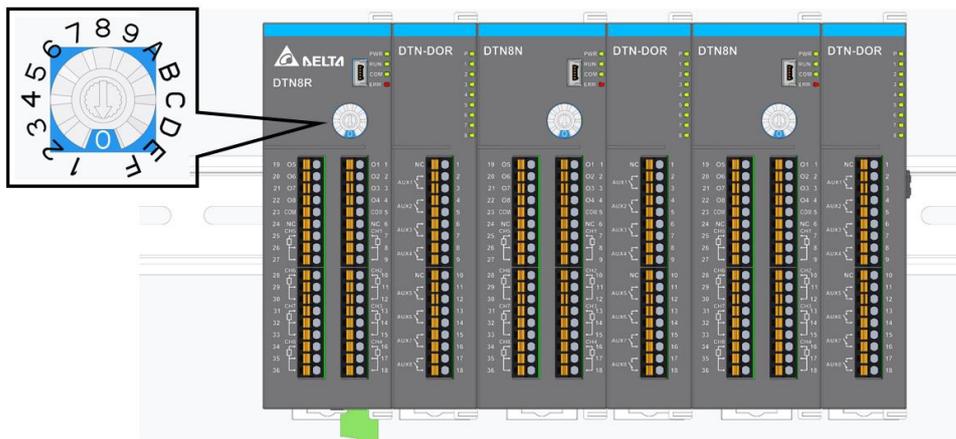
Input sensor type	Communications register value	Ranges
DTNxxPTx		
Measurement resistance (Cu50)	14	-50 ~ 150°C
Resistance temperature sensor (Ni120)	13	-80 ~ 300°C
Platinum measurement resistance (Pt100)	12	-200 ~ 850°C
Platinum measurement resistance (JPt100)	11	-20 ~ 400°C
DTNxxTCx		
Thermocouple D type	16	0 ~ 2,300°C
Thermocouple C type	15	0 ~ 2,300°C
Thermocouple TXK type	10	-150 ~ 800°C
Thermocouple U type	9	-200 ~ 500°C
Thermocouple L type	8	-200 ~ 850°C
Thermocouple B type	7	100 ~ 1,800°C
Thermocouple S type	6	0 ~ 1,700°C
Thermocouple R type	5	0 ~ 1,700°C
Thermocouple N type	4	-200 ~ 1,300°C
Thermocouple E type	3	0 ~ 600°C
Thermocouple T type	2	-200 ~ 400°C
Thermocouple J type	1	-100 ~ 1,200°C
Thermocouple K type	0	-200 ~ 1,300°C

Note: When the C-type and D-type input sensor is switched to Fahrenheit temperature units, the upper limit of the display range is 3270°F.

2.3 Measurement Accuracy

Temperature display precision	Thermocouple: $\pm (0.3\% \text{ FS}, +1^{\circ}\text{C})$
	Platinum measurement resistance: $\pm (0.2\% \text{ FS}, +1^{\circ}\text{C})$

2.4 Station Number Setting



Set the RS-485 ID address by using the front station ID selector button of the DTN measurement module. The settings range is 0 to F. The default value of the main measurement unit is 1, and the default value of the measurement expansion module is 2.

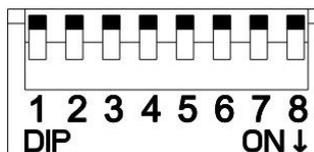
With the external switch Bit8 on top of the DTN main measurement unit, the user can choose whether to offset the station ID by 64.

Knob location	Communications protocol settings switch Bit8	Corresponding node number
0~F	OFF (station ID offset 0)	1–16, Dial 0 = station ID 16
0~F	ON (station ID offset 64)	65–80, Dial 0 = station ID 80

2.5 RS485 Communication Protocol Settings

The RS-485 communication protocol can be configured with the external switch on top of the DTN main measurement unit to set the DTN communication protocol of the same group. All default values are OFF. Communication format: 38400, 7, E, 1, station ID offset 0.

Bit 1	Communication format
OFF	ASCII (default value)
ON	RTU



Bit 2	Bit 3	Bit 4	Communication Speed(bps)
OFF	OFF	OFF	38400 (default value)
ON	OFF	OFF	57600
OFF	ON	OFF	115200

Chapter 2 Specifications and System Configuration

ON	ON	OFF	19200
OFF	OFF	ON	9600
ON	OFF	ON	4800

Bit 5	Bit 6	Bit 7	Communication Protocol Format
OFF	OFF	OFF	7,E,1 (default value)
ON	OFF	OFF	7,O,1
OFF	ON	OFF	7,N,1
ON	ON	OFF	8,E,1
OFF	OFF	ON	8,O,1
ON	OFF	ON	8,N,1
OFF	ON	ON	7,N,2
ON	ON	ON	8,N,2

Bit 8	Station ID offset
OFF	Station ID offset 0
ON	Station ID offset 64

2.6 Expansion Module Installation Method

When installing the DTN series expansion modules, the power is provided by the leftmost main measurement unit and is supplied internally for use.

- Measurement expansion module (optional):

This module provides 8 sets of measurement inputs and 8 sets of output functions. During installation, align the connecting terminals on the left side with the measurement host or measurement expansion module for expansion. You can expand up to 7 measurement expansion modules consecutively. Please cover the rightmost expansion module with a protective cover to avoid any accidental contact with the metal terminals. DTN TC and DTN PT models cannot be used together. When the main unit is a TC model, the expansion units must also be TC models; when the main unit is a PT model, the expansion units must be PT models.

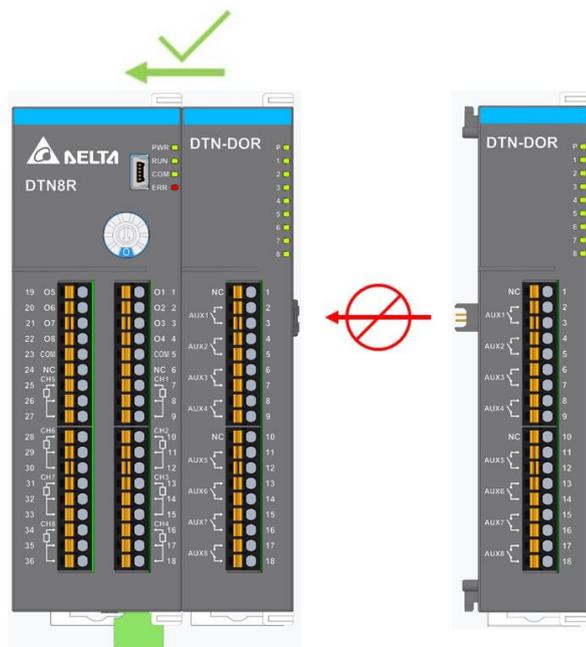
- I/O expansion module (optional):

This module provides 8 sets of auxiliary output functions. During installation, align the connecting terminals on the left side with the measurement host or measurement expansion module for expansion. The number of I/O expansion modules to be installed depends on the total number of measurement hosts and measurement expansion modules combined. When using the maximum number of modules, there will be a total of 8 I/O expansion modules. Please cover the rightmost expansion module with a protective cover to avoid any accidental contact with the metal terminals.

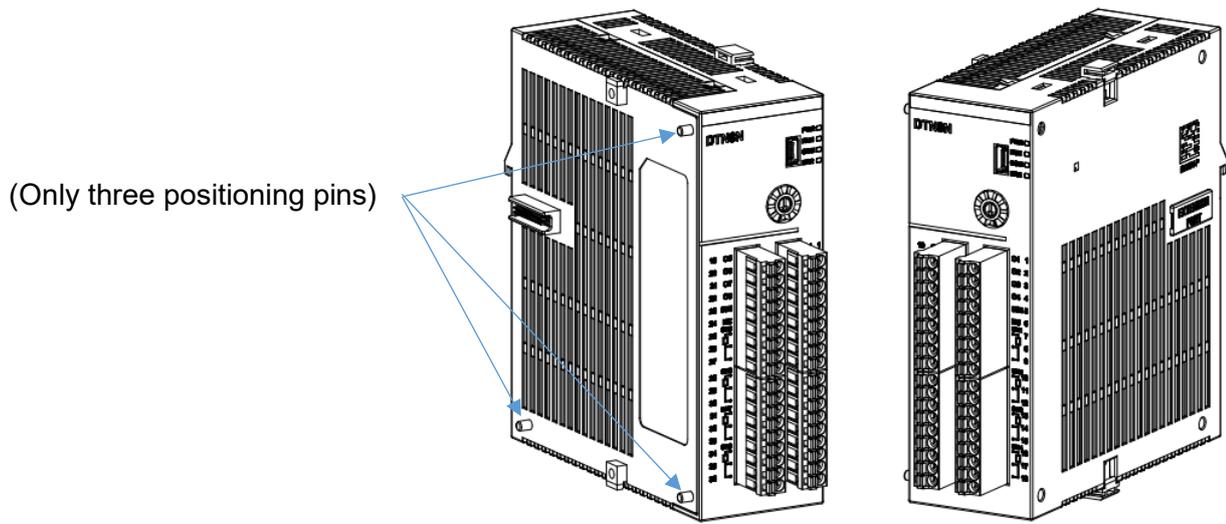
Only one I/O expansion module can be connected to the right side of each measurement unit (it is also acceptable not to connect any I/O expansion module). Connecting more than one I/O expansion module simultaneously is not allowed (the mechanical structure is designed to prevent incorrect installation).

Example of correct installation:

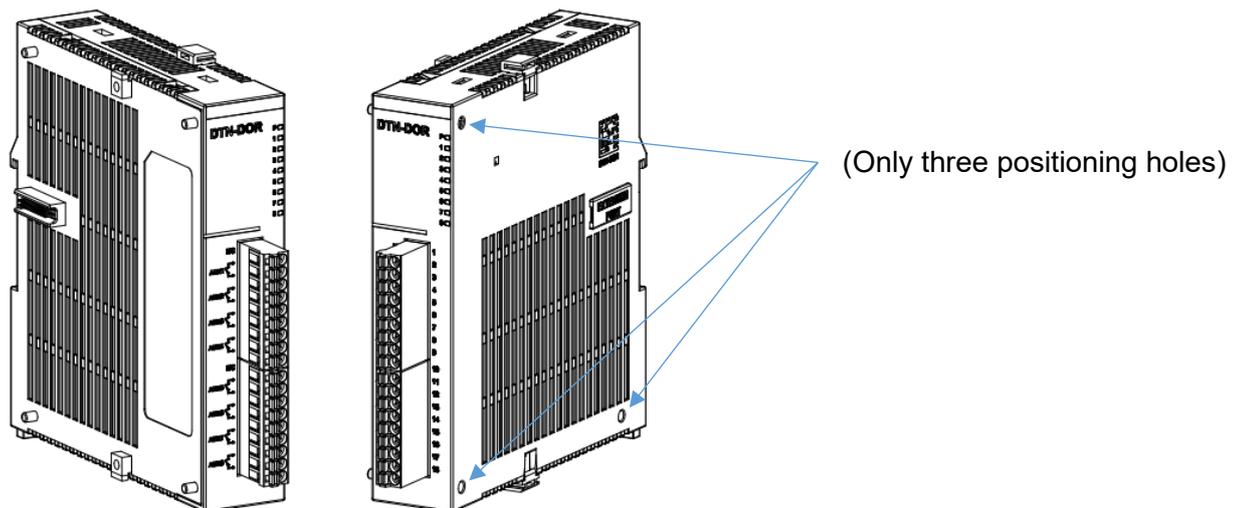
[Measurement Main Unit + I/O Expansion Module] + [Measurement Expansion Module + I/O Expansion Module] + [Measurement Expansion Module + I/O Expansion Module] + Measurement Expansion Module + Measurement Expansion Module...



Installation error-proofing mechanism for the measurement expansion unit:



Installation error-proofing mechanism for the I/O expansion unit:



2.7 Initial Power On State

After powering on the DTN, the main measurement unit will automatically broadcast communication protocols via the internal communication bus according to the external switch settings. This process takes approximately 4 seconds. In this state, the external communication interfaces are unable to communicate.

