Machine Automation Controller

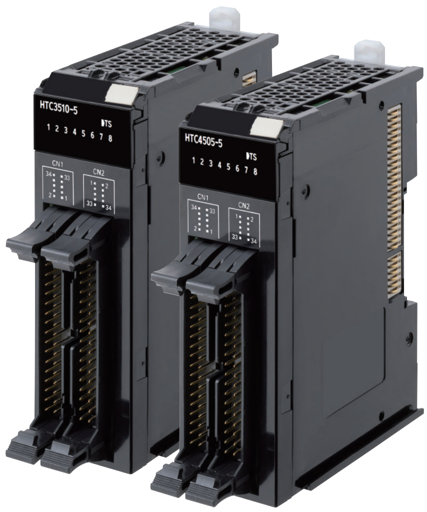
NX-series

Advanced Temperature Control Unit

User's Manual

NX-HTC□□□□

Advanced Temperature Control Unit



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H238-E1-01

Introduction

Thank you for purchasing an NX-series Advanced Temperature Control Unit.
This manual contains information that is necessary to use your NX-series Advanced Temperature Control Unit. Please read this manual and make sure you understand the functionality and performance of the NX-series Temperature Control Unit before you attempt to use it in a control system.
Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).This manual covers the following product.

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- Personnel in charge of managing FA systems and facilities.

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503.

Applicable Products

This manual covers the following product.

- NX-series Advanced Temperature Control Unit
  NX-HTC□□□□

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Section 3 Part Names and Functions

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Relevant Manuals

The table below provides the relevant manuals for the NX-series Advanced Temperature Control Units. Read all of the manuals that are relevant to your system configuration and application to make the most of the NX-series Advanced Temperature Control Units.

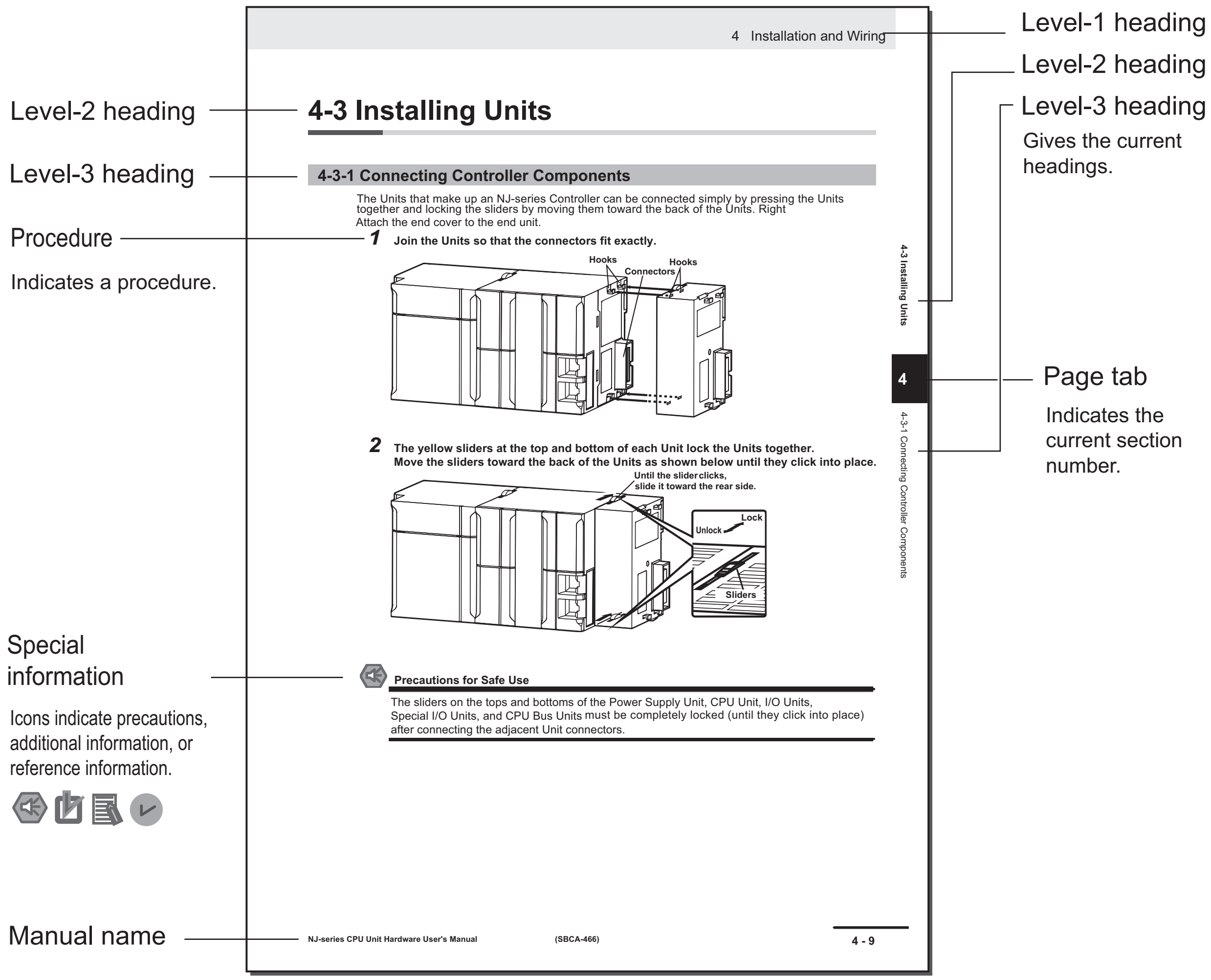
Other manuals, such as related product manuals, are necessary for specific system configurations and applications. Refer to *Related Manuals* on page -29 for the list of the related manuals available.

Manual name	Purpose
NX-series Advanced Temperature Control Units User's Manual	To learn how to use NX-series Advanced Temperature Control Units
NX-series Data Reference Manual	To see a list of data required for system configurations using NX-series Units.

Manual Structure

Page Structure and Icons

The following page structure and icons are used in this manual.



Note This illustration is provided only as a sample. It may not literally appear in this manual.

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

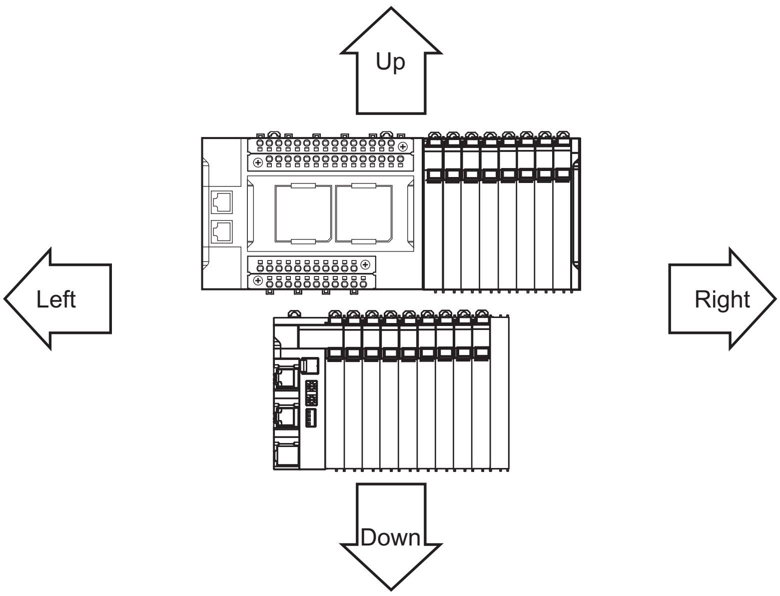
Version Information

Information on differences in specifications and functionality for CPU Units, Industrial PCs, and Communications Coupler Units with different unit versions and for different versions of the Support Software is given.

Note References are provided to more detailed or related information.

Precaution on Terminology

- In this manual, “download” refers to transferring data from the Support Software to a physical device and “upload” refers to transferring data from a physical device to the Support Software.
- In this manual, the directions in relation to the Units are given in the following figure, which shows upright installation.



- This user's manual refers to NY-series IPC Machine Controller Industrial Panel PCs and Industrial Box PCs as simply *Industrial PCs* or as *NY-series Industrial PCs*.
- This user's manual refers to the built-in EtherCAT port on an NJ/NX-series Controller or NY-series Industrial PC as simply a built-in EtherCAT port.
- This user's manual may omit manual names and manual numbers in places that refer to the user's manuals for CPU Units and Industrial PCs. The following table gives some examples.When necessary, refer to *Related Manuals* on page 29 to determine the appropriate manual based on the common text for the omitted contents.

Example:

Manual name	Omitted contents	Common text
NJ/NX-series CPU Unit Software User’s Manual	Software user's manual for the connected CPU Unit or Industrial PC	Software User's Manual
NY-series IPC Machine Controller Industrial Panel PC/Industrial Box PC Software User’s Manual		
NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	User's manual for the built-in EtherCAT port on the connected CPU Unit or Industrial PC	Built-in EtherCAT port
NY-series IPC Machine Controller Industrial Panel PC/Industrial Box PC Built-in EtherCAT® Port User’s Manual		

- This user’s manual may omit manual names and manual numbers in places that refer to the user's manuals for Communications Coupler Units. If you will use a Communications Coupler Unit, refer to *Related Manuals* on page 29 to identify the manual for your Unit.
- This user's manual omits the “x” sign for units displayed in decimals. For example, “x0.1°C” is described as “0.1°C”.

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NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

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Change in Specifications

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

Errors and Omissions

Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

Safety Precautions

Definition of Precautionary Information

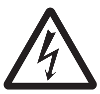
The following notation is used in this manual to provide precautions required to ensure safe usage of the NX-series Advanced Temperature Control Units.

The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.

The following notation is used.

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Symbols

	The circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text. This example indicates prohibiting disassembly.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for electric shock.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a general precaution.
	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.

Warnings

⚠ WARNING

During Power Supply

Do not touch the terminal section while power is ON.

Electric shock may occur.

Do not attempt to take any Unit apart.
In particular, high-voltage parts are present in Units that supply power while power is supplied or immediately after power is turned OFF. Touching any of these parts may result in electric shock. There are sharp parts inside the Unit that may cause injury.

Fail-safe Measures

Provide safety measures in external circuits to ensure safety in the system if an abnormality occurs due to malfunction of the CPU Unit, Industrial PC, other Units, or slaves or due to other external causes affecting operation.

Not doing so may result in serious accidents due to incorrect operation.

Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.

The CPU Unit or Industrial PC, will turn OFF all outputs from Output Units in the following cases. The remote I/O slaves will operate according to the settings in the slaves.

- If a power supply error occurs.
- If the power supply connection becomes faulty.
- If a CPU watchdog timer error or CPU reset occurs.
- If a Controller error in the major fault level occurs.
- While the CPU Unit is on standby until RUN mode is entered after the power is turned ON

External safety measures must be provided to ensure safe operation of the system in such cases.

The outputs may remain ON or OFF due to deposition or burning of the output relays or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.

If external power supplies for slaves or other devices are overloaded or short-circuited, the voltage will drop, outputs will turn OFF, and the system may be unable to read inputs. Provide external safety measures in control with monitoring of external power supply voltage as required so that the system operates safely in such a case.

You must take fail-safe measures to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.

Not doing so may result in serious accidents due to incorrect operation.

Voltage and Current Inputs

Make sure that the voltages and currents that are input to the Units and slaves are within the specified ranges.
Inputting voltages or currents that are outside of the specified ranges may cause accidents or fire.

Transferring

Always confirm safety at the destination node before you transfer Unit configuration information, parameters, settings, or other data from tools such as the Sysmac Studio.
The devices or machines may operate unexpectedly, regardless of the operating mode of the Controller.

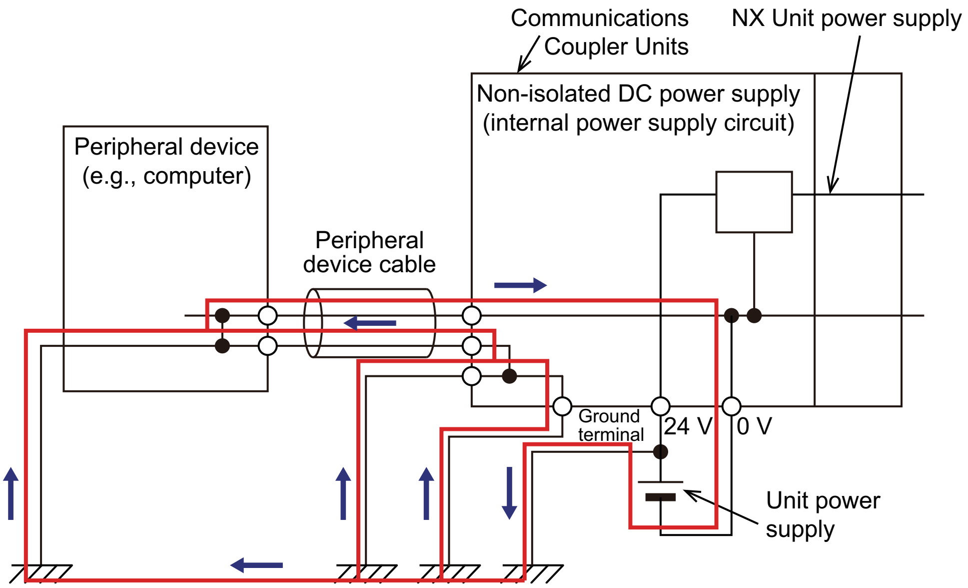
Cautions

CAUTION

Wiring

When you connect a computer or other peripheral device to a Communications Coupler Unit that has a non-isolated DC power supply, either ground the 0-V side of the external power supply (i.e. Unit power supply) or do not ground it at all.

If the peripheral devices are grounded incorrectly, the external power supply (i.e. Unit power supply) may be short-circuited.
Never ground the 24-V side of the power supply, as shown in the following figure.



Online Editing

Execute online editing only after confirming that no adverse effects will be caused by deviations in the timing of I/O. If you perform online editing, the task execution time may exceed the task period, I/O may not be refreshed with external devices, input signals may not be read, and output timing may change.

Actual Operation

Set the parameters of the Advanced Temperature Control Unit correctly according to the controlled system. If the contents of the parameters and the controlled system are different, it could result in equipment damage or accidents due to unexpected operations.

For example, the temperature of the controlled system may increase abnormally in the following cases.

- When heating control is performed by connecting a type K thermocouple while the input type is set to type J thermocouple
- When heating control is performed with the direct/reverse operation set to direct operation

Take adequate security measures against DDoS attacks (Distributed Denial of Service attacks), computer viruses and other technologically harmful programs, unauthorized access and other possible attacks before using this product.

Security Measures

Anti-virus protection

Install the latest commercial-quality antivirus software on the computer connected to the control/monitor system and maintain to keep the software up-to-date.

Security measures to prevent unauthorized access

Take the following measures to prevent unauthorized access to our products.

- Install physical controls so that only authorized personnel can access control/monitor systems and equipment.
- Reduce connections to control/monitor systems and equipment via networks to prevent access from untrusted devices.
- Install firewalls to shut down unused communications ports and limit communications hosts and isolate control/monitor systems and equipment from the IT network.
- Use a virtual private network (VPN) for remote access to control/monitor systems and equipment.
- Scan virus to ensure safety of SD cards or other external storages before connecting them to control/monitor systems and equipment.

Data input and output protection

Validate backups and ranges to cope with unintentional modification of input/output data to control/monitor systems and equipment.

- Checking the scope of data
- Checking validity of backups and preparing data for restore in case of falsification and abnormalities
- Safety design, such as emergency shutdown, in case of data tampering and abnormalities

Data recovery

Backup data and keep the data up-to-date periodically to prepare for data loss.

Precautions for Safe Use

Transporting

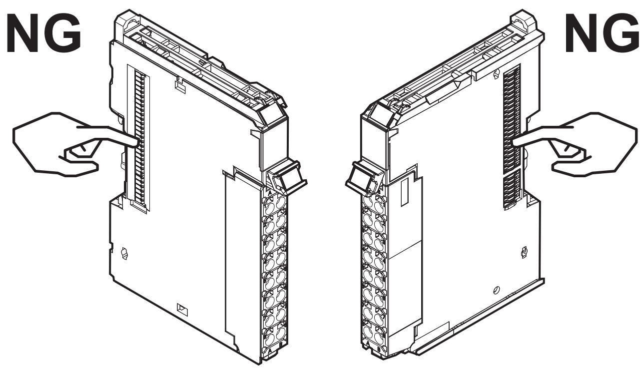
- When transporting any Unit, use the special packing box for it.
  Do not subject any Unit to excessive vibration or shock during transportation.
- Do not drop any Unit or subject it to abnormal vibration or shock.
  Doing so may result in Unit malfunction or burning.

Mounting

- Mount terminal blocks and connectors only after checking the mounting location carefully.
- Be sure that the terminal blocks, expansion cables, and other items with locking devices are properly locked into place.

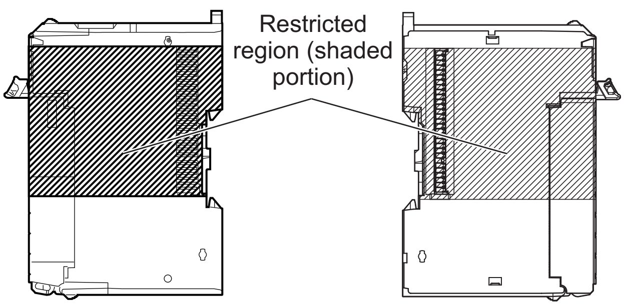
Installation

- Do not attach any labels or tapes on an NX Unit. When the NX Unit is installed or removed, adhesive materials or scraps may adhere to the pins in the NX bus connector, which may result in malfunctions.
- Do not touch the pins in the NX bus connector on an NX Unit. Dirt may adhere to the pins in the NX bus connector, which may result in malfunctions.

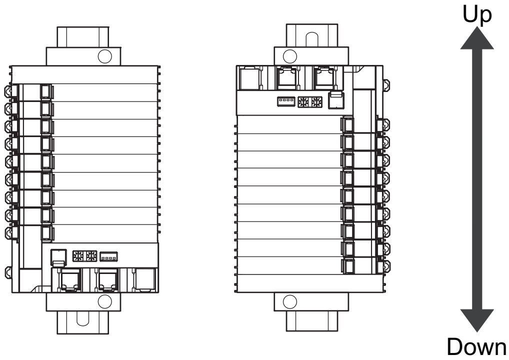


Example: NX Unit (12 mm width)

- Do not write on an NX Unit with ink within the restricted region that is shown in the following do not get this area dirty. When the Unit is installed or removed, ink or dirt may adhere to the pins in the NX bus connector, which may result in malfunctions in the CPU Rack or the Slave Terminal.
  Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for information on the restricted region of CPU Units and Communications Coupler Units.



- For the installation orientations as shown in the following figure. To install Units, hold the cables in place by using ducts or other means so that the End Plate on the bottom is not subjected to the weight of the cables. The weight of the cables may cause the bottom End Plate to slide downward so that the Slave Terminal is no longer secured to the DIN Track, which may cause malfunctions.



Wiring

- Double-check all switches and other settings and double-check all wiring to make sure that they are correct before turning ON the power supply.
  Use the correct wiring parts and tools when you wire the system.
- Do not pull on the cables or bend the cables beyond their natural limit. Also, do not place heavy objects on top of the cables or other wiring lines. Doing so may sever the cable.
- When wiring or installing the Units, do not allow metal fragments to enter the Units.

Power Supply Design

- Use all Units within the I/O power supply ranges that are given in the specifications.
- For CPU Racks of NX-series CPU Units, the I/O power supply current should be less than or equal to the value specified for each type of CPU Unit. For example for an NX1P2 CPU Unit, the current consumption should be 4 A or less. Malfunction or damage may result in if any current outside the specification range is used. Refer to the user's manual of the CPU Unit to be connected for the I/O power supply current for each type of CPU Unit.
- Supply sufficient power according to the contents of this manual.
- Use the power supply voltage that is specified in this manual.
- Do not apply voltages that exceed the rated value to any Input Unit.
- Do not apply voltages or connect loads to the Output Units or slaves in excess of the maximum ratings.
- Inrush current occurs when the power supply is turned ON. When selecting fuses or breakers for external circuits, consider their fusing and detection characteristics as well as the above precautions and allow sufficient margin in shut-off performance.
- Install external breakers and take other safety measures against short-circuiting and overcurrents in external wiring.

Actual Operation

- Check the user program, data, and parameter settings for proper execution before you use them for actual operation.
- If you change the fail-soft operation setting, the output status when the error occurs may also change. Confirm safety before you change the fail-soft operation setting.
- If you use fail-soft operation, write programming to determine whether Unit I/O data is valid. Without such programming, the user program cannot distinguish between Units for which I/O refreshing is continued and Units for which I/O refreshing is stopped.
- When using PID control, turn ON power for the load (e.g., heater) at the same time as or before supplying power to the Advanced Temperature Control Unit. If you turn ON the power supply to the load after you turn ON the power supply to the Advanced Temperature Control Unit, correct tuning and optimum control will not be possible.
- It takes 30 minutes of warm-up time for the measured value to stabilize after you turn ON the Advanced Temperature Control Unit. Start control after the warm-up period elapses.
- Ensure that the load power (e.g., heater) is ON during tuning. If the load power (e.g., heater) is not kept ON during tuning, tuning results will not be calculated correctly and it will not be possible to achieve optimum control.
- When executing D-AT (disturbance autotuning), apply a disturbance using the same method as a disturbance that occurs during control. If a disturbance is applied using a different method, tuning results will not be calculated correctly and it will not be possible to achieve optimum control.

Turning OFF the Power Supply

- Do not disconnect the cable or turn OFF the power supply to the Controller or a Slave Terminal when downloading data or the user program from the Support Software.
- Always turn OFF the external power supply to the Units before attempting any of the following.

  Mounting or removing an NX Unit, Communications Coupler Unit, CPU Unit, or Industrial PC
  Assembling Units
  Setting DIP switches or rotary switches
  Connecting or wiring cables
  Attaching or removing terminal blocks or connectors

  Units that supply power continue to supply power to the Units for up to several seconds after the power supply is turned OFF. The PWR indicator remains lit as long as power is supplied. Confirm that the PWR indicator is not lit before you perform any of the above.

Operation

- Confirm that the controlled system will not be adversely affected before you perform any of the following operations.

  Changing the operating mode of the CPU Unit or the Industrial PC (including changing the setting of the Operating Mode at Startup)

  Changing the user program or settings
  Changing set values or present values
  Forced refreshing
- Confirm the safety of connected devices when restarting Units after changing the parameters of slaves or Units.
- If you transfer parameters for Unit operation settings that are updated when the Unit is restarted after the settings are changed on the Sysmac Studio, the Unit will be restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

General Communications

- Do not exceed the ranges that are given in the specifications for the communications distance and number of connected Units.
- Refer to the user's manual for the Communications Coupler Unit for precautions for the safe use of communications with the connected Communications Coupler Unit.

Unit Replacement

- When you replace a Unit, start operation only after you transfer the settings and variables that are required for operation to the new Unit.

Disposal

- Dispose of the product according to local ordinances as they apply.

Handling the Cold Junction Sensor

- One cold junction sensor is included with the product. Attach the cold junction sensor to the compact Connector-Terminal Block Conversion Unit (XW2K-34G-T) before operation.
- When you use Temperature Input Units that have cold junction sensors, do not remove the cold junction sensors. If the cold junction sensors are removed, you cannot measure the temperature correctly regardless of the cold junction compensation enable/disable setting.
- If you have misplaced the cold junction sensor that came with the product, purchase another cold junction sensor (sold separately).
- Do not use other cold junction sensors. Otherwise, a temperature error may occur.
- Place the cold junction sensor and the Connector-Terminal Block Conversion Unit within operating temperature limits. Otherwise, a temperature error may occur.
- Take anti-static measures so that static electricity is not applied to the cold junction sensor during the Unit installation (unpacking), wiring or other procedures.
- Do not pull or subject the cold junction sensor to physical impact. Doing so may result in failure to accurately measure temperature or in disconnection/short circuit of the cold junction sensor. Make sure you always handle it with care.

Using Heater Burnout Detection and SSR Failure Detection

- Before you perform wiring or maintenance work, always confirm that the power supply to the heater is turned OFF. If you provide power to the heater while the CT terminals are not connected to NX Units, a high voltage will be induced between the CT terminals, causing an electric shock hazard.
- Use a CT that can be connected to the Advanced Temperature Control Unit. If you use any other CTs, the current values may not be accurate. This could result in failure to detect heater burnout or SSR failure. Also, if a SSR failure current is not detected, damage to equipment could result.

Precautions for Correct Use

Storage, Mounting, and Wiring

- Follow the instructions in this manual to correctly perform installation and wiring.
- Do not operate or store the Units in the following locations. Doing so may result in malfunction, in operation stopping, or in burning.
  Locations subject to direct sunlight
  Locations subject to temperatures or humidity outside the range specified in the specifications
  Locations subject to condensation as the result of severe changes in temperature
  Locations subject to corrosive or flammable gases
  Locations subject to dust (especially iron dust) or salts
  Locations subject to exposure to water, oil, or chemicals
  Locations subject to shock or vibration
- Take appropriate and sufficient countermeasures during installation in the following locations.
  Locations subject to strong, high-frequency noise
  Locations subject to static electricity or other forms of noise
  Locations subject to strong electromagnetic fields
  Locations subject to possible exposure to radioactivity
  Locations close to power lines
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up.
- Use the rated power supply voltage for the Units that supply power. Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied in places where the power supply is unstable.
- Install the Units away from sources of heat and ensure proper ventilation. Not doing so may result in malfunction, in operation stopping, or in burning.
- Do not allow foreign matter to enter the openings in the Unit. Doing so may result in Unit burning, electric shock, or failure.
- Do not perform wiring while power is ON. Doing so may cause electric shock.
- Make sure you do not add unnecessary stress to the Advanced Temperature Control Units or the wires while wiring.
  The wires must be secured and fastened so that they do not resonate due to vibration of equipment or other objects in the installed condition.

Actual Operation

- If you change the event level of an error, the output status when the error occurs may also change. Confirm safety before you change an event level.

Turning OFF the Power Supply

- Do not turn OFF the power supply while data is being transferred.
- Do not turn OFF the power supply while parameters are being written to the CPU Unit, the Communications Coupler Unit or NX Units.

Regulations and Standards

Conformance to EU Directives

Applicable Directives

- EMC Directives
- Low Voltage Directive

Concepts

● EMC Directives

OMRON devices that comply with EU Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards.*1

Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer. EMC-related performance of the OMRON devices that comply with EU Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

*1. Applicable EMC (Electromagnetic Compatibility) standards are as follows:
EMS (Electromagnetic Susceptibility): EN 61131-2
EMI (Electromagnetic Interference): EN 61131-2 (Radiated emission: 10-m regulations).

● Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 VAC and 75 to 1,500 VDC meet the required safety standards. The applicable directive is EN 61010-2-201.

● Conformance to EU Directives

The NX-series Units comply with EU Directives. To ensure that the machine or device in which the NX-series Units are used complies with EU Directives, the following precautions must be observed.

- The NX-series Units must be installed within a control panel.
- You must use SELV power supply for the DC power supplies that are connected as the Unit power supplies and I/O power supplies for the NX-series Units.

  Compliance with the EMC standard has been confirmed using the recommended Power Supplies. Refer to the user’s manual for the connected CPU Unit for information on the recommended Power Supplies for a CPU Rack with an NX-series CPU Unit. We recommend that you use the OMRON S8VK-S Series Power Supplies to connect an Advanced Temperature Control Unit on a Slave Terminal.
- NX-series Units that comply with EU Directives also conform to the Common Emission Standard (EN 61131-2). Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions.

  You must therefore confirm that the overall machine or equipment in which the NX-series Units are used complies with EU Directives.
- You must use power supplies with an output hold time of 10 ms or longer for the DC power supplies that are connected as the Unit power supplies and I/O power supplies for the NX-series Units.

- This is a Class A product (for industrial environments). In a residential environment, it may cause radio interference. If radio interference occurs, the user may be required to take appropriate measures.

Conformance Requirement to EU Directives

The immunity test conditions for the NX-series Advanced Temperature Control Units are as follows:

Unit Type	Conversion time	Overall accuracy
Advanced Temperature Control Units	50 ms per Unit	+5% / -5%

The conformity is confirmed when the cable length between the Advanced Temperature Control Unit and any connected external device is 30 m or less.

Conformance to UL and CSA Standards

Some NX-series products comply with UL and CSA standards. If you use an NX-series product that complies with UL or CSA standards and the machinery or system in which you use the NX-series product must also comply with the standards, refer to the *Instruction Sheet* that is provided with the product. The *Instruction Sheet* provides the application conditions for complying with the standards.

Conformance to Shipbuilding Standards

Some NX-series products comply with shipbuilding standards. If you use an NX-series product that complies with shipbuilding standards and the machinery or system in which you use the NX-series product must also comply with the standards, consult with your OMRON representative. Application conditions are defined according to the installation location. Application may not be possible for some installation locations.

For shipbuilding standard usage conditions, refer to Conformance to Shipbuilding Standards in the user's manual for the CPU Unit, Communications Coupler Unit, or Communication Control Unit that the NX Units are connected to.

Note that the usage conditions are provided in the relevant user's manuals for Units whose conformance to shipbuilding standards is confirmed.

Conformance to KC Certification

Observe the following precaution if you use NX-series Unit in Korea.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

This product meets the electromagnetic compatibility requirements for business use.

There is a risk of radio interference when this product is used in home.

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at https://www.fa.omron.co.jp/nj_info_e/.

Unit Versions

This section describes the notation that is used for unit versions, the confirmation method for unit versions, and the relationship between unit versions and Support Software versions.

Unit Versions

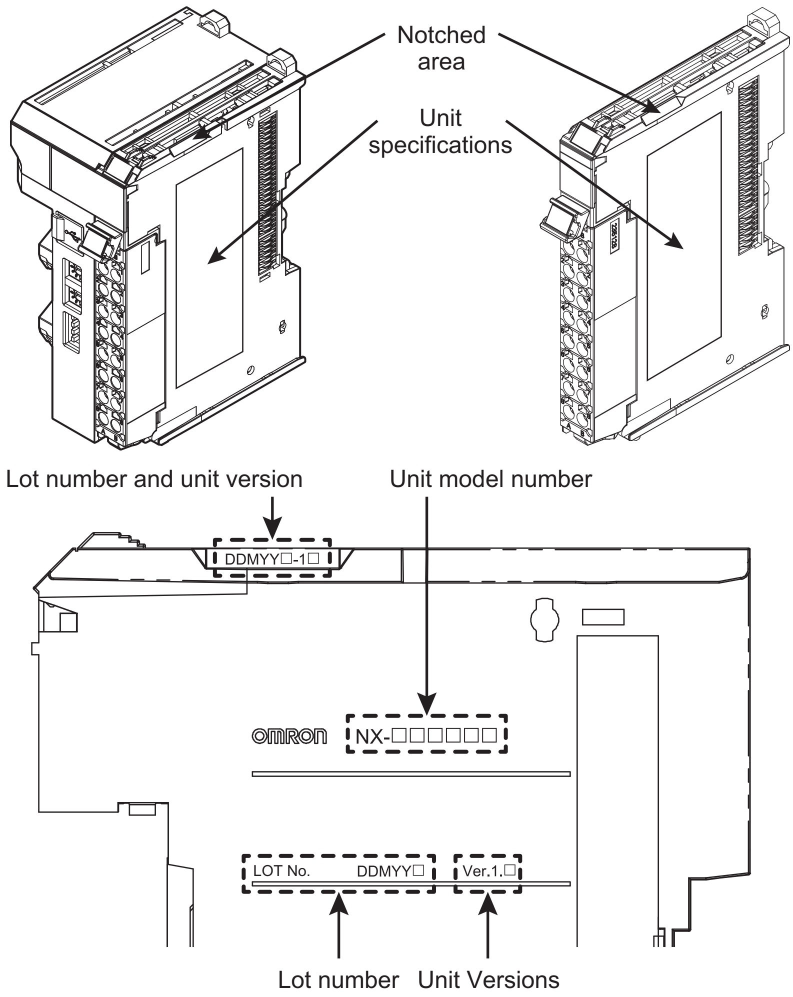
A “Unit version” has been introduced to manage the Units in the NX Series according to differences in functionality accompanying Unit upgrades. Even when two Units have the same model number,

they will have functional differences if they have different Unit versions.

An example is provided below for Slave Terminals. For the notation that is used for the unit versions of CPU Units or Industrial PCs and the confirmation method for unit versions, refer to the user's manual for each Unit.

Notation of Unit Versions on Products

The unit version is given with the Unit specifications on the side of the Unit or in the notched area.



The following information is provided in the Unit specifications on the Unit.

Name	Function
Unit model	Gives the model of the Unit.
Unit Versions	Gives the unit version of the Unit.
Lot number	Gives the lot number of the Unit. DDMYY□: Lot number, □: Used by OMRON. “M” gives the month (1 to 9: January to September, X: October, Y: November, Z: December)

The following information is provided in the notched area on the Unit.

Name	Function
Lot number and unit version	Gives the lot number and unit version of the Unit. • DDMYY□: Lot number, □: Used by OMRON. “M” gives the month (1 to 9: January to September, X: October, Y: November, Z: December) • 1□: Unit Versions The decimal portion of the unit version is omitted. (It is provided in the Unit specifications.)

Confirming Unit Versions with the Support Software

If your NX Unit is connected to a CPU Unit, refer to the user’s manual of the connected CPU Unit for the confirmation method for the unit version of the NX Unit.

If your NX Unit is connected to a Communications Coupler Unit, refer to the user’s manual of the connected Communications Coupler Unit for the confirmation method for the unit version of the Communications Coupler Unit and NX Unit.

Unit Versions and Support Software Versions

The functions that are supported depend on the unit version of the Unit. The version of Support Software that supports the functions that were added for an upgrade is required to use those functions. Refer to *A-6 Version Information with CPU Units* on page A-72 or *A-7 Version Information with Communications Coupler Units* on page A-73 for the functions that are supported by each unit version.

Related Manuals

The following table shows related manuals. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Purpose	Description
NX-series Advanced Temperature Control Unit User's Manual	H238	NX-HTC□□□□	Learning how to use NX-series Advanced Temperature Control Units	The hardware, setup methods, and functions of the NX-series Advanced Temperature Control Units are described.
NX-series Data Reference Manual	W525	NX-□□□□□□	Referencing lists of the data that is required to configure systems with NX-series Units	Lists of the power consumptions, weights, and other NX Unit data that is required to configure systems with NX-series Units are provided.
NX-series System Units User's Manual	W523	NX-PD1□□□ NX-PF0□□□ NX-PC0□□□ NX-TBX01	Learning how to use NX-series System Units	The hardware and functions of the NX-series System Units are described.
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC-SE2□□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
NX-IO Configurator Operation Manual	W585	CXONE-AL□□D-V4	Learning about the operating procedures and functions of the NX-IO Configurator.	Describes the operating procedures of the NX-IO Configurator.
NJ/NX-series Troubleshooting Manual	W503	NX701-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□ NX1P2-□□□□	Learning about the errors that may be detected in an NJ/NX-series Controller.	Concepts on managing errors that may be detected in an NJ/NX-series Controller and information on individual errors are described.
NY-series Troubleshooting Manual	W564	NY532-□□□□ NY512-□□□□	Learning about the errors that may be detected in an NY-series Industrial PC	Concepts on managing errors that may be detected in an NY-series Controller and information on individual errors are described.
NX-series EtherCAT® Coupler Unit User's Manual	W519	NX-ECC20□	Learning how to use the EtherCAT Coupler Unit and EtherCAT Slave Terminals.	The following items are described: the overall system and configuration methods of an EtherCAT Slave Terminal (which consists of an NX-series EtherCAT Coupler Unit and NX Units), and information on hardware, setup, and functions to set up, control, and monitor NX Units through EtherCAT.

Manual name	Cat. No.	Model numbers	Purpose	Description
NX-series EtherNet/IP™ Coupler Unit User's Manual	W536	NX-EIC202	Learning how to use an NX-series EtherNet/IP Coupler Unit and EtherNet/IP Slave Terminals.	The following items are described: the overall system and configuration methods of an EtherNet/IP Slave Terminal (which consists of an NX-series EtherNet/IP Coupler Unit and NX Units), and information on hardware, setup, and functions to set up, control, and monitor NX Units.
NX-series CPU Unit Hardware User’s Manual	W535	NX701-□□□□	Learning the basic specifications of the NX-series NX701 CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NX701 CPU Unit system is provided along with the following information on the CPU Unit. • Features and system configuration • Overview • Part Names and Functions • General specifications • Installation and wiring • Maintenance and Inspection
NX-series NX1P2 CPU Unit Hardware User’s Manual	W578	NX1P2-□□□□	Learning the basic specifications of the NX-series NX1P2 CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NX1P2 CPU Unit system is provided along with the following information on the CPU Unit. • Features and system configuration • Overview • Part Names and Functions • General specifications • Installation and wiring • Maintenance and Inspection
NJ-series CPU Units Hardware User’s Manual	W500	NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning the basic specifications of the NJ-series CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NJ-series system is provided along with the following information on the CPU Unit. • Features and system configuration • Overview • Part Names and Functions • General specifications • Installation and wiring • Maintenance and Inspection
NY-series IPC Machine Controller Industrial Panel PC User's Manual Hardware	W557	NY532-□□□□	Learning the basic specifications of the NY-series Industrial Panel PCs, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NY-series system is provided along with the following information on the Industrial Panel PC. • Features and system configuration • Overview • Part Names and Functions • General specifications • Installation and wiring • Maintenance and Inspection

Manual name	Cat. No.	Model numbers	Purpose	Description
NY-series IPC Machine Controller Industrial Box PC Hardware User's Manual	W556	NY512-□□□□	Learning the basic specifications of the NY-series Industrial Box PCs, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NY-series system is provided along with the following information on the Industrial Box PC. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NJ/NX-series CPU Units Software User's Manual	W501	NX701-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□ NX1P2-□□□□	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software information is provided.	The following information is provided on an NJ/NX-series CPU Unit. • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC User's Manual Software	W558	NY532-□□□□ NY512-□□□□	Learning how to program and set up the Controller functions of an NY-series Industrial PC	The following information is provided on NY-series Machine Automation Control Software. • Controller operation • Controller features • Controller settings • Programming based on IEC 61131-3 language specifications
NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	W505	NX701-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□ NX1P2-□□□□	Using the built-in EtherCAT port on an NJ/NX-series CPU Unit	Information on the built-in EtherCAT port is provided. This manual provides an introduction and provides information on the configuration, features, and setup.
NY-series Industrial Panel PC / Industrial Box PC Built-in EtherCAT® Port User's Manual	W562	NY532-□□□□ NY512-□□□□	Using the built-in EtherCAT port on an NY-series Industrial PC	Information on the built-in EtherCAT port is provided. This manual provides an introduction and provides information on the configuration, features, and setup.
NJ/NX-series Instructions Reference Manual	W502	NX701-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□ NX1P2-□□□□	Learning detailed specifications on the basic instructions of an NJ/NX-series CPU Unit.	The instructions in the instruction set (IEC 61131-3 specifications) are described.
NY-series Instructions Reference Manual	W560	NY532-□□□□ NY512-□□□□	Learning detailed specifications on the basic instructions of an NY-series Industrial PC	The instructions in the instruction set (IEC 61131-3 specifications) are described.

Terminology

Term	Abbreviation	Description
2-PID control	---	A PID control method that simultaneously achieves two characteristics, set point tracking and disturbance suppression.
application layer status, AL status	---	Status for indicating information on errors that occur in an application on a slave.
autotuning	AT	A tuning method that derives the PID constant. It uses the limit cycle method to automatically calculates the PID constant corresponding to the characteristics of the control target.
bumpless	---	The function by which the MV immediately before the switching is inherited during switching from Manual Mode to Auto Mode.
CAN application protocol over EtherCAT	CoE	A CAN application protocol service implemented on EtherCAT.
CAN in Automation	CiA	CiA is the international users' and manufacturers' group that develops and supports higher-layer protocols.
channel	ch	The unit of the temperature control loop in the Advanced Temperature Control Unit.
Communications Coupler Units	---	The generic name of an interface Unit for remote I/O communications on a network between NX Units and a host network master.
CT	CT	An acronym for current transformer. A CT is a current sensor that performs non-contact measurement of alternating currents.
CPU Rack	---	A rack to which a CPU Unit is mounted. For an NX-series CPU Unit to which NX Units can be connected, a CPU Rack refers to a configuration which consists of the CPU Unit, NX Units, and End Covers.
DC time	---	Time indicated by the clock shared between the CPU Unit and the NX Units in a CPU Rack with an NX-series CPU Unit to which NX Units can be connected. EtherCAT slaves that support distributed clock synchronization have a clock that is shared by all slaves in the network. The time that is based on this distributed clock is called the DC time. The same clock is shared by the CPU Unit, NX Units connected to the CPU Unit, and applicable EtherCAT slaves.
device profile	---	A collection of device dependent information and functionality providing consistency between similar devices of the same device type.
device variable	---	A variable that is used to access a specific device through an I/O port by an NJ/NX-series CPU Unit or NY-series Industrial PC. Process data on an EtherCAT slave is allocated to this variable. With an NX-series CPU Unit to which NX Units can be connected, I/O data is assigned to NX Units in the CPU Unit. A user application on a CPU Unit or Industrial PC accesses a device that can be connected, by directly reading and writing this device variable.
distributed clock	DC	Clock distribution mechanism used to synchronize EtherCAT slaves and the EtherCAT master.
EtherCAT slave controller	ESC	A controller for EtherCAT slave communications.
EtherCAT slave information	ESI	An XML file that contains setting information for an EtherCAT slave.
EtherCAT state machine	ESM	An EtherCAT communications state machine.
EtherCAT Technology Group	ETG	The ETG is a global organization in which OEM, end users, and technology providers join forces to support and promote the further technology development.

Term	Abbreviation	Description
EU	---	“EU” stands for Engineering Unit. EU is used as the minimum unit for engineering units such as °C, m, and g. The size of the EU depends on the input type. For example, when the input temperature setting range is −200 to 1,300°C, 1 EU is 1°C, and when the input temperature setting range is −20.0 to 500.0°C, 1 EU is 0.1°C. For analog inputs, the size of the EU depends on the decimal point position of the scaling setting, and 1 EU is the minimum scaling unit.
FF (feedforward) control	---	A control method that performs the required correction operation when a disturbance cause occurs. This is performed before the controlled system is affected, such as before a temperature disturbance occurs.
heating and cooling control type	---	The control type of an Advanced Temperature Control Unit that controls both heating and cooling by two outputs per channel.
hunting	---	The phenomenon in which the measured value oscillates around the set point after reaching the set point.
I/O map settings	---	Settings that assign variables to I/O ports. Assignment information between I/O ports and variables.
I/O port	---	A logical interface that is used by the NJ/NX-series CPU Unit or NY-series Industrial PC to exchange data with an external device (slave or Unit).
I/O refreshing	---	Cyclic data exchange with external devices that is performed with predetermined memory addresses.
index	---	Address of an object within an application process.
linear current output	---	Current output of continuous value.
Loop Burnout Alarm	LBA	A function by which an alarm is output indicating an error somewhere in the control loop when the deviation (Set point - Measured value) does not change by a fixed width (LBA detection width) within a fixed time.
manipulated variable	MV	Measured factors, such as a current temperature, in the Advanced Temperature Control Units.
measured value	PV	A measured current temperature in the Advanced Temperature Control Unit.
network configuration information	---	The EtherCAT network configuration information held by the EtherCAT master.
NX bus	---	The NX-series internal bus.
object	---	An abstract representation of a particular component within a device, which consists of data, parameters, and methods.
object dictionary	OD	Data structure that contains description of data type objects, communication objects and application objects.
Operational	---	A state in which I/O refresh communications and NX message communications are possible between the communications master and the Communications Coupler Unit or NX Units.
overshooting	---	A state where the process value exceeds the set point after reaching it.
PDO communications	---	An acronym for process data communications.
Pre-Operational	---	A state in which NX message communications are possible between the communications master and the Communications Coupler Unit or NX Units, but I/O refresh communications are not possible.
primary periodic task	---	The task with the highest priority.
process data	---	Collection of application objects designated to be downloaded cyclically or acyclically for the purpose of measurement and control.
process data communications	---	One type of EtherCAT communications in which process data objects (PDOs) are used to exchange information cyclically and in realtime. This is also called PDO communications.
process data object	PDO	A structure that describes the mappings of parameters that have one or more process data entities.
receive PDO	RxPDO	A process data object received by an EtherCAT slave.

Term	Abbreviation	Description
Safe-Operational	---	A state in which input refresh communications and NX message communications are possible between the communications master and the Communications Coupler Unit or NX Units, but output refresh communications are not possible.
SDO communications	---	One type of EtherCAT communications in which service data objects (SDOs) are used to transmit information whenever required.
service data object	SDO	CoE asynchronous mailbox communications where all objects in the object dictionary can be read and written.
set point	SP	The target control amount of feedback control.
Slave Information Interface	SII	Slave information that is stored in non-volatile memory in the slave.
Slave Terminal	---	A building-block remote I/O terminal to which a Communications Coupler Unit and NX Units are mounted
SSR	SSR	An acronym for solid-state relay. An SSR is a relay that does not have contacts.
standard control type	---	The control type of an Advanced Temperature Control Unit that controls either heating or cooling by one output per channel.
subindex	---	Sub-address of an object within the object dictionary.
Sync0	---	A signal that gives the interrupt timing based on the distributed clock (DC) in EtherCAT communications. The slaves execute controls according to this interrupt timing.
Sync Manager	SM	Collection of control elements to coordinate access to concurrently used objects.
system fluctuation	---	Temperature variation within and outside the temperature control loop. Example 1: Deterioration of devices such as the heater Example 2: Seasonal changes in the ambient temperature
system performance evaluation	---	One of the operations of adaptive control function of the Advanced Temperature Control Unit. The temperature-rise performance is evaluated by the inclination during the rise in temperature. The system performance is evaluated each time the temperature rises, and the evaluation result is used to determine whether a system fluctuation has occurred.
task period	---	The interval at which the primary periodic task or a periodic task is executed.
temperature control loop	---	A feedback control loop including a temperature input sensor, a controller, and an output device such as the heater.
time-proportional output	---	The function that controls the control output with the supplied manipulated variable as a duty ratio.
transmit PDO	TxPDO	A process data object sent from an EtherCAT slave.
voltage output for driving SSR	---	A voltage output used to drive an SSR.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

Cat. No. H238-E1-01

Revision code

Revision code	Date	Revised content
01	April 2023	Original production

Sections in this Manual

1

Features and System Configuration

This section describes the NX system configuration and the types of Advanced Temperature Control Units.

1-1 Common Features of Advanced Temperature Control Units

The Advanced Temperature Control Units receive signals from the temperature sensor or analog input and control the heater temperature to reach the set point. The temperature sensor supports thermocouple input and resistance thermometer input; the analog input supports current (4 to 20 mA/0 to 20 mA) or voltage (0 to 5 V/0 to 10 V/1 to 5 V). It also has functions to monitor the CT current value and to detect a heater burnout or SSR failures.

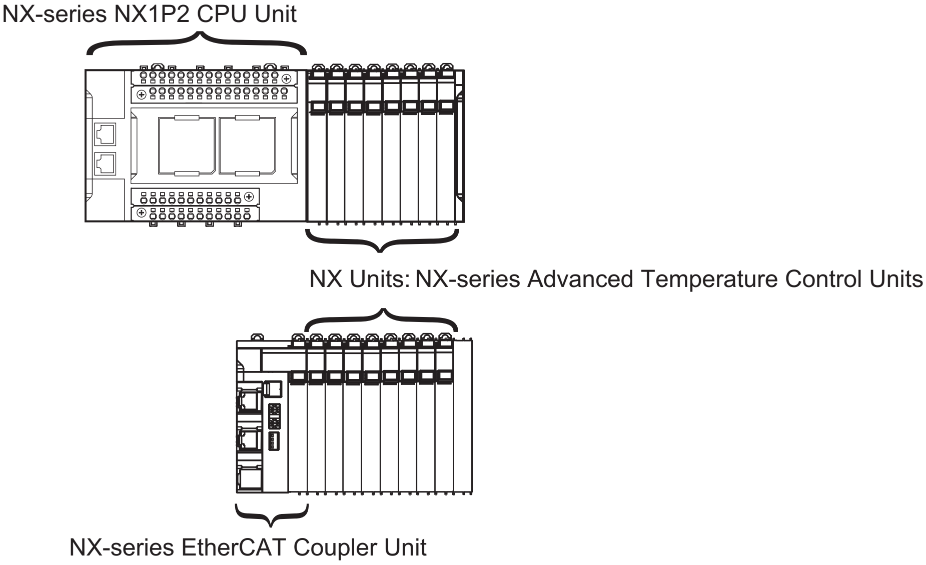
1-1-1 Connectable to CPU Units or Communications Coupler Units

The Advanced Temperature Control Units can be connected to the following Units.*1

- NX-series CPU Unit
- NX-series Communications Coupler Unit

When a CPU Unit and a Communications Coupler Unit are used together, you can unify the methods for installing, wiring, and setting up NX Units, thus being able to reduce design costs.

Example:



*1. For whether NX Units can be connected to the CPU Unit or Communications Coupler Unit to be used, refer to the user's manual for the CPU Unit or Communications Coupler Unit to be used.

1-1-2 Unnecessary to Create the User Program for Temperature Control

Using the Advanced Temperature Control Unit makes it unnecessary to create a user program for temperature control, such as PID operation and time-proportional output, with the CPU Unit or Industrial PC. The Advanced Temperature Control Unit receives the measured values and controls the manipulated variable to reach the set point.

1-1-3 Up to 8-channel Control Points Provided with the 30 mm-Wide Unit (Standard Control Type Only)

The Advanced Temperature Control Units have a maximum of 8-channel control points (for standard control type) with a unit width of 30 mm (4 channels for the heating and cooling control type). The Units allow for multi-point temperature control in a more compact space than two conventional NX-TC Temperature Control Units with 4 channels in the standard control type (48 mm).

1-1-4 Easy I/O Wiring with MIL Connectors

The Advanced Temperature Control Units use the MIL connectors (34 pins/2 rows). Connect input/output wiring from the MIL connector to a Ultra-Compact Interface Wiring System (XW2K-34G-T) which is sold separately. Since the external terminal blocks are used for I/O wiring, no calibration management is required for the terminal blocks.

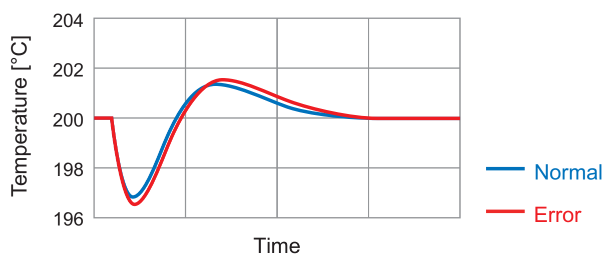
Refer to *Section 4 Installation and Wiring* for details on the wiring method.

1-1-5 Monitoring Temperature Control Waveform to Detect Equipment Abnormalities

Conventional Way of Monitoring Temperature Control Waveform

In production processes, where precise temperature control is needed, control waveforms (e.g., average temperature, maximum temperature, minimum temperature) are monitored to detect workpiece defects or equipment failures. However, subtle temperature changes, as shown in the example below, are difficult to capture.

● Example of Temperature Control Waveform Changes



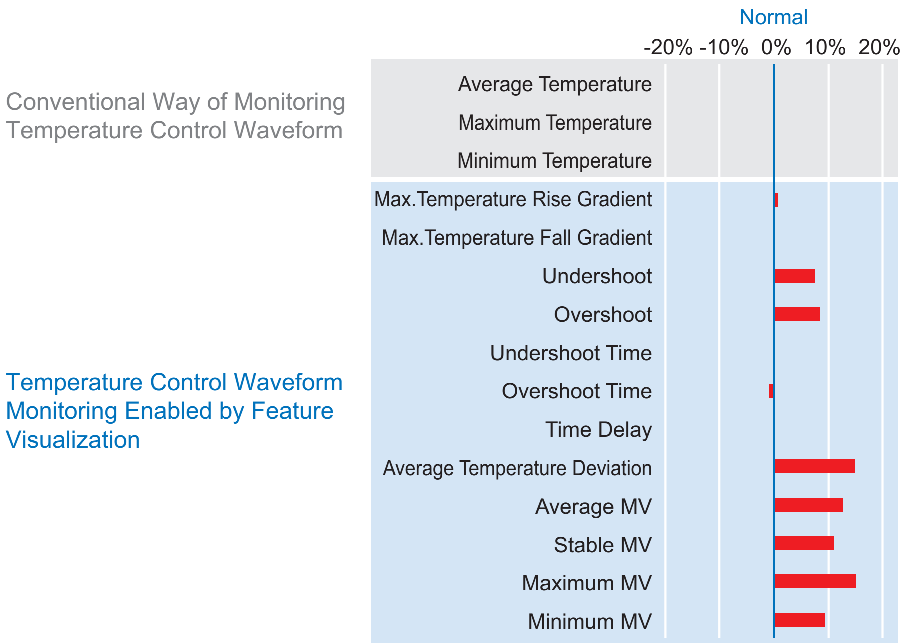
Temperature Control Waveform Monitoring Enabled by Feature Visualization of the Advanced Temperature Control Units

With the Advanced Temperature Control Units, subtle changes in workpieces and environments can be captured through parameters used to monitor temperature and measured values.

Parameters used to monitor temperature:	Overshoot value, undershoot value, time delay, etc.
Parameters used to monitor MV:	Average MV, Stable MV, Maximum MV, etc.

These parameters are referred to as features (feature values). The feature visualization function automatically calculates these features and allows you to detect subtle changes.

● Example of Subtle Changes Detected by the Feature Visualization



For details of the feature visualization function, refer to *7-8 Feature Visualization* on page 7-101.

1-1-6 Universal Input Supported

The input sensor can be set to any of the followings: thermocouple, resistance thermometer, current, and voltage.

Thermocouple input:	K, J, T, E, L, U, N, R, S, B, C/W, PL II
Platinum resistance thermometer input:	Pt100, JPt100
Analog input:	Current (4 to 20 mA/0 to 20 mA), Voltage (1 to 5 V/0 to 5 V/0 to 10 V)

1-1-7 0.01°C Increments Supported

Input types in 0.01°C increments are available for K thermocouple and Pt100 sensors.

- K thermocouple: -50.00 to 700.00°C
- Pt100: -200.00 to 500.00°C

1-1-8 Significant Digits of Single-Precision Floating-Point Values as REAL Data

With using REAL-type measured values, single-precision floating-point values can be represented with significant digits. This allows the values internally processed by this unit to be utilized in the higher-level system.

Example:

[Conventional]: 123.5000°C
[NX-HTC]: 123.4567°C

1-1-9 Heating/Cooling Control Supported (Voltage Output (for driving SSR) (Heating) + Linear Current Output (Cooling))

The following heating/cooling controls are available for the output type.

- Voltage Output (for driving SSR) (Heating) + Linear Current Output (Cooling)

1-1-10 Other Features (Common Features of NX-TC Temperature Control Units)

- The input type can be set independently for each channel.
- You can select either ON/OFF control or PID control.
- You can specify the manipulated variable to output.
- A preset manipulated variable can be output when a Sensor Disconnected Error occurs (MV at Error).
- You can select whether to continue control using a preset operation or to output a preset manipulated variable when a communication error occurs with the CPU Unit or Communications Coupler Unit (Load Rejection MV).
- You can specify the number of display digits after the decimal point for INT-type parameters of measured values, set points and alarm values (including alarm upper and lower limits).
- The manipulated variables of a channel can be output to other channels by using the MV Branch function.
- A temperature alarm can be detected.
- Adjustment parameters such as PID constants can be changed in the I/O data.

1-1-11 Specification Difference between the Temperature Control Units and Advanced Temperature Control Units

The table below lists the main differences in specifications between the NX-TC Temperature Control Units and the NX-HTC Advanced Temperature Control Units.

Item	NX-TC	NX-HTC
Control points (Number of channels)	2 channels or 4 channels	4 channels or 8 channels
Unit width	12 mm or 24 mm	30 mm
Terminal block	Screwless clamping terminal block type (Push-in Plus)	Unit with MIL Connector (Connected to the external Ultra-Compact Interface Wiring System XW2K-34G-T via the MIL connector)
Sensor input	Multiple input • Thermocouple input:K, J, T, E, L, U, N, R, S, B, C/W, PL II • Platinum resistance thermometer input: Pt100 (3-wire type), JPt100 (3-wire type), Pt1000 (3-wire type)	Universal input • Thermocouple input:K, J, T, E, L, U, N, R, S, B, C/W, PL II • Platinum resistance thermometer input: Pt100 (3-wire type), JPt100 (3-wire type) • Analog input: Current (4 to 20 mA/0 to 20 mA), Voltage (1 to 5 V/0 to 5 V/0 to 10 V)
Minimum resolution	0.1°C	0.01 °C max. (input type is thermocouple K (-50 to 700 °C), Pt100 (-200 to 500 °C) only) Other temperature inputs: 0.1°C max.

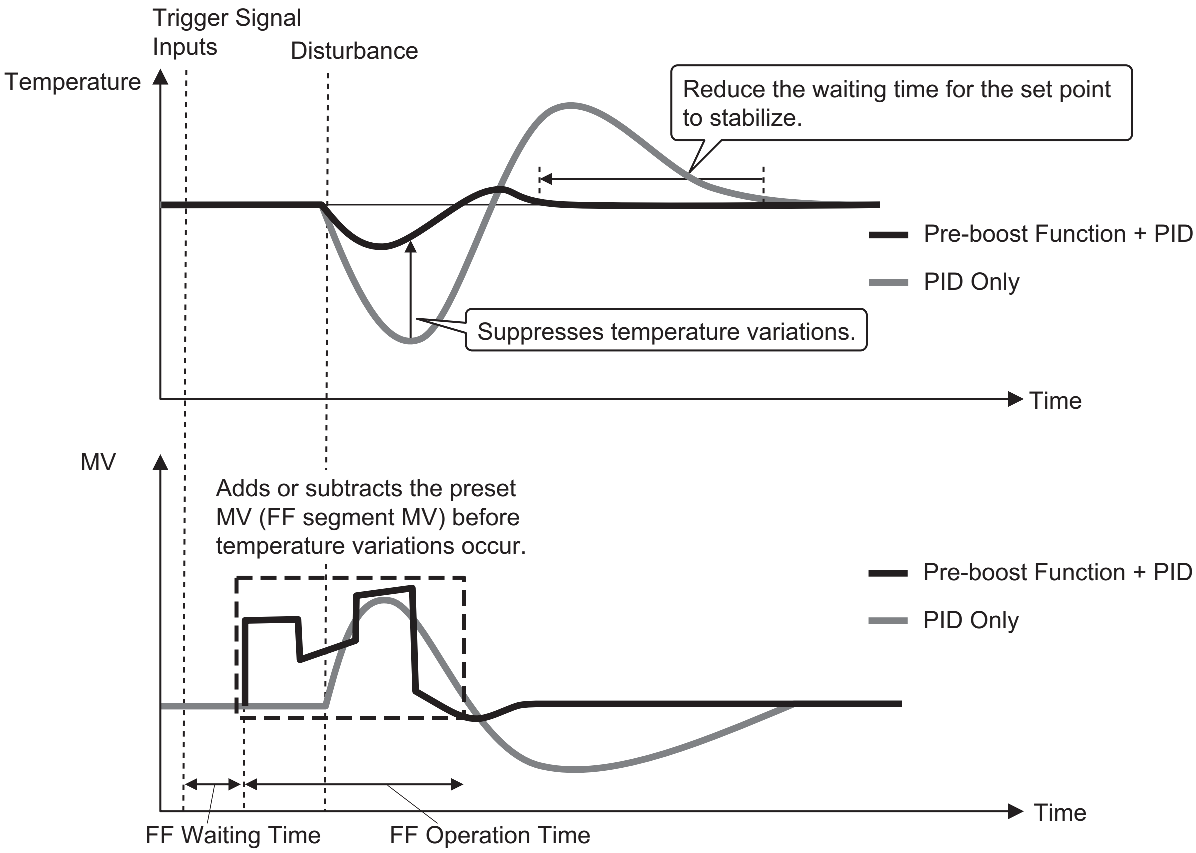
Item	NX-TC	NX-HTC
Storage location for the Unit operation settings	CPU Unit or Communications Coupler Unit to be used	NX-HTC Unit internal memory
Operation command	0: Run 1: Stop	0: Stop 1: Run
Temperature sensor for packing machines and automatic filter adjustment water cooling adjustment	Available	Not available
Water cooling adjustment	Available	Not available
Adaptive control	Available	Not available
Feature visualization	Not available	Available
Control output type	Voltage output (for driving SSR) Heating/cooling control: Voltage output (for driving SSR) (heating) + Voltage output (for driving SSR) (cooling) Linear current output	Voltage output (for driving SSR) Heating/cooling control: Voltage output (for driving SSR) (heating) + Linear current output (cooling)
Single-precision floating point support for measured values (REAL type)	Not available Measured data: 123.456°C (for input type with 1 decimal point) Measured value (REAL type): 123.500°C	Available Actual measurement data: 123.456 °C (for input type with one decimal place) Measured value (REAL type): 123.456 °C
Number of Data Set	INPUT Data Set: 1 OUTPUT Data Set: 1	INPUT Data Set: 4 OUTPUT Data Set: 3

1-2 Features of Standard Control Type (NX-HTC4505)

1-2-1 Disturbance Suppression (Pre-boost Function) to Suppress Temperature Variations Caused by Disturbances

With deposition, molding, and other equipment, temperature variations may occur as a result of performing actions such as loading a workpiece. Temperature variations due to such predictable causes of disturbance can be suppressed to achieve stable temperature control by using the pre-boost function.

This contributes to improvements in productivity by shortening the time required for the set point to stabilize and reducing the number of defective products.



Disturbance suppression (Pre-boost function)

The pre-boost function adds or subtracts the preset manipulated variable to/from the manipulated variable calculated by the Temperature Control Unit before temperature variations occur due to a disturbance.

This pre-boost function performs operation based on the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters, which are calculated automatically by executing D-AT (disturbance autotuning).

The pre-boost function is implemented by inputting a trigger signal to the Temperature Control Unit before temperature variations occur due to a disturbance. The pre-boost function can be used with unit version 1.2 or later.

For details, refer to *7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61.

D-AT (disturbance autotuning)

D-AT (disturbance autotuning) is an adjustment function to automatically calculate and set the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters. Execute D-AT before you use the pre-boost function.

For details, refer to *7-5-2 D-AT (Disturbance Autotuning)* on page 7-71.

1-3 Features of Heating/Cooling Control Type (NX-HTC3510)

1-3-1 Control Output Configuration Combining Voltage for Heating and Linear Current for Cooling

The Advanced Temperature Control Units allow you to set the heating side to voltage output and the cooling side to linear current output.

With this feature, the Advanced Temperature Control Units can control up to 4 channels of proportional valves on the cooling side.

Control type	Outputs	
	Output type	Number of output points per channel
Heating and cooling control	Voltage output (for driving SSR)	1 point per channel
	Linear current output	1 point per channel

Refer to *1-6-3 Application Examples of Heating/Cooling Control* on page 1-24 for application examples.

1-4 System Configuration

The NX-series Advanced Temperature Control Units, one type of NX Units, can be connected to the following Units.

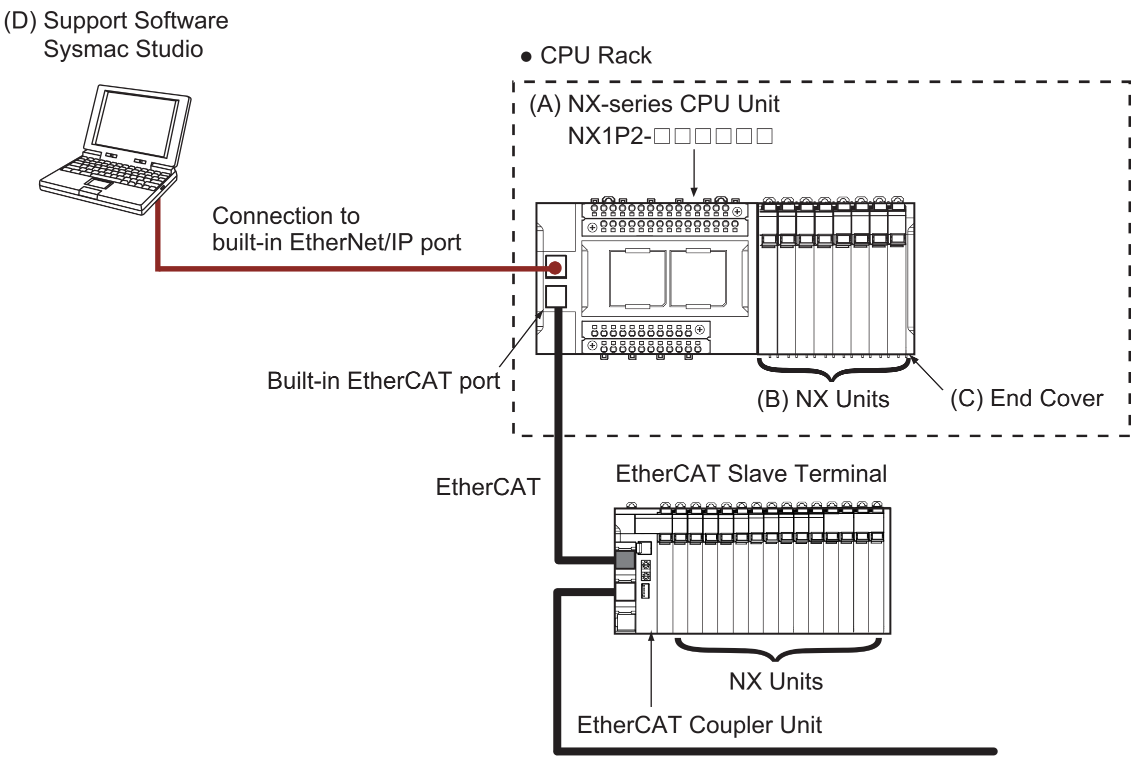
- NX-series CPU Unit
- NX-series Communications Coupler Unit

This section describes the system configuration for each connection of the NX Units.

1-4-1 System Configuration in When Connecting to a CPU Unit

The following figure shows a system configuration when a group of NX Units is connected to an NX-series NX1P2 CPU Unit. You can connect the EtherCAT Slave Terminal to the built-in EtherCAT port on the CPU Unit. Refer to *1-4-2 System Configuration of Slave Terminals* on page 1-12 for details on the system configuration of a Slave Terminal.

For information on system configurations when connecting to any other type of CPU Units, refer to the user's manual for the CPU Unit used in the system.



Symbol	Item	Description
(A)	NX-series CPU Unit	The Unit, which serves as the center of control for a Machine Automation Controller, performs operations such as executing tasks and refreshing I/O for other Units and Slaves. NX Units can be connected to an NX1P2 CPU Unit.
(B)	NX Units	The NX Units perform I/O processing with connected external devices. The NX Units exchange data with the CPU Unit through I/O refreshing. A maximum of eight NX Units can be connected to an NX1P2 CPU Unit.
(C)	End Cover	The End Cover is attached to the end of a CPU Rack.
(D)	Support Software (Sysmac Studio)	A computer software application for setting, programming, debugging, and troubleshooting NJ/NX/NY-series Controllers. For NX1P2 CPU Units, connect to the the built-in EtherNet/IP port to make settings with this Software.

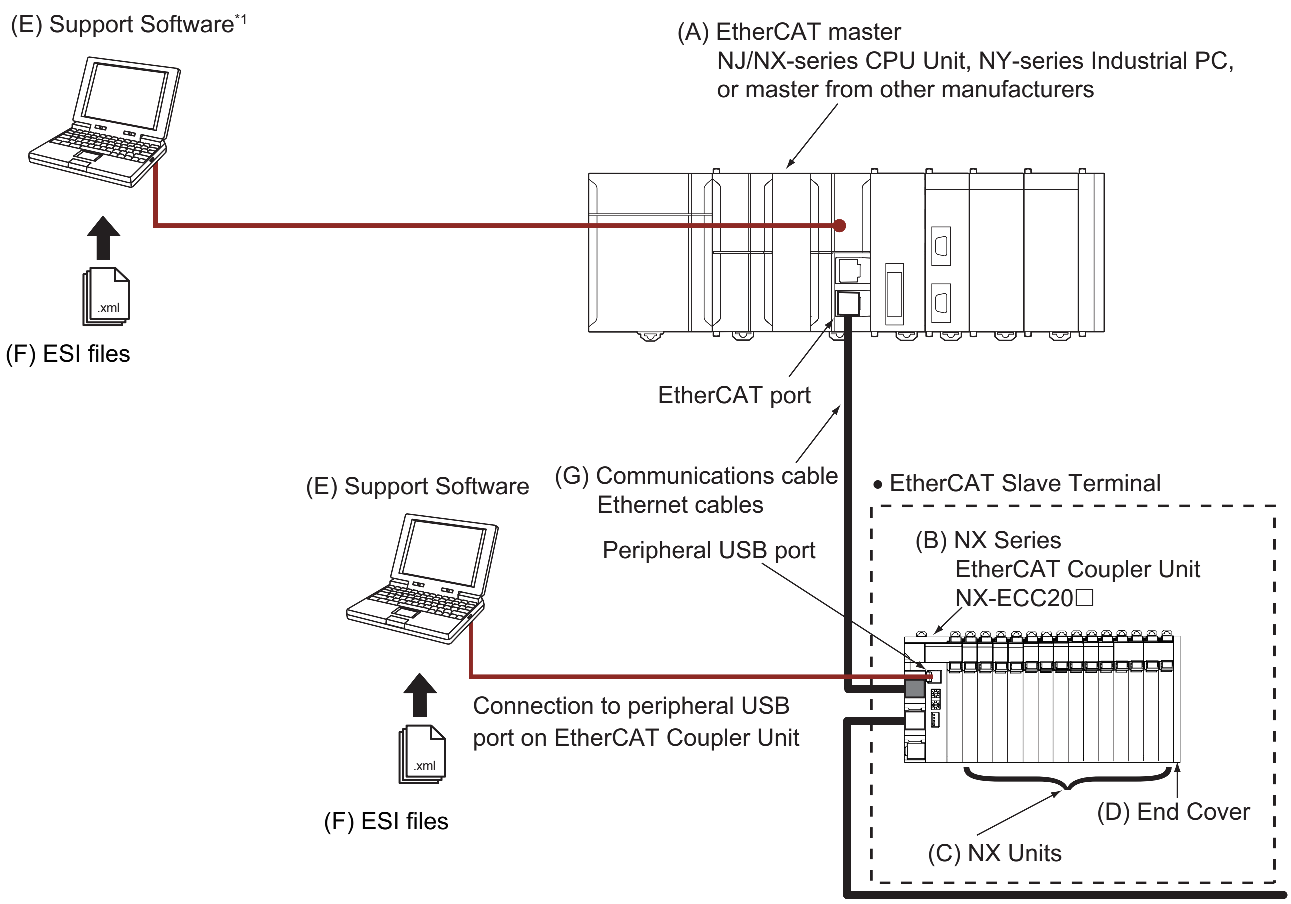
1-4-2 System Configuration of Slave Terminals

A building-block remote I/O slave provided with a group of NX Units connected to a Communications Coupler Unit is generically called a Slave Terminal.

The NX Units can be flexibly combined with a Communications Coupler Unit to achieve the optimum remote I/O slave for the application with less wiring, less work, and less space.

The following figure shows an example of the system configuration when an EtherCAT Coupler Unit is used as a Communications Coupler Unit.

For information on system configurations when connecting to any other type of Communications Coupler Units, refer to the user's manual for the Communications Coupler Unit used in the system.



*1. The connection method for the Support Software depends on the model of the CPU Unit or Industrial PC.

Letter	Item	Description
(A)	EtherCAT master *1	The EtherCAT master manages the network, monitors the status of slaves, and exchanges I/O data with slaves.
(B)	EtherCAT Coupler Unit	The EtherCAT Coupler Unit serves as an interface for process data communications on the EtherCAT network between the NX Units and the EtherCAT master. The I/O data for the NX Units is accumulated in the EtherCAT Coupler Unit and then all of the data is exchanged with the EtherCAT master at the same time. The EtherCAT Coupler Unit can also perform message communications (SDO communications) with the EtherCAT master.
(C)	NX Units	The NX Units perform I/O processing with connected external devices. The NX Units perform process data communications with the EtherCAT master through the EtherCAT Coupler Unit.
(D)	End Cover	The End Cover is attached to the end of the Slave Terminal.
(E)	Support Software *2 *3	A computer software application for configuring the EtherCAT network and EtherCAT Slave Terminal, as well as for programming, monitoring and troubleshooting the Controllers.
(F)	ESI (EtherCAT Slave Information) file	The ESI files contain information that is unique to the EtherCAT Slave Terminals in XML format. You can load an ESI file into the Support Software to easily allocate Slave Terminal process data and make other settings. The ESI files for OMRON EtherCAT slaves are installed in the Support Software. You can obtain the ESI files for the latest models through the Support Software's automatic update function.
(G)	Communications cable	The communications cable must be use a double-shielded cable with aluminum tape and braiding of Ethernet category 5 (100Base-TX) or higher, and use straight wiring.

*1. An EtherCAT Slave Terminal cannot be connected to any of the OMRON CJ1W-NC□81/□82 Position Control Units even though they can operate as EtherCAT masters.

*2. The Support Software means software that is provided by OMRON. If you connect to a master from other company, use the software tool corresponding to that master.

*3. Refer to *1-9 Support Software* on page 1-30 for information on Support Software.

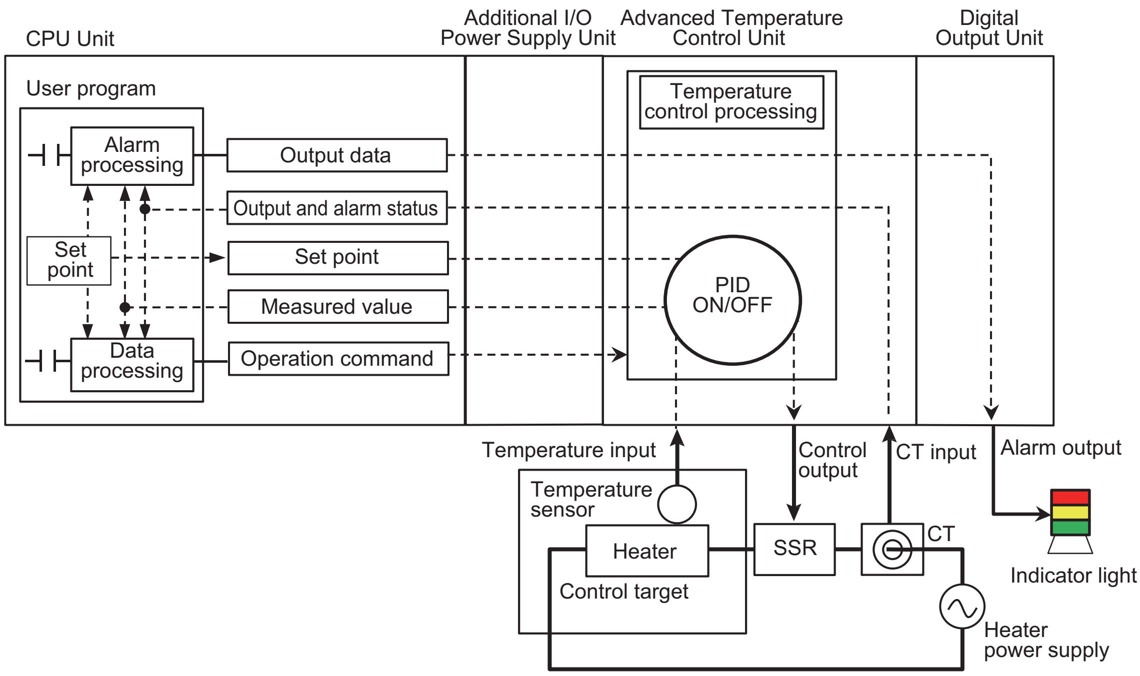
1-5 Temperature Control System

This section describes the temperature control system that combines an Advanced Temperature Control Unit with a CPU Unit or Industrial PC and gives application examples. It also gives an overview of the data stored in the Advanced Temperature Control Unit and the method for accessing such data.

1-5-1 Temperature Control System

The temperature control system can be configured by combining an Advanced Temperature Control Unit with a CPU Unit or Industrial PC. The Advanced Temperature Control Unit controls the temperature according to the set points and operation commands provided by the CPU Unit or Industrial PC. Furthermore, a model with CT inputs detects heater burnout and SSR failures, and notifies the CPU Unit or Industrial PC of the events. The CPU Unit or Industrial PC processes alarm outputs in response to these notifications to prevent the creation of defective products or damage to the machine.
The roles and operations of each Unit are described below for each connection destination.

Connected to a CPU Unit



● Roles of each Unit

The roles of the Units are as follows:

Unit name	Function
CPU Unit	The CPU Unit executes the following user programs: • Set points and operation commands to Advanced Temperature Control Unit • Data processing of measured values and statuses from the Advanced Temperature Control Unit, and alarm outputs to the Digital Output Unit
Advanced Temperature Control Units	The Advanced Temperature Control Unit controls the temperature of the controlled system according to the set points and operation commands provided by the CPU Unit. It also notifies the CPU Unit of the temperature (measured value) of the controlled system and data such as output and alarm statuses.

● Detailed operation

Details of the operation are described below.

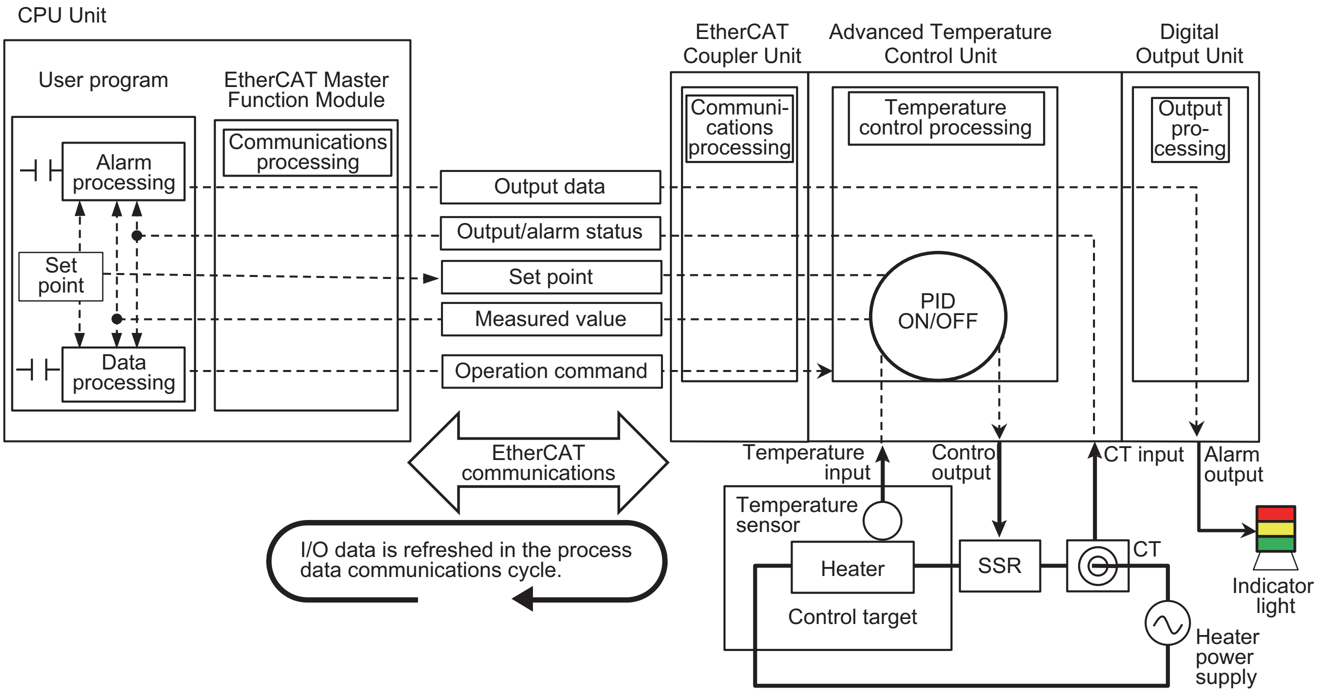
- The CPU Unit transmits the set points and operation commands to the Advanced Temperature Control Unit during each refresh cycle of the NX bus.
- The Advanced Temperature Control Unit controls the temperature of the controlled system according to the set points and operation commands. The Unit monitors inputs from the temperature sensor and CT, and it reflects an error into the output and alarm status when it occurs.
- The temperature data from the controlled system measured by the Advanced Temperature Control Unit and the output and alarm statuses are sent to the CPU Unit during each refresh cycle of the NX bus.
- The CPU Unit generates a control stop operation command or a changed set point based on the output and alarm statuses. When you use the temperature alarm function of the Temperature Control Unit, the data to be output to the digital output unit is generated based on the processing results notified by the output and alarm statuses. When you do not use the temperature alarm function, the alarm processing is performed based on the set point and measured value, and the data to be output to the Digital Output Unit is generated.*1
- The CPU Unit transmits the operation command or changed set point to the Advanced Temperature Control Unit during each refresh cycle of the NX bus. The alarm output data is sent to the Digital Output Unit during each refresh cycle of the NX bus.
- The Advanced Temperature Control Unit controls the temperature of the controlled system according to the changed set point or operation command.
- The Digital Output Unit outputs alarms according to the output data.

*1. The temperature alarm function is supported by Temperature Control Units with unit version 1.1 or later.

Refer to *1-5-2 Overview of the Data in the Advanced Temperature Control Unit and the Access Method* on page 1-18 for an overview of the data stored in the Advanced Temperature Control Unit and the data access method.

Connected to Communications Coupler Unit

This section describes the role and operations of each Unit when an EtherCAT Coupler Unit is used as a Communications Coupler Unit.



● Roles of each Unit

The roles of the Units are as follows:

Unit name	Function
CPU Unit	The CPU Unit executes the following user programs. • Set points and operation commands to the Advanced Temperature Control Unit • Data processing of measured values and statuses from the Advanced Temperature Control Unit, and alarm outputs to the Digital Output Unit
EtherCAT Coupler Unit	The EtherCAT Coupler Unit exchanges data with the CPU Unit via EtherCAT communications. It also exchanges data with the Temperature Control Unit.
Advanced Temperature Control Unit	The Advanced Temperature Control Unit controls the temperature of the controlled system according to the set points and operation commands provided by the CPU Unit. It also notifies the CPU Unit of the temperature (measured value) of the controlled system and data such as output and alarm statuses.

Detailed operation

Details about the temperature control system are described below.

- The CPU Unit transmits the set points and operation commands to the Advanced Temperature Control Unit in each EtherCAT process data communication cycle via PDO communications.
- The Advanced Temperature Control Unit controls the temperature of the control target according to the set points and operation commands. In addition, the Unit monitors inputs from the temperature sensor and CT and it generates an output and alarm status when an error occurs.
- The temperature data from the controlled system measured by the Advanced Temperature Control Unit and the output and alarm statuses are sent to the CPU Unit in each EtherCAT process data communication cycle.
- The CPU Unit generates a control stop operation command or a changed set point based on the output and alarm statuses. When you use the temperature alarm function of the Advanced Temperature Control Unit, the data to be output to the Digital Output Unit is generated based on the processing results notified by the output and alarm statuses. When you do not use the temperature alarm function, the alarm processing is performed based on the set point and temperature data, and the data to be output to the Digital Output Unit is generated.
- The CPU Unit transmits the operation command or changed set point to the Advanced Temperature Control Unit during each process data communications cycle for EtherCAT communications. The alarm output data is sent to the Digital Output Unit during each process data communications cycle of EtherCAT communications.
- The Advanced Temperature Control Unit controls the temperature of the controlled system according to the changed set point or operation command.
- The Digital Output Unit outputs alarms according to the output data.

Refer to *1-5-2 Overview of the Data in the Advanced Temperature Control Unit and the Access Method* on page 1-18 for an overview of the data stored in the Temperature Control Unit and the data access method.

1-5-2 Overview of the Data in the Advanced Temperature Control Unit and the Access Method

This section gives an overview of the data stored in the Advanced Temperature Control Unit and the data access method. Refer to *I/O Data Specifications and Lists of Settings* on page 6-1 for details of the data stored in the Advanced Temperature Control Unit.

Data			Access method
Name*1	**Purpose**	**Description**	
I/O data	For operation	The data below is used for operations or monitoring during machine operation. • Output data Set points, manual manipulated variables, operation commands, alarm values, alarm values upper limit, and alarm values lower limit • Input data Measured values, manipulated variable monitor, operation status, operation status2, and output and alarm statuses, feature value monitor	Make I/O allocation, and read or write the relevant I/O data by executing general purpose instructions from the user program.
	For adjustment	The data below is operated or monitored in Adjusting Unit Operation. Data changes can be applied immediately. • Output data PID constants, heater burnout detection current, SSR failure detection current, PV input shift value, input digital filter, hysteresis (heating), hysteresis (cooling), FFn waiting time, FFn operation time, FFn segment 1 to 4 MV, and FFn segment MV variable correction coefficient (n=1, 2) • Input data PID constants monitor, input digital filter monitor, heater current, FFn waiting time monitor, FFn operation time monitor, and FFn segment 1 to 4 MV monitor (n=1, 2)	Make I/O allocation, and read or write the relevant I/O data by executing general purpose instructions from the user program. This data can also be accessed from the Unit Operation Settings regardless of I/O allocation.

Data			Access method
Name*1	**Purpose**	**Description**	
Unit Operation Settings	For initial settings	The data below is used for making the initial settings. Data changes can be applied after a restart. • Input type, PID ON/OFF, temperature units, etc.	Access the data in either of the following ways. • Make the Unit operation settings on the editing pane of the Support Software. • Set or read the corresponding NX object by executing messages such as special instructions for NX objects in the user program.
	For adjustment	The data below is to determine the set values through adjustments based on unit operation settings. Data changes can be applied immediately. • Data that can also be accessed from I/O data PID constants, heater burnout detection current, SSR failure detection current, PV input shift value, input digital filter, hysteresis (heating), hysteresis (cooling), FFn waiting time, FFn operation time, and FFn segment 1 to 4 MV (n=1, 2) • Data that cannot be accessed from the I/O data PV input slope coefficient, MV at error, MV upper limit, MV lower limit, load rejection MV, dead band, D-AT execution judgment deviation, and feature visualization-related (waveform measurement time, waveform measurement stop (temperature stable control), temperature stable band, temperature stable determination time, MV stable band, MV stable determination time, MV digital filter)	

*1. Some data exists only in NX objects, such as Unit configuration information. Refer to *A-3 List of NX Objects* on page A-16 for details about NX objects.

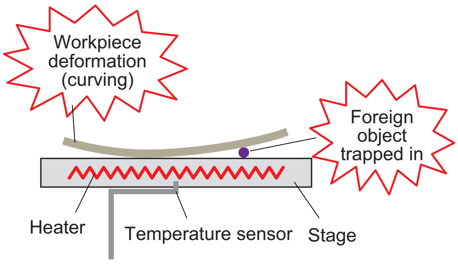
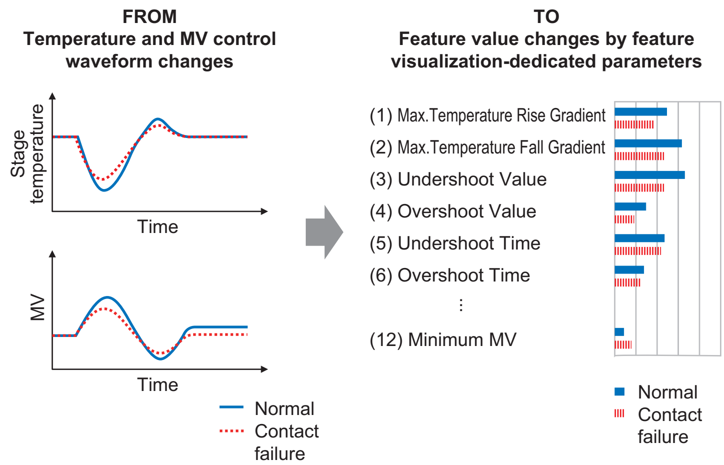
1-6 Application Examples

1-6-1 Application Examples Using the Feature Visualization

The feature visualization is available for all models.

Example 1: Detecting Workpiece Defects by Capturing Changes in Contact Between Stage and Workpiece

Changes in contact between the stage and workpiece, due to factors such as deformation (curving) of the workpiece and foreign objects being trapped in, are detected by the change in feature values.

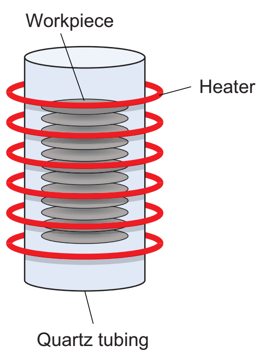
<table>
<tr><th>Contact failure between the stage and workpiece results in workpiece deformation (curving)</th><th>Abnormalities detected by the feature visualization</th></tr>
<tr><td>
</td><td>

(An abnormality with the thermocouple is difficult to be identified based on the waveform changes alone.)
(Abnormalities can be detected early from visualized feature changes.)</td></tr>
</table>

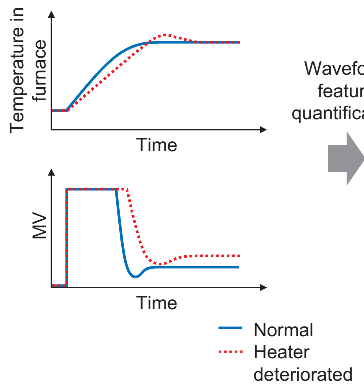
Example 2: Detecting heater deterioration

Temperature changes inside the electric furnace caused by a deteriorated heater can be detected by the feature value changes.