2.7.1 LED Display Status

	PWR(Power)	Power light (green light) → power light [on steadily], indicates that the device is powered up.
	RUN (output Run)	Control light (green light) → control light [on steadily], indicates that control is effective through any one channel.
	COM (Communication)	Communications light (green light) → communications light [flashing], indicates that the system is communicating.
	ERR (Error)	Error indicator light (red light) → When the error indicator light is [on steadily], the possible statuses are as follows When the error indicator light is on, the error message can be read at 202AH.

202AH bit definition	Error message content (ON = error)	202AH bit definition	Error message content (ON = error)
b0	CH1 input error	b5	CH6 input error
b1	CH2 input error	b6	CH7 input error
b2	CH3 input error	b7	CH8 input error
b3	CH4 input error	b8	RS-485 error
b4	CH5 input error	b9	Internal communications error

2.8 Definitions of Commonly Used Terms

Abbreviation	Definitions (English)
PV	Present Value
SV	Setpoint Value
OUT	Output
ALM	Alarm
ALM-H	Alarm High
ALM-L	Alarm Low
TC	Thermocouple
RTD	Resistance Temperature Detector

2.9 Restoring Default Settings

The DTN's default setting values can be restored using the following steps:

Write the content of [1234H] to address [472AH], and write the content of [1357H] to address [474EH], turn off power, and turn on power again.

Chapter 3 Input Function Configuration

3.1 Input Functions

The input sensors supported by the DTN series will vary according to the different input types. These are divided into the thermocouple TC model and resistance temperature detector PT model.

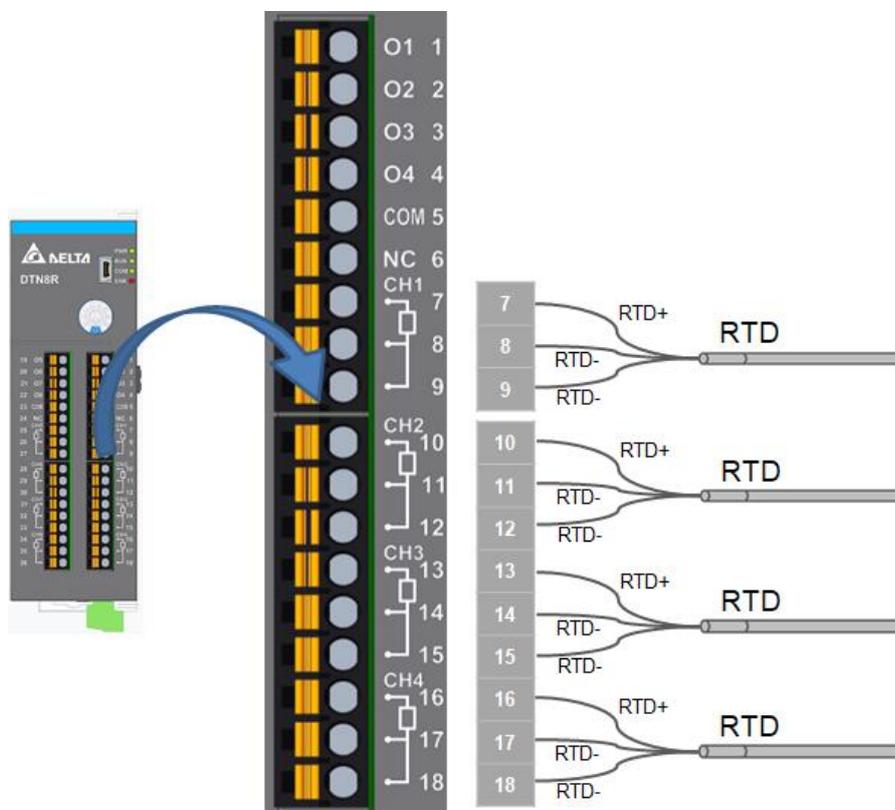
3.1.1 Hardware Configuration

According to the numbering on the front of the measurement module, the corresponding hardware configurations are as follows (blank spaces indicate N/A):

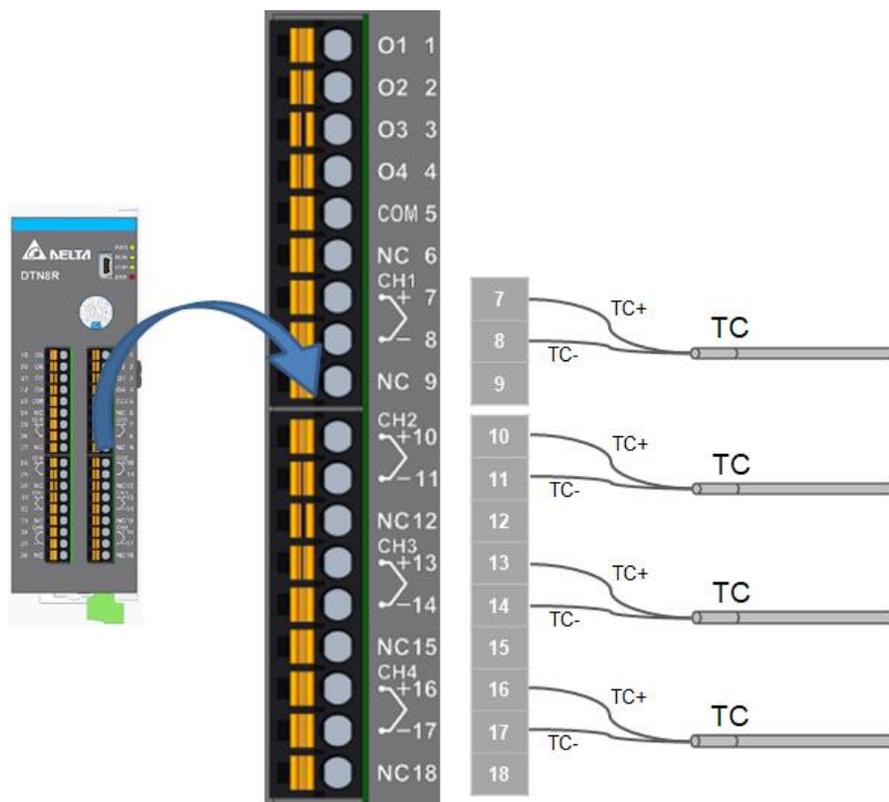
No.	Main measurement unit					Measurement expansion module	
	DTN2RTCx	DTN4RTCx	DTN4RPTx	DTN8RTCx	DTN8RPTx	DTN8NTCx	DTN8NPTx
1	SUB1 NO	CH1 Output +	CH1 Output +				
2	SUB1 COM	CH2 Output +	CH2 Output +				
3		CH3 Output +	CH3 Output +				
4	SUB2 NO	CH4 Output +	CH4 Output +				
5	SUB2 COM	Common Ground	Common Ground				
6							
7	CH1 Output +	CH1 TC+	CH1 RTD+	CH1 TC+	CH1 RTD+	CH1 TC+	CH1 RTD+
8	CH2 Output +	CH1 TC-	CH1 RTD-	CH1 TC-	CH1 RTD-	CH1 TC-	CH1 RTD-
9	Common Ground		CH1 RTD-		CH1 RTD-		CH1 RTD-
10		CH2 TC+	CH2 RTD+	CH2 TC+	CH2 RTD+	CH2 TC+	CH2 RTD+
11		CH2 TC-	CH2 RTD-	CH2 TC-	CH2 RTD-	CH2 TC-	CH2 RTD-
12			CH2 RTD-		CH2 RTD-		CH2 RTD-
13	CH1 TC+	CH3 TC+	CH3 RTD+	CH3 TC+	CH3 RTD+	CH3 TC+	CH3 RTD+
14	CH1 TC-	CH3 TC-	CH3 RTD-	CH3 TC-	CH3 RTD-	CH3 TC-	CH3 RTD-
15			CH3 RTD-		CH3 RTD-		CH3 RTD-
16	CH2 TC+	CH4 TC+	CH4 RTD+	CH4 TC+	CH4 RTD+	CH4 TC+	CH4 RTD+
17	CH2 TC-	CH4 TC-	CH4 RTD-	CH4 TC-	CH4 RTD-	CH4 TC-	CH4 RTD-
18			CH4 RTD-		CH4 RTD-		CH4 RTD-
19				CH5 Output +	CH5 Output +	CH5 Output +	CH5 Output +
20				CH6 Output +	CH6 Output +	CH6 Output +	CH6 Output +
21				CH7 Output +	CH7 Output +	CH7 Output +	CH7 Output +
22				CH8 Output +	CH8 Output +	CH8 Output +	CH8 Output +

23				Common Ground	Common Ground	Common Ground	Common Ground
24							
25				CH5 TC+	CH5 RTD+	CH5 TC+	CH5 RTD+
26				CH5 TC-	CH5 RTD-	CH5 TC-	CH5 RTD-
27					CH5 RTD-		CH5 RTD-
28				CH6 TC+	CH6 RTD+	CH6 TC+	CH6 RTD+
29				CH6 TC-	CH6 RTD-	CH6 TC-	CH6 RTD-
30					CH6 RTD-		CH6 RTD-
31				CH7 TC+	CH7 RTD+	CH7 TC+	CH7 RTD+
32				CH7 TC-	CH7 RTD-	CH7 TC-	CH7 RTD-
33					CH7 RTD-		CH7 RTD-
34				CH8 TC+	CH8 RTD+	CH8 TC+	CH8 RTD+
35				CH8 TC-	CH8 RTD-	CH8 TC-	CH8 RTD-
36					CH8 RTD-		CH8 RTD-

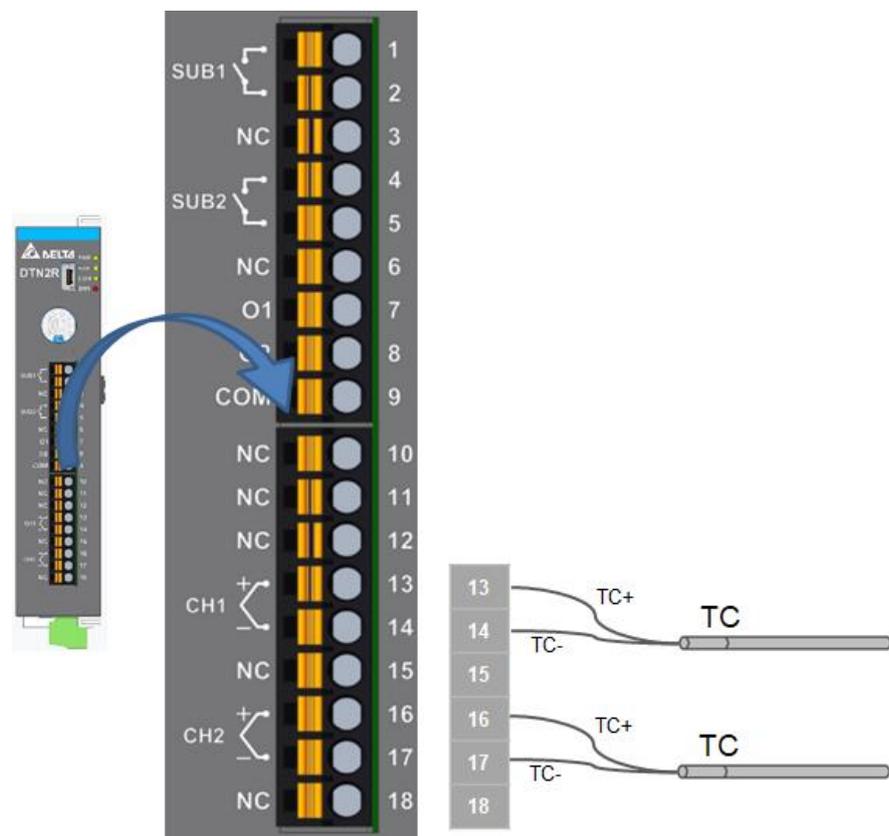
Example 1: Taking DTN8RPTx as an example, connect the three-wire resistance temperature detector to each input channel CH1 to CH4. The installation is as shown in the following diagram. CH5 to CH8 should be connected in the same manner.



Example 2: Taking DTN8RTCx as an example, connect the thermocouple to each input channel CH1 to CH4. The installation is as shown in the following diagram. CH5 to CH8 should be connected in the same manner.