Heater deterioration results in insufficient heating of workpiece	Abnormalities detected by the feature visualization



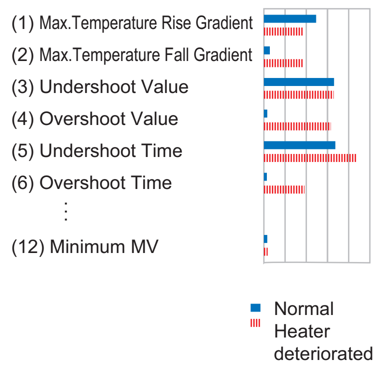
FROM
Temperature and MV control waveform changes



(An abnormality with the thermocouple is difficult to be identified based on the waveform changes alone.)

Waveform feature quantification

TO
Feature value changes by feature visualization-dedicated parameters

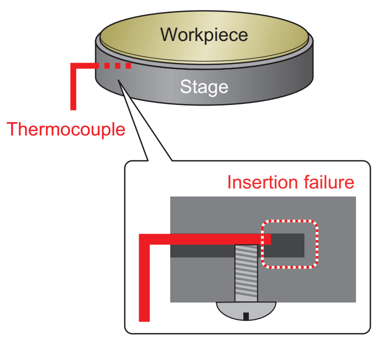


(Abnormalities can be detected early from feature changes made visible.)

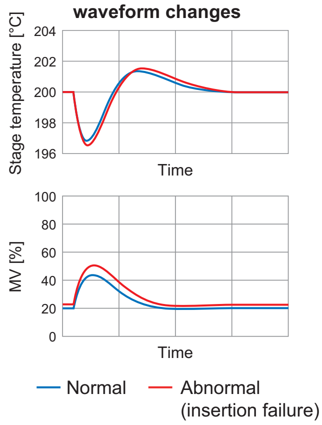
Example 3: Position Shift of the Temperature Sensor

Insertion failure of the thermocouple attached to the stage can be detected by the feature value changes.

Thermocouple insertion failure	Abnormalities detected by the feature visualization

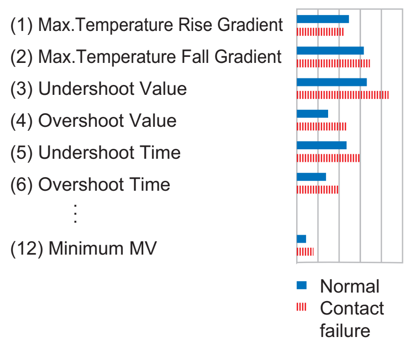


FROM
Temperature and MV control waveform changes



(An abnormality with the thermocouple is difficult to be identified based on the waveform changes alone.)

TO
Feature value changes by feature visualization-dedicated parameters



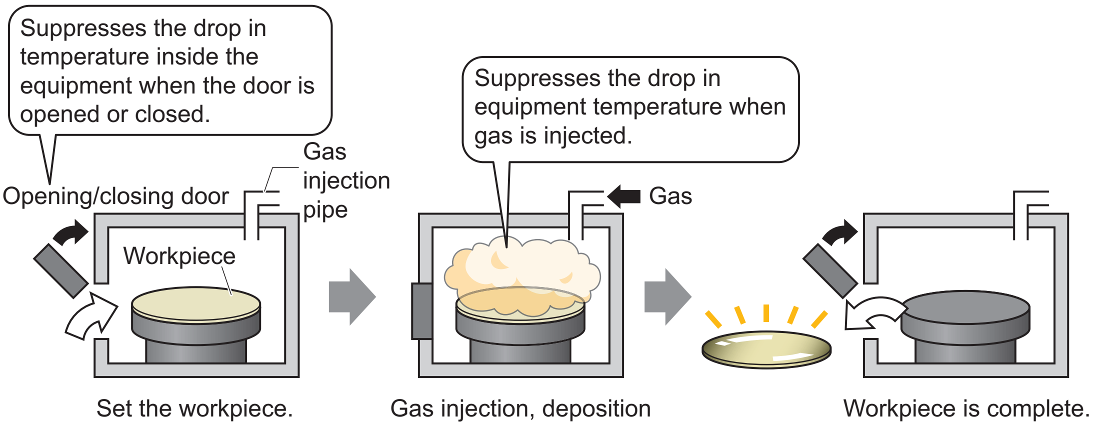
(Abnormalities can be detected early from visualized feature changes.)

1-6-2 Application Examples Using Disturbance Suppression (Pre-boost Function)

The pre-boost function is effective for fluctuations in temperature that occur in manufacturing and testing process.

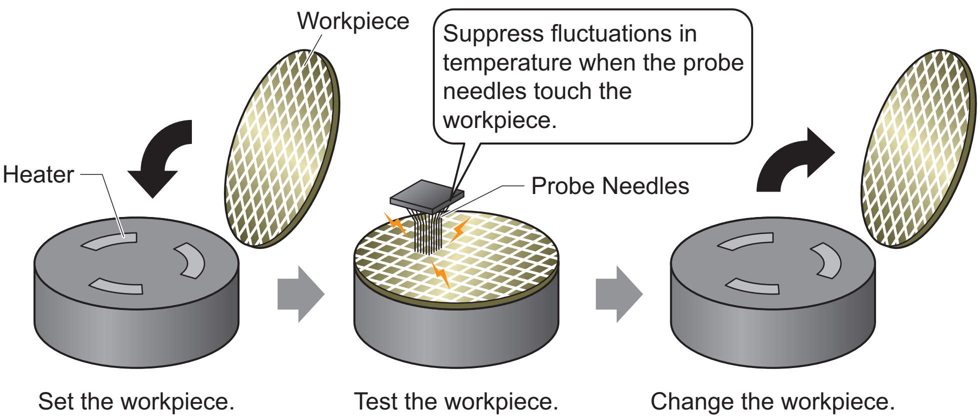
Example 1: Suppression of temperature drops that occur in the deposition process

The pre-boost function contributes to stabilizing quality by suppressing disturbances caused by opening and closing the door or injecting gas.



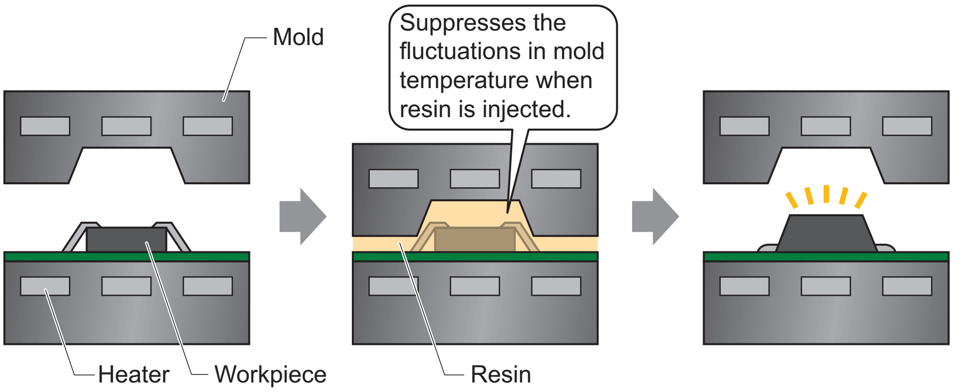
Example 2: Suppression of drops in workpiece temperature that occur in the testing process

The pre-boost function contributes to stabilizing quality by suppressing disturbances caused by workpieces generating heat.



Example 3: Suppression of drops in mold temperature that occur in the molding process

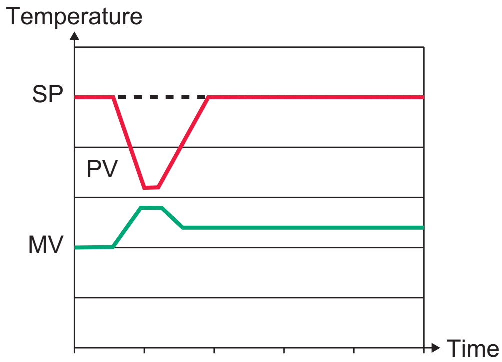
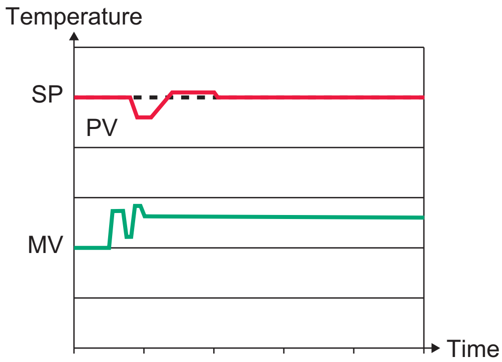
The pre-boost function contributes to stabilizing quality by suppressing disturbances caused by resin injection.



Set the mold. Inject the resin. The molding is completed.

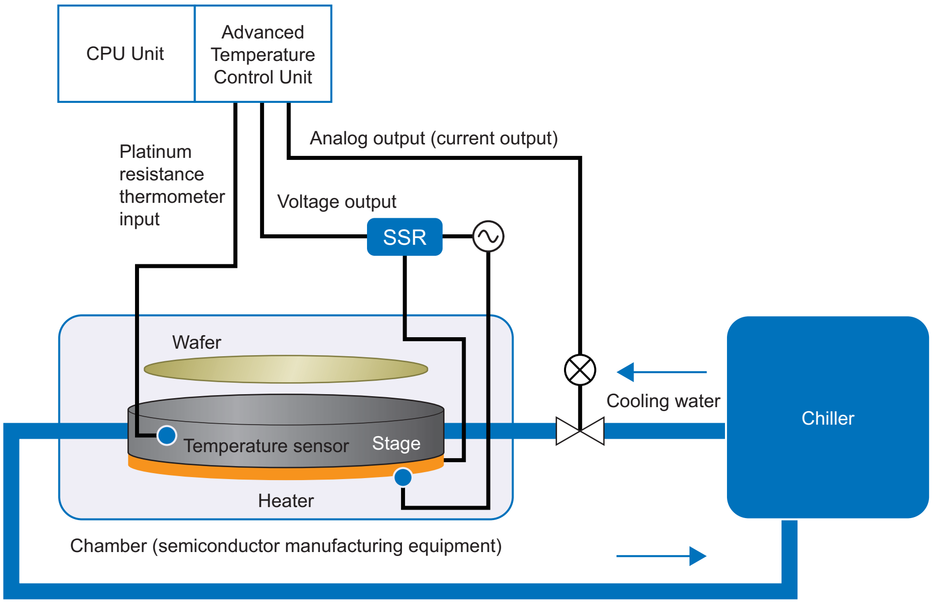
Effectiveness of disturbance suppression (pre-boost function)

The pre-boost function suppresses the fluctuations in temperature caused by disturbances such as the following.

From (with no pre-boost function)	To (with pre-boost function)
The manipulated variable increases after the disturbance occurs, resulting in a large decrease in the current value and the recovery to the set point taking a long time.	The manipulated variable increases before the disturbance occurs, resulting in a small decrease in the current value and the recovery to the set point taking a short time.
	

1-6-3 Application Examples of Heating/Cooling Control

The following figure shows a configuration example of the system that controls the temperature of a semiconductor manufacturing equipment chamber using the Advanced Temperature Control Unit in heating/cooling control type (NX-HTC3510).



1-7 Model List

1-7-1 Model Notation

The Advanced Temperature Control Unit models are assigned based on the following rules.

NX - □□□□□□□ - □

Unit type
  HTC: Advanced temperature control

Number of channels
  3: 4 channel
  4: 8 channel

I/O type
  5: Universal inputs (thermocouple/resistance thermometer/analog voltage and current input)

Other specifications

External connection terminal

No.	External connection terminal
5	MIL connector

Other specifications

No.	Control type	Outputs		Number of CT input points per channel	I/O Refreshing Methods
		Output type	Number of output points per channel		
05	Standard control	Voltage output (for driving SSR)	1 point per channel	1 point per channel	Free-Run refreshing
10	Heating and cooling control	Voltage output (for driving SSR)	1 point per channel	1 point per channel	
		Linear current output	1 point per channel		

Refer to *Section 5 I/O Refreshing* on page 5-1 for details about the I/O refreshing method.

1-7-2 Model List

This section lists the Advanced Temperature Control Unit models.

Refer to *A-1-2 Detailed Specifications* on page A-3 for details.

Advanced Temperature Control Unit 4-point Type (MIL Connector, 30 mm width)

Model	Number of Channels	Input types	Output		Number of CT input points per channel	Control type	I/O Refreshing Methods	Reference
			Output type	Number of output points per channel				
NX-HTC3510-5	4 channels	Universal input	Voltage output (for driving SSR)	4 points	4 points	Heating and cooling control	Free-Run refreshing	Page A-6
			linear current output	4 points				

Advanced Temperature Control Unit 8-point Type (MIL Connector, 30 mm width)

Model	Number of Channels	Input types	Output		Number of CT input points per channel	Control type	I/O Refreshing Methods	Reference
			Output type	Number of output points per channel				
NX-HTC4505-5	8 channels	Universal input	Voltage output (for driving SSR)	8 points	8 points	Standard control	Free-Run refreshing	Page A-9

1-8 List of Functions

This section shows a list of functions performed by the Advanced Temperature Control Units.

Function name		Description	Reference	Applicable Unit
Free-Run Refreshing		With this I/O refreshing method, the refresh cycle of the NX bus and the I/O refresh cycles of the NX Units are asynchronous.	*5-2-3 Free-Run Refreshing* on page 5-7	All models
Selecting Channel To Use		This function disables control processing, error detection, and output for unused channels. The conversion time for its own Unit will not be shortened even if errors are disabled.	*7-2 Selecting Channel to Use* on page 7-9	All models
Input Functions	Input Type Setting	This function sets the input type. Either a sensor input (thermocouple or resistance thermometer) that connects to the temperature input, or an analog input (current 4 to 20 mA/0 to 20 mA, voltage 1 to 5 V/0 to 5 V/0 to 10 V).	*7-3-1 Input Type Settings* on page 7-11	All models
	Temperature Unit Setting (°C/°F)	This function sets the temperature units for measured values to °C (Celsius) or °F (Fahrenheit).	*7-3-2 Temperature Unit (°C/°F) Setting* on page 7-14	All models
	Decimal Point Position Setting	This function sets the number of digits displayed after the decimal point for INT type parameters of measured values, set points and alarm values (including alarm upper and lower limits). If the decimal point position for the above-mentioned parameters is fixed in a host device, design changes concerning the decimal point position can be absorbed when replacing a third-party temperature control Unit.	*7-3-3 Decimal Point Position Setting* on page 7-15	All models
	Cold Junction Compensation Enable/Disable Setting	This function enables or disables cold junction compensation using the cold junction sensor that is mounted on the terminal block when a thermocouple input is used.	*7-3-4 Cold Junction Compensation Enable/Disable* on page 7-18	All models
	Temperature Input Correction	This function corrects measured values, which is used when there are variations in the sensor or when there is a difference in measured value from other measuring instruments. One-point correction and two-point correction methods are provided.	*7-3-5 Temperature Input Correction* on page 7-20	All models
	Input Digital Filter	This function sets the time constant applied to the first-order lag operation filter so that the noise components mixed with the measured value are eliminated.	*7-3-6 Input Digital Filter* on page 7-23	All models
	Terminal Ambient Temperature measurement function	This function measures the temperature around the terminals of the Advanced Temperature Control Unit.	*7-3-7 Measuring the Ambient Temperature around Terminals* on page 7-25	All models
	Analog input settings	This function is for analog input and sets the scaling to use the physical analog quantities of current and voltage as inputs for the control application.	*7-3-8 Analog Input Settings* on page 7-26	All models
Control Processing	ON/OFF Control	This control function uses a preset set point to turn off the control output when the temperature reaches the set point during control.	*7-4-1 ON/OFF control* on page 7-27	All models
	PID Control	PID control is a combination of proportional (P) control, integral (I) control, and differential (D) control. It is a control function that feeds back the detected value to the set point so that they conform to each other.	*7-4-2 PID control* on page 7-30	All models
	Heating/Cooling Control	This function controls both heating and cooling.	*7-4-3 Heating and Cooling Control* on page 7-34	Heating/cooling control type models
	Run or Stop Controls	This function starts and stops temperature control.	*7-4-4 Run or Stop Controls* on page 7-39	All models
	Direct/Reverse Operation	This function specifies direct or reverse operation.	*7-4-5 Direct and Reverse Operation* on page 7-40	All models
	Manual MV (Manual Manipulated Variable)	This function outputs the specified manipulated variable during PID control.	*7-4-6 Manual MV* on page 7-42	All models
	MV at Error	This function outputs a fixed manipulated variable when a Sensor Disconnected Error occurs.	*7-4-7 MV at Error* on page 7-44	All models

Function name		Description	Reference	Applicable Unit
Control Process-ing	MV Limit	This function adds a limit to the manipulated variable calculated by PID control and outputs it.	*7-4-8 MV limit* on page 7-46	All models
	Load Rejection MV	The load rejection means that the connection to the Advanced Temperature Control Unit is interrupted due to a communications error between the CPU Unit and the Communications Coupler Unit host or due to an error on the NX bus. This function performs a preset output operation if any of the following problems occur. • The Advanced Temperature Control Unit connected to the CPU Unit cannot receive the output setting values from the CPU Unit due to an NX bus error or CPU watchdog timer error. • The Slave Terminal cannot receive the output setting values due to a communications error between the Advanced Temperature Control Unit and the Communications Coupler Unit host or due to an error on the NX bus.	*7-4-9 Load Rejection MV* on page 7-48	All models
	MV Branch	The manipulated variables calculated by the slope or offset are output to the branch-destination channel based on the manipulated variables of the branch-source channel.	*7-4-10 MV Branch* on page 7-50	Standard control type models
	Load Short-circuit Protection	The load short-circuit means that an external device (SSR) connected to the voltage output (for driving SSR) of the Advanced Temperature Control Unit is shortcircuited. The load short-circuit protection is a function of the Advanced Temperature Control Unit with voltage output (for driving SSR), which protects output circuits of the Advanced Temperature Control Unit when an external device (SSR) connected to the voltage output (for driving SSR) is shortcircuited.	*7-4-11 Load-short circuit protection* on page 7-60	Models with voltage output (for driving SSR)
	Disturbance suppression (Pre-boost function)	This function suppresses temperature variations by adding or subtracting a preset manipulated variable ahead of temperature variations due to a disturbance.	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61	Standard control type models
Tuning	AT (Autotuning)	This is a tuning method that derives the PID constant. This function automatically calculates the PID constant by the limit cycle method according to the characteristics of the control target.	*7-5-1 Autotuning (AT)* on page 7-68	All models
	D-AT (disturbance autotuning)	This function automatically calculates the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters of the disturbance suppression (pre-boost function).	*7-5-2 D-AT (Disturbance Autotuning)* on page 7-71	Standard control type models
Control Output	Control Period	This function sets the period when the ON/OFF time ratio is changed for voltage output (for driving SSR) in time-proportional operation.	*7-6-1 Control Period* on page 7-77	Models with voltage output (for driving SSR)
	Minimum Output ON/OFF Band	This function specifies the minimum ON/OFF bands for the heating side control output or the cooling side control output. This function can be used to prevent deterioration of mechanical relays when mechanical relays are used in the actuators connected to the output terminals.	*7-6-2 Minimum Output ON/OFF Band* on page 7-79	Models with voltage output (for driving SSR)
	Output Signal Range Setting	This function sets the output signal range of the linear current output. You can specify 4 to 20 mA or 0 to 20 mA.	*7-6-3 Output Signal Range Setting* on page 7-80	Models with linear current output

Function name		Description	Reference	Applicable Unit
Error Detection	Temperature alarms	Function for detecting a deviation or an error in the measured value as an alarm. Alarm operation according to your application can be performed by selecting “Alarm type”.	*7-7-4 Temperature Alarm* on page 7-90	All models
	LBA (Loop Burn-out Alarm)	Function to detect an alarm, assuming that there is an error somewhere in the control loop, if the measured value does not change in a state where there is a control deviation equal to or greater than the threshold value between the set point and the measured value. This function can be used only for temperature input.	*7-7-5 LBA (Loop Burnout Alarm)* on page 7-95	All models
	Sensor Discon-nection Detection	This function detects disconnections in temperature sensors. It also detects that the measured value of the temperature sensor is outside the input indication range.	*7-7-1 Sensor Discon-nection Detection* on page 7-82	All models
	Heater Burnout Detection	This function detects heater burnouts. A heater burnout is detected if the control output is ON and the heater current is equal to or less than the heater burnout detection current.	*7-7-2 Heater Burnout Detection* on page 7-83	Models with CT input
	SSR Failure Detection	This function detects SSR failures. An SSR failure is detected if the control output is OFF and the leakage current is equal to or greater than the SSR failure detection current. An SSR failure is a failure that is caused by an SSR short-circuit.	*7-7-3 SSR Failure Detection* on page 7-86	Models with CT input
Predictive Mainte-nance	Feature Visual-ization	This function enables monitoring of features (as feature data) appearing in the control waveform of set point and disturbance responses.	*7-8 Feature Visual-ization* on page 7-101	All models

1-9 Support Software

The Support Software that is used depends on the system configuration.

- **Support Software for a System Configured with a CPU Unit**

  If your system is configured by connecting an NX Unit to a CPU Unit, the Sysmac Studio is used as the Support Software.

- **Support Software for a System Configured with a Slave Terminal**

  If your system is configured by connecting an NX Unit to a Communications Coupler Unit, refer to the user's manual for the Communications Coupler Unit for information on the Support Software.

Refer to *A-6 Version Information with CPU Units* on page A-72 or *A-7 Version Information with Communications Coupler Units* on page A-73 for information on the Support Software versions.

2

Specifications and Operation Procedures

This section describes the general specifications and individual specifications of Temperature Control Units.

2-1 General Specifications

The general specifications of Advanced Temperature Control Units are provided below.

Item		Specification
Enclosure		Mounted in a panel
Grounding methods		Ground of 100 Ω or less
Operating environment	**Ambient operating temperature**	0 to 55°C
	Ambient operating humidity	10 to 95% (with no icing or condensation)
	Atmosphere	Must be free from corrosive gases.
	Ambient storage temperature	-25 to 70°C (with no icing or condensation)
	Altitude	2,000 m max.
	Pollution degree	Pollution degree 2 or less: Conforms to IEC 61010-2-201.
	Noise immunity	Conforms to IEC 61000-4-4, 2 kV (power supply line)
	Overvoltage category	Category II: Conforms to IEC 61010-2-201.
	EMC immunity level	Zone B
	Vibration resistance	Conforms to IEC 60068-2-6. 5 to 8.4 Hz with amplitude of 3.5 mm, 8.4 to 150 Hz, acceleration of 9.8 m/s^2 100 min each in X, Y, and Z directions (10 sweeps of 10 min each = 100 min total)
	Shock resistance	Conforms to IEC 60068-2-27, 147 m/s^2, 3 times each in X, Y, and Z directions
	Insulation resistance	Refer to the individual specifications of NX Units.
	Dielectric strength	Refer to the individual specifications of NX Units.
Applicable standards*1		cULus: Listed(UL 61010-2-201), UL 121201, EU: EN 61131-2, RCM, KC: KC Registration, UKCA

*1. Refer to the OMRON website (www.ia.omron.com) or ask your OMRON representative for the most recent applicable standards for each model.

2-2 Individual Specifications

Refer to *A-1 Datasheet* on page A-2 for the individual specifications of Temperature Control Units.

2-3 Operation Procedures

This section describes the basic operating procedures to use an Advanced Temperature Control Unit with CT inputs, an NJ/NX/NY-series Controller, and the Sysmac Studio as an example.

Detailed explanations of the following items will be given after an explanation of the overall procedure.

- Unit Initial Settings
- Backing up the tuning parameters

2-3-1 Overall Procedure

The basic procedure is shown below.

Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for the application procedures and the method to download the settings for the connected CPU Unit or Slave Terminal.

For Support Software other than the Sysmac Studio, refer to the operation manual for the Support Software that you are using.

Step	Item	Description	Reference
1	Unit Registration and I/O Allocation Settings	Create a project in the Sysmac Studio. Register the Advanced Temperature Control Unit offline. Set the I/O allocations.	• Sysmac Studio Version 1 Operation Manual (W504) • *6-1-1 Allocable I/O Data* on page 6-2
2	Unit Initial Settings	Make the initial settings for the Advanced Temperature Control Unit according to the Unit functions that you will use. You can make initial setting under the Unit operation settings.	• *2-3-2 Unit Initial Setting Procedure* on page 2-6 • *Section 7 Functions* on page 7-1
3	Creating the User Program	Create the user program with Sysmac Studio.*1	User's manual for connected CPU Unit or Industrial PC
4	Installing Units	Attach the Temperature Control Unit to the CPU Unit or Communications Coupler Unit.	*4-1 Installing NX Units* on page 4-2
5	Wiring the Unit	Wire the Advanced Temperature Control Unit.	• *4-2 Power Supply Types and Wiring* on page 4-8 • *4-3 Wiring the Terminals* on page 4-10
6	Downloading Unit Settings and User Program	Turn ON the power supply of the CPU Rack or Slave Terminal and download the Unit settings that you created in Sysmac Studio to the Advanced Temperature Control Unit. Also download the user program to the CPU Unit or Industrial PC.	*Section 7 Functions* on page 7-1 User's manual for connected CPU Unit or Industrial PC
7	Checking Unit Operation	Perform the following to check the operation of the Advanced Temperature Control Unit. • Use the Sysmac Studio to check the wiring by reading the input data and writing output data for the Advanced Temperature Control Unit. • Check that the Unit settings and user program are running correctly. • Check the measured values and the output and alarm statuses in the I/O data.*1 If necessary, set the set point and send Run or Stop *2 operation commands to instruct run/stop controls.	• *Section 7 Functions* on page 7-1 • *6-1 Specifications of I/O Data* on page 6-2

Step	Item	Description	Reference
8	Adjusting Unit Operation	Perform the following to adjust the operation of the Advanced Temperature Control Unit. • Adjust the tuning parameters using the automatic tuning function for the Advanced Temperature Control Unit control. • Check the heater current and leakage current for normal and abnormal operation in the I/O data. Adjust the set values for the heater burnout detection current and SSR failure detection current as necessary.	• *7-5 Tuning* on page 7-68 • *7-7-2 Heater Burnout Detection* on page 7-83 • *7-7-3 SSR Failure Detection* on page 7-86
9	Backing Up Tuning Parameters	If the tuning parameters were updated in the above step *8. Adjusting Unit Operation*, back up the tuning parameters to the CPU Unit or Communications Coupler Unit. The tuning parameters are stored in the Advanced Temperature Control Unit. Therefore, this procedure must be implemented to transfer the tuning parameters to the new Unit after replacement.	*2-3-3 Backing up the Tuning Parameters* on page 2-7

*1. The output and alarm statuses are output to the internal bits for heater burnout detection and SSR failure detection alarms in the CPU Unit. To output alarms, you have to create a user program, from which the special instructions of NJ/NX/NY-series Controllers, such as the Upper/Lower Limit Alarm Group instruction, is executed. For details about the special instructions to output alarms, refer to the instructions reference manual for the connected CPU Unit or Industrial PC.

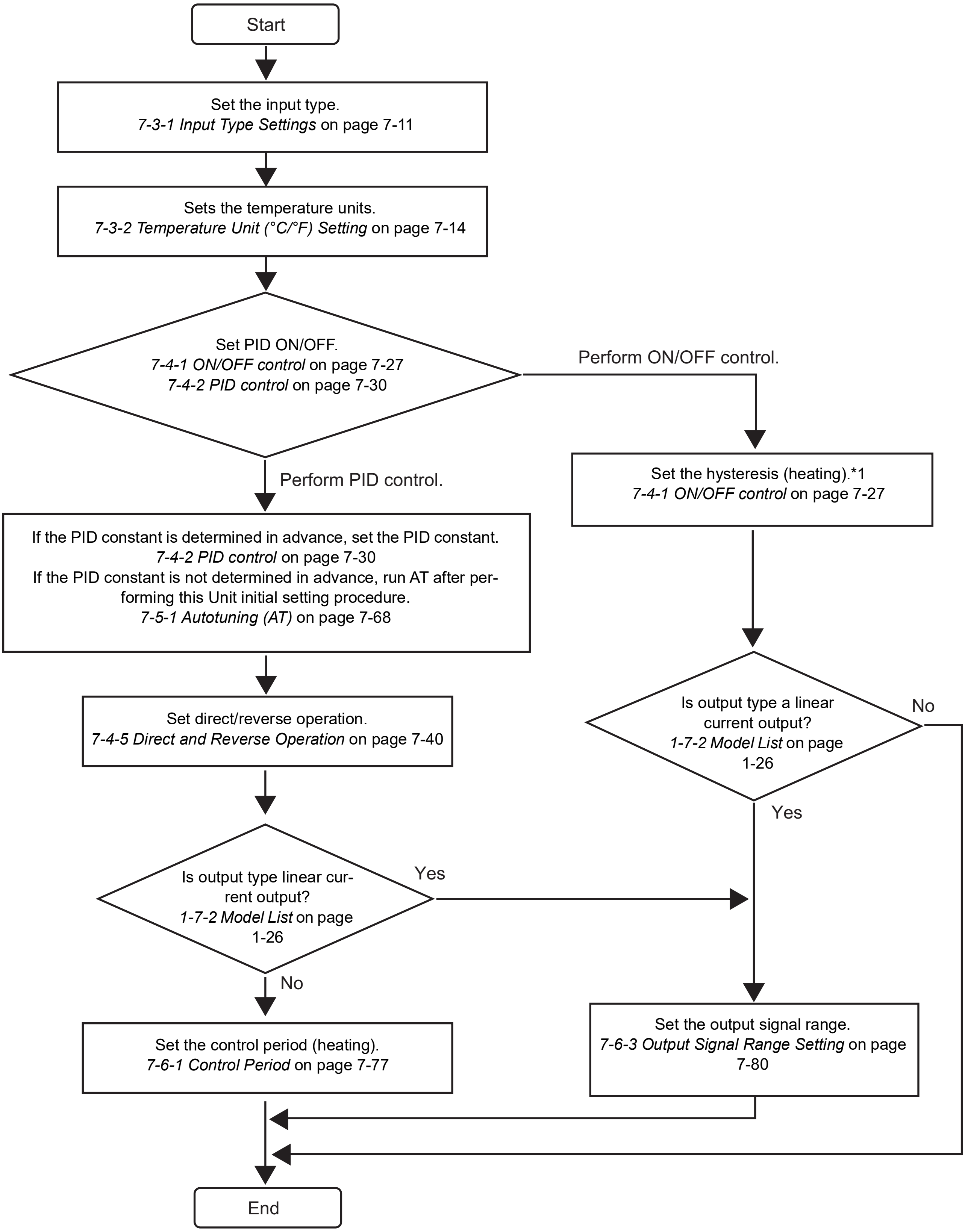
*2.

Precautions for Correct Use

The operation commands for NX-HTC Units are TRUE: RUN, FALSE: STOP. Caution is required because the logic is reversed operation command for NX-TC Units.

2-3-2 Unit Initial Setting Procedure

The Unit initial setting procedure for basic temperature control by the Temperature Control Unit is described below. Basic temperature control means receiving a measured value and controlling the manipulated variable to reach the set point.



*1. For a heating/cooling control type model, also set the hysteresis (cooling).

To use a function not described in this procedure, make the initial settings according to the function to be used. Refer to *Section 7 Functions* on page 7-1 for details about the functions.

2-3-3 Backing up the Tuning Parameters

This section describes the tuning parameter backup procedure.

Refer to *A-5-3 I/O Data Tuning Parameter Update* on page A-61 for the method to perform each procedure.

Step	Item	Description
1	Backing Up Data	When you execute tuning in a system where the host device controls tuning parameters, make sure to save the tuning parameters using the methods shown below. Note that the availability and implementation of the following methods depend on the system configuration. • Backup by the backup function of the NJ/NX/NY-series Controller*1 • Saving NX Unit parameters using the special instructions and messages*2 • Uploading Slave Terminal settings*3

*1. For details on backup using the controller backup function, refer to the user's manual for the connected CPU Unit or Industrial PC.

*2. Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for information on how to save the NX Unit parameters.

*3. Refer to the user's manual for the connected Communications Coupler Unit for the method to upload the Slave Terminal settings.

Precautions for Correct Use

Backup Procedure of the Unit Operation Settings:

The Unit operation settings of the Advanced Temperature Control Unit will be backed up in the NX-HTC Unit. A backup of the Unit operation settings is required for Unit replacement. Refer to *9-2-2 Unit Replacement Procedure* on page 9-4 for details on the backup procedures.

3

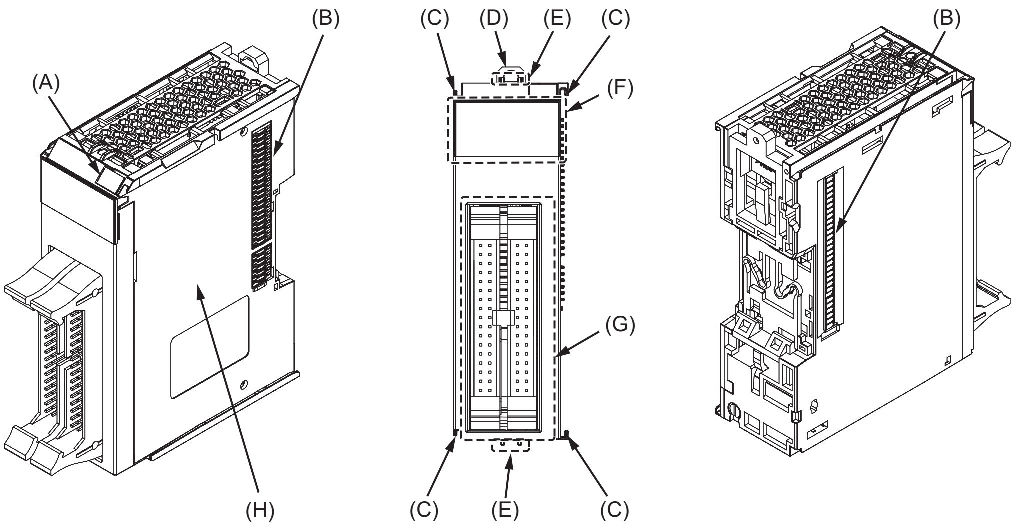
Part Names and Functions

This section describes the names and functions of the parts of the Advanced Temperature Control Units.

3-1 Part Names

This section describes the part names and functions of the Advanced Temperature Control Units.

● Unit with MIL Connector (34-pin connector x 2), 30 mm width, common to 4Ch and 8Ch



(A)	Marker attachment locations	The locations where markers are attached. The markers made by OMRON are installed for the factory setting. Commercially available markers can also be installed. *4-1-2 Attaching Markers* on page 4-4
(B)	NX bus connector	This connector is used to connect each Unit.
(C)	Unit hookup guides	These guides are used to connect two Units.
(D)	DIN Track mounting hooks	These hooks are used to mount the NX Unit to a DIN Track.
(E)	Protrusions for removing the Unit	The protrusions to hold when removing the Unit.
(F)	Indicators	The indicators show the current operating status of the Unit. *3-2 Indicators* on page 3-3
(G)	Connectors	The terminal block is used to connect external devices.
(H)	Unit specifications	The specifications of the Unit are given.

Precautions for Correct Use

Cold junction sensor

- The Advanced Temperature Control Unit is an MIL connector type. The cold junction sensor should be mounted onto an external Ultra-Compact Interface Wiring System (XW2K-34G-T). For the wiring method using a compact Connector-Terminal Block Conversion Unit, refer to *4-3 Wiring the Terminals* on page 4-10.
- A cold junction sensor is bundled with the Advanced Temperature Control Unit.
- Refer to *4-3-9 Installing and Removing the Cold Junction Sensor* on page 4-28 for the procedure of installing and removing the cold junction sensor on a compact Connector-Terminal Block Conversion Unit.

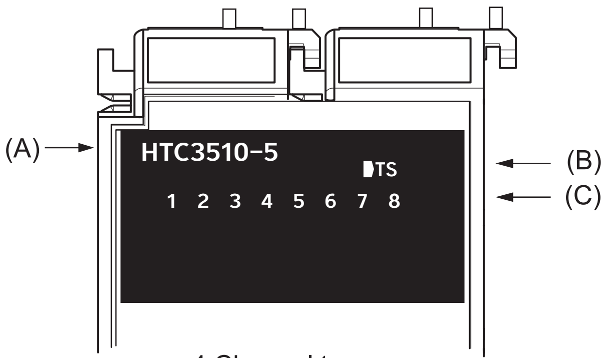
3-2 Indicators

The Advanced Temperature Control Unit is equipped with the indicators to show the current operating status of the Unit.

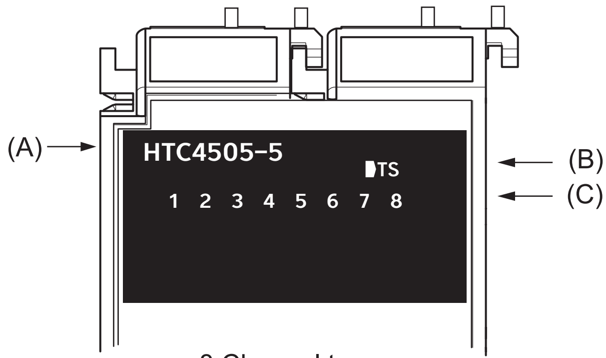
The indicator pattern depends on the number of outputs on the Unit and Unit width, as shown below.

Refer to *A-1 Datasheet* on page A-2 for details on indicators for each model.

● 30 mm width



4 Channel type

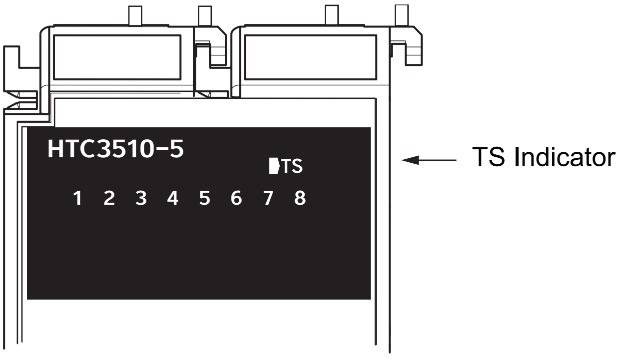


8 Channel type

(A)	Model number indications	Displays the model number of the Advanced Temperature Control Unit. Example: For NX-HTC3510-5, it shows “HTC3510-5” The text is white.
(B)	TS Indicator	Shows the status of the Advanced Temperature Control Unit.
(C)	OUT Indicator	Shows the control output status of the Advanced Temperature Control Unit. The numbers correspond to the output terminal numbers.

3-2-1 TS indicator

Shows the current status of the Advanced Temperature Control Unit and its communications status with the CPU Unit or Communications Coupler Unit.

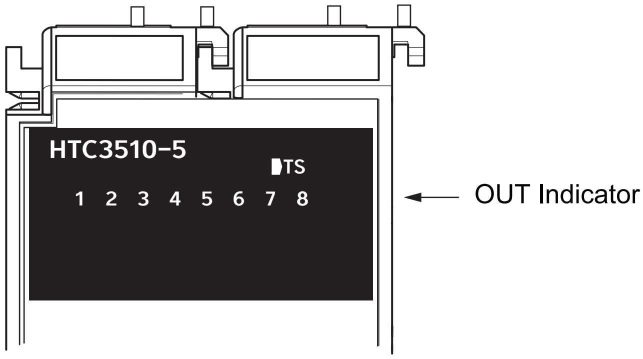


The meanings of light statuses are described as follows:

Green		Lit	• The Unit is operating normally. • The Unit is ready for I/O refreshing.
		Flashing at 2-s intervals.	• Initializing • Restarting is in progress for the Unit. • Downloading
Red		Lit	A hardware failure, WDT error, or other fatal error that is common to all I/O Units occurred.
		Flashing at 1-s intervals.	A communications error or other NX bus-related error that is common to all I/O Units occurred.
---		Not lit	• No Unit power supply • Restarting is in progress for the Unit. • Waiting for initialization start

3-2-2 OUT Indicator

Shows the output status of each output terminal on the Advanced Temperature Control Unit.



The following shows an example of OUT 1. The number of the control output is lit or not lit.

Yellow	1	Lit	Voltage output (for driving SSR): ON Linear current output: when manipulated variable is greater than 0%
---	1	Not lit	Voltage output (for driving SSR): OFF Linear current output: when manipulated variable is 0% or below

4

Installation and Wiring

This section describes how to install the NX Units, the types of power supplies provided to the NX Units and wiring methods, and how to wire the NX Units.

4-1 Installing NX Units

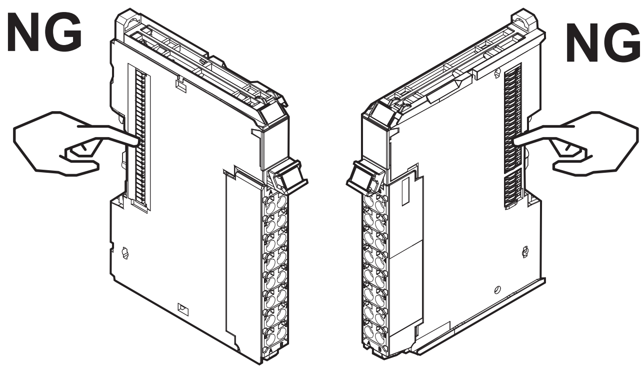
This section describes how to install NX Units. Refer to the user's manual for the CPU Unit or Communications Coupler Unit to which NX Units are connected for information on preparations of installation and installation in a control panel.

4-1-1 Installing NX Units

This section describes how to mount two NX Units to each other.
Always turn OFF the power supply before you mount NX Units.
Always mount NX Units one at a time.
If you attempt to mount multiple NX Units that are already connected together, the connections between the NX Units may separate from each other and fall.

Precautions for Safe Use

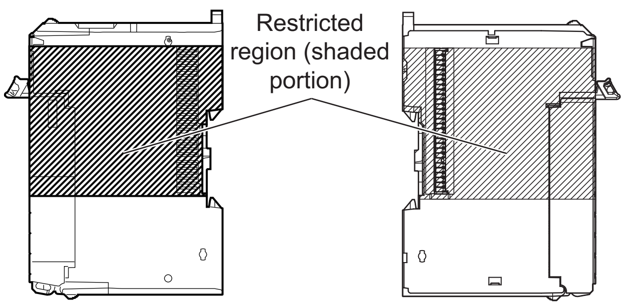
- Always turn OFF the power supply before installing the Unit. If the power supply is not OFF, the Unit may malfunction or may be damaged.
- Do not apply labels or tape on the NX Units. When the Unit is installed or removed, adhesive or scrap may adhere to the pins of the NX bus connector, which may cause malfunctions.
- Do not touch the pins in the NX bus connector on the Unit. Dirt may adhere to the pins in the NX bus connector, which may result in malfunctions.



Example: NX Unit (12 mm width)

- Do not write on an NX Unit with ink within the restricted region that is shown in the following figure. Also do not get this area dirty. When the Unit is installed or removed, ink or dirt may adhere to the pins in the NX bus connector, which may result in malfunctions in the CPU Rack or Slave Terminal.

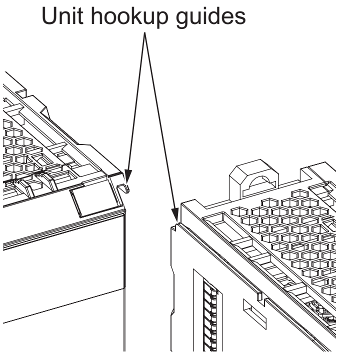
  Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for the restricted region of CPU Unit and Communications Coupler Unit.

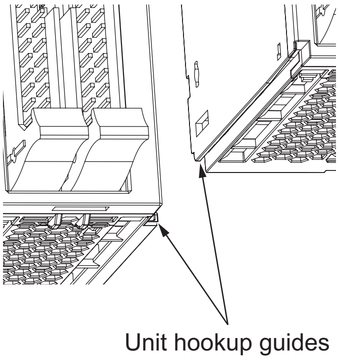


Precautions for Correct Use

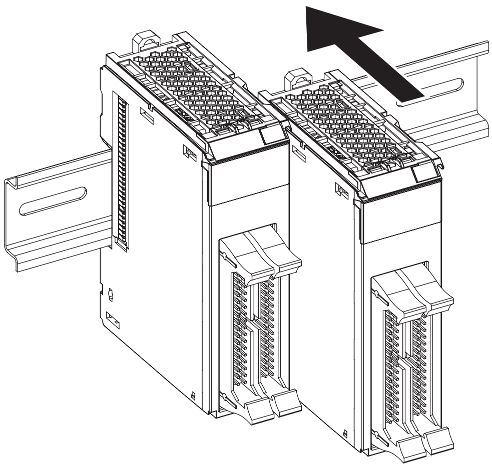
- When you install an NX Unit, do not touch or bump the pins in the NX bus connector.
- When you handle an NX Unit, be careful not to apply any stress to the pins in the NX bus connector. If you install an NX Unit and turns ON the power supply when the pins in the NX bus connector are deformed, a contact defect may cause malfunctions.

1 From the front of the previously mounted NX Unit, engage the Unit hookup guides on a new Unit with the Unit hookup guides on the previously mounted NX Unit.





2 Slide the NX Unit in on the hookup guides.



3 Press the NX Unit with a certain amount of force against the DIN Track until you hear the DIN Track mounting hook lock into place.

When you mount the NX Unit, it is not necessary to release the DIN track mounting hook on the NX Unit.

After you mount the NX Unit, make sure that it is locked to the DIN Track.

Additional Information

- Normally, it is not necessary to release the DIN track mounting hook when you mount the NX Unit. However, if you mount the NX Unit on a DIN Track that is not a recommended DIN Track, the DIN track mounting hook may not lock correctly. If that happens, first unlock the DIN track mounting hook, mount the NX Unit to the DIN Track, then lock the DIN track mounting hook.
- Refer to the user's manual for the CPU Unit to which NX Units can be connected for information on how to mount the CPU Unit, and how to mount NX Units to the CPU Unit.
- Refer to the user's manual for the Communications Coupler Unit for information on how to mount the Communications Coupler Unit, and how to mount the NX Unit to the Communications Coupler Unit.

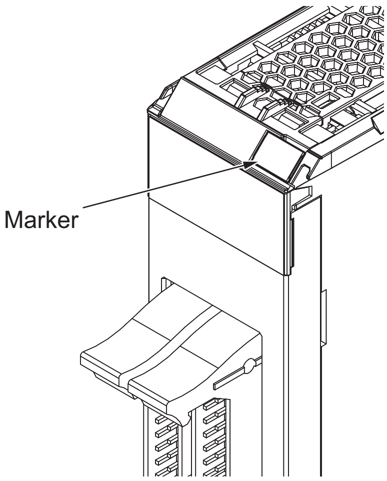
4-1-2 Attaching Markers

Markers can be attached to the NX Units on NX Units to identify them.

The plastic markers made by OMRON are installed for the factory setting. The ID information can be written on them.

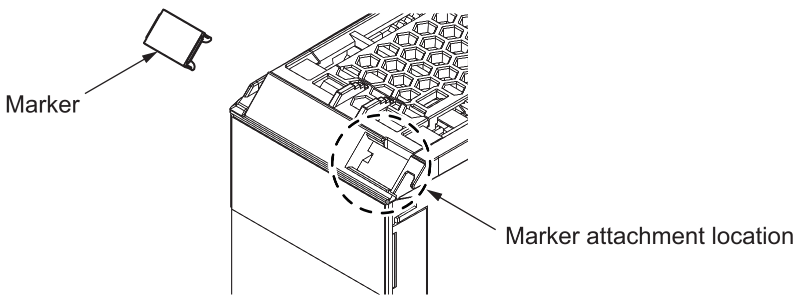
Commercially available markers can also be installed.

Replace the markers made by OMRON if you use commercially available markers now.



● Installation Method

Insert the protrusions on the markers into the marker attachment locations on the NX Units.



<NX Unit>

Commercially Available Markers

Commercially available markers are made of plastic and can be printed on with a special printer.

To use commercially available markers, purchase the following products.

Product name	Model number	
	Manufactured by Phoenix Contact	Manufactured by Weidmuller
Markers	UC1-TMF8	DEK 5/8
Special marker printer	UM EN BLUEMARK X1	PrintJet PRO

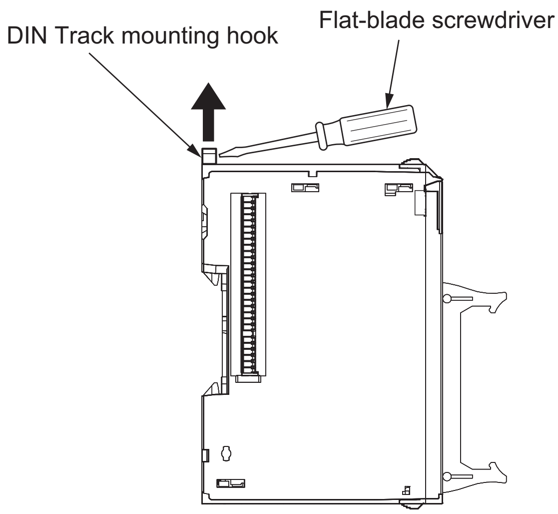
The markers made by OMRON cannot be printed on with commercially available special printers.

4-1-3 Removing NX Units

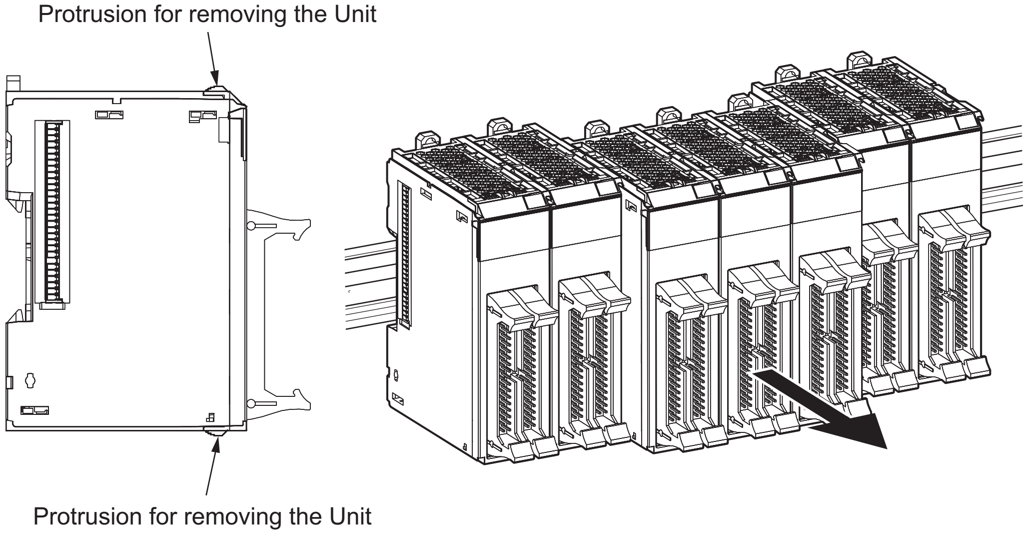
Precautions for Safe Use

Always turn OFF the Unit power supply and I/O power supply before you remove the NX Unit.

1 Use a flat-blade screwdriver to pull up the DIN Track mounting hook on the Unit to remove.



2 Put your fingers on the protrusions for removing multiple NX Units including the Unit to be removed, then pull out straight forward to remove.



Precautions for Correct Use

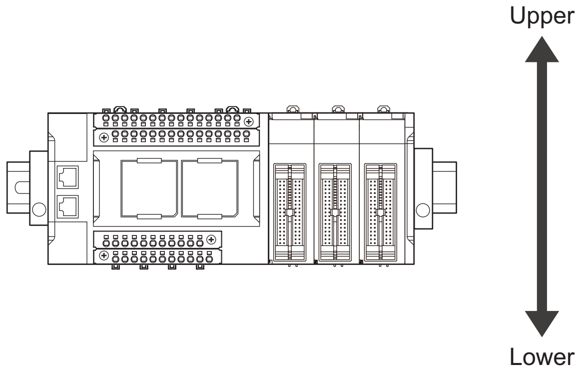
- When removing an NX Unit, remove multiple Units together which include the one you want to remove. If you attempt to remove only one Unit, it is stuck and hard to pull out.
- Do not unlock the DIN track mounting hooks on all of the NX Units at the same time. If you unlock the DIN Track mounting hooks on all of the NX Units at the same time, all of the Units may come off.

4-1-4 Installation Orientation

The following explains the installation orientation for each NX Unit connection destination.

Installation Orientation in the Case of a CPU Unit

Orientation is possible only in the upright installation orientation.



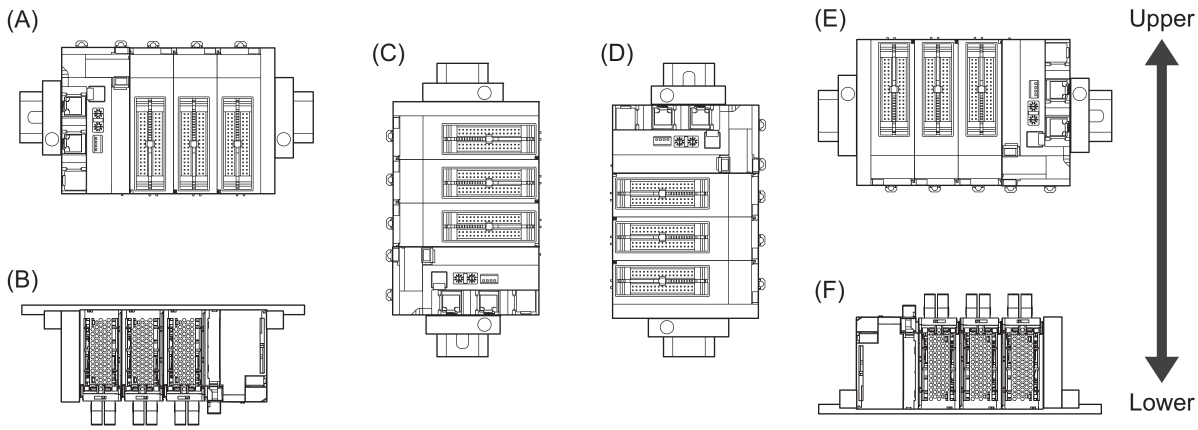
However, there are restrictions on the specifications depending on the NX Units to be used.

Refer to the user's manuals for the NX Units and System Units that you will use for details on restrictions.

Installation Orientation in the Case of a Slave Terminal

Orientation is possible in the following six directions.

(A) is the upright orientation and (B) to (F) are other orientations.



However, there are restrictions on the installation orientation and restrictions to the specifications that can result from the Communications Coupler Units and NX Units that are used.

Refer to the user's manuals for the Communications Coupler Units, NX Units and System Units that you will use for details on restrictions.

Precautions for Safe Use

For installation orientations (C) and (D) in the above figure, support the cables, e.g., with a duct, so that the End Plate on the bottom is not subjected to the weight of the cables. The weight of the cables may cause the bottom End Plate to slide downward so that the Slave Terminal is no longer secured to the DIN Track, which may cause malfunctions.

4-2 Power Supply Types and Wiring

There are the following two types of power supplies that supply power to the NX Units.

Power supply name	Description
NX Unit power supply	This power supply is used for operating the NX Units.
I/O power supply	This power supply is used for driving the I/O circuits of the NX Units and for the connected external devices.

The method for supplying power to the NX Units and the wiring method depend on the specifications for the CPU Unit to which NX Units are connected or the specifications for the Slave Terminal. Refer to Designing the Power Supply System or Wiring, which are described both in the hardware user's manual for the CPU Unit to which NX Units are connected and user's manual for the Communications Coupler Unit, for details on the method for supplying power to the NX Units and the wiring method.

The subsequent sections describe the applications of I/O power supply for the Advanced Temperature Control Units and its supply methods, and how to calculate the total current consumption from the I/O power supply.

4-2-1 Applications of I/O Power Supply and Supply Methods

The applications of I/O power supply and its supply methods for the Advanced Temperature Control Units are given as follows.

Applications of I/O Power Supply

The I/O power supply is used for the following applications.

- Driving the I/O circuits
- Supplying output current for control outputs

I/O Power Supply Method

I/O power is supplied to an Advanced Temperature Control Unit from the NX bus.

This power is supplied through the NX bus connectors by connecting an I/O power supply to the I/O power supply terminals on the Communications Coupler Unit or Additional I/O Power Supply Unit.

For the Units to which I/O power supply is provided by a CPU Rack, refer to *Designing the Power Supply System* or *Wiring* in the hardware user's manual for the CPU Unit to which NX Units are connected.

For the Units to which I/O power supply is provided by a Slave Terminal, refer to *Designing the Power Supply System* or *Wiring* in the user's manual for the Communications Coupler Unit to be connected.

Additional Information

Power Supply-related Units for the NX-series

The following three NX-series Units are related to power supply.

- Additional NX Unit Power Supply Unit
- Additional I/O Power Supply Unit
- I/O Power Supply Connection Unit

Refer to the *NX-series System Unit User's Manual (Cat. No. W523)* for the specifications of these Units.

For a complete list of the latest power supply Units in the NX Series, refer to the product catalog or OMRON websites, or contact your OMRON representatives.

4-3 Wiring the Terminals

This section describes how to wire the terminals on the Advanced Temperature Control Units.

The Advanced Temperature Control Unit is equipped with a MIL connector, which is wired to the external compact Connector-Terminal Block Conversion Unit.

For details on the compact Connector-Terminal Block Conversion Unit, refer to *Ultra-Compact Interface Wiring System XW2K Datasheet (G152)*.

⚠ WARNING

Make sure that the voltages and currents that are input to the Units and slaves are within the specified ranges.

Inputting voltages or currents that are outside of the specified ranges may cause accidents or fire.

Precautions for Correct Use

- **Wiring**

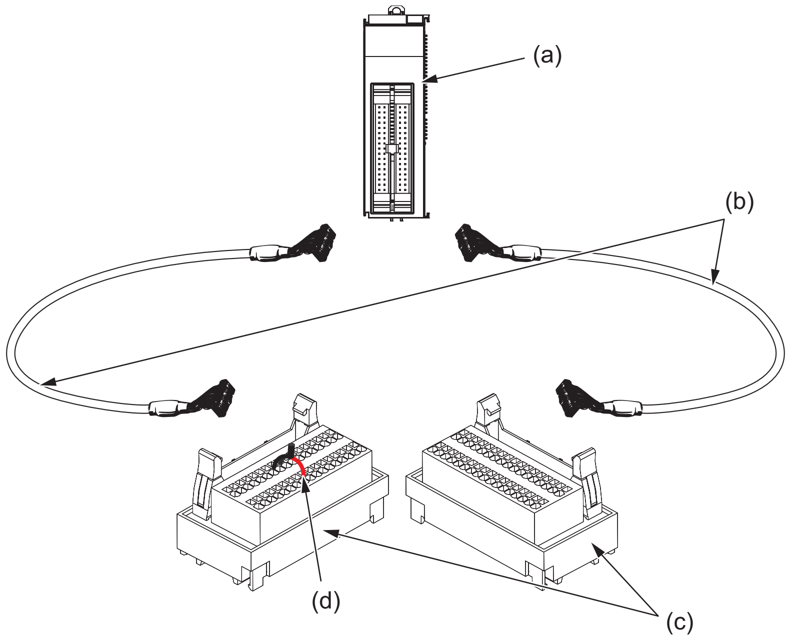
- Do not perform wiring while power is ON. Doing so may cause electric shock.
- Make sure you do not add unnecessary stress to the Advanced Temperature Control Units or the wires while wiring. The wires must be secured and fastened so that they do not resonate due to vibration of equipment or other objects in the installed condition.

Additional Information

- **I/O check function**

Advanced Temperature Control Units do not support I/O check function.

4-3-1 Wiring Example



CN1
(Temperature, analog, cold junction sensor)

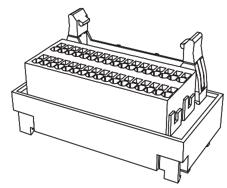
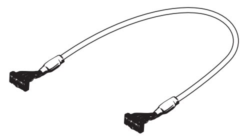
CN2
(Control output and CT input)

Letter	Name	Model numbers	Description
(a)	Advanced Temperature Control Unit	NX-HTC□□□□	This is the Advanced Temperature Control Unit.
(b)	Dedicated connection (shielded) cable for Connector-Terminal Block Conversion Unit	XW2Z-□□□EE	This is a straight wiring (shielded) cable with a 34-pin MIL connector.
(c)	Ultra-Compact Interface Wiring System	XW2K-34G-T	This is a general-purpose type 34-pin compact Connector-Terminal Block Conversion Unit. This converts a MIL connector to a push-in Plus terminal. On the CN1 side, attach the cold junction sensor bundled with the Advanced Temperature Control Unit.
(d)	Cold junction sensor	NX-AUX03	One sensor is included with each bundle of the Advanced Temperature Control Unit. Connect this to the input side of the compact Connector-Terminal Block Conversion Unit. Refer to *4-3-9 Installing and Removing the Cold Junction Sensor* on page 4-28 for details.

4-3-2 Wiring to a MIL Connector

This section explains the wiring method for a MIL connector, as well as the installation and removal methods.
There are two options for wiring: using an OMRON terminal block and a cable, or connecting discrete wires to a general-purpose MIL socket.

Recommended Terminal Block and Special Cable

Product name	Manufacturer	Model numbers	Appearance
Ultra-Compact Interface Wiring System	OMRON	XW2K-34G-T	
Dedicated connector (shielded) cable for Connector-Terminal Block Conversion Unit	OMRON	XW2Z-□□□EE	

Using User-made Cables with Connector

● Available Connectors

Use the following applicable cable-side connectors when you assemble cables with connectors.

Connector type	Model	Manufacturer
Flat Cable Connectors	XG4M-3430-T*1	OMRON
	FRC5-A034-3TOS	DDK Ltd.
Crimped Sockets for Discrete Wires	XG5N-341*2	OMRON

*1. This is a MIL Socket and Strain Relief Set. Always use with the Strain Relief together.

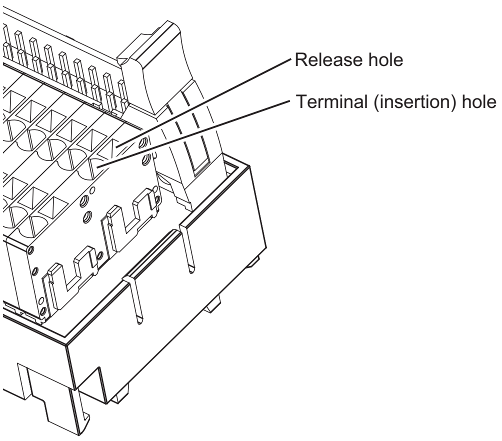
*2. Refer to the connector catalog for details on applicable wires.

● Wiring

- Make sure that all Units are connected properly.
- After the cable side connector is connected, close the lock lever on the Position Interface Unit side connector section to lock it. After you complete the wiring, make sure that the connector is locked.

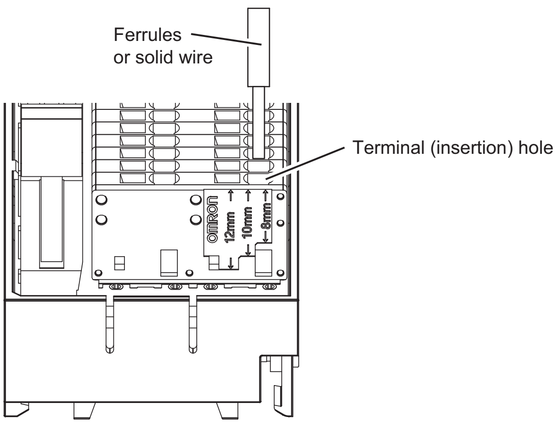
4-3-3 Connecting Wires to Ultra-Compact Interface Wiring System (Push-In Plus Terminal Block)

Part Names of the Terminal Block



Connecting Wires with Ferrules (hereinafter referred to as Ferrules) and Solid Wires

Insert the solid wire or ferrule straight into the Terminal Block until the end strikes the Terminal Block. If a wire is difficult to connect because it is too thin, use a flat-blade screwdriver in the same way as when connecting stranded wire.



Connecting Stranded Wires

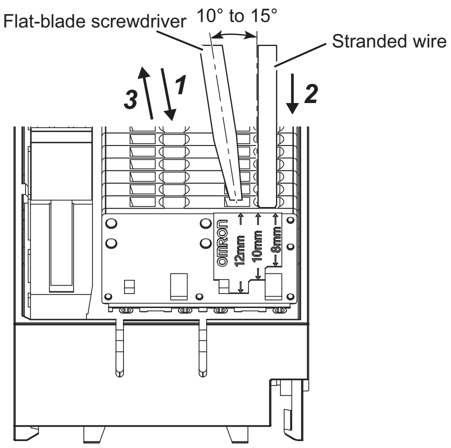
Use the following procedure to connect the wires to the terminal block.

1 Hold a flat-blade screwdriver at an angle and insert it into the release hole.

The angle should be between 10° and 15°. If the flat-blade screwdriver is inserted correctly, you will feel the spring in the release hole respond.

2 With the flat-blade screwdriver still inserted into the release hole, insert the wire into the terminal hole until it strikes the terminal block. Always twist stranded wires together before inserting them.

3 Remove the flat-blade screwdriver from the release hole.



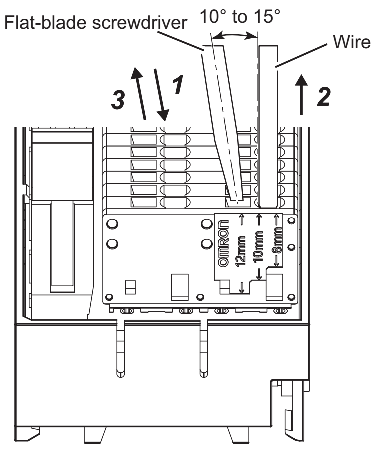
Checking Connections

- After the insertion, pull gently on the wire to make sure that it will not come off and the wire is securely fastened to the terminal block.
- To prevent short circuits, insert the stripped part of a stranded or solid wire or the conductor part of a ferrule until it is hidden inside the terminal insertion hole.

4-3-4 Removing Wires from the Push-In Plus Terminal Block

Use the following procedure to remove wires from the terminal block.
The same method is used to remove stranded wires, solid wires, and ferrules.

1. Hold a flat-blade screwdriver at an angle and insert it into the release hole.
2. With the flat-blade screwdriver still inserted into the release hole, remove the wire from the terminal insertion hole.
3. Remove the flat-blade screwdriver from the release hole.



4-3-5 Applicable Wires, Recommended Ferrules and Crimp Tools

Applicable wire

Applicable wire	**Stranded wire/ Solid wire**	0.08 to 1.5mm^2 (AWG28 to 16)
	Ferrules	With insulation sleeve: 0.14 to 0.5 mm^2 (AWG 26 to 20)
		Without insulation sleeve: 0.75 to 1.5 mm^2 (AWG 18 to 16)

Recommended Ferrules

- **XW2K**

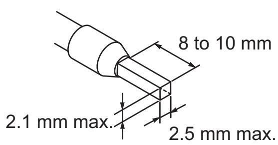
Applicable wire		Ferrule Conductor length (mm)	Stripped wire (mm) (Ferrules used)	Recommended ferrules		
(mm^2)	(AWG)			Manufactured by Phoenix Contact*	Manufactured by Weidmuller	Manufactured by Wago
0.14	26	8	10	AI 0,14-8	H0.14/12	---
0.25	24	8	10	AI 0,25-8	H0.25/12	216-301
		10	12	AI 0,25-10	---	---
0.34	22	8	10	AI 0,34-8	H0.34/12	216-302
		10	12	AI 0,34-10	---	---
0.50	20	8	10	AI 0,5-8	H0.5/14	216-201
		10	12	AI 0,5-10	H0.5/16	216-241
Recommended crimp tools				CRIMPFOX6 CRIMPFOX6T-F CRIMPFOX10S	PZ6 roto	Variocrimp4

*The above recommended ferrules manufactured by Phoenix Contact do not include models ending in “-GB”. Models ending in “-GB” are not recommended because the inner diameter of the insulation sleeve is larger than standard model (models not ending in “-GB”).

Note 1. Make sure that the outer diameter of the wire is smaller than the inner diameter of the insulation sleeve of the recommended ferrule.

2. Make sure that the ferrule processing dimensions conform to the following figure.

Processing dimensions of ferrules



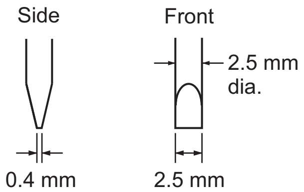
3. For the ferrule which is for applicable wire (0.75 to 1.5 mm^2/AWG 18 to 16), please use a ferrule without an insulation sleeve. (Refer to the following table.)

Applicable wire		Ferrules Conductor length (mm)	Stripped wire (mm) (Ferrules used)	Recommended ferrules		
(mm^2)	(AWG)			Manufactured by Phoenix Contact	Manufactured by Weidmuller	Manufactured by Wago
0.75	18	8	10	A 0, 75-8	---	F-0.75-8
		10	12	A 0, 75-10	H0,75/10	F-0.75-10
1/1.25	18/17	8	8	A 1-8	---	F-1.0-8
		10	10	A 1-10	H1,0/10	F-1.0-10

Applicable wire		Ferrules Conductor length (mm)	Stripped wire (mm) (Ferrules used)	Recommended ferrules		
(mm^2)	(AWG)			Manufactured by Phoenix Contact	Manufactured by Weidmuller	Manufactured by Wago
1.25/1.5	17/16	10	10	A 1,5-10	H1,5/10	F-1.5-10
Recommended crimp tools				CRIMPFOX6 CRIMPFOX6T-F CRIMPFOX10S	PZ6 roto	Variocrimp4

Recommended Flat-blade Screwdriver

Use a flat-blade screwdriver to connect and remove wires. Use the following flat-blade screwdriver. The following table shows manufacturers and models as of 2021/Dec.

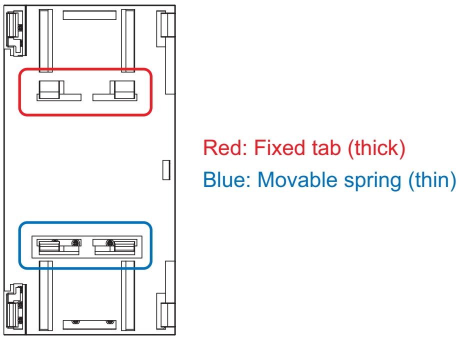


Model numbers	Manufacturer
ESD 0,40×2,5	Wera
SZS 0,4×2,5 SZF 0-0,4×2,5 *	Phoenix Contact
0.4×2.5×75 302	Wiha
AEF.2,5×75	Facom
210-719	Wago
SDIS 0.4×2.5×75	Weidmuller
9900(-2.5×75)	Vessel

* OMRON’s exclusive purchase model XW4Z-00B is available to order as SZF 0-0,4 x 2,5 (manufactured by Phoenix Contact).

4-3-6 Mounting to DIN Track/Removing from DIN Track

Mounting to DIN track vertically

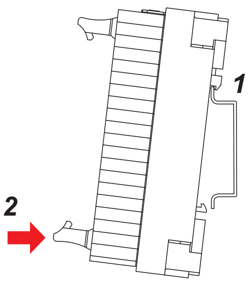


Product bottom surface

● Mounting Method

1 Hook fixed tab.

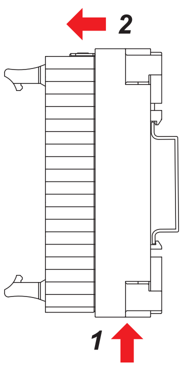
2 Push terminal block onto the DIN track.



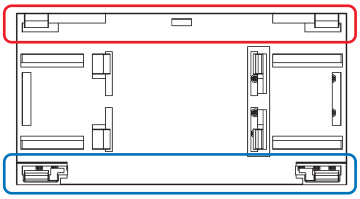
● Removal Method

1 Pressing case upward.

2 Pull the fixed tab side forward.



Mounting to DIN track horizontally



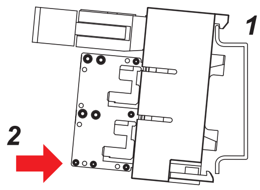
Red: Fixed tab (thick)
Blue: Movable spring (thin)

Product bottom surface

● Mounting Method

1 Hook fixed tab.

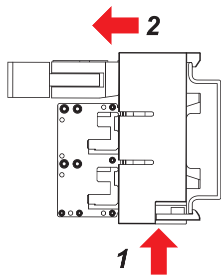
2 Push terminal block onto the DIN track.



● Removal Method

1 Pressing case upward.

2 Pull the fixed tab side forward.

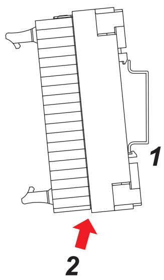


Note (Mounting Method)

If it is difficult to push the front of the main unit due to the wire connections, or if the mounting is hard due to individual differences in track types, it is possible to attach it to the DIN rail with a relatively light force while holding the lower part of the main unit by the mounting method shown in the figure below.

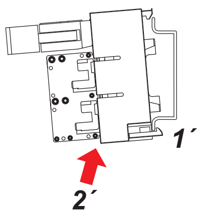
1 Hook the movable spring.

2 Push bottom of the terminal block upward with the terminal block tilted diagonally in relation to the DIN track.



1´ Hook the movable spring.

2´ Push bottom of the terminal block upward with the terminal block tilted diagonally in relation to the DIN track.

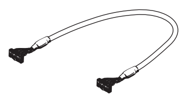


4-3-7 Special Cable for Connector-Terminal Block Conversion Unit

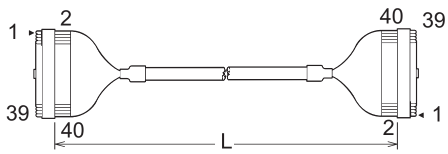
This is a dedicated cable for connecting a MIL connector of the Advanced Temperature Control Unit to a MIL connector of the compact Connector-Terminal Block Conversion Unit.

XW2Z-□□□EE

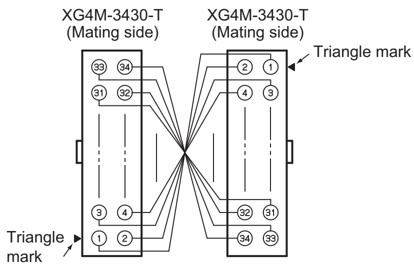
34-pin MIL — 34-pin MIL, Straight Wiring

Appearance	Model	Cable length L (m)	Sheath outer diameter (mm)/ Minimum bending radius (mm)
	XW2Z-050EE	0.5	9.8 dia./R79
	XW2Z-100EE	1	
	XW2Z-150EE	1.5	
	XW2Z-200EE	2	
	XW2Z-300EE	3	
	XW2Z-500EE	5	

Cable Length L (m)



Wiring Diagram

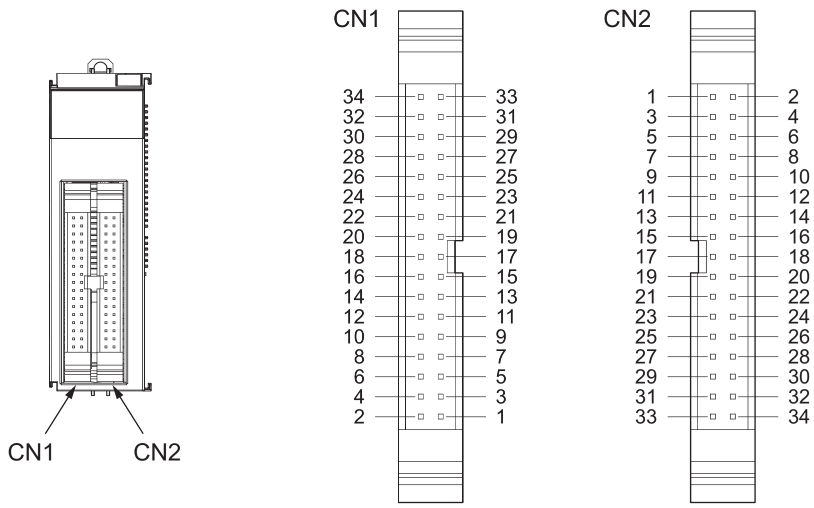


Note: Wire the pins 1:1 so that the Connector pin numbers match.

4-3-8 Terminal Arrangement of the Advanced Temperature Control Unit and the Compact Connector-Terminal Block Conversion Unit

The following table shows the correspondence between MIL connector's connector pins on the Advanced Temperature Control Unit and the terminal arrangement on the Ultra-Compact Interface Wiring System (XW2K-34G-T).

NX-HTC4505 (Standard Control Type)



- **Temperature, Analog, and Cold Junction Sensor Input (CN1 side)**

XW2K-34G-T Terminal No. (Row A)	NX-HTC4505 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
A1	1	A1/I1 (+)	1	I	Resistance thermometer input (A)/Current input (+)
A2	3	B1/TC1 (-)/V1 (-)/I1 (-)	1	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
A3	5	B1/TC1 (+)/V1 (+)	1	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
A4	7	A3/I3 (+)	3	I	Resistance thermometer input (A)/Current input (+)
A5	9	B3/TC3 (-)/V3 (-)/I3 (-)	3	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
A6	11	B3/TC3 (+)/V3 (+)	3	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
A7	13	CJ (B)	1 to 8	I	Cold junction sensor input (B)
A8	15	CJ (B)	1 to 8	I	Cold junction sensor input (B)
A9	17	A5/I5 (+)	5	I	Resistance thermometer input (A)/Current input (+)
A10	19	B5/TC5 (-)/V5 (-)/I5 (-)	5	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)

XW2K-34G-T Terminal No. (Row A)	NX-HTC4505 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
A11	21	B5/TC5 (+)/V5 (+)	5	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
A12	23	A7/I7 (+)	7	I	Resistance thermometer input (A)/Current input (+)
A13	25	B7/TC7 (-)/V7 (-)/I7 (-)	7	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
A14	27	B7/TC7 (+)/V7 (+)	7	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
A15	29	NC	---	---	Not used.
A16	31	NC	---	---	Not used.
A17	33	NC	---	---	Not used.

XW2K-34G-T Terminal No. (Row B)	NX-HTC4505 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
B1	2	A2/I2 (+)	2	I	Resistance thermometer input (A)/Current input (+)
B2	4	B2/TC2 (-)/V2 (-)/I2 (-)	2	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
B3	6	B2/TC2 (+)/V2 (+)	2	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
B4	8	A4/I4 (+)	4	I	Resistance thermometer input (A)/Current input (+)
B5	10	B4/TC4 (-)/V4 (-)/I4 (-)	4	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
B6	12	B4/TC4 (+)/V4 (+)	4	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
B7	14	NC	---	---	Not used.
B8	16	CJ (A)	1 to 8	I	Cold junction sensor input (A)
B9	18	A6/I6 (+)	6	I	Resistance thermometer input (A)/Current input (+)
B10	20	B6/TC6 (-)/V6 (-)/I6 (-)	6	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
B11	22	B6/TC6 (+)/V6 (+)	6	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
B12	24	A8/I8 (+)	8	I	Resistance thermometer input (A)/Current input (+)
B13	26	B8/TC8 (-)/V8 (-)/I8 (-)	8	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
B14	28	B8/TC8 (+)/V8 (+)	8	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)

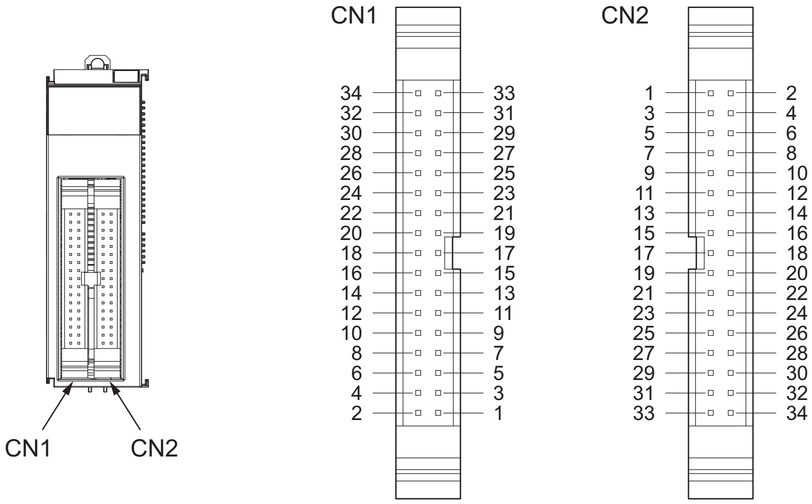
XW2K-34G-T Terminal No. (Row B)	NX-HTC4505 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
B15	30	NC	---	---	Not used.
B16	32	NC	---	---	Not used.
B17	34	NC	---	---	Not used.

- **CT Input/Control Output (CN2 side)**

XW2K-34G-T Terminal No. (Row A)	NX-HTC4505 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
A1	1	CT1	1	I	CT input
A2	3	CT2	2	I	CT input
A3	5	CT3	3	I	CT input
A4	7	CT4	4	I	CT input
A5	9	CT5	5	I	CT input
A6	11	CT6	6	I	CT input
A7	13	CT7	7	I	CT input
A8	15	CT8	8	I	CT input
A9	17	NC	---	---	Not used.
A10	19	OUT1	1	O	Control output (heating side) (+)
A11	21	OUT2	2	O	Control output (heating side) (+)
A12	23	OUT3	3	O	Control output (heating side) (+)
A13	25	OUT4	4	O	Control output (heating side) (+)
A14	27	OUT5	5	O	Control output (heating side) (+)
A15	29	OUT6	6	O	Control output (heating side) (+)
A16	31	OUT7	7	O	Control output (heating side) (+)
A17	33	OUT8	8	O	Control output (heating side) (+)

XW2K-34G-T Terminal No. (Row B)	NX-HTC4505 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
B1	2	CT1	1	I	CT input
B2	4	CT2	2	I	CT input
B3	6	CT3	3	I	CT input
B4	8	CT4	4	I	CT input
B5	10	CT5	5	I	CT input
B6	12	CT6	6	I	CT input
B7	14	CT7	7	I	CT input
B8	16	CT8	8	I	CT input
B9	18	NC	---	---	Not used.
B10	20	IOG1	1	O	Control output (heating side) (-)
B11	22	IOG2	2	O	Control output (heating side) (-)
B12	24	IOG3	3	O	Control output (heating side) (-)
B13	26	IOG4	4	O	Control output (heating side) (-)
B14	28	IOG5	5	O	Control output (heating side) (-)
B15	30	IOG6	6	O	Control output (heating side) (-)
B16	32	IOG7	7	O	Control output (heating side) (-)
B17	34	IOG8	8	O	Control output (heating side) (-)

NX-HTC3510 (Heating and Cooling Control Type)



● Temperature, Analog, Cold Junction Sensor Input (CN1 side)

XW2K-34G-T Terminal No. (Row A)	NX-HTC3510 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
A1	1	A1/I1 (+)	1	I	Resistance thermometer input (A)/Current input (+)
A2	3	B1/TC1 (-)/V1 (-)/I1 (-)	1	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
A3	5	B1/TC1 (+)/V1 (+)	1	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
A4	7	A3/I3 (+)	3	I	Resistance thermometer input (A)/Current input (+)
A5	9	B3/TC3 (-)/V3 (-)/I3 (-)	3	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
A6	11	B3/TC3 (+)/V3 (+)	3	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
A7	13	CJ (B)	1 to 4	I	Cold junction sensor input (B)
A8	15	CJ (B)	1 to 4	I	Cold junction sensor input (B)
A9	17	NC	---	---	Not used.
A10	19	NC	---	---	Not used.
A11	21	NC	---	---	Not used.
A12	23	NC	---	---	Not used.
A13	25	NC	---	---	Not used.
A14	27	NC	---	---	Not used.
A15	29	NC	---	---	Not used.
A16	31	NC	---	---	Not used.
A17	33	NC	---	---	Not used.

XW2K-34G-T Terminal No. (Row B)	NX-HTC3510 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
B1	2	A2/I2 (+)	2	I	Resistance thermometer input (A)/Current input (+)
B2	4	B2/TC2 (-)/V2 (-)/I2 (-)	2	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
B3	6	B2/TC2 (+)/V2 (+)	2	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
B4	8	A4/I4 (+)	4	I	Resistance thermometer input (A)/Current input (+)
B5	10	B4/TC4 (-)/V4 (-)/I4 (-)	4	I	Resistance thermometer input (B)/Thermocouple input (-)/Voltage input (-)/Current input (-)
B6	12	B4/TC4 (+)/V4 (+)	4	I	Resistance thermometer input (B)/Thermocouple input (+)/Voltage input (+)
B7	14	NC	---	---	Not used.
B8	16	CJ (A)	1 to 4	I	Cold junction sensor input (A)
B9	18	NC	---	---	Not used.
B10	20	NC	---	---	Not used.
B11	22	NC	---	---	Not used.
B12	24	NC	---	---	Not used.
B13	26	NC	---	---	Not used.
B14	28	NC	---	---	Not used.
B15	30	NC	---	---	Not used.
B16	32	NC	---	---	Not used.
B17	34	NC	---	---	Not used.

CT Input/Control Output (CN2 side)

XW2K-34G-T Terminal No. (Row A)	NX-HTC3510 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
A1	1	CT1	1	I	CT input
A2	3	CT2	2	I	CT input
A3	5	CT3	3	I	CT input
A4	7	CT4	4	I	CT input
A5	9	NC	---	---	Not used.
A6	11	NC	---	---	Not used.
A7	13	NC	---	---	Not used.
A8	15	NC	---	---	Not used.
A9	17	NC	---	---	Not used.
A10	19	OUT1	1	O	Control output (heating side) (+)
A11	21	OUT2	2	O	Control output (heating side) (+)
A12	23	OUT3	3	O	Control output (heating side) (+)
A13	25	OUT4	4	O	Control output (heating side) (+)
A14	27	OUT5	1	O	Control output (cooling side)(+)
A15	29	OUT6	2	O	Control output (cooling side)(+)
A16	31	OUT7	3	O	Control output (cooling side)(+)
A17	33	OUT8	4	O	Control output (cooling side)(+)

XW2K-34G-T Terminal No. (Row B)	NX-HTC3510 Connector Pin (MIL Connector)				
	Pin No.	Symbol	Ch	I/O	Function
B1	2	CT1	1	I	CT input
B2	4	CT2	2	I	CT input
B3	6	CT3	3	I	CT input
B4	8	CT4	4	I	CT input
B5	10	NC	---	---	Not used.
B6	12	NC	---	---	Not used.
B7	14	NC	---	---	Not used.
B8	16	NC	---	---	Not used.
B9	18	NC	---	---	Not used.
B10	20	IOG1	1	O	Control output (heating side) (-)
B11	22	IOG2	2	O	Control output (heating side) (-)
B12	24	IOG3	3	O	Control output (heating side) (-)
B13	26	IOG4	4	O	Control output (heating side) (-)
B14	28	IOG5	1	O	Control output (cooling side) (-)
B15	30	IOG6	2	O	Control output (cooling side) (-)
B16	32	IOG7	3	O	Control output (cooling side) (-)
B17	34	IOG8	4	O	Control output (cooling side) (-)

4-3-9 Installing and Removing the Cold Junction Sensor

● Handling of the Cold Junction Sensor

- One cold junction sensor is bundled with the Advanced Temperature Control Unit.
- Do not remove the cold junction sensors when you use the Unit. If the cold junction sensors are removed from the Unit, you cannot measure the temperature correctly regardless of the cold junction compensation enable/disable setting.
- If you have misplaced the cold junction sensor that came with the product, purchase another cold junction sensor (sold separately).

Name	Model numbers	Specification
Cold junction sensor	NX-AUX03	Dedicated for Advanced Temperature Control Units (NX-HTC).

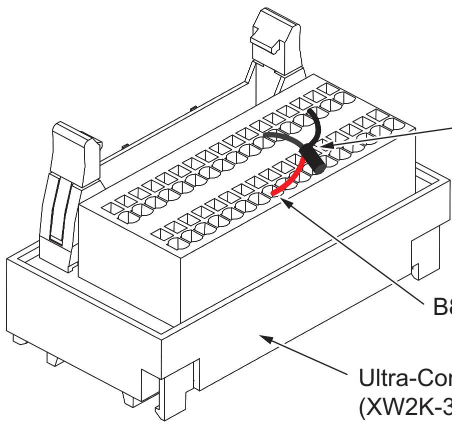
Attaching the Cold Junction Sensor

This section describes the procedure for attaching the cold junction sensor.

Precautions for Correct Use

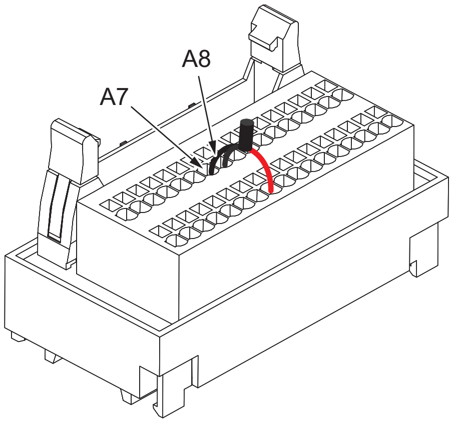
Before you use the Advanced Temperature Control Unit, make sure to attach the cold junction sensor to the Ultra-Compact Interface Wiring System (XW2K-34G-T).