Example 3: Taking DTN2RTCV as an example, connect the thermocouple to each input channel CH1 to CH2. The installation is as shown in the following diagram.



Note:

1. The input terminals of the DTNxxPTx models are designed for three-wire resistance temperature detectors (RTDs). If two-wire or four-wire configurations are required, please refer to the following settings:
 - 1.1 Two-wire connection method: Connect the RTD+ terminal of the resistance temperature detector to the CHx RTD+ designated position. Then connect the RTD- terminal to any available position of the CHx RTD-. Next, short-circuit the two ends of the CHx RTD- within the same input channel. Under ideal conditions, this short-circuited line should be equivalent to (or approximate to) the wire configuration of the RTD- of the temperature sensor in order to achieve circuit compensation.
 - 1.2 "x" in sections 1.1 and 1.2 refer to the input sensor channel number.

3.1.2 Input Type, and Related Settings

According to the selected input type, configure the settings by writing the corresponding configuration values to the communication address of each input channel, as listed in the following table

TC device type setting range: 0–10 · 15 · 16. The default value is 0. RTD device type setting range: 11–14. The default value is 12.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Input sensor type	1100H	1101H	1102H	1103H	1104H	1105H	1106H	1107H

Setting value	Input sensor type	Input sensor range (default value)
DTNxxTCx		
0	Thermocouple K type	-200 ~ 1,300°C
1	Thermocouple J type	-100 ~ 1,200°C
2	Thermocouple T type	-200 ~ 400°C
3	Thermocouple E type	0 ~ 600°C
4	Thermocouple N type	-200 ~ 1,300°C
5	Thermocouple R type	0 ~ 1,700°C
6	Thermocouple S type	0 ~ 1,700°C
7	Thermocouple B type	100 ~ 1,800°C
8	Thermocouple L type	-200 ~ 850°C
9	Thermocouple U type	-200 ~ 500°C
10	Thermocouple TXK type	-150 ~ 800°C
15	Thermocouple C type	0 ~ 2,300°C
16	Thermocouple D type	0 ~ 2,300°C
DTNxxPTx		
11	Platinum measurement resistance (JPt100)	-20 ~ 400°C
12	Platinum measurement resistance (Pt100)	-200 ~ 850°C
13	Resistance temperature sensor (Ni120)	-80 ~ 300°C
14	Resistance temperature sensor (Cu50)	-50 ~ 150°C

Note1: The default value for DTNxxTCx is K type [0000H]. The default value for DTNxxPTx is PT100 [000CH].

Note2: When the C-type and D-type input sensor are switched to Fahrenheit temperature units, the upper limit of the display range is 3270°F.

3.1.3 Setpoint Value

SV value (read): Makes settings in accordance with the target temperature; the SV may not go beyond the upper or lower limit of the SV configured values

Upper limit of SV configured value: Depending on the input sensor type and range, set the sensors' upper limits; the setting may not exceed the upper limit of the input range. The default value for TC models is 13000. The default value for RTD models is 8500. The unit is 0.1°C or 0.1°F.

Lower limit of SV configured value: Depending on the input sensor type and range, set the sensors' lower limits; the setting may not exceed the lower limit of the input range. The default value for TC and RTD models is -2000. The unit is 0.1°C or 0.1°F.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
SV value (read)	1008H	1009H	100AH	100BH	100CH	100DH	100EH	100FH
Upper limit of SV configured value	1108H	1109H	110AH	110BH	110CH	110DH	110EH	110FH
Lower limit of SV configured value	1110H	1111H	1112H	1113H	1114H	1115H	1116H	1117H

3.1.4 Read Present Value

PV value: Reads the measurement value or error message from each channel

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
PV value	1000H	1001H	1002H	1003H	1004H	1005H	1006H	1007H

Communications content	Description of error message content
8001H	Initializing
8002H	Input sensor not connected
8005H	Measured temperature exceeds specifications
8006H	Channel disabled

3.2 Temperature Filter and Input Temperature Deviation Setting

3.2.1 Temperature Filter Setting

Because the input signal may be subject to interference from noise, causing the displayed value to be unstable, this device provides a temperature filter function, which has two parameters that users can set. One is the temperature filter factor, which has a setting range of 0-50, where 0 is no filter; the default value is 2. The greater this value, the stronger the filtering effect; and the slower the displayed input value will appear. The other parameter is the temperature filter range, which has a setting range of 1-990, with units consisting of 0.1°C; the default value is 10 (1.0°C), which indicates that input signal noise within 1.0°C will activate the filter. The setting range can be increased when the fluctuations in input noise are large. Adjustments are explained as follows:

- a. Setting the temperature filter factor: Adjustment range: 0-50
 The calculation formula is: $\text{Displayed value} = (\text{previous displayed value} * n + \text{current present value}) / (n+1)$
- b. Temperature filter range setting: Adjustment range: 1-990, units: 0.1°C

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Temperature filter factor	1118H	1119H	111AH	111BH	111CH	111DH	111EH	111FH
Temperature filter range	1120H	1121H	1122H	1123H	1124H	1125H	1126H	1127H

3.2.2 Input Temperature Deviation Setting

Temperature control applications may encounter the problem of controlling for temperature difference when the temperature at the measurement location and at the sensor location are different. This device meets customers' needs by providing users with the ability to set an input error offset value and gain value. Adjustments are explained as follows:

- a. Input error offset: Setting range: -999-9999, units: 0.1°C
 The calculation formula is: $\text{Displayed value} = \text{measured value} + (\text{input error offset value}/10)$
 Example: The measured value is 25.0°C, the input error offset value is 12, and the displayed value is 26.2°C.
- b. Input error gain: Setting range: -999-1999, units: 0.001 increments
 The calculation formula is: $\text{Displayed value} = \text{measured value} * (1 + \text{input error gain value} / 1000) + \text{input error offset value}$
 Example: The measured value is 25.0°C, input error gain value is 100, and the displayed value is $25.0 * (1 + 100 / 1000) + 0 = 27.5^\circ\text{C}$.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Temperature error offset	1128H	1129H	112AH	112BH	112CH	112DH	112EH	112FH
Temperature error gain	1130H	1131H	1132H	1133H	1134H	1135H	1136H	1137H

Therefore, at different temperatures, the input error offset value can be set directly. When the amounts of error are different, it is necessary to first calculate the linearity of the error, and then perform the adjustment using the input error offset value + input error gain value.

3.3 Other Input Function Settings

3.3.1 Channel Disabled

The main DTN measurement unit or measurement expansion modules may disable unused input channels, which will ensure that the error indicator light does not come on when unused channels have empty contacts. Default value 0 (0 = channel enabled; 1 = channel disabled)

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Channel disabled	2021H (bit0)	2021H (bit1)	2021H (bit2)	2021H (bit3)	2021H (bit4)	2021H (bit5)	2021H (bit6)	2021H (bit7)

3.3.2 Temperature Units

Input channel temperature units may be either °C or °F. The default is Celcius.

Default value 1 (0 = Celsius; 1 = Fahrenheit)

Temperature units	2020H
-------------------	-------

3.3.3 Cold Junction Compensation Selection

When using thermocouple sensors, internal or external cold junction compensation can be selected.

Default value 0 (0 = internal cold junction; 1 = external cold junction).

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Cold junction compensation selection	1138H	1139H	113AH	113BH	113CH	113DH	113EH	113FH

3.3.4 Input Channel Status

Reads the status of other functions of the main measurement unit or measurement expansion module input channels; for example, output of 1 indicates whether the function is on and whether the function is performing auto-tuning.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Input channel status	1040H	1041H	1042H	1043H	1044H	1045H	1046H	1047H

	Corresponding functions (On = 1; Off = 0)
Bit0	Alarm 3
Bit1	Alarm 2
Bit2	°C
Bit3	°F
Bit4	Alarm 1
Bit5	Reserved
Bit6	Output 1
Bit7	AT auto-tuning

Chapter 4 Output and Alarm Function Configuration

4.1 Output Functions

The DTN modular temperature controller series has two physical output types: control output and alarm output. Each channel can provide up to 1 control output and 3 alarm outputs.

The measurement module can only be used for control output. By using an output module in conjunction, it is possible to extend the control output or have a physical output for up to three alarms.

- The I/O expansion module, DTN-DOV(R), features 8 AUX output points that can be freely configured and utilized as needed.

EX1: All 8 AUX output points are configured as control outputs for CH1, enabling one-to-many control.

EX2: The AUX1 to AUX4 output points are configured as control output + 3 alarms for CH1. The AUX5 to AUX8 output points are configured as control output + 3 alarms for CH2.

Output functions	Output interface	Functional description	Output types
Control outputs	Measurement module	Set output as heating or cooling.	Voltage pulse output: DC 12V±10% Analog current output: 4–20mA Analog voltage output: DC 0–10V
	DTN-DOV DTN-DOR	The I/O expansion module can also be configured as the control output. The output actions will be synchronized with the measurement module.	Voltage pulse output: DC 12V±10% Relay output: Single pole single throw switch AC250 2A
Alarm outputs	DTN-DOR	Only I/O expansion modules can be used Up to 8 alarm modes can be independently set. Please refer to Chapter 4.2 Alarm settings	Relay output: Single pole single throw switch AC250 2A

4.1.1 Output Hardware Configuration

According to the numbering on the front of the measurement module, the hardware configurations for the output are as follows (blank spaces indicate N/A):

No.	Measurement main unit					Measurement expansion module	
	DTN2RTCx	DTN4RTCx	DTN4RPTx	DTN8RTCx	DTN8RPTx	DTN8NTCx	DTN8NPTx
1	SUB 1 NO	CH1 Output +	CH1 Output +				
2	SUB 1 COM	CH2 Output +	CH2 Output +				
3		CH3 Output +	CH3 Output +				
4	SUB 2 NO	CH4 Output +	CH4 Output +				

Chapter 4 Output and Alarm Function Configuration

5	SUB 2 COM	Common Ground					
...	...						
7	CH1 Output +	Input	Input	Input	Input	Input	Input
8	CH2 Output +	Input	Input	Input	Input	Input	Input
9	Common Ground		Input		Input		Input
...	...						
19				CH5 Output +	CH5 Output +	CH5 Output +	CH5 Output +
20				CH6 Output +	CH6 Output +	CH6 Output +	CH6 Output +
21				CH7 Output +	CH7 Output +	CH7 Output +	CH7 Output +
22				CH8 Output +	CH8 Output +	CH8 Output +	CH8 Output +
23				Common Ground	Common Ground	Common Ground	Common Ground
...	...						

According to the numbering on the front of the I/O expansion module, the corresponding hardware configurations are as follows (blank spaces indicate N/A):

No.	I/O expansion module	
	DTN-DOV	DTN-DOR
1		
2	AUX1 +	AUX1 NO
3	AUX1 -	AUX1 COM
4	AUX2 +	AUX2 NO
5	AUX2 -	AUX2 COM
6	AUX3 +	AUX3 NO
7	AUX3 -	AUX3 COM
8	AUX4 +	AUX4 NO
9	AUX4 -	AUX4 COM
10		
11	AUX5 +	AUX5 NO
12	AUX5 -	AUX5 COM
13	AUX6 +	AUX6 NO
14	AUX6 -	AUX6 COM
15	AUX7 +	AUX7 NO
16	AUX7 -	AUX7 COM
17	AUX 8 +	AUX8 NO
18	AUX 8 -	AUX8 COM

Notes:

1. "SUB" stands for sub-output in the table above.
2. Refer to Chapter 3.1.1 for information on "For Input" in the table above.
3. "AUX" = Auxiliary Output in the table above.
4. "NO" = Normal Open in the table above.
5. "COM" = Common in the table above.

4.1.2 Output Functions Settings

The DTN measurement module itself has built-in output functionality, where output channels 1 to 8 correspond to input channels 1 to 8. A brief description of each function setting is as follows:

- a. Assignment of Output 1 functions: Setting value 0 = MV, 1 = proportional output (limited to analog output C and L models)
- b. Heating/cooling control cycle for Output 1: Setting range: 4–600, unit: 0.1 seconds, default value: 40
- c. Upper limit of control output 1: Configures output upper limit, setting range: 0–1000, default value: 1000, unit: 0.1%
- d. Lower limit of control output 1: Configures output lower limit, setting range: 0–1000, default value: 0, unit: 0.1%

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Output 1 Function distribution	1200H	1201H	1202H	1203H	1204H	1205H	1206H	1207H
Output 1 Control cycle	1208H	1209H	120AH	120BH	120CH	120DH	120EH	120FH
Output 1 Upper limit settings	1210H	1211H	1212H	1213H	1214H	1215H	1216H	1217H
Output 1 Lower limit settings	1218H	1219H	121AH	121BH	121CH	121DH	121EH	121FH

4.1.3 Auxiliary Output Functions Settings

The DTN measurement module can be combined with the auxiliary output module DTN-DOV(R) for output expansion. During installation, it is necessary to connect the auxiliary output module DTN-DOV(R) to the right side of the measurement module. The output signals of the auxiliary output module are controlled solely by the measurement module on the left side in close proximity.

The output functions of AUX1 to AUX8 can be configured using the " Assignment of auxiliary output sources" and " Assignment of auxiliary output functions". A brief description of the settings is as follows:

- a. Assignment of auxiliary output sources: Set the source channel for controlling this auxiliary output point. The configured values range from 0 to 7, corresponding to input channels 1 to 8.
- b. Assignment of auxiliary output functions: Configured value 0 = disabled, 1 = MV, 2=MV2, 3 = Alarm 1, 4 = Alarm 2, 5 = Alarm 3, default value: 0
- c. Auxiliary output control cycle: When the output function distribution setting is 1=MV or 2=MV2 (as an extension of the control output), the DTN-DOV setting range: 4–600, DTN-DOR setting range: 50–600, default value: 200, unit: 0.1 seconds.
- d. Upper limit of auxiliary output: When the output function distribution setting is 1=MV or 2=MV2 (as an extension of the control output), it configures the output upper limit, setting range: 1–1000, default value: 1000, unit: 0.1%
- e. Lower limit of auxiliary output: When the output function distribution setting is 1=MV or 2=MV2 (as an extension of the control output), it configures output lower limit, setting range: 0–1000, default value: 0, unit: 0.1%

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Assignment of auxiliary output sources	1250H	1251H	1252H	1253H	1254H	1255H	1256H	1257H
Assignment of auxiliary output functions	1258H	1259H	125AH	125BH	125CH	125DH	125EH	125FH
Auxiliary output control cycle	1260H	1261H	1262H	1263H	1264H	1265H	1266H	1267H
Auxiliary output upper limit settings	1268H	1269H	126AH	126BH	126CH	126DH	126EH	126FH
Auxiliary output lower limit settings	1270H	1271H	1272H	1273H	1274H	1275H	1276H	1277H

Example: Users can achieve full control signal output for a single channel through the settings. An example of the settings is as follows:

Channel 1		
Output type	Assignment of auxiliary output sources	Assignment of auxiliary output functions
OUT1 (located in the measurement module)	NA	NA
AUX 1	CH1	Alarm 1
AUX 2	CH1	Alarm 2
AUX 3	CH1	Alarm 3

4.2 Alarm Settings

The DTN modular temperature controller series offers three alarm outputs per channel, with eight alarm modes available. Additionally, there are features such as alarm delay and other configurable settings.

4.2.1 Alarm Function Modes

DTN provides eight selectable input alarm modes. The following table outlines the eight alarm output modes:

Setting Value	Alarm Modes	Alarm Output Functions
0	No alarm functions	No output action
1	Upper and lower limit alarm actions: When the PV value exceeds SV + ALM-H or is lower than the SV – ALM-L value, the corresponding alarm will be generated.	
2	Upper limit alarm generation: When the PV value exceeds the SV + ALM-H value, the corresponding alarm will be generated.	
3	Lower limit alarm generation: When the PV value is lower than the SV-ALM-L value, the corresponding alarm will be generated.	

Setting Value	Alarm Modes	Alarm Output Functions
4	Absolute value upper and lower limits alarm actions: When the PV value exceeds ALM-H or is lower than the ALM-L value, the corresponding alarm will be generated.	
5	Absolute value upper limit alarm actions: When the PV value exceeds the ALM-H value, the corresponding alarm will be generated.	
6	Absolute value lower limit alarm actions: When the PV value is lower than the ALM-L value, the corresponding alarm will be generated.	
7	Delay upper limit alarm actions: When the PV value exceeds the SV + ALM-H value, the corresponding alarm will be generated. When the PV value is lower than the SV + ALM-L value, corresponding alarm will cease.	
8	Delay lower limit alarm actions: When the PV value is lower than the SV - ALM-H value, the corresponding alarm will be generated. When the PV value is higher than the SV - ALM-L value, the corresponding alarm will cease.	

4.2.2 Alarm Function Settings

The DTN measurement module can be combined with the auxiliary output module DTN-DOR for alarm output. A brief description of the alarm function settings is as follows:

- Alarm mode options: Write the needed alarm mode (8 types) setting to the corresponding communications address. The default value is 0.
- Alarm High (ALM-H): Set the alarm upper limit according to the alarm mode. Setting range: -2000–30000, Default value: 40, Unit 0.1°C
- Alarm Low (ALM-L): Set the alarm lower limit according to the alarm mode. Setting range: -2000–30000, Default value: 40, Unit 0.1°C
- Alarm delay: When the alarm is triggered, the alarm signal will be delayed to confirm if the alarm confirmation conditions continue to apply during the delay. If it applies, the alarm will be triggered, setting range: 0–100, default value: 0, unit: 1 second.
- Alarm functions: Turns on/turns off corresponding alarm functions in accordance with a bit number

Alarm function settings (On = 1; Off = 0)	
Bit0	Standby: To ensure that alarm settings are not met, and alarms activated, when the machine is turned on, alarms will be triggered only when the measured value (PV) is within ± 1 increment (temperature: 0.1°C) of the target value (SV)
Bit1	Output reverse: The initial default is Normal Open (NO). When the function is enabled, the alarm is changed to Normal Close (NC). When the power is disconnected, it will stay in NO.
Bit2	Hold: When an alarm is activated, the alarm signal will continue until the turn-off control is used
Bit3	Peak record: Can record the highest or lowest alarm signal values

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Alarm 1 Mode	1300H	1301H	1302H	1303H	1304H	1305H	1306H	1307H
Alarm 1 Delay setting	1308H	1309H	130AH	130BH	130CH	130DH	130EH	130FH

Chapter 4 Output and Alarm Function Configuration

Alarm 1 Function settings	1310H	1311H	1312H	1313H	1314H	1315H	1316H	1317H
Alarm 1 Upper limit alarm	1318H	1319H	131AH	131BH	131CH	131DH	131EH	131FH
Alarm 1 Lower limit alarm	1320H	1321H	1322H	1323H	1324H	1325H	1326H	1327H
Alarm 1 Highest peak	13B0H	13B1H	13B2H	13B3H	13B4H	13B5H	13B6H	13B7H
Alarm 1 Lowest peak	13B8H	13B9H	13BAH	13BBH	13BCH	13BDH	13BEH	13BFH

4.3 Other Output Function Settings

4.3.1 Input Sensor Error Output Value

When an input sensor abnormality occurs, the main DTN measurement unit and measurement expansion modules can employ the setting of this parameter to ensure that the corresponding outputs continue to function (unit: 0.1%).

Possible usage scenarios are as follows:

- 1) Safe output volume: For example, if it is known that the system requires a minimum output of 60%, the user can set this parameter to 50.0. This way, even if there is an abnormality in the input sensor, the output will still be maintained at 50% to prevent excessive temperature differences in the control environment.
- 2) Forced manual output volume: In the absence of an input sensor (which can save sensor costs), the user can manually set the desired output volume using this parameter. Setting range: 0–1000, Default value: 0, Unit 0.1%

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Output 1 operating value when PV is abnormal	1460H	1461H	1462H	1463H	1464H	1465H	1466H	1467H

4.3.2 Analog Output Compensation Adjustment

The analog output voltage and analog output current can be adjusted for upper and lower limits. Users can perform operations with an external measurement device. First, set the output to manual mode and set the output operation to 0%. Measure the current value and calculate the correction value. Then, adjust the lower limit of the output based on the calculated correction value. Next, set the output operation to 100% and measure the current value again. Calculate the correction value and adjust the upper limit of the output accordingly.

Analog output current adjustment increment: 1μA/scale, setting range: -9999–9999, default value: 0

Analog output voltage adjustment increment: 1mV/scale, setting range: -9999–9999, default value: 0

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Fine adjustment of analog output lower limit	1220H	1221H	1222H	1223H	1224H	1225H	1226H	1227H
Fine adjustment of analog output upper limit	1228H	1229H	122AH	122BH	122CH	122DH	122EH	122FH

Example: Assuming the user wants to set the analog current output to correspond to a range of 0-100% from 3.9mA to 20.1mA, the configuration steps are as follows

1. First, manually set the output operation to 0%. Use the measurement device to read the current value, assuming CH1 measures 3.75mA.
2. Calculate the values that require adjustment and write into the corresponding channel after converting it into hexadecimal.
Lower limit adjustment = Target value - Measured value = 3900 - 3750 = 150 (μA) = 0096H. Write to communications address [1220H]
3. Next, manually set the output operation to 100%. Use the measurement device to read the current value, assuming CH1 measures 20.25mA.

4. Calculate the values that require adjustment and write into the corresponding channel after converting it into hexadecimal.
Upper limit adjustment = Target value - Measured value = 20100 - 20250 = -150 (μA) = FF6AH. Write to communications address [1228H]
5. After completing the adjustment of output channel 1, the same steps can be repeated for the other channels.
6. When selecting "L" (analog voltage) output, the adjustment process is similar to the description provided for "C" (analog current) output above.

4.3.3 Retransmission Setting and Compensation Adjustment

The retransmission feature is only applicable to analog output models. It allows specific parameter values to be outputted in the form of analog voltage or analog current.

1) Retransmission source selection:

When setting the physical quantity to be transmitted, the three following options are available. Setting range: 0-2, default value: 0

0= Actual temperature PV

1= Target temperature SV

2= Control operating quantity MV

3= Control operating quantity MV2

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Retransmission source selection	1230H	1231H	1232H	1233H	1234H	1235H	1236H	1237H

➤ Retransmission update time:

Set the retransmission update time in order to avoid to operate valve or drive under higher frequency.

Setting range: 0~2500, default value is 10, unit in 0.1 second.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Retransmission update time	1238H	1239H	123AH	123BH	123CH	123DH	123EH	123FH

➤ Retransmission scaling:

By setting the corresponding parameter values for the low point (4mA or 0V) and high point (20mA or 10V), analog output scaling is achieved.

When the high-point corresponding value is greater than the low-point corresponding value, the output has a positive slope. Default value: -2000.

When the high-point corresponding value is less than the low-point corresponding value, the output has a negative slope. Default value: 8500 for PT models, 13000 for TC models.

When the high-point corresponding value is equal to the low-point corresponding value, the output is 4mA or 0V.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Low-point of retransmission corresponding value	1240H	1241H	1242H	1243H	1244H	1245H	1246H	1247H
High-point of retransmission corresponding value	1248H	1249H	124AH	124BH	124CH	124DH	124EH	124FH

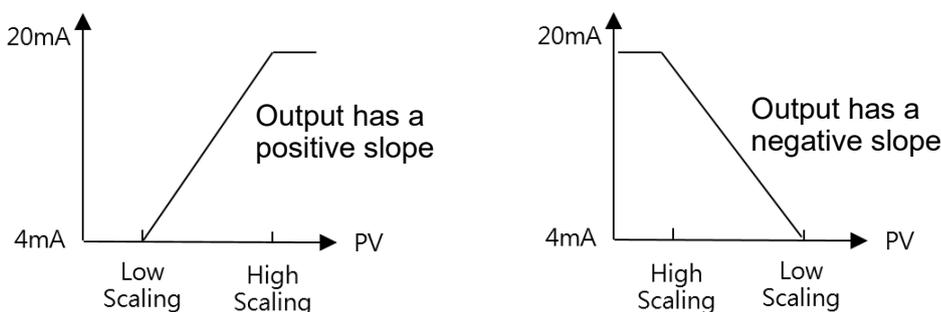
Chapter 4 Output and Alarm Function Configuration

The setting range varies based on the "Retransmission Parameter Selection."