1 Insert the cold junction sensor's ferrule terminal with red wire into No. B8 on the compact Connector-Terminal Block Conversion Unit.



2 Insert the cold junction sensor's ferrule terminal with black wire into No. A7 and No. A8 on the compact Connector-Terminal Block Conversion Unit.

The black wire has no polarity.



Precautions for Correct Use

- Do not touch the cold junction sensor except during installation. The temperature may not be measured correctly and the cold junction sensor may be disconnected.
- When you connect a cold junction sensor to the terminal block, insert the ferrule terminal straight until the tip of the ferrule terminal contacts the terminal block.
- If you have difficulty connecting the ferrule terminal of the cold junction sensor to the terminal block, use a flat-blade screwdriver. Refer to *Connecting Wires with Ferrules (hereinafter referred to as Ferrules) and Solid Wires* on page 4-13 for details.

Removing the Cold Junction Sensor

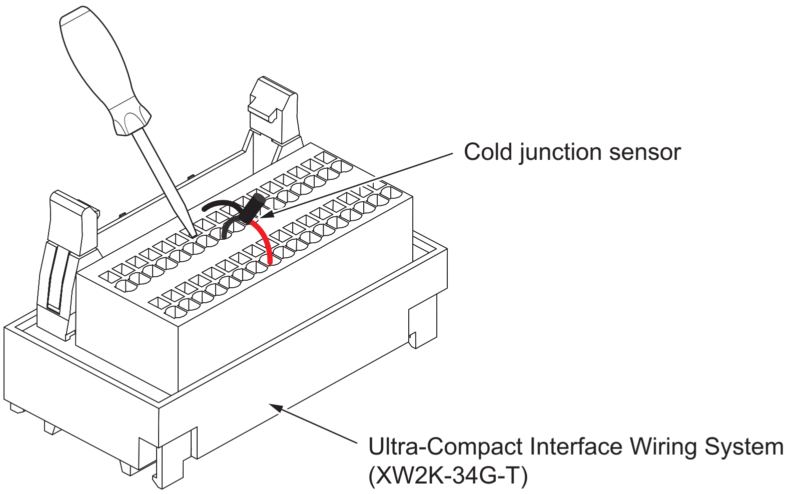
This section describes the procedure for removing the cold junction sensor.

The red wire of the cold junction sensor is blocking the release hole of the Ultra-Compact Interface Wiring System (XW2K-34G-T), so remove it from the black wire.

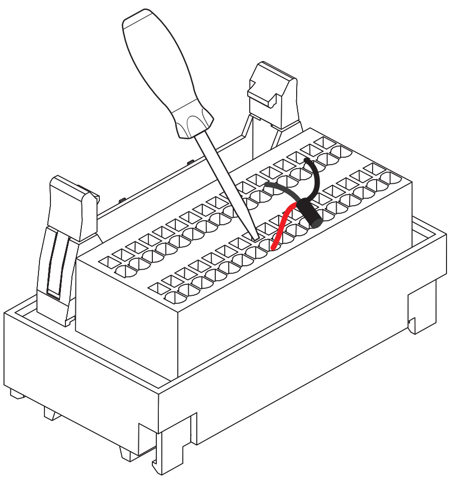
Precautions for Correct Use

Do not remove the cold junction sensor unless it needs to be replaced due to damage and other reasons.

1 Insert a flat-blade screwdriver diagonally into the release hole of the ferrule terminals (No. A7 and No. A8) where the black wire of the cold junction sensor is inserted, and remove the black wire from No. A7. Remove the black wire from No. A8 in the same way.



2 Remove the red wire from No. B8 in the same way as Step 1.



5

I/O Refreshing

This section describes the types and functions of I/O refreshing for the NX Units.

5-1 I/O Refreshing

This section describes I/O refreshing for the NX Units.

5-1-1 I/O Refreshing from CPU Units to NX Units

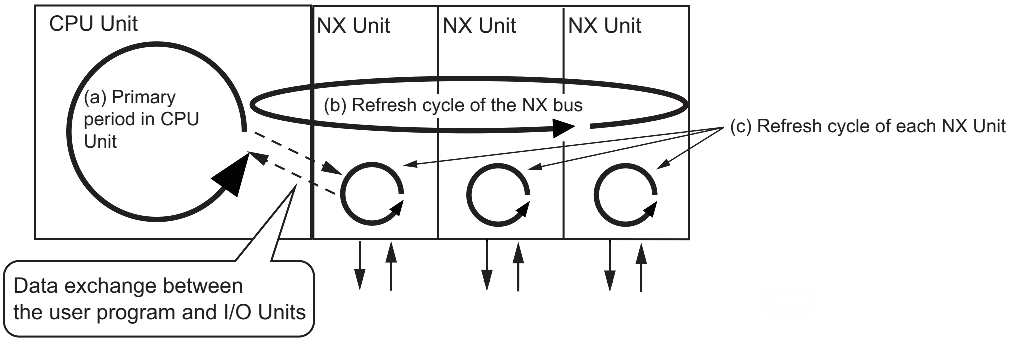
The NX-series CPU Unit performs cyclical I/O refreshing of the NX Units.

The following period and two cycles affect operation of the I/O refreshing between the CPU Unit and the NX Units.

(a) Primary period in CPU Unit

(b) Refresh cycle of the NX bus

(c) Refresh cycle of each NX Unit



The following operation occurs.

- The refresh cycle of the NX bus in item (b) is automatically synchronized with the primary period of the CPU Unit in item (a).
- The refresh cycle of each NX Unit in item (c) depends on the I/O refreshing method which is given below.

Refer to the software user's manual for the connected CPU Unit for detailed information on I/O refreshing between the CPU Unit and the NX Units.

For details on the I/O response times of the NX Unit in a CPU rack, refer to *5-1-3 Calculating the NX Unit I/O Response Times* on page 5-4.

5-1-2 I/O Refreshing from the CPU Unit or Industrial PC to Slave Terminals

The CPU Unit or the Industrial PC performs I/O refreshing cyclically with the Slave Terminals through the Communications Master Unit and the Communications Coupler Unit.

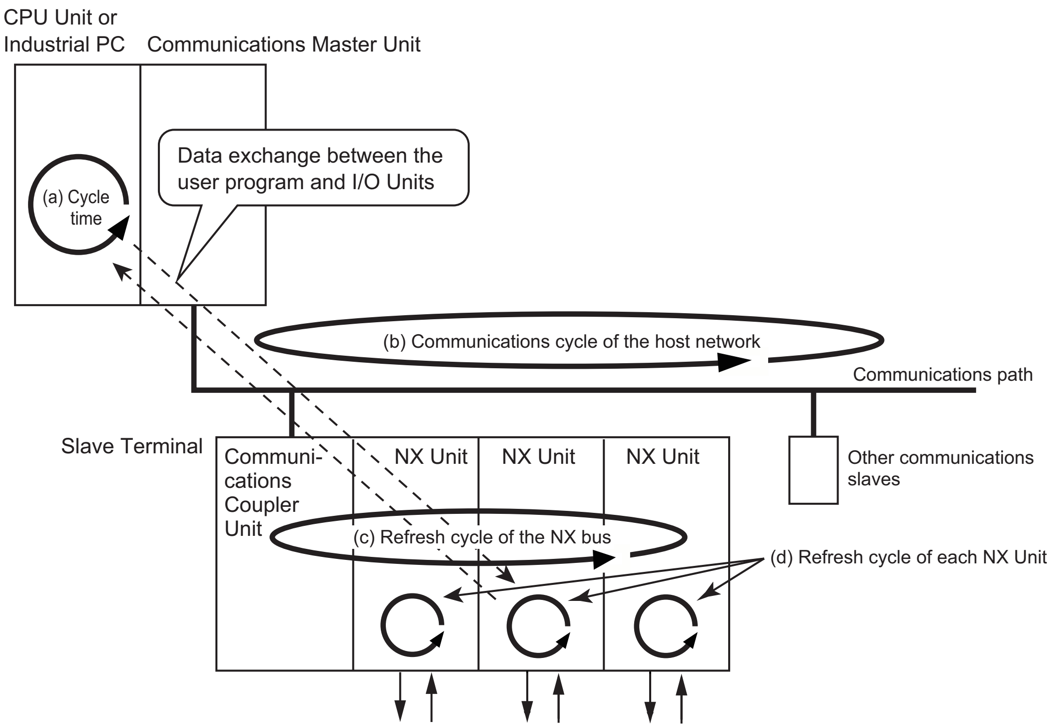
The following four cycles affect operation of the I/O refreshing between the CPU Unit or the Industrial PC and the NX Units in a Slave Terminal:

(a) Cycle time of the CPU Unit or Industrial PC

(b) Communications cycle of the host network

(c) Refresh cycle of the NX bus

(d) Refresh cycle of each NX Unit



The cycle time of the CPU Unit or Industrial PC, the communications cycle of the host network, and the NX bus I/O refresh cycle are determined by the type of the CPU Unit or Industrial PC and the type of communications.

The following explains operations when the built-in EtherCAT port on the NJ/NX-series CPU Unit or NY-series Industrial PC is used for communications with an EtherCAT Slave Terminal, with symbols in the figure.

Refer to the user's manual for the connected Communications Coupler Unit for information on the operation of I/O refreshing for Slave Terminals other than EtherCAT Slave Terminals.

Operation of I/O Refreshing with NX-series CPU Unit

The following shows the operation of I/O refreshing when the built-in EtherCAT port on the NX-series CPU Unit is used for communications with an EtherCAT Slave Terminal.

- The process data communications cycle in item (b) and the refresh cycle of the NX bus in item (c) are automatically synchronized with the primary period or the task period of the priority-5 periodic task of the CPU Unit in item (a) when the distributed clock is enabled in the EtherCAT Coupler Unit.
- The refresh cycle of each NX Unit in item (d) depends on the I/O refreshing method which is given below.

The priority-5 periodic task must be supported by the connected CPU Unit model. Refer to the software user's manual for the connected CPU Unit for the periodic tasks supported by each model of NX-series CPU Unit.

Operation of I/O Refreshing with NJ-series CPU Unit or NY-series Industrial PC

The operation of I/O refreshing is as follows when the built-in EtherCAT port on the NJ-series CPU Unit or NY-series Industrial PC is used for communications with an EtherCAT Slave Terminal.

- The process data communications cycle in item (b) and the refresh cycle of the NX bus in item (c) are automatically synchronized with the primary period of the CPU Unit or Industrial PC in item (a).*1
- The refresh cycle of each NX Unit in item (d) depends on the I/O refreshing method which is given below.

*1. This applies when the distributed clock is enabled in the EtherCAT Coupler Unit.

Refer to the *NX-series EtherCAT Coupler Unit User’s Manual* (Cat. No. W519-E1-08 or later) for detailed information on I/O refreshing between the built-in EtherCAT port and EtherCAT Slave Terminals.

For details on the I/O response times of the NX Unit in a slave terminal, refer to *5-1-3 Calculating the NX Unit I/O Response Times* on page 5-4.

5-1-3 Calculating the NX Unit I/O Response Times

Refer to the manuals shown below to calculate the NX Unit I/O response times according to where the NX Unit is connected.

● Connected to a CPU Unit

Manual name	Meaning
Manuals for the connected CPU Unit Software User's Manual	Describes the method to calculate the I/O response times of the NX Units in the CPU rack.
NX-series Data Reference Manual	Describes the parameter values used to calculate the I/O response times of the NX Units.

● Connected to a Communications Coupler Unit

Manual name	Meaning
User’s manual for the connected Communications Coupler Unit	Describes the method to calculate the I/O response times of the NX Units at the Slave Terminal.
NX-series Data Reference Manual	Describes the parameter values used to calculate the I/O response times of the NX Units.

5-2 I/O Refreshing Methods

This section describes I/O refreshing methods for the NX Units.

5-2-1 Types of I/O Refreshing Methods

The I/O refreshing methods available between the CPU Unit or Communications Coupler Unit and the NX Units depend on the CPU Unit or Communications Coupler Unit that is used.

For the Advanced Temperature Control Units, the available method is fixed to the following Free-Run refreshing.

I/O refreshing method name	Outline of operation
Free-Run refreshing	With this I/O refreshing method, the refresh cycle of the NX bus and I/O refresh cycles of the NX Units are asynchronous.

Refer to the user's manual for the connected CPU Unit for information on I/O refreshing between the CPU Unit and the NX Units.

Refer to the software user's manual for the connected Communications Coupler Unit for information on I/O refreshing between the Communications Coupler Unit and the NX Units.

5-2-2 Setting the I/O Refreshing Methods

Setting Methods between the CPU Unit and the NX Units

The setting method for the I/O refreshing method between the CPU Unit and the NX Units is determined by the connected CPU Unit.
Refer to the software user's manual for the connected CPU Unit for information on the setting method for I/O refreshing between the CPU Unit and the NX Units.

An example is provided below for an NX-series NX1P2 CPU Unit. There is no setting for this in the NX1P2 CPU Unit. Refreshing is determined as described in the following table.

NX Units that support only Free-Run refreshing	NX Units that support both Free-Run refreshing and synchronous I/O refreshing	NX Units that support Free-Run refreshing, synchronous I/O refreshing, and task period prioritized refreshing	NX Units that support only time stamp refreshing*1
Free-Run refreshing	Synchronous I/O refreshing		Time stamp refreshing

*1. Two types of time stamp refreshing are available: one is input refreshing with input changed time and the other is output refreshing with specified time stamp.

As the Advanced Temperature Control Unit is an NX Unit that supports only the Free-Run refreshing method, it operates using Free-Run refreshing.

Setting Methods between the Communications Coupler Unit and the NX Units

The setting method for the I/O refreshing method between the Communications Coupler Unit and the NX Units is determined by the connected Communications Coupler Unit.
Refer to the user’s manual for the connected Communications Coupler Unit for information on the setting method for I/O refreshing between the Communications Coupler Unit and the NX Units.

An example is provided below for when an EtherCAT Coupler Unit is connected to the built-in EtherCAT port on an NJ/NX-series CPU Unit or NY-series Industrial PC.
The I/O refreshing method between the EtherCAT Coupler Unit and each NX Unit depends on whether the DC is enabled in the EtherCAT Coupler Unit.

DC enable setting in the EtherCAT Coupler Unit	NX Units that support only Free-Run refreshing	NX Units that support both Free-Run refreshing and synchronous I/O refreshing	NX Units that support Free-Run refreshing, synchronous I/O refreshing, and task period prioritized refreshing	NX Units that support only time stamp refreshing
Enabled (DC for synchronization)[*1]	Free-Run refreshing	Synchronous I/O refreshing	Synchronous I/O refreshing	Time stamp refreshing
Enabled (DC with priority in cycle time)[*1]			Task period prioritized refreshing	
Disabled (FreeRun)[*2]		Free-Run refreshing	Free-Run refreshing	Operation with time stamp refreshing is not possible.[*3]

*1. The EtherCAT Slave Terminal operates in DC Mode.

*2. The EtherCAT Slave Terminal operates in Free-Run Mode.

*3. Refer to the manuals for the specific NX Units for details on the operation when the DC is set to *Disabled (FreeRun)*.

As the Advanced Temperature Control Unit is an NX Unit that supports only the Free-Run refreshing method, it operates using Free-Run refreshing.

5-2-3 Free-Run Refreshing

With this I/O refreshing method, the refresh cycle of the NX bus and I/O refresh cycles of the NX Units are asynchronous.

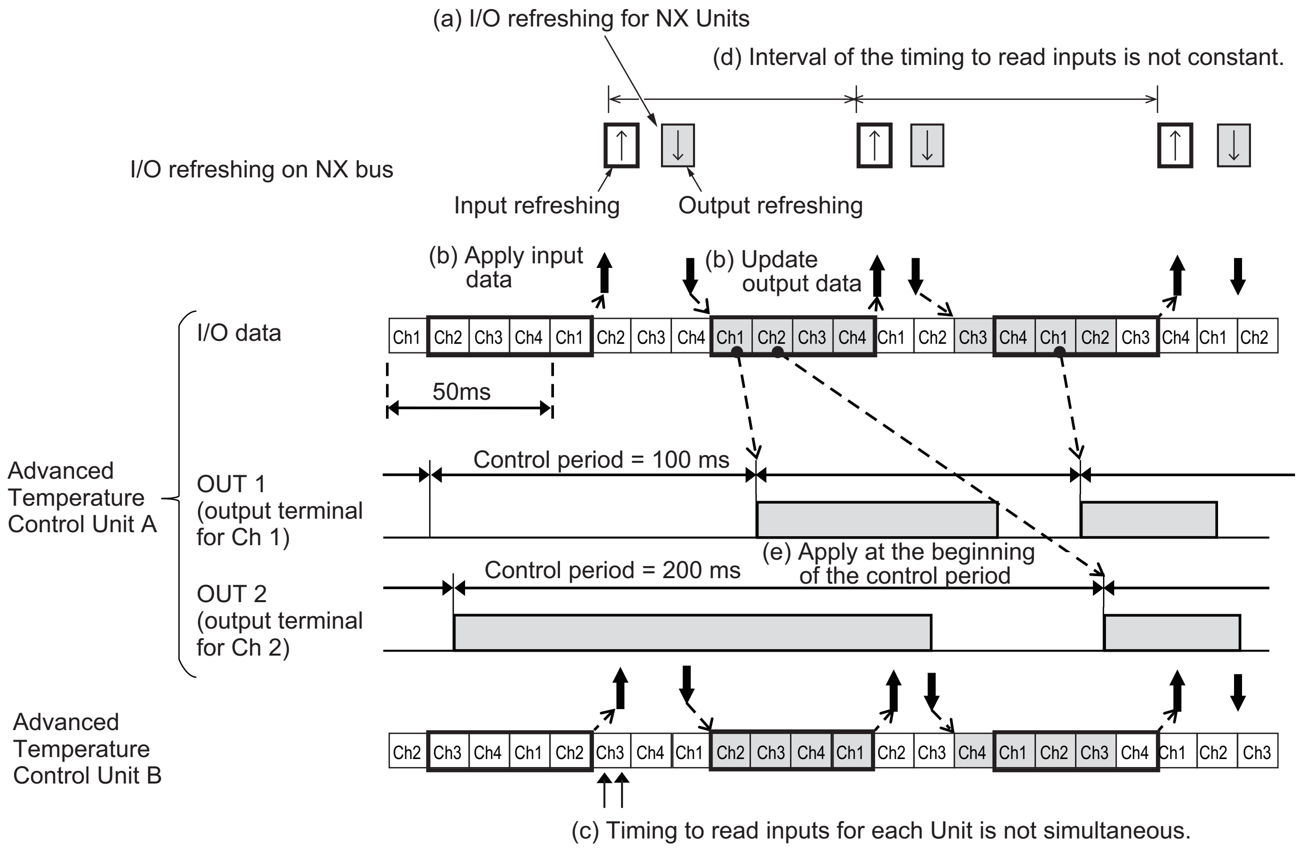
NX Units read inputs and refresh outputs during I/O refreshing.

This method is used when it is not necessary to be aware of factors such as the I/O timing jitter and the concurrency of the timing to read inputs and refresh outputs between the NX Units.

Description of CPU Unit Operation

The following describes the operation of Free-Run refreshing between the CPU Unit and Advanced Temperature Control Unit.

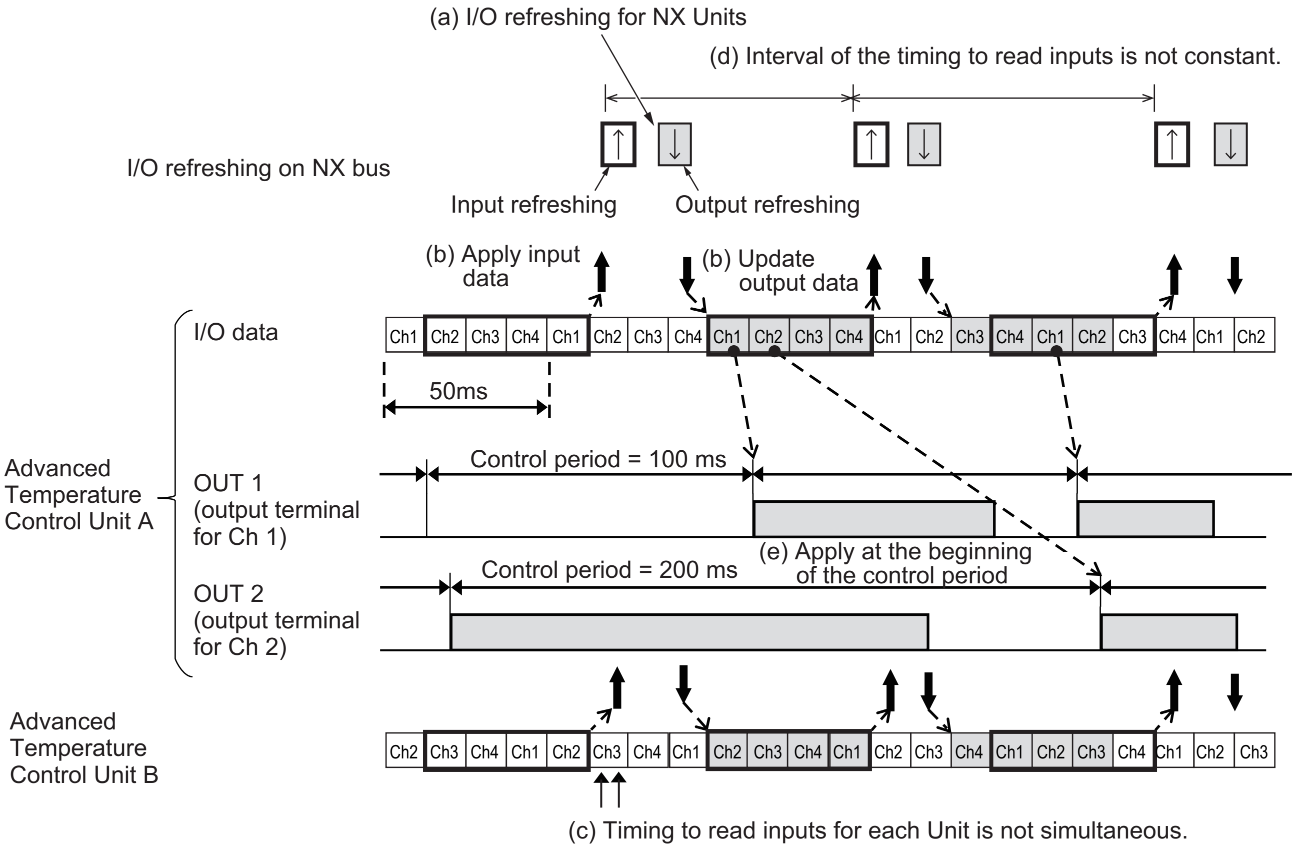
- The CPU Unit performs I/O refreshing for NX Units. (Refer to (a) in the figure below.)
- The Advanced Temperature Control Unit applies the latest input data and updates the output data when the I/Os are refreshed. (Refer to (b) in the figure below.)
- The CPU Unit can read the most recent input data during I/O refreshing.
  However, timing to read inputs or to refresh outputs is different for each NX Unit. (Refer to (c) in the figure below.)
- The interval of I/O refreshing varies with the processing conditions of the CPU Unit. Therefore, the interval of the timing to read inputs or to refresh outputs for NX Unit is not always the same. (Refer to (d) in the figure below.)
- The Advanced Temperature Control Unit repeatedly reads the input and refreshes the output amount (manipulated variable) in the order of the channels at a 50-ms sampling period, which is asynchronous with the NX bus refresh cycle.
- The output amount (manipulated variable) is applied to the output at the start of the control period, which is asynchronous with the sampling period. (Refer to (e) in the figure below.)



Description of Slave Terminal Operation

The following describes the operation of Free-Run refreshing between the Communications Coupler Unit and Advanced Temperature Control Unit.

- The Communications Coupler Unit performs I/O refreshing for NX Units. (Refer to (a) in the figure below.)
- The Advanced Temperature Control Unit applies the latest input data and updates the output data when the I/Os are refreshed. (Refer to (b) in the figure below.)
- The Communications Coupler Unit can read the most recent input data during I/O refreshing. However, timing to read inputs or to refresh outputs for each NX Unit in the Slave Terminal does not occur at the same time. (Refer to (c) in the figure below.)
- The I/O refreshing interval changes according to the processing conditions of the Communications Coupler Unit and host communications master. Therefore, the interval of the timing to read inputs or to refresh outputs for NX Unit is not always the same. (Refer to (d) in the figure below.)
- The Advanced Temperature Control Unit repeatedly reads the input and refreshes the output amount (manipulated variable) in the order of the channels at a 50-ms sampling period, which is asynchronous with the NX bus refresh cycle.
- The output amount (manipulated variable) is applied to the output at the start of the control period, which is asynchronous with the sampling period. (Refer to (e) in the figure below.)



Settings

Add the NX Units that support Free-Run refreshing to the CPU Unit configuration or Slave Terminal configuration.

After you add the Units, set the I/O refreshing method for operation with Free-Run refreshing according to the connected CPU Unit or Communications Coupler Unit.

Refer to *5-2-2 Setting the I/O Refreshing Methods* on page 5-5 for the setting method for the I/O refreshing method.

6

I/O Data Specifications and Lists of Settings

This section describes the I/O data specifications for the Advanced Temperature Control Units and lists of settings.

6-1 Specifications of I/O Data

This section describes the I/O data of the Advanced Temperature Control Units.

6-1-1 Allocable I/O Data

The allocable I/O data for the Advanced Temperature Control Units is given below.

A total of seven I/O entry mappings (four inputs and three outputs) can be assigned to the I/O allocation settings for the Advanced Temperature Control Units.

An I/O entry specific to each model of the Advanced Temperature Control Units is assigned to its I/O entry mappings.

An I/O entry refers to I/O data described throughout this section, and an I/O entry mapping refers to a collection of I/O entries, which is also called a data set.

For the Advanced Temperature Control Units, Data Set 1 is fixed (always used) for the allocation of I/O entry mappings, while other data sets are optional. I/O entries can be added or deleted.

For details on how to add or delete I/O entries in I/O entry mappings, refer to the operation manual for the Support Software you use.

The I/O entry mappings for the Advanced Temperature Control Units are shown in the tables below.

Inputs

<table>
<tr><th rowspan="3">I/O entry mapping name</th><th colspan="8">I/O entries
[Index] (hex)</th></tr>
<tr><th colspan="2" rowspan="2">Type of data</th><th rowspan="2">Default selection</th><th colspan="2">NX-HTC4505</th><th colspan="2">NX-HTC3510</th><th rowspan="2">Maximum entries *2</th></tr>
<tr><th>Number of default entries</th><th>Default size [bytes]</th><th>Number of default entries</th><th>Default size [bytes]</th></tr>
<tr><td>Input Data Set 1</td><td rowspan="4">[6000] Unit Status
[6001] Operating Status
[6002] Output and Alarm Status
[6003] Terminal Ambient Temperature
[6004] Decimal Point Position Monitor
[6005] Measured Value
[6007] MV Monitor Heating
[6009] MV Monitor Cooling
[600B] Heater Current
[600D] Leakage Current
[600F] Proportional Band Monitor</td><td rowspan="4">[6010] Integral Time Monitor
[6011] Derivative Time Monitor
[6012] Proportional Band Cooling Monitor
[6013] Integral Time Cooling Monitor
[6014] Derivative Time Cooling Monitor
[6015] Feature Value (Temperature) Monitor
[6016] Feature Value (MV – Heating) Monitor
[6017] Feature Value (MV – Cooling) Monitor
[601C] Input Digital Filter Monitor
[601D] Response Flag
[601E] Pre-Boost Monitor</td><td>Available</td><td>49
[6001, 6002, 6005, 6007, 600B, 600D]</td><td>114</td><td>29
[6001, 6002, 6005, 6007, 6009, 600B, 600D]</td><td>66</td><td>128</td></tr>
<tr><td>Input Data Set 2</td><td>Available</td><td>24
[600F to 6011]</td><td>48</td><td>24
[600F to 6014]</td><td>48</td><td>24</td></tr>
<tr><td>Input Data Set 3</td><td>Not available</td><td>96
[601E]</td><td>192</td><td>0</td><td>0</td><td>96</td></tr>
<tr><td>Input Data Set 4</td><td>Not available</td><td>96
[6015, 6016]</td><td>192</td><td>64
[6015 to 6017]</td><td>128</td><td>96</td></tr>
</table>

Outputs

<table>
<tr><th rowspan="3">I/O entry mapping name</th><th colspan="8">I/O entries
[Index] (hex)</th></tr>
<tr><th colspan="2" rowspan="2">Type of data</th><th rowspan="2">Default selection</th><th colspan="2">NX-HTC4505</th><th colspan="2">NX-HTC3510</th><th rowspan="2">Maximum entries *2</th></tr>
<tr><th>Number of default entries</th><th>Default size [bytes]</th><th>Number of default entries</th><th>Default size [bytes]</th></tr>
<tr><td>Output Data Set 1</td><td rowspan="3">[7000] Operation Command *1
[7001] Set Point
[7003] Manual MV
[7005] Proportional Band
[7006] Integral Time
[7007] Derivative Time
[7008] Proportional Band Cooling
[7009] Integral Time Cooling
[700A] Derivative Time Cooling</td><td rowspan="3">[7012] Alarm Value 1
[7013] Alarm Value Upper Limit 1
[7014] Alarm Value Lower Limit 1
[7015] Alarm Value 2
[7016] Alarm Value Upper Limit 2
[7017] Alarm Value Lower Limit 2
[7018] Heater Burnout Detection Current
[7019] SSR Failure Detection Current
[701A] PV Input Shift
[701B] Input Digital Filter
[701C] Hysteresis Heating
[701D] Hysteresis Cooling
[701E] Pre-Boost Setting</td><td>Available</td><td>40
[7000, 7001, 7003, 7018, 7019]</td><td>96</td><td>20
[7000, 7001, 7003, 7018, 7019]</td><td>48</td><td>128</td></tr>
<tr><td>Output Data Set 2</td><td>Available</td><td>24
[7005 to 7007]</td><td>48</td><td>24
[7005 to 700A]</td><td>48</td><td>24</td></tr>
<tr><td>Output Data Set 3</td><td>Not available</td><td>112
[701E]</td><td>224</td><td>0</td><td>0</td><td>112</td></tr>
</table>

*1. Output Data Set 1 is always assigned.

*2. The maximum number of registered I/O entries is 247, which is the total of Input and Output entries.

The details of the I/O entries available for I/O entry mappings are described below for each of input and output.

To assign the I/O allocation information of the NX Units or Slave Terminal to an NJ/NX-series CPU Unit or NY-series Industrial PC, use the I/O ports for the allocated I/O data. However, with a Slave Terminal, an I/O port is not used for some communications masters or Communications Coupler Units.

Refer to the user's manual for the connected Communications Coupler Unit for information on how to use I/O data for the Slave Terminal.

Input Data Set 1 to 4

The I/O data that can be assigned to Input Data Set is shown below. Although a default I/O allocation is provided for the data set, you can select from all the data by editing it. Refer to *6-1-3 Registering the Default Values for I/O Data* on page 6-18 for details on I/O data registered by default. Refer to *6-1-2 Details about Aggregated Data* on page 6-12 for more details about aggregated data, such as statuses.

Only the settings from Ch1 to Ch4 are available for the model NX-HTC3510.

Precautions for Correct Use

The NX-HTC model has a maximum of 8 channels of I/O data available (4 channels for cooling control parameters). To make the tables easier to read, this manual describes the same parameters for channels grouped as follows:

The second digit of the subindex is incremented.

Example:

Data name	Index [hex]	Subindex [hex]
Ch1 Measured Value INT	6005	01
...		...
Ch8 Measured Value INT		71
Ch1 Measured Value REAL		02
...		...
Ch8 Measured Value REAL		72

Data name	Index [hex]	Subindex [hex]
Ch1 to Ch8 Measured Value INT	6005	01 to 71
Ch1 to Ch8 Measured Value REAL		02 to 72

Data name	Operation	Data type	Initial value	I/O port name	Index [hex]	Subindex [hex]
Unit Status	Aggregated data for Unit status.*1	WORD	0000 hex	Unit Status	6000	1
Ch1 to Ch8 Operating Status	Aggregated data for Ch1 to Ch8 operating status. *1	WORD	0000 hex	Ch1 to Ch8 Operating Status	6001	01 to 71
Ch1 to Ch8 Operating Status2	Aggregated data for Ch1 to Ch8 operating status 2. *1	WORD	0000 hex	Ch1 to Ch8 Operating Status2		02 to 72
Ch1 to Ch8 Output and Alarm Status	Aggregated data for Ch1 to Ch8 output and alarm status. *1	WORD	0000 hex	Ch1 to Ch8 Output and Alarm Status	6002	01 to 71
Terminal Ambient Temperature	Ambient temperature around the terminals on the Advanced Temperature Control Units. The temperature unit follows the Ch1 Temperature Unit setting, regardless of the Enable/Disable setting of the channel.	INT	0	Terminal Ambient Temperature	6003	01

Data name	Operation	Data type	Initial value	I/O port name	Index [hex]	Subin-dex [hex]
Ch1 to Ch8 Decimal Point Position Monitor	Decimal point position for Ch1 to Ch8. This data indicates the decimal point position of the measured value (INT), set point (INT), alarm value (INT), and alarm upper and lower-limit value (INT) for Ch1 through Ch8. 0: No decimal point 1: One digit decimal point 2: Two digit decimal points 3: Three digit decimal points	UINT	0	Ch1 to Ch8 Decimal Point Position Monitor	6004	01 to 71
Ch1 to Ch8 Measured Value INT	INT-type measured value for Ch1 to Ch8. The unit is EU. *2	INT	0	Ch1 to Ch8 Measured Value INT	6005	01 to 71
Ch1 to Ch8 Measured Value REAL	REAL-type measured value for Ch1 to Ch8. The unit is EU. *3	REAL	0	Ch1 to Ch8 Measured Value REAL		02 to 72
Ch1 to Ch8 MV Monitor Heating INT	INT-type manipulated variable (heating) for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 MV Monitor Heating INT	6007	01 to 71
Ch1 to Ch8 MV Monitor Heating REAL	REAL-type manipulated variable (heat-ing) for Ch1 to Ch8. The unit is %.	REAL	0	Ch1 to Ch8 MV Monitor Heating REAL		02 to 72
Ch1 to Ch4 MV Monitor Cooling INT	INT-type manipulated variable (cooling) for Ch1 to Ch4. It is in units of 0.1%.	INT	0	Ch1 to Ch4 MV Monitor Cooling INT	6009	01 to 31
Ch1 to Ch4 MV Monitor Cooling REAL	REAL-type manipulated variable (cool-ing) for Ch1 to Ch4. The unit is %.	REAL	0	Ch1 to Ch4 MV Monitor Cooling REAL		02 to 32
Ch1 to Ch8 Heater Cur-rent UINT	UINT-type heater current for Ch1 to Ch8. It is in units of 0.1 A.	UINT	0	Ch1 to Ch8 Heater Cur-rent UINT	600B	01 to 71
Ch1 to Ch8 Heater Cur-rent REAL	REAL-type heater current for Ch1 to Ch8. The unit is "A" (amperes).	REAL	0	Ch1 to Ch8 Heater Cur-rent REAL		02 to 72
Ch1 to Ch8 Leakage Current UINT	UINT-type leakage current for Ch1 to Ch8. It is in units of 0.1 A.	UINT	0	Ch1 to Ch8 Leakage Current UINT	600D	01 to 71
Ch1 to Ch8 Leakage Current REAL	REAL-type leakage current for Ch1 to Ch8. The unit is "A" (amperes).	REAL	0	Ch1 to Ch8 Leakage Current REAL		02 to 72
Ch1 to Ch8 Proportional Band Monitor	Proportional band for Ch1 to Ch8. It is in units of 0.01°C or 0.01°F or 0.01%.	UINT	800	Ch1 to Ch8 Proportional Band Monitor	600F	01 to 71
Ch1 to Ch8 Integration Time Monitor	Integral time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	2330	Ch1 to Ch8 Integration Time Monitor	6010	01 to 71
Ch1 to Ch8 Derivative Time Monitor	Derivative time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	400	Ch1 to Ch8 Derivative Time Monitor	6011	01 to 71
Ch1 to Ch4 Proportional Band Cooling Monitor	Proportional band (cooling) for Ch1 to Ch4. It is in units of 0.01°C or 0.01°F or 0.01%.	UINT	800	Ch1 to Ch4 Proportional Band Cooling Monitor	6012	01 to 31
Ch1 to Ch4 Integral Time Cooling Monitor	Integral time (cooling) for Ch1 to Ch4. It is in units of 0.1 s.	UINT	2330	Ch1 to Ch4 Integral Time Cooling Monitor	6013	01 to 31
Ch1 to Ch4 Derivative Time Cooling Monitor	Derivative time (cooling) for Ch1 to Ch4. It is in units of 0.1 s.	UINT	400	Ch1 to Ch4 Derivative Time Cooling Monitor	6014	01 to 31
Ch1 to Ch8 Max.Tem-perature Rise Gradient	Maximum temperature rise gradient for Ch1 to Ch8. It is in units of 0.01°C/sec or 0.01°F/sec or EU/sec.	UINT	0	Ch1 to Ch8 Max.Tem-perature Rise Gradient	6015	01 to 71
Ch1 to Ch8 Max.Tem-perature Fall Gradient	Maximum temperature fall gradient for Ch1 to Ch8. It is in units of 0.01°C/sec or 0.01°F/sec or EU/sec.	UINT	0	Ch1 to Ch8 Max.Tem-perature Fall Gradient		02 to 72
Ch1 to Ch8 Undershoot Value	Undershoot value for Ch1 to Ch8. The unit is EU.	UINT	0	Ch1 to Ch8 Undershoot Value		03 to 73
Ch1 to Ch8 Overshoot Value	Overshoot value for Ch1 to Ch8. The unit is EU.	UINT	0	Ch1 to Ch8 Overshoot Value		04 to 74
Ch1 to Ch8 Undershoot Time	Undershoot time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 Undershoot Time		05 to 75
Ch1 to Ch8 Overshoot Time	Overshoot time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 Overshoot Time		06 to 76

Data name	Operation	Data type	Initial value	I/O port name	Index [hex]	Subin-dex [hex]
Ch1 to Ch8 Time-Delay	Time delay for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 Time-Delay	6015	07 to 77
Ch1 to Ch8 Average Temperature Deviation	Average temperature deviation for Ch1 to Ch8. The unit is EU.	UINT	0	Ch1 to Ch8 Average Temperature Deviation		08 to 78
Ch1 to Ch8 Average MV Heating	Average MV (heating) for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 Average MV Heating	6016	01 to 71
Ch1 to Ch8 Stable MV Heating	Stable MV (heating) for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 Stable MV Heating		02 to 72
Ch1 to Ch8 Max.MV Heating	Maximum MV (heating) for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 Max.MV Heating		03 to 73
Ch1 to Ch8 Min.MV Heating	Minimum MV (heating) for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 Min.MV Heating		04 to 74
Ch1 to Ch4 Average MV Cooling	Average manipulated variable (cooling) for Ch1 to Ch4. It is in units of 0.1%.	INT	0	Ch1 to Ch4 Average MV Cooling	6017	01 to 31
Ch1 to Ch4 Stable MV Cooling	Stable manipulated variable (cooling) for Ch1 to Ch4. It is in units of 0.1%.	INT	0	Ch1 to Ch4 Stable MV Cooling		02 to 32
Ch1 to Ch4 Max.MV Cooling	Maximum manipulated variable (cooling) for Ch1 to Ch4. It is in units of 0.1%.	INT	0	Ch1 to Ch4 Max.MV Cooling		03 to 33
Ch1 to Ch4 Min.MV Cooling	Minimum manipulated variable (cooling) for Ch1 to Ch4. It is in units of 0.1%.	INT	0	Ch1 to Ch4 Min.MV Cooling		04 to 34
Ch1 to Ch8 Input Digital Filter Monitor	Input digital filter monitor for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 Input Digital Filter Monitor	601C	01 to 71
Response Flag	This is the result of applying the I/O data for adjustment.	WORD	0000 hex	Response Flag	601D	01
Ch1 to Ch8 FF1 Waiting Time Monitor	FF1 waiting time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 FF1 Waiting Time Monitor	601E	01 to 71
Ch1 to Ch8 FF1 Operation Time Monitor	FF1 operation time for Ch1 to Ch8. The unit is "s" (seconds).	UINT	1	Ch1 to Ch8 FF1 Operation Time Monitor		02 to 72
Ch1 to Ch8 FF1 Segment1 MV Monitor	FF1 Segment1 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment1 MV Monitor		03 to 73
Ch1 to Ch8 FF1 Segment2 MV Monitor	FF1 Segment2 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment2 MV Monitor		04 to 74
Ch1 to Ch8 FF1 Segment3 MV Monitor	FF1 Segment3 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment3 MV Monitor		05 to 75
Ch1 to Ch8 FF1 Segment4 MV Monitor	FF1 Segment4 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment4 MV Monitor		06 to 76
Ch1 to Ch8 FF2 Waiting Time Monitor	FF2 waiting time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 FF2 Waiting Time Monitor		07 to 77
Ch1 to Ch8 FF2 Operation Time Monitor	FF2 operation time for Ch1 to Ch8. The unit is "s" (seconds).	UINT	1	Ch1 to Ch8 FF2 Operation Time Monitor		08 to 78
Ch1 to Ch8 FF2 Segment1 MV Monitor	FF2 Segment1 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment1 MV Monitor		09 to 79
Ch1 to Ch8 FF2 Segment2 MV Monitor	FF2 Segment2 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment2 MV Monitor		0A to 7A
Ch1 to Ch8 FF2 Segment3 MV Monitor	FF2 Segment3 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment3 MV Monitor		0B to 7B
Ch1 to Ch8 FF2 Segment4 MV Monitor	FF2 Segment4 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment4 MV Monitor		0C to 7C

*1. Refer to *6-1-2 Details about Aggregated Data* on page 6-12 for details about the data.

*2. For temperature input, the settings of the Ch□ Temperature Unit and the Ch□ Decimal Point Position parameters apply. For analog input, the settings of the Ch□ Decimal Point Position parameter apply. Refer to *7-3-1 Input Type Settings* on page 7-11 for details.

*3. The decimal point position for temperature input is automatically set based on the selected sensor, and the settings specified in the Ch□ Temperature Unit parameter apply. For analog input, the settings of the Ch□ Decimal Point Position parameter apply. Refer to *7-3-1 Input Type Settings* on page 7-11 for details.

Output Data Set 1 to 3

The I/O data that can be assigned to Output Data Set is shown below. Although a default I/O allocation is provided for the data set, you can select from all the data by editing it. Refer to *6-1-3 Registering the Default Values for I/O Data* on page 6-18 for details on I/O data registered by default. Refer to *6-1-2 Details about Aggregated Data* on page 6-12 for more details about aggregated data, such as statuses.

Only the settings from Ch1 to Ch4 are available for the model NX-HTC3510.

Precautions for Correct Use

If you change the operation mode of the NJ/NX-series Controller or the CS/CJ/CP-series PLC, the values of the I/O data will not be retained in the factory default settings of the CPU Unit. In such a case, the output data such as the Ch☐ Operation Command and the Ch☐ Set Point parameters in the Advanced Temperature Control Unit will change to 0, which may result in unexpected operation of the Advanced Temperature Control Unit. Follow the methods described below to ensure that the I/O data is retained even when the operation mode is changed.

a) In the case of the NJ/NX-series Controller, set the system-defined variable "_DeviceOutHoldCfg (Device output hold setting)". For details, refer to *NJ/ NX-series CPU Unit Software User's Manual (Cat. No. W501)*.

b) In the case of the CS/CJ/CP-series PLC, set the I/O memory hold flag. For details, refer to the user's manual of the connected CPU Unit.

All of the I/O data including the other NX Units can be retained using the methods above. If there is some data that you do not want to retain, remove the assignment of the data that you want to retain from the output data, and create a user program to be accessed through message communications.

Data name	Operation	Data type	Initial value	I/O port name	Index [hex]	Subindex [hex]
Ch1 to Ch8 Operation Command	Aggregated data for Ch1 to Ch8 Operation Command. *1	WORD	0000 hex	Ch1 to Ch8 Operation Command	7000	01 to 71
Ch1 to Ch8 Operation Command2	Aggregated data for Ch1 to Ch8 Operation Command2. *1	WORD	0000 hex	Ch1 to Ch8 Operation Command2		02 to 72
Ch1 to Ch8 Set Point INT *2 *3	INT-type set point for Ch1 to Ch8. The unit is EU.	INT	0	Ch1 to Ch8 Set Point INT	7001	01 to 71
Ch1 to Ch8 Set Point REAL *2 *4	REAL-type set point for Ch1 to Ch8. The unit is EU.	REAL	0	Ch1 to Ch8 Set Point REAL		02 to 72
Ch1 to Ch8 Manual MV INT *5 *6	INT-type manual manipulated variable for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 Manual MV INT	7003	01 to 71
Ch1 to Ch8 Manual MV REAL *5 *7	REAL-type manual manipulated variable for Ch1 to Ch8. The unit is %.	REAL	0	Ch1 to Ch8 Manual MV REAL		02 to 72
Ch1 to Ch8 Proportional Band	Proportional band for Ch1 to Ch8. It is in units of 0.01°C or 0.01°F or 0.01%.	UINT	800	Ch1 to Ch8 Proportional Band	7005	01 to 71
Ch1 to Ch8 Integration Time	Integral time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	2330	Ch1 to Ch8 Integration Time	7006	01 to 71
Ch1 to Ch8 Derivative Time	Derivative time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	400	Ch1 to Ch8 Derivative Time	7007	01 to 71
Ch1 to Ch4 Proportional Band Cooling	Proportional band (cooling) for Ch1 to Ch4. It is in units of 0.01°C or 0.01°F or 0.01%.	UINT	800	Ch1 to Ch4 Proportional Band Cooling	7008	01 to 31
Ch1 to Ch4 Integral Time Cooling	Integral time (cooling) for Ch1 to Ch4. It is in units of 0.1 s.	UINT	2330	Ch1 to Ch4 Integral Time Cooling	7009	01 to 31
Ch1 to Ch4 Derivative Time Cooling	Derivative time (cooling) for Ch1 to Ch4. It is in units of 0.1 s.	UINT	400	Ch1 to Ch4 Derivative Time Cooling	700A	01 to 31

Data name	Operation	Data type	Initial value	I/O port name	Index [hex]	Subin-dex [hex]
Ch1 to Ch8 Alarm Value 1 INT *8 *9	INT-type alarm value 1 for Ch1 to Ch8. The unit is EU. The unit is “s” (seconds) when LBA (Loop burnout alarm) is used.	INT	0	Ch1 to Ch8 Alarm Value 1 INT	7012	01 to 71
Ch1 to Ch8 Alarm Value 1 REAL *8 *10	REAL-type alarm value 1 for Ch1 to Ch8. The unit is EU. The unit is “s” (seconds) when LBA (Loop burnout alarm) is used.	REAL	0	Ch1 to Ch8 Alarm Value 1 REAL		02 to 72
Ch1 to Ch8 Alarm Value Upper Limit 1 INT *9	INT-type alarm value upper limit 1 for Ch1 to Ch8. The unit is EU.	INT	0	Ch1 to Ch8 Alarm Value Upper Limit 1 INT	7013	01 to 71
Ch1 to Ch8 Alarm Value Upper Limit 1 REAL *10	REAL-type alarm value upper limit 1 for Ch1 to Ch8. The unit is EU.	REAL	0	Ch1 to Ch8 Alarm Value Upper Limit 1 REAL		02 to 72
Ch1 to Ch8 Alarm Value Lower Limit 1 INT *9	INT-type alarm value lower limit 1 for Ch1 to Ch8. The unit is EU.	INT	0	Ch1 to Ch8 Alarm Value Lower Limit 1 INT	7014	01 to 71
Ch1 to Ch8 Alarm Value Lower Limit 1 REAL *10	REAL-type alarm value lower limit 1 for Ch1 to Ch8. The unit is EU.	REAL	0	Ch1 to Ch8 Alarm Value Lower Limit 1 REAL		02 to 72
Ch1 to Ch8 Alarm Value 2 INT *9	INT-type alarm value 2 for Ch1 to Ch8. The unit is EU.	INT	0	Ch1 to Ch8 Alarm Value 2 INT	7015	01 to 71
Ch1 to Ch8 Alarm Value 2 REAL *10	REAL-type alarm value 2 for Ch1 to Ch8. The unit is EU.	REAL	0	Ch1 to Ch8 Alarm Value 2 REAL		02 to 72
Ch1 to Ch8 Alarm Value Upper Limit 2 INT *9	INT-type alarm value upper limit 2 for Ch1 to Ch8. The unit is EU.	INT	0	Ch1 to Ch8 Alarm Value Upper Limit 2 INT	7016	01 to 71
Ch1 to Ch8 Alarm Value Upper Limit 2 REAL *10	REAL-type alarm value upper limit 2 for Ch1 to Ch8. The unit is EU.	REAL	0	Ch1 to Ch8 Alarm Value Upper Limit 2 REAL		02 to 72
Ch1 to Ch8 Alarm Value Lower Limit 2 INT *9	INT-type alarm value lower limit 2 for Ch1 to Ch8. The unit is EU.	INT	0	Ch1 to Ch8 Alarm Value Lower Limit 2 INT	7017	01 to 71
Ch1 to Ch8 Alarm Value Lower Limit 2 REAL *10	REAL-type alarm value lower limit 2 for Ch1 to Ch8. The unit is EU.	REAL	0	Ch1 to Ch8 Alarm Value Lower Limit 2 REAL		02 to 72
Ch1 to Ch8 Heater Burn-out Detection Current UINT	UINT-type heater burnout detection cur-rent for Ch1 to Ch8. It is in units of 0.1 A.	UINT	0	Ch1 to Ch8 Heater Burn-out Detection Current UINT	7018	01 to 71
Ch1 to Ch8 Heater Burn-out Detection Current REAL	REAL-type heater burnout detection cur-rent for Ch1 to Ch8. The unit is "A" (amperes).	REAL	0	Ch1 to Ch8 Heater Burn-out Detection Current REAL		02 to 72
Ch1 to Ch8 SSR Failure Detection Current UINT	UINT-type SSR failure detection current for Ch1 to Ch8. It is in units of 0.1 A.	UINT	500	Ch1 to Ch8 SSR Failure Detection Current UINT	7019	01 to 71
Ch1 to Ch8 SSR Failure Detection Current REAL	REAL-type SSR failure detection current for Ch1 to Ch8. The unit is "A" (amperes).	REAL	50	Ch1 to Ch8 SSR Failure Detection Current REAL		02 to 72
Ch1 to Ch8 PV Input Shift	PV input shift for Ch1 to Ch8. It is in units of 0.01°C or 0.01°F or EU.	INT	0	Ch1 to Ch8 PV Input Shift	701 A	01 to 71
Ch1 to Ch8 Input Digital Filter	Input digital filter for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 Input Digital Filter	701B	01 to 71
Ch1 to Ch8 Hysteresis Heating	Hysteresis (heating) for Ch1 to Ch8. It is in units of 0.1°C or 0.1°F or 0.01%.	UINT	10	Ch1 to Ch8 Hysteresis Heating	701C	01 to 71
Ch1 to Ch4 Hysteresis Cooling	Hysteresis (cooling) for Ch1 to Ch4. It is in units of 0.1°C or 0.1°F or 0.01%.	UINT	10	Ch1 to Ch4 Hysteresis Cooling	701D	01 to 31

Data name	Operation	Data type	Initial value	I/O port name	Index [hex]	Subindex [hex]
Ch1 to Ch8 FF1 Waiting Time	FF1 waiting time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 FF1 Waiting Time	701E	01 to 71
Ch1 to Ch8 FF1 Operation Time	FF1 operation time for Ch1 to Ch8. The unit is "s" (seconds).	UINT	1	Ch1 to Ch8 FF1 Operation Time		02 to 72
Ch1 to Ch8 FF1 Segment1 MV	FF1 Segment1 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment1 MV		03 to 73
Ch1 to Ch8 FF1 Segment2 MV	FF1 Segment2 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment2 MV		04 to 74
Ch1 to Ch8 FF1 Segment3 MV	FF1 Segment3 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment3 MV		05 to 75
Ch1 to Ch8 FF1 Segment4 MV	FF1 Segment4 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF1 Segment4 MV		06 to 76
Ch1 to Ch8 FF1 Segment MV Variable Correction Coefficient	FF1 segment MV variable correction coefficient for Ch1 to Ch8. It is in increments of 0.01.	UINT	100	Ch1 to Ch8 FF1 Segment MV Variable Correction Coefficient		07 to 77
Ch1 to Ch8 FF2 Waiting Time	FF2 waiting time for Ch1 to Ch8. It is in units of 0.1 s.	UINT	0	Ch1 to Ch8 FF2 Waiting Time		08 to 78
Ch1 to Ch8 FF2 Operation Time	FF2 operation time for Ch1 to Ch8. The unit is "s" (seconds).	UINT	1	Ch1 to Ch8 FF2 Operation Time		09 to 79
Ch1 to Ch8 FF2 Segment1 MV	FF2 Segment1 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment1 MV		0A to 7A
Ch1 to Ch8 FF2 Segment2 MV	FF2 Segment2 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment2 MV		0B to 7B
Ch1 to Ch8 FF2 Segment3 MV	FF2 Segment3 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment3 MV		0C to 7C
Ch1 to Ch8 FF2 Segment4 MV	FF2 Segment4 MV for Ch1 to Ch8. It is in units of 0.1%.	INT	0	Ch1 to Ch8 FF2 Segment4 MV		0D to 7D
Ch1 to Ch8 FF2 Segment MV Variable Correction Coefficient	FF2 segment MV variable correction coefficient for Ch1 to Ch8. It is in increments of 0.01.	UINT	100	Ch1 to Ch8 FF2 Segment MV Variable Correction Coefficient		0E to 7E

*1. Refer to *6-1-2 Details about Aggregated Data* on page 6-12 for details about the data.

*2. Ch□ Set Point INT and the Ch□ Set Point REAL parameters cannot be used at the same time. Assign one of them.

*3. The range of data that can be set to the Ch□ Set Point INT parameter is as follows.
-32400 to 32400
However, if you set a value that exceeds the input setting range determined according to the input type, the upper limit or the lower limit of the input setting range is applied as the set point. For temperature input, the settings of the Ch□ Temperature Unit and the Ch□ Decimal Point Position parameters will apply. For analog input, the settings of the Ch□ Decimal Point Position parameter will apply. Refer to *7-3-1 Input Type Settings* on page 7-11 for details.

*4. The range of data that can be set to the Ch□ Set Point REAL parameter is as follows.
-3240 to 3240
However, if you set a value that exceeds the input setting range determined according to the input type, the upper limit or the lower limit of the input setting range is applied as the set point. The decimal point position for temperature input is automatically set based on the selected sensor, and the settings of the Ch□ Temperature Unit parameter will apply. For analog input, the settings of the Ch□ Decimal Point Position parameter will apply. Refer to *7-3-1 Input Type Settings* on page 7-11 for details.

*5. The Ch□ Manual MV INT and the Ch□ Manual MV REAL parameters cannot be used at the same time. Assign one of them.

*6. The range of data that can be set to the Ch□ Manual MV INT parameter is as follows. If a negative value is set for the heating/cooling control type, it results in the cooling output.
Standard control: -50 to 1050
Heating and cooling control -1050 to 1050

*7. The range of data that can be set to the Ch□ Manual MV REAL parameter is as follows. If a negative value is set for the heating/cooling control type, it results in the cooling output.
Standard control: -5 to 105
Heating and cooling control -105 to 105

*8. Ch□ Alarm Value□ INT and the Ch□ Alarm Value□ REAL parameters cannot be used at the same time. Assign one of them.

*9. The range of data that can be set to INT-type data of the Ch☐ Alarm Value 1, Ch☐ Alarm Value Upper Limit 1, Ch☐ Alarm Value Lower Limit 1, Ch☐ Alarm Value 2, Ch☐ Alarm Value Upper Limit 2, and the Ch☐ Alarm Value Lower Limit 2 parameter is as follows.
-32400 to 32400
For temperature input, the settings of the Ch☐ Temperature Unit and Ch☐ Decimal Point Position parameters will apply. For analog input, the settings of the Ch☐ Decimal Point Position parameter will apply. Refer to *7-3-1 Input Type Settings* on page 7-11 for details.

*10. The range of data that can be set to REAL-type data of the Ch☐ Alarm Value 1, Ch☐ Alarm Value Upper Limit 1, Ch☐ Alarm Value Lower Limit 1, Ch☐ Alarm Value 2, Ch☐ Alarm Value Upper Limit 2, and the Ch☐ Alarm Value Lower Limit 2 parameter is as follows.
-3240 to 3240
The decimal point position for temperature input is automatically set based on the selected sensor, and the settings of the Ch☐ Temperature Unit parameter will apply. For analog input, the settings of the Ch☐ Decimal Point Position parameter will apply. Refer to *7-3-1 Input Type Settings* on page 7-11 for details.

6-1-2 Details about Aggregated Data

The status and operation command settings are described in index numbers 6000 hex, 6001hex, 6002 hex and 7000 hex.
The aggregated data is described in detail for each of the following data.

- Unit Status
- Operating Status
- Output and Alarm Status
- Operation Command

Unit Status

Aggregated data for Unit status.

Data name	Data type	Initial value	I/O port name	Index	Subindex
Unit Status	WORD	0000 hex	Unit Status	6000 hex	01 hex

Details about Unit Status are shown in the table below.

[redacted]				
0	Terminal Ambient Temperature Error	0: No errors occurred 1: Error occurred	BOOL	Terminal Ambient Temperature Error
1 to 15	Reserved	---	---	---

*1. 1 and 0 represent TRUE and FALSE.

Operating Status/Operating Status2

Aggregated data for the Ch□ Operating Status and Operating Status2.

Data name	Data type	Initial value	I/O port name	Index	Subindex
Ch1 to Ch8 Operating Status	WORD	0000 hex	Ch1 to Ch8 Operating Status	6001 hex	01 to 71 hex
Ch1 to Ch8 Operating Status2	WORD	0000 hex	Ch1 to Ch8 Operating Status2		02 to 72 hex

● Details about Ch□ Operating Status

Details about Ch□ Operating Status are shown in the table below.

Bit	Data name	Description*1	Data type	I/O port name
0	Ch□ RUN or STOP Status	0: Stop 1: Run	BOOL	Ch□ RUN or STOP Status
1	Ch□ 100 Percent AT Status	0: 100% AT Stopping 1: 100% AT Executing	BOOL	Ch□ 100 Percent AT Status
2	Ch□ 40 Percent AT Status	0: 40% AT Stopping 1: 40% AT Executing	BOOL	Ch□ 40 Percent AT Status
3 to 8	Reserved	---	---	---
9	Ch□ Auto or Manual Status	0: Auto mode 1: Manual mode	BOOL	Ch□ Auto or Manual Status
10	Ch□ Reflect Manual MV Status *2	0: Not reflected 1: Reflected	BOOL	Ch□ Reflect Manual MV Status

Bit	Data name	Description*1	Data type	I/O port name
11	Ch□ Inverting Direct or Reverse Operation Status	0: Not inverting 1: Inverting	BOOL	Ch□ Inverting Direct or Reverse Operation Status
12	Ch□ Measuring Waveform Status	0: Waveform measurement is not in progress 1: Waveform measurement is in progress	BOOL	Ch□ Measuring Waveform Status
13	Ch□ Within Temperature Stable Band Status	0: Not within the stable band 1: Within the stable band	BOOL	Ch□ Within Temperature Stable Band Status
14	Ch□ Temperature Stable Control Status	0: Stable control disabled 1: Stable control enabled	BOOL	Ch□ Temperature Stable Control Status
15	Ch□ MV Stable Control Status	0: Stable control disabled 1: Stable control enabled	BOOL	Ch□ MV Stable Control Status

*1. 1 and 0 represent TRUE and FALSE.

*2. It is reflected only when Operating Status is assigned to the IN data.

● Details about Ch□ Operating Status2*1

Details about Ch□ Operating Status2 are shown in the table below.

Bit	Data name	Description*2	Data type	I/O port name
0	Ch□ FF or D-AT mode Monitor	0: FF mode 1: D-AT mode	BOOL	Ch□ FF or D-AT mode Monitor
1	Ch□ FF1 or D-AT1 Execute Status	0: Stopping 1: Executing	BOOL	Ch□ FF1 or D-AT1 Execute Status
2	Ch□ FF2 or D-AT2 Execute Status	0: Stopping 1: Executing	BOOL	Ch□ FF2 or D-AT2 Execute Status
3	Ch□ D-AT Complete Status	0: D-AT is not completed 1: D-AT is completed	BOOL	Ch□ D-AT Complete Status
4	Ch□ D-AT1 Execution Judgement Deviation Error	0: Normal 1: Error	BOOL	Ch□ D-AT1 Execution Judgement Deviation Error
5	Ch□ D-AT2 Execution Judgement Deviation Error	0: Normal 1: Error	BOOL	Ch□ D-AT2 Execution Judgement Deviation Error
6 to 15	Reserved	---	---	---

*1. Only the standard control type is used. The heating and cooling control type is always FALSE.

*2. 1 and 0 represent TRUE and FALSE.

Output and alarm status

Aggregated data for the Ch☐ Output and Alarm Status.

Data name	Data type	Initial value	I/O port name	Index	Subindex
Ch1 to Ch8 Output and Alarm Status	WORD	0000 hex	Ch1 to Ch8 Output and Alarm Status	6002 hex	01 to 71 hex

Details about the Ch☐ Output and Alarm Status are shown in the table below.

Bit	Data name	Description*1	Data type	I/O port name
0	Ch☐ Heating Control Output	0:OFF 1: ON	BOOL	Ch☐ Heating Control Output
1	Ch☐ Cooling Control Output	0:OFF 1: ON	BOOL	Ch☐ Cooling Control Output
2	Ch☐ Sensor Disconnected Error	0: No errors occurred 1: Error occurred	BOOL	Ch☐ Sensor Disconnected Error
3	Ch☐ Cold Junction Error	0: No errors occurred 1: Error occurred	BOOL	Ch☐ Cold Junction Error
4	Ch☐ AD Converter Error	0: No errors occurred 1: Error occurred	BOOL	Ch☐ AD Converter Error
5	Ch☐ Heater Burnout Detection	0: Not detected 1: Detected	BOOL	Ch☐ Heater Burnout Detection
6	Ch☐ SSR Failure Detection	0: Not detected 1: Detected	BOOL	Ch☐ SSR Failure Detection
7	Ch☐ Heater Current Hold	0: Updated 1: Not updated	BOOL	Ch☐ Heater Current Hold
8	Ch☐ Heater Current Exceeded	0: The measurement range is not exceeded 1: The measurement range is exceeded	BOOL	Ch☐ Heater Current Exceeded
9	Ch☐ Alarm 1 Detection	0: Not detected 1: Detected	BOOL	Ch☐ Alarm 1 Detection
10	Ch☐ Alarm 2 Detection	0: Not detected 1: Detected	BOOL	Ch☐ Alarm 2 Detection
11 to 15	Reserved	---	---	---

*1. 1 and 0 represent TRUE and FALSE.

Operation Command/Operation Command2

Aggregated data for the Ch□ Operation Command and Operation Command2.

Data name	Data type	Initial value	I/O port name	Index	Subindex
Ch1 to Ch8 Operation Command	WORD	0000 hex	Ch1 to Ch8 Operation Command	7000 hex	01 to 71 hex
Ch1 to Ch8 Operation Command2	WORD	0000 hex	Ch1 to Ch8 Operation Command2		02 to 72 hex

- The operation commands and operation commands2 are executed in ascending order from bit 0.
- If commands are sent at the same time for operation commands for the same function, only the operation command with the most significant bit is executed.

  Example) When 100 Percent AT and AT Cancel parameters are used at the same time, only AT Cancel parameter is executed.
- When the detection method is edge (rising), the operation command is executed immediately after the value changes from 0 to 1.

  To use the operation command again, first set the value to 0 and then change it to 1.
- If the execution conditions are not satisfied when the operation command is sent, the operation command is not executed, but is set as pending. The operation command is executed when the execution conditions are satisfied.

  Example) If 40 Percent AT parameter is executed during the execution of 100 Percent AT parameter, 40 Percent AT parameter will be executed after the execution of 100 Percent AT parameter is completed.
- If the operation command is 1 when the power supply is turned ON, the edge (rising) is detected and the operation command is executed.

● Details about Ch□ Operation Command

Details about Ch□ Operation Command are shown in the table below.

Bit	Data name	Description*1	Detection method	Data type	I/O port name
0	Ch□ RUN or STOP	0: Stop 1: Run	Level	BOOL	Ch□ RUN or STOP
1	Ch□ 100 Percent AT	0 to 1: 100% AT Executing	Edge (rising)	BOOL	Ch□ 100 Percent AT
2	Ch□ 40 Percent AT	0 to 1: 40% AT Executing	Edge (rising)	BOOL	Ch□ 40 Percent AT
3	Ch□ AT Cancel	0 to 1: AT Cancel	Edge (rising)	BOOL	Ch□ AT Cancel
4	Reserved	---	---	---	---
5	Reserved	---	---	---	---
6	Reserved	---	---	---	---
7	Reserved	---	---	---	---
8	Ch□ Auto or Manual*2	0: Auto mode 1: Manual mode	Level	BOOL	Ch□ Auto or Manual
9	Ch□ Reflect Manual MV	0: Not reflected 1: Reflected	Level	BOOL	Ch□ Reflect Manual MV
10	Ch□ Inverting Direct or Reverse Operation	0: Not inverting 1: Inverting	Level	BOOL	Ch□ Inverting Direct or Reverse Operation
11	Reserved	---	---	---	---
12	Ch□ Start Waveform Measurement	0 to 1: Start waveform measurement	Edge (rising)	BOOL	Ch□ Start Waveform Measurement
13	Ch□ Stop Waveform Measurement	0 to 1: Stop waveform measurement	Edge (rising)	BOOL	Ch□ Stop Waveform Measurement

Bit	Data name	Description*1	Detection method	Data type	I/O port name
14	Ch☐ Fixed SP for Waveform Measurement	0: Based on the set point 1: Based on the set point when waveform measurement starts	Level	BOOL	Ch☐ Fixed SP for Waveform Measurement
15	Reserved	---	---	---	---

*1. 1 and 0 represent TRUE and FALSE.

*2. If you switch to manual mode during AT execution, AT is canceled.

● Details about Ch☐ Operation Command2

Details about Ch☐ Operation Command2 are shown in the table below.

Bit	Data name	Description*1	Detection method	Data type	I/O port name
0	Ch☐ FF or D-AT mode	0: FF mode 1: D-AT mode	Level	BOOL	Ch☐ FF or D-AT mode
1	Ch☐ FF1 or D-AT1 Execute*2	0 to 1: FF1 or D-AT1 Executing	Edge (rising)	BOOL	Ch☐ FF1 or D-AT1 Execute
2	Ch☐ FF2 or D-AT2 Execute*2	0 to 1: FF2 or D-AT2 Executing	Edge (rising)	BOOL	Ch☐ FF2 or D-AT2 Execute
3	Ch☐ FF or D-AT Cancel	0 to 1: FF or D-AT Cancel	Edge (rising)	BOOL	Ch☐ FF or D-AT Cancel
4 to 15	Reserved	---	---	---	---

*1. 1 and 0 represent TRUE and FALSE.

*2. If "FF1 or D-AT1 Execute" is once again sent or "FF2 or D-AT2 Execute" is sent while "FF1 or D-AT1 Execute" is being performed, it will be ignored. "FF1 or D-AT1 Execute" will continue to be performed.

The execution conditions for each operation command are shown in the table below.

Data name	Execution condition *1
RUN/STOP	Command always accepted
100 Percent AT, and 40 Percent AT	Command cannot be accepted in any of the following cases: • RUN/STOP is set to "Stop". • ON/OFF control • 40 Percent AT is executed during 100 Percent AT execution. • 100 Percent AT is executed during 40 Percent AT execution. • 40 Percent AT is executed for the heating/cooling control type. • Auto or Manual is set to “Manual Mode”. • Another channel is selected for MV Branch Operation.
Ch□ Auto or Manual	Command cannot be accepted for ON/OFF control.
Ch□ Reflect Manual MV	Command always accepted
Inverting Direct or Reverse Operation	Command cannot be accepted in any of the following cases: • AT execution in progress • Auto or Manual is set to “Manual Mode”. • D-AT execution in progress
Start Waveform Measurement, and Stop Waveform Measurement	Command cannot be accepted in any of the following cases: • Sensor disconnected error • Loads OFF
FF or D-AT mode	Command cannot be accepted if FF or D-AT Execute Status is “Executing”.
FF or D-AT Execute	Command cannot be accepted in any of the following cases: • Heating/cooling control type • RUN/STOP is set to “Stop”. • ON/OFF control • AT execution in progress • Another channel is selected for MV Branch Operation. • FF2 executed during FF1 execution, or FF1 executed during FF2 execution. • D-AT2 executed during D-AT1 execution, or D-AT1 executed during D-AT2 execution.

*1. If the execution conditions are not satisfied when the operation command is sent, the operation command is not executed, but is set as pending. The operation command is executed when the execution conditions are satisfied.

Example) If 40 Percent AT parameter is executed during the execution of 100 Percent AT parameter, 40 Percent AT parameter will be executed after the execution of 100 Percent AT parameter is completed.

6-1-3 Registering the Default Values for I/O Data

The tables below show the I/O allocation availability for each Index and model. The dataset initial value parameter indicates the corresponding dataset number.

For NX-HTC3510, allocation is available for channels from Ch1 through Ch4 only.

Input Data Set

Index [hex]	Subindex [hex]	Data name	8Ch Standard control With CT input NX-HTC4510		4Ch Heating and cooling control With CT input NX-HTC3510	
			I/O allocation	Data set initial value	I/O allocation	Data set initial value
6000	01	Unit Status	Available	---	Available	---
6001	01 to 71	Ch1 to Ch8 Operating Status	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1
	02 to 72	Ch1 to Ch8 Operating Status2	Available	---	Available	---
6002	01 to 71	Ch1 to Ch8 Output and Alarm Status	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1
6003	01	Terminal Ambient Temperature	Available	---	Available	---
6004	01 to 71	Ch1 to Ch8 Decimal Point Position Monitor	Available	---	Available	---
6005	01 to 71	Ch1 to Ch8 Measured Value INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Measured Value REAL*1	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1
6007	01 to 71	Ch1 to Ch8 MV Monitor Heating INT	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1
	02 to 72	Ch1 to Ch8 MV Monitor Heating REAL	Available	---	Available	---
6009	01 to 31	Ch1 to Ch4 MV Monitor Cooling INT	Not available	---	Available (default)	Input Data Set 1
	02 to 32	Ch1 to Ch4 MV Monitor Cooling REAL	Not available	---	Available	---
600B	01 to 71	Ch1 to Ch8 Heater Current UINT	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1
	02 to 72	Ch1 to Ch8 Heater Current REAL	Available	---	Available	---
600D	01 to 71	Ch1 to Ch8 Leakage Current UINT	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1
	02 to 72	Ch1 to Ch8 Leakage Current REAL	Available	---	Available	---
600F	01 to 71	Ch1 to Ch8 Proportional Band Monitor	Available (default)	Input Data Set 2	Available (default)	Input Data Set 2
6010	01 to 71	Ch1 to Ch8 Integral Time Monitor	Available (default)	Input Data Set 2	Available (default)	Input Data Set 2
6011	01 to 71	Ch1 to Ch8 Derivative Time Monitor	Available (default)	Input Data Set 2	Available (default)	Input Data Set 2

Index [hex]	Subindex [hex]	Data name	8Ch Standard control With CT input NX-HTC4510		4Ch Heating and cooling control With CT input NX-HTC3510	
			I/O allocation	Data set initial value	I/O allocation	Data set initial value
6012	01 to 31	Ch1 to Ch4 Proportional Band Cooling Monitor	Not available	---	Available (default)	Input Data Set 2
6013	01 to 31	Ch1 to Ch4 Integral Time Cooling Monitor	Not available	---	Available (default)	Input Data Set 2
6014	01 to 31	Ch1 to Ch4 Derivative Time Cooling Monitor	Not available	---	Available (default)	Input Data Set 2
6015	01 to 71	Ch1 to Ch8 Max.Temperature Rise Gradient	Available	Input Data Set 4	Available	Input Data Set 4
	02 to 72	Ch1 to Ch8 Max.Temperature Fall Gradient	Available	Input Data Set 4	Available	Input Data Set 4
	03 to 73	Ch1 to Ch8 Undershoot Value	Available	Input Data Set 4	Available	Input Data Set 4
	04 to 74	Ch1 to Ch8 Overshoot Value	Available	Input Data Set 4	Available	Input Data Set 4
	05 to 75	Ch1 to Ch8 Undershoot Time	Available	Input Data Set 4	Available	Input Data Set 4
	06 to 76	Ch1 to Ch8 Overshoot Time	Available	Input Data Set 4	Available	Input Data Set 4
	07 to 77	Ch1 to Ch8 Time-Delay	Available	Input Data Set 4	Available	Input Data Set 4
	08 to 78	Ch1 to Ch8 Average Temperature Deviation	Available	Input Data Set 4	Available	Input Data Set 4
6016	01 to 71	Ch1 to Ch8 Average MV Heating	Available	Input Data Set 4	Available	Input Data Set 4
	02 to 72	Ch1 to Ch8 Stable MV Heating	Available	Input Data Set 4	Available	Input Data Set 4
	03 to 73	Ch1 to Ch8 Max.MV Heating	Available	Input Data Set 4	Available	Input Data Set 4
	04 to 74	Ch1 to Ch8 Min.MV Heating	Available	Input Data Set 4	Available	Input Data Set 4
6017	01 to 31	Ch1 to Ch4 Average MV Cooling	Not available	---	Available	Input Data Set 4
	02 to 32	Ch1 to Ch4 Stable MV Cooling	Not available	---	Available	Input Data Set 4
	03 to 33	Ch1 to Ch4 Max.MV Cooling	Not available	---	Available	Input Data Set 4
	04 to 34	Ch1 to Ch4 Min.MV Cooling	Not available	---	Available	Input Data Set 4
601C	01 to 71	Ch1 to Ch8 Input Digital Filter Monitor	Available	---	Available	---
601D	01	Response Flag	Available (default)	Input Data Set 1	Available (default)	Input Data Set 1

Index [hex]	Subindex [hex]	Data name	8Ch Standard control With CT input NX-HTC4510		4Ch Heating and cooling control With CT input NX-HTC3510	
			I/O allocation	Data set initial value	I/O allocation	Data set initial value
601E	01 to 71	Ch1 to Ch8 FF1 Waiting Time Monitor	Available	Input Data Set 3	Not available	---
	02 to 72	Ch1 to Ch8 FF1 Operation Time Monitor	Available	Input Data Set 3	Not available	---
	03 to 73	Ch1 to Ch8 FF1 Segment1 MV Monitor	Available	Input Data Set 3	Not available	---
	04 to 74	Ch1 to Ch8 FF1 Segment2 MV Monitor	Available	Input Data Set 3	Not available	---
	05 to 75	Ch1 to Ch8 FF1 Segment3 MV Monitor	Available	Input Data Set 3	Not available	---
	06 to 76	Ch1 to Ch8 FF1 Segment4 MV Monitor	Available	Input Data Set 3	Not available	---
	07 to 77	Ch1 to Ch8 FF2 Waiting Time Monitor	Available	Input Data Set 3	Not available	---
	08 to 78	Ch1 to Ch8 FF2 Operation Time Monitor	Available	Input Data Set 3	Not available	---
	09 to 79	Ch1 to Ch8 FF2 Segment1 MV Monitor	Available	Input Data Set 3	Not available	---
	0A to 7A	Ch1 to Ch8 FF2 Segment2 MV Monitor	Available	Input Data Set 3	Not available	---
	0B to 7B	Ch1 to Ch8 FF2 Segment3 MV Monitor	Available	Input Data Set 3	Not available	---
	0C to 7C	Ch1 to Ch8 FF2 Segment4 MV Monitor	Available	Input Data Set 3	Not available	---

*1. Measured values (REAL type) are digitized to the significant digits of single-precision floating-point type.

Output Data Set

Index [hex]	Subindex [hex]	Data name	8Ch Standard control With CT input NX-HTC4510		4Ch Heating and cooling control With CT input NX-HTC3510	
			I/O allocation	Data set initial value	I/O allocation	Data set initial value
7000	01 to 71	Ch1 to Ch8 Operation Command	Available (default)	Output Data Set 1	Available (default)	Output Data Set 1
	02 to 72	Ch1 to Ch8 Operation Command2*1	Available	---	Available	---
7001	01 to 71	Ch1 to Ch8 Set Point INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Set Point REAL	Available (default)	Output Data Set 1	Available (default)	Output Data Set 1
7003	01 to 71	Ch1 to Ch8 Manual MV INT	Available (default)	Output Data Set 1	Available (default)	Output Data Set 1
	02 to 72	Ch1 to Ch8 Manual MV REAL	Available	---	Available	---
7005	01 to 71	Ch1 to Ch8 Proportional Band	Available (default)	Output Data Set 2	Available (default)	Output Data Set 2
7006	01 to 71	Ch1 to Ch8 Integral Time	Available (default)	Output Data Set 2	Available (default)	Output Data Set 2
7007	01 to 71	Ch1 to Ch8 Derivative Time	Available (default)	Output Data Set 2	Available (default)	Output Data Set 2
7008	01 to 31	Ch1 to Ch4 Proportional Band Cooling	Not available	---	Available (default)	Output Data Set 2
7009	01 to 31	Ch1 to Ch4 Integral Time Cooling	Not available	---	Available (default)	Output Data Set 2
700A	01 to 31	Ch1 to Ch4 Derivative Time Cooling	Not available	---	Available (default)	Output Data Set 2
7012	01 to 71	Ch1 to Ch8 Alarm Value 1 INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Alarm Value 1 REAL	Available	---	Available	---
7013	01 to 71	Ch1 to Ch8 Alarm Value Upper Limit 1 INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Alarm Value Upper Limit 1 REAL	Available	---	Available	---
7014	01 to 71	Ch1 to Ch8 Alarm Value Lower Limit 1 INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Alarm Value Lower Limit 1 REAL	Available	---	Available	---
7015	01 to 71	Ch1 to Ch8 Alarm Value 2 INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Alarm Value 2 REAL	Available	---	Available	---
7016	01 to 71	Ch1 to Ch8 Alarm Value Upper Limit 2 INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Alarm Value Upper Limit 2 REAL	Available	---	Available	---
7017	01 to 71	Ch1 to Ch8 Alarm Value Lower Limit 2 INT	Available	---	Available	---
	02 to 72	Ch1 to Ch8 Alarm Value Lower Limit 2 REAL	Available	---	Available	---
7018	01 to 71	Ch1 to Ch8 Heater Burnout Detection Current UINT	Available (default)	Output Data Set 1	Available (default)	Output Data Set 1
	02 to 72	Ch1 to Ch8 Heater Burnout Detection Current REAL	Available	---	Available	---

Index [hex]	Subindex [hex]	Data name	8Ch Standard control With CT input NX-HTC4510		4Ch Heating and cooling control With CT input NX-HTC3510	
			I/O allocation	Data set initial value	I/O allocation	Data set initial value
7019	01 to 71	Ch1 to Ch8 SSR Failure Detection Current UINT	Available (default)	Output Data Set 1	Available (default)	Output Data Set 1
	02 to 72	Ch1 to Ch8 SSR Failure Detection Current REAL	Available	---	Available	---
701 A	01 to 71	Ch1 to Ch8 PV Input Shift	Available	---	Available	---
701B	01 to 71	Ch1 to Ch8 Input Digital Filter	Available	---	Available	---
701C	01 to 71	Ch1 to Ch8 Hysteresis Heating	Available	---	Available	---
701D	01 to 31	Ch1 to Ch4 Hysteresis Cooling	Not available	---	Available	---
701E	01 to 71	Ch1 to Ch8 FF1 Waiting Time	Available	Output Data Set 3	Not available	---
	02 to 72	Ch1 to Ch8 FF1 Operation Time	Available	Output Data Set 3	Not available	---
	03 to 73	Ch1 to Ch8 FF1 Segment1 MV	Available	Output Data Set 3	Not available	---
	04 to 74	Ch1 to Ch8 FF1 Segment2 MV	Available	Output Data Set 3	Not available	---
	05 to 75	Ch1 to Ch8 FF1 Segment3 MV	Available	Output Data Set 3	Not available	---
	06 to 76	Ch1 to Ch8 FF1 Segment4 MV	Available	Output Data Set 3	Not available	---
	07 to 77	Ch1 to Ch8 FF1 Segment MV Variable Correction Coefficient	Available	Output Data Set 3	Not available	---
	08 to 78	Ch1 to Ch8 FF2 Waiting Time	Available	Output Data Set 3	Not available	---
	09 to 79	Ch1 to Ch8 FF2 Operation Time	Available	Output Data Set 3	Not available	---
	0A to 7A	Ch1 to Ch8 FF2 Segment1 MV	Available	Output Data Set 3	Not available	---
	0B to 7B	Ch1 to Ch8 FF2 Segment2 MV	Available	Output Data Set 3	Not available	---
	0C to 7C	Ch1 to Ch8 FF2 Segment3 MV	Available	Output Data Set 3	Not available	---
	0D to 7D	Ch1 to Ch8 FF2 Segment4 MV	Available	Output Data Set 3	Not available	---
	0E to 7E	Ch1 to Ch8 FF2 Segment MV Variable Correction Coefficient	Available	Output Data Set 3	Not available	---

*1. Not accessible via message communications.

6-1-4 Response Flag

The response flag of the Advanced Temperature Control Units is given below.

Checking the Result of Response Flag

The response flag can be used to check the status whether I/O data is successfully written or not.

Response Flag	
Writing ends normally	**Writing ends in error**
0000 hex	Low-order byte: Sub-index number of the I/O data for adjustment upon occurrence of an error Example) If the data for adjustment Ch2 Proportional Band (Index: 7005 hex, Subindex: 02 hex) is written during AT, an error occurs in the operation conditions, and 0502 hex is notified.

The operation, performed when a write error occurs, is described below.

If an error occurs during writing of multiple data, the largest number assigned in the I/O data is reflected in the response flag.

Example) If Ch2 Proportional Band (Index: 7005 hex, Subindex: 02 hex) is assigned after Ch4 PV Input Shift (Index: 701A hex, Subindex: 04 hex) in the I/O data, and a write error due to exceeding the setting range occurs in both, the response flag becomes 0502 hex.

Even if an error occurs during writing of multiple I/O-assigned data, the writing of the remaining data continues.

The operation of data, in which a write error has occurred, continues with the values before writing.
If a write error occurs when power supply is turned ON, the operation continues with the values saved in the Unit.

6-1-5 Data for Adjustment

Advanced Temperature Control Units have data that can be accessed from both the Output data and the Unit operation settings. These data are called Data for Adjustment.

How to Access the Data for Adjustment

When you set a value in Data for Adjustment, it is immediately applied to the Advanced Temperature Control Units.

Precautions for Correct Use

- Use either of the following methods if some Data for Adjustment in the Unit Operation Settings is also assigned to that in the Output data during writing of Data for Adjustment.
  a) Remove the Data for Adjustment assigned to the Output data, which is duplicated with that assigned to the Unit Operation Settings.
  b) Set a value for the Data for Adjustment assigned to the Output data, which is duplicated with that assigned to the Unit Operation Settings.
  If the Data for Adjustment is written without making the setting above, an incorrect value will apply to the Advanced Temperature Control Unit, resulting in an unexpected operation.

  Example) Data with a default value of 0, such as Integral Time and Derivative Time, is reflected, and the performance of PID control is not achieved.
- The reflection of the output data is suspended during AT, or during D-AT executing.
  The parameters of the Advanced Temperature Control Unit are not changed by I/O refresh after AT or D-AT is started. The data is written to the Unit after AT or D-AT ends.

Additional Information

When the PID constant or the pre-boost function parameters of the I/O Data for Adjustment is assigned to the output data and used, read the value in the input data when the power supply is turned ON, and reflect the value as the default values of the output data.
Since the PID constant, or the pre-boost function parameters may be updated in the Advanced Temperature Control Unit by tuning, read the value in the input data, and reflect the value in the output data.
A sample program is prepared for these operations. For details, refer to *A-5-3 I/O Data Tuning Parameter Update* on page A-61.
Refer to the *1-5-2 Overview of the Data in the Advanced Temperature Control Unit and the Access Method* on page 1-18 for information on I/O Data for Adjustment and how to access those I/O data.

6-2 List of Settings

⚠ CAUTION

Correctly set the various settings for the Advanced Temperature Control Units according to the controlled system. Any discrepancy between the settings and the controlled system may result in unexpected operation that causes damage to the Unit or an accident.

For example, the temperature of the controlled system may rise abnormally high in the following cases.

- When heating control is performed by connecting a type K thermocouple while the input type is set to type J thermocouple
- When heating control is performed with the direct/reverse operation set to direct operation

Setting details, setting ranges, and default values for the functions that can be used with the Advanced Temperature Control Units are described below.

The setting items of the Advanced Temperature Control Unit differ according to the following Advanced Temperature Control Unit elements and the number of channels.

- Control type: Standard control type or heating/cooling control type
- Output type: voltage output for driving SSR or linear current output
- With CT input: heater burnout detection function or SSR failure detection function

Lists of settings are shown below for each of these elements.

Refer to *1-7-2 Model List* on page 1-26 for details about the control and output types, CT input availability and the number of channels for each model of the Advanced Temperature Control Units.

If you change any parameter for which changes will be applied only after a Unit restart, restart the NX Unit. The settings are reflected after the Unit is restarted.

It is not necessary to restart the NX Unit for parameters that are updated immediately. The settings are updated immediately after the changed settings are transferred even if the NX Unit is not restarted.

Precautions for Safe Use

If you transfer parameters for Unit operation settings that are updated when the Unit is restarted after the settings are changed on the Support Software, the Unit will be restarted after the transfer is completed. Always ensure safety of the connected devices before you transfer the Unit operation settings.

Set the setting items using one of the following methods.

- Setting the Unit operation settings using the Support Software
- Setting the corresponding NX objects via message communications with, such as dedicated instructions.

The method to access NX objects through instructions or other messages depends on where the NX Unit is connected.

If the NX Unit is connected to a CPU Unit, access is possible with the Read NX Unit Object instruction and the Write NX Unit Object instruction of the NJ/NX-series Controller. When the NX Unit is connected to a Communications Coupler Unit, the method depends on the connected Communications Coupler Unit or communications master.

Refer to the user's manual for the connected Communications Coupler Unit for method to use messages to access NX objects on Slave Terminals.

Channel enable/disable parameters

The parameter for enabling or disabling each channel of the Advanced Temperature Control Unit is shown in the table below. This parameter is available for all models.

Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Enable/Disable	Set to enable or disable the channel. FALSE: Disabled TRUE: Enabled	TRUE	FALSE/ TRUE	---	5000 hex	01 to 71 hex	After the Unit is restarted	*7-2 Selecting Channel to Use* on page 7-9

Input function parameters

The input function parameters are shown in the table below. These parameters are available for all models.

Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Input Type	Set the sensor and range connected to the input. When the temperature unit is set to °F for temperature input, the input range and input convertible range are given by the following formula. Temperature [°F] = Temperature [°C] x 1.8 + 32 For analog input, the input setting range depends on the scaling parameters, and the position of the decimal point depends on the decimal point position parameter.	0	*4	---	5001 hex	01 to 71 hex	After the Unit is restarted	*7-3-1 Input Type Settings* on page 7-11
Ch1 to Ch8 Temperature Unit	If temperature input is set as the input type, you need to specify the unit of the EU parameter temperature unit (Celsius °C or Fahrenheit °F). 0: °C 1: °F	0	0/1	---	5001 hex	02 to 72 hex	After the Unit is restarted	*7-3-2 Temperature Unit (°C/°F) Setting* on page 7-14

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Decimal Point	Sets the decimal point position for INT type parameters of measured values, set point, alarm values, and alarm upper and lower limits. 0: No decimal point 1: One digit decimal point*1 2: Two digit decimal points*1 3: Three digit decimal points*1 4: Depends on the decimal point position of the input type*2	4	0/1/2/3/4	---	5001 hex	03 to 73 hex	After the Unit is restarted	*7-3-3 Decimal Point Position Setting* on page 7-15
Ch1 to Ch8 Cold Junction Compensation Enable/Disable	Set to enable or disable cold junction compensation for the thermocouple input. FALSE: Disabled TRUE: Enabled	TRUE	FALSE/ TRUE	---	5001 hex	04 to 74 hex	After the Unit is restarted	*7-3-4 Cold Junction Compensation Enable/Disable* on page 7-18
Ch1 to Ch8 PV Input Shift	Set the PV input correction value to offset the measured value.	0	-19999 to 32400*3	Temperature input: 0.01°C or 0.01°F Analog input: EU*3	5001 hex	05 to 75 hex	Immediately	*7-3-5 Temperature Input Correction* on page 7-20
Ch1 to Ch8 PV Input Slope Coefficient	Sets the correction coefficient to correct the slope of the measured value.	1000	1 to 9999	0.001	5001 hex	06 to 76 hex	Immediately	*7-3-5 Temperature Input Correction* on page 7-20
Ch1 to Ch8 Input Digital Filter	To remove noise of measured value, set a filter value for the primary delay calculation.	0	0 to 9999	0.1 s	5001 hex	07 to 77 hex	Immediately	*7-3-6 Input Digital Filter* on page 7-23
Ch1 to Ch8 Scaling Upper Limit	Specify the upper limit value of the input setting range when the input type is set to analog input.	100	-19999 to 32400	EU	5001 hex	08 to 78 hex	After the Unit is restarted	*7-3-6 Input Digital Filter* on page 7-23
Ch1 to Ch8 Scaling Lower Limit	Specify the lower limit value of the input setting range when the input type is set to analog input.	0	-19999 to 32400	EU	5001 hex	09 to 79 hex	After the Unit is restarted	*7-3-6 Input Digital Filter* on page 7-23

*1. If the input type is temperature input and the number of decimal places in the setting is greater than the decimal point position of the input type, the rule “Depends on the decimal point position of the input type” applies.