Retransmission Low-Point Corresponding Value / Retransmission High-Point Corresponding Value Setting Range	
PV	Sensor Type Temperature Lower Limit ~ Sensor Type Temperature Upper Limit
SV	Sensor Type Temperature Lower Limit ~ Sensor Type Temperature Upper Limit
MV	-999.9% ~ 999.9%
MV2	-999.9% ~ 999.9%

In the left image, the positive slope shows that the value of the [Retransmission High-Point Corresponding Value] is higher than the value of the [Retransmission Low-Point Corresponding Value].

In the right image, the negative slope shows that the value of the [Retransmission High-Point Corresponding Value] is lower than the value of the [Retransmission Low-Point Corresponding Value].



Retransmission Output Operation Diagram

For example: Let's take transmitting the actual temperature PV from 0 to 500 degrees through a 4~20mA analog current signal.

- 1) Set the retransmission parameter selection to 0 (actual temperature PV).
- 2) Set the temperature value corresponding to 4mA through the "Retransmission Low-Point Corresponding Value": Write the value 0 (unit 0.1°C/°F)
- 3) Set the temperature value corresponding to 20mA through the "Retransmission High-Point Corresponding Value": Write the value 5000 (unit 0.1°C/°F).

Chapter 5 Control Functions and Operating Instructions

5.1 Control Functions

The DTN multi-channel modular temperature controller offers various control modes, including PID control, ON-OFF control, slope control, and manual control.

The default value for the control mode is 0 (0 = PID and 1 = ON-OFF). The default value for the control action is 0 (0 = heating, 1 = cooling, 2 = heating/cooling).

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Control method	1400H	1401H	1402H	1403H	1404H	1405H	1406H	1407H
Control actions	1408H	1409H	140AH	140BH	140CH	140DH	140EH	140FH

Note: The heating/cooling dual output function is only supported in firmware version v1.6 or later.

5.1.1 PID Control Function Settings

By setting the control mode to PID control, the output signal can effectively and steadily control the heating device to quickly reach and maintain the desired target temperature value. Typically, PID parameter values are obtained through auto-tuning. However, if users have specific requirements, they can manually adjust the PID values.

- a · Output 1 operating value: Read the output operating value from each PID control cycle, unit: 0.1%
- b · Output 2 operating value: Read the output operating value from each PID control cycle, unit: 0.1%
- c · Run/stop: The value can be set as 0 = stop or 1 = execute. The default value is 1.
- d · Auto-tuning: The value can be set as 0 = stop or 1 = execute. The default value is 0.
- e · Proportional control error compensation: When the I parameter is set as 0, it will reduce error compensation in reaching the SV value. Setting range: 0–1000, default value: 0, unit 0.1%
- f · Proportional band (P), integration time (I), derivative time (D): PID parameter settings

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Output 1 operating value	1010H	1011H	1012H	1013H	1014H	1015H	1016H	1017H
Output 2 operating Value	1018H	1019H	101AH	101BH	101CH	101DH	101EH	101FH
Run/stop	1020H	1021H	1022H	1023H	1024H	1025H	1026H	1027H
Auto-tuning	1028H	1029H	102AH	102BH	102CH	102DH	102EH	102FH
Output 1 control cycle	1208H	1209H	120AH	120BH	120CH	120DH	120EH	120FH
Proportional control error compensation value Ti = 0 hour setting	1430H	1431H	1432H	1433H	1434H	1435H	1436H	1437H
Proportional band	1500H	1508H	1510H	1518H	1520H	1528H	1530H	1538H
Integration time	1501H	1509H	1511H	1519H	1521H	1529H	1531H	1539H
Derivative time	1502H	150AH	1512H	151AH	1522H	152AH	1532H	153AH

Chapter 5 Control Functions and Operating Instructions

Cooling proportional band	1503H	150BH	1513H	151BH	1523H	152BH	1533H	153BH
Cooling integration time	1504H	150CH	1514H	151CH	1524H	152CH	1534H	153CH
Cooling derivative time	1505H	150DH	1515H	151DH	1525H	152DH	1535H	153DH
Heating/Cooling control deadband	1438H	1439H	143AH	143BH	143CH	143DH	143EH	143FH

Notes:

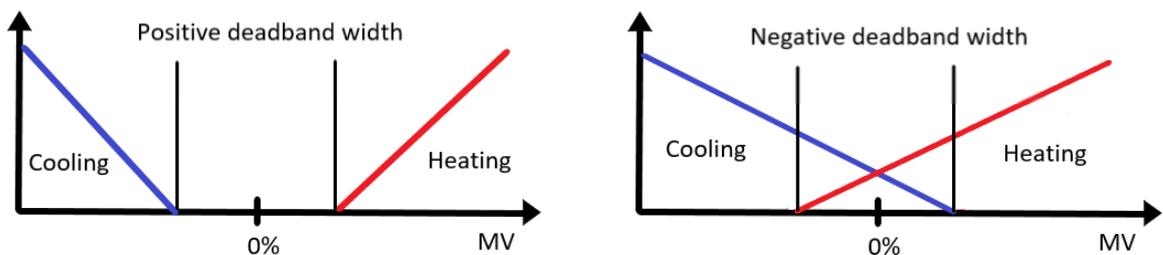
1. After performing auto-tuning, the system will automatically calculate and generate the values for proportional control error compensation, proportional band, integral time, and derivative time.
 2. It is necessary to make sure that the input and output channels are properly connected to the corresponding equipment and measurement and control parameters have been set before performing auto-tuning
 3. If the system's heating rate is fast, the control cycle cannot be set to be too long.
 4. If the output is a relay output, because of relay service life issues, when the control cycle is too short, it may shorten the relay's service life
- Dual Control Output: When select heating/cooling dual control, one of the control output is for heating and the other one is for cooling. Each control output has its own PID parameters.

If the control behavior is set to heating and cooling, you can set the inactive dead zone (as shown below).

This parameter will be automatically enabled during dual output control. The purpose is to avoid energy waste caused by frequent heating/cooling control actions. When using PID heating and cooling control, calculated output <0% represents cooling output; calculated output >0% represents heating output.

For example: When Deadband is set to 2.0%, it means that the output does not act when the PID calculated output is between -1% and 1%.

For example: When Deadband is set to -10.0%, it means that when the PID calculated output is between -5% and 5%, the heating and cooling outputs operate at the same time.



Note 1: When the inactive dead zone is in PID mode, the unit is 0.1% and the size is between -100.0%~100.0%.

Note 2: The heating and cooling dual output function is only supported in firmware version v1.6 or later.

5.1.2 Slope Control Function Settings

Relying on the already-set SV value, the system will control the temperature increase slope until it reaches a fixed temperature.

- a. Slope settings: Setting range: 0–3000, default value: 0, unit: 0.1°C/minute or 0.1°F/minute

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Slope setting	1038H	1039H	103AH	103BH	103CH	103DH	103EH	103FH
Time unit for slope control	2023H (0=minutes; 1=seconds)							

Example: When the slope is set as 5 (unit 0.1 degrees/minute), and SV is set as 200.0°C, this implies that the temperature will rise at a rate of 0.5°C/min. from room temperature until a temperature of 200.0°C has been reached.

5.1.3 Manual Control Function Settings

When switching from automatic control to manual control, the user can forcefully set the output to a fixed percentage. There are a few characteristics of the switch.

Switching from PID control to manual control: The output operating value before the switch is retained.

Example: When the PID control output is 20%, the control output will still be 20% after switching to manual control. The user can change the output percentage after the switch.

Switching from manual control to PID control: The PID value will be calculated using the output operating value before the switch.

Example: If it was 40% for manual control, the program will take 40% as an initial value in PID calculations after switching to PID, and will output a new operating value signal

- a. Manual switching: The value can be set as 0 = automatic or 1 = manual. The default value is 0.
 b. Read manual output operating value: Setting range: 0–1000, Default value: 0, Unit 0.1%

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Manual switching	1030H	1031H	1032H	1033H	1034H	1035H	1036H	1037H
Read manual output 1 operating value	1450H	1451H	1452H	1453H	1454H	1455H	1456H	1457H
Read manual output 2 operating value	1458H	1459H	145AH	145BH	145CH	145DH	145EH	145FH

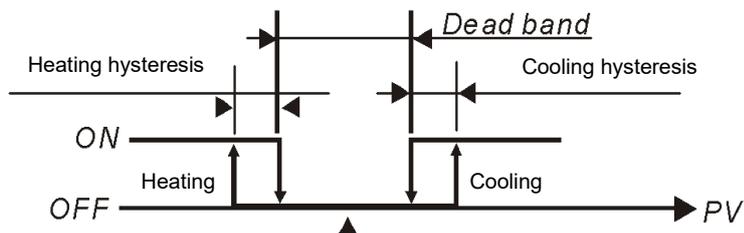
Note: If power to the device is turned off while under manual control status, the original output % value will be retained after restarting power

5.1.4 ON-OFF Control Function Setting

Function description: When set to heating output, the output is OFF when the PV value is greater than the SV set value, and the output is ON when the PV value is less than (SV set value - adjustment gain set value).

Chapter 5 Control Functions and Operating Instructions

When set to cooling output, the output is ON when the PV value is greater than (SV set value + adjustment gain set value), and the output is OFF when the PV value is less than the set value.



- Heating/cooling control dead band (Dead band): Set when using the dual output function. Usually the temperature oscillation will be larger when using ON-OFF control than PID control. In order to avoid frequent back and forth heating/cooling output in heating/cooling dual control, the heating/cooling output will not operate within the temperature error range of the control dead band. Unit 0.1°C.
- ON-OFF hysteresis adjustment: Set the hysteresis adjustment value during heating output to reduce the switching frequency. Unit 0.1°C.
- ON-OFF cooling side hysteresis adjustment: Set the hysteresis adjustment value during cooling output when using the dual output function. Unit 0.1°C.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Heating/cooling control deadband	1438H	1439H	143AH	143BH	143CH	143DH	143EH	143FH
ON-OFF hysteresis adjustment	1440H	1441H	1442H	1443H	1444H	1445H	1446H	1447H
ON-OFF cooling side hysteresis adjustment	1448H	1449H	144AH	144BH	144CH	144DH	144EH	144FH

Chapter 6 Quick Start Guide

6.1 Communication Settings and Wiring

The DTN does not have a built-in display panel for operation. Therefore, parameter configuration needs to be performed through a communication method.

- 1) Connect the hardware of the [main measurement unit DTN8R], [I/O expansion module DTN-DOR(V)] and [measurement expansion module DTN8N] first.

If I/O expansion modules are used, they need to be installed on the right side of each measurement module. Additionally, each measurement module can only be paired with one I/O expansion module at most.

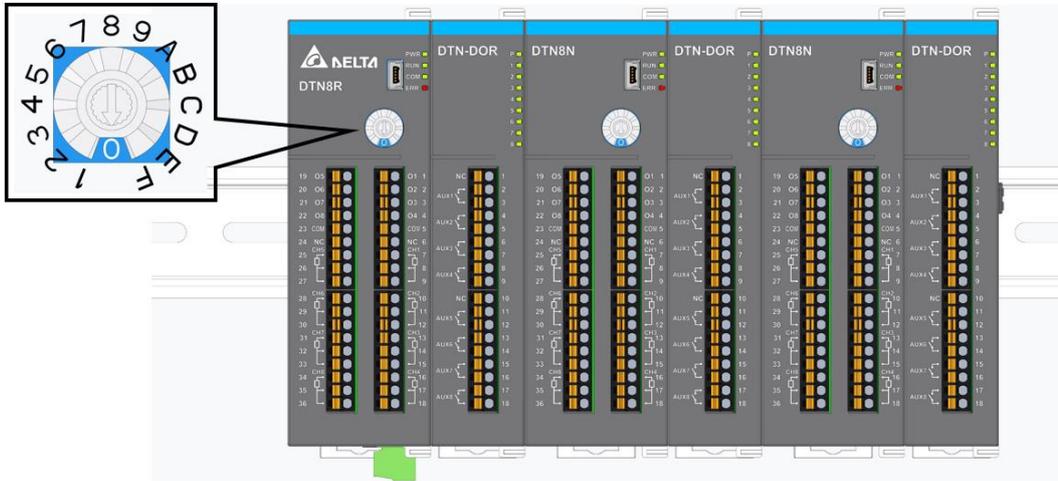


- 2) Set the communication protocol using the external switch above the [main measurement unit]. It is recommended to keep the factory default values of b1 to b8 all in the OFF state. The default values are 38400, 7, E, 1, and ASCII.