*2. It is disabled for analog Input. If it is selected, the rule “One digit decimal point” applies.

*3. The position of the decimal point during analog input depends on the position of the Ch☐ Decimal Point Position parameter.

*4. The meanings of settings and data range for the Ch☐ Input Type parameter are as follows:

Set value	Meaning	
0	Pt100	-200.00 to 500.00°C /-300.00 to 920.00 °F
1	Pt100	-200.0 to 850.0°C /-300.0 to 1500.0°F
2	JPt100	-199.9 to 500.0°C /-199.9 to 900.0°F
3	K	-50.00 to 700.00°C /-50.00 to 1280.00°F
4	K	-200.0 to 1300.0°C /-300.0 to 2300.0°F
5	J	-100.0 to 850.0°C /-100.0 to 1500.0°F
6	T	-200.0 to 400.0°C /-300.0 to 700.0°F
7	E	-200.0 to 600.0°C /-300.0 to 1100.0°F
8	L	-100.0 to 850.0°C /-100.0 to 1500.0°F
9	U	-200.0 to 400.0°C /-300.0 to 700.0°F
10	N	-200.0 to 1300.0°C /-300.0 to 2300.0°F

Set value	Meaning	
11	R	0.0 to 1700.0°C /0.0 to 3000.0°F
12	S	0.0 to 1700.0°C /0.0 to 3000.0°F
13	B	0.0 to 1800.0°C /0.0 to 3200.0°F
14	C/W	0.0 to 2300.0°C /0.0 to 3200.0°F
15	PLII	0.0 to 1300.0°C /0.0 to 2300.0°F
16	4 to 20 mA	One of the following ranges by scaling -19999 to 32400 -1999.9 to 3240.0 -199.99 to 324.00 -19.999 to 32.400
17	0 to 20 mA	
18	1 to 5 V	
19	0 to 5 V	
20	0 to 10 V	

Control common parameters

The common control parameters for NX-HTC4505 and NX-HTC3510 are as follows.

Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 PID ON/OFF	Set ON/OFF control or 2-PID control. 0: ON/OFF control 1: 2-PID control	1	0/1	---	5002 hex	01 to 71 hex	After the Unit is restarted	*7-4-1 ON/OFF control* on page 7-27 *7-4-2 PID control* on page 7-30
Ch1 to Ch8 Proportional Band	Proportional band used for 2-PID control. It is used for the heating side for the heating/cooling control Units.	800	1 to 65000	Temperature input is 0.01°C or 0.01°F; Analog input is 0.01%	5002 hex	02 to 72 hex	Immediately	*7-4-2 PID control* on page 7-30
Ch1 to Ch8 Integral Time	Integration time used for 2-PID control. It is used for the heating side for the heating/cooling control Units.	2330	0 to 39999	0.1 s	5002 hex	03 to 73 hex	Immediately	*7-4-2 PID control* on page 7-30
Ch1 to Ch8 Derivative Time	Derivative time used for 2-PID control. It is used for the heating side for the heating/cooling control Units.	400	0 to 39999	0.1 s	5002 hex	04 to 74 hex	Immediately	*7-4-2 PID control* on page 7-30
Ch1 to Ch8 Hysteresis (Heating)	Used for ON/OFF control. Hysteresis is set to start heating depending on how much temperature decreases for the set point.	10	1 to 9999	Temperature input is 0.1°C or 0.1°F; Analog input is 0.01%	5002 hex	05 to 75 hex	Immediately	*7-4-1 ON/OFF control* on page 7-27
Ch1 to Ch8 Direct/Reverse Operation	Sets reverse operation or direct operation. 0: Reverse operation 1: Direct operation	0	0/1	---	5002 hex	06 to 76 hex	After the Unit is restarted	*7-4-7 MV at Error* on page 7-44
Ch1 to Ch8 MV at Error	Used during 2-PID control. Sets the manipulated variable that is output when a sensor input error occurs.	0	Standard control -50 to 1050 Heating and cooling control type -1050 to 1050	0.1%	5002 hex	07 to 77 hex	Immediately	*7-4-7 MV at Error* on page 7-44

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 MV Upper Limit	Used during 2-PID control. It is set in the case of controlling the upper-limit of manipulated value (MV).	1000	Standard control -50 to 1050 Heating and cooling control type 0 to 1050	0.1%	5002 hex	08 to 78 hex	Immediately	*7-4-8 MV limit* on page 7-46
Ch1 to Ch8 MV Lower Limit	Used during 2-PID control. It is set in the case of controlling the lower-limit of manipulated variable (MV).	Standard control: 0 Heating and cooling control: -1000	Standard control -50 to 1050 Heating and cooling control type -1050 to 0	0.1%	5002 hex	09 to 79 hex	Immediately	*7-4-8 MV limit* on page 7-46
Ch1 to Ch8 Load Rejection Output Setting	This function performs a preset output operation when the output settings cannot be received due to a communications error between the host and the Advanced Temperature Control Unit or due to an NX bus error. Used during 2-PID control. Sets the output operation to perform at load rejection. 0: Continue the control 1: Output the manipulated variable (MV) at the load rejection	0	0/1	---	5002 hex	0A to 7A hex	After the Unit is restarted	*7-4-9 Load Rejection MV* on page 7-48
Ch1 to Ch8 Load Rejection MV	Used during 2-PID control. Sets the manipulated variable to output if “Output the manipulated variable (MV) at the load rejection” is set in the load rejection output settings.	0	Standard control -50 to 1050 Heating and cooling control type -1050 to 1050	0.1%	5002 hex	0B to 7B hex	Immediately	*7-4-9 Load Rejection MV* on page 7-48
Ch1 to Ch8 α	Sets the α constants of 2-PID control. Use the default values for this setting data under normal situations.	65	0 to 100	0.01	5002 hex	0C to 7C hex	After the Unit is restarted	*7-4-2 PID control* on page 7-30

Heating and cooling control parameters

The heating/cooling control parameters are shown in the table below. These parameters are available only for NX-HTC3510, which is a heating/cooling control type.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch4 Proportional Band (Cooling)	Cooling-side proportional band used for 2-PID control.	800	1 to 65000	Temperature input is 0.01°C or 0.01°F; Analog input is 0.01%	5003 hex	01 to 31 hex	Immediately	*7-4-2 PID control* on page 7-30
Ch1 to Ch4 Integral Time (Cooling)	Cooling-side integration time used for 2-PID control.	2330	0 to 39999	0.1 s	5003 hex	02 to 32 hex	Immediately	*7-4-2 PID control* on page 7-30
Ch1 to Ch4 Derivative Time (Cooling)	Cooling-side derivative time used for 2-PID control.	400	0 to 39999	0.1 s	5003 hex	03 to 33 hex	Immediately	*7-4-2 PID control* on page 7-30
Ch1 to Ch4 Dead Band	This is a dead zone for turning OFF the heating and cooling outputs used in heating/cooling control type models.	0	-1999 to 9999	Temperature input is 0.1°C or 0.1°F; Analog input is 0.01%	5003 hex	04 to 34 hex	Immediately	*7-4-3 Heating and Cooling Control* on page 7-34
Ch1 to Ch4 Hysteresis (Cooling)	Used for ON/OFF control. Hysteresis is set to start heating depending on how much temperature decreases for the set point.	10	1 to 9999	Temperature input is 0.1°C or 0.1°F; Analog input is 0.01%	5003 hex	05 to 35 hex	Immediately	*7-4-1 ON/OFF control* on page 7-27
Ch1 to Ch4 Heating/Cooling Tuning Method	Sets the tuning method for heating/cooling control that is used for autotuning (AT). 0: Same as heating control 1: Linear 2: Air cooling 3: Water cooling	0	0/1/2/3	---	5003 hex	06 to 36 hex	After the Unit is restarted	*7-4-3 Heating and Cooling Control* on page 7-34
Ch1 to Ch4 LCT Cooling Output Minimum ON Time	This parameter sets the minimum output ON time for the cooling-side control output during autotuning. Sets the time required for starting the actuator connected to the cooling-side control output.	2	1 to 10	0.1 s	5003 hex	07 to 37 hex	After the Unit is restarted	*7-4-3 Heating and Cooling Control* on page 7-34

Parameters for voltage output for driving SSR that are common to all control models

The table below shows parameters for the common voltage output for driving SSR, which are common to NX-HTC4505 and NX-HTC3510. Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Control Period (Heating)	Sets the control period (heating) for time-proportional output. -2: 0.1 s -1: 0.2 s 0: 0.5 s 1 to 99: 1 to 99 s	2	-2 to 99	---	5009 hex	01 to 71 hex	After the Unit is restarted	*7-6-1 Control Period* on page 7-77
Ch1 to Ch8 Minimum Output ON/OFF Band	Sets the minimum manipulated variable output by the heating side control output or the cooling side control output. You are recommended to change them according to the operating conditions of the actuator connected to the output terminals.	10	0 to 500	0.1%	5009 hex	02 to 72 hex	After the Unit is restarted	*7-6-2 Minimum Output ON/OFF Band* on page 7-79

Parameters for linear current output

The parameter for linear current output is shown in the table below. This is a parameter in the NX-HTC3510 model with a linear current output.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch4 Output Signal Range	Sets the output signal range according to actuator that is connected to output terminal. 0: 4 to 20 mA 1: 0 to 20 mA	0	0/1	---	500B hex	01 to 31 hex	After the Unit is restarted	*7-6-3 Output Signal Range Setting* on page 7-80

Parameters for MV branch operation

The parameters for MV branch operation are shown in the table below. These parameters are available for NX-HTC4505, which is a standard control type model.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 MV Branch Operation	Set whether to enable or disable the measured value of the branch-source channel and the local channel.	0	0 to 15	---	500C hex	01 to 71 hex	After the Unit is restarted	*7-4-10 MV Branch* on page 7-50
Ch1 to Ch8 MV Slope	Set the slope value for the calculation and output of the manipulated variables of the branch-source channel.	1000	1 to 9999	0.001	500C hex	02 to 72 hex	Immediately	*7-4-10 MV Branch* on page 7-50
Ch1 to Ch8 MV Offset	Set the offset for the calculation and output of the manipulated variables of the branch-source channel.	0	-1999 to 9999	0.1%	500C hex	03 to 73 hex	Immediately	*7-4-10 MV Branch* on page 7-50

Heater error detection parameters

Heater error detection is a generic term for heater burnout detection and SSR fault detection. The heater error detection parameters are shown in the table below. Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Heater Burnout Detection Current	Sets the heater burnout detection current. The heater burnout detection is output when the heater current value falls below the setting of the parameter. When the setting value is 0, Heater Burnout Detection bit of the Channel Output And Alarm Status is changed to OFF. When the setting value is 500, Heater Burnout Detection bit is changed to ON.	0	0 to 500	0.1 A	500D hex	01 to 71 hex	Immediately	*7-7-2 Heater Burnout Detection* on page 7-83
Ch1 to Ch8 SSR Failure Detection Current	Sets the current to detect SSR failure. A SSR failure detection is output when the leakage current value exceeds the setting of this parameter. When the setting value is 500, SSR Failure Detection bit of the Channel Output And Alarm Status is changed to OFF. When the value is 0, SSR Failure Detection bit is changed to ON.	500	0 to 500	0.1 A	500D hex	02 to 72 hex	Immediately	*7-7-3 SSR Failure Detection* on page 7-86

Temperature alarms parameters

The alarm parameters are shown in the table below. These parameters are available for all models. Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Alarm 1 Type	Set the alarm type in accordance with the alarm operation.	0	0 to 12	---	500E hex	01 to 71 hex	After the Unit is restarted	*7-7-4 Temperature Alarm* on page 7-90
Ch1 to Ch8 Alarm 2 Type		0	0 to 12	---	500E hex	02 to 72 hex	After the Unit is restarted	*7-7-4 Temperature Alarm* on page 7-90
Ch1 to Ch8 Alarm 1 Hysteresis	Set the hysteresis for whether to detect an alarm when the deviation or measured value exceeds the alarm value or alarm value upper and lower limit set in accordance with the alarm type.	2	1 to 9999	Temperature input is 0.1°C or 0.1°F; Analog input is 0.01%	500E hex	03 to 73 hex	After the Unit is restarted	*7-7-4 Temperature Alarm* on page 7-90
Ch1 to Ch8 Alarm 2 Hysteresis		2	1 to 9999	Temperature input is 0.1°C or 0.1°F; Analog input is 0.01%	500E hex	04 to 74 hex	After the Unit is restarted	*7-7-4 Temperature Alarm* on page 7-90

Disturbance suppression (Pre-boost function) parameters

The pre-boost function parameters are shown in the table below. These parameters are available for NX-HTC4505, which is a standard control type model.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 FF1 Waiting Time	It is a parameter with pre-boost function. In the case of FF mode, it is the waiting time until FF1 segment 1 Manipulated Variable is output after the operation command FF1 or D-AT1 Execute parameter is executed. This parameter is automatically calculated by D-AT execution.	0	0 to 2000	0.1 s	5010 hex	01 to 71 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF1 Operation Time	It is a parameter with pre-boost function. It sets the operation time to output FF1 Manipulated Variable. The time divided the set operation time into four quarters is the operation time of each FF segment Manipulated Variable. This parameter is automatically calculated by D-AT execution.	1	1 to 3600	Seconds	5010 hex	02 to 72 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF1 Segment1 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF1 Segment 1. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 1. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	03 to 73 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF1 Segment2 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF1 Segment 2. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 2. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	04 to 74 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF1 Segment3 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF1 Segment 3. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 3. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	05 to 75 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 FF1 Segment4 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF1 Segment 4. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 4. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	06 to 76 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF1 Segment MV Variable Correction Coefficient	It is a parameter with pre-boost function. It sets the correction coefficient to adjust the manipulated variable of four segments of FF1 at the same time.	100	1 to 999	0.01	5010 hex	07 to 77 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF2 Waiting Time	It is a parameter with pre-boost function. For the case of FF mode, it is the waiting time until FF2 segment 1 Manipulated Variable is output after the operation command FF1 or D-AT2 Execute parameter is executed. This parameter is automatically calculated by D-AT execution.	0	0 to 2000	0.1 s	5010 hex	08 to 78 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF2 Operation Time	It is a parameter with pre-boost function. This sets the operation time to output the FF2 MV. The time divided the set operation time into four quarters is the operation time of each FF segment Manipulated Variable. This parameter is automatically calculated by D-AT execution.	1	1 to 3600	Seconds	5010 hex	09 to 79 hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF2 Segment1 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF2 Segment 1. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 1. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	0A to 7A hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF2 Segment2 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF2 Segment 2. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 2. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	0B to 7B hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 FF2 Segment3 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF2 Segment 3. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 3. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	0C to 7C hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF2 Segment4 MV	It is a parameter with pre-boost function. It sets the Manipulated Variable of FF2 Segment 4. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 4. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	5010 hex	0D to 7D hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 FF2 Segment MV Variable Correction Coefficient	It is a parameter with pre-boost function. It sets the correction coefficient to adjust the manipulated variable of four segments of FF2 at the same time.	100	1 to 999	0.01	5010 hex	0E to 7E hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61
Ch1 to Ch8 D-AT Execution Judgement Deviation	It sets the temperature deviation to execute the D-AT execution judgment and the disturbance occurrence judgment. When D-AT is executed, D-AT is started if the absolute deviation between the measured value (PV) and the set point (SP) is equal or less than this parameter. After D-AT is started, it is judged that the disturbance has occurred if the absolute deviation between the measured value (PV) and the set point (SP) is more than this parameter.	10	1 to 9999	Temperature input is 0.1°C or 0.1°F; Analog input is 0.01%	5010 hex	0F to 7F hex	Immediately	*7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61

Parameters of the Feature Visualization Function

The feature visualization parameters are shown in the table below. Note that the NX-HTC3510 model has settings for Ch1 through Ch4 only.

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 Waveform Measurement Time	This sets the time to measure a waveform. After the waveform measurement time has elapsed since the start of the measurement, the waveform measurement stops. Set 0 to disable this function. Even when this function is enabled, it is possible to stop the waveform measurement by an operation command or temperature adjustment.	0	0 to 65000	Seconds	5011 hex	01 to 71 hex	Immediately	*7-8 Feature Visualization* on page 7-101
Ch1 to Ch8 Waveform Measurement Stop (Temperature Stable Control)	It enables the stop of waveform measurement during temperature adjustment. False: Disabled (Default) True: Enabled Even when this function is enabled, it is possible to stop the waveform measurement by an operation command or based on temperature measurement time.	0	0/1	---	5011 hex	02 to 72 hex	Immediately	*7-8 Feature Visualization* on page 7-101
Ch1 to Ch8 Temperature Stable Band	This sets the stable band used to determine the temperature stable control status. It is also used with the undershoot value, overshoot value, and time-delay measurement.	10	0 to 32000	EU	5011 hex	03 to 73 hex	Immediately	*7-8 Feature Visualization* on page 7-101
Ch1 to Ch8 Temperature Stable Determination Time	This sets the time to determine the temperature stable control. When the temperature settling judgment time elapses while the measured value is within the temperature settling range of the set point plus/minus value, the temperature is settling. Set 0 to disable this function.	10	0 to 9999	Seconds	5011 hex	04 to 74 hex	Immediately	*7-8 Feature Visualization* on page 7-101
Ch1 to Ch8 MV Stable Band	This sets the stable band used to determine the MV stable control. After the MV stable determination time has elapsed with the MV remaining within the stable band during temperature stable control, the MV stable control is enabled.	100	1 to 999	0.1%	5011 hex	05 to 75 hex	Immediately	*7-8 Feature Visualization* on page 7-101

Data name	Description	Default value	Setting range	Unit	Index	Subindex	Update timing	Reference
Ch1 to Ch8 MV Stable Determination Time	This sets the time to determine the MV stable control. After the MV stable determination time has elapsed with the MV remaining within the stable band during temperature stable control, the MV stable control is enabled. Set 0 to disable this function.	10	0 to 9999	Seconds	5011 hex	06 to 76 hex	Immediately	*7-8 Feature Visualization* on page 7-101
Ch1 to Ch8 MV Digital Filter	In the measurement of feature values, set a filter (time constant) to cancel the noise of the manipulated variable. For example, if this parameter is set to 10 seconds and the MV changes from 0% to 100%, the value is changed 63% after 10 seconds. Set 0 to disable this function.	0	0 to 9999	0.1 s	5011 hex	07 to 77 hex	Immediately	*7-8 Feature Visualization* on page 7-101

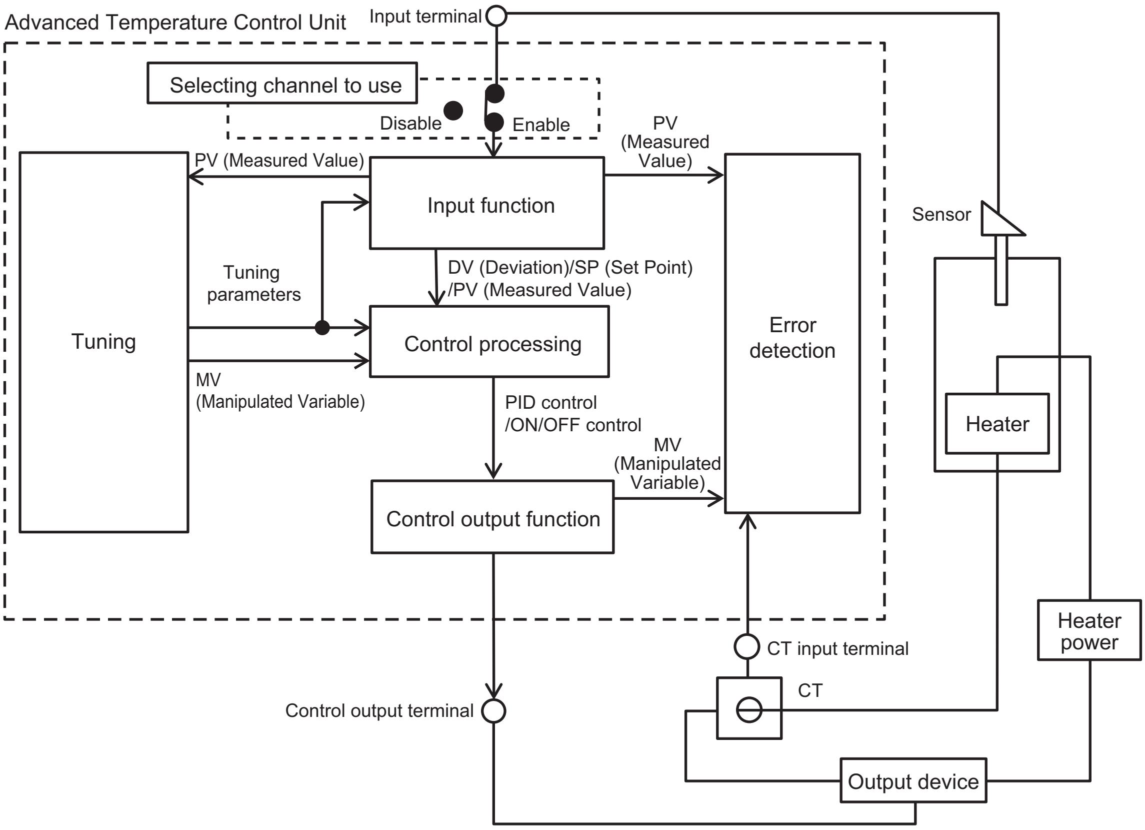
7

Functions

This section describes the Advanced Temperature Control Unit functions.

7-1 Function Block Diagram

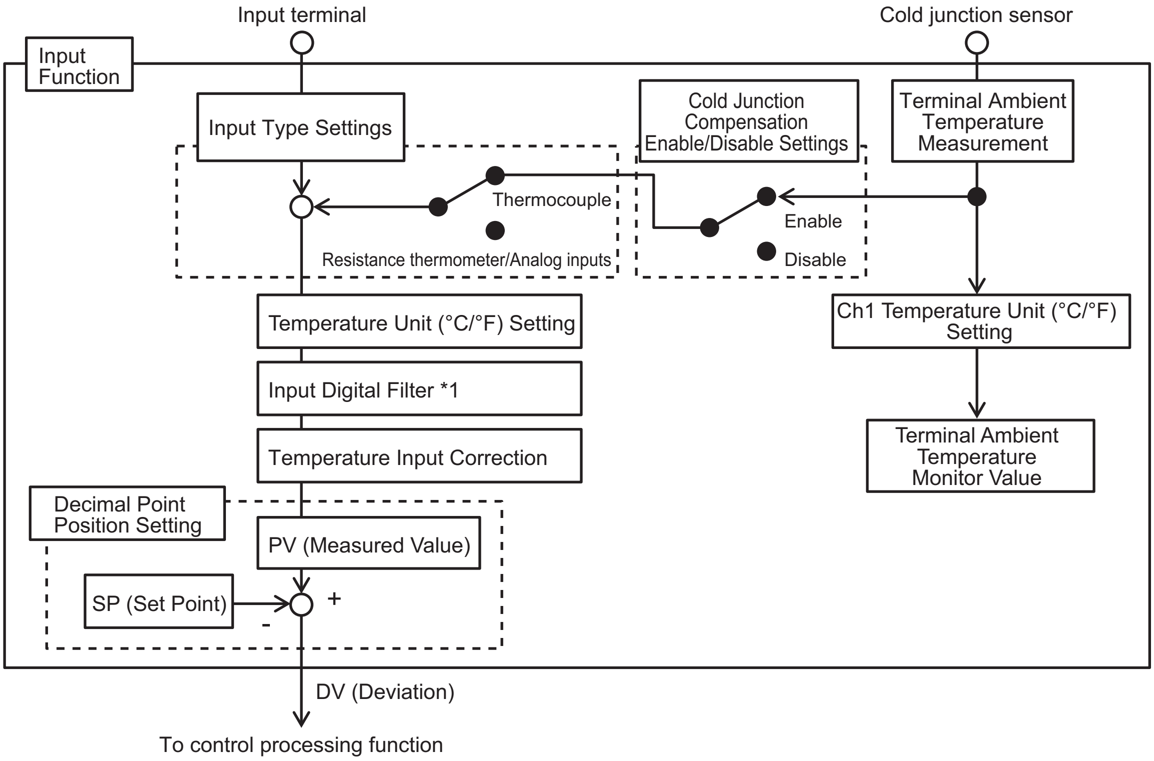
This section shows an overall view of the functional blocks of the Advanced Temperature Control Unit.



The details of each block are described below.

7-1-1 Input Function Block Diagram

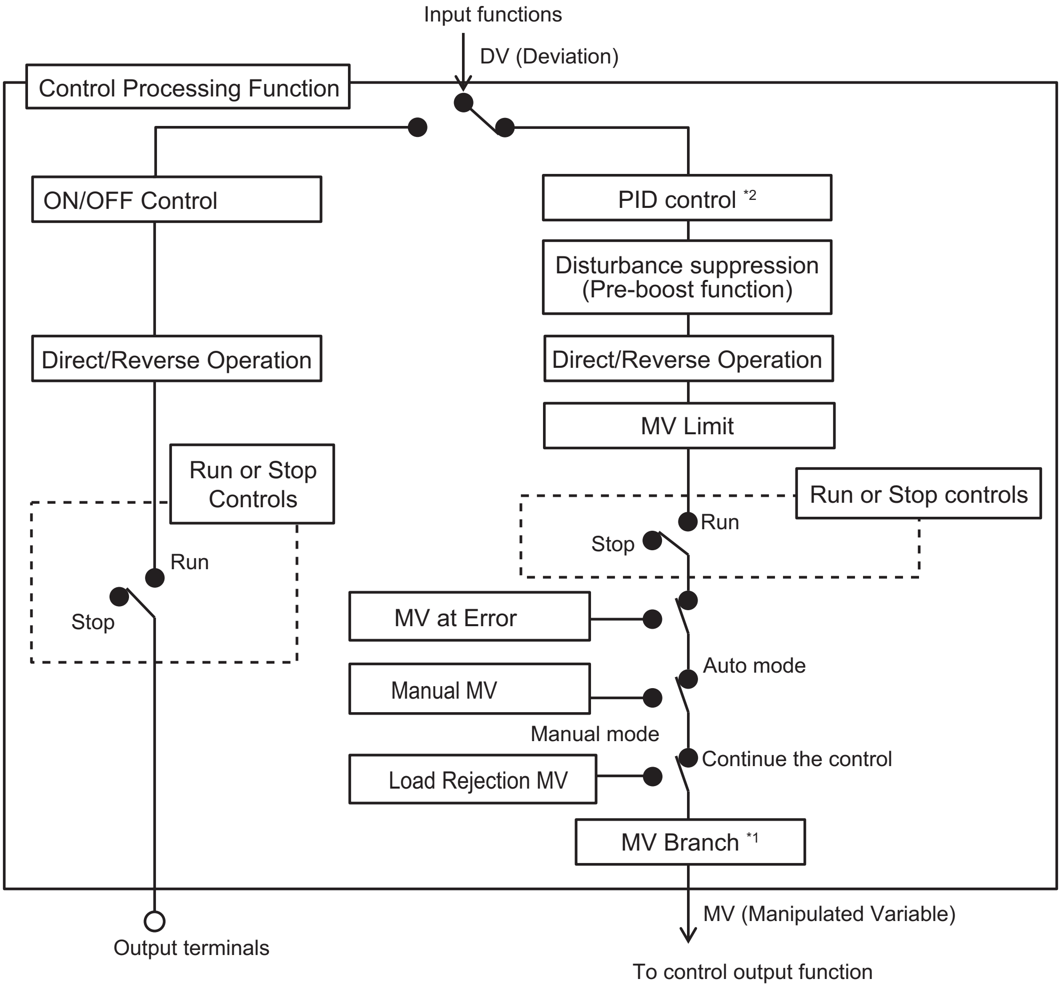
A block diagram of the input functions is shown below.



*1. Refer to *7-1-3 Tuning Function Block Diagram* on page 7-6 for details on the related tuning functions.

7-1-2 Control Processing Function Block Diagram

A block diagram of the control processing functions is shown below.



*1. For the detailed block diagram, refer to *7-4-10 MV Branch* on page 7-50.

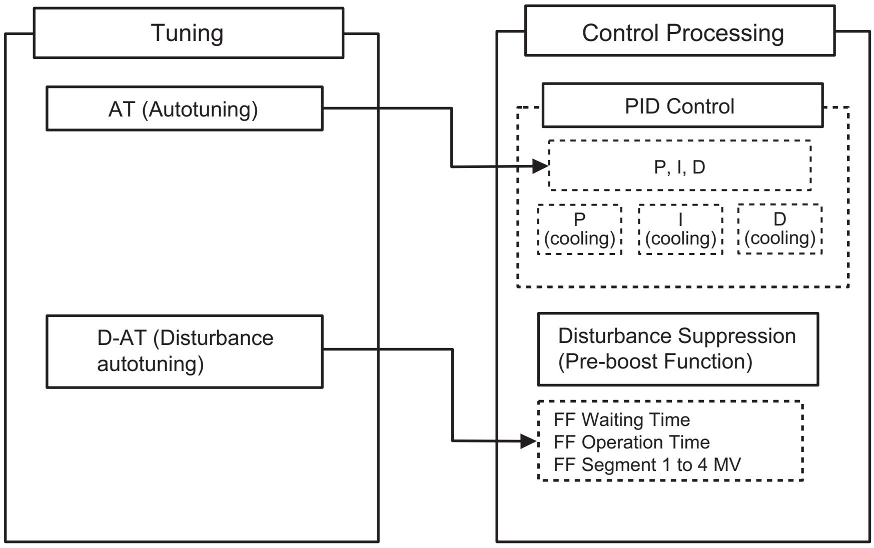
*2. MV (manipulated variable) is calculated even if the tuning function is activated. For related tuning functions, refer to *7-1-3 Tuning Function Block Diagram* on page 7-6.

7-1-3 Tuning Function Block Diagram

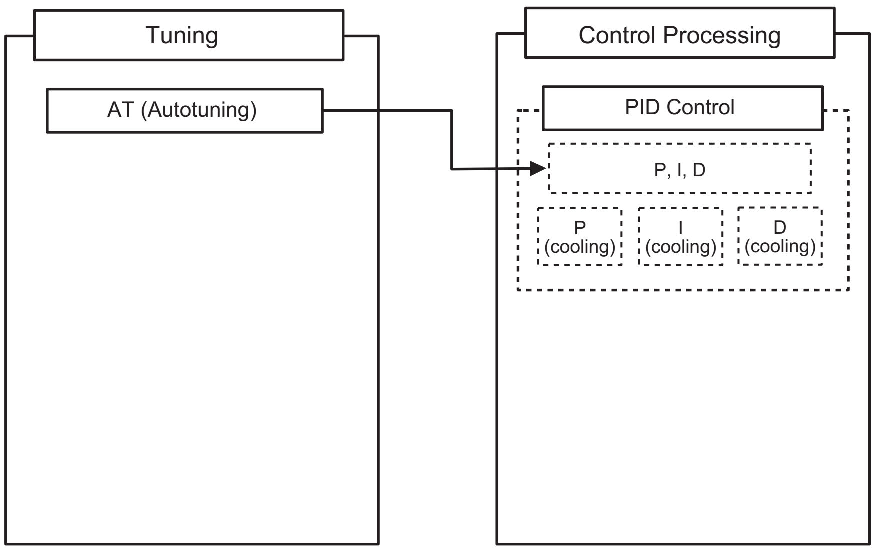
Block diagrams of the tuning functions are shown below. The tuning functions differ according to the control type of the Advanced Temperature Control Unit.

The tuning functions for each control type are shown below.

● Standard control



● Heating and cooling control

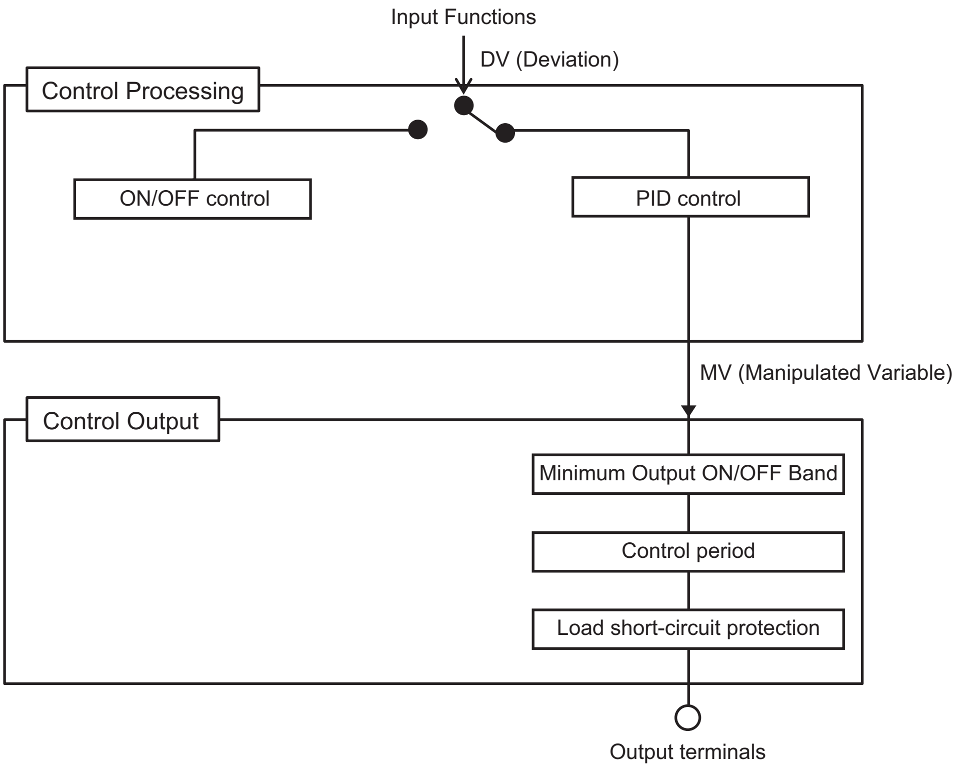


7-1-4 Control Output Function Block Diagram

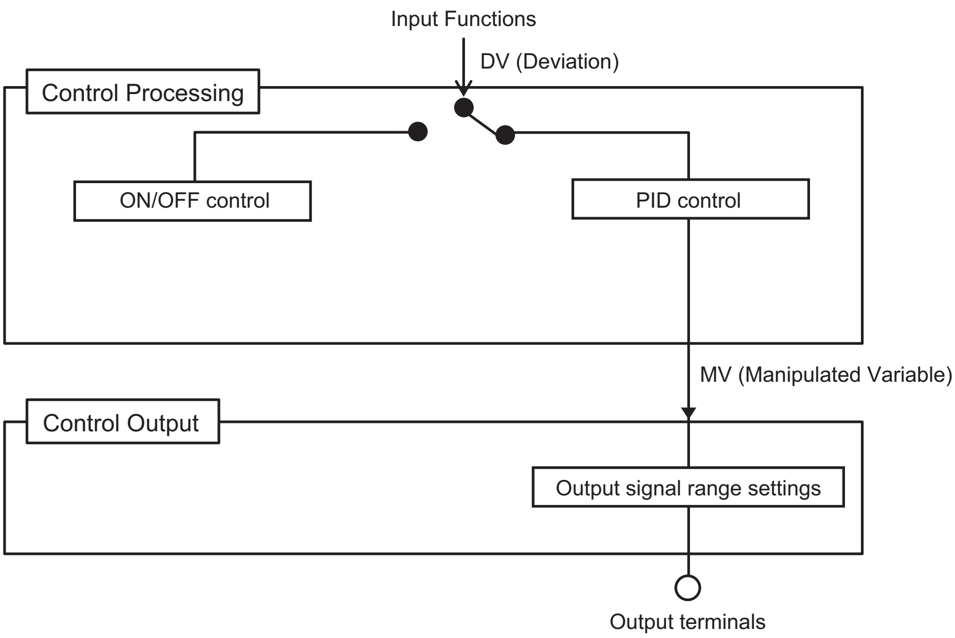
Block diagrams of the control output functions are shown below. The control output functions differ according to the output type of the Advanced Temperature Control Unit.

The control output functions for each Unit output type are shown below.

● Voltage output (for driving SSR)

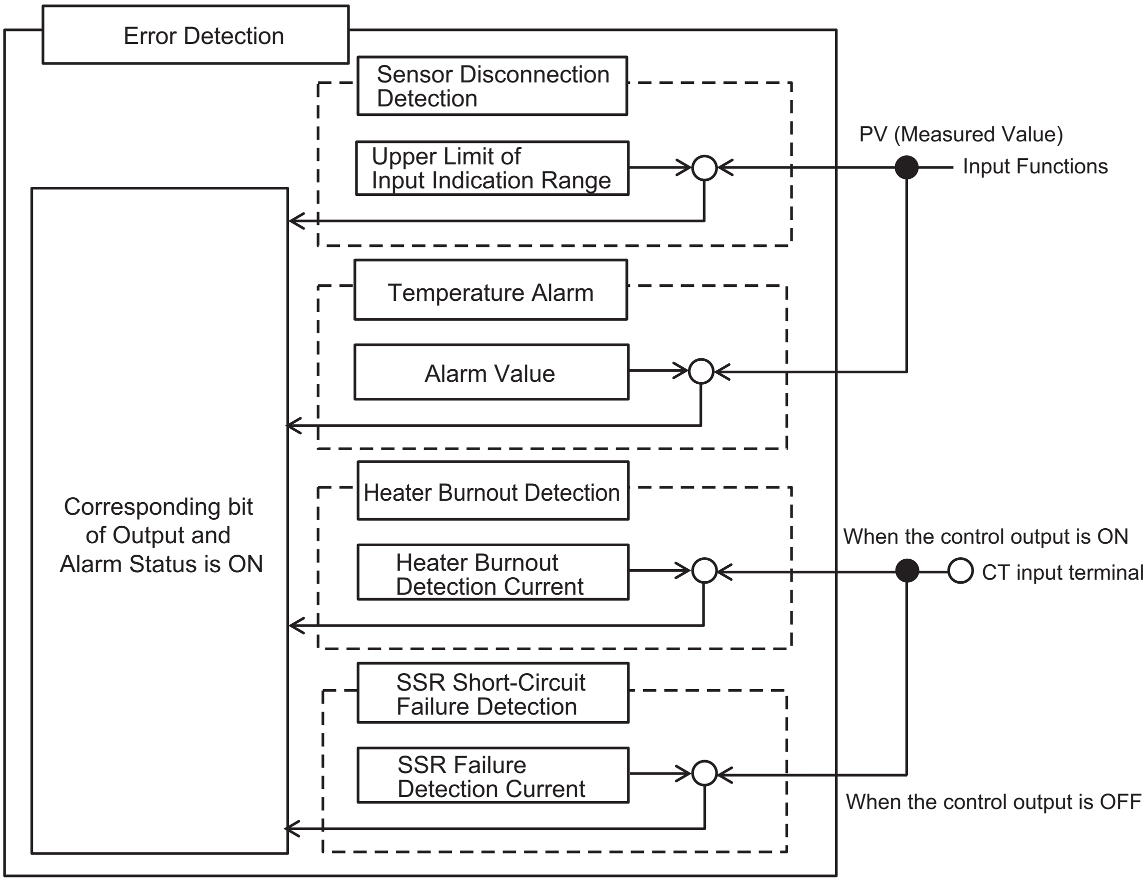


● Linear current output



7-1-5 Error Detection Function Block Diagram

Block diagrams of the error detection functions are shown below. Only the error detection functions related to sensor and CT connections are shown.



7-2 Selecting Channel to Use

This section describes how to select the channels to use.

Purpose

This function is used to avoid errors in unused channels.

Details on the Function

Control processing, error detection, and output processing are disabled for unused channels.

However, the conversion time for its own Unit will not be shortened even if the channels are disabled.

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ Enable/Disable	Ch☐ Enable/Disable	Sets the corresponding channel to enabled or disabled. FALSE: Disabled TRUE: Enabled	TRUE	TRUE or FALSE	---	After the Unit is restarted

*1. Ch☐ represents the channel number.

● Measured value and status of disabled channels

The measured value and status of channels set to Disabled are fixed to 0 after the power is turned ON again or the Unit is restarted. And the output is fixed to OFF.

The I/O data that are fixed to 0 are as follows:

- Operating Status
- Output and Alarm Status
- Measured Value
- MV Monitor
- Heater Current
- Leakage Current
- Feature Value Monitor

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Select *True* (Enable) or *False* (Disable) from the list of Channel Enable/Disable Setting for the channel you want to set.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing screen for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-3 Input Function

This section describes the input functions.

7-3-1 Input Type Settings

Overview and Purpose

This function allows you to specify a sensor to be connected to temperature input or analog input, as well as the ranges.

Details on the Function

The following description provides the input type and its corresponding input setting range and input indication range.

- The input setting range represents a range in which set points can be specified, and the input indication range represents a measurable range of measured values.
- If a measured value falls outside the input indication range, the Sensor Disconnected Error bit of the Output and Alarm Status turns ON, and the upper limit value of the input indication range is displayed as the measured value.
- The default value is set to 0 (Pt100).

● Settings or Monitoring

Data name *1	Support Software display	Description	Default	Setting/Monitoring range	Read/Write type	Update timing
Ch□ Input Type	Ch□ Input Type	Sets the type of input connected to the temperature input or analog input.	0	See the table below	RW	After the Unit is restarted

*1. Ch□ represents the channel number.

Set value	Input type			Remarks
	Sensor	Input setting range	Input indication range	
0	Pt100	-200.00 to 500.00°C/-300.00 to 920.00°F	-220.00 to 520.00°C/-340.00 to 960.00°F *1	Resistance thermometer
1	Pt100	-200.0 to 850.0°C/-300.0 to 1500.0°F	-220.0 to 870.0°C/-340.0 to 1540.0°F	
2	JPt100	-199.9 to 500.0°C/-199.9 to 900.0°F	-219.9 to 520.0°C/-239.9 to 940.0°F	
3	K	-50.00 to 700.00°C/-50.00 to 1280.00°F	-70.00 to 720.00°C/-90.00 to 1320.00°F *1	Thermocouple
4	K	-200.0 to 1300.0°C/-300.0 to 2300.0°F	-220.0 to 1320.0°C/-340.0 to 2340.0°F	
5	J	-100.0 to 850.0°C/-100.0 to 1500.0°F	-120.0 to 870.0°C/-140.0 to 1540.0°F	
6	T	-200.0 to 400.0°C/-300.0 to 700.0°F	-220.0 to 420.0°C/-340.0 to 740.0°F	

Set value	Input type			Remarks
	Sensor	Input setting range	Input indication range	
7	E	-200.0 to 600.0°C/-300.0 to 1100.0°F	-220.0 to 620.0°C/-340.0 to 1140.0°F	Thermocouple
8	L	-100.0 to 850.0°C/-100.0 to 1500.0°F	-120.0 to 870.0°C/-140.0 to 1540.0°F	
9	U	-200.0 to 400.0°C/-300.0 to 700.0°F	-220.0 to 420.0°C/-340.0 to 740.0°F	
10	N	-200.0 to 1300.0°C/-300.0 to 2300.0°F	-220.0 to 1320.0°C/-340.0 to 2340.0°F	
11	R	0.0 to 1700.0°C/0.0 to 3000.0°F	-20.0 to 1720.0°C/-40.0 to 3040.0°F	
12	S	0.0 to 1700.0°C/0.0 to 3000.0°F	-20.0 to 1720.0°C/-40.0 to 3040.0°F	
13	B	0.0 to 1800.0°C/0.0 to 3200.0°F	-20.0 to 1820.0°C/-40.0 to 3240.0°F	
14	C/W	0.0 to 2300.0°C/0.0 to 3200.0°F	-20.0 to 2320.0°C/-40.0 to 3240.0°F	
15	PLII	0.0 to 1300.0°C/0.0 to 2300.0°F	-20.0 to 1320.0°C/-40.0 to 2340.0°F	
16	4 to 20 mA	One of the following ranges according to the scaling: -19999 to 32400 -1999.9 to 3240.0 -199.99 to 324.00 -19.999 to 32.400	-5% to 105% of the input setting range, but within the range of the data type *1	Analog input
17	0 to 20 mA			
18	1 to 5 V			
19	0 to 5 V			
20	0 to 10 V			

*1. For measured values (INT type),
if the input indication range exceeds the INT type range (-32768 to 32767), a measured value should be within the INT type range.

Additional Information

- Refer to *7-3-3 Decimal Point Position Setting* on page 7-15 for the decimal point position of INT measured values.
- To convert the temperature unit from Celsius to Fahrenheit, use the following equation.
  Fahrenheit temperature (°F) = Celsius temperature (°C) x 1.8 + 32
- For integer-type measured values, treat any digits of a measured value that exceed the specified resolution as reference values. The same is true if the data type is an integer type and a large number of digits are set for display with the decimal point position setting.

● Operation when the measured value is outside the input indication range

If the measured value falls outside the input indication range, the "Ch☐ Sensor Disconnected Error" bit of "Ch☐ Output and Alarm Status" in the I/O data turns ON and the measured value becomes the upper limit value of the input indication range.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

● Operation when the input type differs from the connected sensor

Measured values cannot be correctly measured.

Number of decimal places for REAL-type data

The number of valid decimal places for REAL-type data of set points and alarm values is defined as the number of decimal places in the input setting range of each sensor. Refer to the tables in *7-3-1 Input Type Settings* on page 7-11 for details.

e.g., When input type 0 (Pt100): -200.00 to 500.00°C and set point (INT or REAL): 123456 or 123.456,

the set point is set to 123.47.

Third decimal place is rounded.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.
   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.
2. Select the input type from the list of Input Type Setting for the channel you want to set.
   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.
3. Click the **Transfer to Unit** Button.
   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-3-2 Temperature Unit (°C/°F) Setting

Overview and Purpose

This function is used for temperature unit selection, allowing you to specify either Celsius (°C) or Fahrenheit (°F) for the temperature unit.

Details on the Function

The set temperature unit is applied to parameters with temperature units, such as measured values and set points. The relational expression between °C (Celsius) and °F (Fahrenheit) is shown below.

Measured value (°F) = Measured value (°C) x 1.8 + 32

Set parameters with temperature units, such as set points, to match the set temperature unit.

The Advanced Temperature Control Units do not consider the temperature units when performing numerical conversion.

- **Settings**

The settings are shown in the following table.

Data name*1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Temperature Unit	Ch□ Temperature Unit	Sets °C (Celsius) or °F (Fahrenheit) as the temperature unit for measured values and set points. 0: °C 1: ° F	0	0 or 1	---	After the Unit is restarted

*1. Ch□ represents the channel number.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Select *[°C]* or *[°F]* from the drop-down list for Temperature Unit of the channel (Ch□) you wish to set.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.
The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-3-3 Decimal Point Position Setting

Overview and Purpose

For INT-type parameters such as the measured value, set point, alarm values (including the upper and lower limit values), this function allows you to specify the number of display digits after the decimal point.

When you replace a temperature control unit with the Advanced Temperature Control Units, the decimal point setting change on the host device is no longer needed with this function.

Details on the Function

It is used as the decimal point position when accessing INT-type parameters such as the measured value, set point, alarm values (including the upper and lower limit values).

Temperature input	• When “Follow the Decimal Point Position of an Input Type” is selected, unconverted parameter values are used. • When “No Decimal Point” or “One Digit Decimal Point” is selected and the number of decimal places differs from the “Input Type” setting, converted parameter values are used.
Analog input	• Regardless of the setting, unconverted parameter values are used. • When “Follow the Decimal Point Position of an Input Type” is selected, the rule “One digit decimal point” applies.

● Settings or Monitoring

Parameter	Settings or Monitoring Range	Unit	Default	RW type	Update timing
Ch□ Decimal Point Position	0: No Decimal Point 1: One Digit Decimal Point*1 2: Two Digit Decimal Point*1 3: Three Digit Decimal Point*1 4: Follow the Decimal Point Position of an Input Type*2	---	4	RW	After the Unit is restarted
Ch□ Decimal Point Position Monitor	0: No Decimal Point 1: One Digit Decimal Point 2: Two Digit Decimal Point 3: Three Digit Decimal Point	---	---	RO	---

*1. If the input type is temperature input and the number of decimal places in the setting is greater than the decimal point position of the input type, “Follow the Decimal Point Position of an Input Type” applies.

*2. It is disabled for analog Input. If it is selected, “One Digit Decimal Point” applies.

Here are some examples of parameter value conversion with temperature input.

● Configuring the Set Point (INT)

Input Type setting	Decimal Point Position setting	Setting value of Set Point (INT)	Set Point used for control processing
4: K -200.0 to 1300.0°C One digit decimal point	0: No Decimal Point	1234	1234.0°C
		12345	1300.0°C*2
	1: One Digit Decimal Point 2: Two Digit Decimal Point*3 3: Three Digit Decimal Point*3 4: Follow the Decimal Point Position of an Input Type	1234	123.4°C*1
0: Pt100 -200.00 to 500.00°C Two digit decimal points	0: No Decimal Point	123	123.00°C
		1234	324.00°C*2
	1: One Digit Decimal Point	1234	123.40°C
		12345	324.00°C*2
	2: Two Digit Decimal Point 3: Three Digit Decimal Point*3 4: Follow the Decimal Point Position of an Input Type	1234	12.34°C*1

*1. If the input type is temperature input and the number of decimal places in the setting is greater than the decimal point position of the input type, “Follow the Decimal Point Position of an Input Type” applies.
*2. It is disabled for analog Input. If it is selected, “One Digit Decimal Point” applies.
*3. Since the number of decimal places is greater than the decimal point position of the input type, the rule “Follow the Decimal Point Position of an Input Type” applies.

● Displaying the Measured Value (INT)

Input Type setting	Decimal Point Position setting	Measured value used for control processing	Measured Value (INT) displayed
4: K -200.0 to 1300.0°C One digit decimal point	0: No Decimal Point	123.4°C	123*1
		123.5	124*1
	1: One Digit Decimal Point 2: Two Digit Decimal Point*4 3: Three Digit Decimal Point*4 4: Follow the Decimal Point Position of an Input Type	123.44°C	1234*2 *3
		123.45°C	1235*2 *3
0: Pt100 -200.00 to 500.00°C Two decimal digits	0: No Decimal Point	123.40°C	123*1
		123.50°C	124*1
	1: One Digit Decimal Point	123.44°C	1234 *2
		123.45°C	1235 *2
	2: Two Digit Decimal Point 3: Three Digit Decimal Point*4 4: Follow the Decimal Point Position of an Input Type	123.454°C	12345*2 *3
		123.455°C	12346*2 *3

*1. First decimal place is rounded off to convert to a value with no decimal point.
*2. The value in the second decimal place is rounded and converted to a value with one decimal place.
*3. The parameter is not converted because the number of decimal places determined by the Input Type matches the number of decimal places determined by the specified decimal point position.
*4. Since the number of decimal places is greater than the decimal point position of the input type, the rule “Follow the Decimal Point Position of an Input Type” applies.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Select the decimal point position from the list of Decimal Point Position Setting for the channel you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-3-4 Cold Junction Compensation Enable/Disable

Overview and Purpose

This function enables or disables the cold junction compensation using the cold junction sensor that are mounted on terminal blocks, when a thermocouple input is used.

Enable this function normally.

Precautions for Safe Use

Do not remove the cold junction sensor installed on the Ultra-Compact Interface Wiring System (XW2K-34G-T) when you use the Unit. If the cold junction sensor is disconnected, the upper limit value of the input indication range is displayed as the measured value, regardless of the enable/disable setting of cold junction compensation.

Details on the Function

● If Cold Junction Compensation is Enabled

The measured value includes cold junction compensation that is performed using the cold junction sensor installed on the Ultra-Compact Interface Wiring System (XW2K-34G-T).

● If Cold Junction Compensation is Disabled

The measured value does not include cold junction compensation that is performed using the cold junction sensor installed on the Ultra-Compact Interface Wiring System (XW2K-34G-T).

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ Cold Junction Compensation Enable/Disable	Ch☐ Cold Junction Compensation Enable/Disable	Set to enable or disable cold junction compensation for the thermocouple input. FALSE: Disable TRUE: Enable	TRUE	TRUE or FALSE	---	After the Unit is restarted

*1. Ch☐ represents the channel number.

● Cold Junction Sensor Error Detected

- If a cold junction sensor is disconnected, the upper limit value of the input indication range is displayed as the measured value. At this time, the Ch☐ Cold Junction Error bit in the Ch☐ Output and Alarm Status will turn ON, and a Cold Junction Sensor Error (event code: 05110000 hex) will occur.
- When the cause of the cold junction sensor error is removed, the normal measured value is displayed. When the cause of the error is removed and the error is reset, the "Ch☐ Cold Junction Sensor Error" bit of the "Ch☐ Output and Alarm Status" turns OFF.
- Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.
- Refer to *8-3-3 Event Codes* on page 8-7 for details on events.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Select *True* (Enable) or *False* (Disable) from the drop-down list for Channel Enable/Disable Setting of the channel (Ch□) you wish to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-3-5 Temperature Input Correction

Purpose

This function corrects measured values.

It is used when there is a noticeable variation among values given from multiple sensors or from values measured with other gauges.

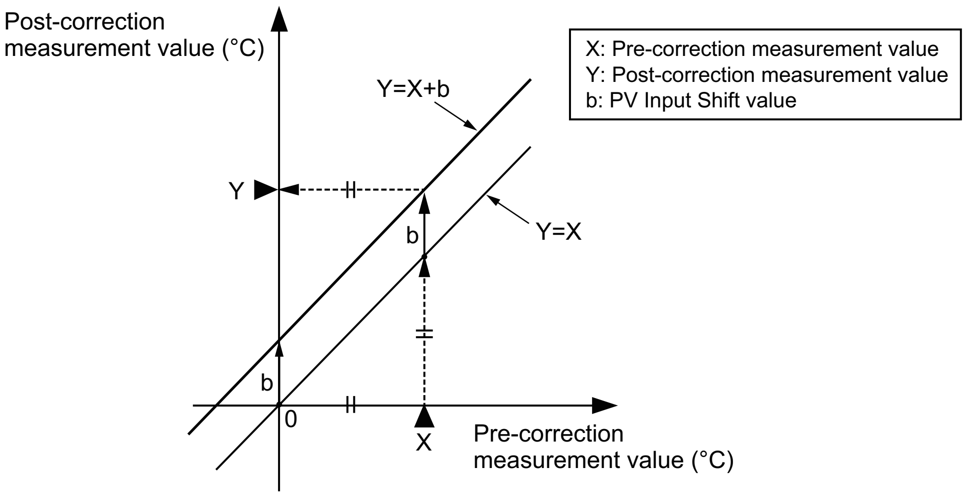
Details on the Function

One-point correction and two-point correction methods are provided.

One-point Correction

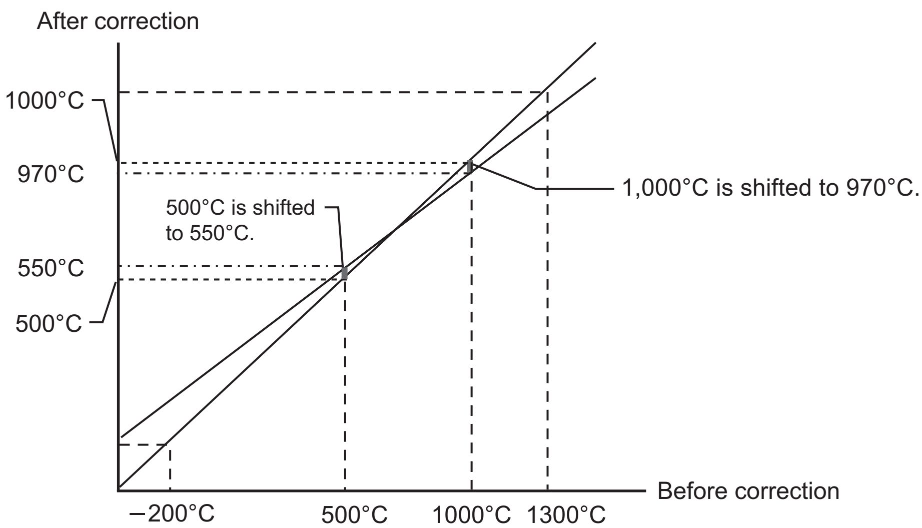
For all points in the sensor's measurement range, measured values are shifted by the value set for the PV Input Shift.

For example, if you want to increase measured values by 1.2°C, set the PV Input Shift to 1.20. Then the measured values are increased by 1.2°C at all measured points in the measurement range.



Two-point Correction

This method sets a slope with 0°C or 0°F as the origin, and shifts measured values by the value set for the PV Input Shift.



The 2-point correction method is shown below.

1 Extract measured value at two points before correction and define the measured value for each point after correction.

The example below shows the procedure.

Measured value before correction (°C)	Measured value after correction (°C)
500	550
1000	970

2 Calculate the correction coefficient of the PV input slope.

(970°C - 550°C) / (1000°C - 500°C) = 0.840

At this time, do not set the PV Input Slope Coefficient in the Advanced Temperature Control Unit.

3 Input the measured value before correction in the Advanced Temperature Control Unit.

In this example, assume that 500°C was entered.

4 Set the value calculated at step 2 as the PV Input Slope Coefficient.

5 Read the measured value.

In this example, assume that 420°C was read.

6 Calculate the difference between the corrected measured value determined at step 1 and the measured value at step 5.

(550°C - 420°C) = 130°C

7 Set the value calculated at step 6 as the PV Input Shift.

● Settings or Monitoring

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ PV Input Shift*2	Ch□ PV Input Shift	Set the value for offset correction of the measured value.	0	Temperature input: -19999 to 32400	0.01°C or 0.01°F	Immediately
				Analog input: -19999 to 32400*3	EU	
Ch□ PV Input Slope Coefficient	Ch□ PV Input Slope Coefficient	Select the correction coefficient to correct the slope of the measured value.	1000	1 to 9999	0.001	Immediately

*1. Ch□ represents the channel number.
*2. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.
*3. The position of the decimal point for analog input follows the Ch□ Decimal Point Position parameter.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Enter set values in the [PV Input Shift] and [PV Input Slope Coefficient] text boxes for the channel (Ch□) you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

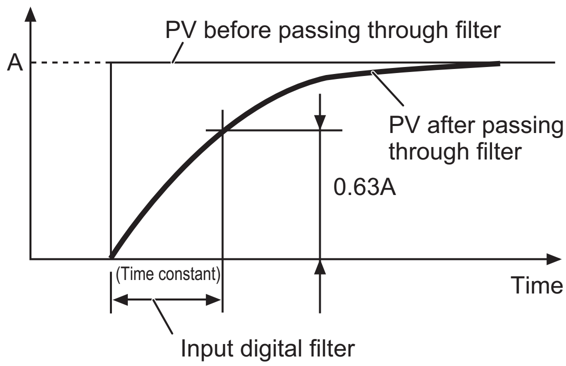
7-3-6 Input Digital Filter

Overview and Purpose

Sets a time constant applied to the filter of the primary delay calculation in order to eliminate the noise component of the measured value.

Details on the Function

If the Input Digital Filter parameter is set to any value other than "0.0", it functions as a low-pass filter to reduce high-frequency noise.



● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Input Digital Filter*2	Ch□ Input Digital Filter	Sets the time constant for the input digital filter.	0	0 to 9999	0.1 s	Immediately

*1. Ch□ represents the channel number.

*2. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.

● Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Enter a set value in the [Input Digital Filter] text box for the channel (Ch□) you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

7-3-7 Measuring the Ambient Temperature around Terminals

Overview and Purpose

This function monitors ambient temperature of the Ultra-Compact Interface Wiring System (XW2K-34G-T) used with the Advanced Temperature Control Units.

This can be used to monitor for signs of abnormality such as abnormal heat generation in the control panel.

Details on the Function

Ambient temperature around the terminals is determined by the temperature calculated using the cold junction sensor connected to the distributed terminal blocks.

The measured ambient temperature around the terminals can be confirmed from the following I/O data. However, the following I/O data is not registered by default. Add this I/O entry to the I/O entry mapping.

For details, refer to *6-1-1 Allocable I/O Data* on page 6-2.

● Settings or Monitoring

Data name	Support Software display	Description	Default	Measurement range	Unit
Terminal Ambient Temperature	Terminal Ambient Temperature	Measures the terminal ambient temperature.	---	-300 to 1710	0.1°C or 0.1°F

The temperature unit of the terminal ambient temperature depends on the "Ch1 Temperature Unit" setting, regardless of the "Ch1 Enable/Disable" setting.

● Operation when the ambient temperature is outside the measurement range

If the ambient temperature is outside the measurement range, an ambient temperature error is detected and the "Terminal Ambient Temperature Error" bit in "Unit Status" of the I/O data is turned ON.

Refer to *Unit Status* on page 6-12 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Target NX Units

All Advanced Temperature Control Units

Setting Method

No setting is required.

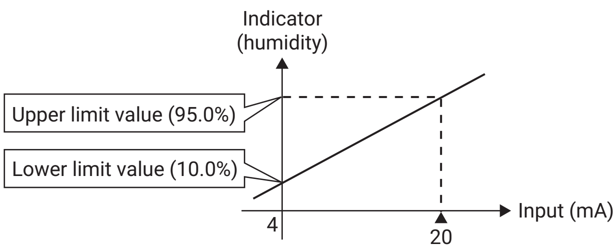
7-3-8 Analog Input Settings

Overview and Purpose

Analog input can be used.
Analog input can be selected from 4 to 20 mA, 0 to 20 mA, 1 to 5 V, 0 to 5 V, 0 to 10V.

Details on the Function

- For analog input, scaling is adjustable according to the controlled item.
- The scaling upper limit, scaling lower limit, and decimal point position parameters are used for scaling.
- The Scaling upper limit parameter defines the physical quantity of the upper limit value of the input; the Scaling lower limit parameter defines the physical quantity of the lower limit value of the input, and the Decimal point position parameter specifies the number of digits after the decimal point.
- A scaling example of the analog input type (4 to 20 mA) is shown below. Once the scaling is completed, humidity can be read directly. The decimal point position is set to 1 decimal place.



- Make sure that the scaling upper limit value is greater than the scaling lower limit value in the scaling setting. If you set the scaling where the scaling lower limit is greater than the scaling upper limit, the greater value is interpreted as the scaling upper limit.

Settings or Monitoring

Data name	Support Software display	Description	Default value	Settings or Monitoring range	Unit	Update timing
Ch□ Scaling Upper Limit	Ch□ Scaling Upper Limit	Sets the upper limit value of input setting range when analog input is selected for the input type.	100	-19999 to 32400	EU	After the Unit is restarted
Ch□ Scaling Lower Limit	Ch□ Scaling Lower Limit	Sets the lower limit value of input setting range when analog input is selected for the input type.	0	-19999 to 32400	EU	After the Unit is restarted
Ch□ Decimal Point	Ch□ Decimal Point	Sets the decimal point position for parameters whose data type is INT for measured values, set points and alarm values (including the upper and lower limit values).	4	1: One Digit Decimal Point 2: Two Digit Decimal Point 3: Three Digit Decimal Point 4: Follow the Decimal Point Position of an Input Type*1	---	After the Unit is restarted

*1. It is disabled for analog Input. If it is selected, “One Digit Decimal Point” applies.

7-4 Control Processing

This section describes the control processing functions of the Advanced Temperature Control Unit.

The control processing functions of the Advanced Temperature Control Unit can be roughly divided into the following two functions:

- ON/OFF control
- PID control

Calculation functions associated with these controls are described in this section after the description of ON/OFF control and PID control.

7-4-1 ON/OFF control

Overview and Purpose

The ON/OFF control turns OFF the control output when the temperature being controlled reaches a preset set point.

Use ON/OFF control for automatic control where no accuracy is required such as when hunting is tolerated. In the case of heating control*1, the control output turns OFF when the measured value exceeds the set point and turns ON when the measured value is lower than the set point.

*1. For reverse operation

Details on the Function

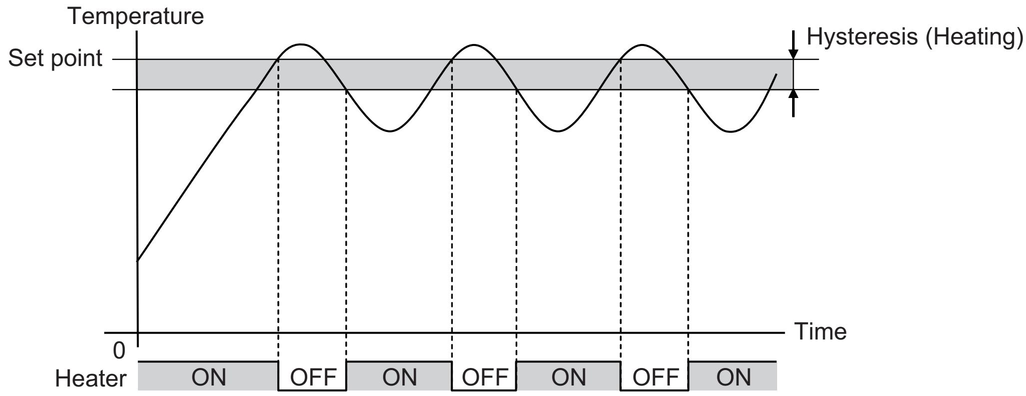
When the control output turns OFF, the temperature begins to fall and the control output turns ON again. This operation is repeated over a certain temperature range. At this time, the Hysteresis parameter determines how much the temperature must fall below the set point before the control output turns ON again. Also, the Direct/Reverse Operation parameter determines whether the control output increases or decreases in response to an increase or decrease in measured value.

● Hysteresis

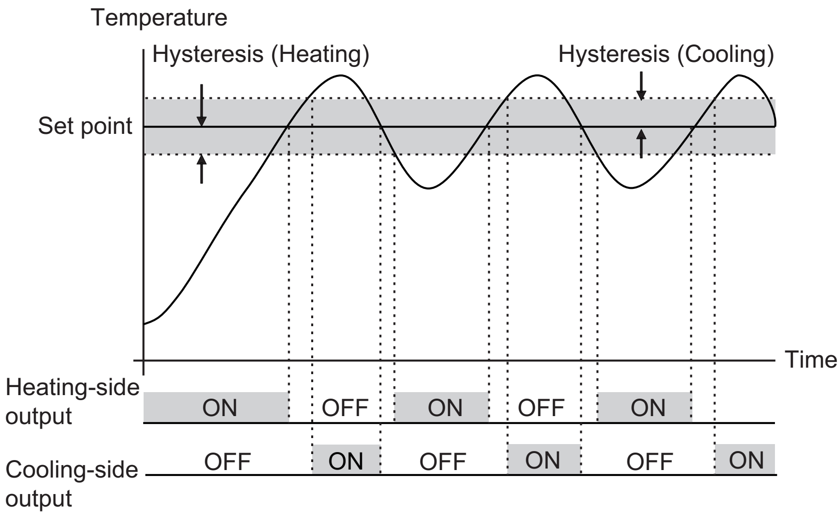
With ON/OFF control, hysteresis is used to stabilize operation during ON/OFF switches.
The width of the hysteresis loop determines the sensitivity. The control output (heating) and control output (cooling) functions are set in the Hysteresis (Heating) and Hysteresis (Cooling) parameters, respectively. In standard control, the setting of the Hysteresis (Heating) parameter is used regardless of whether the control type is heating control or cooling control.

Some operation examples are shown below.

a) Standard control type and reverse operation



b) Heating/cooling control type



● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ PID ON/OFF	Ch□ PID ON/OFF	Set ON/OFF control or 2-PID control. 0: ON/OFF control 1: 2-PID control	1	0 or 1	---	After the Unit is restarted
Ch□ Direct/Reverse Operation	Ch□ Direct/Reverse Operation	Sets reverse operation or direct operation. 0: Reverse operation 1: Direct operation Refer to *7-4-5 Direct and Reverse Operation* on page 7-40 for details about this function.	0	0 or 1	---	After the Unit is restarted
Ch□ Dead Band*2	Ch□ Dead Band	Sets the dead zone to turn OFF the heating and cooling outputs. Refer to *Dead Band* on page 7-34 under *7-4-3 Heating and Cooling Control* on page 7-34 for details.	0	-1999 to 9999	Temperature input: 0.0°C or 0.0°F Analog input: 0.00%	Immediately
Ch□ Hysteresis (Heating)*3	Ch□ Hysteresis (Heating)	Sets the hysteresis to determine how much the temperature must fall below the set point before heating is started.	10	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	Immediately

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Hysteresis (Cooling)*3	Ch□ Hysteresis (Cooling)	Sets the hysteresis to determine how much the temperature must fall below the set point before cooling is started.	10	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	Immediately

*1. Ch□ represents the channel number.
*2. Parameter for the heating/cooling control type only.
*3. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Checking the Control Status

With the standard control type, the control output status can be checked using the Heating Control Output bit of the Ch□ Output and Alarm Status in the I/O data. With the heating/cooling control type, the control output status can be checked using the Heating Control Output and Cooling Control Output bits of the Ch□ Output and Alarm Status in the I/O data.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. For settings related to ON/OFF control of the channel being set (Ch□), select a setting item from the dropdown list or enter the set value in the text box.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings below are applied after the Unit is restarted.
   - Ch□ PID ON/OFF

- Ch□ Direct/Reverse Operation

The following settings are applied immediately.

- Ch□ Dead Band
- Ch□ Hysteresis (Heating)
- Ch□ Hysteresis (Cooling)

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-4-2 PID control

Overview and Purpose

PID control is a combination of proportional (P) control, integral (I) control, and derivative (D) control that feeds back the detected value to the set point and makes them match.

The proportional action performs smooth control with less hunting. The integral action corrects the offset between the set point and the measured value. The derivative action speeds up response to sudden temperature change.

This is used when you want to perform smoother automatic control without generating hunting.

Details on the Function

For PID control, it is necessary to set the setting items for the "Proportional Band", "Integration Time", and "Derivative Time" PID constants.

Use AT (autotuning) or manual setting to set the PID constants.

- If the control characteristics are not known
  By using AT (autotuning), the optimal PID constants are automatically calculated and set.
- If the control characteristics are already known
  Set the PID constants manually and adjust the control.

Refer to *7-5-1 Autotuning (AT)* on page 7-68 for details about AT (autotuning).

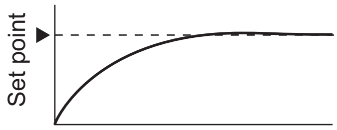
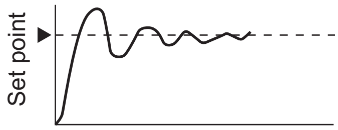
Setting the "Integration Time" and "Derivative Time" PID constants to "0" results in proportional operation.

For proportional operation, when the measured value reaches the set point, the manipulated variable will be 50.0%.

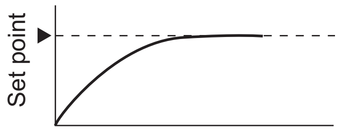
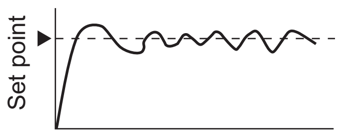
● Change in measured value when PID constants are changed

The change in measured value when a PID constant is changed manually is shown below.

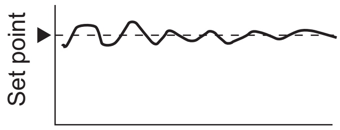
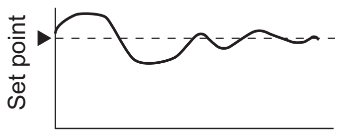
a) When P (Proportional Band) Is Changed

Change in constant	Change in measured value	
Increased		The curve rises gradually, and a long stabilization time is created, but overshooting is prevented.
Decreased		Overshooting and hunting occur, but the set value is quickly reached and the temperature stabilizes.

b) When I (Integral Time) Is Changed

Change in constant	Change in measured value	
Increased		It takes a long time to reach the set point. It takes time to achieve a stable state, but overshooting, undershooting, and hunting are reduced.
Decreased		Overshooting and undershooting occur. Hunting occurs. The Unit starts up faster.

c) When D (Derivative Time) Is Changed

Change in constant	Change in measured value	
Increased		Overshooting, undershooting, and stabilization times are reduced, but fine hunting occurs on changes in the curve itself.
Decreased		Overshooting and undershooting increase, and it takes time to return to the set point.

Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ PID ON/OFF	Ch☐ PID ON/OFF	Set ON/OFF control or 2-PID control. 0: ON/OFF control 1: 2-PID control	1	0 to 1	---	After the Unit is restarted
Ch☐ Proportional Band*2	Ch☐ Proportional Band	Sets the Proportional Band (P) used for 2-PID control. It is used for the heating side for the heating/cooling control type.	800	1 to 65000	Temperature input: 0.01°C or 0.01°F Analog input: 0.01%	Immediately
Ch☐ Integration Time*2	Ch☐ Integration Time	Sets the Integration Time (I) used for 2-PID control. It is used for the heating side for the heating/cooling control type.	2330	0 to 39999	0.1 s	Immediately
Ch☐ Derivative Time*2	Ch☐ Derivative Time	Sets the Derivative Time (D) used for 2-PID control. It is used for the heating side for the heating/cooling control type.	400	0 to 39999	0.1 s	Immediately
Ch☐ Proportional Band (Cooling)*2*3	Ch☐ Proportional Band (Cooling)	Sets the cooling side Proportional Band (P) used for 2-PID control.	800	1 to 65000	Temperature input: 0.01°C or 0.01°F Analog input: 0.01%	Immediately
Ch☐ Integral Time (Cooling)*2*3	Ch☐ Integral Time (Cooling)	Sets the cooling side Integration Time (I) used for 2-PID control.	2330	0 to 39999	0.1 s	Immediately
Ch☐ Derivative Time (Cooling)*2*3	Ch☐ Derivative Time (Cooling)	Sets the cooling side Integration Time (I) used for 2-PID control.	400	0 to 39999	0.1 s	Immediately
Ch☐ α	Ch☐ Alpha	Sets the α constants of 2-PID control. Normally use the default values for this setting data.	65	0 to 100	0.01	After the Unit is restarted

*1. Ch☐ represents the channel number.

*2. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.

*3. Parameter for the heating/cooling control type only.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Checking the Control Status

With the standard control type, the control output status can be checked using the Heating Control Output bit of the Ch☐ Output and Alarm Status in the I/O data. In addition, the manipulated variable calculated for PID control can be checked using "Ch☐ MV Monitor (Heating)" in the I/O data.

With the heating/cooling control type, the control output status can be checked using the Heating Control Output and Cooling Control Output bits of the Ch☐ Output and Alarm Status in the I/O data. In addition, the manipulated variables calculated for PID control can be checked using "Ch☐ MV Monitor (Heating)" and "Ch☐ MV Monitor (Cooling)" in the I/O data.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Refer to *6-1-1 Allocable I/O Data* on page 6-2 for details about MV Monitor.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 For settings related to PID control of the channel being set (Ch☐), select a setting item from the dropdown list or enter the set value in the text box.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings below are applied after the Unit is restarted.

- Ch☐ PID ON/OFF
- Ch☐ α

The following settings are applied immediately.

- Ch☐ Proportional Band
- Ch☐ Integration Time
- Ch☐ Derivative Time
- Ch☐ Proportional Band (Cooling)
- Ch☐ Integral Time (Cooling)
- Ch☐ Derivative Time (Cooling)

Precautions for Safe Use

After using the Support Software to change the Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-4-3 Heating and Cooling Control

Overview and Purpose

This function controls both heating and cooling. It is used to control temperature in the systems which are difficult to control with only heating. For one temperature input, temperature control is performed with two outputs, heating and cooling.

This function is provided only by a heating/cooling control type of the Advanced Temperature Control Unit.

Details on the Function

"Dead Band" and "Heating/Cooling Tuning Method" can be set with the heating and cooling control type Advanced Temperature Control Units.

The PID constant can be set independently on the heating side and cooling side.

The PID constants for heating and cooling are automatically set after you select a tuning method that meets the cooling characteristics in the Heating/Cooling Tuning Method parameter and execute auto-tuning.

In addition, "LCT Cooling Output Minimum ON Time" and "Water-Cooling Output Adjustment" are available for extruders.

These functions are described below.

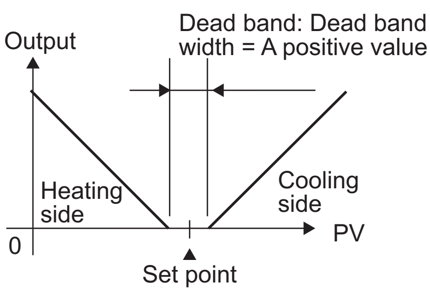
- **Dead Band**

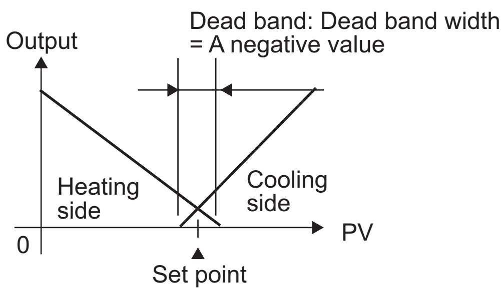
"Dead Band" can be used to set the dead zone to turn OFF the heating and cooling outputs.

When you set a negative value to Dead Band, the Advanced Temperature Control Unit operates in overlapped dead bands.

If the Unit operates in overlapping band, bumpless function may not work properly for when operation mode is switched between manual and automatic.

The default is 0.0 EU for temperature input and 0.00% FS for analog input.



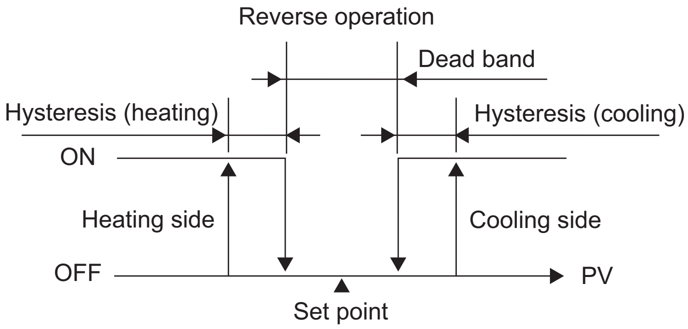


Additional Information

three-position control

Setting the PID ON/OFF parameter to "ON/OFF" control enables three-position control. "Hysteresis" and "Dead Band" can be used to set the dead zone to turn OFF the heating and cooling outputs.

The operation is described below.

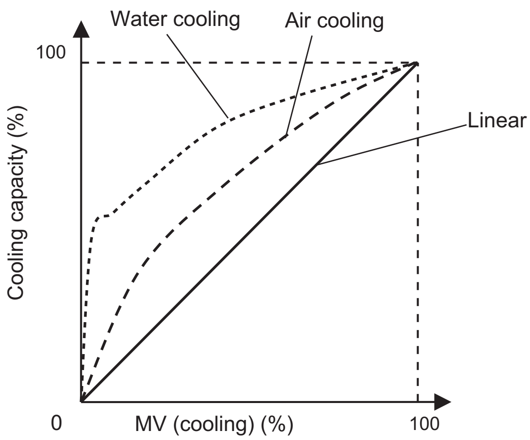


● Heating/Cooling Tuning Method

The tuning method can be selected according to the cooling characteristics.

When AT (autotuning) is executed after making this setting, the PID constant is set automatically according to the cooling characteristics.

The "Air cooling" and "Water cooling" settings are for extruders, while "Linear" is for equipment other than extruders. They have the following cooling characteristics.



Cooling Characteristics

Set values	Description
Same as heating control	Calculates the PID constants with the same tuning method as heating control.
Linear	Performs tuning for an application with linear cooling characteristics and calculates the PID constants.
Air cooling	Performs tuning for an application with non-linear cooling characteristics, such as an extruder that is a plastic molding machine, and calculates the PID constants. This control offers fast and stable response characteristics. Select "Air cooling" or "Water cooling" according to the cooling method of the application. However, if the control temperature is less than 100°C, do not select these methods, but select "Linear" even for an extruder. Also, set "Ch□ Minimum Output ON/OFF Band" to "0" to operate the actuator connected to the output terminal.[*1]
Water cooling	

*1. For details, refer to *7-6-2 Minimum Output ON/OFF Band* on page 7-79.

LCT Cooling Output Minimum ON Time

This is a function for extruders.

This parameters sets the minimum output ON time for the cooling-side control output during auto-tuning.

Sets the time required for operation of the actuator connected to the cooling-side control output (Unit: second).

The default setting of "LCT Cooling Output Minimum ON Time" is based on the actuator operation time of a standard extruder.

An example of a setting calculation is shown below.

a) Configuration

This example uses an Advanced Temperature Control Unit with heating and cooling control outputs and a voltage output for driving SSR, to which relays and solenoid valves are connected.

b) Calculation parameters

Item	Value
Fixed value for Advanced Temperature Control Unit	0.02 s
Relay operation time	0.02 s
Solenoid valve operation time	0.06 s
Safety factor	2

c) Calculations

LCT Cooling Output Minimum ON Time

= (Fixed value for Advanced Temperature Control Unit + Relay operation time + Solenoid valve operation time) × Safety factor

= (0.02 s + 0.02 s + 0.06 s) × 2

= 0.2 s

Settings

The valid parameters differ for ON/OFF control and PID control.

The table below shows the parameters that are valid during ON/OFF control.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ Dead Band*2	Ch☐ Dead Band	Sets the dead zone to turn OFF the heating and cooling outputs for heating/cooling control type models. When this setting is used with hysteresis, the three-position control is possible.	0	-1999 to 9999	Temperature input: 0.0°C or 0.0°F Analog input: 0.00%	Immediately

*1. Ch☐ represents the channel number.

*2. Parameter for the heating/cooling control type only.

The table below shows the parameters that are valid during PID control.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Heating/Cooling Tuning Method*2	Ch□ Heating/Cooling Tuning Method	Sets the tuning method for heating/cooling control that is used for autotuning (AT). 0: Same as heating control 1: Linear 2: Air cooling 3: Water cooling	0	0, 1, 2 or 3	---	After the Unit is restarted
Ch□ LCT Cooling Output Minimum ON Time*2	Ch□ LCT Cooling Output Minimum ON Time	This parameter sets the minimum output ON time for the cooling-side control output during autotuning. Sets the time required for operation of the actuator connected to the cooling-side control output. The default setting is based on the actuator operation time of a standard extruder.	2	1 to 10	0.1 s	After the Unit is restarted

*1. Ch□ represents the channel number.

*2. Parameter for the heating/cooling control type only.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Target NX Units

Heating/cooling control type Advanced Temperature Control Unit

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 For settings related to heating/cooling control of the channel being set (Ch□), select a setting item from the dropdown list or enter the set value in the text box.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings below are applied after the Unit is restarted.

- Ch□ Heating/Cooling Tuning Method
- Ch□ LCT Cooling Output Minimum ON Time

The following settings are applied immediately.

- Ch□ Dead Band

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-4-4 Run or Stop Controls

Overview and Purpose

You can sent start/stop commands for temperature control.

Precautions for Safe Use

It takes 30 minutes of warm-up time for the measured value to stabilize after you turn ON the Advanced Temperature Control Unit. Start control after the warm-up period elapses.

Details on the Function

When temperature control is started (TRUE: RUN), this function outputs the manipulated variable (MV) to make the measured value (PV) follow the set point (SP), and conversely, when temperature control is stopped (STOP), this function turns the manipulated variable (MV) OFF (0).

The operation command of this function is reset to the default value right after power cycling or a restart of the Unit.

● Settings or Monitoring

Data name	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ RUN or STOP	Ch☐ RUN or STOP	Sets the operation command to RUN or STOP.	FALSE	FALSE: STOP TRUE: RUN	---	Immediately
Ch☐ RUN or STOP Status	Ch☐ RUN or STOP Status	Monitors the operating status that goes to RUN or STOP.	FALSE	FALSE: STOP TRUE: RUN	---	---

Precautions for Correct Use

Observe that the RUN/STOP logic for both the operation command and operation status is reversed from the NX-TC Temperature Control Unit.

Setting name		NX-TC	NX-HTC
Operation Command	RUN or STOP	0: Run 1: Stop	FALSE: STOP TRUE: RUN
Operating Status	RUN or STOP	0: Run 1: Stop	FALSE: STOP TRUE: RUN

● How to Execute the Function

Manipulate the Run or Stop bit of "Ch☐ Operation Command" in the I/O data.

Refer to *Operation Command/Operation Command2* on page 6-15 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

● Execution Status Check

The run or stop status of the control can be checked using the Run or Stop Status bit of "Ch☐ Operating Status" in the I/O data.

Refer to *Operating Status/Operating Status2* on page 6-12 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Target NX Units

All Advanced Temperature Control Units

Setting Method

No setting is required.

7-4-5 Direct and Reverse Operation

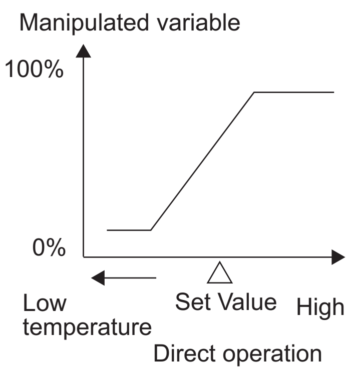
Overview and Purpose

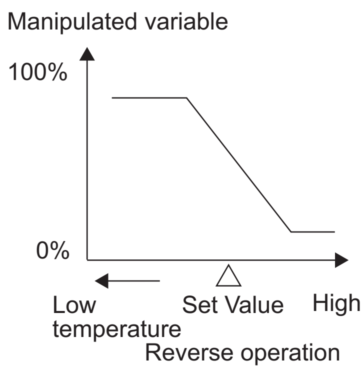
This function specifies reverse operation or direct operation. It is used to switch between heating control and cooling control.

Details on the Function

Specify direct operation to perform control that increases the manipulated variable in response to an increase in a measured value, as in cooling control.

Conversely, specify reverse operation to perform control that increases the manipulated variable in response to a decrease in a measured value, as in heating control.





● Settings

The settings are shown in the following table.

Data name [*1]	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Direct/Reverse Operation	Ch□ Direct/Reverse Operation	Sets direct operation or reverse operation. 0: Reverse operation 1: Direct operation	0	0 or 1	---	After the Unit is restarted

*1. Ch□ represents the channel number.

Changing Direct/Reverse Operation

Direct/reverse operation can be changed by changing the "Ch□ Direct/Reverse Operation" setting, but a restart is necessary after changing the setting. To change the operation immediately without a restart, manipulate the "Inverting Direct or Reverse Operation Status" bit of "Ch□ Operation Command" in the I/O data.

The operation command of this function is reset to the default value right after power cycling or a restart of the Unit.

Refer to *Operation Command/Operation Command2* on page 6-15 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Execution Status Check

The execution status can be checked using the "Inverting Direct or Reverse Operation Status" bit of "Ch□ Operating Status" in the I/O data.

Refer to *Operating Status/Operating Status2* on page 6-12 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Select *Direct or Reverse* from the drop-down list for Direct/Reverse Operation of the channel (Ch□) you wish to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-4-6 Manual MV

Overview and Purpose

Used to manually specify a manipulated variable.

This function is enabled only during PID control.

Details on the Function

This function is used in manual mode during PID control.

Manual control is called "manual mode", and automatic control is called "auto mode".

In manual mode, output is given with the manipulated variable specified in "Ch□ Manual MV" in the I/O data.

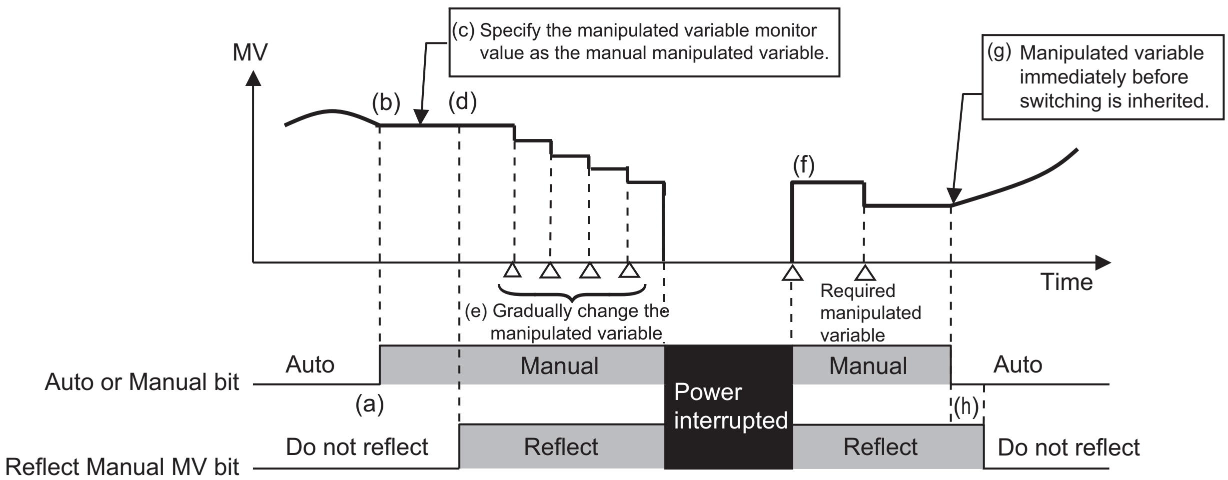
In auto mode, output is not given with the specified manipulated variable.

To switch the mode, manipulate the "Auto or Manual" bit of "Ch□ Operation Command" in the I/O data.

● Operation to Prevent Sudden Change in Manipulated Variable

When switching from the auto mode to the manual mode, the manipulated variable is passed on to prevent a sudden change in the manipulated variable. The operation is described below.

- When in the auto mode, set the "Reflect Manual MV" bit of "Ch□ Operation Command" in the I/O data to "Do not reflect" and change to the manual mode. ((A) in the diagram)
  At this time, the output manipulated variable is the manipulated variable at the time of switching to manual mode. ((B) in the diagram)
- To change the manipulated variable after switching to the manual mode, read the manipulated variable from "Ch□ MV Monitor" in the I/O data before setting the "Reflect Manual MV" bit to "Reflect". Specify this value for "Ch□ Manual MV" in the I/O data. ((c) in the diagram) After specifying the read manipulated variable, set the "Reflect Manual MV" bit to "Reflect" to pass on the manipulated variable. ((d) in the diagram)
- After passing on the manipulated variable, gradually modify the manipulated variable. ((e) in the diagram)
- After a power failure, the manipulated variable when the power supply is turned ON again is determined by "Ch□ Manual MV". ((f) in the diagram)
- When switching from the manual mode to the auto mode, the manipulated variable just before switching is passed on and PID control is performed. ((g) in the diagram)
- In the auto mode, "Manual MV" is not applied regardless of the specified value of the "Reflect Manual MV" bit. ((h) in the diagram)



Specifying the Manual Manipulated Variable

Specify the manual manipulated variable with "Ch□ Manual MV" in the I/O data.

For details about the manual manipulated variable, refer to *6-1-1 Allocable I/O Data* on page 6-2.

How to Execute the Function

To switch the mode, manipulate the "Auto or Manual" bit of "Ch□ Operation Command" in the I/O data. To reflect the manipulated variable, manipulate the "Reflect Manual MV" bit of "Ch□ Operation Command" in the I/O data.

Refer to *Operation Command/Operation Command2* on page 6-15 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Execution Status Check

The mode status can be checked using the "Auto or Manual Status" bit of "Ch□ Operating Status" in the I/O data.

The reflect status of the manual manipulated variable can be checked using the "Reflect Manual MV " bit of "Ch□ Operating Status" in the I/O data.

Refer to *Operating Status/Operating Status2* on page 6-12 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

MV restrictions when the function for limiting simultaneous outputs is used together

Manual MV is restricted by MV Upper Limit and MV Lower Limit.

Target NX Units

All Advanced Temperature Control Units

Setting Method

No setting is required.

7-4-7 MV at Error

Overview and Purpose

This function outputs a fixed manipulated variable when a sensor disconnected error occurs.

This function is enabled only during PID control.

Details on the Function

The output manipulated variable (MV) can be specified when a sensor disconnected error occurs.

When a sensor disconnected error occurs, the manipulated variable at error is output.

When the Load Rejection Output Setting is set to "Output the manipulated variable at the Load Rejection", the Load Rejection MV is output with priority over the MV at Error. For details about the Load Rejection Output Setting, refer to*7-4-9 Load Rejection MV* on page 7-48.

- **Settings**

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ MV at Error	Ch☐ MV at Error	Sets the manipulated variable to output when a sensor disconnected error occurs.	0.0	• Standard control -50 to 1050 • Heating and cooling control -1050 to 1050	0.1 %	Immediately

*1. Ch☐ represents the channel number.

- **Precautions When You Change Set Values**

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Enter a set value in the [MV at Error] text box for the channel (Ch□) you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

7-4-8 MV limit

Overview and Purpose

This function limits the manipulated variable calculated by PID control and outputs it.

This function is enabled only during PID control.

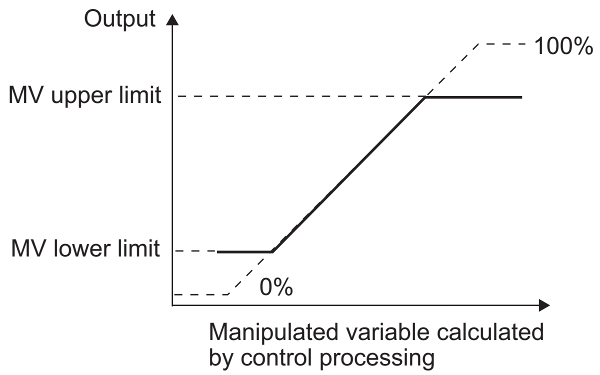
Details on the Function

The manipulated variable limit operation differs according to the control type of the Advanced Temperature Control Unit.

The limit operation is described below for the standard control type and heating/cooling control type.

- **MV limit operation for standard control type**

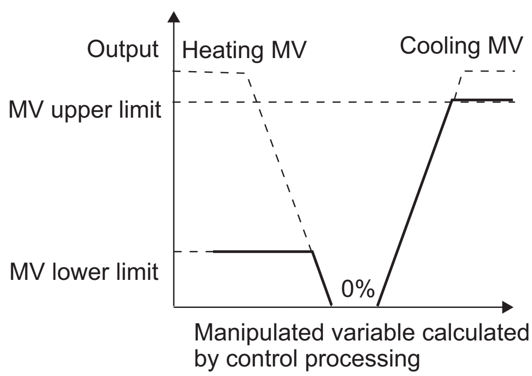
The manipulated variable calculated by the PID control processing is limited by the MV Upper Limit and MV Lower Limit values.



- **MV limit operation for heating/cooling control type**

MV Upper Limit: limit for heating-side manipulated variable.

MV Lower Limit: limit for cooling-side manipulated variable.



Settings

The settings are shown in the following table.

Data name [*1]	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ MV Upper Limit	Ch☐ MV Upper Limit	It is set in the case of controlling the upper-limit of manipulated value (MV).	1000	• standard control -50 to 1050 • heating and cooling control 0 to 1050	0.1 %	Immediately
Ch☐ MV Lower Limit[*2]	Ch☐ MV Lower Limit	It is set in the case of controlling the lower-limit of manipulated variable (MV).	• standard control 0 • heating and cooling control -1000	• standard control -50 to 1050 • heating and cooling control -1050 to 0	0.1 %	Immediately

*1. Ch☐ represents the channel number.

*2. If the MV Lower Limit is set to a value higher than the MV Upper Limit, the MV Lower Limit value is restricted to the MV Upper Limit value during control. For example, for the following settings with the standard control type, 1000 is applied as the lower limit value during control.
- MV Upper Limit set value: 1000
- MV Lower Limit set value: 1050

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Enter the set value in the [MV Upper Limit] or [MV Lower Limit] text box for the specified channel to be set (Ch☐).

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.
The settings are transferred from the Sysmac Studio to the NX Unit.
The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

7-4-9 Load Rejection MV

Overview and Purpose

This function performs a preset output operation when the Advanced Temperature Control Unit cannot receive the output settings from the CPU Unit due to an NX bus error or CPU Unit watchdog timer error.

With a Slave Terminal, this function performs a preset output operation when the Advanced Temperature Control Unit cannot receive output settings due to a communications error between the host and the Communications Coupler Unit or due to an NX bus error.

This function is enabled only during PID control.

Details on the Function

When the Advanced Temperature Control Unit cannot receive the output settings, when the CPU Unit is abnormal for example, you can specify whether to continue the control or output a preset manipulated variable.

Settings	Description
Continue the control.	Control continues even if an error occurs that prevents the output settings being received. However, the tuning function is canceled.
Output the manipulated variable (MV) at the load rejection.	The specified Load Rejection MV is output if an error occurs that prevents the output settings being received.*1

*1. When parameters that are applied after the Unit is started are changed, the Advanced Temperature Control Unit cannot receive the output settings, and therefore, the manipulated variable at load rejection is output.

"Load Rejection MV" is output with priority over the "Manual MV" and "MV at Error".

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ Load Rejection Output Setting	Ch☐ Load Rejection Output Setting	Sets the output status at load rejection. 0: Continue the control 1: Output the manipulated variable (MV) at the load rejection	0	0 or 1	---	After the Unit is restarted
Ch☐ Load Rejection MV	Ch☐ Load Rejection MV	Sets the manipulated variable to output if "Output the manipulated variable (MV) at the load rejection" is set in the load rejection output settings.	0	• standard control -50 to 1050 • Heating and cooling control -1050 to 1050	0.1 %	Immediately

*1. Ch☐ represents the channel number.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Select the set value from the drop-down list for Load Rejection Output Setting of the channel (Ch☐) you wish to set. If "Output the manipulated variable (MV) at the load rejection" is selected, enter a set value in the "Load Rejection MV" text box.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings below are applied after the Unit is restarted.

- Ch☐ Load Rejection Output Setting

The following settings are applied immediately.

- Ch☐ Load Rejection MV

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-4-10 MV Branch

Overview and Purpose

This function outputs the manipulated variables of a channel to another channel.

The manipulated variables, where the slope or offset is calculated for the manipulated variables of the branch source, can be output to the branch-destination channel.

This makes it possible to reduce the number of input sensors, cables, and construction cost. This function is available only for the standard control type.

Also, this function is enabled only during PID control.

Details on the Function

The calculation is performed by using the value of “Ch□ MV Slope” and “Ch□ MV Offset” based on the manipulated variables of the channel selected in the setting of “Ch□ MV Branch Operation”, and the calculated manipulated variables are output.

The calculation method is shown below.

MV of branch-destination channel = MV of branch-source channel × MV slope of branch-destination channel + MV offset of branch-destination channel

● Selection of the branch-source channel

Make the setting available in “Ch□ MV Branch Operation”. Set the operation command (RUN/STOP) to RUN before proceeding.

As an example, the setting items of the MV branch operation of Ch2 are shown below.

Data name	Setting range
Ch2 MV Branch Operation	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4 to 15: Disable

- When “Disable” is set
  The MV branch function is disabled. Normal control is executed for Ch2.

- When “Select Ch1” is set

  The operation of MV branch is performed with the branch-source channel as Ch1, and the calculated MV is output to Ch2. The “Measured value” of Ch2, and functions such as the temperature alarm that use the measured value are enabled.

- When “Select Ch1 [Disable the measured value]” is selected

  The operation of MV branch is performed with the branch-source channel as Ch1, and the calculated MV is output to Ch2. However, the “Measured value” of Ch2, and functions such as the temperature alarm that use the measured value are disabled. In such a case, the “Measured value” and the "Sensor Disconnected Error" of "Ch□ Output and Alarm Status" are fixed as “0”.

- When “Select Ch2” is selected

  The local channel is selected. In such a case, the MV slope and offset are calculated for the manipulated variables of the local channel, and the calculated manipulated variables are output.

The valid setting range of “MV Branch Operation” differs for each channel. A channel having a larger number than the channel to be set cannot be set as the manipulated variable of the branch source. For details on the setting range of the “MV Branch Operation” of each channel, refer to *Settings* on page 7-56.

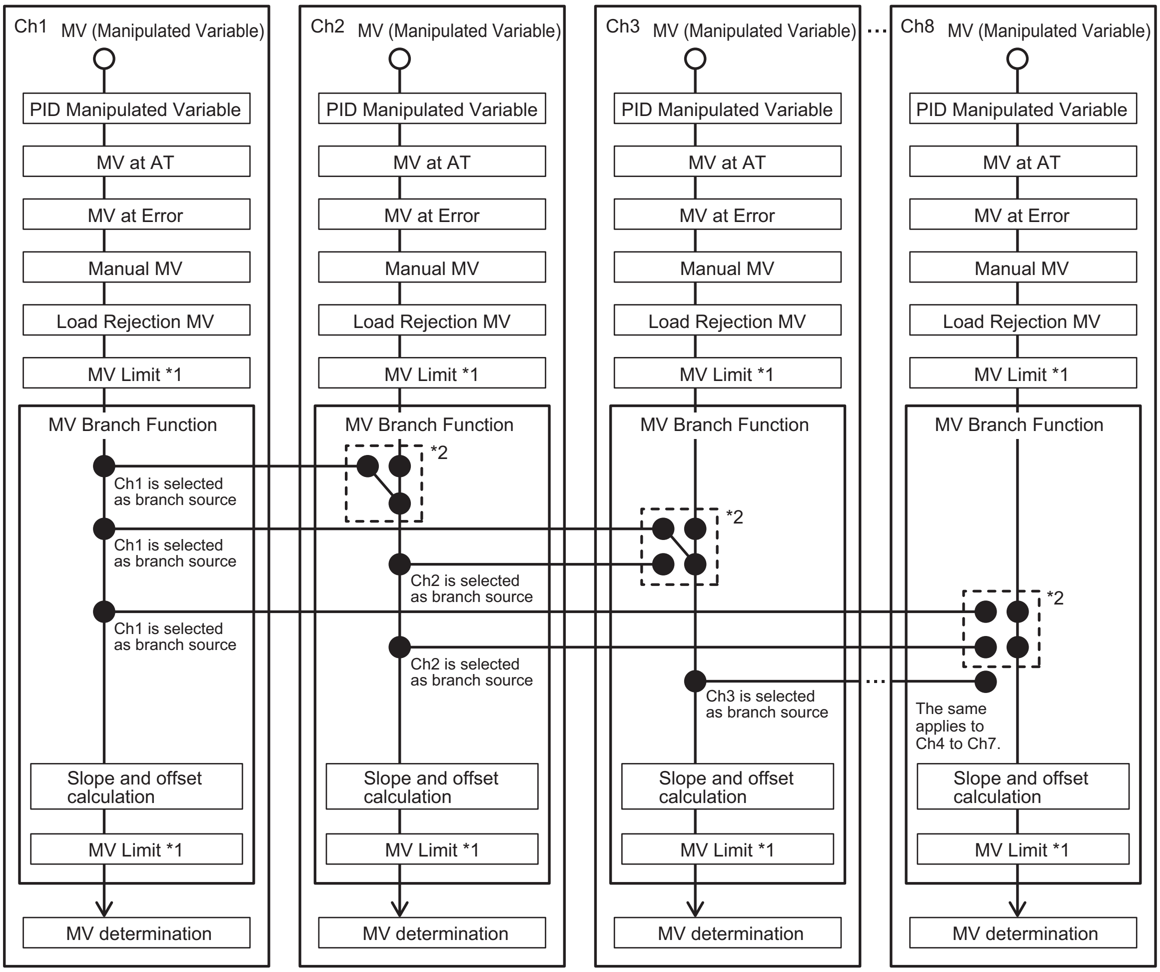
● When tuning is performed

When using tuning such as AT, be sure to make the following settings before tuning.
The control performance may degrade if the following settings are changed after tuning.

- Set the "MV Branch Operation", "MV Slope", and "MV Offset".
- Set the "MV Slope" and "MV Offset" of the Ch to execute tuning to the default value.

● Operation Example

The function flow diagram of the MV branch operation is shown below.
Examples of the operation based on the flow diagram are also provided with explanation.



*1. For details on the MV Limit, refer to *7-4-8 MV limit* on page 7-46.

*2. Even if another channel is selected for “MV Branch Operation”, the local channel will be selected in the following cases, and the calculation of the slope and offset will not be performed.

In the manual mode

During load rejection

Each example of the operation described below has the same settings for the following parameters.

- MV Branch Operation
- MV Slope
- MV Offset

The Examples from 2 to 5 show the operation with respectively different settings and status from those in Example 1.

Example 2: Operation performed when “Ch□ Enable/Disable” is changed.

Example 3: Operation performed when “Ch□ Run/Stop” is changed.

Example 4: Operation performed when “Ch□ Auto/Manual” is changed.

Example 5: Operation performed when the connection status of the sensor is changed.

Example 1) Operation that acts as reference for each operation example

When Enable/Disable is set to Enable for all channels, and also the Run state and Auto mode are set, the MV branch is calculated for Ch2 and Ch3 based on the manipulated variable of Ch1 selected as the branch source, and the calculated manipulated variable is output. Further, the MV branch is calculated for Ch4 based on the manipulated variable of Ch4 itself, and the calculated manipulated variable is output.

Item		Ch1	Ch2	Ch3	Ch4
Settings	Ch□ Enable/Disable	Enable			
	MV Branch Operation	0:Disable	1: Select Ch1	2: Select Ch1 [Disable the measured value]	7: Select Ch4
	MV Slope	1.000	0.900	0.800	0.700
	MV Offset	0.0%	10.0%	20.0%	30.0%
Status	Ch□ RUN or STOP	TRUE: RUN			
	Ch□ Auto or Manual Status	FALSE: Auto			
	Sensor connection	Connected			
	Sensor Disconnected Error	FALSE: No errors occurred			
MV	Manual MV	0.0%			
	MV at Error	0.0%			
	PID Manipulated Variable	50.0%	---	---	60.0%
	Calculated MV of MV Branch	50.0%	55.0%	60.0%	72.0%
MV to output		50.0%	55.0%	60.0%	72.0%
Important points of operation		Since the MV branch operation is disabled, the PID manipulated variable is output.	The MV branch operation is enabled. Calculated manipulated variable = 50.0 (%) × 0.900 + 10.0	The MV branch operation is enabled. Calculated manipulated variable = 50.0 (%) × 0.800 + +20.0	The MV branch operation is enabled. Calculated manipulated variable = 60.0 (%) × 0.700 + +30.0

Example 2) Operation performed when “Ch□ Enable/Disable” is changed

When Enable/Disable is set to Disable for Ch1 and Ch4, and Ch2 and Ch3 are enabled, the manipulated variable of Ch1 and Ch4 is not output. Also, since the Ch1 selected in the MV branch operation for Ch2 and Ch3 is disabled, the manipulated variable becomes 0.0%.

Item		Ch1	Ch2	Ch3	Ch4
Settings	Ch□ Enable/Disable	Disable	Enable	Enable	Disable
	MV Branch Operation	0:Disable	1: Select Ch1	2: Select Ch1 [Disable the measured value]	7: Select Ch4
	MV Slope	1.000	0.900	0.800	0.700
	MV Offset	0.0%	10.0%	20.0%	30.0%
Status	Ch□ RUN or STOP	TRUE: RUN			
	Ch□ Auto or Manual Status	FALSE: Auto			
	Sensor connection	Connected			
	Sensor Disconnected Error	FALSE: No errors occurred			
MV	Manual MV	0.0%			
	MV at Error	0.0%			
	PID Manipulated Variable	0.0%	---	---	0.0%
	Calculated MV of MV Branch	0.0%	10.0%	20.0%	30.0%
MV to output		0.0%	0.0%	0.0%	0.0%

Item	Ch1	Ch2	Ch3	Ch4
Important points of operation	Since Ch1 Enable/Disable is Disable, the manipulated variable becomes 0.0%.	Since Ch1, which is the selected channel, is disabled, the MV branch is disabled.	Since Ch1, which is the selected channel, is disabled, the MV branch is disabled.	Since Ch4 Enable/Disable is Disable, the manipulated variable becomes 0.0%.

Example 3) Operation performed when “Ch☐ Run/Stop” is changed

When Run/Stop parameter is set to the Stop state for Ch2 and Ch4, the manipulated variable of Ch2 and Ch4 becomes 0.0%.

Item		Ch1	Ch2	Ch3	Ch4
Settings	Ch☐ Enable/Disable	Enable			
	MV Branch Operation	0: Disable	1: Select Ch1	2: Select Ch1 [Disable the measured value]	7: Select Ch4
	MV Slope	1.000	0.900	0.800	0.700
	MV Offset	0.0%	10.0%	20.0%	30.0%
Status	Ch☐ RUN or STOP	TRUE: RUN	TRUE: RUN	FALSE: STOP	TRUE: RUN
	Ch☐ Auto or Manual Status	FALSE: Auto			
	Sensor connection	Connected			
	Sensor Disconnected Error	FALSE: No errors occurred			
MV	Manual MV	0.0%			
	MV at Error	0.0%			
	PID Manipulated Variable	50.0%	---	---	60.0%
	Calculated MV of MV Branch	50.0%	55.0%	60.0%	72.0%
MV to output		50.0%	0.0%	60.0%	0.0%
Important points of operation		The operation is the same as Example 1.	When the Stop state is set for Ch2, the manipulated variable becomes 0.0%.	The operation is the same as Example 1.	When the Stop state is set for Ch4, the manipulated variable becomes 0.0%.

Example 4) Operation performed when “Ch☐ Auto/Manual” is changed

When Ch2 and Ch4 are set to manual mode, the manual manipulated variable is output in Ch2 and Ch4.

Item		Ch1	Ch2	Ch3	Ch4
Settings	Ch☐ Enable/Disable	Enable			
	MV Branch Operation	0: Disable	1: Select Ch1	2: Select Ch1 [Disable the measured value]	7: Select Ch4
	MV Slope	1.000	0.900	0.800	0.700
	MV Offset	0.0%	10.0%	20.0%	30.0%
Status	Ch☐ RUN or STOP	TRUE: RUN			
	Ch☐ Auto or Manual Status	FALSE: Auto	TRUE: Manual	FALSE: Auto	TRUE: Manual
	Sensor connection	Connected			
	Sensor Disconnected Error	FALSE: No errors occurred			

Item		Ch1	Ch2	Ch3	Ch4
MV	Manual MV	0.0%	40.0%	0%	70.0%
	MV at Error	0.0%			
	PID Manipulated Variable	50.0%	---	---	60.0%
	Calculated MV of MV Branch	50.0%	55.0%	60.0%	72.0%
MV to output		50.0%	40.0%	60.0%	70.0%
Important points of operation		The operation is the same as Example 1.	When Ch2 is set to manual mode, the manipulated variable becomes the manual manipulated variable.	The operation is the same as Example 1.	When Ch4 is set to manual mode, the manipulated variable becomes the manual manipulated variable.

Example 5) Operation performed when the connection status of the sensor is changed

When the sensor of Ch2, Ch3, and Ch4 is disconnected or not connected, the occurrence of the “Sensor Disconnected Error” of each channel, and the output manipulated variable are as shown below.

Item		Ch1	Ch2	Ch3	Ch4
Settings	Ch□ Enable/Disable	Enable			
	MV Branch Operation	0:Disable	1: Select Ch1	2: Select Ch1 [Disable the measured value]	7: Select Ch4
	MV Slope	1.000	0.900	0.800	0.700
	MV Offset	0.0%	10.0%	20.0%	30.0%
Status	Ch□ RUN or STOP	TRUE: RUN			
	Ch□ Auto or Manual Status	FALSE: Auto			
	Sensor connection	Connected	Disconnected, not connected	Disconnected, not connected	Disconnected, not connected
	Sensor Disconnected Error	FALSE: No errors occurred	TRUE: Occurred	FALSE: No errors occurred	TRUE: Occurred
MV	Manual MV	0.0%			
	MV at Error	0.0%	5.0%	15.0%	25.0%
	PID Manipulated Variable	50.0%	---	---	60.0%
	Calculated MV of MV Branch	50.0%	55.0%	60.0%	72.0%
MV to output		50.0%	55.0%	60.0%	25.0%
Important points of operation		The operation is the same as Example 1.	The Sensor Disconnected Error occurs. The manipulated variable of Ch2 is output as the value processed by the MV branch operation based on the manipulated variable of the selected Ch1.	Since the MV branch operation is “Select Ch1 [Disable the measured value]”, the Sensor Disconnected Error does not occur. The manipulated variable of Ch3 is output as the value processed by the MV branch operation based on the manipulated variable of the selected Ch1.	The Sensor Disconnected Error occurs. The manipulated variable is the MV at Error.

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch1 MV Branch Operation	Ch1 MV Branch Operation	Set whether to enable or disable the measured value of the branch-source channel and the local channel. If you select [Disable the measured value], the “Measured value” and the functions that use the measured value can be disabled.	0	0: Disable 1: Select Ch1 2 to 15: Disable	---	After the Unit is restarted
Ch2 MV Branch Operation	Ch2 MV Branch Operation		0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4 to 15: Disable	---	After the Unit is restarted
Ch3 MV Branch Operation	Ch3 MV Branch Operation		0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4: Select Ch2 [Disable the measured value] 5: Select Ch3 6 to 15: Disable	---	After the Unit is restarted
Ch4 MV Branch Operation	Ch4 MV Branch Operation		0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4: Select Ch2 [Disable the measured value] 5: Select Ch3 6: Select Ch3 [Disable the measured value] 7: Select Ch4 8 to 15: Disable	---	After the Unit is restarted
Ch5 MV Branch Operation	Ch5 MV Branch Operation		0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4: Select Ch2 [Disable the measured value] 5: Select Ch3 6: Select Ch3 [Disable the measured value] 7: Select Ch4 8: Select Ch4 [Disable the measured value] 9: Select Ch5 10 to 15: Disable	---	After the Unit is restarted

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch6 MV Branch Operation	Ch6 MV Branch Operation	Set whether to enable or disable the measured value of the branch-source channel and the local channel. If you select [Disable the measured value], the “Measured value” and the functions that use the measured value can be disabled.	0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4: Select Ch2 [Disable the measured value] 5: Select Ch3 6: Select Ch3 [Disable the measured value] 7: Select Ch4 8: Select Ch4 [Disable the measured value] 9: Select Ch5 10: Select Ch5 [Disable the measured value] 11: Select Ch6 12 to 15: Disable	---	After the Unit is restarted
Ch7 MV Branch Operation	Ch7 MV Branch Operation		0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4: Select Ch2 [Disable the measured value] 5: Select Ch3 6: Select Ch3 [Disable the measured value] 7: Select Ch4 8: Select Ch4 [Disable the measured value] 9: Select Ch5 10: Select Ch5 [Disable the measured value] 11: Select Ch6 12: Select Ch6 [Disable the measured value] 13: Select Ch7 14 to 15: Disable	---	After the Unit is restarted

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch8 MV Branch Operation	Ch8 MV Branch Operation	Set whether to enable or disable the measured value of the branch-source channel and the local channel. If you select [Disable the measured value], the “Measured value” and the functions that use the measured value can be disabled.	0	0: Disable 1: Select Ch1 2: Select Ch1 [Disable the measured value] 3: Select Ch2 4: Select Ch2 [Disable the measured value] 5: Select Ch3 6: Select Ch3 [Disable the measured value] 7: Select Ch4 8: Select Ch4 [Disable the measured value] 9: Select Ch5 10: Select Ch5 [Disable the measured value] 11: Select Ch6 12: Select Ch6 [Disable the measured value] 13: Select Ch7 14: Select Ch7 [Disable the measured value] 15: Select Ch8	---	After the Unit is restarted
Ch☐ MV Slope	Ch☐ MV Slope	Set the slope value for the calculation and output of the manipulated variables of the branch-source channel.	1000	1 to 9999	0.001	Immediately
Ch☐ MV Offset	Ch☐ MV Offset	Set the offset for the calculation and output of the manipulated variables of the branch-source channel.	0	-1999 to 9999	0.1%	Immediately

*1. Ch☐ represents the channel number.

Target NX Units

Standard control type Advanced Temperature Control Unit

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 For settings related to the MV branch operation of the channel being set (Ch□), select a setting item from the dropdown list or enter the set value in the text box.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings below are applied after the Unit is restarted.

- Ch□ MV Branch Operation

The following settings are applied immediately.

- Ch□ MV Slope
- Ch□ MV Offset

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-4-11 Load-short circuit protection

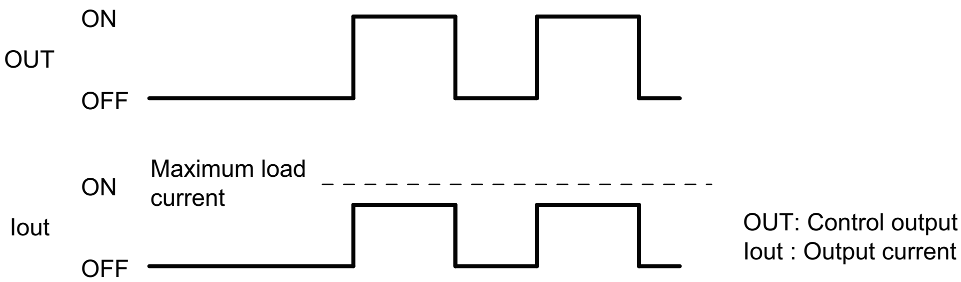
Overview and Purpose

This function protects the output circuit of the Advanced Temperature Control Unit, if an external device connected to the control output is short-circuited. This function is provided for the Advanced Temperature Control Unit with voltage outputs for driving SSR.

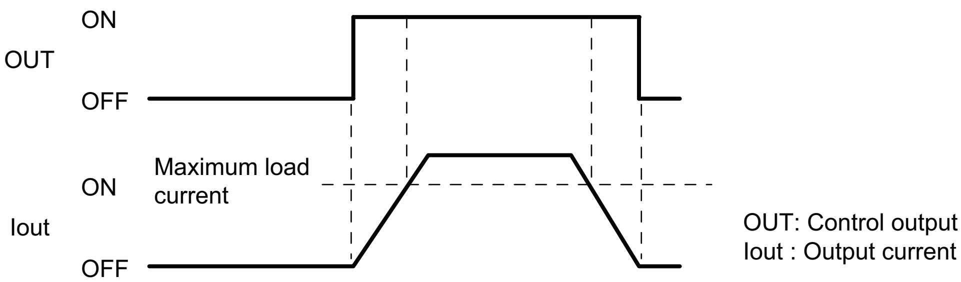
Details on the Function

As shown in the diagram below, when the control output (OUT) turns ON, the transistor turns ON and the output current (Iout) flows.

The output circuit transistor in the Advanced Temperature Control Unit generates heat when the output current (Iout) flows.



If a load short-circuit occurs and the output current (Iout) exceeds the maximum load current, the load short-circuit protection circuit operates to restrict the output current (Iout) to approx. 120% of the maximum load current.



- **Restrictions on Use**

The load short-circuit protection function only protects internal circuits temporarily.

The output elements deteriorate if the short-circuit is not corrected. If an external load is short-circuited, immediately turn OFF the applicable control output and remove the cause of the short-circuit.

Target NX Units

Advanced Temperature Control Units whose output type is voltage outputs for driving SSR.

Setting Method

No setting is required.

7-4-12 Disturbance Suppression (Pre-boost Function)

Overview and Purpose

- The pre-boost function adds or subtracts the preset manipulated variable to/from the manipulated variable calculated by the Advanced Temperature Control Unit before temperature variations occur due to a disturbance.
- The pre-boost function performs operation based on the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters, which are calculated automatically by executing D-AT (disturbance autotuning).
- The pre-boost function is implemented by inputting a trigger signal to the Advanced Temperature Control Unit before temperature variations occur due to a disturbance.
- The two patterns of "FF1" and "FF2" can be set for the FF segment manipulated variables. "FF" is added to related parameter names.
- This function is not available when ON/OFF control is used.

Details on the Function

The parameters used to operate the pre-boost function are described below. They are calculated automatically by executing D-AT.

● FF Waiting Time

This is the parameter for the time to wait from the start of disturbance suppression to the output of the disturbance manipulated variable.

● FF Operation Time

This sets the operation time to output the MV. The time resulting from dividing the set operation time into four quarters is the operation time of each segment manipulated variable.

● MV (FF Segment 1 to 4 MV)

The MV consists of four segments.

● Pre-boost Function Modes

The pre-boost function has the following two modes.

The parameters of the pre-boost function are adjusted automatically in the D-AT mode and then the function is used by switching to the FF mode. Refer to *Procedure for Using Pre-boost Function* on page 7-64 for details.

Mode	Description	Mode transition method
D-AT mode	This is the mode to automatically adjust the parameters of the pre-boost function. The parameters of the pre-boost function are set automatically by executing D-AT.	"1: D-AT mode" is commanded with the "FF or D-AT mode" bit in "Ch□ Operation Command2".
FF mode	This is the mode in which the pre-boost function operates.	"0: FF mode" is commanded with the "FF or D-AT mode" bit in "Ch□ Operation Command2".

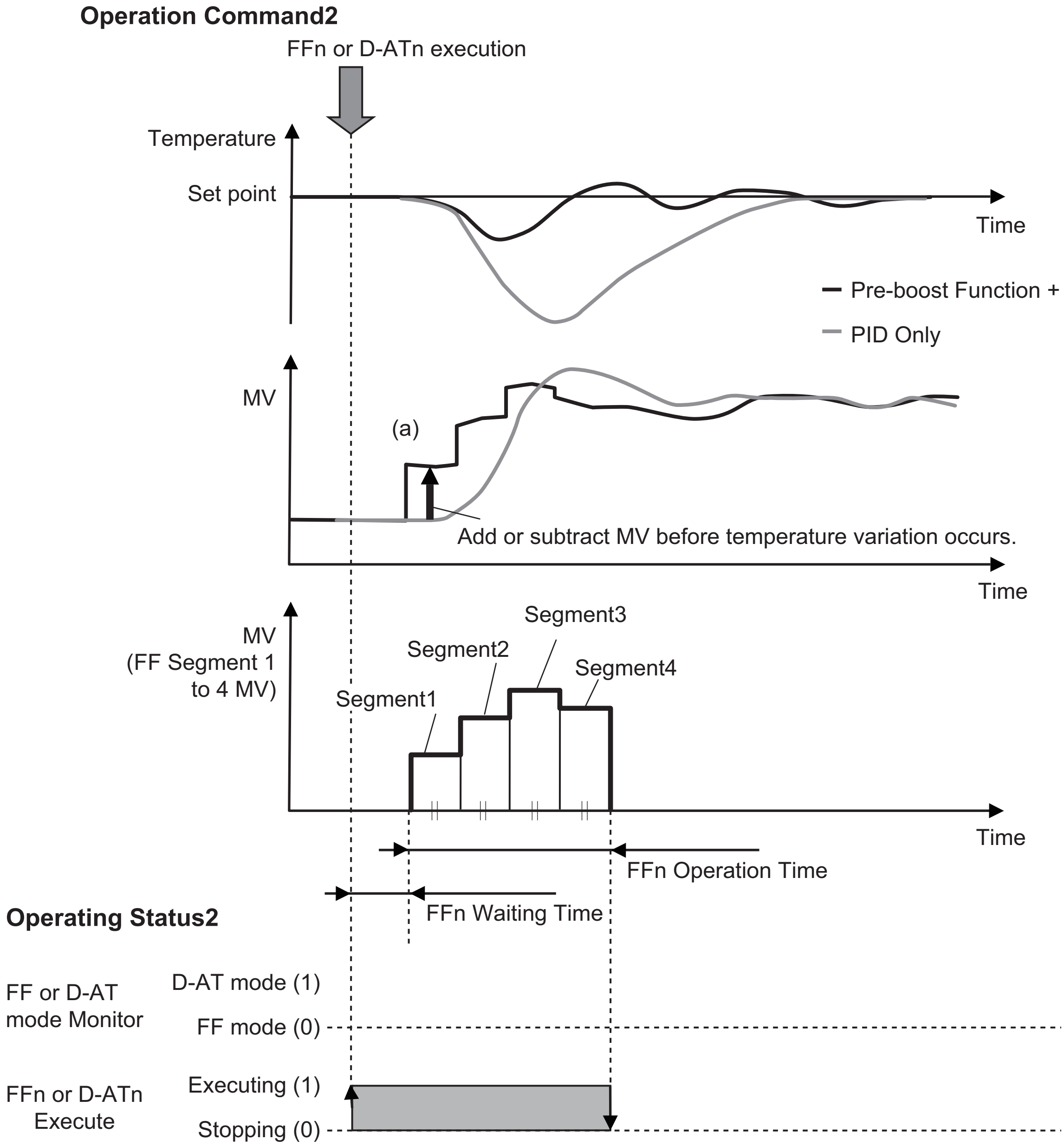
The default is FF mode.

D-AT mode operation

Refer to *7-5-2 D-AT (Disturbance Autotuning)* on page 7-71 for D-AT mode operation.

FF mode operation

When FF is executed with the "FFn or D-ATn Execute" bit of "Ch☐ Operation Command2" in the I/O data at the timing of an operation that causes a disturbance in the FF mode, the Advanced Temperature Control Unit adds or subtracts the MV and outputs the result after the FF Waiting Time. (Refer to (a) in the figure below.) The temperature variations can be suppressed by using the manipulated variable to negate temperature variations before they occur. This is effective if FF is executed when the timing of disturbance occurrence is clear. The MV, FF Waiting Time, and FF Operation Time parameters are set automatically by executing D-AT.



● Settings

The settings are shown in the following table.

Data name[*1]	Description[*1]	remarks
FFn Waiting Time	This is the time to wait from when the "FFn or D-ATn Execute" operation command is executed to when the FFn Segment1 MV is output in the FF mode. This parameter is automatically calculated by D-AT execution.	When using this data in the I/O data, perform I/O allocation. This data is not registered in the default values for the I/O data.
FFn Operation Time	Set the operation time to output the MV. The time divided the set operation time into four quarters is the operation time of each FF segment Manipulated Variable. This parameter is automatically calculated by D-AT execution.	
FFn Segment1 MV	Set the MV of FFn segments 1 to 4. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 1 to 4. This parameter is automatically calculated by D-AT execution.	
FFn Segment2 MV		
FFn Segment3 MV		
FFn Segment4 MV		

*1. n=1, 2

● Execution condition

This function can be executed when the Advanced Temperature Control Unit operates under the following conditions.

The function cannot be executed if any of the conditions is not satisfied.

Operating condition	Setting item and status to check the operating condition
PID control	"Ch☐ PID ON/OFF" setting is set to "1:2-PID control".
Auto mode	"Auto or Manual Status" bit of "Ch☐ Operating Status" is set to "0: Auto mode".
Running	"Run or Stop Status" bit of "Ch☐ Operating Status" is set to "1: Run".
AT Stopping	"100 Percent AT Status" bit of "Ch☐ Operating Status" is set to "0: 100% AT Stopping" and the 40 Percent AT Status bit of "Ch☐ Operating Status" is set to "0: 40% AT Stopping".
FF mode	"FF or D-AT mode Monitor" of "Ch☐ Operating Status2" is set to "0: FF mode".
FF or D-AT for a different number is "Stopping"	"Ch☐ FF1 or D-AT1 Execute Status" or "Ch☐ FF2 or D-AT2 Execute Status" of "Ch☐ Operating Status2" is set to "0: FF or D-AT is not in progress"
Another channel is selected in MV Branch Operation	Another channel is selected in the setting of "Ch☐ MV Branch Operation".

Canceling Pre-boost Function

The pre-boost function (MV addition or subtraction) is canceled in the following cases.

- When "1: FF or D-AT Cancel" is commanded with "FF or D-AT Cancel" bit in "Ch□ Operation Command2"
- When "Manual mode" is commanded with "Auto or Manual" in "Ch□ Operation Command"
- When "Stop" is commanded with "Run or Stop" in "Ch□ Operation Command"
- When "100% AT Executing" is commanded with "100 Percent AT" in "Ch□ Operation Command"
- When "40% AT Executing" is commanded with "40 Percent AT" in "Ch□ Operation Command"
- When "Inverting" is commanded with "Direct/Reverse Operation" in "Ch□ Operation Command"
- When an input error occurs

Procedure for Using Pre-boost Function

The procedure to use the pre-boost function is shown below. However, explanations of the setting items and I/O data Ch□ are omitted.

1 Perform the following settings or operations to prepare for use of the pre-boost function.

(1) Set a numerical value for "Set Point" in the I/O data.

(2) Set the "Run or Stop" bit of Operation Command in the I/O data to "Run"

Control starts.

(3) Set the "100 Percent AT" bit to "100% AT Executing" or the "40 Percent AT" bit to "40% AT Executing" for the Operation Command in the I/O data, or set the PID constants calculated in advance by autotuning.

2 Execute D-AT. Perform the following operations.

(1) Set the "FF or D-AT mode" bit of Operation Command2 in the I/O data to "D-AT mode".

(2) Set the "FFn or D-ATn Execute" bit of Operation Command2 in the I/O data to "FFn or D-ATn Execute" while the measured value has stabilized close to the set point. [*1]

The D-AT is executed and the temperature variations due to disturbance are measured. The parameters of the pre-boost function are set automatically when the D-AT completes after temperature variations are detected. [*2]

3 Execute the pre-boost function (MV addition or subtraction). Perform the following settings and operations.

(1) Set the "FF or D-AT mode" bit of Operation Command2 in the I/O data to "FF mode".

(2) Set the "FFn or D-ATn Execute" bit of Operation Command2 in the I/O data to "FFn or D-ATn Execute" while the measured value has stabilized close to the set point. [*1]

The pre-boost function (MV addition or subtraction) is executed and the temperature variations due to the disturbance are suppressed. [*2]

*1. "FFn or D-ATn Execute" of Operation Command2 in the I/O data should be executed in synchronization with disturbance trigger input. Create a program to operate the bit of the operation command at the same time as a disturbance trigger input signal.

*2. If the FF Waiting Time parameter of the pre-boost function is calculated as 0 second, the start timing of D-AT can be expected to be late. If the pre-boost function is used while 0 second is set, disturbance suppression will not be sufficiently effective. Start D-AT execution at a timing earlier than the timing at which the phenomenon causing the disturbance (e.g., loading of workpiece) occurs. The aim is a timing that is earlier by 1/3 of the integration time calculated by autotuning.
FF execution and D-AT execution must be implemented at the same timing and earlier in respect to the occurrence of the disturbance cause. Therefore, if the timing of FF execution is changed for a reason such as equipment improvements, execute D-AT again.

Additional Information

The manipulated variable of all four segments to be used in the FF mode can also be manually adjusted at the same time. Set "Ch□ FFn Segment MV Correction Coefficient".

Examples:
When the segment MV correction coefficient is 0.9, the MV of segments 1 to 4 will change to 90%.
When the segment MV correction coefficient is 1.2, the MV of segments 1 to 4 will change to 120%.

Precautions for Correct Use

The effect of disturbance suppression may be reduced or temperature disturbances may be greater if the following parameters, which are regarded as system fluctuations, are changed after D-AT execution. In such cases, execute D-AT again.

- Set Point
- PV Input Shift
- PV Input Slope Coefficient
- Input Digital Filter
- MV Upper Limit
- MV Lower Limit
- Control Period
- PID Constant
- MV Slope
- MV Offset
- Minimum Output ON/OFF Band

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ FF1 Waiting Time*2	Ch□ FF1 Waiting Time	For the case of FF mode, it is the waiting time until FF1 segment 1 Manipulated Variable is output after the operation command FF1 or D-AT1 Execute parameter is executed. This parameter is automatically calculated by D-AT execution.	0	0 to 2000	0.1 s	Immediately
Ch□ FF1 Operation Time*2	Ch□ FF1 Operation Time	It sets the operation time to output FF1 Manipulated Variable. The time divided the set operation time into four quarters is the operation time of each FF segment Manipulated Variable. This parameter is automatically calculated by D-AT execution.	1	1 to 3600	Seconds	Immediately
Ch□ FF1 Segment1 MV*2	Ch□ FF1 Segment1 MV	It sets the Manipulated Variable of FF1 Segment 1. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 1. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Immediately

Data name *1	Support Software display	Description	De-fault	Setting range	Unit	Update timing
Ch☐ FF1 Segment2 MV*2	Ch☐ FF1 Segment2 MV	It sets the Manipulated Variable of FF1 Segment 2. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 2. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Imme-diately
Ch☐ FF1 Segment3 MV*2	Ch☐ FF1 Segment3 MV	It sets the Manipulated Variable of FF1 Segment 3. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 3. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Immedi-ately
Ch☐ FF1 Segment4 MV*2	Ch☐ FF1 Segment4 MV	It sets the Manipulated Variable of FF1 Segment 4. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 4. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Imme-diately
Ch☐ FF1 Segment MV Variable Correction Coefficient*2	Ch☐ FF1 Segment MV Variable Correction Coefficient	It sets the correction coefficient to adjust the manipulated variable of four segments of FF1 at the same time.	100	1 to 999	0.01	Imme-diately
Ch☐ FF2 Waiting Time*2	Ch☐ FF2 Waiting Time	For the case of FF mode, it is the waiting time until FF2 segment 1 Manipulated Variable is output after the operation command "FF2/D-AT2 execution" is executed. This parameter is automatically calculated by D-AT execution.	0	0 to 2000	0.1 s	Imme-diately
Ch☐ FF2 Operation Time*2	Ch☐ FF2 Operation Time	It sets the operation time to output FF2 Manipulated Variable. The time divided the set operation time into four quarters is the operation time of each FF segment Manipulated Variable. This parameter is automatically calculated by D-AT execution.	1	1 to 3600	Seconds	Imme-diately
Ch☐ FF2 Segment1 MV*2	Ch☐ FF2 Segment1 MV	It sets the Manipulated Variable of FF2 Segment 1. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 1. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Imme-diately

Data name *1	Support Software display	Description	De-fault	Setting range	Unit	Update timing
Ch□ FF2 Segment2 MV*2	Ch□ FF2 Segment2 MV	It sets the Manipulated Variable of FF2 Segment 2. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 2. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Imme-diately
Ch□ FF2 Segment3 MV*2	Ch□ FF2 Segment3 MV	It sets the Manipulated Variable of FF2 Segment 3. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 3. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Imme-diately
Ch□ FF2 Segment4 MV*2	Ch□ FF2 Segment4 MV	It sets the Manipulated Variable of FF2 Segment 4. FF Manipulated Variable consists of four segments. And, it results in the Manipulated Variable of Segment 4. This parameter is automatically calculated by D-AT execution.	0	-1999 to 1999	0.1%	Imme-diately
Ch□ FF2 Segment MV Variable Correction Coefficient*2	Ch□ FF2 Segment MV Variable Correction Coefficient	It sets the correction coefficient to adjust the manipulated variable of four segments of FF2 at the same time.	100	1 to 999	0.01	Imme-diately
Ch□ D-AT Execution Judgement Deviation	Ch□ D-AT Execute Judgement Deviation	It sets the temperature deviation to execute the D-AT execution judgment and the disturbance occurrence judgment. When D-AT is executed, D-AT is started if the absolute deviation between the measured value (PV) and set point (SP) is equal or less than this parameter. After D-AT is started, it is judged that the disturbance has occurred if the absolute deviation between the measured value (PV) and the set point (SP) is more than this parameter.	10	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.1%	Imme-diately

*1. Ch□ represents the channel number.

*2. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.

7-5 Tuning

The tuning function automatically calculates the adjustment values necessary for control and determines the set values according to the target system of temperature control. This function also notifies when parameters are updated by tuning.

Precautions for Safe Use

Keep the power supply to the load (e.g., heater) ON during tuning.

Otherwise, correct tuning results will not be calculated and optimal control is not possible.

Precautions for Correct Use

- If a failure occurs in the Advanced Temperature Control Unit, the tuning parameters stored by the tuning function in the Advanced Temperature Control Unit are lost. Save the tuning parameters so that they can be restored.
- When using values calculated by the tuning function of the Advanced Temperature Control Unit, do not configure the settings using the output data. The values calculated by the Advanced Temperature Control Unit are overwritten by the values of the output data. To use output data, the tuning parameters in the input data must be applied to the output data beforehand. A sample program has been prepared for these operations. For details, refer to *A-5-3 I/O Data Tuning Parameter Update* on page A-61.

7-5-1 Autotuning (AT)

Overview and Purpose

When AT is executed, the optimum PID constant for the set point at the time of execution is automatically calculated.

If you do not know the control characteristics before performing PID control, execute AT.

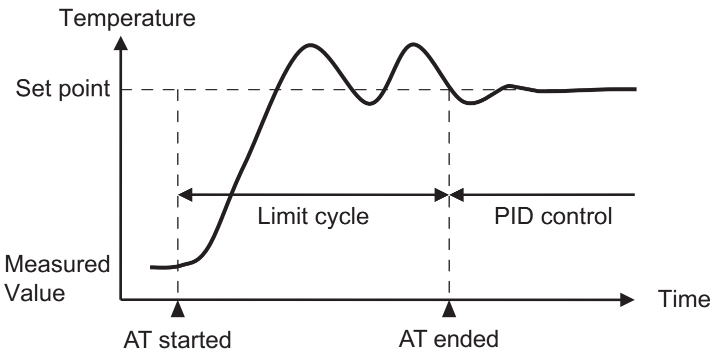
In addition, this Unit adopts a limit cycle method that will forcibly change the manipulated variable to obtain the characteristics of the controlled system.

Details on the Function

The types of autotuning available are 100% AT and 40% AT. 100% and 40% indicate the manipulated variable to generate the limit cycle. Only the standard control type can execute 40% AT. It cannot be executed by the Units with heating and cooling control.

100 Percent AT

Operation is performed as shown in the diagram below, regardless of the deviation (DV) at the start of AT execution. Use 100% AT to shorten the AT execution time. However, this results in greater overshoot than 40% AT.



40 Percent AT

40% AT can reduce the overshoot which could occur during temperature increase in limit cycle.

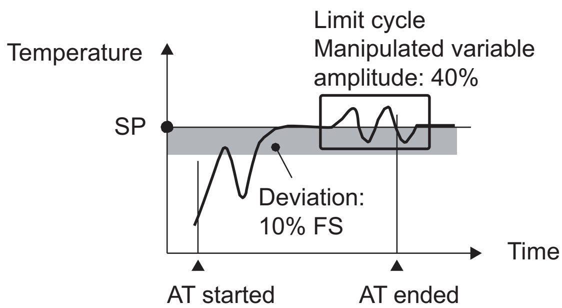
It is used when a system which needs temperature control may malfunction due to overshoot during 100% AT.

However, the autotuning execution time may be longer than for 100% AT.

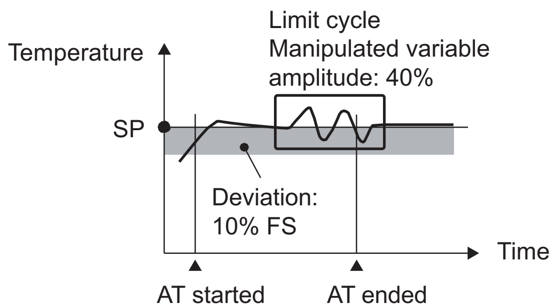
If the deviation (DV) at the start of 40% AT is 10% FS or more, the limit cycle runs once before the measured value reaches the set point and the provisional PID constant is calculated. Temperature is controlled with the PID constant until it reaches the set point so that no overshoot occurs, and then the limit cycle is performed.

If the deviation (DV) at the start of 40% AT is less than 10% FS, the limit cycle is performed as it is.

The operation is described in the following table.



Deviation at start of AT ≥ 10% FS



Deviation at start of AT < 10% FS

AT Cancel

When AT Cancel is executed, the executing 100% AT or 40% AT are canceled.

Execution condition

This function can be executed when the Advanced Temperature Control Unit is operating under the following conditions.

It cannot be executed if any of the conditions is not satisfied.

Operating condition	Setting item and status to check the operating condition
PID control	"Ch□ PID ON/OFF" setting is "1: 2-PID control".
Auto mode	"Auto or Manual Status" bit of "Ch□ Operating Status" is set to "0: Auto mode".
Running	"Run or Stop Status" bit of "Ch□ Operating Status" is set to "1: Run".
No load rejection occurred	TS indicator lights green on Advanced Temperature Control Unit.
Measured value is within the input indication range	Refer to *7-3-1 Input Type Settings* on page 7-11 for information on the input indication range of each input.

- **Operation when a control stop command occurs during AT execution**

After setting the Run or Stop bit of "Ch□ Operation Command" in the I/O data to "Stop", autotuning is canceled and control stops. Autotuning does not restart even if the Run or Stop bit is set to "Run" again.

To restart autotuning, run AT by operation command after setting the bit to "Run".

- **Changing setting data during AT execution**

Changes to the setting data while autotuning is running are not applied to the Unit.

- **Operations When Load Rejection Occurs**

AT is canceled.

Precautions for Correct Use

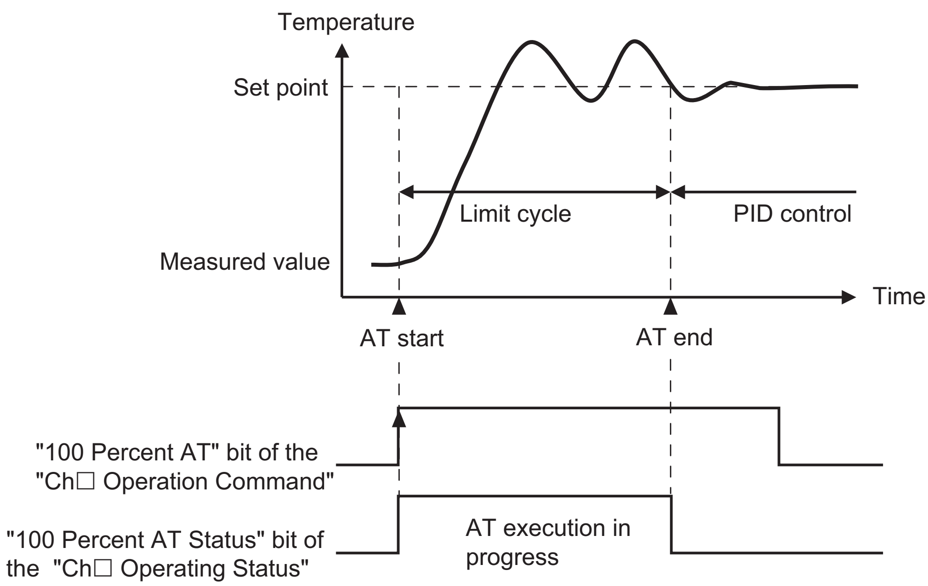
When the "100 Percent AT Status" bit and "40 Percent AT Status" bit of "Ch□ Operating Status" in the I/O data are ON, do not turn OFF the power as the tuning results may be saved in the nonvolatile memory in the Advanced Temperature Control Unit.

If the power is turned OFF while the results are saved in the nonvolatile memory, the tuning parameters stored in the Advanced Temperature Control Unit are disabled and the tuning parameters last saved in the CPU Unit or Communications Coupler Unit to which the Advanced Temperature Control Unit is connected are enabled.

- **Checking the execution method and execution status**

To execute AT, use the "100 Percent AT" bit or the "40 Percent AT" bit of the "Ch□ Operation Command" of I/O data. To cancel AT, use the "AT Cancel" bit. Refer to *Operation Command/Operation Command2* on page 6-15 in *6-1-2 Details about Aggregated Data* on page 6-12 for details on operation commands.

The execution status of AT can be checked from the "100 Percent AT Status" bit or the "40 Percent AT Status" bit of the *"Ch□ Operating Status"* of I/O data. Refer to *Operating Status/Operating Status2* on page 6-12 in *6-1-2 Details about Aggregated Data* on page 6-12 for details on the status.



Target NX Units

All Advanced Temperature Control Units
However, only the standard control type can run 40% AT.

Setting Method

No setting is required.

7-5-2 D-AT (Disturbance Autotuning)

Precautions for Safe Use

When executing D-AT (disturbance autotuning), apply a disturbance using the same method as a disturbance that occurs during control.

If a disturbance is applied using a different method, correct tuning results will not be calculated and optimal control is not possible.

Overview and Purpose

D-AT (disturbance autotuning) is an adjustment function to automatically calculate and set the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters of the pre-boost function.

Execute D-AT before you use the pre-boost function.

For the details on the pre-boost function, refer to *7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61.

This function is available only for the standard control type.

Details on the Function

When D-AT is executed in the D-AT mode, the setting values of the following parameters are calculated automatically.

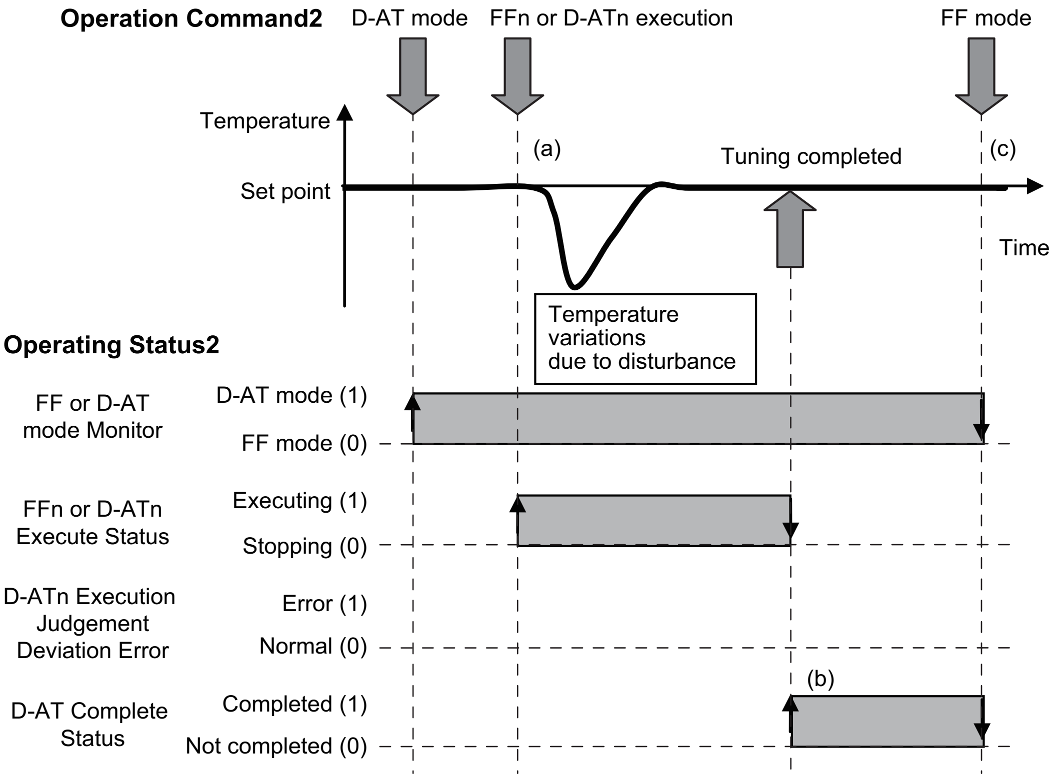
D-AT execution types	Calculated parameters
D-AT1 Execute	FF1 Waiting Time, FF1 Operation Time, FF1 Segment 1 to 4 MV
D-AT2 Execute	FF2 Waiting Time, FF2 Operation Time, FF2 Segment 1 to 4 MV

● D-AT Operation in Normal State

When D-AT is executed with the "FFn or D-ATn Execute" bit of "Ch□ Operation Command2" in the I/O data at the timing of an operation that causes a disturbance in the D-AT mode, the Advanced Temperature Control Unit measures the temperature variations due the disturbance. (Refer to (a) in the figure below.) When the tuning is completed, the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters are calculated automatically and the "D-AT Complete Status" bit of "Ch□ Operating Status2" in the I/O data becomes "1: Completed". (Refer to (b) in the figure below.)

The "1: Completed" state is maintained until the power supply is turned ON or restarted, a D-AT execution operation command is sent, or the mode is switched to FF mode. (Refer to (c) in the figure below.)

The operation timing to execute D-AT is the same as that for the pre-boost function. The timing of the duration from executing D-AT with the "FFn or D-ATn Execute" bit to the occurrence of the disturbance (temperature variation) needs to be adjusted. Refer to *Procedure for Using Pre-boost Function* on page 7-64 in *7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61 for details.



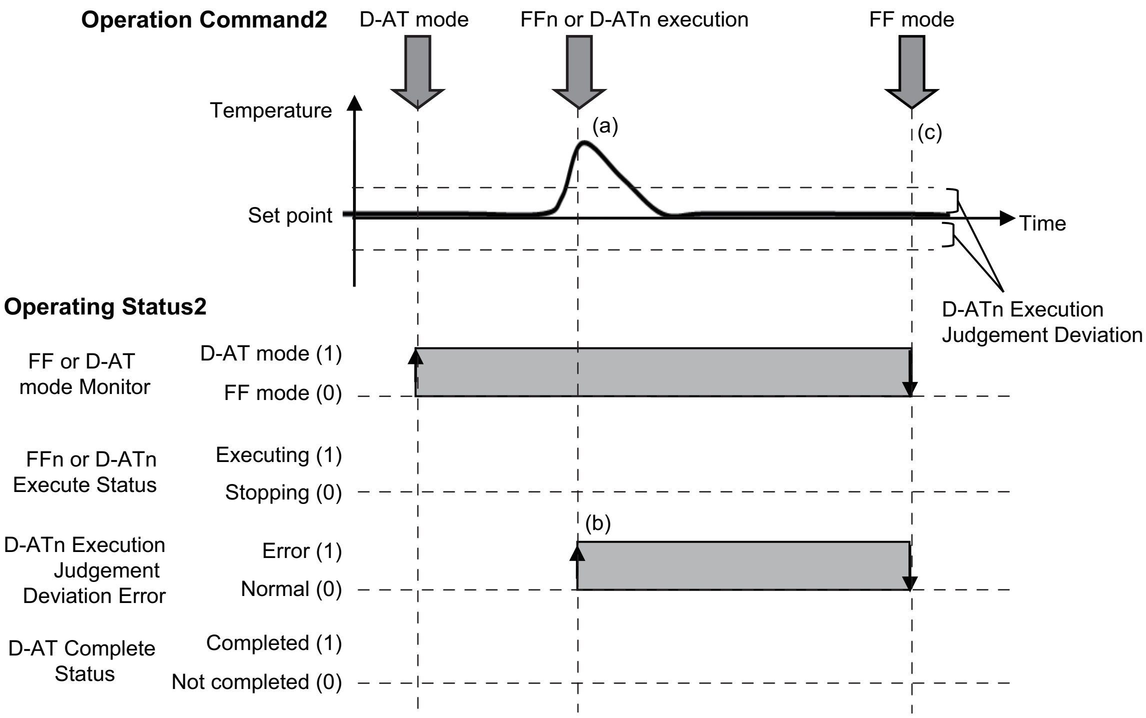
If D-AT is canceled during execution, the "FFn or D-AT Execute Status" bit of "Ch□ Operating Status2" changes from "1: Executing" to "0: Stopping".

In such a case, "1: D-AT mode" is maintained for the "FF or D-AT mode Monitor" bit of "Ch□ Operating Status2".

● D-AT Operation in Error State

If the measured value is larger than the threshold value set in "Ch□ D-AT Execution Judgment Deviation" at the time of D-AT execution, D-AT will not be executed. (Refer to (a) in the figure below.) The "D-ATn Execution Judgment Deviation Error" bit of "Ch□ Operating Status2" in the I/O data changes from "0: Normal" to "1: Error".(Refer to (b) in the figure below.)

The "1: Error" state is maintained until the power supply is turned ON or restarted, a D-AT execution operation command is sent, or the mode is switched to FF mode. (Refer to (c) in the figure below.)



● Execution condition

This function can be run when the Advanced Temperature Control Unit is operating under the following conditions.

It cannot be executed if any of the conditions is not satisfied.

Operating condition	Setting item and status to check the operating condition
PID control	"Ch□ PID ON/OFF" setting is "1:2-PID control".
Auto mode	"Auto or Manual Status" bit of "Ch□ Operating Status" is set to "0: Auto mode".
Running	"Run or Stop Status" bit of "Ch□ Operating Status" is set to "1: Run".
AT Stopping	100 Percent AT Status bit of "Ch□ Operating Status" is set to "0: 100% AT Stopping" and the 40 Percent AT Status bit of "Ch□ Operating Status" is set to "0: 40% AT Stopping".
D-AT mode	"FF or D-AT mode mode Monitor" bit of "Ch□ Operating Status2" is set to "1: D-AT mode".
Deviation between measured value and set point is within the D-AT execution judgment deviation	• Check the measured value using "Ch□ Measured Value INT" or "Ch□ Measured Value REAL". • Check the set point using "Ch□ Set Point INT" or "Ch□ Set Point REAL". • Check "Ch□ D-AT Execution Judgement Deviation" set value.
Integration time is 2 (s) or more	Check that the "Ch□ Integration Time" setting is "2" or more.

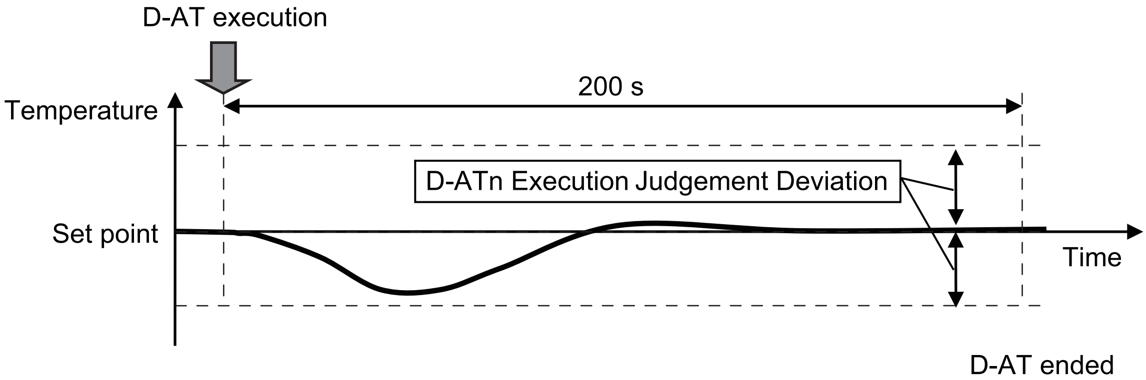
● Canceling D-AT

D-AT is canceled in the following cases.

- When "1: FF or D-AT Cancel" is commanded with the "FF or D-AT Cancel" bit of "Ch☐ Operation Command2"
- When "Manual mode" is commanded with "Auto or Manual" in "Ch☐ Operation Command"
- When "Stop" is commanded with "Run or Stop" in "Ch☐ Operation Command"
- When "100% AT Executing" is commanded with "100 Percent AT" in "Ch☐ Operation Command"
- When "40% AT Executing" is commanded with "40 Percent AT" in "Ch☐ Operation Command"
- When load rejection occurs
- When an input error occurs

● D-AT Operation for Small Temperature Variation Range when Disturbance

- If the state of |Measured value (PV) - set point (SP)| ≤ "D-AT Execution Judgment Deviation" continued for 200 seconds or more, use of the pre-boost function is automatically judged to be unnecessary and then D-AT ends and the values of the FF Waiting Time, FF Operation Time, and FF Segment 1 to 4 MV parameters are initialized.



● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ D-AT Execution Judgement Deviation	Ch☐ D-AT Execute Judgement Deviation	It sets the temperature deviation to execute the D-AT execution judgment and the disturbance occurrence judgment. When D-AT is executed, D-AT is started if the absolute deviation between the measured value (PV) and the set point (SP) is equal or less than this parameter. After D-AT is started, it is judged that the disturbance has occurred if the absolute deviation between the measured value (PV) and the set point (SP) is more than this parameter.	10	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%*2	Immediately

*1. Ch☐ represents the channel number.
*2. Follows the "Ch☐ Temperature Unit" setting.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

How to Execute the Function

To execute D-AT, use the "FF1 or D-AT1 Execute" or "FF2 or D-AT2 Execute" bit of the "Ch□ Operation Command2" in the I/O data.

Refer to *Operation Command/Operation Command2* on page 6-15 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about Operation Command.

The "FF1 or D-AT1 Execute " or "FF2 or D-AT2 Execute" operation command needs to be synchronized with disturbance trigger input. Create a program to operate the bit of the operation command at the same time as a disturbance trigger input signal. Refer to *Procedure for Using Pre-boost Function* on page 7-64 in *7-4-12 Disturbance Suppression (Pre-boost Function)* on page 7-61 for details.

Precautions for Correct Use

When executing D-AT (disturbance autotuning), set the PID constants that are automatically calculated by autotuning.

The effect of disturbance suppression will be reduced or temperature disturbances will become greater if D-AT is executed with the PID constants set as follows.

- When the PID constants are the default values
- When the PID constants are manually set

Execution Status Check

The execution status can be checked using the following bits of "Ch□ Operating Status2" in the I/O data.

Bit	Data name	Meaning	Description
0	FF or D-AT mode	0: FF mode 1: D-AT mode	The current mode can be checked.
1	FF1 or D-AT1 Execute Status*1	0: Stopping 1: Executing	FF mode: The execution status of FF1 can be checked. D-AT mode: The execution status of D-AT1 can be checked.
2	FF2 or D-AT2 Execute Status*2	0: Stopping 1: Executing	FF mode: The execution status of FF2 can be checked. D-AT mode: The execution status of D-AT2 can be checked.
3	D-AT Complete Status	0: D-AT is not completed 1: D-AT is completed	FF mode: Fixed to 0. D-AT mode: The completion of D-AT can be checked.
4	D-AT1 Execution Judgement Deviation Error	0: Normal 1: Error	FF mode: Fixed to 0. D-AT mode: If D-AT2 is not executed because the execution condition of "Ch□ Execution Judgment Deviation" is not satisfied when the D-AT1 operation command is received, this becomes "1: Error". The error state is maintained until the state becomes any of the following. • Cycle the power supply • Restarting • Sending of D-AT1 or D-AT2 operation command • Sending of operation command to switch to FF mode

Bit	Data name	Meaning	Description
5	D-AT2 Execution Judgement Deviation Error	0: Normal 1: Error	FF mode: Fixed to 0. D-AT mode: If D-AT2 is not executed because the execution condition of "Ch□ Execution Judgment Deviation" is not satisfied when the D-AT2 operation command is received, this becomes "1: Error". The error state is maintained until the state becomes any of the following. • Cycle the power supply • Restarting • Sending of D-AT1 or D-AT2 operation command • Sending of operation command to switch to FF mode

*1. FF1 is executed in the FF mode and D-AT1 is executed in the D-AT mode.

*2. FF2 is executed in the FF mode and D-AT2 is executed in the D-AT mode.

Target Units

Standard control type Advanced Temperature Control Unit

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 For settings related to pre-boost function of the channel being set (Ch□), select a setting item from the dropdown list or enter the set value in the text box.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

7-6 Control Output Functions

This section describes the control output functions.

7-6-1 Control Period

Overview and Purpose

This function sets the period when changing the time ratio between ON and OFF of voltage output (for driving SSR) with time-proportional operation.

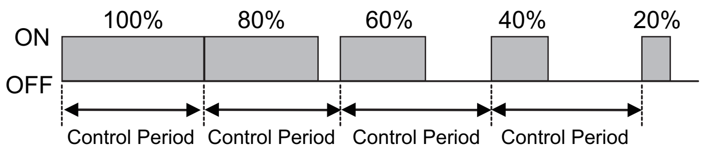
This function is available only if the Advanced Temperature Control Unit is the voltage output for driving SSR type.

This function is enabled only during PID control.

A shorter control period improves controllability. However, if you need to consider the service life of the actuator connected to the output terminal, you are recommended to change the control period according to the service life.

Details on the Function

The set control period is converted to 100% manipulated variable, and ON and OFF are output with the specified manipulated variable.



The control output ON time (Ton) is expressed by the following formula.

Ton [s] = control period [s] × manipulated variable [%] / 100

- **Settings**

The settings are shown in the following table.

Data name [*1]	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Control Period (Heating)	Ch□ Control Period (Heating)	Sets the control period (heating) for time-proportional output. -2: 0.1 s -1: 0.2 s 0: 0.5 s 1 to 99: 1 to 99 s	2	-2, -1, 0, 1 to 99	Seconds	After the Unit is restarted

*1. Ch□ represents the channel number.

Target NX Units

Advanced Temperature Control Unit whose output type is voltage output for driving SSR.

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Enter a set value in the "Control Period" text box for the channel (Ch□) you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-6-2 Minimum Output ON/OFF Band

Overview and Purpose

This function specifies the minimum ON/OFF range of the heating side control output or the cooling side control output.

This function is available only with Advanced Temperature Control Units with voltage output for driving SSR.

This function is enabled only during PID control.

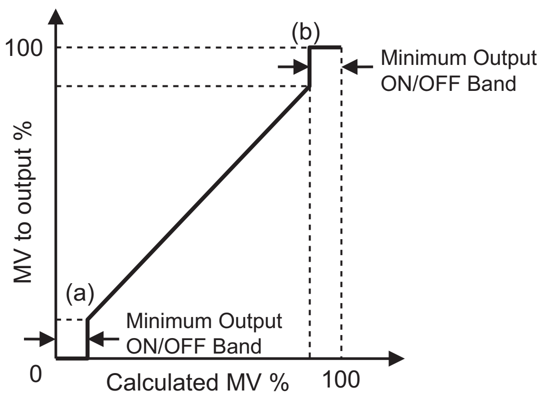
This function can be used to prevent deterioration of the mechanical relay if a mechanical relay is used as the actuator connected to the control output.

You are recommended to set the minimum ON/OFF range according to the operation conditions of the external devices connected to control outputs.

Details on the Function

0% is output if the manipulated variable calculated by the Advanced Temperature Control Unit is less than the value of "Ch□ Minimum Output ON/OFF Band". ((a) in the diagram)

100% is output if the manipulated variable calculated by the Advanced Temperature Control Unit is larger than the value (100% - "Ch□ Minimum Output ON/OFF Band"). ((b) in the diagram)



When operating with "Ch□ Heating/Cooling Tuning Method" set to "Air cooling" or "Water cooling", set "Ch□ Minimum Output ON/OFF Band" to "0". Refer to *7-4-3 Heating and Cooling Control* on page 7-34 for details about Heating/Cooling Tuning Method.

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Minimum Output ON/OFF Band	Ch□ Minimum Output ON/OFF Band	Sets the minimum manipulated variable output by the heating side control output or the cooling side control output.	10	0 to 500	0.1%	After the Unit is restarted

*1. Ch□ represents the channel number.

Target NX Units

Advanced Temperature Control Units whose output type is voltage output for driving SSR.

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Enter a set value in the "Minimum Output ON/OFF Band" text box for the channel (Ch□) you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-6-3 Output Signal Range Setting

Overview and Purpose

This function sets the output signal range of the linear current output. Used to set the output signal range according to actuator that is connected to output terminal.

This function is available only with the Advanced Temperature Control Unit whose output type is linear current output.

Details on the Function

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ Output Signal Range	Ch□ Output Signal Range	Sets the output signal range according to actuator that is connected to output terminal. 0: 4 to 20 mA 1: 0 to 20 mA	0	0 or 1	-	After the Unit is restarted

*1. Ch□ represents the channel number.

Target NX Units

Advanced Temperature Control Units whose output type is linear current output.

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Select the range from the drop-down list for Output Signal Range of the channel (Ch□) you wish to set.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-7 Error Detection

This section describes the error detection functions.

7-7-1 Sensor Disconnection Detection

Overview and Purpose

This function detects a temperature sensor disconnection. It also detects the measured value is outside the input indication range.

Details on the Function

- **Temperature sensor disconnection operation**

Temperature sensor disconnections include unconnected sensors and incorrectly wired sensors.

When a temperature sensor disconnection occurs, or the measured value is outside the input indication range, the measured value becomes the upper limit value of the input indication range.

At this time, the "Sensor Disconnected Error" bit of "Ch☐ Output and Alarm Status" for the corresponding channel turns ON and a "Sensor Disconnected Error" event (event code: 65100000 hex) occurs.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Refer to *8-3-3 Event Codes* on page 8-7 for details on events.

- **Operation when the cause of the disconnection is removed**

When the cause of the sensor disconnection is removed, the measured value becomes the normal value and the "Sensor Disconnected Error" bit of "Ch☐ Output and Alarm Status" turns OFF.

- **When an input digital filter is used**

When the input digital filter is enabled, the disconnection detection is performed using input values before the input digital filter processing.

Target NX Units

All Advanced Temperature Control Units

Setting Method

No setting is required.

7-7-2 Heater Burnout Detection

Overview and Purpose

This function detects heater burnouts. A heater burnout is detected if the control output is ON and the heater current is equal to or less than the heater burnout detection current.

Details on the Function

● Measuring heater current

A heater burnout is detected by measuring the heater current when the control output is ON.

Connect the CT in advance and connect the heater wire to the CT.

Refer to *A-4 CT (Current Transformer)* on page A-46 for details about the current transformer (CT).

● Heater burnout detection operation

If a heater burnout occurs, the current flowing into the heater drops below the heater burnout detection current. The "Heater Burnout Detection" bit of "Ch□ Output and Alarm Status" in the I/O data turns ON and a "Heater Burnout Detected" event (event code: 652C0000 hex) occurs.

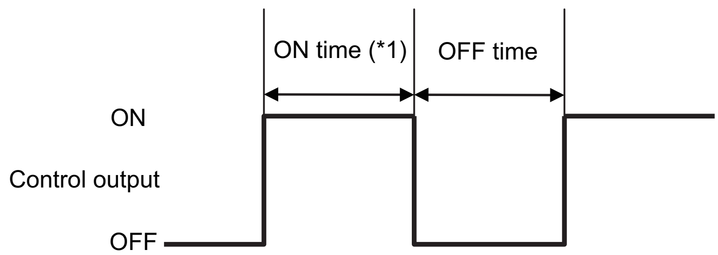
When no heater burnout occurs, the current flowing in the heater is larger than the heater burnout detection current, and the heater is evaluated as normal as power is supplied to it. The "Heater Burnout Detection" bit of "Ch□ Output and Alarm Status" turns OFF.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Refer to *8-3-3 Event Codes* on page 8-7 for details on events.

The table below shows the relationship between the control output and the "Heater Burnout Detection" bit.

Control output	Power to heater	"Heater Burnout Detection" bit *2
ON	Yes	OFF
	No (heater burnout)	ON
OFF	Yes	OFF
	No (heater burnout)	OFF



*1. The heater burnout detection is performed under the following specified conditions.

- The control period is 500 ms or more and the control output ON time is greater than 100 ms.
- The control period is 200 ms or less and the control output ON time is greater than 30 ms.

*2. If the ON time of the control output is less than the time specified above, the last determined value is retained in the NX-HTC along with the heater current value, which may cause the ON/OFF of the control output to not be as shown in the table above.

- **Settings to check operation**

When "Ch□ Heater Burnout Detection Current" is set to "0.0", the "Heater Burnout Detection" bit of "Ch□ Output and Alarm Status" is forcibly turned OFF. When it is set to "50.0", the "Heater Burnout Detection" bit of "Ch□ Output and Alarm Status" is forcibly turned ON.

- **If the control output ON time is less than the specified time**

If the control output ON time is less than the specified time, the "Heater Current Hold" bit of "Ch□ Output and Alarm Status" in the I/O data turns ON. In this case, the last measured heater current value is held in "Ch□ Heater Current" in the I/O data.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

- **If the heater current exceeds the measurement range**

If the heater current exceeds the measurement range, the "Heater Current Exceeded" bit of "Ch□ Output and Alarm Status" in the I/O data turns ON. In this case, the upper limit value of the measurement range is applied to "Ch□ Heater Current" in the I/O data.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

- **Control status when a heater burnout is detected**

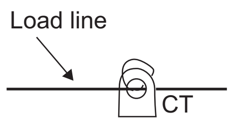
Control continues when a heater burnout is detected.

- **Timing of turning ON the power supply for the heater**

Turn ON the heater power supply at the same time as or before the Advanced Temperature Control Unit power supply. If the heater power is turned ON later, the "Heater Burnout Detection" bit of "Ch□ Output and Alarm Status" in the I/O data turns ON.

Precautions for Correct Use

- The actual current flowing in the heater may not match the rated current value of the heater. Use "Ch□ Heater Current" in the I/O data to check the actual current value.
- Detection may be unstable if the difference between the normal current and the current at heater burnout is small. To have stable detection, set the detection current to ensure the difference between the two current values to be 1.0 A or more for a heater operating below 10.0 A, and to 2.5 A or more for a heater operating with 10.0 or more.
  If the heater current is too small, wind the load line several times, as shown in the diagram below.
  Each turn doubles the detection current.



When you wind a load line through the CT hole multiple times, calculate the heater burnout detection current using the following formula.

$$\text{Half of the heater burnout detection current set value} = \frac{\text{(Normal current + Current when heater burnout occurs)} \times \text{Number of turns through CT}}{2}$$

- To meet the UL Listing requirements, use the E54-CT1L or E54-CT3L Current Transformer in condition that it is mounted at a factory of the equipment manufacturer.

Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ Heater Burnout Detection Current*2	Ch☐ Heater Burnout Detection Current	Sets the heater burnout detection current. The heater burnout detection is output when the heater current value falls below the setting of the parameter. When the set value is "0", the "Heater Burnout Detection" bit of "Ch☐ Output and Alarm Status" turns OFF. When the set value is "50", the "Heater Burnout Detection" bit turns ON.	0	0 to 500	0.1 A	Immediately

*1. Ch☐ represents the channel number.

*2. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.

Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

How to check the current value flowing in CT

The current value flowing in the CT when the control output is ON can be checked using "Ch☐ Heater Current" in the I/O data.

Refer to *6-1-1 Allocable I/O Data* on page 6-2 for details about the heater current.

Target NX Units

Advanced Temperature Control Units with CT inputs and also whose output type is voltage output for driving SSR.

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. Enter a set value in the [Heater Burnout Detection Current] text box for the channel (Ch☐) you want to set.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

7-7-3 SSR Failure Detection

Overview and Purpose

This function detects SSR failures. An SSR failure is detected if the control output is OFF and the leakage current is equal to or greater than the detection current. An SSR failure is a failure that is caused by an SSR short-circuit.

Details on the Function

● Measuring leakage current

A SSR failure is detected by measuring the leakage current when the control output is OFF.

Connect the CT in advance and connect the heater wire to the CT.

Refer to *A-4 CT (Current Transformer)* on page A-46 for details about the current transformer (CT).

● SSR failure detection operation

As a leakage current flows when the SSR fails, the current value exceeds the SSR failure detection current. The "SSR Failure Detection" bit of "Ch□ Output and Alarm Status" turns ON and a "SSR Failure Detected" event (event code: 652D0000 hex) occurs.

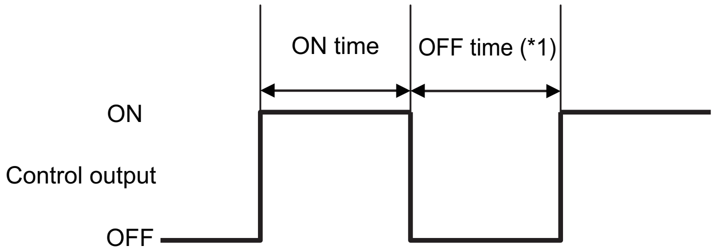
If the SSR does not fail, the leakage current is smaller than the SSR failure detection current, and the operation is regarded to be normal as no power is supplied to the heater. The "SSR Failure Detection" bit of "Ch□ Output and Alarm Status" turns OFF.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

Refer to *8-3-3 Event Codes* on page 8-7 for details on events.

The table below shows the relationship between the control output and the "SSR Failure Detection" bit.

Control output	Power to heater	"SSR Failure Detection" bit *2
ON	Yes (SSR failure)	OFF
	No	OFF
OFF	Yes (SSR failure)	ON
	No	OFF



*1. The SSR failure detection is performed under the following specified conditions.
- The control period is 500 ms or more and the control output OFF time is greater than 100 ms.
- The control period is 200 ms or less and the control output OFF time is greater than 38 ms.

*2. If the ON time of the control output is less than the time specified above, the last determined value is retained in the NX-HTC along with the the leakage current value,, which may cause the ON/OFF of the control output to not be as shown in the table above.

Settings to check operation

When "Ch☐ SSR Failure Detection Current" is set to "0.0", the "SSR Failure Detection" bit of "Ch☐ Output and Alarm Status" in the I/O data is forcibly turned ON. When it is set to "50.0", the "SSR Failure Detection" bit of "Ch☐ Output and Alarm Status" turns OFF.

If the control output Off time is less than the specified time

If the control output Off time is less than the specified time, the "Heater Current Hold" bit of "Ch☐ Output and Alarm Status" in the I/O data turns ON. In this case, the last measured leakage current value is held in "Ch☐ Leakage Current" in the I/O data.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details about the statuses.

If the leakage current exceeds the measurement range

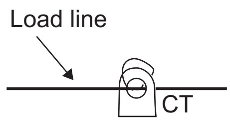
If the leakage current exceeds the measurement range, the upper limit value of the measurement range is applied to "Ch☐ Leakage Current" in the I/O data.

Control status when an SSR failure is detected

Control continues even when an SSR failure is detected.

Precautions for Correct Use

- The actual current flowing in the heater may not match the rated current value of the heater. Use "Ch□ Leakage Current" in the I/O data to check the actual current value.
- Detection may be unstable if the difference between the normal current and the current at heater burnout is small. To have stable detection, set the detection current to ensure the difference between the two current values to be 1.0 A or more for a heater operating below 10.0 A, and to 2.5 A or more for a heater operating with 10.0 or more.
  If the heater current is too small, wind the load line several times, as shown in the diagram below.
  Each turn doubles the detection current.



When you wind a load line through the CT hole multiple times, calculate the SSR failure detection current using the following formula.

$$\text{Half of the SSR failure detection current set value} = \frac{\text{(Leakage current when Output is OFF + Current at SSR failure)} \times \text{Number of turns through CT}}{2}$$

- To meet UL Listing requirements, use the E54-CT1L or E54-CT3L Current Transformer in condition that it is mounted at a factory of the equipment manufacturer.

● Settings

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch□ SSR Failure Detection Current*2	Ch□ SSR Failure Detection Current	Sets the current to detect SSR failure. A SSR failure detection is output when the leakage current value exceeds this set value. When the set value is "50", the "SSR Failure Detection" bit of "Ch□ Output and Alarm Status" turns OFF. When the set value is "0", the "SSR Failure Detection" bit turns ON.	500	0 to 500	0.1 A	Immediately

*1. Ch□ represents the channel number.

*2. This parameter can be accessed from the I/O data as well. Refer to *6-2 List of Settings* on page 6-25 for details.

● Precautions When You Change Set Values

When adjusting the set value of the setting item whose update timing is "Immediately" in the actual system, change this set value only and transfer it to the Unit.

Note that a restart is required after changing the set value of a setting item whose update timing is "After the Unit is restarted" and transferring it to the Unit.

● How to check the current value flowing in CT

The current value flowing in the CT when the control output is OFF can be checked using "Ch□ Leakage Current" in the I/O data.

Refer to *6-1-1 Allocable I/O Data* on page 6-2 for details about the leakage current.

Target NX Units

Advanced Temperature Control Units with CT inputs and also whose output type is voltage output for driving SSR.

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Enter a set value in the [SSR Failure Detection Current] text box for the channel (Ch□) you want to set.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The changed settings are applied immediately.

Additional Information

It is not necessary to restart an NX Unit after changing the parameters.

7-7-4 Temperature Alarm

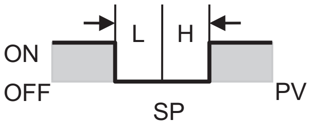
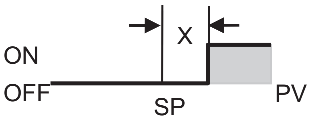
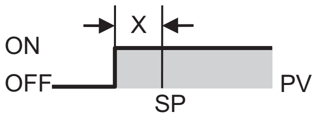
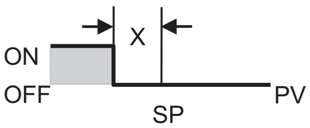
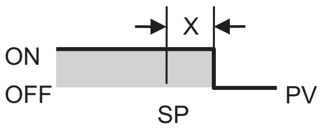
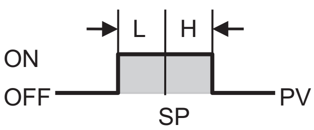
Overview and Purpose

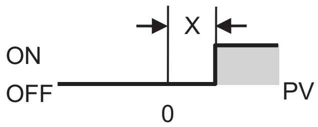
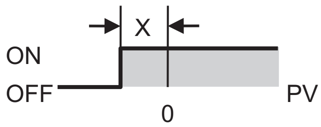
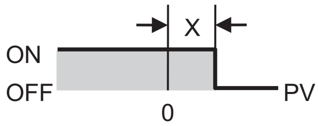
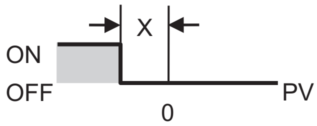
Function for detecting a deviation or an error in the measured value as an alarm. Alarm operation corresponding to the use can be performed by selecting “Alarm type”.

Details on the Function

● Settings of the alarm operation

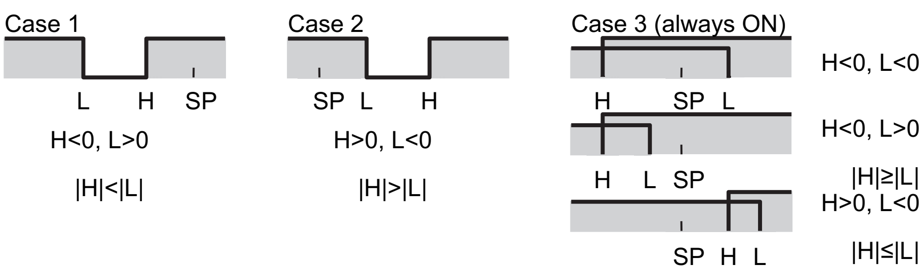
Each channel has two alarm functions, and the alarm operation is set by the “Ch□ Alarm 1 Type” or “Ch□ Alarm 2 Type”. The alarm types that can be set are as shown below.