Bit 1	ASCII/RTU	Bit 2	Bit 3	Bit 4	Speed	Bit 5	Bit 6	Bit 7	Format	Bit 8	ID Address
OFF	ASCII	OFF	OFF	OFF	38400	OFF	OFF	OFF	7, E, 1	ON	Add 64
ON	RTU	ON	OFF	OFF	57600	ON	OFF	OFF	7, O, 1	OFF	Original
		OFF	ON	OFF	115200	OFF	ON	OFF	7, N, 1		
		ON	ON	OFF	19200	ON	ON	OFF	8, E, 1		
		OFF	OFF	ON	9600	OFF	OFF	ON	8, O, 1		
		ON	OFF	ON	4800	ON	OFF	ON	8, N, 1		
						OFF	ON	ON	7, N, 2		
						ON	ON	ON	8, N, 2		

- 3) The DTN station ID set by the knobs on the [main measurement unit] and [measurement expansion module] cannot be the same.

For example, in the following diagram with three DTN measurement modules, it is recommended to adjust the knobs sequentially to set the station numbers as 1, 2, and 3, respectively.



- 4) Connect the wiring for the [input sensor] and [output].



Input: When connecting sensor wires, please refer to the terminal illustrations below because of the differences between 2-wire type thermocouples (TC) and 3-wire type

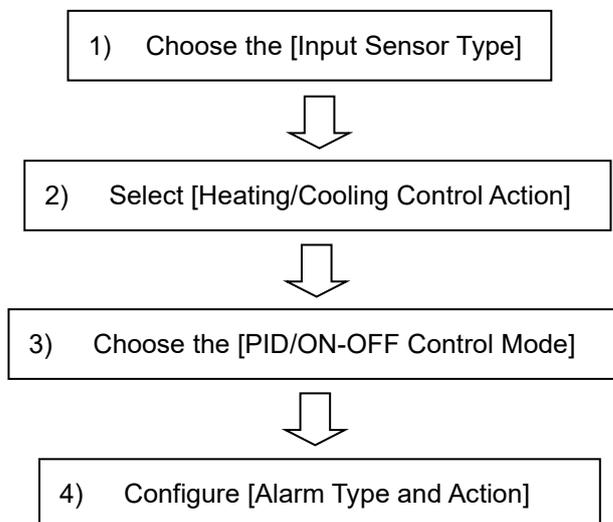
Output	
O1	CH1 Output +
O2	CH2 Output +
O3	CH3 Output +
O4	CH4 Output +
O5	CH5 Output +
O6	CH6 Output +
O7	CH7 Output +
O8	CH8 Output +
COM	Common Ground

- 5) Connect the [RS485 communications] and [DC24V Power] cables separately below the [measurement unit].



6.2 Basic Parameter Settings

To complete the basic setup for temperature control on the temperature controller, follow the four steps below:



1) Choose the [Input Sensor Type]:

1-1) Based on the type of sensor used, write the values into the addresses 1100H to 1107H.

Example: The first channel CH1 uses a "J-type thermocouple", so the setting value 1 should be written to the address 1100H.

Similarly, the setting for CH2 should be written to the address 1101H.

The different measurement units are distinguished by different station IDs.

Input sensor type (Refer to the configured values in the following table)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1100H	1101H	1102H	1103H	1104H	1105H	1106H	1107H

Setting value	Input sensor type	Setting value	Input sensor type	Setting value	Input sensor type
0	Thermocouple K type	6	Thermocouple S type	12	Platinum measurement resistance (Pt100)
1	Thermocouple J type	7	Thermocouple B type	13	Resistance temperature sensor (Ni120)
2	Thermocouple T type	8	Thermocouple L type	14	Resistance temperature sensor (Cu50)
3	Thermocouple E type	9	Thermocouple U type	15	Thermocouple C type
4	Thermocouple N type	10	Thermocouple TXK type	16	Thermocouple D type
5	Thermocouple R type	11	Platinum measurement resistance (JPt100)		

1-2) Read the current temperature (PV value)

Example: CH1 reads the address 1000H.

If there is a problem with the input (such as disconnected sensor, wrong sensor type, or others), different error states will read the corresponding values in the following figure. At that time, please confirm the connection method and sensor type selection.

Current temperature value (PV value) (Takes 0.1°C as the measurement unit)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1000H	1001H	1002H	1003H	1004H	1005H	1006H	1007H

Return value (hexadecimal)	Return value (decimal)	Description of error content
H8001	K32769	Initializing
H8002	K32770	Input sensor not connected
H8005	K32773	Measured temperature exceeds specifications
H8006	K32774	Channel disabled

2) Select [Heating/Cooling Control Action]:

The default action is set to heating (therefore no configuration is required). Heating action is more commonly used. Details about the heating action are as follows.

Control actions (0: Heating; 1: Cooling; 2: heating/cooling)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1408H	1409H	140AH	140BH	140CH	140DH	140EH	140FH

Note: The heating/cooling dual output function is only supported in firmware version v1.6 or later.

3) Choose the [PID/ON-OFF Control Mode]:

The default is PID (therefore no configuration is required). The PID mode is more commonly used. Details about the PID method are as follows.

Control method (0: PID; 1: ON-OFF)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1400H	1401H	1402H	1403H	1404H	1405H	1406H	1407H

1-3) Run Auto Tuning (AT):

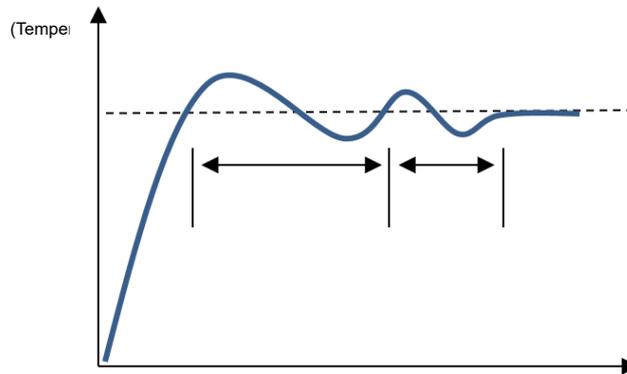
- To achieve precise PID temperature control, it is recommended to perform AT first. During this process, the system will automatically calculate the relevant parameters such as P, I, and D.
- Configure the temperature SV to the actual heating temperature required (such as setting 1008H of CH1 to 100.0 degrees).
- Start [Auto Tuning (AT)] computing (such as set 1028H of CH1 to 1). The system will automatically calculate P, I, and D parameters during the heating

process. Complete AT for the other channels by following the same steps.

Temperature set value (SV) (Takes 0.1°C as the unit)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1008H	1009H	100AH	100BH	100CH	100DH	100EH	100FH
Auto-tuning AT (0: Stop; 1: Run)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1028H	1029H	102AH	102BH	102CH	102DH	102EH	102FH

- During the AT process, it typically requires two cycles of heating and cooling oscillations to complete. The duration of the AT process can vary depending on the heating/cooling speed of the specific system being controlled. The waiting time will also vary.

When AT is complete, the system will automatically set 1028H to 0. The user can use 1028H to determine if AT is complete.



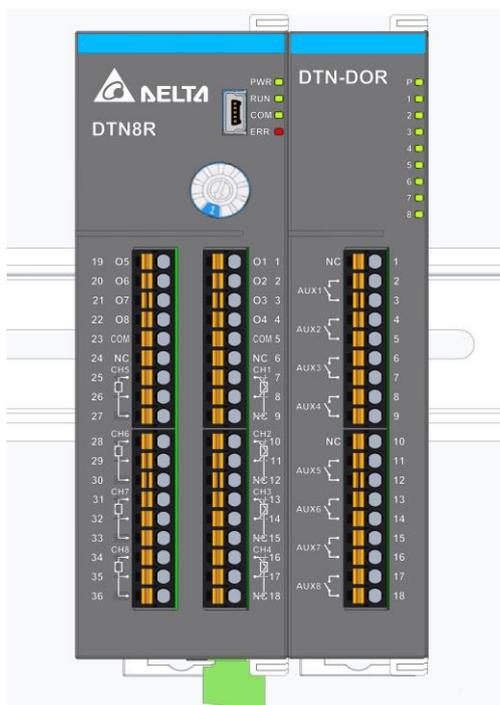
- When AT is complete, the basic control settings are configured. Set SV to any temperature and the system will automatically execute PID constant temperature control.

4) Configure [Alarm Type and Action Mode]:

The alarm function is not a mandatory setting and can be configured based on specific requirements. When the alarm conditions are met, the I/O expansion module will output a signal indicating the current alarm status.

- Only one expansion DTN-DOR (8 alarm AUX outputs) can be installed on the right side of each measurement module. The 8 outputs can be freely assigned to the measurement module channels on the left side for use. Up to 3 alarms (Alarm 1 to Alarm 3) can be designated for each channel.

Example: CH1 has utilized Alarm1 to Alarm3. As a result, CH2 to CH8 can only be allocated the remaining $8 - 3 = 5$ alarm points for their respective alarms.



1-4) Example description:

First, assign the 8 alarm AUX outputs to the channels.

For example: AUX1 to AUX2 should be assigned to CH1 for Alarm 1 to Alarm 2. The remaining AUX3 to AUX8 will maintain the default values and is assigned to CH3 to CH8 for Alarm 1.

- Set 1250H and 1251H to 0 first (assigned to CH1).

Assignment of auxiliary output sources 0-7(CH1-CH8)	AUX1	AUX2	AUX3	AUX4	AUX5	AUX6	AUX7	AUX8
		1250H	1251H	1252H	1253H	1254H	1255H	1256H
Default:	0 (CH1)	1 (CH2)	2 (CH3)	3 (CH4)	4 (CH5)	5 (CH6)	6 (CH7)	7 (CH8)

- Set 1258H to 3 (Alarm 1 function) and set 1259H to 4 (Alarm 2 function).

125AH to 125FH are configured as 3 for CH3 to CH8 alarm 1 functions.

Assignment of auxiliary output functions 0: Disable; 1: MV; 2: MV2 3: Alarm 1 4: Alarm 2 5: Alarm 3	AUX1	AUX2	AUX3	AUX4	AUX5	AUX6	AUX7	AUX8
		1258H	1259H	125AH	125BH	125CH	125DH	125EH
Default:	0	0	0	0	0	0	0	0

- 8 alarm modes are provided to choose from.

For example: Select mode 1 for alarm 1 of CH1. The alarm will be triggered when the temperature is above 5 degrees or below 3.5 degrees.

1300H is set to 1. 1318H is set to 50. 1320H is set to 35. (Unit: 0.1 degrees)

For example: Select mode 4 for alarm 2 of CH1. The alarm will be triggered when the absolute temperature is above 105 degrees or below 97.5 degrees.

1338H is set to 4. 1350H is set to 1050. 1358H is set to 975. (Unit: 0.1 degrees)

For example: Select mode 1 for alarm 1 of CH3. The alarm will be triggered when the temperature is above 5 degrees or below 3.5 degrees.

1302H is set to 1. 131AH is set to 50. 1322H is set to 35. (Unit: 0.1 degrees)

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Alarm 1 Mode	1300H	1301H	1302H	1303H	1304H	1305H	1306H	1307H
Alarm 1 Upper limit (unit 0.1°C)	1318H	1319H	131AH	131BH	131CH	131DH	131EH	131FH
Alarm 1 Lower (unit 0.1°C)	1320H	1321H	1322H	1323H	1324H	1325H	1326H	1327H
Alarm 2 Mode	1338H	1339H	133AH	133BH	133CH	133DH	133EH	133FH
Alarm 2 Upper limit (unit 0.1°C)	1350H	1351H	1352H	1353H	1354H	1355H	1356H	1357H
Alarm 2 Lower (unit 0.1°C)	1358H	1359H	135AH	135BH	135CH	135DH	135EH	135FH

Setting value	Alarm mode	Alarm output functions
0	No alarm functions	No output action
1	Upper and lower limit alarm actions: When the PV value exceeds $SV + ALM-H$ or is lower than the $SV - ALM-L$ value, the corresponding alarm will be generated.	
2	Upper limit alarm generation: When the PV value exceeds the $SV + ALM-H$ value, the corresponding alarm will be generated.	
3	Lower limit alarm generation: When the PV value is lower than the $SV - ALM-L$ value, the corresponding alarm will be generated.	
4	Absolute value upper and lower limits alarm actions: When the PV value exceeds $ALM-H$ or is lower than the $ALM-L$ value, the corresponding alarm will be generated.	
5	Absolute value upper limit alarm actions: When the PV value exceeds the $ALM-H$ value, the corresponding alarm will be generated.	
6	Absolute value lower limit alarm actions: When the PV value is lower than the $ALM-L$ value, the corresponding alarm will be generated.	
7	Hysteresis upper limit alarm actions: When the PV value exceeds the $SV + ALM-H$ value, the corresponding alarm will be generated. When the PV value is lower than the $SV + ALM-L$ value, the corresponding alarm will cease.	
8	Hysteresis lower limit alarm actions: When the PV value is lower than the $SV - ALM-H$ value, the corresponding alarm will be generated. When the PV value is higher than the $SV - ALM-L$ value, the corresponding alarm will cease.	

6.3 Advanced Parameter Settings

The following are the advanced settings for temperature control. The settings are generally not adjusted. The user can consider configuring the advanced settings if the precision of temperature control does not meet the requirements.

1) Shorten the PID control cycle:

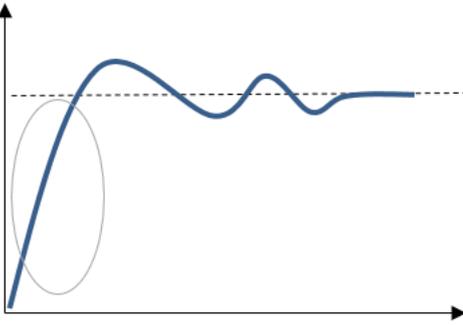
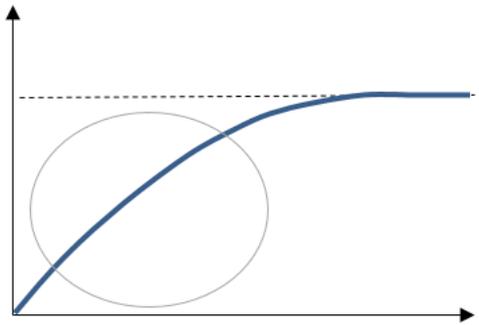
- When using V (voltage pulse), C (linear voltage), or L (linear current) as hardware outputs, the default control cycle is set to 4.0 seconds (ON-OFF output will be executed every 4.0 seconds). If more precise temperature control is required, the control cycle can be shortened (e.g., change it to 1.0 second). In this case, the system will execute the ON-OFF output every 1.0 second.
- In general, when using V output with SSR and C output with SCR, there are typically fewer concerns about the lifespan due to the number of switch operations. However, if the user is using output devices that have a limited lifespan due to switch operations, it is not recommended to set the control cycle time too short.

For example: When changing the control cycle of CH1 to 1.0 second, set 1208H as 10. (Unit: 0.1 seconds)

Output 1 control cycle (0.1–60.0 seconds)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
	1208H	1209H	120AH	120BH	120CH	120DH	120EH	120FH

2) Manual adjustment of PID parameters:

2-1) The principles of the PID parameter actions are as follows:

Proportional (P) parameters:	
<p>The smaller the P value: Faster temperature increases, but overheating will occur during heating.</p>	<p>The larger the P value: Slower temperature increases. It can reduce the occurrence of overheating but the heating time is longer.</p>
	

Integral (I) parameters:	
<p>The smaller the I value: Faster heating during the constant temperature stage, but can easily cause temperature oscillations.</p>	<p>The larger the I value: Slower temperature increases during the constant temperature stage. It can reduce the occurrence of temperature oscillation but the time it takes to reach the constant temperature is longer.</p>
Differential (D) parameters:	
<p>The smaller the D value: When the constant temperature is reached, the output reaction to sudden temperature drops is smaller.</p>	<p>The larger the D value: When the constant temperature is reached, the output reaction to sudden temperature drops is larger. It can return to the temperature faster, but may cause temperature oscillations.</p>

2-2) The PID parameters obtained after AT are used to adjust the settings. It is recommended to increase or decrease the settings by 1/4 of the value.

For example, if the original P value is 4.4 ($4.4/4 = 1.1$), you can decrease the P value by setting it to $4.4 - 1.1 = 3.3$. Similarly, to increase the P value, you can set it to $4.4 + 1.1 = 5.5$.

Scenario descriptions:

- When you want fast heating and can tolerate larger temperature deviations: Decrease P.
- When you want to avoid overheating during heating: Increase P.
- When you want to reach the constant temperature state faster after heating: Decrease I.
- When you want to avoid oscillation in the constant temperature state after heating: Increase I.
- When the temperature falls, the re-heating causes oscillations: Decrease D.
- When the temperature falls rapidly, you want to quickly re-heat to the configured value: Increase D.

2-3) The following are the PID setting parameters. For example, to change the P value of CH1 to 5.5, set 1500H to 55.

	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Percentage (P) (unit 0.1°C)	1500H	1508H	1510H	1518H	1520H	1528H	1530H	1538H
Integral (I) (unit: 1 seconds)	1501H	1509H	1511H	1519H	1521H	1529H	1531H	1539H
Differential (D) (unit: 1 seconds)	1502H	150AH	1512H	151AH	1522H	152AH	1532H	153AH

Chapter 7 Appendix-Communication Registers

7.1 RS485 Communications

1. Before turning on power to the main measurement unit, first set the external switches (set the baud rate), dial (set the station IDs), and all measurement expansion module dial station IDs.
2. Functions: 03H = Read the contents of a register, up to 64 words. 06H = Write a single word to a register. 10H = Write multiple words to a register, up to 64 words.
3. The following register address is expressed in hexadecimal.

Name	Description	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
PV current temperature value/input error code	Takes 0.1°C as the measurement unit Please refer to Table (5)	1000H	1001H	1002H	1003H	1004H	1005H	1006H	1007H
SV temperature configured value	Takes 0.1°C as the measurement unit	1008H	1009H	100AH	100BH	100CH	100DH	100EH	100FH
Output 1 Operating value	MV1	1010H	1011H	1012H	1013H	1014H	1015H	1016H	1017H
Output 2 Operating value	MV2	1018H	1019H	101AH	101BH	101CH	101DH	101EH	101FH
Run/stop	0: Stop 1: Execute	1020H	1021H	1022H	1023H	1024H	1025H	1026H	1027H
Auto-tuning	0: Stop 1: Run	1028H	1029H	102AH	102BH	102CH	102DH	102EH	102FH
Manual switching	0: Automatic 1: Manual	1030H	1031H	1032H	1033H	1034H	1035H	1036H	1037H
Slope setting	Unit: 0.1°C (2023H set to minutes/seconds) Range: 0–3,000	1038H	1039H	103AH	103BH	103CH	103DH	103EH	103FH
Input channel status	Enabled = 1; off = 0 Bit0: Alarm 3 Bit1: Alarm 2 Bit2: °C Bit3: °F Bit4: Alarm 1 Bit5: Reserved Bit6: Output 1 Bit7: Self-tuning	1040H	1041H	1042H	1043H	1044H	1045H	1046H	1047H
Input sensor type	Input function comparisons (Chapter 3.1.2)	1100H	1101H	1102H	1103H	1104H	1105H	1106H	1107H

Chapter 7 Appendix-Communication Registers

Name	Description	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Upper limit of SV configured value	Range: SV lower limit–upper limit of input range	1108H	1109H	110AH	110BH	110CH	110DH	110EH	110FH
Lower limit of SV configured value	Range: Lower limit of input range–SV upper limit	1110H	1111H	1112H	1113H	1114H	1115H	1116H	1117H
Temperature filter factor	Range: 0–50 Default: 8	1118H	1119H	111AH	111BH	111CH	111DH	111EH	111FH
Temperature filter range	Unit: 0.1°C Range: 1–100 Default: 10 (1.0°C)	1120H	1121H	1122H	1123H	1124H	1125H	1126H	1127H
Temperature error offset value	Unit: 0.1°C Range: -999–+999	1128H	1129H	112AH	112BH	112CH	112DH	112EH	112FH
Temperature error gain value	Range: -999–+999	1130H	1131H	1132H	1133H	1134H	1135H	1136H	1137H
Cold junction compensation selection	0: Internal cold contact 1: External cold contact	1138H	1139H	113AH	113BH	113CH	113DH	113EH	113FH
Output 1 Function distribution	0: MV1 1: Retransmission	1200H	1201H	1202H	1203H	1204H	1205H	1206H	1207H
Output 1 Control cycle	1–600 (0.1–60.0 seconds)	1208H	1209H	120AH	120BH	120CH	120DH	120EH	120FH
Control output 1 Upper limit settings	Lower limit of control output setting–100%. The unit is 0.1%.	1210H	1211H	1212H	1213H	1214H	1215H	1216H	1217H
Control output 1 Lower limit settings	0–% of upper limit of control output setting. The unit is 0.1%	1218H	1219H	121AH	121BH	121CH	121DH	121EH	121FH
Analog output Fine adjustment of lower limit	Current (4–20mA) or voltage output adjustment	1220H	1221H	1222H	1223H	1224H	1225H	1226H	1227H
Analog output Fine adjustment of upper limit	Current (4–20mA) or voltage output adjustment	1228H	1229H	122AH	122BH	122CH	122DH	122EH	122FH
Retransmission selected type	0: PV, 1: SV, 2: MV,	1230H	1231H	1232H	1233H	1234H	1235H	1236H	1237H
Retransmission update time	0–2500 (0–250.0 seconds)	1238H	1239H	123AH	123BH	123CH	123DH	123EH	123FH
Retransmission value		1240H	1241H	1242H	1243H	1244H	1245H	1246H	1247H

Chapter 7 Appendix-Communication Registers

Name	Description	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
corresponding to the low point									
Retransmission corresponding value of the high point		1248H	1249H	124AH	124BH	124CH	124DH	124EH	124FH
Assignment of auxiliary output sources	0-7(CH1-CH8)	1250H	1251H	1252H	1253H	1254H	1255H	1256H	1257H
Assignment of auxiliary output functions	0: Disable 1: MV1 3: Alarm 1 4: Alarm 2 5: Alarm 3	1258H	1259H	125AH	125BH	125CH	125DH	125EH	125FH
Auxiliary output control cycle	1-600 (0.1-60.0 seconds)	1260H	1261H	1262H	1263H	1264H	1265H	1266H	1267H
Auxiliary output upper limit settings	Lower limit of control output setting-100%. The unit is 0.1%.	1268H	1269H	126AH	126BH	126CH	126DH	126EH	126FH
Auxiliary output lower limit settings	0-% of upper limit of control output setting. The unit is 0.1%	1270H	1271H	1272H	1273H	1274H	1275H	1276H	1277H
Alarm 1 Mode	For details, refer to alarm output mode options.	1300H	1301H	1302H	1303H	1304H	1305H	1306H	1307H
Alarm 1 Delay setting	Setting range: 0-100 (Unit: Seconds)	1308H	1309H	130AH	130BH	130CH	130DH	130EH	130FH
Alarm 1 Function settings	Bit0: Enabling standby functions Bit1: Output reverse Bit2: Hold enable Bit3: Peak record	1310H	1311H	1312H	1313H	1314H	1315H	1316H	1317H
Alarm 1 Upper limit alarm	Alarm triggered when temperature exceeds upper limit	1318H	1319H	131AH	131BH	131CH	131DH	131EH	131FH
Alarm 1 Lower limit alarm	Alarm triggered when temperature exceeds lower limit	1320H	1321H	1322H	1323H	1324H	1325H	1326H	1327H
Alarm 2 Mode	For details, refer to alarm output mode options.	1338H	1339H	133AH	133BH	133CH	133DH	133EH	133FH