Setting value	Alarm type	Alarm function		Alarm operation
		Alarm value (X or H/L) is positive	Alarm value (X or H/L) is negative	
0	OFF	Alarm is always OFF		Alarm function OFF.
1	Upper and lower-limit *1		*2	The upward deviation with respect to the set point (SP) is set in alarm value upper limit (H), and the downward deviation with respect to the set point is set in alarm value lower limit (L). The alarm turns ON when the value is outside the scope of deviation.
2	Upper-limit			The upward deviation with respect to the set point (SP) is set in the alarm value (X). The alarm turns ON when the value exceeds the deviation.
3	Lower-limit			The downward deviation with respect to the set point (SP) is set in the alarm value (X). The alarm turns ON when the value is below the deviation.
4	Upper and lower-limit range *1		*3	The upward deviation with respect to the set point (SP) is set in alarm value upper limit (H), and the downward deviation with respect to the set point is set in alarm value lower limit (L). The alarm turns ON when the value is within the scope of deviation.

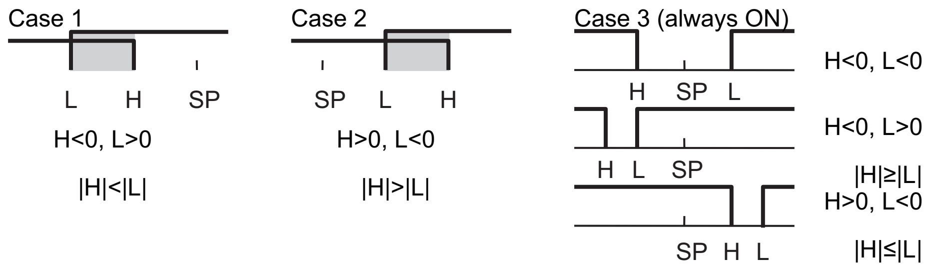
Setting value	Alarm type	Alarm function		Alarm operation
		Alarm value (X or H/L) is positive	Alarm value (X or H/L) is negative	
5	Upper- and lower-limit with standby sequence*1	Same as set value 1*4	*5	A standby sequence is added to the alarm operation of "1: Upper and lower-limit".
6	Upper-limit with standby sequence	Same as set value 2		A standby sequence is added to the alarm operation of "2: Upper-limit".
7	Lower-limit with standby sequence	Same as set value 3		A standby sequence is added to the alarm operation of "3: Lower-limit".
8	Absolute-value upper-limit			Regardless of the set point (SP), the alarm turns ON when the measured value (PV) is larger than the alarm value (X).
9	Absolute-value lower-limit			Regardless of the set point (SP), the alarm turns ON when the measured value (PV) is smaller than the alarm value (X).
10	Absolute-value upper-limit with standby sequence	Same as set value 8		A standby sequence is added to the alarm operation of "8: Absolute-value upper-limit".
11	Absolute-value lower-limit with standby sequence	Same as set value 9		A standby sequence is added to the alarm operation of "9: Absolute-value lower-limit".
12	LBA (Loop Burnout Alarm)	Only the Alarm 1 Type is enabled for LBA (Loop Burnout Alarm). Refer to *7-7-5 LBA (Loop Burnout Alarm)* on page 7-95 for details about this function.		

*1. The upper and lower limits can be set individually.

*2. Upper and lower-limit alarm



*3. Upper and lower-limit range



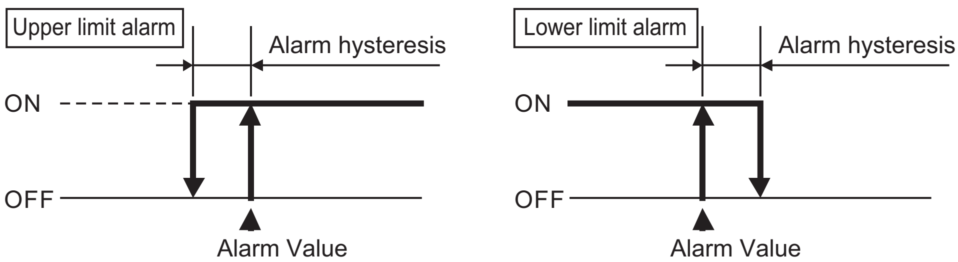
*4. Alarm with upper and lower-limit standby sequence
Always OFF when the upper-limit and lower-limit hysteresis overlap.

*5. Alarm with upper and lower-limit standby sequence
In the upper and lower-limit alarm shown above in *2,

- The alarm is always OFF in case of 1 and 2 when the upper-limit and lower-limit hysteresis overlap.
- The alarm is always OFF in case of 3.

● Alarm hysteresis

A hysteresis can be set for alarm detection during ON/OFF switching, as shown below.



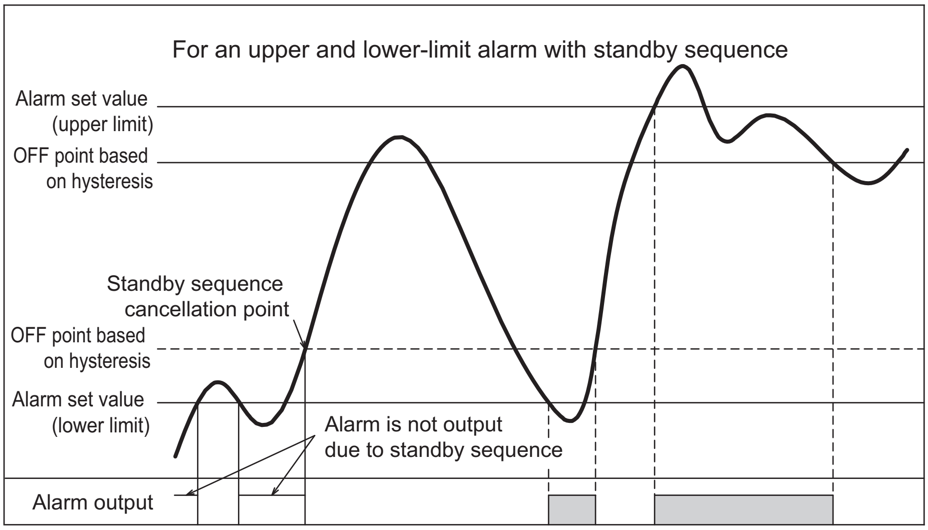
● Standby sequence

The function by which an alarm is not detected when the measured value moves out of the alarm range until it next enters back within the alarm range is called a “standby sequence”. For example, in the case of the “Lower limit”, generally, the measured value when the power supply is turned ON is smaller than the set point, and is therefore within the alarm range and an alarm is detected in such a state. Thus, if “Lower limit with standby sequence” is selected, an alarm is detected for the first time when the measured value exceeds the alarm setting value and moves out of the alarm range, and then again falls below the alarm value.

If the measured value falls outside the alarm range, the standby sequence is cleared, but thereafter, the standby sequence is restarted (reset) under the conditions described below.

- When operation is started (including when the power is turned ON and restarted), when the alarm value (alarm value upper and lower limit) or PV input shift, or PV input slope coefficient is changed, and when the set point is changed.

  Next, the operation of an alarm with a standby sequence will be shown with “5: Upper and lower-limit alarm with standby sequence” as an example.



● Setting the alarm value

The alarm value implies the temperature when an alarm is detected. After setting the alarm operation based on the alarm type, set the alarm value.

The three types, namely Alarm Value (X), Alarm Value Upper Limit (H), and Alarm Value Lower Limit (L) described above in the "● Settings of the alarm operation" table are the alarm values. Set these alarm values in "Ch☐ Alarm Value 1", "Ch☐ Alarm Value 2", "Ch☐ Alarm Value Upper Limit 1", "Ch☐ Alarm Value Upper Limit 2", "Ch☐ Alarm Value Lower Limit 1", or "Ch☐ Alarm Value Lower Limit 2", in the I/O data.

For details on alarm values, refer to *A-3-3 Objects That Accept I/O Allocations* on page A-18.

● Alarm detection operation

When an alarm that occurs as a result of the alarm value or alarm upper and lower-limit value set in accordance with the alarm type is detected, the "Alarm 1 Detection" bit or "Alarm 2 Detection" bit of "Ch☐ Output and Alarm Status" of the I/O data turns ON, and the "Alarm Detection" event (event code: 652E0000 hex) occurs.

Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details on the status.

Refer to *8-3-3 Event Codes* on page 8-7 for details on events.

- **Settings**

The settings are shown in the following table.

Data name *1	Support Software display	Description	Default	Setting range	Unit	Update timing
Ch☐ Alarm 1 Type	Ch☐ Alarm 1 Type	Set the alarm type in accordance with the alarm operation. 12: Only the Alarm 1 Type is enabled for LBA (Loop Burnout Alarm).	0	0: No alarm function 1: Upper and lower-limit alarm 2: Upper-limit alarm 3: Lower-limit alarm 4: Upper and lower-limit range alarm 5: Upper and lower-limit alarm with standby sequence 6: Upper-limit alarm with standby sequence 7: Lower-limit alarm with standby sequence 8: Absolute value upper-limit alarm 9: Absolute value lower-limit alarm 10: Absolute value upper-limit alarm with standby sequence 11: Absolute value lower-limit alarm with standby sequence 12: LBA (Loop Burnout Alarm)	-	After the Unit is restarted
Ch☐ Alarm 2 Type	Ch☐ Alarm 2 Type		0	0: No alarm function 1: Upper and lower-limit alarm 2: Upper-limit alarm 3: Lower-limit alarm 4: Upper and lower-limit range alarm 5: Upper and lower-limit alarm with standby sequence 6: Upper-limit alarm with standby sequence 7: Lower-limit alarm with standby sequence 8: Absolute value upper-limit alarm 9: Absolute value lower-limit alarm 10: Absolute value upper-limit alarm with standby sequence 11: Absolute value lower-limit alarm with standby sequence 12: No alarm function	-	After the Unit is restarted
Ch☐ Alarm 1 Hysteresis	Ch☐ Alarm 1 Hysteresis	Set the hysteresis for whether to detect an alarm when the deviation or measured value exceeds the alarm value or alarm value upper and lower limit set in accordance with the alarm type.	2	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	After the Unit is restarted
Ch☐ Alarm 2 Hysteresis	Ch☐ Alarm 2 Hysteresis		2	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	After the Unit is restarted

*1. Ch☐ represents the channel number.

Target NX Units

All Advanced Temperature Control Units

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software for the method to display the Unit operation setting interface and the method to transfer settings to the NX Unit with Support Software other than the Sysmac Studio.

1. Display the Edit Unit Operation Settings Tab Page.

   For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2. For settings related to the temperature alarm of the channel being set (Ch☐), select a setting item from the dropdown list or enter the set value in the text box.

   Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details about the editing method for the Unit operation settings.

3. Click the **Transfer to Unit** Button.

   The settings are transferred from the Sysmac Studio to the NX Unit.

   The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

7-7-5 LBA (Loop Burnout Alarm)

Overview and Purpose

This function can be used only for temperature input.

Function to detect an alarm, assuming that there is an error somewhere in the control loop, if the measured value does not change in a state where there is a control deviation equal to or greater than the threshold value between the set point and the measured value.

It can be used as the detection means when the temperature control loop does not operate normally.

Details on the Function

● Using LBA

LBA can be used only with Alarm 1. Set “Ch☐ Alarm 1 Type” to “12: LBA (Loop Burnout Alarm)”. If you set other than “12: LBA (Loop Burnout Alarm)”, LBA will be disabled. Also, if you set the setting value “12: LBA (Loop Burnout Alarm)” in “Ch☐ Alarm 2 Type”, alarm 2 will be disabled. For details on “Ch☐ Alarm 1 Type”, refer to *7-7-4 Temperature Alarm* on page 7-90.

● LBA detection operation

When a loop burnout is detected by LBA, the “Alarm 1 Detection” bit of "Ch☐ Output and Alarm Status" in the I/O data turns ON. Refer to *Output and alarm status* on page 6-14 in *6-1-2 Details about Aggregated Data* on page 6-12 for details on the status.

● Execution condition

This function can be executed when the Advanced Temperature Control Unit is operating under the following conditions.

It cannot be executed if any of the conditions is not satisfied.

Operating condition	Setting item and status to check the operating condition
AT Stopping	"100 Percent AT Status" bit of "Ch☐ Operating Status" is "0: 100% AT Stopping" and the "40 Percent AT Status" bit of "Ch☐ Operating Status" is "0: 40% AT Stopping".
Auto mode	“Auto or Manual Status" bit of "Ch☐ Operating Status" is "0: Auto mode".
Running	“Run or Stop Status" bit of "Ch☐ Operating Status" is "1: Run".
MV branch operation is disabled or the local channel is selected	“Ch☐ MV Branch Operation” is “Disable” or the local channel is selected.

● LBA parameters

There are some parameters that can be set in LBA and some that cannot be set.

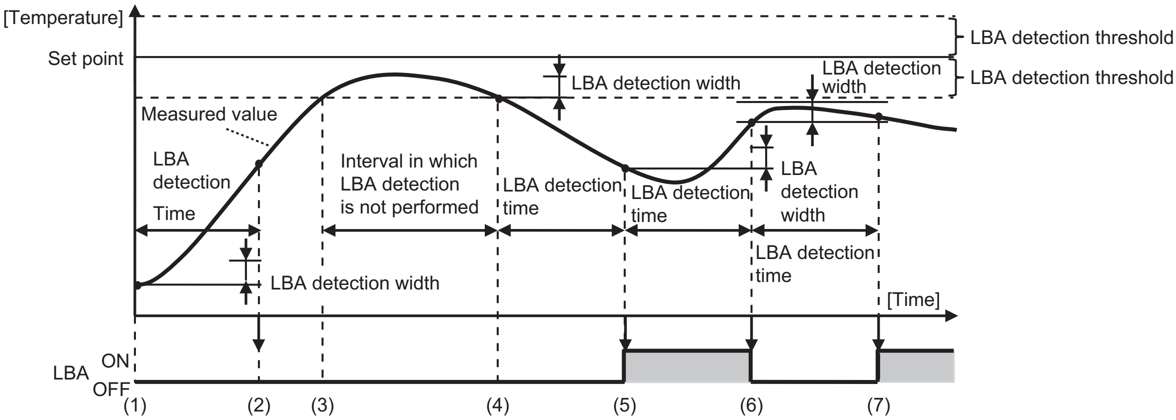
Parameter	Description	Feasibility of changing setting value	Method of setting the setting value
LBA detection time	The time interval when an LBA is detected.	Possible.	• Automatic setting based on AT results*1 • Manual setting
LBA detection threshold	The threshold for determining the temperature range in which LBA detection is not performed. Set point ± LBA detection threshold is the temperature range.	Not Possible	No
LBA detection width	The temperature width in which LBA detection is performed. An LBA is detected if the variation in the measured value is less than the detected width when the LBA detection time has elapsed.	Not Possible	No

*1. If you are using a method for making automatic settings based on the AT results, either implement AT beforehand, or set the same setting value as the AT results in the same Temperature Control System. The AT results in this section indicate the setting value of the proportional band, derivative time, MV limit, and the Limiting Simultaneous Outputs function.

The details of each parameter are described after the operation example.

Operation Example

An operation example and description of the operation of LBA are provided below.



Interval	LBA	Description of operation
(1) to (2)	OFF	Since the control deviation reduces (approaches the set point), and the reduction width of the control deviation is larger than the “LBA detection width”, LBA continues to be OFF.
(3) to (4)	OFF	Since the measured value is within the “LBA detection threshold”, LBA detection is not performed. (LBA continues to be OFF.)
(4) to (5)	OFF to ON	Since the measured value is outside the “LBA detection threshold”, and a reduction in the control deviation that is larger than the “LBA detection width” is not seen within the LBA detection time, LBA turns ON.
(5) to (6)	ON to OFF	Since the control deviation is in a direction approaching the set point, and the control deviation is reduced by more than the “LBA detection width”, LBA turns OFF.
(6) to (7)	OFF to ON	Although the control deviation is in a direction approaching the set point, the reduction width of the control deviation is smaller than the “LBA detection width”, LBA turns ON.

LBA detection time

The time interval when an LBA is detected after the measured value moves outside the range of the LBA detection threshold. Normally, if the measured value is outside the range of the LBA detection threshold, it rises or falls after an unnecessary amount of time has elapsed. LBA turns ON unless the measured value changes in the expected direction after the lapse of a fixed period of time (LBA detection time). The LBA detection time is set automatically based on the AT results. However, in the case of heating/cooling control type and ON/OFF control, automatic settings cannot be made based on the AT results. Therefore, if automatic settings cannot be made, make the manual settings shown below.

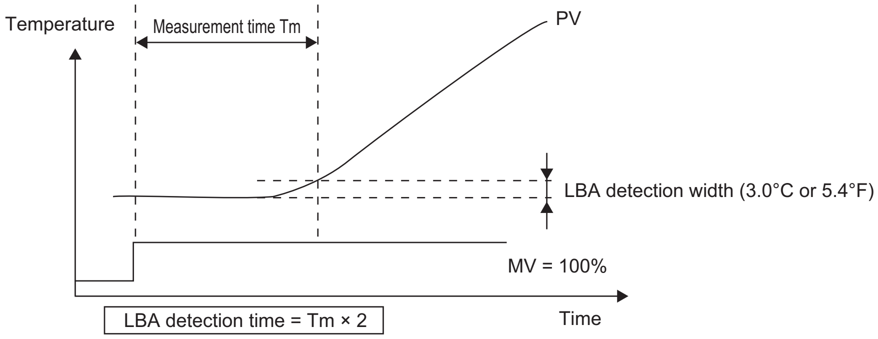
a) Method of making manual settings of the LBA detection time

Set a value that is twice the measured time (Tm) calculated by the method described below in “Ch□ Alarm Value 1” as the “LBA detection time”.

If the value exceeds the setting range of the LBA detection time, it is restricted by the setting range.

1 Maximize the output.

2 Measure the time period until the input change width reaches the LBA detection width.



3 Set a value that is twice the measured time as the "LBA detection time".

4 Set "LBA detection time" in "Ch□ Alarm Value 1" of I/O data.

The set LBA detection time is applied instantaneously.
The setting items of "Ch□ Alarm 1" are shown below.

For details on the Ch□ Alarm Value 1, refer to *A-3-3 Objects That Accept I/O Allocations* on page A-18.

If "1" or a higher value is set in "Ch□ Alarm Value 1", it is given priority over the value set automatically based on the AT results, and is applied in the LBA detection time of the Advanced Temperature Control Unit. If a value less than "1" is set in "Ch□ Alarm Value 1", the value set automatically based on the AT results is applied in the LBA detection time of the Advanced Temperature Control Unit. However, in the case of heating/cooling control type or ON/OFF control, the LBA detection time is applied in the operation of the Advanced Temperature Control Unit as "0: Disable function".

Additional Information

The LBA detection time is an unpublished parameter. To understand the LBA detection time when it is set automatically based on the AT results, perform the calculation by the calculation formula shown below. If the calculation result exceeds 9999 seconds, it is restricted to 9999 seconds. If the calculation result is "0", the function is disabled.

LBA detection time = 2 × Derivative time + 4800 × Derivative time / ((Maximum value of the output manipulated variable - Minimum value of the output manipulated variable) × Proportional band)

If the calculation result is "0", the function is disabled.

The maximum value or minimum value of the output manipulated variable implies the manipulated variable that is restricted by the MV limit and the Limiting Simultaneous Outputs function.

Calculation example 1) When the AT results that form the basis of the automatic setting are in the factory default state

- Conditions

Item	Description
Derivative Time	40.0 s
Proportional Band	8.00°C
MV Upper Limit	100%
MV Lower Limit	0%

- Calculation formula

  LBA detection time = 2 × 40 + 4800 × 40 / (100 × 8) = 320 seconds

Calculation example 2) When the AT results that form the basis of the automatic setting are in other than the factory default state

- Conditions

Item	Description
Derivative Time	10.0 s
Proportional Band	20.00°C
MV Upper Limit	80%
MV Lower Limit	20.00%

- Calculation formula

  LBA detection time = 2 × 10 + 4800 × 10 / ((80 - 20) × 20) = 60 seconds

● Timing of resetting the calculation of the LBA detection time

The timing of resetting of the calculation of the LBA detection time, and recalculation is described below.

- When the measured value moves out of the range from within the temperature range of the LBA detection threshold
- When the measured value is outside the range of the LBA detection threshold, and a value is set in “Ch□ Alarm Value 1” in the manual setting during the LBA operation.
- When the set value of the proportional band, derivative time, or MV limit is changed
- When the execution conditions are satisfied

● LBA detection threshold

The threshold for determining the temperature range in which LBA detection is not performed. Set point ± LBA detection threshold is the temperature range.

An area where LBA cannot be detected is provided so that if a large disturbance occurs right in the middle of setting the measured value as the set point, LBA is not detected erroneously due to the continuance of the state when the manipulated value is maximum or minimum for a fixed period as a result of the disturbance response.

The LBA detection threshold is an unpublished parameter. This data cannot be set and checked.

The LBA detection threshold is fixed as 8.0°C if the temperature unit is Celsius, and as 14.4°F if the temperature unit is Fahrenheit.

● LBA detection width

The temperature width for performing LBA detection.

Since the variation in the measured value is high due to control characteristics, the LBA operation becomes unstable. The LBA detection width is provided for correctly detecting changes in the manipulated variable. If the temperature variation is smaller than the LBA detection width at the time the LBA detection time elapses, it is considered to “Not change in the expected direction”, and the LBA turns ON.

The LBA detection width is an unpublished parameter. This data cannot be set and checked.

The LBA detection width is fixed as 3.0°C if the temperature unit is Celsius, and as 5.4°F if the temperature unit is Fahrenheit.

Restrictions

The following limits are applied when you use LBA.

Item	Details of limit
Restrictions concerning automatic settings based on AT results	If you are using LBA, check the operation thoroughly. If you are using the method for making automatic settings based on the AT results, some control loops may not be able to detect expected errors, while some control loops may detect unexpected states as an error. If the operations are not as expected, use the method of making manual settings. Moreover, after using the method for making automatic settings based on the AT results, you may not be able to detect expected errors, or may detect unexpected states as an error if the following setting values are changed. In such cases too, use the method of making manual settings. • Proportional Band • Derivative Time • MV Upper Limit • MV Lower Limit
Restrictions when another output is interfering	If another output is interfering and exerting an effect, such as when you are using the MV branch function, you may not be able to detect expected errors, or may detect unexpected states as an error.
Restrictions on disturbances	If unexpected excessively large disturbance occurs continuously in the Advanced Temperature Control Unit, and the large deviation does not reduce, LBA may be detected.
Restrictions concerning the set point	• If the set point is close to the ambient temperature, a deviation in a normal state may be within the LBA detection threshold even in the case of a burnout failure, and may not be detected. • If an excessively large or excessively small set point that cannot be reached even at the maximum or minimum manipulated variable is set, the control deviation in the normal state is retained and LBA may be detected.
Restrictions concerning the failure mode	• The failure mode in the temperature-rise direction during the temperature-rise control cannot be detected. Example: SSR short-circuit failure • The failure in the temperature-drop direction during the temperature-drop control cannot be detected. Example: Heater burnout failure

Target NX Units

All Advanced Temperature Control Units

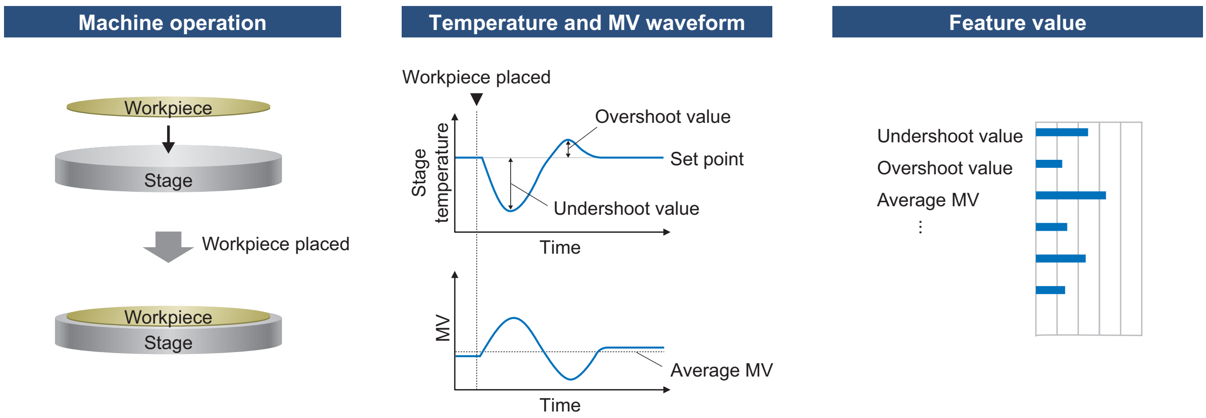
7-8 Feature Visualization

7-8-1 Overview

The feature visualization function enables the automatic calculation of temperature and other measured values, as well as the waveform characteristics of the manipulated variables. The waveform characteristics include variables, such as overshoot value, undershoot value, and average MV. In this manual, these waveform characteristics are referred to as features (feature values).

If any changes are observed in temperature or MV waveform during control, the changes will be reflected in the feature value as well. By comparing the feature values with those under normal conditions, abnormalities can be detected at an early stage.

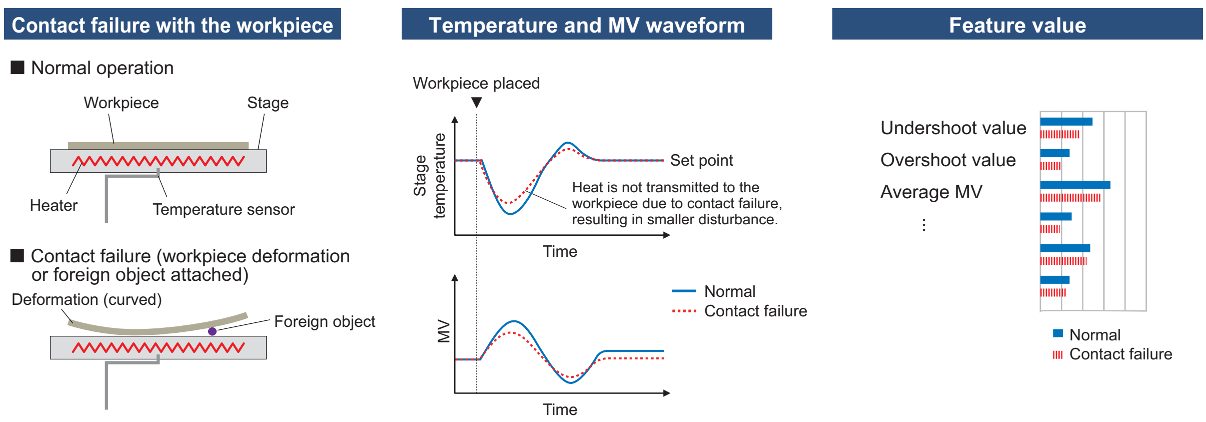
For example, when a workpiece is placed on the stage, the following changes are observed with the temperature and MV waveform, expressed by the undershoot and overshoot values as the feature values.



7-8-2 Examples of Contact Failure between Stage and Workpiece

This is an example of feature values derived from the temperature and MV waveform in a situation where a foreign object is attached to the stage causing contact failure with the workpiece.

The Advanced Temperature Control Unit can detect contact failure by capturing feature values such as the undershoot value and overshoot value during changes from the normal conditions.



7-8-3 Details on the Function

Monitored Features

The following describes the feature values that can be monitored by the feature visualization function.

The feature values are calculated during the following two conditions: Measuring Waveform Status and MV Stable Control Status.

● Feature values calculated during waveform measurement

The Measuring Waveform Status refers to a state from the start to the end of the waveform measurement.

For the procedure on how to start and stop waveform measurement, refer to *7-8-4 Waveform Measurement Method* on page 7-105.

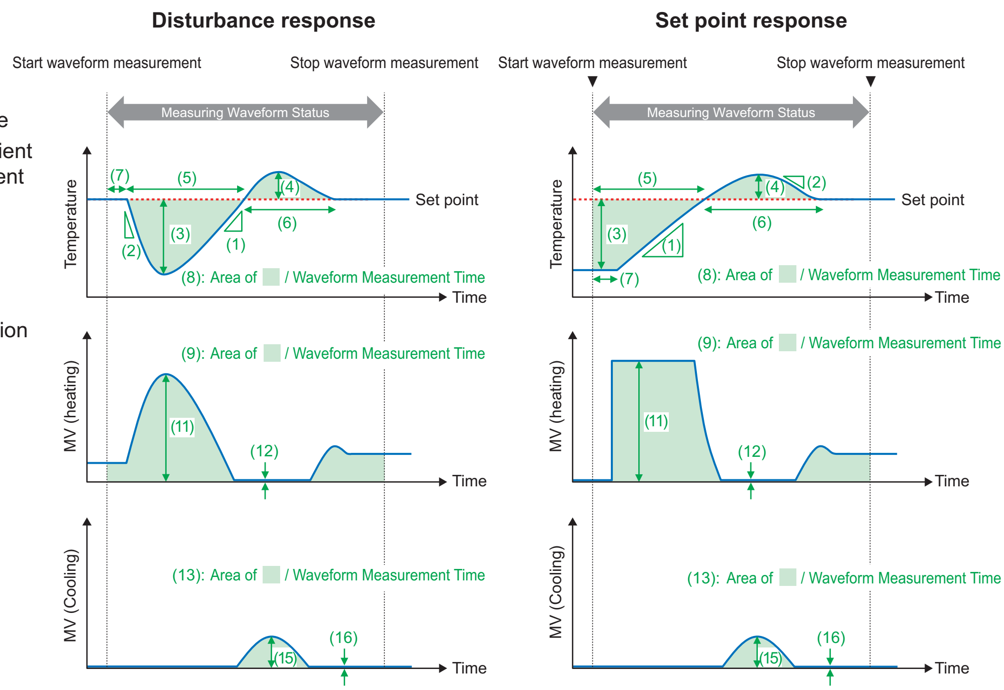
Feature values calculated during waveform measurement are as follows:

■ Feature values of temperature

(1) Max.Temperature Rise Gradient
(2) Max.Temperature Fall Gradient
(3) Undershoot Value
(4) Overshoot Value
(5) Undershoot Time
(6) Overshoot Time
(7) Time Delay
(8) Average Temperature Deviation

■ Feature values of MV

(9) Average MV Heating
(11) Max.MV Heating
(12) Min.MV Heating
(13) Average MV Cooling
(15) Max.MV Cooling
(16) Min.MV Cooling



● Feature value calculated for MV Stable Control Status

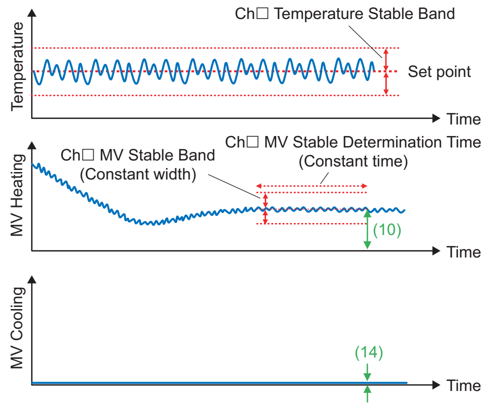
MV Stable Control Status refers to a state where the MV remains within a certain range for a specified time while the temperature is being stabilized.

For details on the conditions to determine the MV Stable Control Status, refer to *7-8-5 Stability Determination Method* on page 7-110.

The feature values calculated during waveform measurement are classified into the two types:

The Ch☐ Stable MV Heating and the Ch☐ Stable MV Cooling.

■ Feature values of MV
(10) Stable MV Heating
(14) Stable MV Heating



Additional Information

Since the Measuring Waveform Status and the MV Stable Control Status function independently, they may be present simultaneously.

● Execution condition

This function can be executed when the Advanced Temperature Control Unit operates under the following conditions.
The function cannot be executed if any of the conditions is not satisfied.

Operating condition	Settings and status to check the operating condition
No load rejection occurred	TS indicator lights green on Advanced Temperature Control Unit.
Measured value is within the input indication range	Refer to *7-3-1 Input Type Settings* on page 7-11 for information on the input indication range of each input type.

Monitored Features

The Advanced Temperature Control Unit can monitor feature values using the following setting parameters.

Feature Value Monitor			Calculation Timing
Classification	Data name	Description	
Feature Value Monitor (Temperature)	Max.Temperature Rise Gradient	Maximum slope of the temperature rise	Measuring Waveform Status
	Max.Temperature Fall Gradient	Maximum slope of the temperature fall	Measuring Waveform Status
	Undershoot Value	The lowest value of temperature below the set point (Maximum value of SP minus PV)	Measuring Waveform Status
	Overshoot Value	The highest value of temperature above the set point (Maximum value of PV minus SP)	Measuring Waveform Status
	Undershoot Time	Duration of undershoot state (Cumulative time of the state where SP minus Temperature Stable Band*1 is greater than PV)	Measuring Waveform Status
	Overshoot Time	Duration of overshoot state (Cumulative time of the state where SP plus Temperature Stable Band*1 is less than PV)	Measuring Waveform Status
	Time Delay	Duration since the start of waveform measurement until the temperature changes (PV at the start of waveform measurement±Time when the value falls outside the Stable Band (*1))	Measuring Waveform Status
	Average Temperature Deviation	Mean absolute value of temperature deviation (SP minus PV)	Measuring Waveform Status
Feature Value Monitor (MV)	Average MV Heating	Average value of MV (heating)	Measuring Waveform Status
	Stable MV Heating	MV during MV Stable Control (heating)	MV Stable Control Status
	Max.MV Heating	Maximum value of MV (heating)	Measuring Waveform Status
	Min.MV Heating	Minimum value of MV (heating)	Measuring Waveform Status
	Average MV Cooling	Average value of MV (cooling)	Measuring Waveform Status
	Stable MV Cooling	MV during MV Stable Control (cooling)	MV Stable Control Status
	Max.MV Cooling	Maximum value of MV (cooling)	Measuring Waveform Status
	Min.MV Cooling	Minimum value of MV (cooling)	Measuring Waveform Status

*1. It refers to the setting parameter of the Ch□ Temperature Stable Band.

7-8-4 Waveform Measurement Method

This section describes the procedure for measuring control waveforms to monitor feature values. The following three types are available.

(1) Starting and Stopping Waveform Measurement by Operation Command

● Starting Waveform Measurement

1. Change the Ch☐ Start Waveform Measurement bit of the Ch☐ Operation Command from FALSE to TRUE: Start Waveform Measurement.

   The waveform measurement starts.

   Once the waveform measurement has started, the Ch☐ Measuring Waveform Status bit of the Ch☐ Operating Status parameter is changed to TRUE: Waveform Measurement in Progress.

● Stopping Waveform Measurement

1. Change the Ch☐ Stop Waveform Measurement bit of the Ch☐ Operation Command from FALSE to TRUE: Stop Waveform Measurement.

   The waveform measurement stops.

   Once the waveform measurement has stopped, the Ch☐ Measuring Waveform Status bit of the Ch☐ Operating Status parameter is changed to FALSE: Waveform Measurement Not in Progress.

● Settings

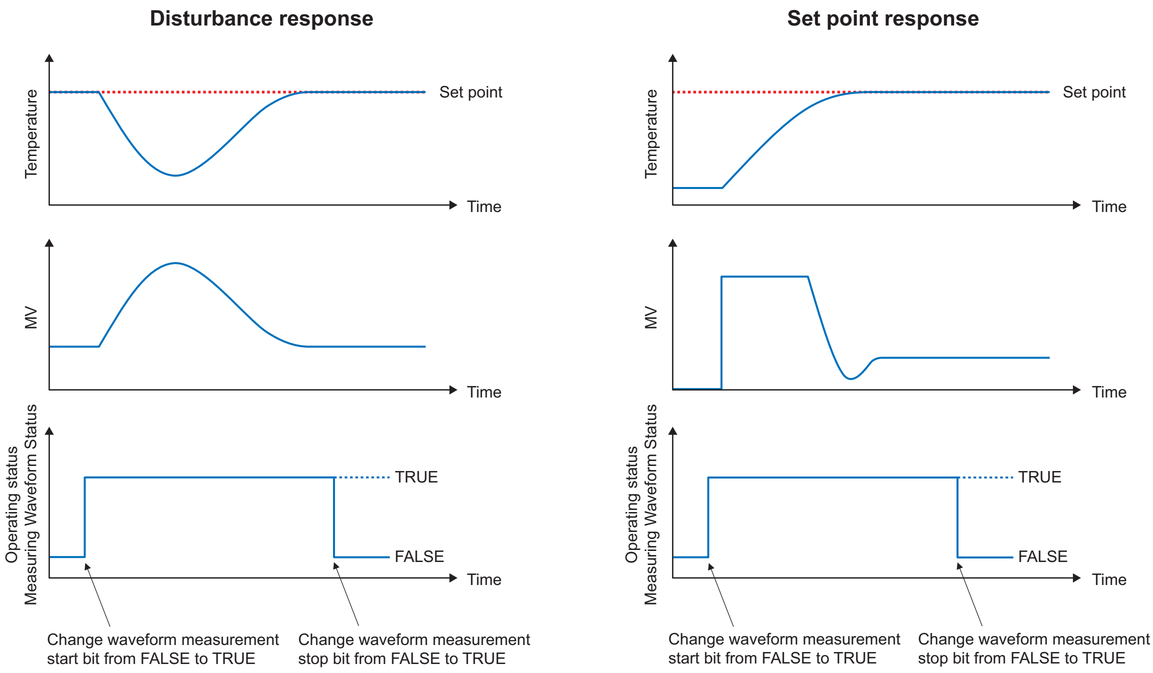
Ch☐ Operating Status (Index: 6001 hex)

Bit	Data name	Function	Data type	I/O port name
12	Ch☐ Measuring Waveform Status	FALSE: Measurement not in progress TRUE: Measurement in progress	BOOL	Ch☐ Measuring Waveform Status

Ch☐ Operation Command (Index: 7000 hex)

Bit	Data name	Function	Data type	I/O port name
12	Ch☐ Start Waveform Measurement	FALSE to TRUE: Start Waveform Measurement	BOOL	Ch☐ Start Waveform Measurement
13	Ch☐ Stop Waveform Measurement	FALSE to TRUE: Stop Waveform Measurement	BOOL	Ch☐ Stop Waveform Measurement

● **Operation Examples**



(2) Stopping the Started Waveform Measurement by Elapsed Time

● **Starting Waveform Measurement**

1 Set the Ch☐ Waveform Measurement Time to a value other than the default (0: Disabled).

2 Change the Start Waveform Measurement bit of the Ch☐ Operation Command to TRUE: Start Waveform Measurement.

The waveform measurement starts.

● **Stopping Waveform Measurement**

1 Once the waveform measurement has started and the Ch☐ Waveform Measurement Time has elapsed, stop the waveform measurement.

● **Disable the Function**

1 Set the value of the Ch☐ Waveform Measurement Time to other than 0: Disabled.

This setting can disable the stopping of waveform measurement based on the passage of time.

● **Settings**

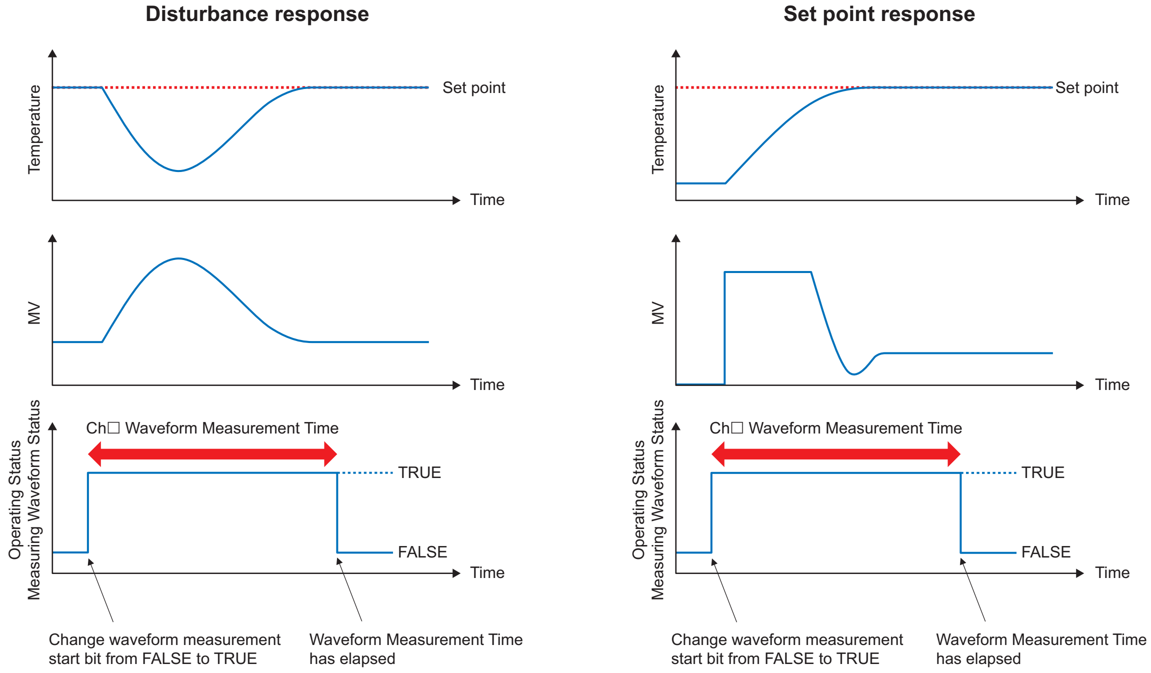
Setting Parameter (Index: 5011 hex)

Data name	Setting range	Unit	Default	Data type	Update timing
Ch☐ Waveform Measurement Time	0 to 65000	Seconds	0: Disable	UINT	Immediately

Ch☐ Operation Command (Index: 7000 hex)

Bit	Data name	Function	Data type	I/O port name
12	Ch☐ Start Waveform Measurement	FALSE to TRUE: Start Waveform Measurement	BOOL	Ch☐ Start Waveform Measurement

Operation Examples



(3) Stopping the Started Waveform Measurement by Temperature Stable Control

Once the waveform measurement has started and the waveform remained for the duration of the Ch□ Temperature Stable Determination Time, the waveform measurement will be stopped.

However, if the waveform remains within the Ch□ Temperature Stable Band at the start of waveform measurement, the Temperature Stable Control will not be determined until the waveform falls outside the range.

Starting Waveform Measurement

1. Set the feature visualization parameter of the Ch□ Temperature Stable Band.
2. Change the Ch□ Waveform Measurement Stop parameter (Temperature Stable Control) to TRUE: Enabled.
3. Change the Start Waveform Measurement bit of the Ch□ Operation Command to TRUE.

   The waveform measurement will start.

Stopping Waveform Measurement

1. When the control waveform falls outside the range of the Ch☐ Temperature Stable Band and then the control waveform enters and remains within the Ch☐ Temperature Stable Band for the duration of the Ch☐ Temperature Stable Determination Time, the waveform measurement will be stopped.

To Disable the Function

1. Set the Ch☐ Stop Waveform Measurement (Temperature Stable Control) to FALSE.

   This setting can disable the stopping of waveform measurement triggered by the temperature control.

Settings

Ch☐ Setting Parameters (Index: 5011 hex) (Unit operation settings)

Data name	Setting range	Unit	Default	Data type	Update Timing
Ch☐ Temperature Stable Band	0 to 32000	EU	10	UINT	Immediately
Ch☐ Temperature Stable Determination Time	0 to 9999	Seconds	10	UINT	Immediately
Ch☐ Waveform Measurement Stop (Temperature Stable Control)	FALSE: Disabled TRUE: Enabled	---	FALSE: Disabled	BOOL	Immediately

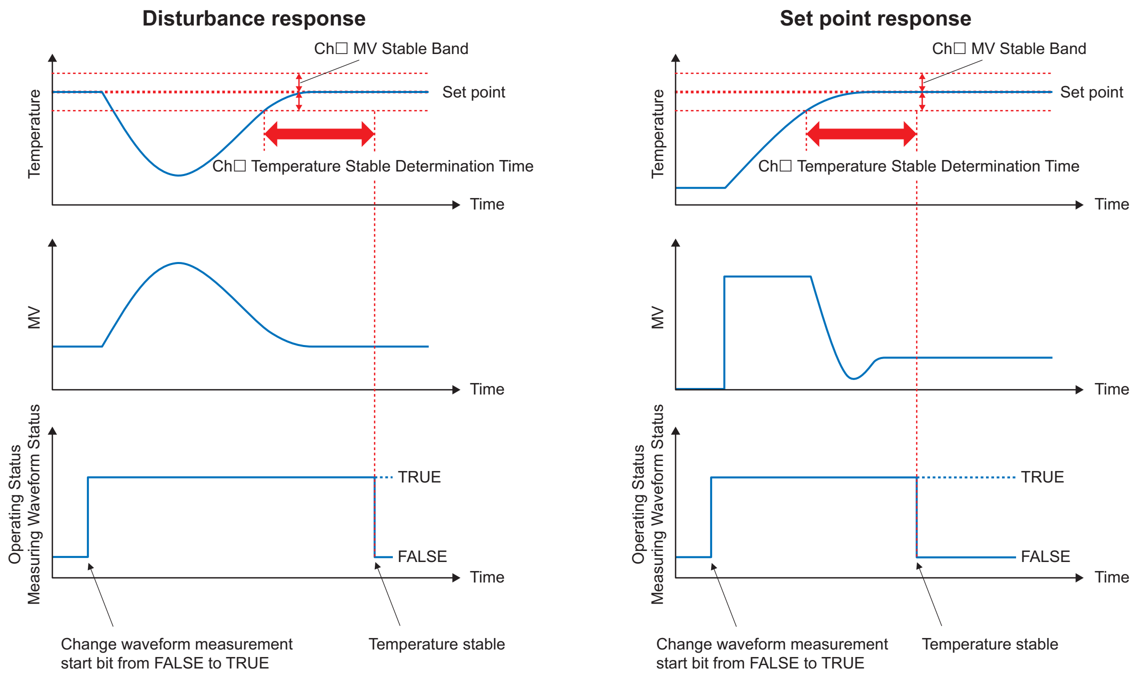
Ch☐ Operating Status (Index: 6001 hex)

Data name	Setting range	Data type
Ch☐ Within Temperature Stable Band	FALSE: Control Disabled TRUE: Control Enabled	BOOL
Ch☐ Temperature Stable Control Status	FALSE: Stable control disabled TRUE: Stable control enabled	BOOL

Ch☐ Operation Command (Index: 7000 hex)

Bit	Data name	Function	Data type	I/O port name
12	Ch☐ Start Waveform Measurement	FALSE to TRUE: Start Waveform Measurement	BOOL	Ch☐ Start Waveform Measurement

● Operation Examples



Additional Information

Once the waveform measurement has started, the setting parameter value is set to zero-cleared.
(It excludes the cases of the Ch☐ Stable MV Heating and the Ch☐ Stable MV Cooling.)
Then, the feature value calculation starts and the setting parameters are updated.

When the waveform measurement stops, the setting parameter stores the value that is updated immediately before the measurement stopped.

If the waveform measurement result exceeds the monitored range, the value will be clamped to the upper limit of the monitored range.

When any of the following conditions are satisfied after the waveform measurement has started, the waveform measurement will be stopped forcibly:

- 65,000 seconds (approx. 18 hours) have elapsed since the waveform measurement started;
- The execution conditions are no longer satisfied.

7-8-5 Stability Determination Method

This section describes the procedure for determining if the temperature or MV stable control is being enabled based on the measured waveforms.

This section describes the procedure for determining if the temperature or MV stable control is being enabled based on the measured waveforms.

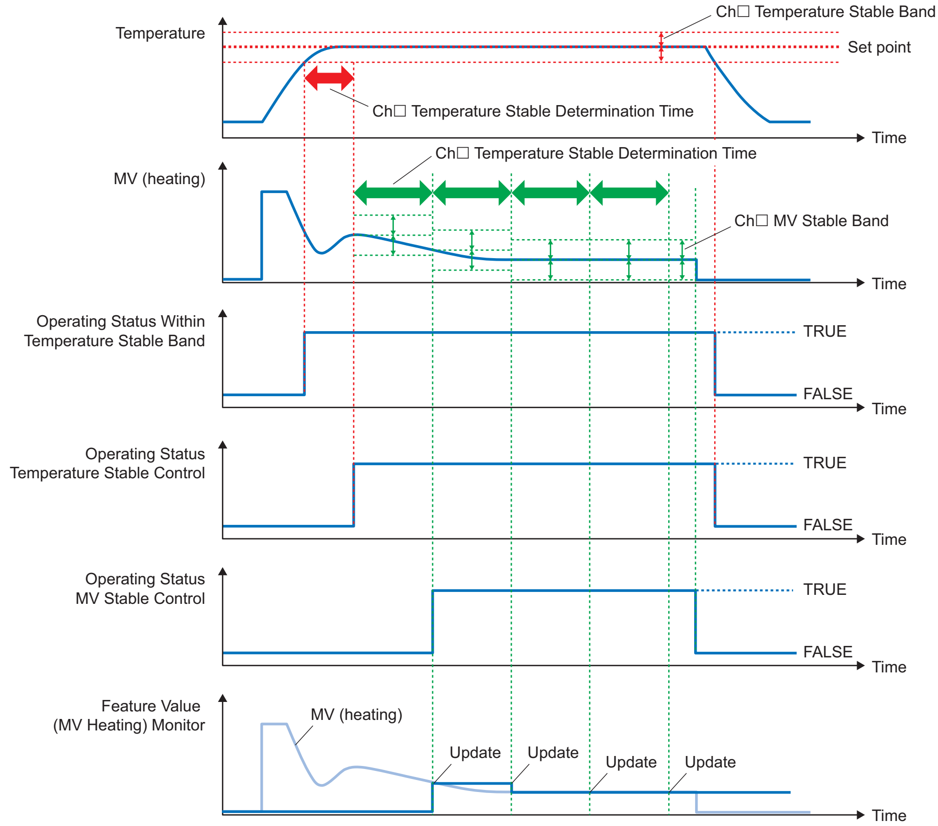
Parameters Updated by Stability Determination	Data name
Ch☐ Operating Status	Ch☐ Temperature Stable Control bit
	Ch☐ MV Stable Control bit
Ch☐ Feature Value Monitor	Ch☐ Stable MV Heating
	Ch☐ Stable MV Cooling

How the Stability Determination Works

(1) When the measured value becomes within the temperature control band (SP± Ch☐ Temperature Stable Band), the Within Temperature Stable Band bit of the Ch☐ Operating Status parameter is changed to TRUE. Under that state, when the determination time (Ch☐ Temperature Stable Determination Time) has elapsed, the Temperature Stable Control Status bit of the Ch☐ Operating Status parameter is changed to TRUE: Stable Control Enabled.

(2) The temperature settling bit is TRUE: Settling judgment of the manipulated variable starts when settling is in progress. If the manipulated variable (MV) stays in the settling band of the manipulated variable for the judgment time (the Ch☐ manipulated variable settling judgment time), the manipulated variable settling bit of the Ch☐ Operating Status parameter is changed to TRUE: Settling, and the Ch☐ Settling MV heating and Ch settling MV cooling are updated. The manipulated variable settling band means the range of ±Ch☐ manipulated variable settling width based on the manipulated variable at the time when the temperature setting bit is changed to TRUE.

(3) When the Temperature Stable Control Status bit is changed to TRUE: Stable Control Enabled, the MV stability determination starts. When the manipulated variable (MV) remains within the MV stable band for the duration of the Ch☐ MV Stable Determination Time, the MV Stable Control Status bit of the Ch☐ Operating Status parameter is changed to TRUE: Stable Control Enabled, and the Ch☐ Stable MV Heating and the Ch☐ Stable MV Cooling will be updated. The MV stable band means that the MV is within a range of ±Ch☐ MV Stable Band from the MV



● Settings

Ch□ Setting Parameters (Index: 5011 hex) (Unit Operation Settings)

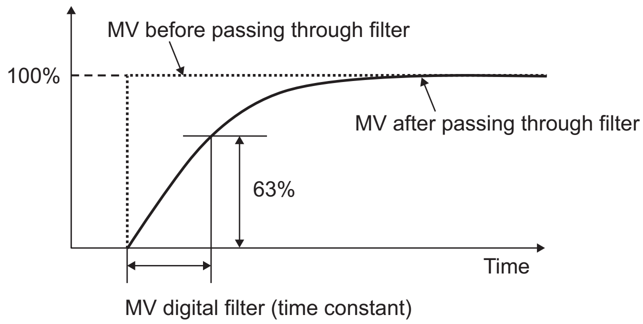
Data name	Setting range	Unit	Default	Data type	Update timing
Ch□ Temperature Stable Band	0: Disable 1 to 32000	EU	10	UINT	Immediately
Ch□ Temperature Stable Determina-tion Time	0: Disable 1 to 9999	Seconds	10	UINT	Immediately
Ch□ MV Stable Band	1 to 999	0.1%	100	UINT	Immediately
Ch□ MV Stable Determination Time	0: Disable 1 to 9999	Seconds	10	UINT	Immediately

Ch□ Operating Status (Index: 6001 hex)

Data name	Setting range	Data type
Ch□ Within Temperature Stable Band Status	FALSE: Not within the stable band TRUE: Within the stable band	BOOL
Ch□ Temperature Stable Control Status	FALSE: Stable control disabled TRUE: Stable control enabled	BOOL
Ch□ MV Stable Control Status	FALSE: Stable control disabled TRUE: Stable control enabled	BOOL

7-8-6 How to Minimize the MV Variations (MV Digital Filter)

- In some cases, the MV may fluctuate depending on the operating environment or conditions of the Advanced Temperature Control Units. Using the MV digital filter allows you to calculate setting parameters for stabilized manipulated variables.
- It applies a first-order lag filter to the MV being output by the Unit.
- The MV digital filter is exclusively used by the feature visualization function. It does not affect manipulated variables used for controls.
- The figure below shows the filtered MV.



● Settings

Ch☐ Setting Parameters (Index: 5011 hex) (Unit Operation Settings)

Data name	Setting range	Unit	Default	Data type	Update timing
Ch☐ MV Digital Filter	0: Disable 1 to 9999	0.1 s	0	UINT	Immediately

Ch☐ Operation Command (Index: 7000 hex)

Bit	Setting name	Function	Data type	I/O port name
14	Fixed SP for Waveform Measurement	FALSE: Based on the set point TRUE: Based on the set point when waveform measurement starts	BOOL	Ch☐ Fixed SP for Waveform Measurement

Target NX Units

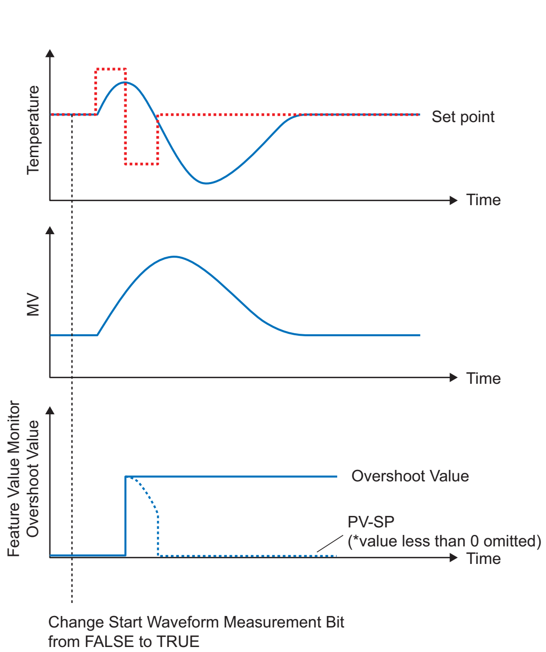
All the Advanced Temperature Control Units

7-8-7 How to Fix the Set Point (SP) Used for Feature Calculations and Status Judgment during Waveform Measurement (Fixed SP for Waveform Measurement)

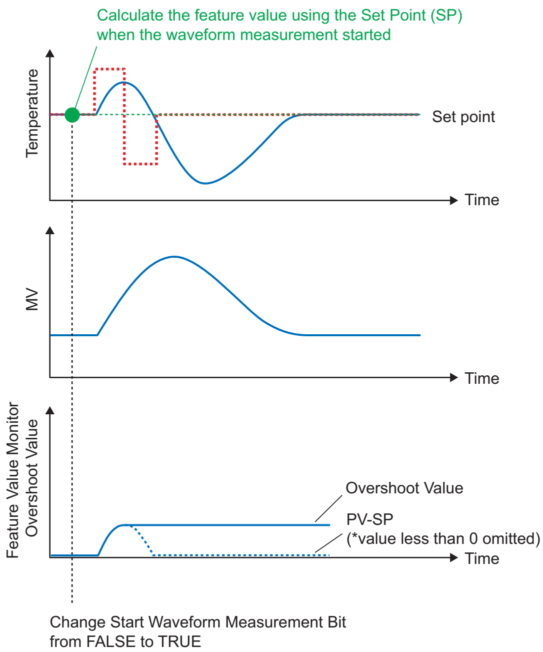
This method is used to suppress the temperature fluctuations during a workpiece input and when the set point is changed while waveform measurement is in progress.

- When “Operation Command-Fixed SP for Waveform Measurement” is FALSE, the set point changed by a user is used for feature value calculation.
- When “Operation Command-Fixed SP for Waveform Measurement” is TRUE, the set point when the waveform measurement was started (“Operation Command-Waveform Measurement Start” was changed from FALSE to TRUE) is used for feature value calculation. In this case, even if the set point is changed during waveform measurement, the set point when the waveform measurement was started will still be used for feature value calculation.
- This operation command affects only the following setting parameters that use a set point for feature value calculation.
- Undershoot value, overshoot value, undershoot time, overshoot time, average temperature deviation
- Even when “Operation Command-Fixed SP for Waveform Measurement” is changed while “Operating Status-Waveform Measurement” is TRUE, the change will not be reflected in the operation.

Fixed SP for Waveform Measurement is FALSE



Fixed SP for Waveform Measurement is TRUE



● Settings

Ch☐ Operation Command (Index: 7000 hex)

Bit	Setting name	Function	Data type	I/O port name
14	Fixed SP for Waveform Measurement	FALSE: Based on the set point TRUE: Based on the set point when waveform measurement starts	BOOL	Ch☐ Fixed SP for Waveform Measurement

7-8-8 Parameters Related to Feature Visualization

Operation Commands

Data name	Function	Data type	I/O port name
Ch☐ Start Waveform Measurement	FALSE to TRUE: START	BOOL	Ch☐ Start Waveform Measurement
Ch☐ Stop Waveform Measurement	FALSE to TRUE: STOP	BOOL	Ch☐ Stop Waveform Measurement
Ch☐ Fixed SP for Waveform Measurement	FALSE: Based on the set point TRUE: Based on the set point when waveform measurement starts	BOOL	Ch☐ Fixed SP for Waveform Measurement

Operating Status

Data name	Setting range	Data type
Ch☐ Measuring Waveform Status	FALSE: Waveform Measurement Not in Progress TRUE: Waveform Measurement in Progress	BOOL
Ch☐ Within Temperature Stable Band Status	FALSE: PV is outside the SP±Stable Band TRUE: PV is within SP±Stable Band	BOOL
Ch☐ Temperature Stable Control Status	FALSE: Stable Control Disabled TRUE: Control Enabled	BOOL
Ch☐ MV Stable Control Status	FALSE: Stable Control Disabled TRUE: Control Enabled	BOOL

Feature Value Monitor

Data name	Setting/monitoring range	Unit	Data type	Default
Max.Temperature Rise Gradient	0 to 65000	Temperature input: 0.01°C/seconds or 0.01°F/seconds Analog input: EU/seconds	UINT	0
Max.Temperature Fall Gradient				
Undershoot Value	0 to 65000	EU		
Overshoot Value				
Undershoot Time	0 to 65000	0.1 s		
Overshoot Time				
Time-Delay	0 to 9999	0.1 s		
Average Temperature Deviation	0 to 65000	EU		
Average MV Heating	Standard control: -50 to 1050 Heating and cooling control: 0 to 1050	0.1 %	INT	
Stable MV Heating				
Max.MV Heating				
Min.MV Heating				
Average MV Cooling	0 to 1050			
Stable MV Cooling				
Max.MV Cooling				
Min.MV Cooling				

Setting Parameters

Data name	Setting/monitoring range	Unit	Data type	Default
Waveform Measurement Time	0: Disable 1 to 65000	Seconds	UINT	0: Disable
Waveform Measurement Stop (Temperature Stable Control)	FALSE: Disabled TRUE: Enabled	---	BOOL	FALSE: Disabled
Temperature Stable Band	0: Disable 1 to 32000	EU	UINT	10
Temperature Stable Determination Time	0: Disable 1 to 9999	Seconds	UINT	10
MV Stable Band	1 to 999	0.1 %	UINT	100 (10.0%)
MV Stable Determination Time	0: Disable 1 to 9999	Seconds	UINT	10
MV Digital Filter	0: Disable 1 to 9999	0.1 s	UINT	0: Disable

Setting Method

The setting method with Sysmac Studio is given below.

Even if you use other Support Software than the Sysmac Studio, set the parameters given in the procedure on the Unit operation setting interface and transfer them to the NX Units.

Refer to the operation manual for your Support Software (other than Sysmac Studio) for information on how to display the Unit operation setting interface and how to transfer settings to the NX Units.

1 Display the Edit Unit Operation Settings Tab Page.

For the display methods, refer to *A-8 Displaying the Edit Unit Operation Settings Tab Page* on page A-74.

2 Select True (Enable) or False (Disable) from the [Enable/Disable] pull-down list of channels (Ch□) to be specified.

Refer to *A-9 Edit Unit Operation Settings Tab Page* on page A-77 for details on the Edit Pane of the Unit operation settings.

3 Click the **Transfer to Unit** Button.

The settings are transferred from the Sysmac Studio to the NX Unit.

The settings are applied after the Unit is restarted.

Precautions for Safe Use

After using the Support Software to change Unit Operation Setting parameters that are applied when the Unit is restarted and transferring them to the Unit, the Unit is restarted after the transfer is completed. Always ensure safety of the connected devices before transferring the Unit operation settings.

8

Troubleshooting

This section describes how to check and troubleshoot errors that occur during use of the Advanced Temperature Control Units.

8-1 How to Check for Errors

Use one of the following error checking methods.

- Checking the indicators
- Troubleshooting with the Support Software

Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for information on checking errors with the troubleshooting functions of the Support Software.

8-2 Checking for Errors with the Indicators

You can use the TS indicators on the Advanced Temperature Control Units to check the Advanced Temperature Control Unit status and level of errors.

Here, the possible errors shown by the TS indicator and their troubleshooting tips are described below.

The status of the indicator is indicated by the following abbreviations.

Abbreviation	Indicator status
Lit	Lighting up
Not Lit	Not lighting up
FS ( )	Flashing. The numeric value in parentheses is the flashing interval.
---	Undefined

Main Errors and Corrections

TS indicator		Cause	Correction
Green	Red		
Lit	Not Lit	---	--- (This is the normal status.)
FS (2 s)	Not Lit	• Initializing • Downloading	--- (Normal. Wait until the processing is completed.)
Lit	Lit	This status is not present.	
Not Lit	Not Lit	The Unit power supply is not supplied.	Check the following items and supply the Unit power supply correctly. [Check items for power supply] • Make sure that the power supply cable is wired correctly. • Make sure that the power supply cable is not disconnected. • Make sure that power supply voltage is within the specified range. • Make sure that the power supply has enough capacity. • Make sure that power supply has not failed.
		• Waiting for initialization start • Restarting	--- (Normal. Wait until the processing is completed.)
		If you cannot resolve the problem after you check the above items and cycle the Slave Terminal power supply, the Unit may have a hardware failure. If this happens, replace the Unit.	
Not Lit	Lit	Hardware failure	If this error occurs after you cycle the Slave terminal power supply, replace the Unit.
Not Lit	Lit	Non-volatile Memory Hardware Error	Refer to Event *Non-volatile Memory Hardware Error* on page 8-14.
Not Lit	Lit	Unit Calibration Value Error	Refer to Event *Unit Calibration Value Error* on page 8-17.
Not Lit	Lit	Control Parameter Error in Unit	Refer to Event *Control Parameter Error in Unit* on page 8-18.
Not Lit	FS (1 s)	I/O Entries Exceeded	Refer to Event *I/O Entries Exceeded* on page 8-19.

TS indicator		Cause	Correction
Green	Red		
Not Lit	Lit	NX Unit Processing Error	Refer to Event *NX Unit Processing Error* on page 8-20.
Not Lit	Lit	A/D Converter Error	Refer to Event *A/D Converter Error* on page 8-15.
Not Lit	Lit	NX Unit Clock Not Synchronized Error	Refer to Event *NX Unit Clock Not Synchronized Error* on page 8-11.
Not Lit	FS (1 s)	NX Unit I/O Communications Error	Refer to Event *NX Unit I/O Communications Error* on page 8-25.
The indicator status is held immediately before the event occurred.		Cold Junction Sensor Error	Refer to Event *Cold Junction Sensor Error* on page 8-16.
		Sensor Disconnected Error	Refer to Event *Sensor Disconnected Error* on page 8-21.
		Heater Burnout Detected	Refer to Event *Heater Burnout Detected* on page 8-22.
		SSR Failure Detected	Refer to Event *SSR Failure Detected* on page 8-23.
		Alarm Detected	Refer to Event *Alarm Detected* on page 8-24.
		NX Message Communications Error	Refer to Event *NX Message Communications Error* on page 8-28.

8-3 Checking for Errors and Troubleshooting Using the Support Software

The error management in the NX Series is based on the methods used for the NJ/NX/NY-series Controllers.

This allows you to use the Support Software in order to check the details on errors and their troubleshooting tips.

The error checking method varies depending on the Support Software.

8-3-1 Checking for Errors with the Sysmac Studio

When an error occurs, you can place the Sysmac Studio online to the Controller or the Communications Coupler Unit to check current Controller errors and the log of past Controller errors.

Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for details on how to check errors.

Current Errors

Open the Controller Errors Tab Page in the Sysmac Studio to check the following information displayed for current errors: Level, Source, Source Details, Event Name, Event Codes, Details, Attached Information 1 to 4, and Action and Correction.

Observations and information events cannot be displayed on this tab page.

Additional Information

Number of Current Errors

Up to 15 errors can be reported simultaneously as the current errors in the Advanced Temperature Control Units.

If the number of errors exceeds the maximum number of reportable current errors, errors are reported with a priority given to the oldest and highest-level errors. Errors that exceed the limit on simultaneous error notifications are not reported.

Errors that are not reported are still reflected in the error status.

Log of Past Errors

Open the Controller Event Log Tab Page in the Sysmac Studio to check the following information displayed for past errors: Time, Level, Source, Source Details, Event Name, Event Code, Details, Attached Information 1 to 4, and Action and Correction.

Additional Information

Number of Logs of Past Errors

The event logs of the Advanced Temperature Control Units are stored in their own memory.
The system event log can record 15 events. The access event log can record 6 events.

Refer to the troubleshooting manual for the connected CPU Unit or Industrial PC and the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on the items that you can check and how to check errors.
Refer to *8-3-3 Event Codes* on page 8-7 for details on event codes.

8-3-2 Checking for Errors with the Support Software Other Than the Sysmac Studio

You can check the error descriptions and logs with the Support Software other than the Sysmac Studio.
For information on how to check errors, refer to the user's manual for the connected Communications Coupler Unit and the operation manual for the Support Software.
Refer to *8-3-3 Event Codes* on page 8-7 for information on event codes.

The number of current errors and the number of event logs for past errors in the Advanced Temperature Control Units are the same as those using the Sysmac Studio.

8-3-3 Event Codes

The errors (i.e., events) that can occur in the Advanced Temperature Control Units are given on the following pages.

The following abbreviations are used in the event level column.

Abbreviation	Name
Maj	Major fault level
Prt	Partial fault level
Min	Minor fault level
Obs	Observation
Info	Information

Symbol	Meaning
S	Event levels that are defined by the system.
U	Event levels that can be changed by the user. *1

*1. This symbol appears only for events for which the user can change the event level.

Refer to the troubleshooting manual for the connected CPU Unit or Industrial PC for information on NJ/NX/NY-series event codes.

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
00200000 hex	Non-volatile Memory Hardware Error	An error occurred in non-volatile memory.	• Non-volatile memory failure.			S			P. 8-14
05100000 hex	A/D Converter Error	An error occurred in the A/D converter	• Noise • A/D converter failure			S			P. 8-15
05110000 hex	Cold Junction Sensor Error	The temperature cannot be converted because a disconnection from the cold junction sensor is detected.	• There is a faulty connection to the cold junction sensor. • The cold junction sensor failed.			S	U		P. 8-16
10440000 hex	Unit Calibration Value Error	An error occurred in the area where unit calibration values are saved.	• An error in the area of non-volatile memory where unit calibration values are saved.			S			P. 8-17
104A0000 hex	Control Parameter Error in Unit	An error occurred in the control parameters that are saved in the Unit.	For NX-CPU Units • The CPU Unit was turned OFF while writing the Unit operation settings or the parameters with Unit functions was in progress. For Communications Coupler Units • The Communications Coupler Unit was turned OFF while writing the Unit operation settings or the parameters with Unit functions was in progress. Common to all (not only for NX bus master) • An error in the area where the Unit operation settings are saved.			S			P. 8-18
39350000 Hex	I/O Entries Exceeded	The total number of entries assigned to the I/O data set exceeds 247.	• The total number of entries assigned to the I/O data set exceeds 247, the maximum number of entries that can be stored in the NX bus.			S			P. 8-19
40200000 hex	NX Unit Processing Error	A fatal error occurred in an NX Unit.	• An error occurred in the software.			S			P. 8-20

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
65100000 hex	Sensor Disconnected Error	A disconnected temperature sensor was detected.	• The temperature sensor is damaged or the wires are broken. • An unused channel is not disabled. • The wiring of the temperature sensor is incorrect. • The input type is not set correctly when this error occurs in the Temperature Control Unit. • The measured value exceeds the input indication range when this error occurs in the Temperature Control Unit. • The PV Input Shift or the PV Input Slope Coefficient is not set correctly when this error occurs in the Temperature Control Unit.			S	U		P. 8-21
652C0000 hex	Heater Burnout Detected	A heater burnout was detected.	• A heater was burned out or damaged. • The setting of the Heater Burnout Detection Current is too high. • A CT input that is not used is allocated to a control output in the CT Allocation setting when this error occurs in the Heater Burnout Detection Unit. • An unused channel is not disabled when this error occurs in the Temperature Control Unit.			S	U		P. 8-22
652D0000 hex	SSR Failure Detected	An SSR failure was detected.	• The SSR was short-circuited or damaged. • The setting of the SSR Failure Detection Current is too small. • A CT input that is not used is allocated to a control output in the CT Allocation setting when this error occurs in the Heater Burnout Detection Unit. • An unused channel is not disabled when this error occurs in the Temperature Control Unit.			S	U		P. 8-23

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
652E0000 hex	Alarm Detected	The alarm set for the alarm type was detected.	An alarm was detected, which was set to output in the following cases according to the alarm type: • if a measured value deviates for the amount specified by the alarm upper limit and/or alarm lower limit, or • if a measured value is greater or smaller than the specified alarm value. The following values that are set according to the alarm type do not conform to the alarm that is to be detected. • Alarm value • Alarm upper limit and alarm lower limit			S	U		P. 8-24

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
8020 0000 hex	NX Unit I/O Communications Error	An I/O communications error occurred in an NX Unit.	For the NX bus of CPU Units • An error that prevents normal NX bus communications occurred in a CPU Unit. • An NX Unit is not mounted properly. • The power cable for the Unit power supply is disconnected, or the wiring from the Unit power supply to the NX Units is incorrect. • The power cable for the Unit power supply is broken. • The voltage of the Unit power supply is outside the specified range, or the capacity of the Unit power supply is insufficient. • There is a hardware error in an NX Unit. For Communications Coupler Units • An error that prevents normal NX bus communications occurred in a Communications Coupler Unit. • The NX Unit is not mounted properly. • The power cable for the Unit power supply is disconnected. Or, the wiring from the Unit power supply to the NX Units is incorrect. • The power cable for the Unit power supply is broken. • The voltage of the Unit power supply is outside the specified range. Or, the capacity of the Unit power supply is insufficient. • There is a hardware error in the NX Unit.			S			P. 8-25
8024 0000 hex	NX Unit Clock Not Synchronized Error	A time information error occurred in an NX Unit.	For the NX bus of CPU Units • There is a hardware error in an NX Unit. • There is a hardware error in a CPU Unit. For Communications Coupler Units • There is a hardware error in an NX Unit. • There is a hardware error in an EtherCAT Coupler Unit.			S			P. 8-27

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
80220000 hex	NX Message Communications Error	An error was detected in message communications and the message frame was discarded.	For the NX bus of CPU Units • The message communications load is high. For Communications Coupler Units • The message communications load is high. • The communications cable is disconnected or broken. • Message communications were cutoff in communications.				S		P. 8-28
90400000 hex	Event Log Cleared	The event log was cleared.	• The event log was cleared by the user.					S	P. 8-29

8-3-4 Details on Errors

This section describes the information that is given for individual errors.

How to Read Error Descriptions

The items that are used to describe individual errors (events) are described in the following copy of an error table.

<table>
<tr><td>Event name</td><td colspan="3">Gives the name of the error.</td><td>Event code</td><td colspan="2">Gives the code of the error.</td></tr>
<tr><td>Meaning</td><td colspan="6">Gives a short description of the error.</td></tr>
<tr><td>Source</td><td colspan="2">Gives the source of the error.</td><td>Source details</td><td>Gives details on the source of the error.</td><td>Detection timing</td><td>Tells when the error is detected.</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Tells the level of influence on control.*1</td><td>Log category</td><td colspan="2">Tells which log the error is saved in.*2</td></tr>
<tr><td>Recovery</td><td colspan="5">Gives the recovery method.*3</td></tr>
<tr><td>Effects</td><td>User program</td><td>Tells what will happen to execution of the user program. *4</td><td>Operation</td><td colspan="3">Provides special information on the operation that results from the error.</td></tr>
<tr><td>Indicators</td><td colspan="6">Gives the status of the built-in EtherNet/IP port and built-in EtherCAT port indicators. Indicator status is given only for errors in the EtherCAT Master Function Module and the EtherNet/IP Function Module.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="6">Lists the variable names, data types, and meanings for system-defined variables that provide direct error notification, that are directly affected by the error, or that contain settings that cause the error.</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="6">Lists the possible causes, corrections, and preventive measures for the error.</td></tr>
<tr><td>Attached information</td><td colspan="6">This is the attached information that is displayed by the Support Software or an HMI.*5,*6</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">Provides precautions, restrictions, and supplemental information. If the user can set the event level, the event levels that can be set, the recovery method, operational information, and other information are also provided.</td></tr>
</table>

*1. One of the following:
Major fault: Major fault level
Partial fault: Partial fault level
Minor fault: Minor fault level
Observation
Information

*2. One of the following:
System: System event log
Access: Access event log

*3. One of the following:
Automatic recovery: Normal status is restored automatically when the cause of the error is removed.
Error reset: Normal status is restored when the error is reset after the cause of the error is removed.
Cycle the power supply: Normal status is restored when the power supply to the Controller is turned OFF and then back ON after the cause of the error is removed.
Controller reset: Normal status is restored when the Controller is reset after the cause of the error is removed.
Depends on cause: The recovery method depends on the cause of the error.

*4. One of the following:
Continues: Execution of the user program will continue.
Stops: Execution of the user program stops.
Starts: Execution of the user program starts.

*5. “System information” indicates internal system information that is used by OMRON.

*6. Refer to the appendices of the troubleshooting manual for the connected CPU Unit or Industrial PC for the applicable range of the HMI Troubleshooter.

Error Descriptions

<table>
<tr><th>Event name</th><td colspan="3">Non-volatile Memory Hardware Error</td><th>Event code</th><td colspan="2">00200000 hex</td></tr>
<tr><th>Meaning</th><td colspan="6">An error occurred in non-volatile memory.</td></tr>
<tr><th>Source</th><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><th>Source details</th><td>NX Unit</td><th>Detection timing</th><td>When power is turned ON to the NX Unit</td></tr>
<tr><th rowspan="2">Error attributes</th><th>Level</th><td colspan="2">Minor fault</td><th>Log category</th><td colspan="2">System</td></tr>
<tr><th>Recovery</th><td colspan="5">For the NX bus of CPU Units
Cycle the power supply to the Unit or restart the NX bus.
For Communications Coupler Units
Cycle the power supply to the Unit or restart the Slave Terminal.
If the errors are detected in the Controller, reset all of the errors in the Controller.</td></tr>
<tr><th>Effects</th><th>User program</th><td>Continues.</td><th>Operation</th><td colspan="3">I/O refreshing for the NX Unit stops. Messages cannot be sent to the NX Unit.</td></tr>
<tr><th rowspan="2">System-defined variables</th><th colspan="2">Variable</th><th colspan="2">Data type</th><th colspan="2">Name</th></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><th rowspan="2">Cause and correction</th><th colspan="2">Assumed cause</th><th colspan="2">Correction</th><th colspan="2">Prevention</th></tr>
<tr><td colspan="2">Non-volatile memory failure.</td><td colspan="2">For the NX bus of CPU Units
Cycle the power supply to the Unit or restart the NX bus. If the error persists even after you make the above correction, replace the relevant NX Unit.
For Communications Coupler Units
Cycle the power supply to the Unit or restart the Slave Terminal. If the error persists even after you make the above correction, replace the relevant NX Unit.</td><td colspan="2">None</td></tr>
<tr><th>Attached information</th><td colspan="6">None</td></tr>
<tr><th>Precautions/ Remarks</th><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">A/D Converter Error</td><td>Event code</td><td colspan="2">05100000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An error occurred in the A/D converter</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">Reset error in the NX Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The process value goes to 32767 for INT data, to 2147483647 for DINT data, and to 1.0E+10 for REAL data.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">Noise</td><td colspan="2">Cycle the power to the NX Unit and see if this clears the error.
If the error occurs frequently, check for noise entry paths and implement noise countermeasures as required.</td><td colspan="2">Implement noise countermeasures.</td></tr>
<tr><td colspan="2">A/D converter failure</td><td colspan="2">If cycling the power supply to the NX Unit does not clear the error, replace the NX Unit.</td><td colspan="2">None</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Channel
0001 hex: Channel 1
0010 hex: Channel 2
0100 hex: Channel 3
1000 hex: Channel 4
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if errors occur at the same time for all channels (1 to 4), then 1111 hex is given.
Attached Information 2: Error Channel
0001 hex: Channel 5
0010 hex: Channel 6
0100 hex: Channel 7
1000 hex: Channel 8
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if errors occur at the same time for all channels (5 to 8), then 1111 hex is given.</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Cold Junction Sensor Error</td><td>Event code</td><td colspan="2">05110000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The temperature cannot be converted because the cold junction sensor is disconnected.</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">Reset error in the NX Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Operation before Cause Is Removed: The process value goes to 32767 for INT data, to 2147483647 for DINT data, and to 1.0E+10 for REAL data.
Operation after Cause Is Removed: The process value returns to normal when the connection is restored.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">There is a faulty connection to the cold junction sensor.</td><td colspan="2">Check the connections to the cold junction sensor on the terminal block and correct any bad connections that are found.</td><td colspan="2">Make sure that the cold junction sensor is corrected correctly on the terminal block.</td></tr>
<tr><td colspan="2">The cold junction sensor failed.</td><td colspan="2">If the Cold Junction Sensor is sold separately, replace the Cold Junction Sensor. If the error still occurs, replace the NX Unit.</td><td colspan="2">None</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Channel
0001 hex: Channel 1
0010 hex: Channel 2
0100 hex: Channel 3
1000 hex: Channel 4
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if errors occur at the same time for all channels (1 to 4), then 1111 hex is given.
Attached Information 2: Error Channel
0001 hex: Channel 5
0010 hex: Channel 6
0100 hex: Channel 7
1000 hex: Channel 8
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if errors occur at the same time for all channels (5 to 8), then 1111 hex is given.</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">You can change the event level to the observation level.</td></tr>
</table>

Event name	Unit Calibration Value Error			**Event code**	10440000 hex	
Meaning	An error occurred in the area where unit calibration values are saved.					
Source	Depends on where the Support Software is connected and the system configuration.		**Source details**	NX Unit	**Detection timing**	When power is turned ON to the NX Unit
Error attributes	**Level**	Minor fault		**Log category**	System	
	Recovery	None				
Effects	**User program**	Continues.	**Operation**	I/O refreshing for the NX Unit stops.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An error in the area of non-volatile memory where unit calibration values are saved.		If cycling the power supply to the NX Unit does not clear the error, replace the NX Unit.		None	
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Control Parameter Error in Unit</td><td>Event code</td><td colspan="2">104A0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An error occurred in the control parameters that are saved in the Unit.</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>When power is turned ON to the NX Unit</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">For NX-CPU Units
When Fail-soft Operation is Set to Stop
Restart the NX Unit and then reset the error in the NX Bus Function Module.
When Fail-soft Operation Is Set to Fail-soft
Restart the NX Unit and then reset the error in the NX Unit.

For Communications Coupler Units
When Fail-soft Operation Is Set to Stop
If errors are detected in the Controller, restart the NX Unit and then reset all of the errors in the Controller.
If errors are not detected in the Controller, restart the NX Unit and then reset the error in the Communications Coupler Unit.
When Fail-soft Operation Is Set to Fail-soft
Restart the NX Unit and then reset the error in the Communications Coupler Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">I/O refreshing for the NX Unit stops.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">For NX-CPU Units
The CPU Unit was turned OFF while writing the Unit operation settings or the parameters with Unit functions was in progress.
For Communications Coupler Units
The Communications Coupler Unit was turned OFF while writing the Unit operation settings or the parameters with Unit functions was in progress.
Common to all (not only for NX bus master)
An error in the area where the Unit operation settings are saved.</td><td colspan="2">Download the Unit operation settings of the NX Unit again.
If the error persists even after you make the above correction, replace the NX Unit.</td><td colspan="2">For NX-CPU Units
Do not turn OFF the CPU Unit while transfer of the Unit operation settings of the NX Unit, execution of the NX_SaveParam instruction or execution of Unit functions of writing parameters is in progress.
For Communications Coupler Units
Do not turn OFF the Communications Coupler Unit while transfer of the Unit operation settings of the NX Unit from the Support Software, save of NX Unit parameters through a message or execution of Unit functions of writing parameters is in progress.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	I/O Entries Exceeded			**Event code**	39350000 hex	
Meaning	The total number of entries assigned to the I/O data set exceeds 247.					
Source	Depending on where the Support Software is connected and the system configuration.		**Source details**	NX Unit	**Detection timing**	When power is turned ON to the NX Unit
Error attributes	**Level**	Minor fault		**Log category**	System	
	Recovery	Remap I/O entries in the I/O Allocation Settings.				
Effects	**User program**	Continues.	**Operation**	I/O refreshing for the NX Unit stops.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The total number of entries assigned to the I/O data set exceeds 247, the maximum number of entries that can be stored in the NX bus.		Edit the number of entries using the software tool to bring the total number of entries assigned to the I/O data set within 247, and then download again the I/O allocation settings for the NX Unit.		Make sure that the total number of entnries assigned to the I/O data set is within 247.	
Attached information	Attached information 1: Excessive number of entries Excessive entries if the total number of entries assigned to the I/O data set exceeds 247. For example, if the total number of entries assigned to the I/O data set shows 249, then the excessive number of entries must be 0002 hex.					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">NX Unit Processing Error</td><td>Event code</td><td colspan="2">40200000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">A fatal error occurred in an NX Unit.</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">For the NX bus of CPU Units
Cycle the power supply to the NX Unit and then reset the error in the NX Bus Function Module.
For Communications Coupler Units
Cycle the power supply to the NX Unit and then reset the error in the Communications Coupler Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">I/O refreshing for the NX Unit stops. Messages cannot be sent to the NX Unit.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An error occurred in the software.</td><td colspan="2">Contact your OMRON representative.</td><td colspan="2">None</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: System information
Attached information 2: System information
Attached information 3: System information
Attached information 4: System information</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Sensor Disconnected Error</td><td>Event code</td><td colspan="2">65100000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">A disconnected temperature sensor was detected.</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">Reset error in the NX Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Operation before Cause Is Removed: The process value goes to 32767 for INT data, to 2147483647 for DINT data, and to 1.0E+10 for REAL data.
Operation after Cause Is Removed: The process value returns to normal when the connection is restored.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="7">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The temperature sensor is damaged or the wires are broken.</td><td colspan="2">Check the temperature sensor for damage or broken wires and replace it if it is damaged or there are broken wires.</td><td colspan="2">Make sure that the temperature sensor is not damaged and that no wires are broken before you use it.</td></tr>
<tr><td colspan="2">An unused channel is not disabled.</td><td colspan="2">Set the Channel Enable/Disable Setting parameter to FALSE for the unused channels.</td><td colspan="2">Set the Channel Enable/Disable Setting parameter to FALSE for the unused channels.</td></tr>
<tr><td colspan="2">The wiring to the temperature sensor is incorrect.</td><td colspan="2">Check the position where the temperature sensor is connected and the polarity. If it is wrong, connect it properly.</td><td colspan="2">Check the position where the temperature sensor is connected and the polarity for proper connection.</td></tr>
<tr><td colspan="2">The input type is not set correctly when this error occurs in the Temperature Control Unit.</td><td colspan="2">Check the Input Type parameter setting. Set a proper value if it is incorrect.</td><td colspan="2">Check the Input Type parameter setting, and set a proper value.</td></tr>
<tr><td colspan="2">The measured value exceeds the input indication range when this error occurs in the Temperature Control Unit.</td><td colspan="2">Investigate a cause why the measured value exceeded the input indication range. Take a proper action.</td><td colspan="2">Investigate a cause why the measured value exceeded the input indication range. Take a proper action.</td></tr>
<tr><td colspan="2">The PV Input Shift or the PV Input Slope Coefficient is not set correctly when this error occurs in the Temperature Control Unit.</td><td colspan="2">Set a proper value to the PV Input Shift or PV Input Slope Coefficient parameter. If no compensation is performed for temperature inputs, set the PV Input Shift to 0, and the PV Input Slope Coefficient to 1000.</td><td colspan="2">Set a proper value to the PV Input Shift or PV Input Slope Coefficient parameter. If no compensation is performed for temperature inputs, set the PV Input Shift to 0, and the PV Input Slope Coefficient to 1000.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Channel
0001 hex: Channel 1
0010 hex: Channel 2
0100 hex: Channel 3
1000 hex: Channel 4
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if errors occur at the same time for all channels (1 to 4), then 1111 hex is given.
Attached Information 2: Error Channel
0001 hex: Channel 5
0010 hex: Channel 6
0100 hex: Channel 7
1000 hex: Channel 8
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if errors occur at the same time for all channels (5 to 8), then 1111 hex is given.</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">You can change the event level to the observation level.</td></tr>
</table>

<table>
<tr><th>Event name</th><td colspan="3">Heater Burnout Detected</td><th>Event code</th><td colspan="2">652C0000 hex</td></tr>
<tr><th>Meaning</th><td colspan="6">A heater burnout was detected.</td></tr>
<tr><th>Source</th><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><th>Source details</th><td>NX Unit</td><th>Detection timing</th><td>Continuously</td></tr>
<tr><th rowspan="2">Error attributes</th><th>Level</th><td colspan="2">Minor fault</td><th>Log category</th><td colspan="2">System</td></tr>
<tr><th>Recovery</th><td colspan="5">Reset error in the NX Unit.</td></tr>
<tr><th>Effects</th><th>User program</th><td>Continues.</td><th>Operation</th><td colspan="3">Operation will continue.</td></tr>
<tr><th rowspan="2">System-defined variables</th><th colspan="2">Variable</th><th colspan="2">Data type</th><th colspan="2">Name</th></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><th rowspan="5">Cause and correction</th><th colspan="2">Assumed cause</th><th colspan="2">Correction</th><th colspan="2">Prevention</th></tr>
<tr><td colspan="2">A heater was burned out or damaged.</td><td colspan="2">Check the heater to see if it is burned out or damaged. If the heater is burned out or damaged, replace it.</td><td colspan="2">Find the reasons for the heater burnout or damage and take suitable preventive measures.</td></tr>
<tr><td colspan="2">The setting of the Heater Burnout Detection Current is too high.</td><td colspan="2">Set the Heater Burnout Detection Current to a suitable value.</td><td colspan="2">Set the Heater Burnout Detection Current to a suitable value.</td></tr>
<tr><td colspan="2">A CT input that is not used is allocated to a control output in the CT Allocation setting when this error occurs in the Heater Burnout Detection Unit.</td><td colspan="2">Set the CT Allocation setting for a CT input that is not used to Do not use.</td><td colspan="2">Set the CT Allocation setting for a CT input that is not used to Do not use.</td></tr>
<tr><td colspan="2">An unused channel is not disabled when this error occurs in the Temperature Control Unit.</td><td colspan="2">Set the Channel Enable/Disable Setting parameter to FALSE for the unused channels.</td><td colspan="2">Set the Channel Enable/Disable Setting parameter to FALSE for the unused channels.</td></tr>
<tr><th>Attached information</th><td colspan="6">Attached Information 1: Error Channel
0001 hex: Channel 1
0010 hex: Channel 2
0100 hex: Channel 3
1000 hex: Channel 4
If this error occurs at the same time for more than one CT input, the sum of the codes is given.
For example, if errors occur at the same time for all of CT1 to CT4, then 1111 hex is given.
Attached Information 2: Error Channel
0001 hex: Channel 5
0010 hex: Channel 6
0100 hex: Channel 7
1000 hex: Channel 8
If this error occurs at the same time for more than one channel, the sum of the codes is given.
For example, if errors occur at the same time for all channels (5 to 8), then 1111 hex is given.</td></tr>
<tr><th>Precautions/ Remarks</th><td colspan="6">You can change the event level to the observation level.</td></tr>
</table>

<table>
<tr><th>Event name</th><td colspan="3">SSR Failure Detected</td><th>Event code</th><td colspan="2">652D0000 hex</td></tr>
<tr><th>Meaning</th><td colspan="6">An SSR failure was detected.</td></tr>
<tr><th>Source</th><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><th>Source details</th><td>NX Unit</td><th>Detection timing</th><td>Continuously</td></tr>
<tr><th rowspan="2">Error attributes</th><th>Level</th><td colspan="2">Minor fault</td><th>Log category</th><td colspan="2">System</td></tr>
<tr><th>Recovery</th><td colspan="5">Reset error in the NX Unit.</td></tr>
<tr><th>Effects</th><th>User program</th><td>Continues.</td><th>Operation</th><td colspan="3">Operation will continue.</td></tr>
<tr><th rowspan="2">System-defined variables</th><th colspan="2">Variable</th><th colspan="2">Data type</th><th colspan="2">Name</th></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><th rowspan="5">Cause and correction</th><th colspan="2">Assumed cause</th><th colspan="2">Correction</th><th colspan="2">Prevention</th></tr>
<tr><td colspan="2">The SSR was short-circuited or damaged.</td><td colspan="2">Check the SSR to see if it is short-circuited or damaged. If the SSR is short-circuited or damaged, replace it.</td><td colspan="2">Find the reasons for the SSR short circuit or damage and take suitable preventive measures.</td></tr>
<tr><td colspan="2">The setting of the SSR Failure Detection Current is too small.</td><td colspan="2">Set the SSR Failure Detection Current to a suitable value.</td><td colspan="2">Set the SSR Failure Detection Current to a suitable value.</td></tr>
<tr><td colspan="2">A CT input that is not used is allocated to a control output in the CT Allocation setting when this error occurs in the Heater Burnout Detection Unit.</td><td colspan="2">Set the CT Allocation setting for a CT input that is not used to Do not use.</td><td colspan="2">Set the CT Allocation setting for a CT input that is not used to Do not use.</td></tr>
<tr><td colspan="2">An unused channel is not disabled when this error occurs in the Temperature Control Unit.</td><td colspan="2">Set the Channel Enable/Disable Setting parameter to FALSE for the unused channels.</td><td colspan="2">Set the Channel Enable/Disable Setting parameter to FALSE for the unused channels.</td></tr>
<tr><th>Attached information</th><td colspan="6">Attached Information 1: Error Channel
0001 hex: Channel 1
0010 hex: Channel 2
0100 hex: Channel 3
1000 hex: Channel 4
If this error occurs at the same time for more than one CT input, the sum of the codes is given.
For example, if errors occur at the same time for all of CT1 to CT4, then 1111 hex is given.
Attached Information 2: Error Channel
0001 hex: Channel 5
0010 hex: Channel 6
0100 hex: Channel 7
1000 hex: Channel 8
If this error occurs at the same time for more than one channel, the sum of the codes is given.
For example, if errors occur at the same time for all channels (5 to 8), then 1111 hex is given.</td></tr>
<tr><th>Precautions/ Remarks</th><td colspan="6">You can change the event level to the observation level.</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Alarm Detected</td><td>Event code</td><td colspan="2">652E0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The alarm set for the alarm type was deteted.</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">Reset error in the NX Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Operation will continue.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An alarm was detected, which was set to output in the following cases according to the alarm type:
• if a measured value deviates for the amount specified by the alarm upper limit and/or alarm lower limit, or
• if a measured value is greater or smaller than the specified alarm value.</td><td colspan="2">Investigate the cause why the alarm was detected. Take a proper action.</td><td colspan="2">Investigate the cause why the alarm was detected. Take a proper action.</td></tr>
<tr><td colspan="2">The following values that are set according to the alarm type do not conform to the alarm that is to be detected.
• Alarm value
• Alarm upper limit and alarm lower limit</td><td colspan="2">Set a proper value for the following set items according to the alarm type.
• Alarm value
• Alarm upper limit and alarm lower limit</td><td colspan="2">Set a proper value for the following set items according to the alarm type.
• Alarm value
• Alarm upper limit and alarm lower limit</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Channel of Alarm 1 Error
0001 hex: Channel 1
0010 hex: Channel 2
0100 hex: Channel 3
1000 hex: Channel 4
Channel of Alarm 2 Error
0002 hex: Channel 1
0020 hex: Channel 2
0200 hex: Channel 3
2000 hex: Channel 4
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if the Alarm 1 Error and Alarm 2 Error occur at the same time for all channels (1 to 4), then 3333 hex is given.
Attached information 2: Channel of Alarm 1 Error
0001 hex: Channel 5
0010 hex: Channel 6
0100 hex: Channel 7
1000 hex: Channel 8
Channel of Alarm 2 Error
0002 hex: Channel 5
0020 hex: Channel 6
0200 hex: Channel 7
2000 hex: Channel 8
If this error occurs at the same time for more than one channel, the sum of the codes is given. For example, if the Alarm 1 Error and Alarm 2 Error occur at the same time for all channels (5 to 8), then 3333 hex is given.</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">You can change the event level to the observation level.</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">NX Unit I/O Communications Error</td><td>Event code</td><td colspan="2">80200000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An I/O communications error occurred in an NX Unit.</td></tr>
<tr><td>Source</td><td colspan="2">Depends on where the Support Software is connected and the system configuration.</td><td>Source details</td><td>NX Unit</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td rowspan="2">Error attributes</td><td>Level</td><td colspan="2">Minor fault</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Recovery</td><td colspan="5">For the NX bus of CPU Units
When Fail-soft Operation Is Set to Stop
Reset the error in the NX Bus Function Module.
When Fail-soft Operation Is Set to Fail-soft
Reset the error in the NX Unit.
For Communications Coupler Units
When Fail-soft Operation Is Set to Stop
If the errors are detected in the Controller, reset all of the errors in the Controller.
If the errors are not detected in the Controller, reset errors in the Communications Coupler Unit and NX Unit.
When Fail-soft Operation Is Set to Fail-soft
Reset errors in the Communications Coupler Unit and NX Unit.</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The NX Unit will continue to operate.
Input data: Updating input values stops.
Output data: The output values depend on the Load Rejection Output Setting.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="8">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="6">For the NX bus of CPU Units</td></tr>
<tr><td colspan="2">An error that prevents normal NX bus communications occurred in a CPU Unit.</td><td colspan="2">Check the error that occurred in the CPU Unit and perform the required corrections.</td><td colspan="2">Take preventive measures against the error that occurred in the CPU Unit.</td></tr>
<tr><td colspan="2">An NX Unit is not mounted properly.</td><td colspan="2">Mount the NX Units and End Cover securely and secure them with End Plates.</td><td colspan="2">Mount the NX Units and End Cover securely and secure them with End Plates.</td></tr>
<tr><td colspan="2">The power cable for the Unit power supply is disconnected, or the wiring from the Unit power supply to the NX Units is incorrect.</td><td colspan="2">Wire the Unit power supply to the NX Units securely.</td><td colspan="2">Wire the Unit power supply to the NX Units securely.</td></tr>
<tr><td colspan="2">The power cable for the Unit power supply is broken.</td><td colspan="2">If the power cable between the Unit power supply and the NX Units is broken, replace it.</td><td colspan="2">None</td></tr>
<tr><td colspan="2">The voltage of the Unit power supply is outside the specified range, or the capacity of the Unit power supply is insufficient.</td><td colspan="2">Configure the power supply system configuration correctly according to the power supply design method.</td><td colspan="2">Configure the power supply system configuration correctly according to the power supply design method.</td></tr>
<tr><td colspan="2">There is a hardware error in an NX Unit.</td><td colspan="2">If the error persists even after you make the above correction, replace the NX Unit.</td><td colspan="2">None</td></tr>
</table>

Cause and correction	For Communications Coupler Units		
	An error that prevents normal NX bus communications occurred in a Communications Coupler Unit.	Check the error that occurred in the Communications Coupler Unit and perform the required corrections.	Take preventive measures against the error that occurred in the Communications Coupler Unit.
	The NX Unit is not mounted properly.	Mount the NX Units and End Cover securely and secure them with End Plates.	Mount the NX Units and End Cover securely and secure them with End Plates.
	The power cable for the Unit power supply is disconnected. Or, the wiring from the Unit power supply to the NX Units is incorrect.	Correctly wire the Unit power supply to the NX Units.	Correctly wire the Unit power supply to the NX Units.
	The power cable for the Unit power supply is broken.	If the power cable between the Unit power supply and the NX Units is broken, replace it.	None
	The voltage of the Unit power supply is outside the specified range. Or, the capacity of the Unit power supply is insufficient.	Correctly configure the power supply system according to the power supply design methods.	Correctly configure the power supply system according to the power supply design methods.
	There is a hardware error in the NX Unit.	If the error occurs again even after you make the above correction, replace the NX Unit.	None
Attached information	None		
Precautions/ Remarks	None		

Event name	NX Unit Clock Not Synchronized Error			Event code	8024 0000 hex	
Meaning	A time information error occurred in an NX Unit.					
Source	Depends on where the Support Software is connected and the system configuration.		Source details	NX Unit	Detection timing	Continuously
Error attributes	Level	Minor fault		Log category	System	
	Recovery	For the NX bus of CPU Units Cycle the power supply to the Unit. For Communications Coupler Units Cycle the power supply to the Unit and then reset all of the errors in the Controller.				
Effects	User program	Continues.	Operation	The NX Unit will continue to operate. Input data: Updating input values stops. Output data: The output values depend on the Load Rejection Output Setting.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	For the NX bus of CPU Units					
	There is a hardware error in an NX Unit.		If the error occurs only in a specific NX Unit, replace the relevant NX Unit.		None	
	There is a hardware error in a CPU Unit.		If the error occurs in all of the NX Units mounted on a CPU Unit, replace the CPU Unit.		None	
	For Communications Coupler Units					
	There is a hardware error in an NX Unit.		If the error occurs only in a specific NX Unit, replace the relevant NX Unit.		None	
	There is a hardware error in an EtherCAT Coupler Unit.		If the error occurs in all of the NX Units mounted on a Communications Coupler Unit, replace the Communications Coupler Unit.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	NX Message Communications Error			**Event code**	80220000 hex	
Meaning	An error was detected in message communications and the message frame was discarded.					
Source	Depends on where the Support Software is connected and the system configuration.		**Source details**	NX Unit	**Detection timing**	During NX message communications
Error attributes	**Level**	Observation		**Log category**	System	
	Recovery	---				
Effects	**User program**	Continues.	**Operation**	Not affected.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	For the NX bus of CPU Units					
	The message communications load is high.		Reduce the number of times that instructions are used to send NX messages.		Reduce the number of times that instructions are used to send NX messages.	
	For Communications Coupler Units					
	The message communications load is high.		Reduce the number of times that instructions are used to send NX messages.		Reduce the number of times that instructions are used to send NX messages.	
	The communications cable is disconnected or broken. This cause does not apply if attached information 2 is 0 (NX bus).		Connect the communications cable securely.		Connect the communications cable securely.	
	Message communications were cutoff by executing the followings in message communications. • Transfer of parameters by the Support Software • Restoration of the backup data (if this error occurred in the EtherCAT Slave Terminal) • Disconnection of an EtherCAT slave (if this error occurred in the EtherCAT Slave Terminal)		---		---	
Attached information	Attached information 1: System information Attached information 2: Type of communications where error occurred 0: NX bus 1: EtherCAT 2: Serial communications (USB) 3: EtherNet/IP 65535: Internal Unit communications (routing)					
Precautions/ Remarks	None					

Event name	Event Log Cleared		**Event code**	90400000 hex	
Meaning	The event log was cleared.				
Source	Depends on where the Support Software is connected and the system configuration.	**Source details**	NX Unit	**Detection timing**	When commanded from user
Error attributes	**Level**	Information	**Log category**	Access	
	Recovery	---			
Effects	**User program**	Continues.	**Operation**	Not affected.	
System-defined variables	**Variable**		**Data type**	**Name**	
	None		---	---	
Cause and correction	**Assumed cause**		**Correction**	**Prevention**	
	The event log was cleared by the user.		---	---	
Attached information	Attached information 1: Events that were cleared 1: The system event log was cleared. 2: The access event log was cleared.				
Precautions/ Remarks	None				

8-4 Resetting Errors

Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for details on how to reset errors.

8-5 Unit-specific Troubleshooting

The following table shows the errors inherent to the Advanced Temperature Control Unit, their assumed causes, and corrections.

Error	Assumed cause	Correction
The following occur the first time power is connected: • Temperature error is large. • Sensor disconnected error	Input type mismatch.	Check the sensor type and reset the input type correctly.
	Temperature sensor is not installed properly.	Check the temperature sensor installation location and polarity and install correctly.
TS indicator flashes red.	The total number of entries assigned to the I/O data set exceeds 247.	Set the total number of data in the I/O data set within 247.
The following occur during operation: • Temperature error is large. • Sensor disconnected error	Temperature sensor has burnt out or short-circuited.	Check whether the temperature sensor has burnt out or short-circuited.
	Temperature sensor lead wires and power lines are in the same conduit, causing noise from the power lines (generally, measured values will be unstable).	Wire the lead wires and power lines in separate conduits, or wire them using a more direct path.
	Connection between the Temperature Control Unit and thermocouple is using copper wires.	Connect the thermocouple's lead wires directly, or connect compensating conductors that are suitable for the thermocouple.
	Installation location of temperature sensor is unsuitable.	Make sure that the location that is being measured with the temperature sensor is suitable.
	PV Input shift is not set correctly (default: 0.0°C)	Set a suitable PV Input Shift. If PV Input Shift is not required, set the input shift value to 0.0.
	Temperature Unit was changed after the PV Input Shift value was set.	Implement one of the following measures. • After loading PV Input Shift value, perform the unit conversion calculation and make the setting again. • Perform temperature input calibration again and set PV Input Shift value.
Overshooting, Undershooting, Hunting	Unsuitable PID constant	Set appropriate PID constants using either of the following methods. • Execute AT (autotuning). • Set PID constants individually using manual settings.
	SSR operation failure	Use breeder resistance if the problem is due to leakage current. Also, consider the error was detected by the SSR failure detection.
	The power supply to the load (e.g., heater) was turned ON or OFF during tuning.	During tuning, ensure that the power for the load (e.g., heater) is ON. Otherwise, the correct tuning result cannot be calculated and optimal control will not be possible.

Error	Assumed cause	Correction
Temperature is not rising	Specified operation is unsuitable for required control (default: Reverse operation).	Select either direct or reverse operation depending on the required control. Reverse operation is used for heating operations.
	Heater is burnt out or deteriorated.	Check whether heater burnout or deterioration have occurred. Also, consider the error was detected by the heater burnout detection.
	Unsuitable PID constant	Set appropriate PID constants using either of the following methods. • Execute AT (autotuning). • Set PID constants individually using manual settings.
Temperature is not rising	Insufficient heater capacity.	Check whether the heater's heating capacity is sufficient.
	Cooling system in operation.	Check whether a cooling system is operating.
	Peripheral devices have heat prevention device operating.	Set the heating prevention temperature setting to a value higher than the set temperature of the Temperature Control Unit.
No output. (Output indicator is not lit)	A stop command was given. (When the power is cycled or the Unit is restarted: Stop)	Use the Run or Stop bit of the I/O data Ch☐ Operation Command to instruct Run.
	Settings do not match the target control operation. (default: Reverse operation)	Set direct operation or reverse operation according to the target control. For heating operation, set Reverse operation.
	For ON/OFF operation, a large value for the hysteresis is set. (default: 1.0°C)	Set an appropriate value for the hysteresis.
No output. (Output indicator is lit or flashing)	I/O power is not supplied.	Check that the I/O power is supplied.
	The I/O power supply is outside the ratings.	Set the I/O power supply voltage so that it is within the rated voltage range.
	Incorrect wiring to the connected external device.	Check the wiring with the connected external device.
	The wiring to the connected external device is disconnected.	Check the wiring with the connected external device.
	The connected external device is faulty.	Replace the connected external device.
	Load short-circuit protection activated.	Eliminate the cause of the short-circuit.
	The resistance value on the linear current output side exceeds the allowable load resistance.	Make sure that the total input impedance of the devices connected to the output side, including the resistance value (round trip) of the wires used for connection, is less than the allowable load resistance.
Temperature Control Unit does operate.	A stop command was given. (When the power is cycled or the Unit is restarted: Stop)	Use the Run or Stop bit of the I/O data Ch☐ Operation Command to instruct Run.
	Set Ch☐ Enable/Disable to Disable.	Set Ch☐ Enable/Disable to Enable.
The cold junction sensor error occurs when the cold junction compensation is disabled.	The cold junction sensor is disconnected.	Connect the cold junction sensor.
No heater burnout detected.	The manipulated variable is not output.	The Unit detects a heater burnout when the control output is ON. Turn control output ON or make the setting to allow it to turn ON/OFF.
	The value of the Heater Burnout Detection Current is too small.	Set the Heater Burnout Detection Current to a suitable value.

Error	Assumed cause	Correction
Heater current or leakage current does not change.	The manipulated variable is not output. Or, the manipulated variable is output continuously.	The Unit updates the heater current when the control output is ON, and the leakage current when the control output is OFF. Set the Unit so that the control output turns ON and OFF.
Temperature control cannot be stopped.	Load rejection occurred.	Check if a Controller error, communications coupler Unit error, or NX bus error occurred. In addition, to specify the Temperature Control Unit output operation when load rejection occurs, consider the use of the manipulated variable at load rejection. Refer to *7-4-9 Load Rejection MV* on page 7-48 for details on the manipulated variable at load rejection.
AT does not work.	A stop command was given. (When the power is cycled or the Unit is restarted: Stop)	Use the Run or Stop bit of the I/O data Ch□ Operation Command to instruct Run.
Setting data cannot be changed.	AT, Automatic Filter Adjustment and D-AT are being executed.	Change the setting data after confirming that the "100 Percent AT Status", "40 Percent AT Status", "Automatic Filter Adjustment Status", "FF1 or D-AT1 Execute Status", and "FF2 or D-AT2 Execute Status" bits of "Ch□ Operating Status" in the I/O data are all OFF.
A mismatch is notified when Compare with Backup File is executed.	The tuning parameters are updated depending on whether tuning is performed by a user operation, or by the automatic execution of the Temperature Control Unit.	Perform backup with the backup function. For details, refer to *2-3-3 Backing up the Tuning Parameters* on page 2-7.
If the parameters of the Unit Operation Settings are verified after being transferred, verification mismatch will occur.	Output data was overwritten after a unit restart that occurred during parameter transfer, etc., because adjustment data for unit operation settings was assigned to Output data. *1	Set either of the following. • Cancel allocation of adjustment data allocated to Output data. • Set a value in the adjustment data assigned to Output data. For details, refer to *6-1-5 Data for Adjustment* on page 6-24.

*1. Transfer the parameters of the unit operation setting that the setting after change with the support software is reflected after the unit is restarted. Then restart the unit after the transfer completes.

8-6 Troubleshooting Flowchart

Refer to the user's manual for the connected CPU Unit or Communications Coupler Unit for details on the standard troubleshooting process when an error occurs.

9

Inspection and Maintenance

This section describes how to clean, inspect, and maintain the Temperature Control Units.

9-1 Cleaning and Inspection

The daily device maintenance, such as cleaning and inspection, is described below.

Make sure to perform daily or periodic inspections in order to maintain the Temperature Control Unit functions in the best operating condition.

9-1-1 Cleaning

Perform the following cleanings periodically to ensure the Temperature Control Units are maintained in the best operating condition.

- Wipe the equipment over with a soft, dry cloth when performing daily cleaning.
- If dirt remains even after wiping with a soft, dry cloth, wipe with a cloth that has been wet with a sufficiently diluted detergent (2%) and wrung dry.
- The NX Units get stained if items such as rubber, vinyl products, and adhesive tape are left on the NX Units for a long period. Remove such items during regular cleaning.

Precautions for Correct Use

- Never use benzene, thinners, other volatile solvents, or chemical cloths.
- Do not touch the NX bus connectors.

9-1-2 Periodic Inspection

The NX Units do not have limited lifetime parts. However, its elements can deteriorate under improper environmental conditions. Periodic inspections are thus required to ensure that the required conditions are being maintained.

Periodic inspections are recommended at least once every six months to a year, but more frequent inspections may be necessary depending on the environments.

Take immediate steps to correct the situation if any of the criteria in the following table are not met.

Periodic Inspection Items

No.	Inspection item	Inspection point	Criteria	Correction
1	External power supply	Is the power supply voltage measured at the terminal block within standards?	Within the power supply voltage range	Use a voltage tester to check the power supply at the terminals. Take necessary steps to bring the power supply within the power supply voltage range.
2	I/O power supply	Is the power supply voltage measured at the I/O terminal block within standards?	Voltages must be within I/O specifications of each NX Unit.	Use a voltage tester to check the power voltage at the terminals. Take necessary steps to bring the I/O power supply within NX Unit standards.
3	Ambient environment	Is the ambient operating temperature within standards?	0 to 55°C	Use a thermometer to check the temperature and ensure that the ambient operating temperature remains between 0 to 55°C inclusive.
		Is the ambient operating humidity within standards?	Relative humidity must be 10% to 95% with no condensation.	Use a hygrometer to check the humidity and ensure that the ambient operating humidity remains between 10% and 95% inclusive. Make sure that condensation does not occur due to rapid changes in temperature.
		Is it subject to direct sunlight?	Not in direct sunlight	Protect the NX Units if necessary.
		Is there an accumulation of dirt, dust, salt, metal powder, etc.?	No accumulation	Clean and protect the NX Units if necessary.
		Is there water, oil, or chemical sprays on the NX Units?	No spray	Clean and protect the NX Units if necessary.
		Are there corrosive or flammable gases in the area of the NX Units?	No spray	Check by smell or use a sensor.
		Are the NX Units subject to shock or vibration?	Vibration resistance and shock resistance must be within specifications.	Install cushioning or other vibration and shock absorbing equipment if necessary.
		Are there noise sources near the NX Units?	No significant noise sources	Either separate the NX Units and noise source, or protect the NX Units.
4	Installation and wiring	Are the DIN track mounting hooks for each NX Unit securely locked?	No looseness	Securely lock the DIN track mounting hooks.
		Are the cable connectors fully inserted and locked?	No looseness	Correct any improperly installed connectors.
		Are there any loose screws on the End Plates (PFP-M)?	No looseness	Tighten loose screws with a Phillips-head screwdriver.
		Are the NX Units connected to each other along the hookup guides and until they touch the DIN track?	You must connect and fix the NX Units to the DIN track.	Connect the NX Units to each other along the hookup guides and until they touch the DIN track.
		Are there any damaged external wiring cables?	No visible damage	Check visually and replace cables if necessary.

Tools Required for Inspections

Required Tools

- Phillips screwdriver
- Flat-blade screwdriver
- Voltage tester or digital voltmeter
- Industrial alcohol and pure cotton cloth

Tools Required Occasionally

- Oscilloscope
- Thermometer and hygrometer

9-2 Maintenance Procedures

9-2-1 Storing Tuning Parameters

If a failure occurs in an Advanced Temperature Control Unit, the tuning parameters stored in the Temperature Control Unit using the tuning function are lost. Save the tuning parameters periodically as required so that they can be restored.

9-2-2 Unit Replacement Procedure

The Unit Operation Settings of an Advanced Temperature Control Unit are stored only in the Unit.

Therefore, use the backup function in the Controller or Tool or execute the user program for backup to transfer parameters of the Unit Operation Settings at the time of Unit replacement of the Unit.

Backup procedure

Back up the parameters of the Unit operation settings.

For backup support and methods when an NJ/NX-series CPU Unit is not used, refer to the user's manual for the connected CPU Unit or industrial PC.

1. Back up the parameters of the Unit operation settings. Refer to the *NJ-series CPU Unit Software User’s Manual (Cat. No. W501)* for details on backing up data.
2. Turn OFF the whole device or disconnect the Slave Terminal that contains an NX Unit to replace from the industrial EtherNet network.
3. Turn OFF the Unit power supply and the I/O power supply of the Slave Terminal.
4. Replace the NX Unit. For an NX Unit with a hardware switch, return the hardware switch to the same settings as before replacement.
5. Turn ON the Unit power supply and the I/O power supply of the Slave Terminal.
6. Restore the data in the backup file.
7. Turn OFF the Unit power supply and the I/O power supply of the Slave Terminal.
8. Turn ON the whole device or reconnect the Slave Terminal to the industrial EtherNet network.
9. Compares the parameters between Unit Operational Settings and the backed up data.

A

Appendices

The appendices provide datasheets, dimensions, and other information on the Advanced Temperature Control Units.

A-1 Datasheet

The specifications of the Advanced Temperature Control Units are described below.

A-1-1 Model List

Advanced Temperature Control Units (4-Channel Type) (MIL Connector, 30 mm Width)

Model numbers	Number of channels	Input type	Outputs		Number of CT input points	Control type	I/O refreshing method	Reference
			Output type	Number of output points				
NX-HTC3510-5	4Ch	Universal inputs	Voltage output (for driving SSR)	4 points	4 points	Heating and cooling control	Free-Run refreshing	P. A-6
			Linear current output	4 points				

Advanced Temperature Control Units (8-Channel Type) (MIL Connector, 30 mm)

Model numbers	Number of channels	Input type	Outputs		Number of CT input points	Control type	I/O refreshing method	Reference
			Output type	Number of output points				
NX-HTC4505-5	8Ch	Universal inputs	Voltage output (for driving SSR)	8 points	8 points	Standard control	Free-Run refreshing	P. A-9

A-1-2 Detailed Specifications

Description of data sheet items

The items on the datasheet of the Advanced Temperature Control Units are explained in the table below.

Item		Description
Unit name		The name of the Unit.
Model numbers		The model number of the Unit.
Number of channels		The number of control loops of the Unit.
Control type		Control type of the Unit.
Points per channel		The number of sensor inputs, CT inputs, and control outputs for each channel of the Unit. Values in parentheses indicate the number of points per Unit.
External connection terminal		The type of terminal block or connector that is used to wire the Unit. For a screwless clamping terminal block, this item also indicates the number of terminals.
I/O refreshing method		The I/O refreshing method of the Unit. Only Free-Run refreshing is supported.
Indicators		The type and layout of the indicators on the Unit.
Sensor Input section	**Sensor type**	A sensor that can be connected to the Unit.
	Input impedance	The input impedance of the thermocouple input, analog voltage input, and analog current input to the Unit.
	Resolution	The resolution of a thermocouple input and a platinum resistance thermometer input for the Unit. Defined in °C.
	Reference accuracy	The reference conversion accuracy of sensor inputs of the Unit. Defined at an ambient temperature of 25°C.
	Temperature coefficient	The conversion coefficient of sensor inputs of the Unit.
	Cold junction compensation error	The cold junction compensation error of the Unit.
	Input disconnection detection current	The current with which the Unit detects disconnection at thermocouple inputs.
	Input detection current	The current value to detect temperature inputs with this Unit using a platinum resistance thermometer.
	Effect of conductor resistance	The effect of conductor resistance of the Unit.
	Warm-up period	The warm-up period of the Unit. If the Unit is warmed up, the temperature inside the Unit is stable, as well as the measurement value. If the Unit is not warmed up, the temperature data error becomes larger.
	Conversion time	The time required to convert sensor input signals of the Unit to temperature data.

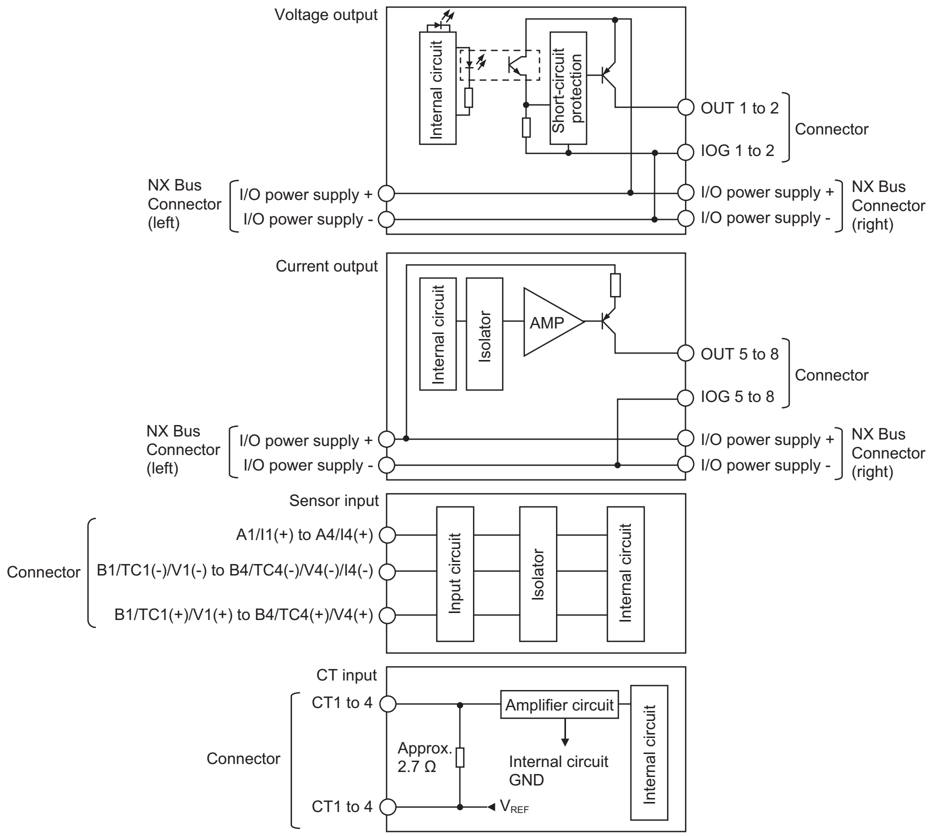
Item			Description
CT Input section	CT current input range		The input range of the CT input signals in the Unit.
	Input resistance		The internal resistance of the Unit, viewed from the CT input terminal of the Unit.
	Connectable CTs		The CT models that can be connected to the Unit.
	Maximum heater current		The maximum current value that can flow through the primary heater power line of the CT that is connected to the Unit.
	Resolution		The resolution of the CT current converted value in the Unit.
	Overall accuracy (25°C)		The CT current input conversion accuracy of the Unit. Defined at 25°C.
	Influence of temperature (0 to 55°C)		The accuracy of the CT current inputs that are influenced by changes in the ambient temperature of the Unit. It is defined as the deviation from the over-all accuracy.
	Conversion time		The time required to convert CT input signals to heater current converted values in the Unit.
Control Output section	Common	Control output type and points per channel	Type of control output of this Unit and the number of points per channel. There are two types of control output: voltage output (for driving SSR) and linear current output.
		Number of con-trol output points	The number of control output points of the Unit.
		MV	The range of the value of a manipulated variable that can be output from the Unit.
		Rated Voltage	The rated voltage for control output.
		Operating Load Voltage Range	The load voltage range of the control outputs on the Unit.
	Voltage output (for driving SSR)	Internal I/O com-mon	The polarity that the Unit uses to connect to output devices.
		Control period	The period when the ON/OFF time ratio is changed for time-proportional operation of voltage outputs (for driving SSR) in the Unit.
		Maximum load current	The maximum load current for voltage output (for driving SSR) of the Unit. Defines the specification of each voltage output (for driving SSR) point and for each Unit.
		Maximum Inrush Current	The maximum allowable inrush current of the voltage output (for driving SSR) of the Unit. The inrush current of the connected external load must be lower than this value.
		Leakage current	The leakage current when the voltage output (for driving SSR) of the Unit is OFF.
		Residual voltage	The residual voltage when the voltage output (for driving SSR) of the Unit is ON.
		Load Short-cir-cuit Protection	Whether the load short-circuit protection function of the voltage output (for driving SSR) is installed in this Unit.
	Linear cur-rent output	Allowable load resistance	The allowable load resistance of the linear current output of this Unit.
		Resolution	The resolution of the linear current output of the Unit.
		Output range	The output range of the linear current output of the Unit.
		Overall accuracy (25°C)	The overall accuracy of the linear current output of the Unit.
		Influence of tem-perature (0 to 55°C)	The accuracy of the linear current outputs that are influenced by changes in the ambient temperature of the Unit. It is defined as the deviation from the overall accuracy.
Dimensions			The dimensions of the Unit. The dimensions are given in the form W × H × D. The dimensions are given in millimeters.

Item	Description
Isolation method	The isolation method between the following circuits in the Unit: • Between input circuit and internal circuit • Between output circuit and internal circuit • Between input circuits • Between output circuits
Insulation resistance	The insulation resistance between the insulated circuits in the Unit.
Dielectric strength	The dielectric strength between the insulated circuits in the Unit.
I/O power supply method	The method for supplying I/O power to the Unit. The supply method is determined for each Unit. The power is supplied from the NX bus or the external source.
Current capacity of I/O power supply terminals	The current capacity of the I/O power supply terminals (IOV and IOG) on the Unit. When I/O power is supplied to external devices connected to this Unit, do not supply a voltage that exceeds this value.
NX Unit power consumption	The NX Unit power consumption of this Unit. Shows the power consumption when the NX Unit is connected to a CPU Unit and when connected to a Communications Coupler Unit.
Current consumption from I/O power supply	The current consumption of the Unit from the I/O power supply. The current consumption of any connected external devices is excluded.
Weight	The weight of the Unit.
Circuit configuration	The circuit layout of the sensor input, CT input and control output circuits of the Unit.
Installation orientation and restrictions	The installation orientation of the CPU Unit and the Slave Terminal, including this Unit. Any restrictions to specifications that result from the installation orientation are also given.
Terminal connection diagram	The connection diagram between the Unit and external devices. Shows any I/O Power Supply Connection Units or Shield Connection Units that are required to connect a connected external device.

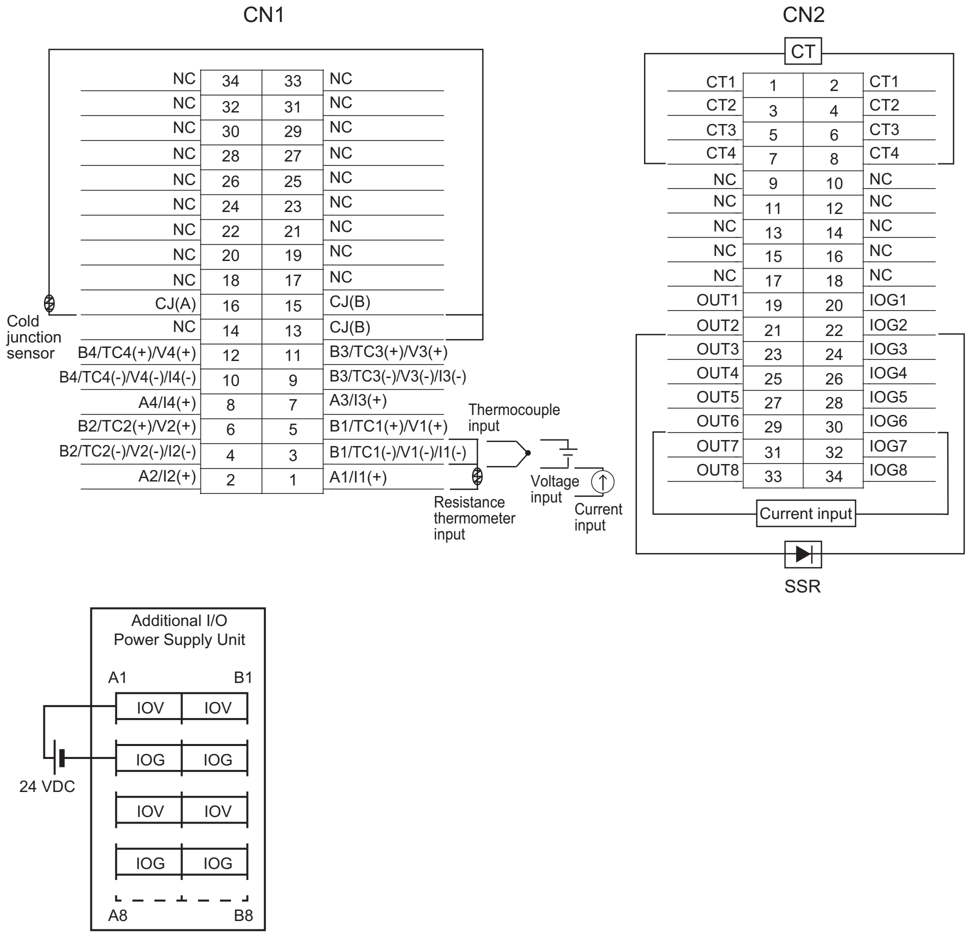
4-Channel Type, MIL Connector, 30 mm Width

<table>
<tr><td colspan="2">Unit name</td><td>Advanced Temperature Control Units (4-Channel Type)</td><td colspan="3">Model</td><td>NX-HTC3510-5</td></tr>
<tr><td colspan="2">Number of Channels</td><td>4 channels</td><td colspan="3">Control type</td><td>Heating and cooling control</td></tr>
<tr><td colspan="2">Number of points per channel</td><td>• Universal inputs: 1 point per channel (4 points per Unit)
• CT Input: 1 point per channel (4 points per Unit)
• Control Output: 2 points per channel (8 points per Unit)</td><td colspan="3">External connection terminal</td><td>MIL connector 34 poles, 2 rows *4</td></tr>
<tr><td colspan="2">I/O refreshing method</td><td colspan="5">Free-Run Refreshing</td></tr>
<tr><td colspan="2" rowspan="4">Indicators</td><td rowspan="4">TS indicator and output indicators

</td><td colspan="2" rowspan="8">CT
Input section</td><td>CT current input range</td><td>0 to 0.125 A</td></tr>
<tr><td>Input resistance</td><td>Approx. 2.7 Ω</td></tr>
<tr><td>Connectable CTs</td><td>E54-CT1, E54-CT3, E54-CT1L, and E54-CT3L</td></tr>
<tr><td>Maximum heater current</td><td>50 A AC</td></tr>
<tr><td rowspan="16">Sensor Input section</td><td rowspan="4">Sensor type *1</td><td rowspan="4">• Thermocouple input: K, J, T, E, L, U, N, R, S, B, C/W, PL II
• Platinum resistance thermometer input: Pt100 (three-wire), JPt100 (three-wire)
• Analog input
Current: 4 to 20 mA, 0 to 20 mA
Voltage: 1 to 5 V, 0 to 5 V, 0 to 10 V</td><td>Resolution</td><td>0.1 A</td></tr>
<tr><td>Overall accuracy (25°C)</td><td>±5% (full scale) ±1 digit</td></tr>
<tr><td>Influence of temperature (0 to 55°C)</td><td>±2% (full scale) ±1 digit</td></tr>
<tr><td>Conversion time</td><td>50 ms per Unit</td></tr>
<tr><td>Input impedance</td><td>Thermocouple input: 20 Ω min.
Analog voltage input: 1 MΩ min.
Analog current input: 150 Ω max.</td><td rowspan="12">Control Output section</td><td rowspan="5">Common</td><td>Control output type and number of control outputs per channel</td><td>Voltage output for driving SSR, 1 point per channel
Linear current output, 1 point per channel</td></tr>
<tr><td rowspan="3">Resolution</td><td rowspan="3">• 0.01°C max. (Thermocouple K (input type):
-50 to 700°C and Pt100:
-200 to 500°C only)
• 0.1°C max. (except for the above-mentioned)</td><td>Number of control output Methods points</td><td>8 (heating: 4, cooling: 4)</td></tr>
<tr><td>Manipulated variable</td><td>-105 to +105%</td></tr>
<tr><td>Rated Voltage</td><td>24 VDC</td></tr>
<tr><td>Reference accuracy</td><td>*2</td><td>Operating Load Voltage Range</td><td>12 to 28.8 VDC</td></tr>
<tr><td>Temperature coefficient</td><td>*2</td><td rowspan="7">Voltage output (for driving SSR)</td><td>Internal I/O common</td><td>PNP</td></tr>
<tr><td rowspan="2">Cold junction compensation error</td><td rowspan="2">±1.2°C *3</td><td>Control Period</td><td>0.1, 0.2, 0.5, 1 to 99s</td></tr>
<tr><td>Maximum load current</td><td>21 mA per point, 84 mA per Unit</td></tr>
<tr><td rowspan="2">Input disconnection detection current</td><td rowspan="2">Approx. 0.1 uA</td><td>Maximum Inrush Current</td><td>0.3 A max. per point, 10 ms max.</td></tr>
<tr><td>Leakage current</td><td>0.1 mA max.</td></tr>
<tr><td rowspan="2">Input detection current</td><td rowspan="2">0.25 mA</td><td>Residual voltage</td><td>1.5 V max.</td></tr>
<tr><td>Load Short-circuit Protection</td><td>Provided</td></tr>
</table>

Sensor Input section	**Effect of conductor resistance**	• Thermocouple input: 0.1°C/Ω (100 Ω or less per conductor) • Platinum resistance thermometer input: 0.06°C/Ω (20 Ω or less per conductor)	**Control Output section**	**Linear current output**	**Allowable load resistance**	350 Ω max.
					Resolution	1/10,000
					Output range	0 to 20 mA 4 to 20 mA
					Overall accuracy (25°C)	±0.3% of full scale, but 1% of full scale at 0 to 4 mA of 0 to 20 mA range
	Warm-up period	30 minutes			**Influence of temperature (0 to 55°C)**	±0.3% (full scale)
	Conversion time	50 ms per Unit				
Dimensions		30 mm (W) ×100 mm (H) ×71 mm (D)	**Isolation method**			• Between sensor inputs and internal circuitry: Power = Transformer, Signal = Digital isolator • Between sensor inputs: Power = Transformer, Signal = Digital isolator • No isolation between internal circuits and CT inputs • Between control output and internal circuit: Photocoupler (voltage output), digital isolator (linear current output) • No isolation between control outputs
Insulation resistance		20 MΩ min. between isolated circuits (at 100 VDC)				
I/O power supply method		Supplied from the NX bus.				
NX Unit power consumption		• Connected to a CPU Unit 1.55 W max. • Connected to Communications Coupler Unit 1.35 W max.	**Dielectric strength**			510 VAC between isolated circuits for 1 minute with a leakage current of 5 mA max.
			Current capacity of I/O power supply terminals			IOG: 0.1 A max. per terminal
			Current consumption from I/O power supply			30 mA max.
Weight		125 g max.				
Circuit configuration						

<table>
<tr>
<td>Installation orientation and restrictions</td>
<td>Mounting orientation:
• Connect to CPU Unit
Front mounting orientation is possible
• Connect to Communications Coupler Unit
Six orientations are possible

Limitation:
The cold junction compensation error varies according to the input type. For details, refer to A-1-4 Cold Junction Compensation Error Specifications for Units That Support Thermocouple Inputs on page A-14.</td>
</tr>
<tr>
<td>Terminal connection diagram *5</td>
<td>


</td>
</tr>
</table>

*1. For the setting ranges and indication ranges of the sensors, refer to the *7-3-1 Input Type Settings* on page 7-11.

*2. For details, refer to the *A-1-3 Reference Accuracy and Temperature Coefficient Table* on page A-12.

*3. The cold junction compensation error varies according to the input type. For details, refer to *A-1-4 Cold Junction Compensation Error Specifications for Units That Support Thermocouple Inputs* on page A-14.

*4. Make sure you use an Connector-Terminal Block Conversion Unit to route the sensor input side.
The recommended Connector-Terminal Block Conversion Unit is XW2K-34G-T and its dedicated connecting cable is XW2Z-□□□ EE.

*5. The cold junction sensor used for cold junction compensation is provided with the Advanced Temperature Control Unit. (The sensor is not premounted on the Unit.) Make sure you connect the cold junction sensor to the Ultra-Compact Interface Wiring System (XW2K-34G-T) before using the Advanced Temperature Control Unit. For details, refer to the *4-3-9 Installing and Removing the Cold Junction Sensor* on page 4-28.

8-Channel Type, MIL Connector, 30 mm Width

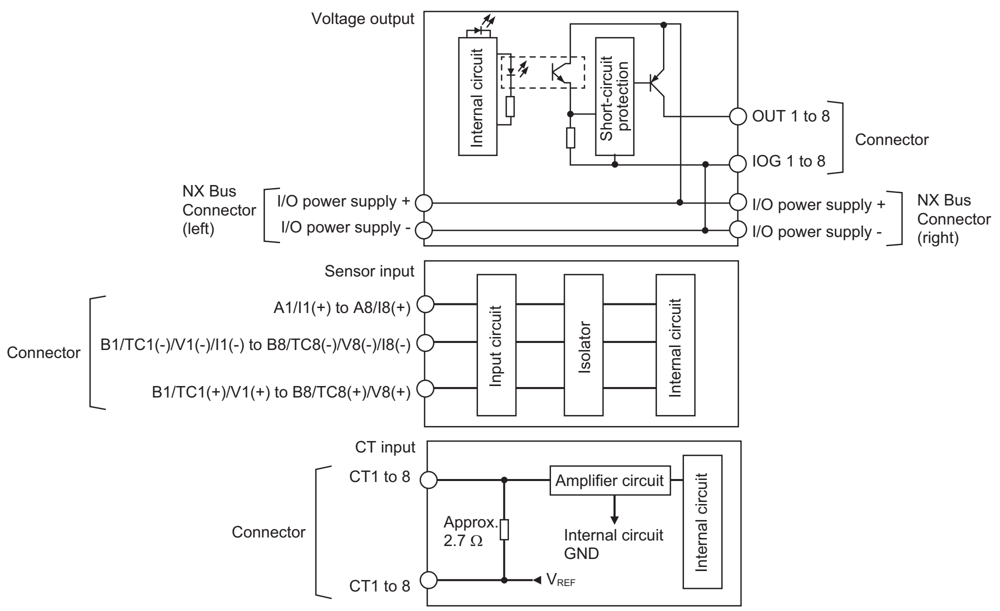
Unit name	Advanced Temperature Control Units (8-Channel Type)	**Model**	NX-HTC4505-5
Number of Channels	8 channels	**Control type**	Standard control
Number of points per channel	• Universal inputs: 1 point per channel (8 points per Unit) • CT Input: 1 point per channel (8 points per Unit) • Control Output: 1 point per channel (8 points per Unit)	**External connection terminal**	MIL connector 34 poles, 2 rows *4
I/O refreshing method	Free-Run Refreshing		

Indicators		TS indicator and output indicators 
Sensor Input section	**Sensor type** *1	• Thermocouple input: K, J, T, E, L, U, N, R, S, B, C/W, PL II • Platinum resistance thermometer input: Pt100 (three-wire), JPt100 (three-wire) • Analog input Current: 4 to 20 mA, 0 to 20 mA Voltage: 1 to 5 V, 0 to 5 V, 0 to 10 V
	Input impedance	Thermocouple input: 20 Ω min. Analog voltage input: 1 MΩ min. Analog current input: 150 Ω max.
	Resolution	• 0.01°C max. (Thermocouple K (input type): -50 to 700°C and Pt100: -200 to 500°C only) • 0.1°C max. (except for the above-mentioned)
	Reference accuracy	*2
	Temperature coefficient	*2
	Cold junction compensation error	±1.2°C *3
	Input disconnection detection current	Approx. 0.1 uA

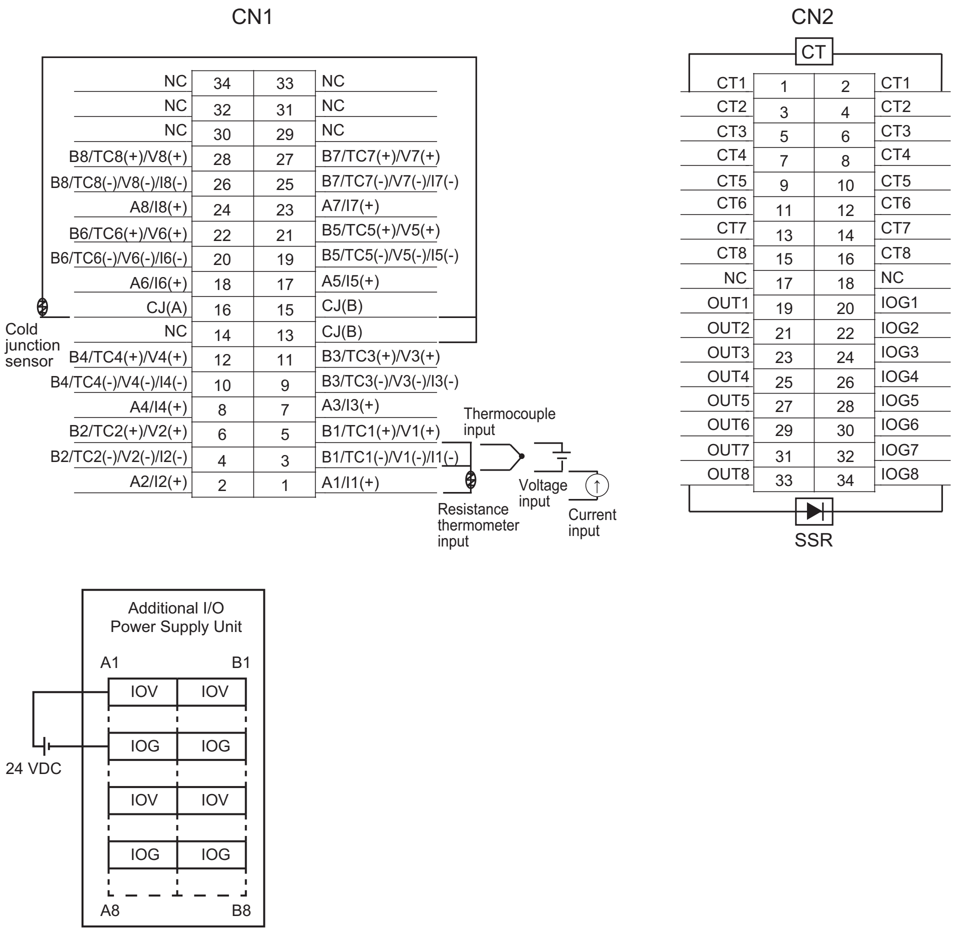
CT Input section		**CT current input range**	0 to 0.125 A
		Input resistance	Approx. 2.7 Ω
		Connectable CTs	E54-CT1, E54-CT3, E54-CT1L, and E54-CT3L
		Maximum heater current	50 A AC
		Resolution	0.1 A
		Overall accuracy (25°C)	±5% (full scale) ±1 digit
		Influence of temperature (0 to 55°C)	±2% (full scale) ±1 digit
		Conversion time	50 ms per Unit
Control Output section	**Common**	**Control output type and number of control outputs per channel**	Voltage output for driving SSR, 1 point per channel
		Number of control output Methods points	8
		Manipulated variable	-5 to +105%
		Rated Voltage	24 VDC
		Operating Load Voltage Range	12 to 28.8 VDC
	Voltage output (for driving SSR)	**Internal I/O common**	PNP
		Control Period	0.1, 0.2, 0.5, 1 to 99s
		Maximum load current	21 mA per point, 168 mA per Unit
		Maximum Inrush Current	0.3 A max. per point, 10 ms max.
		Leakage current	0.1 mA max.
		Residual voltage	1.5 V max.
		Load Short-circuit Protection	Provided

Sensor Input section	**Input detection current**	0.25 mA
	Effect of conductor resistance	• Thermocouple input: 0.1°C/Ω (100 Ω or less per conductor) • Platinum resistance thermometer input: 0.06°C/Ω (20 Ω or less per conductor)
	Warm-up period	30 minutes
	Conversion time	50 ms per Unit
Dimensions		30 mm (W) ×100 mm (H) ×71 mm (D)
Insulation resistance		20 MΩ min. between isolated circuits (at 100 VDC)
I/O power supply method		Supplied from the NX bus.
NX Unit power consumption		• Connected to a CPU Unit 1.95 W max. • Connected to Communications Coupler Unit 1.65 W max.

Control Output section	**Linear current output**	**Allowable load resistance**	---
		Resolution	---
		Output range	---
		Overall accuracy (25°C)	---
		Influence of temperature (0 to 55°C)	---
Isolation method			• Between sensor inputs and internal circuitry: Power = Transformer, Signal = Digital isolator • Between sensor inputs: Power = Transformer, Signal = Digital isolator • No isolation between internal circuits and CT inputs • Between control output and internal circuit: Photocoupler (voltage output) • No isolation between control outputs
Dielectric strength			510 VAC between isolated circuits for 1 minute with a leakage current of 5 mA max.
Current capacity of I/O power supply terminals			IOG: 0.1 A max. per terminal
Current consumption from I/O power supply			20 mA max.

Weight	130 g max.
Circuit configuration	

<table>
<tr><td>Installation orientation and restrictions</td><td>Mounting orientation:
• Connect to CPU Unit
Front mounting orientation is possible
• Connect to Communications Coupler Unit
Six orientations are possible

Limitation:
The cold junction compensation error varies according to the input type. For details, refer to A-1-4 Cold Junction Compensation Error Specifications for Units That Support Thermocouple Inputs on page A-14.</td></tr>
<tr><td>Terminal connection diagram *5</td><td>


</td></tr>
</table>

*1. For the setting ranges and indication ranges of the sensors, refer to the *7-3-1 Input Type Settings* on page 7-11.

*2. For details, refer to the *A-1-3 Reference Accuracy and Temperature Coefficient Table* on page A-12.

*3. The cold junction compensation error varies according to the input type. For details, refer to *A-1-4 Cold Junction Compensation Error Specifications for Units That Support Thermocouple Inputs* on page A-14.

*4. Make sure you use an Connector-Terminal Block Conversion Unit to route the sensor input side.
The recommended Connector-Terminal Block Conversion Unit is XW2K-34G-T and its dedicated connecting cable is XW2Z-☐☐☐ EE.

*5. The cold junction sensor used for cold junction compensation is provided with the Advanced Temperature Control Unit. (The sensor is not premounted on the Unit.) Make sure you connect the cold junction sensor to the Ultra-Compact Interface Wiring System (XW2K-34G-T) before using the Advanced Temperature Control Unit. For details, refer to the *4-3-9 Installing and Removing the Cold Junction Sensor* on page 4-28.

A-1-3 Reference Accuracy and Temperature Coefficient Table

Reference accuracies and temperature coefficients are shown below by input type and measurement temperature.

To convert the temperature unit from Celsius to Fahrenheit, use the following equation.
Fahrenheit temperature (°F) = Celsius temperature (°C) x 1.8 + 32

Set values	Input type		Measurement temperature (°C)	Reference accuracy °C (%)	Temperature coefficient °C/°C *1 (ppm/°C *2)
	Sensor	Temperature range (°C)			
0	Pt100	-200.00 to 500.00	-200.00 to 300.00	±0.70 (±0.1%)	±0.10 (±150 ppm/°C)
			300.00 to 500.00		±0.20 (±300 ppm/°C)
1	Pt100	-200.0 to 850.0	-200.0 to 300.0	±1.0 (±0.1%)	±0.1 (±100 ppm/°C)
			300.0 to 700.0	±2.0 (±0.2%)	±0.2 (±200 ppm/°C)
			700.0 to 850.0	±2.5 (±0.25%)	±0.25 (±250 ppm/°C)
2	JPt100	-199.9 to 500.0	-199.9 to 300.0	±0.8 (±0.12%)	±0.1 (±150 ppm/°C)
			300.0 to 500.0		±0.2 (±300 ppm/°C)
3	K	-50.00 to 700.00	-50.0 to 400.0	±0.75 (±0.1%)	±0.30 (±400 ppm/°C)
			400.0 to 700.0		±0.38 (±510 ppm/°C)
4	K	-200.00 to 1300.00	-200.0 to -100.0	±1.5 (±0.1%)	±0.15 (±100 ppm/°C)
			-100.0 to 400.0		±0.30 (±200 ppm/°C)
			400.0 to 1300.0		±0.38 (±250 ppm/°C)
5	J	-100.0 to 850.0	-100.0 to 400.0	±1.4 (±0.15%)	±0.14 (±150 ppm/°C)
			400.0 to 850.0	±1.2 (±0.13%)	±0.28 (±300 ppm/°C)
6	T	-200.0 to 400.0	-200.0 to -100.0	±1.2 (±0.2%)	±0.30 (±500 ppm/°C)
			-100.0 to 400.0		±0.12 (±200 ppm/°C)
7	E	-200.0 to 600.0	-200.0 to 400.0	±1.2 (±0.15%)	±0.12 (±150 ppm/°C)
			400.0 to 600.0	±2.0 (±0.25%)	±0.24 (±300 ppm/°C)
8	L	-100.0 to 850.0	-100.0 to 300.0	±1.1 (±0.12%)	±0.11 (±120 ppm/°C)
			300.0 to 700.0	±2.2 (±0.24%)	±0.22 (±240 ppm/°C)
			700.0 to 850.0		±0.28 (±300 ppm/°C)
9	U	-200.0 to 400.0	-200.0 to 400.0	±1.2 (±0.2%)	±0.12 (±200 ppm/°C)
10	N	-200.0 to 1300.0	-200.0 to 400.0	±1.5 (±0.1%)	±0.30 (±200 ppm/°C)
			400.0 to 1000.0		
			1000.0 to 1300.0		±0.38 (±250 ppm/°C)
11	R	0.0 to 1700.0	0.0 to 500.0	±1.75 (±0.11%)	±0.44 (±260 ppm/°C)
			500.0 to 1200.0	±2.5 (±0.15%)	
			1200.0 to 1700.0		
12	S	0.0 to 1700.0	0.0 to 600.0	±2.5 (±0.15%)	±0.44 (±260 ppm/°C)
			600.0 to 1100.0		
			1100.0 to 1700.0		
13	B	0.0 to 1800.0	0.0 to 400.0	Reference accuracy cannot be guaranteed	Reference accuracy cannot be guaranteed
			400.0 to 1200.0	±3.6 (±0.2%)	±0.45 (±250 ppm/°C)
			1200.0 to 1800.0	±5.0 (±0.28%)	±0.54 (±300 ppm/°C)
14	C/W	0.0 to 2300.0	0.0 to 300.0	±1.15 (±0.05%)	±0.46 (±200 ppm/°C)
			300.0 to 800.0	±2.3 (±0.1%)	
			800.0 to 1500.0	±3.0 (±0.13%)	
			1500.0 to 2300.0		±0.691 (±300 ppm/°C)
15	PL II	0.0 to 1300.0	0.0 to 400.0	±1.3 (±0.1%)	±0.23 (±200 ppm/°C)
			400.0 to 800.0	±2.0 (±0.15%)	±0.39 (±300 ppm/°C
			800.0 to 1300.0		±0.65 (±500 ppm/°C)

Set values	Input type		Reference accuracy (%)	Temperature coefficient (ppm/°C)
	Sensor	Input range		
16	Analog current	4 to 20 mA	0.1	340 ppm/°C
17	Analog current	0 to 20 mA	0.1	340 ppm/°C
18	Analog voltage	1 to 5 V	0.1	340 ppm/°C
19	Analog voltage	0 to 5 V	0.1	340 ppm/°C
20	Analog voltage	0 to 10 V	0.1	340 ppm/°C

*1. An error for a measured value when the ambient temperature changes by 1°C.
The following formula is used to calculate the error of the measured value for thermocouple inputs..
Overall accuracy = Reference accuracy + Temperature characteristic x Change in the ambient temperature + Cold junction compensation error
For resistance thermometer inputs, there is no cold junction compensation error.
(Calculation example)

- Conditions

Item	Description
Ambient temperature	30°C
Measured value	100.0°C
Thermocouple	K (4)
Reference accuracy 25°C	-200.0 to 1,300.0: ±1.5°C

- The characteristic values are formulated from the datasheet or reference accuracy and temperature coefficient table under the above conditions

Item	Description
Reference accuracy	30°C
Temperature coefficient	-100.0 to 400.0°C: ±0.30°C/°C
Change in the ambient temperature	25°C -> 30°C 5 deg
Cold junction compensation error	±1.2°C

Therefore,
Overall accuracy = Reference accuracy + Temperature characteristic x Change in the ambient temperature + Cold junction compensation error
= ±1.5°C +(±0.30°C/°C) x 5 deg + ±1.2°C
= ±4.2°C

Then the overall accuracy is ±4.2°C.

*2. The ppm value is for the full scale of the temperature range.

A-1-4 Cold Junction Compensation Error Specifications for Units That Support Thermocouple Inputs

The cold junction compensation error for thermocouple inputs is as follows.

The cold junction compensation error is ±1.2°C.

However, there are exceptions depending on the input type and temperature. Those conditions and the cold junction compensation error are as in the table below.

Input type and temperature range	Cold junction compensation error
T below -90°C	±3.0°C
J, E, K and N below -100°C	
U, L and PLII	
R and S below 200°C	
B below 400°C	Not guaranteed
C/W	±3.0°C

In order to measure with accuracy

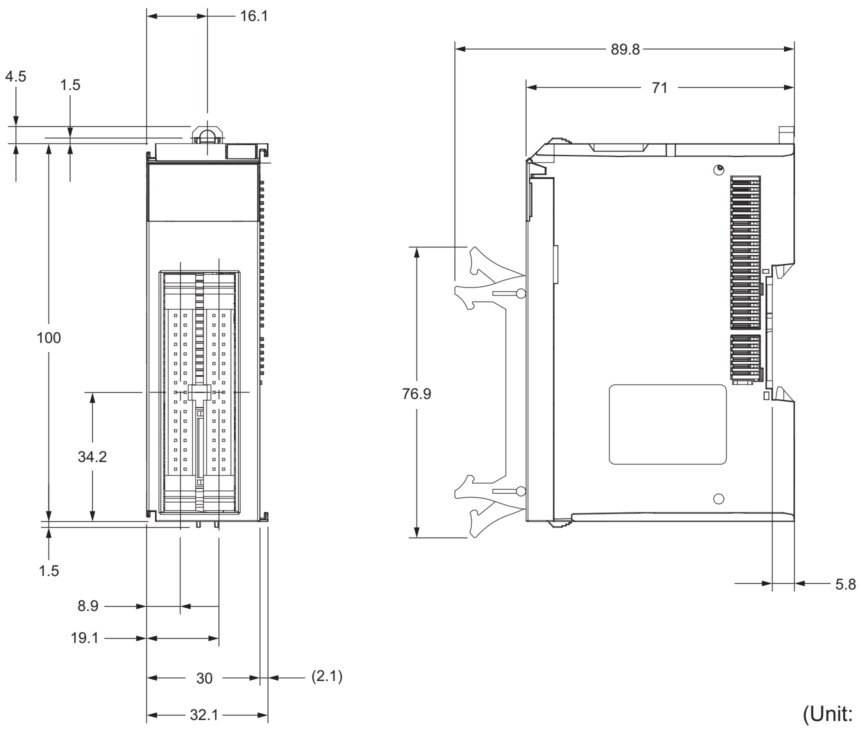
Install the cold junction sensor and its mounted Connector-Terminal Block Conversion Unit far enough away from any heat-generating elements.

Otherwise, the heat from those elements increases the cold junction compensation error.

A-2 Dimensions

A-2-1 Unit with MIL Connector

30 mm Width



(Unit: mm)

A-3 List of NX Objects

This section describes the NX objects of the Advanced Temperature Control Units.

The method to access NX objects through instructions or other messages depends on where the NX Unit is connected.

If the NX Unit is connected to a CPU Unit, access is possible with the Read NX Unit Object instruction and the Write NX Unit Object instruction. When the NX Unit is connected to a Communications Coupler Unit, the method depends on the connected communications master and Communications Coupler Unit.

Refer to the user's manual for the connected Communications Coupler Unit for method to use messages to access NX objects on Slave Terminals.

A-3-1 Format of Object Descriptions

In this manual, NX objects are described with the following format.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute

Index (hex)	:	This is the index of the NX object that is expressed as a four-digit hexadecimal number.
Subindex (hex)	:	This is the subindex of the NX object that is expressed as a two-digit hexadecimal number.
Object name	:	This is the name of the object. For a subindex, this is the name of the subindex.
Default	:	This is the value that is set by default.
Data range	:	For a read-only (RO) NX object, this is the range of the data you can read. For a read-write (RW) NX object, this is the setting range of the data.
Unit	:	The unit is the physical units.
Data types	:	This is the data type of the object.
Access	:	This data tells if the object is read-only or read/write. RO: Read only RW: Read/write
I/O allocation	:	This tells whether I/O allocation is allowed.
Data attribute	:	This is the timing when changes to writable NX objects are enabled. Y: Enabled by restarting N: Enabled at all times -: Write-prohibited

A-3-2 Unit Information Objects

This object gives the product information.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
1000	---	NX Bus Identity	---	---	---	---	---	---	---
	00	Number of Entries	7	7	---	USINT	RO	Not Possible	---
	02	Model	*1	---	---	ARRAY [0..11] OF BYTE	RO	Not Possible	---
	03	Device Type	*2	---	---	UDINT	RO	Not Possible	---
	05	Vendor Code	00000001 hex *3	---	---	UDINT	RO	Not Possible	---
	06	Unit Versions	*4	---	---	UDINT	RO	Not Possible	---
	07	Serial number	*5	00000000 to FFFFFFFF hex	---	UDINT	RO	Not Possible	---
1001	---	Production Info	---	---	---	---	---	---	---
	00	Number of Entries	4	4	---	USINT	RO	Not Possible	---
	01	Lot number	*6	00000000 to FFFFFFFF hex	---	UDINT	RO	Not Possible	---
	02	Hardware Version	*7	---	---	ARRAY [0..19] OF BYTE	RO	Not Possible	---
	03	Software Version	*7	---	---	ARRAY [0..19] OF BYTE	RO	Not Possible	---

*1. The Unit product models are assigned in ASCII code. If all 12 bytes are not required, the remaining bytes are filled with spaces ($20).

*2. The product codes are assigned for each product models.
Bits 0 to 31:Product code

*3. OMRON vendor code

*4. Bits 24 to 31: Integer part of the Unit version
Bits 16 to 23: Fractional part of the Unit version
Bits 0 to 15: Reserved
(Example) For Ver.1.0, 0100□□□□ hex

*5. A unique serial number is assigned for each product Unit.
Bits 0 to 31: Serial number

*6. The year, month, and day of production are assigned to the “lot number”.
Bits 24 to 31:Date of production
Bits 16 to 23:Month of production
Bits 8 to 15:Year of production
Bits 0 to 7:Reserved

*7. The version is returned in ASCII code. It is given as follows:”V” ($56), integer part of version, period ($2E), decimal part of version. If all 20 bytes are not required, the remaining bytes are filled with spaces ($20).
Example for version 1.00:$56$31$2E$30$30$20$20$20$20$20$20$20$20$20$20$20$20$20$20$20

A-3-3 Objects That Accept I/O Allocations

These objects accept I/O allocations.

If you assign any of the objects that are described below to I/O, you can no longer access those objects with the Read NX Unit Object instruction, Write NX Unit Object instruction, or other messages.

Precautions for Correct Use

The Advanced Temperature Control Unit provides I/O data for up to 8 channels (4 channels for cooling control parameters). In this manual, the same parameters between channels are omitted for easier reading as shown in the table below.

The second digit is incremented for the subindex.

Example:

Data name	Index [hex]	Subindex [hex]
Ch1 Measured Value INT	6005	01
•••		•••
Ch8 Measured Value INT		71
Ch1 Measured Value REAL		02
•••		•••
Ch8 Measured Value REAL		72

Data name	Index [hex]	Subindex [hex]
Ch1 to Ch8 Measured Value INT	6005	01 to 71
Ch1 to Ch8 Measured Value REAL		02 to 72

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6000	-	Unit Status	---	---	---	---	---	---	---
	00	Number of Entries	1	1	---	USINT	RO	Not Possible	---
	01	Unit Status	0000 hex	0000 to FFFF hex	---	WORD	RO	Possible.	---

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6001	---	Channel Operat-ing Status	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Oper-ating Status	0000 hex	0000 to FFFF hex	---	WORD	RO	Possible.	---
	02 to 72	Ch1 to Ch8 Oper-ating Status2	0000 hex	0000 to FFFF hex	---	WORD	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6002	-	Channel Output and Alarm Status	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Output and Alarm Status	0000 hex	0000 to FFFF hex	---	WORD	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6003	---	Unit	---	---	---	---	---	---	---
	00	Number of Entries	1	1	---	USINT	RO	Not Possi-ble	---
	01	Terminal Ambient Temperature	0	-300 to 1710	0.1°C or 0.1°F*1	INT	RO	Possible.	---

*1. The temperature unit follows the Ch1 Temperature Unit setting, regardless of the Ch1 Enable/Disable setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6004	---	Decimal Point Position Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Decimal Point Position Monitor	0	0: No decimal point 1: One digit decimal point 2: Two digit decimal points 3: Three digit decimal points	---	UINT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6005	---	Measured Value	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Measured Value INT	0	-32400 to 32400*2	EU*3	INT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 Measured Value REAL	0	-32400 to 32400*2	EU*4	REAL	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When an error occurs, the maximum value in the input setting range that is determined by the selected input type is applied.

*3. When the EU unit is Temperature Input, it depends on the Ch□ Temperature Unit and the Ch□ Decimal Point Position setting. For analog input, it depends on the Ch□ Decimal Point Position setting.

*4. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch□ Temperature unit. For analog input, it depends on the Ch□ Decimal Point Position setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6007	---	MV Monitor Heating	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 MV Monitor Heating INT	*2	*2	0.1%	INT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 MV Monitor Heating REAL	*3	*3	%	REAL	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. The default value and data range for “Ch□ MV Monitor (Heating) INT” are as follows.

NX Unit	Default value	Data range
NX-HTC4505	0	-50 to 1050
NX-HTC3510	0	0 to 1050

*3. The default value and data range for “Ch□ MV Monitor (Heating) REAL” are as follows.

NX Unit	Default value	Data range
NX-HTC4505	0	-5 to 105
NX-HTC3510	0	0 to 105

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6009	---	MV Monitor Cooling	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possible	---
	01 to 31	Ch1 to Ch4 MV Monitor Cooling INT	0	0 to 1050	0.1%	INT	RO	Possible.	---
	02 to 32	Ch1 to Ch4 MV Monitor Cooling REAL	0	0 to 105	%	REAL	RO	Possible.	---

This is an object held by the heating/cooling control type NX-HTC3510 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
600B	---	Heater Current UINT	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Heater Current UINT*2	0	0 to 550	0.1 A	UINT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 Heater Current REAL*2	0	0 to 55	A	REAL	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Refer to *7-7-2 Heater Burnout Detection* on page 7-83 for details of the current values when the ON time of the control output is less than the specified time or when the heater current exceeds the measurement range.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
600D	---	Leakage Current	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Leak-age Current UINT*2	0	0 to 550	0.1 A	UINT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 Leak-age Current REAL*2	0	0 to 55	A	REAL	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Refer to *7-7-3 SSR Failure Detection* on page 7-86 for details of the current values when the OFF time of the control output is less than the specified time or when the leakage current exceeds the measurement range.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
600F	---	Proportional Band Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Proportional Band Monitor	800	1 to 65000	Temperature input: 0.01°C or 0.01°F*2 Analog input: 0.01%	UINT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Follows the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6010	---	Integral Time Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Integral Time Monitor	2330	0 to 39999	0.1 s	UINT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6011	---	Derivative Time Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Deriva-tive Time Monitor	400	0 to 39999	0.1 s	UINT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6012	---	Proportional Band Cooling Monitor	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possi-ble	---
	01 to 31	Ch1 to Ch4 Pro-portional Band Cooling Monitor	800	1 to 65000	Tempera-ture input: 0.01°C or 0.01°F*1 Analog input: 0.01%	UINT	RO	Possible.	---

This is an object held by the heating/cooling control type NX-HTC3510 only.

*1. Follows the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6013	---	Integral Time Cool-ing Monitor	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possi-ble	---
	01 to 31	Ch1 to Ch4 Inte-gral Time Cooling Monitor	2330	0 to 39999	0.1 s	UINT	RO	Possible.	---

This is an object held by the heating/cooling control type NX-HTC3510 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
6014	---	Derivative Time Cooling Monitor	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possi-ble	---
	01 to 31	Ch1 to Ch4 Deriva-tive Time Cooling Monitor	400	0 to 39999	0.1 s	UINT	RO	Possible.	---

This is an object held by the heating/cooling control type NX-HTC3510 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allo-cation	Data attribute
6015	---	Feature Value (Temperature) Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Pos-sible	---
	01 to 71	Ch1 to Ch8 Max.Tempera-ture Rise Gra-dient	0	0 to 65000	Temperature input: 0.01°C/sec-ond or 0.01°F/second*2 Analog input: EU/second	UINT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 Max.Tempera-ture Fall Gradi-ent	0	0 to 65000	Temperature input: 0.01°C/sec-ond or 0.01°F/second*2 Analog input: EU/second	UINT	RO	Possible.	---
	03 to 73	Ch1 to Ch8 Undershoot Value	0	0 to 65000	EU	UINT	RO	Possible.	---
	04 to 74	Ch1 to Ch8 Overshoot Value	0	0 to 65000	EU	UINT	RO	Possible.	---
	05 to 75	Ch1 to Ch8 Undershoot Time	0	0 to 65000	0.1 s	UINT	RO	Possible.	---
	06 to 76	Ch1 to Ch8 Overshoot Time	0	0 to 65000	0.1 s	UINT	RO	Possible.	---
	07 to 77	Ch1 to Ch8 Time-Delay	0	0 to 9999	0.1 s	UINT	RO	Possible.	---
	08 to 78	Ch1 to Ch8 Average Tem-perature Devi-ation	0	0 to 65000	EU	UINT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Follows the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6016	---	Feature Value (MV Heating) Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Average MV Heating	*2	*2	0.1%	INT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 Stable MV Heating	*2	*2	0.1%	INT	RO	Possible.	---
	03 to 73	Ch1 to Ch8 Max.MV Heating	*2	*2	0.1%	INT	RO	Possible.	---
	04 to 74	Ch1 to Ch8 Min.MV Heating	*2	*2	0.1%	INT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. The default value and data range for “Ch□ Average MV (Heating)” are as follows.

NX Unit	Default value	Data range
NX-HTC4505	0	-50 to 1050
NX-HTC3510	0	0 to 1050

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
6017	---	Feature Value (MV Cooling) Monitor	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possible	---
	01 to 31	Ch1 to Ch4 Average MV Cooling	0	0 to 1050	0.1%	INT	RO	Possible.	---
	02 to 32	Ch1 to Ch4 Stable MV Cooling	0	0 to 1050	0.1%	INT	RO	Possible.	---
	03 to 33	Ch1 to Ch4 Max.MV Cooling	0	0 to 1050	0.1%	INT	RO	Possible.	---
	04 to 34	Ch1 to Ch4 Min.MV Cooling	0	0 to 1050	0.1%	INT	RO	Possible.	---

This is an object held by the heating/cooling control type NX-HTC3510 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
601C	---	Input Digital Filter Monitor	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Input Digital Filter Monitor	0	0 to 9999	0.1 s	UINT	RO	Possible.	---

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
601D	---	Response Flag	---	---	---	---	---	---	---
	00	Number of Entries	1	1	---	USINT	RO	Not Possible	---
	01	Response Flag*1	0000 hex	0000 to FFFF hex	---	WORD	RO	Possible.	---

*1. This is the reflection result of the adjustment I/O data. Refer to *6-1-4 Response Flag* on page 6-23 for details on the response flag.

Index (hex)	Subindex (Hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
601E	---	PreBoost Monitor	---	---	---	---	---	---	---
	00	Number of Entries	127	127	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 FF1 Waiting Time Monitor	0	0 to 2000	0.1 s	UINT	RO	Possible.	---
	02 to 72	Ch1 to Ch8 FF1 Operation Time Monitor	1	1 to 3600	Seconds	UINT	RO	Possible.	---
	03 to 73	Ch1 to Ch8 FF1 Segment1 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	04 to 74	Ch1 to Ch8 FF1 Segment2 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	05 to 75	Ch1 to Ch8 FF1 Segment3 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	06 to 76	Ch1 to Ch8 FF1 Segment4 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	07 to 77	Ch1 to Ch8 FF2 Waiting Time Monitor	0	0 to 2000	0.1 s	UINT	RO	Possible.	---
	08 to 78	Ch1 to Ch8 FF2 Operation Time Monitor	1	1 to 3600	Seconds	UINT	RO	Possible.	---
	09 to 79	Ch1 to Ch8 FF2 Segment1 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	0A to 7A	Ch1 to Ch8 FF2 Segment2 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	0B to 7B	Ch1 to Ch8 FF2 Segment3 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---
	0C to 7C	Ch1 to Ch8 FF2 Segment4 MV Monitor	0	-1999 to 1999	0.1%	INT	RO	Possible.	---

This is an object held by the standard control type NX-HTC4505 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7000	---	Channel Operation Command	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Operation Command	0000 hex	0000 to FFFF hex	---	WORD	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Operation Command2*2	0000 hex	0000 to FFFF hex	---	WORD	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Not accessible via message communications.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7001	---	Set Point	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Set Point INT	0	-32400 to 32400*2	EU*3	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Set Point REAL	0	-32400 to 32400*2	EU*4	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. If you set a value that exceeds the input setting range determined by the input type, the upper limit or the lower limit of the input setting range is applied as the set point.
*3. When the EU unit is Temperature Input, it depends on the Ch□ Temperature Unit and Ch□ Decimal Point Position setting. For analog input, it depends on the Ch□ Decimal Point Position setting.
*4. The valid number of decimal places depends on the input type. Also, for temperature input, it depends on the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7003	---	Manual MV	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Manual MV INT*2	*2	*2	0.1%	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Manual MV REAL*3	*3	*3	%	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. The default value and data range for “Ch□ Manual MV INT” are as follows. If you set a negative value on the heating and cooling control type on the Unit, it will be a cooling output.

NX Unit	Default value	Data range
NX-HTC4505	0	-50 to 1050
NX-HTC3510	0	-1050 to 1050

*3. The default value and data range for “Ch□ Manual MV REAL” are as follows. If you set a negative value on the heating and cooling control type on the Unit, it will be a cooling output.

NX Unit	Default value	Data range
NX-HTC4505	0	-5 to 105
NX-HTC3510	0	-105 to 105

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7005	---	Proportional Band	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	---	---
	01	Ch1 to Ch8 Proportional Band	800	1 to 65000	Temperature input: 0.01°C or 0.01°F*2 Analog input: 0.01%	UINT	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Follows the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7006	---	Integral Time	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Integral Time	2330	0 to 39999	0.1 s	UINT	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7007	---	Derivative Time	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Derivative Time	400	0 to 39999	0.1 s	UINT	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7008	---	Proportional Band Cooling	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	---	---
	01 to 31	Ch1 to Ch4 Proportional Band Cooling	800	1 to 65000	Temperature input: 0.01°C or 0.01°F*1 Analog input: 0.01%	UINT	RW	Possible.	N

This is an object held by the heating/cooling control type NX-HTC3510 only.

*1. Follows the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7009	---	Integral Time Cooling	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possible	---
	01 to 31	Ch1 to Ch4 Integral Time Cooling	2330	0 to 39999	0.1 s	UINT	RW	Possible.	N

This is an object held by the heating/cooling control type NX-HTC3510 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
700 A	---	Derivative Time Cooling	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possible	---
	01 to 31	Ch1 to Ch4 Derivative Time Cooling	400	0 to 39999	0.1 s	UINT	RW	Possible.	N

This is an object held by the heating/cooling control type NX-HTC3510 only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7012	---	Alarm Value 1	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Alarm Value 1 INT	0	-32400 to 32400	EU*2 *3	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Alarm Value 1 REAL	0	-32400 to 32400	EU*3 *4	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When the EU unit is Temperature Input, it depends on the Ch☐ Temperature Unit and the Ch☐ Decimal Point Position setting. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*3. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch☐ Temperature unit. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*4. The unit becomes as shown below depending on the Ch☐ Alarm 1 Type Setting.

Ch☐ Alarm 1 Type Setting	Unit
1 to 11: Temperature alarm	°C or °F or %
12: LBA (Loop Burnout Alarm)	Seconds This function is available with temperature input only.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
7013	---	Alarm Value Upper Limit 1	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Alarm Value Upper Limit 1 INT	0	-32400 to 32400	EU*2	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Alarm Value Upper Limit 1 REAL	0	-32400 to 32400	EU*3	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When the EU unit is Temperature Input, it depends on the Ch☐ Temperature Unit and the Ch☐ Decimal Point Position setting. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*3. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch☐ Temperature unit. For analog input, it depends on the Ch☐ Decimal Point Position setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
7014	---	Alarm Value Lower Limit 1	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Alarm Value Lower Limit 1 INT	0	-32400 to 32400	EU*2	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Alarm Value Lower Limit 1 REAL	0	-32400 to 32400	EU*3	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When the EU unit is Temperature Input, it depends on the Ch☐ Temperature Unit and the Ch☐ Decimal Point Position setting. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*3. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch☐ Temperature unit. For analog input, it depends on the Ch☐ Decimal Point Position setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
7015	---	Alarm Value 2	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Alarm Value 2 INT	0	-32400 to 32400	EU*2	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Alarm Value 2 REAL	0	-32400 to 32400	EU*3	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When the EU unit is Temperature Input, it depends on the Ch☐ Temperature Unit and the Ch☐ Decimal Point Position setting. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*3. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch☐ Temperature unit. For analog input, it depends on the Ch☐ Decimal Point Position setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
7016	---	Alarm Value Upper Limit 2	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Alarm Value Upper Limit 2 INT	0	-32400 to 32400	EU*2	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Alarm Value Upper Limit 2 REAL	0	-32400 to 32400	EU*3	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When the EU unit is Temperature Input, it depends on the Ch☐ Temperature Unit and the Ch☐ Decimal Point Position setting. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*3. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch☐ Temperature unit. For analog input, it depends on the Ch☐ Decimal Point Position setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
7017	---	Alarm Value Lower Limit 2	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Alarm Value Lower Limit 2 INT	0	-32400 to 32400	EU*2	INT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Alarm Value Lower Limit 2 REAL	0	-32400 to 32400	EU*3	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. When the EU unit is Temperature Input, it depends on the Ch☐ Temperature Unit and the Ch☐ Decimal Point Position setting. For analog input, it depends on the Ch☐ Decimal Point Position setting.

*3. When the EU unit is Temperature Input, the decimal point position is automatically set by the selected sensor and depends on the Ch☐ Temperature unit. For analog input, it depends on the Ch☐ Decimal Point Position setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
7018	---	Heater Burnout Detection Current	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Heater Burnout Detection Current UINT	0	0 to 500	0.1 A	UINT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 Heater Burnout Detection Current REAL	0	0 to 50	A	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
7019	---	SSR Failure Detection Current	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 SSR Failure Detection Current UINT	500	0 to 500	0.1 A	UINT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 SSR Failure Detection Current REAL	50	0 to 50	A	REAL	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
701 A	---	PV Input Shift	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 PV Input Shift	0	-19999 to 32400	Temperature input: 0.01°C or 0.01°F*2 Analog input: EU*3	INT	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Follows the “Ch□ Temperature Unit” setting.
*3. The decimal point position depends on the “Ch□ Decimal Point Position” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
701B	---	Input Digital Filter	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Input Digital Filter	0	0 to 9999	0.1 s	UINT	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
701C	---	Hysteresis Heating	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 Hyster-esis Heating	10	1 to 9999	Tempera-ture input: 0.1°C or 0.1°F*2 Analog input: 0.01%	UINT	RW	Possible.	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Unit	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

*2. Follows the “Ch Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
701D	---	Hysteresis Cooling	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possi-ble	---
	01 to 31	Ch1 to Ch4 Hyster-esis Cooling	10	1 to 9999	Tempera-ture input: 0.1°C or 0.1°F*1 Analog input: 0.01%	UINT	RW	Possible.	N

This is an object held by the heating/cooling control type NX-HTC3510 only.

*1. Follows the “Ch□ Temperature Unit” setting.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O alloca-tion	Data attribute
701E	---	PreBoost Setting	---	---	---	---	---	---	---
	00	Number of Entries	127	127	---	USINT	RO	Not Possi-ble	---
	01 to 71	Ch1 to Ch8 FF1 Waiting Time	0	0 to 2000	0.1 s	UINT	RW	Possible.	N
	02 to 72	Ch1 to Ch8 FF1 Operation Time	1	1 to 3600	Sec-onds	UINT	RW	Possible.	N
	03 to 73	Ch1 to Ch8 FF1 Segment1 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	04 to 74	Ch1 to Ch8 FF1 Segment2 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	05 to 75	Ch1 to Ch8 FF1 Segment3 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	06 to 76	Ch1 to Ch8 FF1 Segment4 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	07 to 77	Ch1 to Ch8 FF1 Segment MV Vari-able Correction Coefficient	100	1 to 999	0.01	UINT	RW	Possible.	N
	08 to 78	Ch1 to Ch8 FF2 Waiting Time	0	0 to 2000	0.1 s	UINT	RW	Possible.	N
	09 to 79	Ch1 to Ch8 FF2 Operation Time	1	1 to 3600	Sec-onds	UINT	RW	Possible.	N
	0A to 7A	Ch1 to Ch8 FF2 Segment1 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	0B to 7B	Ch1 to Ch8 FF2 Segment2 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	0C to 7C	Ch1 to Ch8 FF2 Segment3 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	0D to 7D	Ch1 to Ch8 FF2 Segment4 MV	0	-1999 to 1999	0.1%	INT	RW	Possible.	N
	0E to 7E	Ch1 to Ch8 FF2 Segment MV Vari-able Correction Coefficient	100	1 to 999	0.01	UINT	RW	Possible.	N

This is an object held by the standard control type NX-HTC4505 only.

A-3-4 Other Objects

The list below shows objects of Unit operation settings.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5000	---	Ch Enable/Disable	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Enable/Disable	TRUE	FALSE/ TRUE	---	BOOL	RW	Not Possible	Y

Ch5 to Ch8 are not available in NX-HTC3510.
*1. The default value and data range for Number of Entries are as follows.

NX Units	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

- Refer to *Channel enable/disable parameters* on page 6-26 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the Ch Enable/Disable objects.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5001	---	Inputs	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Input Type	0	0 to 20	---	USINT	RW	Not Possible	Y
	02 to 72	Ch1 to Ch8 Temperature Unit	0	0 or 1	---	USINT	RW	Not Possible	Y
	03 to 73	Ch1 to Ch8 Decimal Point	4	0, 1, 2, 3 or 4	---	USINT	RW	Not Possible	Y
	04 to 74	Ch1 to Ch8 Cold Junction Compensation Enable/Disable	TRUE	FALSE/ TRUE	---	BOOL	RW	Not Possible	Y
	05 to 75	Ch1 to Ch8 PV Input Shift	0	-19999 to 32400	Temperature input: 0.01°C or 0.01°F Analog input: EU	INT	RW	Not Possible	N
	06 to 76	Ch1 to Ch8 PV Input Slope Coefficient	1000	1 to 9999	0.001	INT	RW	Not Possible	N
	07 to 77	Ch1 to Ch8 Input Digital Filter	0	0 to 9999	0.1 s	UINT	RW	Not Possible	N
	08 to 78	Ch1 to Ch8 Scaling Upper Limit	100	-19999 to 32400	EU	INT	RW	Not Possible	Y
	09 to 79	Ch1 to Ch8 Scaling Lower Limit	0	-19999 to 32400	EU	INT	RW	Not Possible	Y

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Units	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

- Refer to *Input function parameters* on page 6-26 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the input objects.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5002	---	Control Common	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 PID ON/OFF	1	0 or 1	---	USINT	RW	Not Possible	Y
	02 to 72	Ch1 to Ch8 Proportional Band	800	1 to 65000	Temperature input: 0.01°C or 0.01°F Analog input: 0.01%	UINT	RW	Not Possible	N
	03 to 73	Ch1 to Ch8 Integration Time	2330	0 to 39999	0.1 s	UINT	RW	Not Possible	N
	04 to 74	Ch1 to Ch8 Derivative Time	400	0 to 39999	0.1 s	UINT	RW	Not Possible	N
	05 to 75	Ch1 to Ch8 Hysteresis (Heating)	10	1 to 9999	Temperature input: 0.01°C or 0.01°F Analog input: 0.01%	UINT	RW	Not Possible	N
	06 to 76	Ch1 to Ch8 Direct/Reverse Operation	0	0 or 1	---	USINT	RW	Not Possible	Y
	07 to 77	Ch1 to Ch8 MV at Error	0	standard control -50 to 1050 heating and cooling control -1050 to 1050	0.1%	INT	RW	Not Possible	N
	08 to 78	Ch1 to Ch8 MV Upper Limit	1000	standard control -50 to 1050 heating and cooling control 0 to 1050	0.1%	INT	RW	Not Possible	N
	09 to 79	Ch1 to Ch8 MV Lower Limit	standard control: 0 heating and cooling control: -1000	standard control -50 to 1050 heating and cooling control -1050 to 0	0.1%	INT	RW	Not Possible	N
	0A to 7A	Ch1 to Ch8 Load Rejection Output Setting	0	0 or 1	---	USINT	RW	Not Possible	Y

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5002	0B to 7B	Ch1 to Ch8 Load Rejection MV	0	standard control -50 to 1050 heating and cooling control -1050 to 1050	0.1%	INT	RW	Not Possible	N
	0C to 7C	Ch1 to Ch8 α	65	0 to 100	0.01	USINT	RW	Not Possible	Y

Ch5 to Ch8 are not available in NX-HTC3510.