Chapter 7 Appendix-Communication Registers

Name	Description	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Alarm 2 Delay setting	Setting range: 0–100 (Unit: Seconds)	1340H	1341H	1342H	1343H	1344H	1345H	1346H	1347H
Alarm 2 Function settings	Bit0: Enabling standby functions Bit1: Output reverse Bit2: Hold enable Bit3: Peak record	1348H	1349H	134AH	134BH	134CH	134DH	134EH	134FH
Alarm 2 Upper limit alarm	Alarm triggered when temperature exceeds upper limit	1350H	1351H	1352H	1353H	1354H	1355H	1356H	1357H
Alarm 2 Lower limit alarm	Alarm triggered when temperature exceeds lower limit	1358H	1359H	135AH	135BH	135CH	135DH	135EH	135FH
Alarm 3 Mode	For details, refer to alarm output mode options.	1370H	1371H	1372H	1373H	1374H	1375H	1376H	1377H
Alarm 3 Delay setting	Setting range: 0–100 (Unit: Seconds)	1378H	1379H	137AH	137BH	137CH	137DH	137EH	137FH
Alarm 3 Function settings	Bit0: Enabling standby functions Bit1: Output reverse Bit2: Hold enable Bit3: Peak record	1380H	1381H	1382H	1383H	1384H	1385H	1386H	1387H
Alarm 3 Upper limit alarm	Alarm triggered when temperature exceeds upper limit	1388H	1389H	138AH	138BH	138CH	138DH	138EH	138FH
Alarm 3 Lower limit alarm	Alarm triggered when temperature exceeds lower limit	1390H	1391H	1392H	1393H	1394H	1395H	1396H	1397H
Alarm reset settings	B0: Alarm 1 B1: Alarm 2 B2: Alarm 3	13A8H	13A9H	13AAH	13ABH	13ACH	13ADH	13AEH	13AFH
Alarm 1 Highest peak	Records highest alarm value	13B0H	13B1H	13B2H	13B3H	13B4H	13B5H	13B6H	13B7H
Alarm 1 Lowest peak	Records lowest alarm value	13B8H	13B9H	13BAH	13BBH	13BCH	13BDH	13BEH	13BFH

Chapter 7 Appendix-Communication Registers

Name	Description	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Alarm 2 Highest peak	Records highest alarm value	13C0H	13C1H	13C2H	13C3H	13C4H	13C5H	13C6H	13C7H
Alarm 2 Lowest peak	Records lowest alarm value	13C8H	13C9H	13CAH	13CBH	13CCH	13CDH	13CEH	13CFH
Alarm 3 Highest peak	Records highest alarm value	13D0H	13D1H	13D2H	13D3H	13D4H	13D5H	13D6H	13D7H
Alarm 3 Lowest peak	Records lowest alarm value	13D8H	13D9H	13DAH	13DBH	13DCH	13DDH	13DEH	13DFH
Control method	0: PID 1: ON-OFF	1400H	1401H	1402H	1403H	1404H	1405H	1406H	1407H
Control actions	0 = heating 1 = cooling	1408H	1409H	140AH	140BH	140CH	140DH	140EH	140FH
PID mode options	0: Standard 1: Fast	1410H	1411H	1412H	1413H	1414H	1415H	1416H	1417H
Proportional control error compensation value. Ti = 0 setting	0.0–100.0% Unit: 0.1%	1430H	1431H	1432H	1433H	1434H	1435H	1436H	1437H
Heating/cooling control deadband	0.0 ~ 100.0% 單位 : 0.1%	1438H	1439H	143AH	143BH	143CH	143DH	143EH	143FH
ON-OFF heating hysteresis adjustment	Unit: 0.1 (PV measurement unit) Range: 0–9,999	1440H	1441H	1442H	1443H	1444H	1445H	1446H	1447H
ON-OFF cooling hysteresis adjustment	Unit: 0.1 (PV measurement unit) Range: 0–9,999	1448H	1449H	144AH	144BH	144CH	144DH	144EH	144FH
Read manual output 1 Operating value	Unit: 0.1%	1450H	1451H	1452H	1453H	1454H	1455H	1456H	1457H
Output 1 when PV is abnormal Operating value	Unit: 0.1%	1460H	1461H	1462H	1463H	1464H	1465H	1466H	1467H
Proportional band	Unit: 0.1 (°C or °F) Range: 0–9,999	1500H	1508H	1510H	1518H	1520H	1528H	1530H	1538H
Integration time	Unit: Second Range: 0–9,999	1501H	1509H	1511H	1519H	1521H	1529H	1531H	1539H
Derivative time	Unit: Second Range: 0–9,999	1502H	150AH	1512H	151AH	1522H	152AH	1532H	153AH
Cooling proportional band	Unit: 0.1 (°C or °F) Range: 0–9,999	1503H	150BH	1513H	151BH	1523H	152BH	1533H	153BH
Cooling integration time	Unit: Second Range: 0–9,999	1504H	150CH	1514H	151CH	1524H	152CH	1534H	153CH

Chapter 7 Appendix-Communication Registers

Name	Description	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Cooling derivative time	Unit: Second Range: 0–9,999	1506H	150EH	1516H	151EH	1526H	152EH	1536H	153EH
Integration default value	0.0–100.0% Unit: 0.1%	1506H	150EH	1516H	151EH	1526H	152EH	1536H	153EH

Name	Position	Min. value	Max. value	Default:	Access method	Description
Firmware version	2000H				Read Only	
Temperature units	2020H	0	1	1	Read/Write	0 = °F 1 = °C
Channel disabled	2021H	0x00	0xFF	0x00	Read/Write	0 = Channel enabled 1 = Channel disabled
Start status setting	2022H	0x00	0xFF	0x00	Read/Write	0 = According to the channel settings 1 = Stop on startup
Time unit for slope control	2023H	0	1	0	Read/Write	0=Min; 1=Sec
Output reverse settings	2024H	0x00	0xFF	0x00	Read/Write	b0–b7: Output 1 b8–b15: AUX1–AUX8 0 = Positive 1 = Negative

Error code

Error codes can be read from addresses 1000H–1007H. When the input is normal, the functional addresses 1000H–1007H will read as the input value. When there is an input error (except when stable and the input exceeds the range), it will read as the error messages of 0x8001–0x8006.

Return value	Description of error content
8001H	Initializing
8002H	Input sensor not connected
8003H	RTD shorted
8005H	Measured temperature exceeds specifications
8006H	Channel disabled

Analog output current adjustment increment: 1μA/scale

Analog output voltage adjustment increment: 1mV/scale

Reset all to default: Write the data 1234H to communication function address 472AH, then write the data 1357H to communication function address 474EH. After rebooting the system, the changes will take effect.

Communications transmission format: 03H = byte read; 06H = byte write

ASCII mode:

Chapter 7 Appendix-Communication Registers

Read command		Read reply string		Write command		Write reply string	
Initial word	':'	Initial word	':'	Initial word	':'	Initial word	':'
Machine address 1	'0'	Machine address 1	'0'	Machine address 1	'0'	Machine address 1	'0'
Machine address 0	'1'	Machine address 0	'1'	Machine address 0	'1'	Machine address 0	'1'
Function command 1	'0'	Function command 1	'0'	Function command 1	'0'	Function command 1	'0'
Function command 0	'3'	Function command 0	'3'	Function command 0	'6'	Function command 0	'6'
Read data /bit initial address	'1'	Reply data length (bytes)	'0'	Data address	'1'	Data address	'1'
	'0'		'4'		'0'		'0'
	'0'	Address H1000	'0'		'0'		'0'
	'0'		'1'		'1'		'1'
Read data length /bit length (word/bit)	'0'	Data content	'F'	Write data content	'0'	Write data content	'0'
	'0'		'4'		'3'		'3'
	'0'	Address H1001	'0'		'E'		'E'
	'2'		'0'		'8'		'8'
LRC1 check code	'E'	Data content	'0'	LRC1 check code	'F'	LRC1 check code	'F'
LRC0 check code	'A'		'0'	LRC0 check code	'D'	LRC0 check code	'D'
Stop word 1	CR	LRC1 check code	'0'	Stop word 1	CR	Stop word 1	CR
Stop word 0	LF	LRC0 check code	'3'	Stop word 0	LF	Stop word 0	LF
		Stop word 1	CR				
		Stop word 0	LF				

Communications transmission format: 10H = Multiple byte write

Write command		Write reply string	
Initial word	':'	Initial word	':'
Machine address 1	'0'	Machine address 1	'0'
Machine address 0	'1'	Machine address 0	'1'
Function command 1	'1'	Function command 1	'1'
Function command 0	'0'	Function command 0	'0'
Data address	'0'	Data address	'0'
	'0'		'0'
	'F'		'F'
	'8'		'8'
Number of write-in data entries	'0'	Number of write-in data entries	'0'
	'0'		'0'
	'0'		'0'
	'2'		'2'
Number of bytes of write-in data	'0'	LRC1 check code	'F'
	'4'	LRC0 check code	'5'
Write-in 1 data entry	'0'	Stop word 1	CR
	'0'	Stop word 0	LF
	'0'		
	'1'		
Write-in 2 data entry	'0'		
	'0'		
	'0'		
	'1'		
LRC1 check code	'E'		
LRC0 check code	'F'		
Stop word 1	CR		
Stop word 0	LF		

LRC check code

ASCII uses LRC for error checking; this method adds the bytes in all transmitted data, discarding the smallest bit, and then taking the complement of 2; LRC check code consists of the "machine address" added to the "data content".

Example: Assuming the data in a packet consists of [01H, 03H, 41H, FFH, 00H, 02H], the sum of the packet's data content is taken as follows:

$01H+03H+41H+FFH+00H+02H=146H$. Discard the carry and only take 46H.

Taking the complement of 2 from **[46H]** leaves **[BAH]** as the LRC check code.

RTU mode

Read command		Read reply string		Write command		Write reply string	
Machine address	01H	Machine address	01H	Machine address	01H	Machine address	01H
Function command	03H	Function command	03H	Function command	06H	Function command	06H
Read data initial address	10H	Reply data length (bytes)	04H	Write data address	10H	Write data address	10H
	00H				01H		01H
Read data length (characters/word)	00H	Data content 1	01H	Write data content	03H	Write data content	03H
	02H		F4H		20H		20H
CRC least bit	C0H	Data content 2	03H	CRC least bit	DDH	CRC least bit	DDH
CRC highest bit	CBH		20H	CRC highest bit	E2H	CRC highest bit	E2H
			CRC least bit	BBH			
			CRC highest bit				15H

CRC check codes:

RTU uses CRC to perform error checking. The following is an explanation of calculation steps and example program:

Step 1: Enter the 16-bit register of content consisting of FFFFH, and term it the "CRC" register.

Step 2: Perform the Exclusive OR operation on the first byte of the command information and the least byte of the 16-bit CRC register, and return results to the CRC register.

Step 3: Examine the least significant bit (LSB) in the CRC register; if this bit is 0, it is shifted to the right by one bit; if this bit is 1, after the CRC register value is shifted to the right by one bit, perform Exclusive OR operation with A001H.

Step 4: Return to step 3, and perform step 3 8 times before proceeding to step 5.

Step 5: Repeat steps 2-4 on the next byte in the command information, until all bytes have been completely processed. At this time, the content of the CRC register will be the error detection value.

Example CRC parity program

```

        unsigned int reg_crc = 0xffff;

i = 0;
while (length--)
{  reg_crc ^= RTUData[i];
   i ++;
   for (j = 0; j < 8; j++)
   {  if (reg_crc & 0x01)      reg_crc = (reg_crc >> 1) ^ 0xA001;
      else                    reg_crc = reg_crc >> 1;
   }
}

```

```
return(reg_crc);
```

7.2 Communication Software

PC communication settings software: In order to facilitate the setting of parameters, this company provides free PC software. Please download DTSoft from the Delta website.