- Refer to *Control common parameters* on page 6-28 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the control common objects.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5003	---	Heating and Cooling Control	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possible	---
	01 to 31	Ch1 to Ch4 Proportional Band (Cooling)	800	1 to 65000	Temperature input: 0.01°C or 0.01°F Analog input: 0.01%	UINT	RW	Not Possible	N
	02 to 32	Ch1 to Ch4 Integral Time (Cooling)	2330	0 to 39999	0.1 s	UINT	RW	Not Possible	N
	03 to 33	Ch1 to Ch4 Derivative Time (Cooling)	400	0 to 39999	0.1 s	UINT	RW	Not Possible	N
	04 to 34	Ch1 to Ch4 Dead Band	0	-1999 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	INT	RW	Not Possible	N
	05 to 35	Ch1 to Ch4 Hysteresis (Cooling)	10	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	UINT	RW	Not Possible	N
	06 to 36	Ch1 to Ch4 Heating/Cooling Tuning Method	0	0, 1, 2 or 3	---	USINT	RW	Not Possible	Y
	07 to 37	Ch1 to Ch4 LCT Cooling Output Minimum ON Time	2	1 to 10	0.1 s	USINT	RW	Not Possible	Y

- Refer to *Heating and cooling control parameters* on page 6-30 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the heating and cooling control objects.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5009	---	Control Common - Voltage Output (for driving SSR)	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Control Period (Heating)	2	-2 to 99	---	INT	RW	Not Possible	Y
	02 to 72	Ch1 to Ch8 Minimum Output ON/OFF Band	10	0 to 500	0.1%	UINT	RW	Not Possible	Y

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Units	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

- Refer to *Parameters for voltage output for driving SSR that are common to all control models* on page 6-31 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the objects for voltage output for driving SSR that are common to all control outputs.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
500B	---	linear current output	---	---	---	---	---	---	---
	00	Number of Entries	63	63	---	USINT	RO	Not Possible	---
	01 to 31	Ch1 to Ch4 Output Signal Range	0	0 or 1	---	USINT	RW	Not Possible	Y

- Refer to *Parameters of the Feature Visualization Function* on page 6-37 under *6-2 List of Settings* on page 6-25 for details on the functions and the meaning of set values of each object of Feature Visualization.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
500C	---	MV Branch	---	---	---	---	---	---	---
	00	Number of Entries	127	127	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 MV Branch Operation	0	0 to 15	---	USINT	RW	Not Possible	Y
	02 to 72	Ch1 to Ch8 MV Slope	1000	1 to 9999	0.001	INT	RW	Not Possible	N
	03 to 73	Ch1 to Ch8 MV Offset	0	-1999 to 9999	0.1%	INT	RW	Not Possible	N

- For details on the functions and the meaning of set values of each object of MV Branch, refer to *Parameters for MV branch operation* on page 6-32 under *6-2 List of Settings* on page 6-25.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
500D	---	Heater Burnout Detection	---	---	---	---	---	---	---
	00	Number of Entries	127	127	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Heater Burnout Detection Current	0	0 to 500	0.1A	UINT	RW	Not Possible	N
	02 to 72	Ch1 to Ch8 SSR Failure Detection Current	500	0 to 500	0.1A	UINT	RW	Not Possible	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Units	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

- Refer to *Heater error detection parameters* on page 6-32 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the objects for heater error detection.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
500E	---	Alarm	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Alarm 1 Type	0	0 to 12	---	USINT	RW	Not Possible	Y
	02 to 72	Ch1 to Ch8 Alarm 2 Type	0	0 to 12	---	USINT	RW	Not Possible	Y
	03 to 73	Ch1 to Ch8 Alarm 1 Hysteresis	2	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	UINT	RW	Not Possible	Y
	04 to 74	Ch1 to Ch8 Alarm 2 Hysteresis	2	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.01%	UINT	RW	Not Possible	Y

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Units	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

- For details on the functions and the meaning of set values of each object of Alarm, refer to *Temperature alarms parameters* on page 6-33 under *6-2 List of Settings* on page 6-25.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5010	---	PreBoost	---	---	---	---	---	---	---
	00	Number of Entries	127	127	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 FF1 Waiting Time	0	0 to 2000	0.1 s	UINT	RW	Not Possible	N
	02 to 72	Ch1 to Ch8 FF1 Operation Time	1	1 to 3600	Seconds	UINT	RW	Not Possible	N
	03 to 73	Ch1 to Ch8 FF1 Segment1 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	04 to 74	Ch1 to Ch8 FF1 Segment2 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	05 to 75	Ch1 to Ch8 FF1 Segment3 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	06 to 76	Ch1 to Ch8 FF1 Segment4 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	07 to 77	Ch1 to Ch8 FF1 Segment MV Variable Correction Coefficient	100	1 to 999	0.01	UINT	RW	Not Possible	N
	08 to 78	Ch1 to Ch8 FF2 Waiting Time	0	0 to 2000	0.1 s	UINT	RW	Not Possible	N
	09 to 79	Ch1 to Ch8 FF2 Operation Time	1	1 to 3600	Seconds	UINT	RW	Not Possible	N
	0A to 7A	Ch1 to Ch8 FF2 Segment1 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	0B to 7B	Ch1 to Ch8 FF2 Segment2 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	0C to 7C	Ch1 to Ch8 FF2 Segment3 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	0D to 7D	Ch1 to Ch8 FF2 Segment4 MV	0	-1999 to 1999	0.1%	INT	RW	Not Possible	N
	0E to 7E	Ch1 to Ch8 FF2 Segment MV Variable Correction Coefficient	100	1 to 999	0.01	UINT	RW	Not Possible	N
	0F to 7F	Ch1 to Ch8 D-AT Execution Judgement Deviation	10	1 to 9999	Temperature input: 0.1°C or 0.1°F Analog input: 0.1%	UINT	RW	Not Possible	N

- Refer to *Disturbance suppression (Pre-boost function) parameters* on page 6-34 under *6-2 List of Settings* on page 6-25 for the function and meaning of each set value for the PreBoost objects.

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Unit	Data type	Access	I/O allocation	Data attribute
5011	---	Feature visualization	---	---	---	---	---	---	---
	00	Number of Entries	*1	*1	---	USINT	RO	Not Possible	---
	01 to 71	Ch1 to Ch8 Waveform Measurement Time	0	0 to 65000	Seconds	UINT	RW	Not Possible	N
	02 to 72	Ch1 to Ch8 Waveform Measurement Stop (Temperature Stable Control)	0	0 or 1	---	BOOL	RW	Not Possible	N
	03 to 73	Ch1 to Ch8 Temperature Stable Band	10	0 to 32000	EU	UINT	RW	Not Possible	N
	04 to 74	Ch1 to Ch8 Temperature Stable Determination Time	10	0 to 9999	Seconds	UINT	RW	Not Possible	N
	05 to 75	Ch1 to Ch8 MV Stable Band	100	1 to 999	0.1%	UINT	RW	Not Possible	N
	06 to 76	Ch1 to Ch8 MV Stable Determination Time	10	0 to 9999	Seconds	UINT	RW	Not Possible	N
	07 to 77	Ch1 to Ch8 MV Digital Filter	0	0 to 9999	0.1 s	UINT	RW	Not Possible	N

Ch5 to Ch8 are not available in NX-HTC3510.

*1. The default value and data range for Number of Entries are as follows.

NX Units	Default value	Data range
NX-HTC4505	127	127
NX-HTC3510	63	63

- Refer to *Parameters of the Feature Visualization Function* on page 6-37 under *6-2 List of Settings* on page 6-25 for details on the functions and the meaning of set values of each object of Feature Visualization.

A-4 CT (Current Transformer)

This section describes how to install CTs and how to calculate alarm currents.

Precautions for Safe Use

Use one of the CTs that can be connected to the Advanced Temperature Control Units. If you use any other CTs, the heater currents or leakage currents may not be accurate. This could result in failure to detect heater burnout or SSR failure. Also, if a SSR failure current is not detected, damage to equipment could result.

A-4-1 Connectable CTs

The following CTs can be connected.

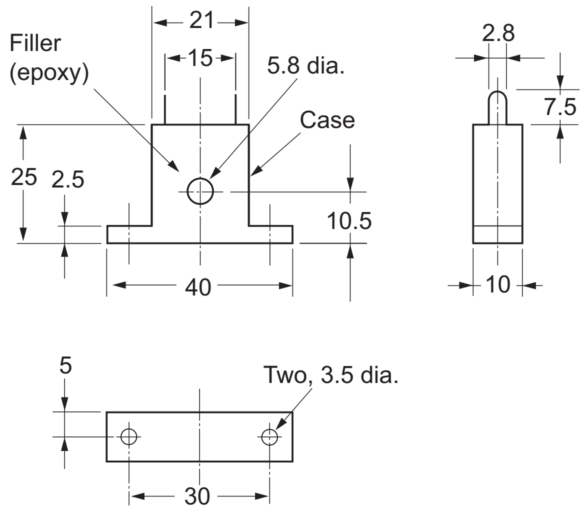
Specification

Item	Specifications			
Model number	E54-CT1	E54-CT3[*1]	E54-CT1L	E54-CT3L[*1]
Manufacturer	OMRON			
Maximum continuous heater current	50 A	120 A[*2]	50 A	120 A[*2]
Number of turns through CT	400±2 turns			
Dielectric strength	1,000 VAC (for 1 min)		1,500 VAC (1 minute)	
Vibration resistance	50 Hz, 98 m/s2			
Weight	Approx. 11.5 g	Approx. 50 g	Approx. 14 g	Approx. 57 g
Accessories	None	Armature (2), Plug (2)	None	None

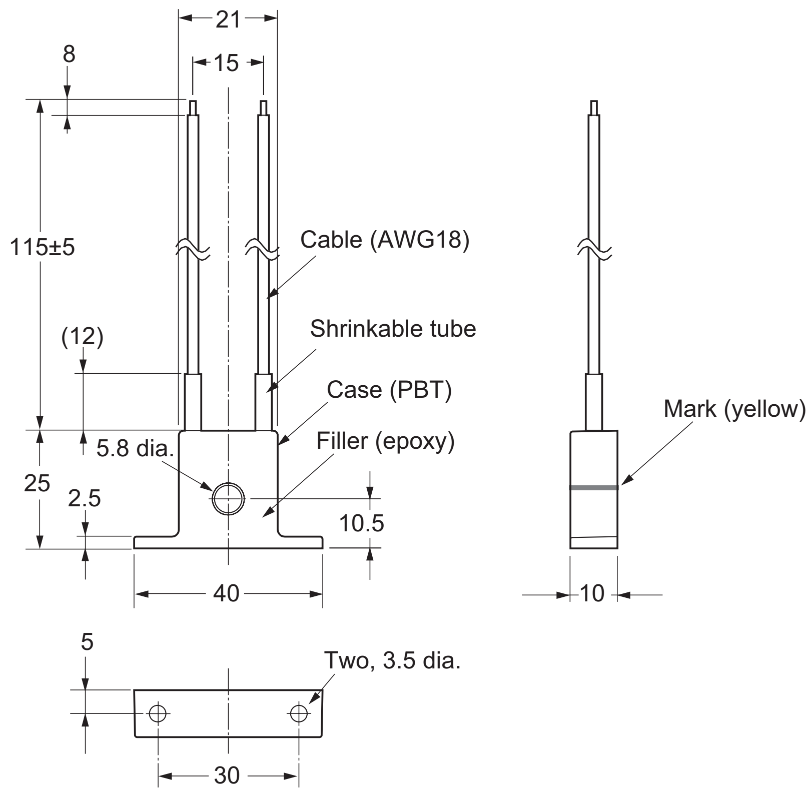
*1. To meet UL Listing requirements, use the E54-CT1L or E54-CT3L Current Transformer under the condition that it is mounted at a factory of the equipment manufacturer.
*2. With the Advanced Temperature Control Units, the maximum continuous current that can flow through the heater is 50 A. Therefore, set the current that flows through the heater to 50 A or less.

Dimensions (Unit: mm)

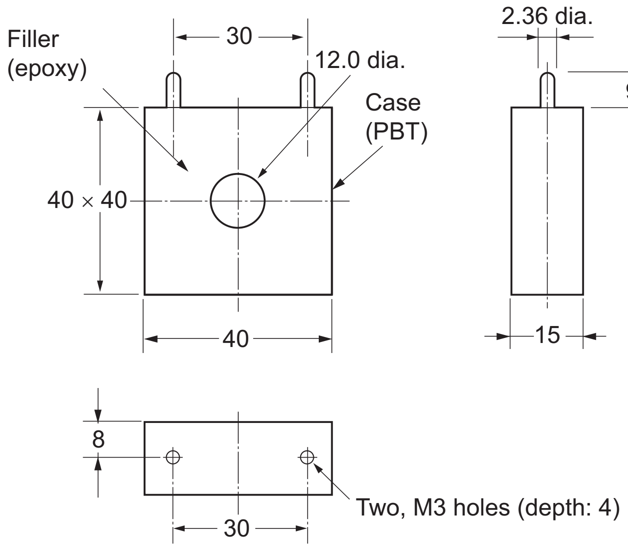
- E54-CT1



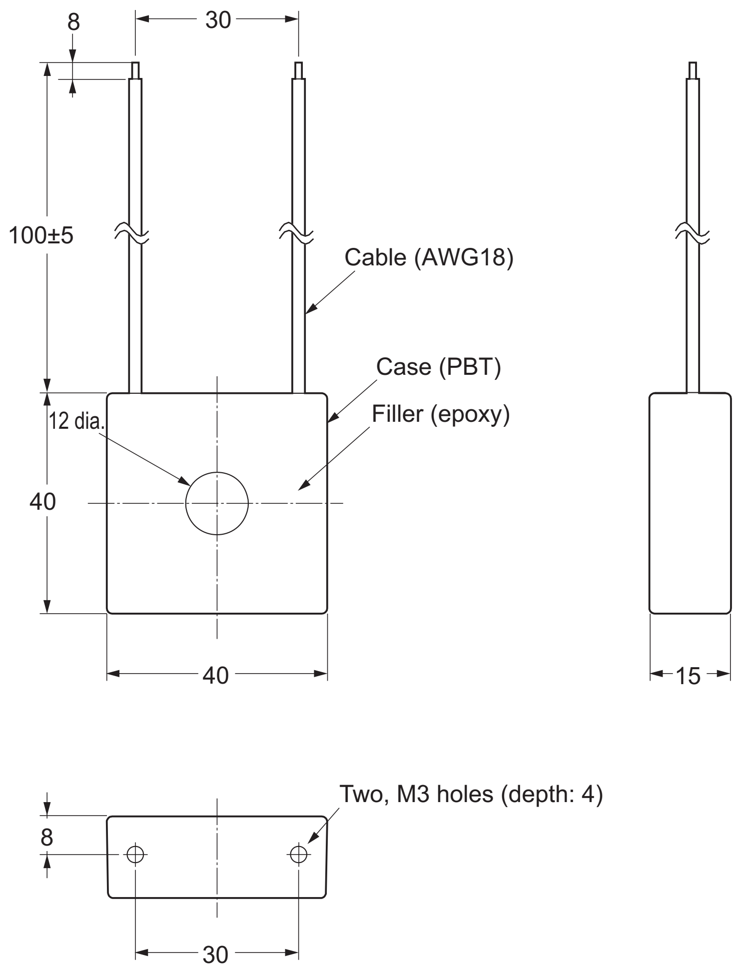
- E54-CT1L



- E54-CT3

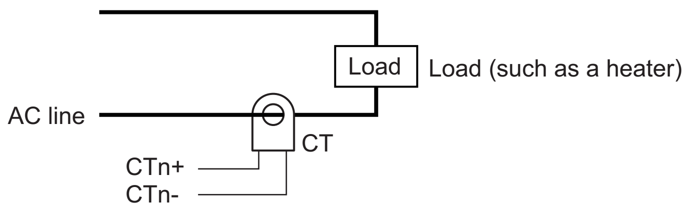


- E54-CT3L



A-4-2 CT Installation Locations

Connect the CT to the CT input terminal of the Advanced Temperature Control Unit, and wire the heater power line through the opening on the CT. Install the CT in the location shown in the following figure.



A-4-3 Calculation Methods for Heater Burnout Detection Currents and SSR Failure Detection Currents

How to Calculate Detection Currents

If you wire only one heater power line through a CT, calculate the set values using the following formu-las.

$$\text{Heater burnout detection current} = \frac{\text{Normal current} + \text{Current when heater burnout occurs}}{2}$$

$$\text{SSR failure detection current} = \frac{\text{Leakage current}^{*1} + \text{Current when SSR failure occurs}}{2}$$

*1. This is the current when the SSR is OFF.

Calculate the set values of Heater burnout detection currents when you wire multiple heater power lines through a CT by using the current when the heater with the smallest current burns out, as indicated in the following formula. If all currents are the same when heater burnout occurs, use the value for when one heater burns out.

$$\text{Heater burnout detection current} = \frac{\text{Normal heater current} + \text{Heater current when the heater that has the smallest current burns out}}{2}$$

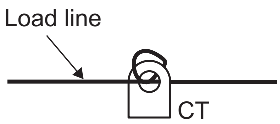
If you wire multiple heater power lines through a CT, the total of the heater currents must be 50 A or less.

Conditions for Stable Detection

If the difference between the current in normal operation and the current when an abnormality occurs is small, detection may become unstable. To enable stable detection, make sure the following conditions are met.

Heater current	Condition for stable burnout detection	Condition for stable SSR failure detection
Less than 10.0 A	Normal current - Current when heater burnout occurs ≥ 1 A	Current when SSR failure occurs - Leakage current ≥ 1 A
10.0 A min. or more	Normal current - Current when heater burnout occurs ≥ 2.5 A	Current when SSR failure occurs - Leakage current ≥ 2.5 A

If the heater current is not large enough to meet the above conditions, wind the heater power line through the CT hole multiple times, as shown in the following figure.



If you wind a heater power line through the CT hole multiple times, calculate the Heater burnout detection current using the following formula.

$$\text{Heater burnout detection current} = \frac{(\text{Normal current} + \text{Current when heater burnout occurs}) \times \text{Number of turns through CT}}{2}$$

One turn of the heater power line doubles the heater burnout detection current.

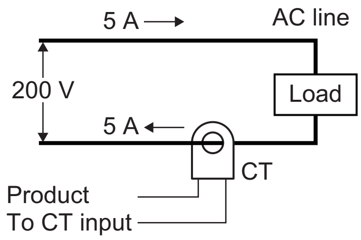
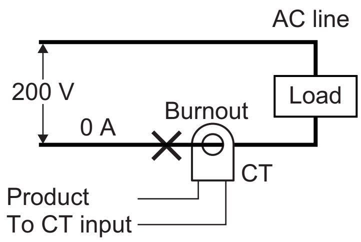
If you wind a heater power line through a CT hole multiple times, adjust the number of turns so that the normal current is 50 A or less.

Examples of Calculating Heater Burnout Detection Currents

This section provides examples of calculating heater burnout detection currents.

● Single-phase Heaters

A calculation example is given below for a 200-VAC, 1-kW heater.

Status	Heater current
Normal	The heater current is 5 A. 
Burnout	The heater current is 0 A. 

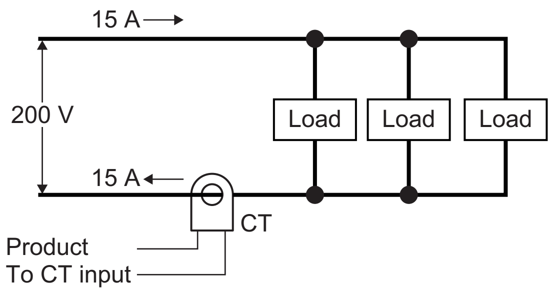
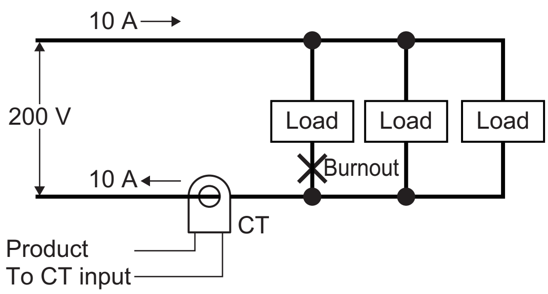
The heater current is 5 A at normal operation, and it is 0 A when the heater burnout occurs, so the heater burnout detection current is calculated as follows:

$$\text{Heater burnout detection current} = \frac{\text{Normal current + Heater burnout current}}{2}$$

$$= \frac{5 + 0}{2} = 2.5\ [\text{A}]$$

● Three-phase Heaters

A calculation example is given below for three 200-VAC, 1-kW heaters.

Status	During heater current burnout
Normal	The heater current is 15A. 
Burnout	The heater current is 10 A. 

The heater current is 15 A at normal operation, and it is 10 A when the heater burnout occurs, so the heater burnout detection current is calculated as follows:

$$\text{Heater burnout detection current} = \frac{\text{Normal current} + \text{Heater burnout current}}{2}$$

$$= \frac{15 + 10}{2} = 12.5\ [\text{A}]$$

A-5 Sample programming

This section describes the assumed sample programming when a Advanced Temperature Control Unit is used.

The sample programs to be described are shown in the table below.

Sample program name	remarks
Inheriting the MV when switching to Manual Mode	---
Output data of tuning parameter update	---

The sample programs assume the system configuration where the Advanced Temperature Control Unit is connected to the EtherCAT Slave Terminal.

Items common to all sample programs are described first, followed by details about each sample program.

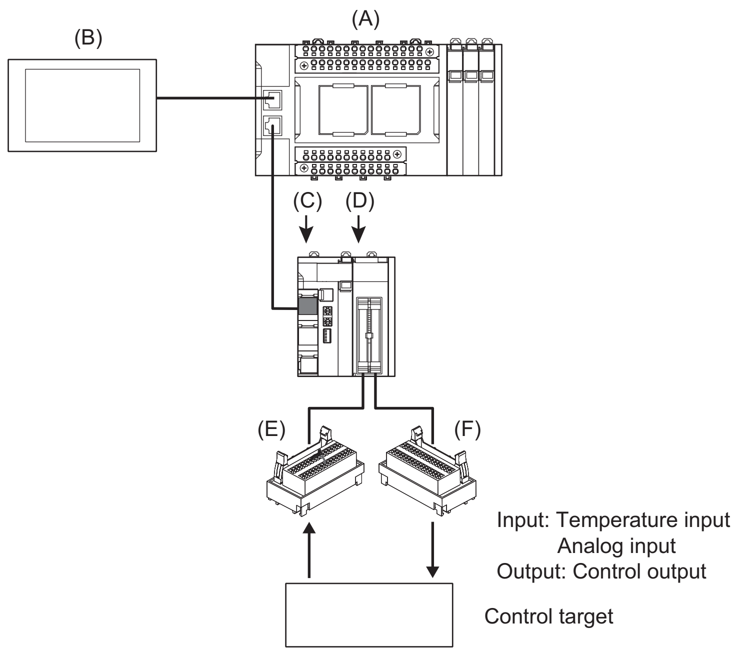
As for the usage example when a Advanced Temperature Control Unit is connected to an NX-series NX1P2 CPU Unit, refer to *A-5-4 When the Temperature Control Unit is Connected to a CPU Unit* on page A-67.

A-5-1 Items Common to Each Sample Program

This section describes the contents common to each sample program.

System configuration

The system configuration is given below.



Letter	Description	Model	Remarks
(A)	Controller and EtherCAT Master	NX1P2-9024DT	---
(B)	Touch panel	---	For details, refer to *Touch Panel Specifications* on page A-54.
(C)	EtherCAT Coupler Unit	NX-ECC201	Node address: 1

Letter	Description	Model	Remarks
(D)	Advanced Temperature Control Units	NX-HTC4505-5	• NX Unit number: 1 • Channel used: Ch1
(E)	Ultra-Compact Interface Wiring System (CN1)	XW2K-34G-T	Connect the cold junction sensor to the input terminal block.
(F)	Ultra-Compact Interface Wiring System (CN2)	XW2K-34G-T	---

Touch Panel Specifications

The following sample programs can be run only when the touch panel is connected to the controller.

- Inheriting the MV when switching to Manual Mode

The following I/O information is handled through the touch panel.

Input/Output	information
Inputs	Manual MV*1
Output	Manual MV Editable Flag*1

*1. Used in the program for inheriting the MV when switching to Manual Mode.

Unit operation settings

This section describes the Unit operation settings of the Advanced Temperature Control Unit that are common to each sample program.

Item	Set value	Meaning of setting
Ch1 Enable/Disable	TRUE	Enable
Ch2 Enable/Disable	FALSE	Disable
Ch1 PID ON/OFF	2-PID	2-PID control

Functions of the Advanced Temperature Control Unit used in each sample program are described below. The settings must be configured to ensure that the execution conditions of each function are satisfied. Check the reference section for details on the execution conditions.

Sample programming	Function	Reference
Inheriting the MV when switching to Manual Mode	Manual MV	*7-4-6 Manual MV* on page 7-42 Only the settings specified in the table above constitute the execution conditions.
I/O data tuning parameter update	AT	*7-5-1 Autotuning (AT)* on page 7-68
	D-AT	*7-5-2 D-AT (Disturbance Autotuning)* on page 7-71

Programs Used in Common

This section describes a part of the sample program that determines whether communications is possible or not. The program section is commonly used in all sample programs.

Because it is used as the determiner of communications possibility, this program section is written in the beginning of each sample program. The description of this program is omitted in the explanation of each sample program.

● I/O Map

The following table shows the settings of variables that are assigned to the I/O Map on the Sysmac Studio.

I/O port name	Variable name	Description	Data type	Variable Type
NX_Unit_Message_Enabled_Status_125	E001_NX-_Unit_Message_Enabled_Status_125[1]	NX Unit (Unit1) Message Communications Enable	ARRAY[0..125] OF BOOL	Global Variable
NX_Unit_I_O_-Data_Active_Status_125	E001_NX-_Unit_I_O_-Data_Active_Status_125[1]	NX Unit (Unit1) I/O Communications Enabled	ARRAY[0..125] OF BOOL	Global Variable

● External variables

The external variables used in the program are described below.

Use the global variable table and system-defined variables shown below as the external variables.

a) Global variable table

Variable name*1	Data types	Default value	AT	Retain	Networks Publish	Description
E001_NX-_Unit_Message_Enabled_Status_125[1]	ARRAY[0..125] OF BOOL	FALSE	ECAT://node#1/NX Unit Message Enabled Status 125	FALSE	Do not publish.	NX Unit (Unit1) Message Communications Enabled
E001_NX-_Unit_I_O_-Data_Active_Status_125[1]	ARRAY[0..125] OF BOOL	FALSE	ECAT://node#1/NX Unit I/O Data Active Status 125	FALSE	Do not publish.	NX Unit (Unit1) I/O Communications Enabled
TC01_Mes_is_Ready	BOOL	FALSE	---	FALSE	Do not publish.	Message communications possible.
TC01_IO_is_Ready	BOOL	FALSE	---	FALSE	Do not publish.	I/O Communications Enabled

*1. Variables starting with "TC01" are for a Advanced Temperature Control Unit whose device name is defined as "TC01".

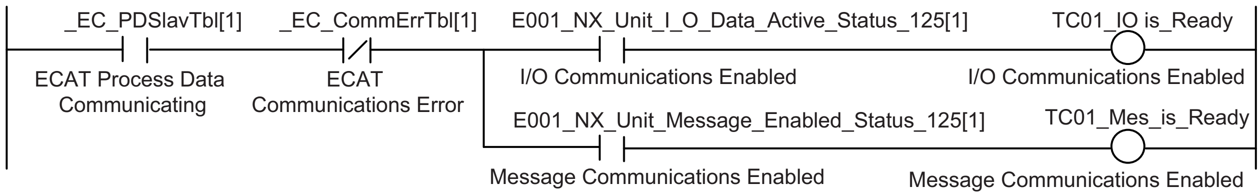
b) System-defined variables

Variable name	Description	Data type
_EC_PDSlavTbl[1]	EtherCAT Process Data Communicating Slave Table (Node1)	ARRAY[1..192] OF BOOL
_EC_CommErrTbl[1]	EtherCAT Communications Error Slave Table (Node1)	ARRAY[1..192] OF BOOL

Internal variables

There are no internal variables used in the program.

Ladder Programming



ST Programming

```
// Initialization of variable
TC01_IO_is_Ready:= FALSE;                    //I/O Communications Not Possible
TC01_Mes_is_Ready:= FALSE;                   // Message Communications Not Possible

// ECAT Process Data Communicating, and No ECAT Communications Error
IF (_EC_PDSlavTbl[1] = TRUE) AND (_EC_CommErrTbl[1] = FALSE) THEN
        // I/O Communications Enabled
        IF (E001_NX_Unit_I_O_Data_Active_Status_125[1] = TRUE) THEN
                   TC01_IO_is_Ready := TRUE;// I/O Communications Enabled
        END_IF;
        // Message Communications Enabled
        IF (E001_NX_Unit_Message_Enabled_Status_125[1] = TRUE) THEN
                   TC01_Mes_is_Ready := TRUE;// Message Communications Enabled
        END_IF;
END_IF;
```

A-5-2 Inheriting the MV when Switching to Manual Mode

This section describes the program used for inheriting the last MV of Auto Mode as the initial value of the manual MV when switching from Auto Mode to Manual mode. This program is necessary to avoid sudden change in the MV.

In the Auto Mode, set the "Ch1 Reflect Manual MV" operation command to "FALSE: Do not reflect", and set the "Ch1 Manual MV" on the touch panel to the not-editable state. If you switch to Manual Mode on the touch panel, the operation command of Manual Mode is sent. After ensuring from the status variable that the Advanced Temperature Control Unit is running in Manual Mode, reflect "Ch1 MV Monitor (Heating) (REAL)" of I/O data to "Ch1 Manual MV (REAL)" of I/O data. Thereafter, change the "Reflect Manual MV" operation command to "TRUE: Reflect", and set the "Ch1 Manual MV" on the touch panel to the editable state.

I/O Map

The following table shows the settings of variables that are assigned to the I/O Map on the Sysmac Studio.

I/O port name	Variable name *1	Description	Data type	Variable Type
Ch1 Reflect Manual MV	TC01_Ch1_Reflect_Manual_MV	Ch1 Reflect Manual MV (operation command) FALSE: Do Not Reflect TRUE: Reflect	BOOL	Global Variable
Ch1 Auto or Manual	TC01_Ch1_Auto_or_Manual	Ch1 Auto or Manual (operation command) FALSE: Automatic TRUE: Manual	BOOL	Global Variable
Ch1 Auto or Manual Status	TC01_Ch1_Auto_or_Manual_Status	Ch1 Auto or Manual (Status) FALSE: Automatic TRUE: Manual	BOOL	Global Variable
Ch1 MV Monitor Heating REAL	TC01_Ch1_MV_Monitor_Heating_REAL	Ch1 MV Monitor (Heating) (REAL)	REAL	Global Variable
Ch1 Manual MV REAL	TC01_Ch1_Manual_MV_REAL	Ch1 Manual MV REAL	REAL	Global Variable
Ch1 Reflect Manual MV Status	TC01_Reflect_Manual_MV_Status	Ch1 Reflect Manual MV (Status) FALSE: Not reflected TRUE: Reflected	BOOL	Global Variable

*1. Variables starting with "TC01" are for a Advanced Temperature Control Unit whose device name is defined as "TC01".

Variable Table

The external variables and internal variables used in the program are described below.

● External variables

Use the global variable table shown below as the external variables.

Variable name*1*2*3	Data types	Default value	AT	Retain	Network Publish	Description
TC01_Ch1_Reflect_Manual_MV	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operation Command/Ch1 Reflect Manual MV	FALSE	Do not publish.	Ch1 Reflect Manual MV (operation command) FALSE: Do Not Reflect TRUE: Reflect
TC01_Ch1_Auto_or_Manual	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operation Command/Ch1 Auto or Manual	FALSE	Do not publish.	Ch1 Auto or Manual (operation command) FALSE: Automatic TRUE: Manual
TC01_Ch1_Auto_or_Manual_Status	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 Auto or Manual Status	FALSE	Do not publish.	Ch1 Auto or Manual (Status) FALSE: Automatic TRUE: Manual
TC01_Ch1_MV_Monitor_Heating_REAL	REAL	0	ECAT://node#[1,1]/Ch1 MV Monitor Heating REAL	FALSE	Do not publish.	Ch1 MV Monitor (Heating) (REAL)
TC01_Ch1_Manual_MV_REAL	REAL	0	ECAT://node#[1,1]/Ch1 Manual MV REAL	FALSE	Do not publish.	Ch1 Manual MV REAL
TC01_Ch1_Reflect_Manual_MV_Status	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 Reflect Manual MV Status	FALSE	Do not publish.	Ch1 Reflect Manual MV (Status) FALSE: Not reflected TRUE: Reflected
PTO_EnableMV	BOOL	FALSE	---	FALSE	Publish Only	Manual MV Editable Flag FALSE: Editing Not Possible TRUE: Editing Possible
TC01_IO_is_Ready	BOOL	FALSE	---	FALSE	Do not publish.	I/O Communications Enabled
PTI_Ch1_Manual	BOOL	FALSE	---	TRUE	Publish Only	Ch1 Manual This variable is set by the user from the touch panel.
PTI_Ch1_Manual_MV	REAL	0	---	TRUE	Publish Only	Ch1 Manual MV This variable is set by the user from the touch panel.

*1. Variables starting with "TC01" are for a Advanced Temperature Control Unit whose device name is defined as "TC01".

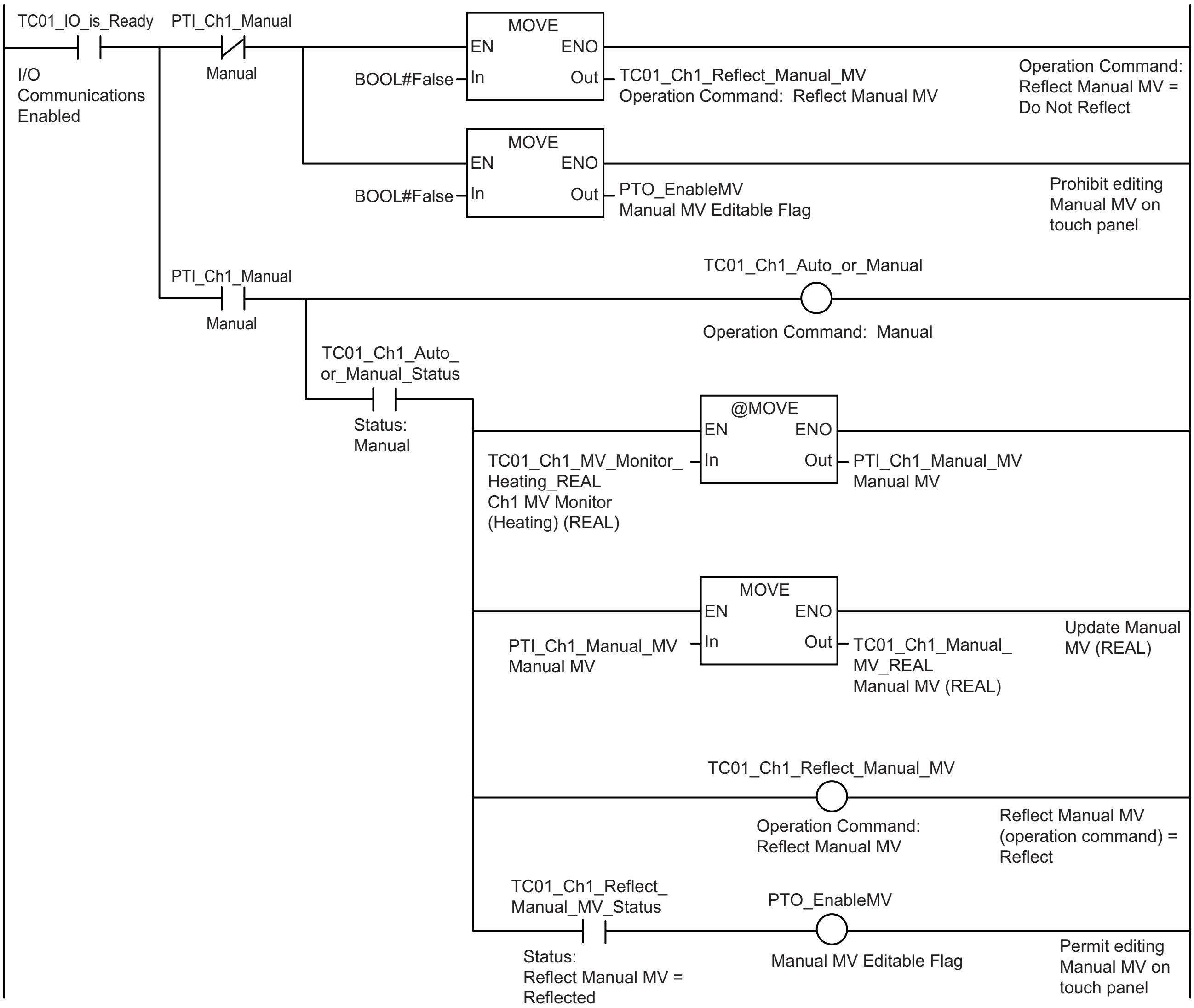
*2. Variables starting with "PTI" are defined as the input of the touch panel.

*3. Variables starting with "PTO" are defined as the output of the touch panel.

Internal variables

Variable name	Description	Default	Data types
Ch1_Auto_or_Manual_previous_value	Ch1 Auto or Manual Previous Value	FALSE	BOOL

Ladder Programming



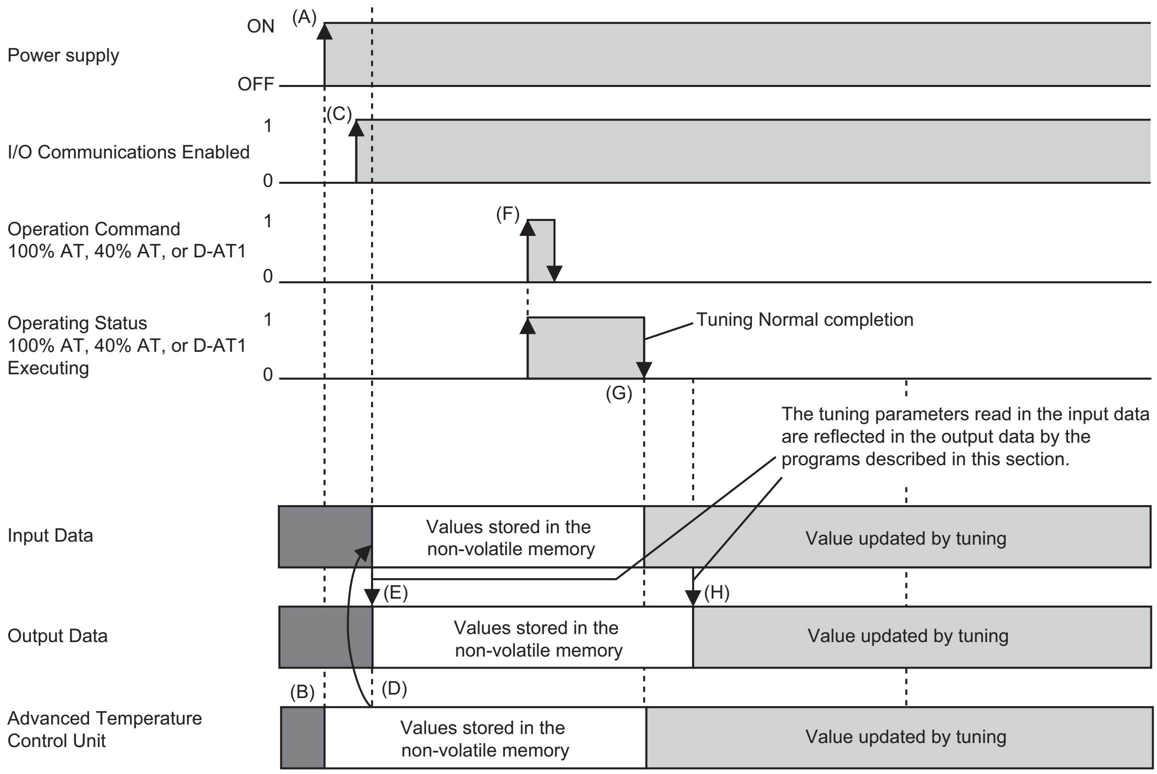
ST Programming

```
// Initialization of variable
TC01_Ch1_Auto_or_Manual := FALSE; // Operation Command: Auto or Manual = Auto
TC01_Ch1_Reflect_Manual_MV := FALSE; // Operation Command: Reflect Manual MV = Do Not
// Reflect
PTO_EnableMV := FALSE; // Prohibit editing Manual MV on touch panel

// I/O Communications Enabled
IF (TC01_IO_is_Ready = TRUE) THEN
    // In the case of Manual
    IF (PTI_Ch1_Manual = TRUE) THEN
        TC01_Ch1_Auto_or_Manual := TRUE; // Operation Command: Auto or Manual = Man-
ual
        // In the case of Status: Auto or Manual = Manual
        IF (TC01_Ch1_Auto_or_Manual_Status = TRUE) THEN
           // When switching from Auto -> Manual, set MV Monitor (Heating) (REAL) to
            // Ch1 Manual MV
            IF (Ch1_Auto_or_Manual_previous_value = FALSE) THEN
                    PTI_Ch1_Manual_MV := TC01_Ch1_MV_Monitor_Heating_REAL;
            END_IF;
            // Set Ch1 Manual MV to Ch1 Manual MV (REAL)
            TC01_Ch1_Manual_MV_REAL := PTI_Ch1_Manual_MV;
            // Operation Command: Reflect Manual MV = Reflect
            TC01_Ch1_Reflect_Manual_MV := TRUE;
            // In the case of Status: Reflect Manual MV = Reflected
            IF (TC01_Ch1_Reflect_Manual_MV = TRUE) THEN
                    // Permit editing Manual MV on touch panel
                    PTO_EnableMV := TRUE;
            END_IF;
        END_IF;
    END_IF;
END_IF;

// Update Previous Value
Ch1_Auto_or_Manual_previous_value := TC01_Ch1_Auto_or_Manual_Status;
```

A-5-3 I/O Data Tuning Parameter Update

This section describes a program that reflects the tuning parameters of the input data in the output data when the power is turned on, and updates the tuning parameters that are updated at the time of execution of tuning to the output data. This sample program is an example during the execution of tuning by AT or D-AT1. When using D-AT2, convert D-AT1 to D-AT2.

The timing chart when the power is turned on and when tuning is executed is shown below.



Process	Description
(A)	Power is supplied to the NX Unit.
(B)	The Advanced Temperature Control Unit starts with the tuning parameters saved in the internal non-volatile memory.
(C)	The I/O communications are enabled.
(D)	In the state when I/O communications are enabled, the tuning parameters of the Advanced Temperature Control Unit are automatically reflected in the input data.
(E)	This process is executed in the program described in this section. Make sure that I/O communications are enabled, and reflect the tuning parameters read from the input data in the output data.
(F)	After you set the "100 Percent AT" or "40 Percent AT" bit of "Ch□ Operation Command" or the "FF1 or D-AT1 Execute" bit of "Ch□ Operation Command2" to "1: Execute", the "100 Percent AT Status" or "40 Percent AT Status" of "Ch□ Operating Status" or the "FF1 or D-AT1 Execute Status" of "Ch□ Operating Status2" is automatically changed to "1: Executing". After confirming the change to "1: Executing", return the "100 Percent AT" or "40 Percent AT" bit of "Ch□ Operation Command" or the "FF1 or D-AT Execute" bit of "Ch□ Operation Command2" to "0".
(G)	If the "100 Percent AT", "40 Percent AT", or "FF1 or D-AT1" is completed normally, then the "100 Percent AT Status" or "40 Percent AT Status" bit of "Ch□ Operating Status" or the "FF1 or D-AT1 Execute Status" bit of "Ch□ Operating Status2" is automatically set to "0: Stopping". The tuning parameters are automatically written to the non-volatile memory of the Advanced Temperature Control Unit.
(H)	This process is executed in the program described in this section. The tuning parameters read in the input data are reflected in the output data.

I/O Map

The following table shows the settings of variables that are assigned to the I/O Map on the Sysmac Studio.

I/O port name	Variable name *1	Description	Data type	Variable Type
Ch1 100 Percent AT Status	TC01_Ch1_100_Percent_AT_Status	Ch1 100% AT Execution Status	BOOL	Global Variable
Ch1 40 Percent AT Status	TC01_Ch1_40_Percent_AT_Status	Ch1 40% AT Execution Status	BOOL	Global Variable
Ch1 FF1 or D-AT1 Execute Status	TC01_Ch1_FF1_or_D-AT1_Execute_Status	Ch1 FF1 or D-AT1 Execution Status	BOOL	Global Variable
Ch1 FF or D-AT mode Monitor	TC01_Ch1_FF_or_D_AT_mode_Monitor	Ch1 FF or D-AT mode Status	BOOL	Global Variable
Ch1 Proportional Band Monitor	TC01_Ch1_Proportional_Band_Monitor	Ch1 Proportional Band Monitor	UINT	Global Variable
Ch1 Integration Time Monitor	TC01_Ch1_Integration_-Time_Monitor	Ch1 Integral Time Monitor	UINT	Global Variable
Ch1 Derivative Time Monitor	TC01_Ch1_Derivative_-Time_Monitor	Ch1 Derivative Time Monitor	UINT	Global Variable
Ch1 FF1 Waiting Time Monitor	TC01_Ch1_FF1_Waiting_Time_Monitor	Ch1 FF1 Waiting Time Monitor	UINT	Global Variable
Ch1 FF1 Operation Time Monitor	TC01_Ch1_FF1_Operation_Time_Monitor	Ch1 FF1 Operation Time Monitor	UINT	Global Variable
Ch1_FF1_Segment1_MV_Monitor	TC01_Ch1_FF1_Segment1_MV_Monitor	Ch1 FF1 Segment1 MV Monitor	INT	Global Variable
Ch1_FF1_Segment2_MV_Monitor	TC01_Ch1_FF1_Segment2_MV_Monitor	Ch1 FF1 Segment2 MV Monitor	INT	Global Variable
Ch1_FF1_Segment3_MV_Monitor	TC01_Ch1_FF1_Segment3_MV_Monitor	Ch1 FF1 Segment3 MV Monitor	INT	Global Variable
Ch1_FF1_Segment4_MV_Monitor	TC01_Ch1_FF1_Segment4_MV_Monitor	Ch1 FF1 Segment4 MV Monitor	INT	Global Variable
Ch1 Proportional Band	TC01_Ch1_Proportional_Band	Ch1 Proportional Band	UINT	Global Variable
Ch1 Integration Time	TC01_Ch1_Integration_-Time	Ch1 Integration Time	UINT	Global Variable
Ch1 Derivative Time	TC01_Ch1_Derivative_-Time	Ch1 Derivative Time	UINT	Global Variable
Ch1 FF1 Waiting Time	TC01_Ch1_FF1_Waiting_Time	Ch1 FF1 Waiting Time	UINT	Global Variable
Ch1 FF1 Operation Time	TC01_Ch1_FF1_Operation_Time	Ch1 FF1 Operation Time	UINT	Global Variable
Ch1_FF1_Segment1_MV	TC01_Ch1_FF1_Segment1_MV	Ch1 FF1 Segment1 MV	INT	Global Variable
Ch1_FF1_Segment2_MV	TC01_Ch1_FF1_Segment2_MV	Ch1 FF1 Segment2 MV	INT	Global Variable
Ch1_FF1_Segment3_MV	TC01_Ch1_FF1_Segment3_MV	Ch1 FF1 Segment3 MV	INT	Global Variable
Ch1_FF1_Segment4_MV	TC01_Ch1_FF1_Segment4_MV	Ch1 FF1 Segment4 MV	INT	Global Variable

*1. Variables starting with "TC01" are for a Advanced Temperature Control Unit whose device name is defined as "TC01".

Variable Table

The external variables and internal variables used in the program are described below.

● External variables

Use the global variable table shown below as the external variables.

Variable name*1	Data types	Default value	AT	Retain	Network Publish	Description
TC01_Ch1_100_Percent_AT_Status	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 100 Percent AT Status	FALSE	Do not publish.	Ch1 100% AT Execution Status
TC01_Ch1_40_Percent_AT_Status	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 40 Percent AT Status	FALSE	Do not publish.	Ch1 40% AT Execution Status
TC01_Ch1_FF1_or_D_AT1_Execute_Status	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operating Status2/ Ch1 FF or D_AT1 Execute Status	FALSE	Do not publish.	Ch1 FF1 or D-AT1 Execution Status
TC01_Ch1_FF_or_D_AT_mode_Monitor	BOOL	FALSE	ECAT://node#[1,1]/Ch1 Operating Status2/Ch1 FF or D-AT mode Monitor	FALSE	Do not publish.	Ch1 FF or D-AT mode Status
TC01_Ch1_Proportional_Band_Monitor	UINT	0	ECAT://node#[1,1]/Ch1 Proportional Band Monitor	FALSE	Do not publish.	Ch1 Proportional Band Monitor
TC01_Ch1_Integration_Time_Monitor	UINT	0	ECAT://node#[1,1]/Ch1 Integration Time Monitor	FALSE	Do not publish.	Ch1 Integral Time Monitor
TC01_Ch1_Derivative_Time_Monitor	UINT	0	ECAT://node#[1,1]/Ch1 Derivative Time Monitor	FALSE	Do not publish.	Ch1 Derivative Time Monitor
TC01_Ch1_FF1_Waiting_Time_Monitor	UINT	0	ECAT://node#[1,1]/Ch1 FF1 Waiting Time Monitor	FALSE	Do not publish.	Ch1 FF1 Waiting Time Monitor
TC01_Ch1_FF1_Operation_Time_Monitor	UINT	1	ECAT://node#[1,1]/Ch1 FF1 Operation Time Monitor	FALSE	Do not publish.	CH1 FF1 Operation Time Monitor
TC01_Ch1_FF1_Segment1_MV_Monitor	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment1 MV Monitor	FALSE	Do not publish.	Ch1 FF1 Segment1 MV Monitor
TC01_Ch1_FF1_Segment2_MV_Monitor	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment2 MV Monitor	FALSE	Do not publish.	Ch1 FF1 Segment2 MV Monitor
TC01_Ch1_FF1_Segment3_MV_Monitor	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment3 MV Monitor	FALSE	Do not publish.	Ch1 FF1 Segment3 MV Monitor
TC01_Ch1_FF1_Segment4_MV_Monitor	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment4 MV Monitor	FALSE	Do not publish.	Ch1 FF1 Segment4 MV Monitor
TC01_Ch1_Proportional_Band	UINT	0	ECAT://node#[1,1]/Ch1 Proportional Band	FALSE	Do not publish.	Ch1 Proportional Band
TC01_Ch1_Integration_Time	UINT	0	ECAT://node#[1,1]/Ch1 Integration Time	FALSE	Do not publish.	Ch1 Integration Time
TC01_Ch1_Derivative_Time	UINT	0	ECAT://node#[1,1]/Ch1 Derivative Time	FALSE	Do not publish.	Ch1 Derivative Time

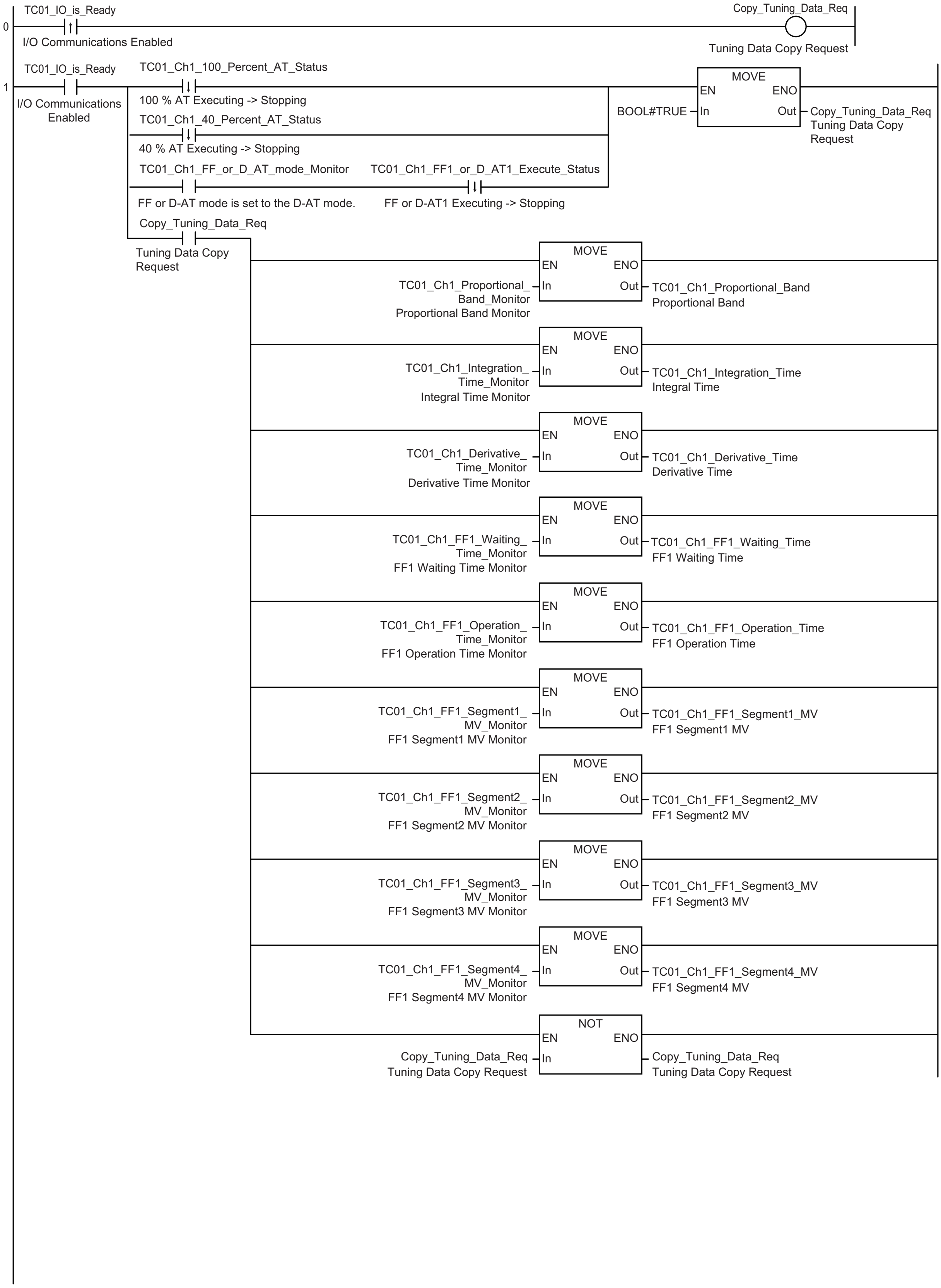
Variable name*1	Data types	Default value	AT	Retain	Network Publish	Description
TC01_Ch1_FF1_Waiting_Time	UINT	0	ECAT://node#[1,1]/Ch1 FF1 Waiting Time	FALSE	Do not publish.	Ch1 FF1 Waiting Time
TC01_Ch1_FF1_Operation_Time	UINT	1	ECAT://node#[1,1]/Ch1 FF1 Operation Time	FALSE	Do not publish.	CH1 FF1 Operation Time
TC01_Ch1_FF1_Segment1_MV	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment1 MV	FALSE	Do not publish.	Ch1 FF1 Segment1 MV
TC01_Ch1_FF1_Segment2_MV	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment2 MV	FALSE	Do not publish.	Ch1 FF1 Segment2 MV
TC01_Ch1_FF1_Segment3_MV	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment3 MV	FALSE	Do not publish.	Ch1 FF1 Segment3 MV
TC01_Ch1_FF1_Segment4_MV	INT	0	ECAT://node#[1,1]/Ch1 FF1 Segment4 MV	FALSE	Do not publish.	Ch1 FF1 Segment4 MV
TC01_IO_is_Ready	BOOL	FALSE	---	FALSE	Do not publish.	I/O Communications Enabled

*1. Variables starting with "TC01" are for a Advanced Temperature Control Unit whose device name is defined as "TC01".

● Internal variables

Variable name	Description	Default	Data types
Copy_Tuning_Data_Req	Tuning Data Copy Request	FALSE	BOOL
TC01_IO_is_Ready_previous_value	I/O Communications Enabled Previous Value	FALSE	BOOL
Ch1_100_Percent_AT_Status_previous_value	Ch1 100% AT Execution Status Previous Value	FALSE	BOOL
Ch1_40_Percent_AT_Status_previous_value	Ch1 40% AT Execution Status Previous Value	FALSE	BOOL
Ch1_FF1_or_D_AT1_Execute_Status_previous_value	Ch1 FF1 or D-AT1 Execution Status Previous Value	FALSE	BOOL

Ladder Programming



ST Programming

```
// When I/O Communications Disabled changes to Enabled (during startup)
IF ((TC01_IO_is_Ready_previous_value = FALSE) AND (TC01_IO_is_Ready = TRUE)) THEN
    // Tuning data copy request sent
    Copy_Tuning_Data_Req := TRUE;
END_IF;
// When I/O Communications is Enabled
IF (TC01_IO_is_Ready = TRUE) THEN
    // When the execution status of either 100% AT or 40% AT
    // from executing to stopping,
    // or, when D-AT or FF mode is set to the D-AT mode, and when D-AT1 changes
    // from executing to stopping
    IF ( (Ch1_100_Percent_AT_Status_previous_value = TRUE) AND (TC01_Ch1_100_
       Percent_AT_Status = FALSE) OR
       (Ch1_40_Percent_AT_Status_previous_value = TRUE) AND (TC01_Ch1_40_Percent_AT_
       Status = FALSE) OR
       (TC01_Ch1_FF_or_D_AT_mode_Monitor = TRUE) AND (Ch1_FF1_or_D_AT1_Execute_
       Status_previous_value = TRUE) AND (TC01_Ch1_FF1_or_D_AT1_Execute_Status =
       FALSE) ) THEN
    // THEN Tuning data copy request sent
    Copy_Tuning_Data_Req := TRUE;
    END_IF;
    // When Tuning Data Copy Request is sent
    IF (Copy_Tuning_Data_Req = TRUE) THEN
            // Copy tuning data from In data to Out data
            TC01_Ch1_Proportional_Band := TC01_Ch1_Proportional_Band_Monitor;
            TC01_Ch1_Integration_Time := TC01_Ch1_Integration_Time_Monitor;
            TC01_Ch1_Derivative_Time := TC01_Ch1_Derivative_Time_Monitor;
            TC01_Ch1_FF1_Waiting_Time := TC01_Ch1_FF1_Waiting_Time_Monitor;
            TC01_Ch1_FF1_Operation_Time := TC01_Ch1_FF1_Operation_Time_Monitor;
            TC01_Ch1_FF1_Segment1_MV := TC01_Ch1_FF1_Segment1_MV_Monitor;
            TC01_Ch1_FF1_Segment2_MV := TC01_Ch1_FF1_Segment2_MV_Monitor;
            TC01_Ch1_FF1_Segment3_MV := TC01_Ch1_FF1_Segment3_MV_Monitor;
            TC01_Ch1_FF1_Segment4_MV := TC01_Ch1_FF1_Segment4_MV_Monitor;

            // No Tuning Data Copy Request
            Copy_Tuning_Data_Req := FALSE;
    END_IF;
END_IF;

// Update Previous Value
TC01_IO_is_Ready_previous_value := TC01_IO_is_Ready;
Ch1_100_Percent_AT_Status_previous_value := TC01_Ch1_100_Percent_AT_Status;
Ch1_40_Percent_AT_Status_previous_value := TC01_Ch1_40_Percent_AT_Status;
Ch1_FF1_or_D_AT1_Execute_Status_previous_value := TC01_Ch1_FF1_or_D_AT1_Execute_
Status;
```

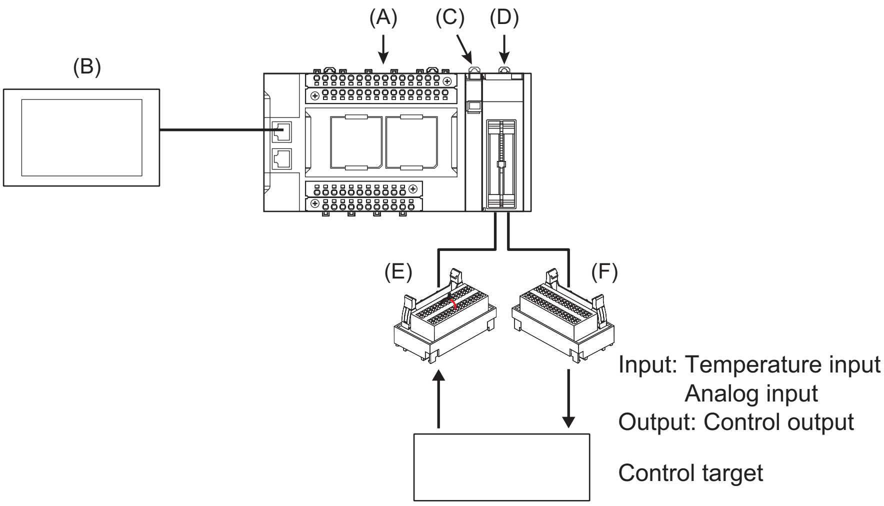
A-5-4 When the Temperature Control Unit is Connected to a CPU Unit

This section describes a usage example in which the Temperature Control Unit in the configuration example above is connected to an NX-series NX1P2 CPU Unit. Only the differences from the previous configuration example in which the Temperature Control Unit is connected in an EtherCAT Slave Terminal are described.

Consider these differences while reading the above example that uses an EtherCAT Slave Terminal.

System Configuration

The system configuration example is given below.



Letter	Description	Model	Differences from example using an EtherCAT Slave Terminal
(A)	Controller and EtherCAT Master	NX1P2-9024DT	This is an NX1P2 CPU Unit.
(B)	Touch panel	---	These are the same as in the other example.
(C)	Additional I/O Power Supply Unit	NX-PF630	The NX1P2 CPU Unit does not have an I/O power supply terminal for the NX Unit. An Additional I/O Power Supply Unit must be installed as the right adjacent Unit of the CPU Unit.
(D)	Advanced Temperature Control Units	NX-HTC4505-5	These are the same as in the other example.
(E)	Ultra-Compact Interface Wiring System (CN1)	XW2K-34G-T	These are the same as in the other example.
(F)	Ultra-Compact Interface Wiring System (CN2)	XW2K-34G-T	These are the same as in the other example.

In contrast to the NX Unit configuration using an EtherCAT Slave Terminal, the Additional I/O Power Supply Unit must be installed as the right adjacent Unit of the CPU Unit in order to supply I/O power to the Advanced Temperature Control Unit. Therefore, the NX Unit number of the NX Unit changes. These are described in the following table.

Unit classification	Model	Differences from example using an EtherCAT Slave Terminal
CPU Unit	NX1P2-9024DT	This is an NX1P2 CPU Unit.
Additional I/O Power Supply Unit	NX-PF630	Installed as the right adjacent Unit of the CPU Unit in order to supply I/O power to the Advanced Temperature Control Unit. Its NX Unit number is 1.
Advanced Temperature Control Units	NX-HTC4505-5	The NX Unit number is increased by 1 to be 2.

Touch Panel Specifications

These settings are the same as in the example that uses an EtherCAT Slave Terminal.

Unit operation settings

These settings are the same as in the example that uses an EtherCAT Slave Terminal.

Programs Used in Common

The following settings apply to the program that determine communicatios possibility when the Advanced Temperature Control Unit is connected to a CPU Unit.

I/O Map

There is no variable to be allocated to the I/O map from the Sysmac Studio.

External variables

The external variables used in the program are described below.

Use the global variable table and system-defined variables shown below as the external variables.

a) Global variable table

Variable name*1	Data types	Default value	AT	Retain	Network Publish	Description
TC01_Mes_is_Ready	BOOL	FALSE	---	FALSE	Do not publish.	Message communications possible.
TC01_IO_is_Ready	BOOL	FALSE	---	FALSE	Do not publish.	I/O Communications Enabled

*1. Variables starting with "TC01" are for a Advanced Temperature Control Unit whose device name is defined as "TC01".

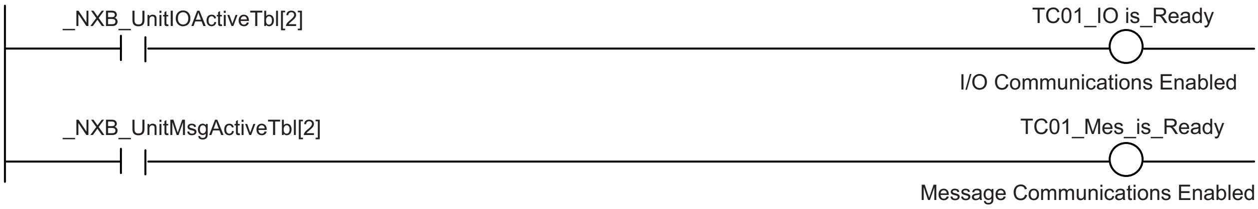
b) System-defined variables

Variable name	Description	Data type
_NXB_UnitIOActiveTbl [2]	NX Unit I/O Data Communicating Status (Unit2)	ARRAY[0..8] OF BOOL
_NXB_UnitMsgActiveTbl [2]	NX Unit Message Communications Enabled Status (Unit2)	ARRAY[0..8] OF BOOL

Internal variables

There are no internal variables used in the program.

● Ladder Programming



● ST Programming

```
// Initialization of variable
TC01_IO_is_Ready:= FALSE;             //I/O Communications Not Possible
TC01_Mes_is_Ready:= FALSE;            // Message Communications Not Possible

// I/O Communications Enabled
IF (_NXB_UnitIOActiveTbl[2] = TRUE) THEN
    TC01_IO_is_Ready := TRUE; // I/O Communications Enabled
END_IF;
// Message Communications Enabled
IF (_NXB_UnitMsgActiveTbl[2] = TRUE) THEN
    TC01_Mes_is_Ready := TRUE;// Message Communications Enabled
END_IF;
```

Settings of Each Sample Program

In contrast to the sample programs for the configuration with the EtherCAT Slave Terminal, AT specifications of the following variables are different. Note that the I/O map, LD program, or ST program are the same as in the example that uses an EtherCAT Slave Terminal.

● Inheriting the MV when switching to Manual Mode

Variable name	AT specification in the case of EtherCAT Slave Terminal	AT specification when the Temperature Control Unit is connected to the CPU Unit
TC01_Ch1_Reflect_Manual_MV	ECAT://node#[1,1]/Ch1 Operation Command/Ch1 Reflect Manual MV	IOBus://unit#2/Ch1 Operation Command/Ch1 Reflect Manual MV
TC01_Ch1_Auto_or_Manual	ECAT://node#[1,1]/Ch1 Operation Command/Ch1 Auto or Manual	IOBus://unit#2/Ch1 Operation Command/Ch1 Auto or Manual
TC01_Ch1_Auto_or_Manual_Status	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 Auto or Manual Status	IOBus://unit#2/Ch1 Operating Status/Ch1 Auto or Manual Status
TC01_Ch1_MV_Monitor_Heating_REAL	ECAT://node#[1,1]/Ch1 MV Monitor Heating REAL	IOBus://unit#2/Ch1 MV Monitor Heating REAL
TC01_Ch1_Manual_MV_REAL	ECAT://node#[1,1]/Ch1 Manual MV REAL	IOBus://unit#2/Ch1 Manual MV REAL
TC01_Ch1_Reflect_Manual_MV_Status	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 Reflect Manual MV Status	IOBus://unit#2/Ch1 Operating Status/Ch1 Reflect Manual MV Status

● I/O data tuning parameter update

Variable name	AT specification in the case of EtherCAT Slave Terminal	AT specification when the Temperature Control Unit is connected to the CPU Unit
TC01_Ch1_100_Percent_AT_Status	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 100 Percent AT Status	IOBus://unit#2/Ch1 Operating Status/Ch1 100 Percent AT Status
TC01_Ch1_40_Percent_AT_Status	ECAT://node#[1,1]/Ch1 Operating Status/Ch1 40 Percent AT Status	IOBus://unit#2/Ch1 Operating Status/Ch1 40 Percent AT Status
TC01_Ch1_FF1_or_D_AT1_Execute_Status	ECAT://node#[1,1]/Ch1 Operating Status2/Ch1 FF or D_AT1 Execute Status	IOBus://unit#2/Ch1 Operating Status2/Ch1 FF or D_AT1 Execute Status
TC01_Ch1_Proportional_Band_Monitor	ECAT://node#[1,1]/Ch1 Proportional Band Monitor	IOBus://unit#2/Ch1 Proportional Band Monitor
TC01_Ch1_Integration_Time_Monitor	ECAT://node#[1,1]/Ch1 Integration Time Monitor	IOBus://unit#2/Ch1 Integration Time Monitor
TC01_Ch1_Derivative_Time_Monitor	ECAT://node#[1,1]/Ch1 Derivative Time Monitor	IOBus://unit#2/Ch1 Derivative Time Monitor
TC01_Ch1_FF1_Waiting_Time_Monitor	ECAT://node#[1,1]/Ch1 FF1 Waiting Time Monitor	IOBus://unit#2/Ch1 FF1 Waiting Time Monitor
TC01_Ch1_FF1_Operation_Time_Monitor	ECAT://node#[1,1]/Ch1 FF1 Operation Time Monitor	IOBus://unit#2/Ch1 FF1 Operation Time Monitor
TC01_Ch1_FF1_Segment1_MV_Monitor	ECAT://node#[1,1]/Ch1 FF1 Segment1 MV Monitor	IOBus://unit#2/Ch1 FF1 Segment1 MV Monitor
TC01_Ch1_FF1_Segment2_MV_Monitor	ECAT://node#[1,1]/Ch1 FF1 Segment2 MV Monitor	IOBus://unit#2/Ch1 FF1 Segment2 MV Monitor
TC01_Ch1_FF1_Segment3_MV_Monitor	ECAT://node#[1,1]/Ch1 FF1 Segment3 MV Monitor	IOBus://unit#2/Ch1 FF1 Segment3 MV Monitor
TC01_Ch1_FF1_Segment4_MV_Monitor	ECAT://node#[1,1]/Ch1 FF1 Segment4 MV Monitor	IOBus://unit#2/Ch1 FF1 Segment4 MV Monitor
TC01_Ch1_Proportional_Band	ECAT://node#[1,1]/Ch1 Proportional Band	IOBus://unit#2/Ch1 Proportional Band
TC01_Ch1_Integration_Time	ECAT://node#[1,1]/Ch1 Integration Time	IOBus://unit#2/Ch1 Integration Time
TC01_Ch1_Derivative_Time	ECAT://node#[1,1]/Ch1 Derivative Time	IOBus://unit#2/Ch1 Derivative Time
TC01_Ch1_FF1_Waiting_Time	ECAT://node#[1,1]/Ch1 FF1 Waiting Time	IOBus://unit#2/Ch1 FF1 Waiting Time
TC01_Ch1_FF1_Operation_Time	ECAT://node#[1,1]/Ch1 FF1 Operation Time	IOBus://unit#2/Ch1 FF1 Operation Time
TC01_Ch1_FF1_Segment1_MV	ECAT://node#[1,1]/Ch1 FF1 Segment1 MV	IOBus://unit#2/Ch1 FF1 Segment1 MV
TC01_Ch1_FF1_Segment2_MV	ECAT://node#[1,1]/Ch1 FF1 Segment2 MV	IOBus://unit#2/Ch1 FF1 Segment2 MV
TC01_Ch1_FF1_Segment3_MV	ECAT://node#[1,1]/Ch1 FF1 Segment3 MV	IOBus://unit#2/Ch1 FF1 Segment3 MV
TC01_Ch1_FF1_Segment4_MV	ECAT://node#[1,1]/Ch1 FF1 Segment4 MV	IOBus://unit#2/Ch1 FF1 Segment4 MV

A-6 Version Information with CPU Units

This section provides version-related information when connecting Units to a CPU Unit. This section describes the relationships between the unit versions of each Unit and the CPU Unit, and Sysmac Studio version, and the specification changes for each unit version of each Unit.

A-6-1 Relationship between Unit Versions of Units

The relationship between the unit versions of each Unit and the CPU Unit, and Sysmac Studio version are shown below.

Interpreting the Version Combination Tables

The items that are used in the version combination tables are given below.

Refer to the user's manual for the CPU Unit for the models of CPU Unit to which NX Units can be connected.

NX Units		Corresponding unit versions/versions	
Model	**Unit version**	**CPU Unit**	**Sysmac Studio**
Model numbers of NX Units.	Unit versions of NX Units.	Unit versions of the CPU that are compatible with the NX Units.	Sysmac Studio versions that are compatible with the NX Units and CPU Unit.

Version Information when Connecting the NX Unit to the CPU Unit

- With the combinations of the unit versions/versions shown below, you can use the functions that are supported by the unit version of the Unit model. Use the unit versions/versions (or the later/higher unit versions/versions) that correspond to the NX Unit models and the unit versions. You cannot use the specifications that were added or changed for the relevant NX Unit models and the unit versions unless you use the corresponding unit versions/versions.
- Depending on the type and model of the Unit to which the NX Unit is connected, some Units do not have the corresponding versions given in the table. If a Unit does not have the specified version, support is provided by the oldest available version after the specified version. Refer to the user' s manuals for the specific Units for the relation between models and versions.
- If you use the corresponding unit versions/versions given in the following table or later/higher versions, refer to the version information in the user's manual for the CPU Unit.

NX Units		Corresponding unit versions/versions	
Model	**Unit version**	**CPU Unit**	**Sysmac Studio**
NX-HTC4505	Ver.1.0	Ver.1.13	Ver.1.54
NX-HTC3510	Ver.1.0		

A-7 Version Information with Communications Coupler Units

This section provides version-related information when connecting Units to a Communications Coupler Unit.

Version information is provided separately for each Communications Coupler Unit that an NX Unit is connected to.

A-7-1 Connection to an EtherCAT Coupler Unit

This section describes the relationship between the unit versions of each Unit, EtherCAT Coupler Unit, CPU Unit and Industrial PC, versions of the Sysmac Studio, and the specification changes for each unit version.

Relationship between Unit Versions of Units

The items that are used in the version combination table are given below.

NX Units		Corresponding unit versions/versions		
Model	Unit version	EtherCAT Coupler Unit	CPU Unit or Industrial PC	Sysmac Studio
Model numbers of NX Units.	Unit versions of NX Units.	Unit versions of EtherCAT Coupler Units that are compatible with the NX Units.	Unit version of the NJ/NX-series CPU Units or NY-series Industrial PCs that are compatible with the EtherCAT Coupler Unit.	Sysmac Studio versions that are compatible with the NX Units, EtherCAT Coupler Units, CPU Units, and Industrial PCs.

The version combination table is given below.

- With the combinations of the unit versions/versions shown below, you can use the functions that are supported by the unit version of the Unit model. Use the unit versions/versions (or the later/higher unit versions/versions) that correspond to the NX Unit models and the unit versions. You cannot use the specifications that were added or changed for the relevant NX Unit models and the unit versions unless you use the corresponding unit versions/versions.
- Depending on the type and model of the Unit to which the NX Unit is connected, some Units do not have the corresponding versions given in the table. If a Unit does not have the specified version, support is provided by the oldest available version after the specified version. Refer to the user’ s manuals for the specific Units for the relation between models and versions.
- You cannot connect the relevant NX Unit to the target Communications Coupler Unit if "---" is shown in the corresponding unit versions/versions column.
- If you use the corresponding unit versions/versions given in the following table or later/higher versions, refer to the version information in the user’s manual for the Communications Coupler Unit, CPU Unit, and Industrial PC.

NX Units		Corresponding unit versions/versions		
Model	Unit version	EtherCAT Coupler Unit	CPU Unit or Industrial PC	Sysmac Studio
NX-HTC4505	Ver.1.0	Ver.1.2	Ver.1.14	Ver.1.54
NX-HTC3510	Ver.1.0	Ver.1.2	Ver.1.14	Ver.1.54

A-8 Displaying the Edit Unit Operation Settings Tab Page

A-8-1 Connection to a CPU Unit

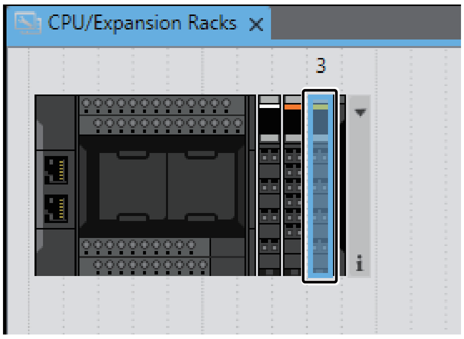
This section describes how to display the Edit Unit Operation Settings Tab Page that is used to create Unit operation settings on the Sysmac Studio for the NX Units connected to the CPU Unit.

You can use the methods described below to display the Edit Unit Operation Settings Tab Page on the CPU and Expansion Racks Tab Page on the Sysmac Studio.

Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for the method of displaying the CPU and Expansion Racks Tab Page.

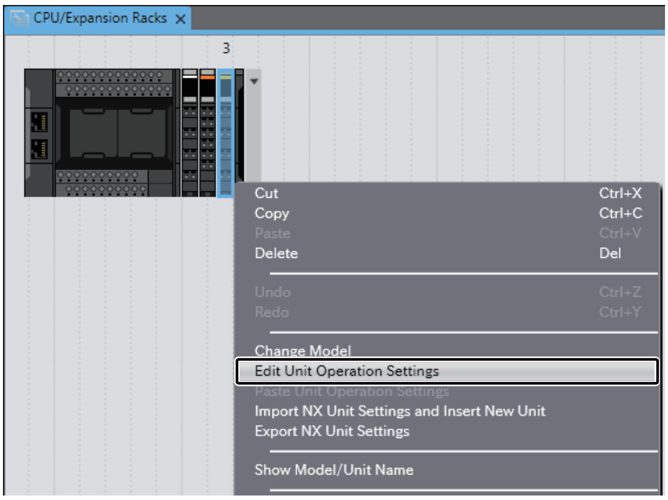
● Method 1

Double-click the NX Unit to set.



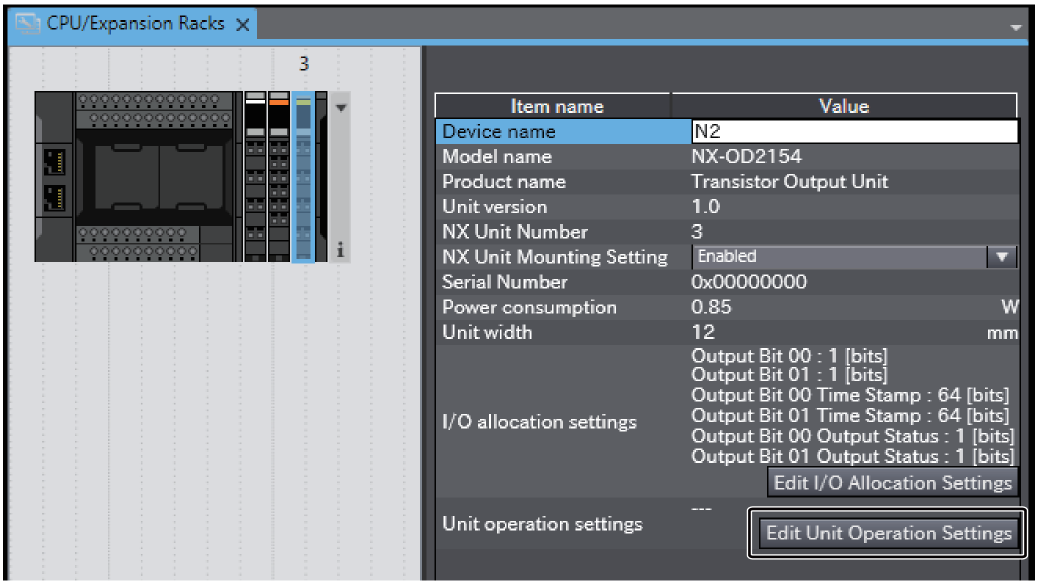
● Method 2

Right-click the NX Unit and select Edit Unit Operation Settings from the menu.



● Method 3

Select the NX Unit and click the Edit Unit Operation Settings Button.



A-8-2 Connection to the Slave Terminal

This section describes how to display the Edit Unit Operation Settings Tab Page that is used to create Unit operation settings on the Sysmac Studio for NX Units in the Slave Terminal.

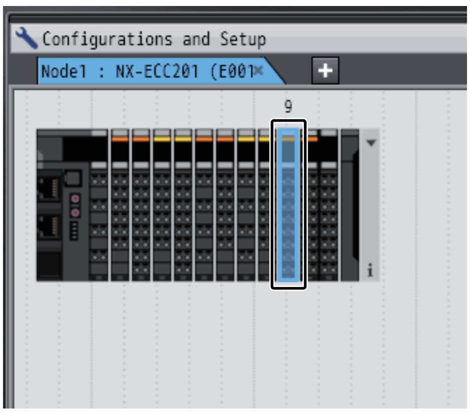
You can use the methods described below to display the Edit Unit Operation Settings Tab Page on the Edit Slave Terminal Configuration Tab Page on the Sysmac Studio.

Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for the method of displaying the CPU and Expansion Racks Tab Page.

Refer to the operation manual for your Support Software for the method to display the Edit Slave Terminal Configuration Tab Page or Edit Unit Operation Settings Tab Page with Support Software other than the Sysmac Studio.

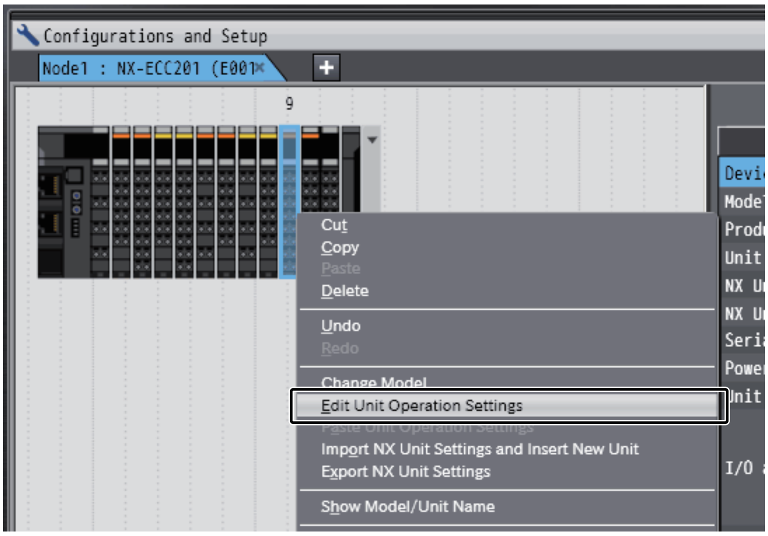
● Method 1

Double-click the NX Unit to set.



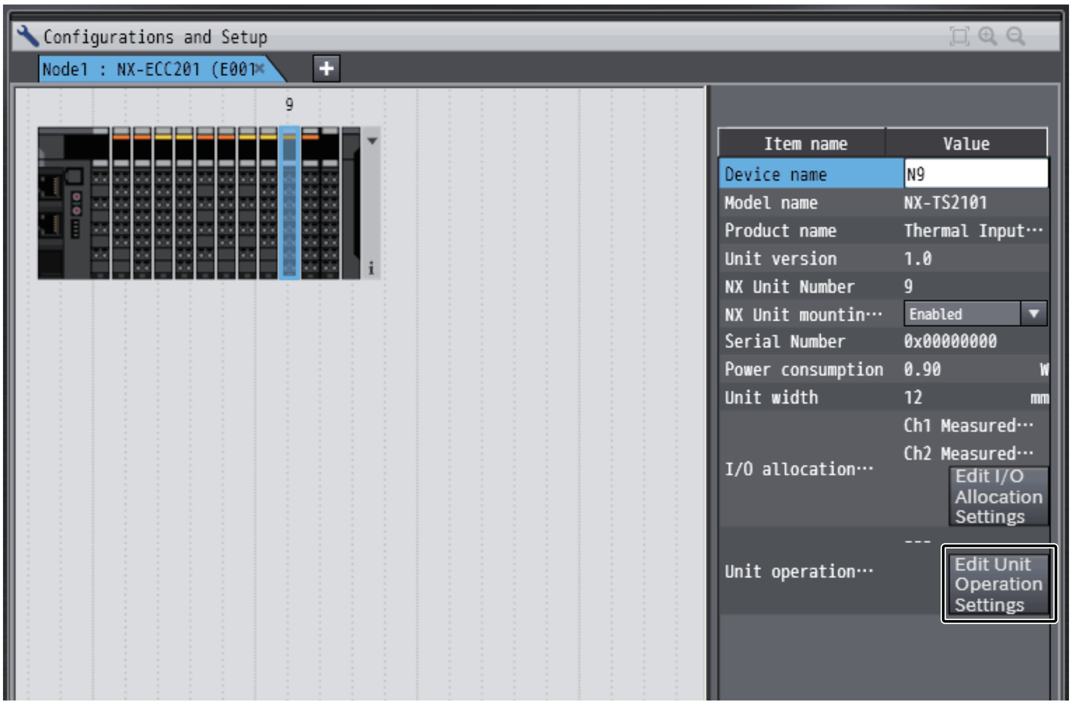
● Method 2

Right-click the NX Unit and select Edit Unit Operation Settings from the menu.



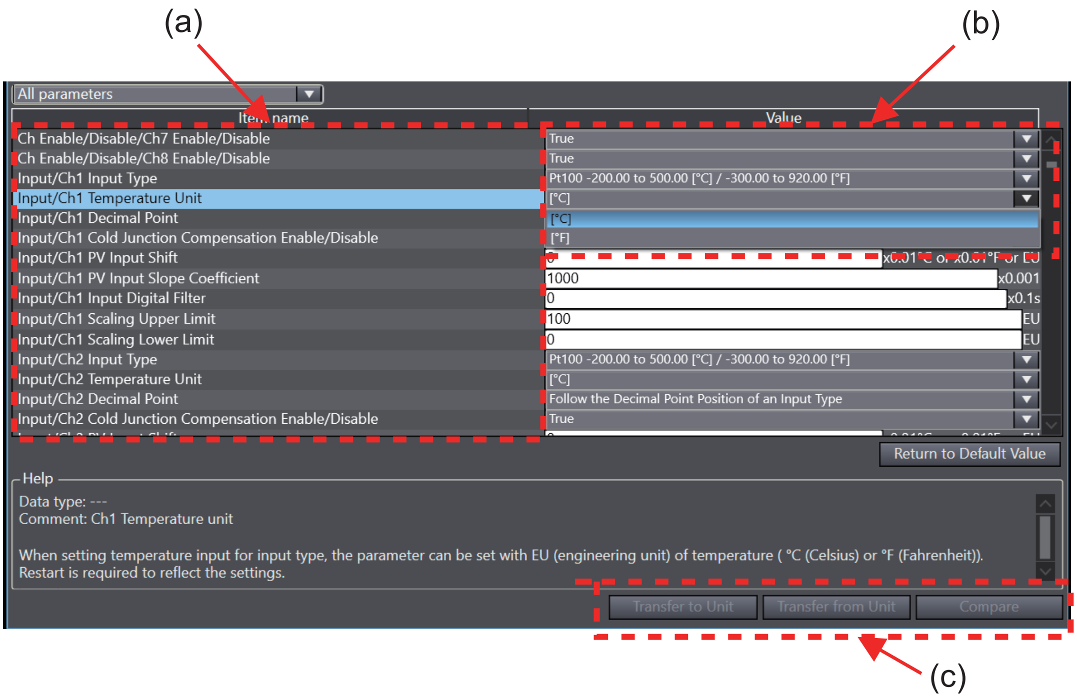
● Method 3

Select the NX Unit and click the Edit Unit Operation Settings Button.



A-9 Edit Unit Operation Settings Tab Page

This section describes the Edit Unit Operation Settings Tab Page on the Sysmac Studio. If you use the Support Software other than the Sysmac Studio, refer to the operation manual for your Support Software for the pane to edit the Unit operation settings.

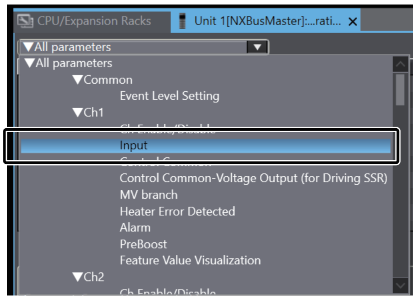


Symbol	Description
(a)	Setting items for Unit operation settings.
(b)	The set values of the setting items. Select a setting item from the drop-down list or enter the set value in the text box.
(c)	Transfer and Compare buttons. To transfer the Unit operation settings from Sysmac Studio to the NX Unit, click the **Transfer to Unit** Button.

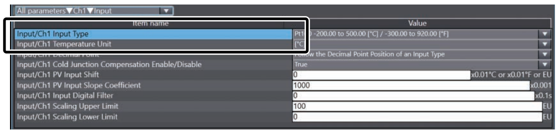
Additional Information

- You can click the list button on the Edit Unit Operation Settings Tab Page to narrow the items that are displayed. The following screen captures show an example of displaying only the input functions for Ch1.

Example:



Select Input Functions under Ch1.



Only the input functions for Ch1 are displayed.

- If you set a value different from the default value, the value on the Sysmac Studio is displayed in a different color.
- You can click the **Return to Default Value** Button to return all set values on the Sysmac Studio to the default values.
- Help for the settings is displayed at the bottom of the Edit Unit Operation Settings Tab Page.

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