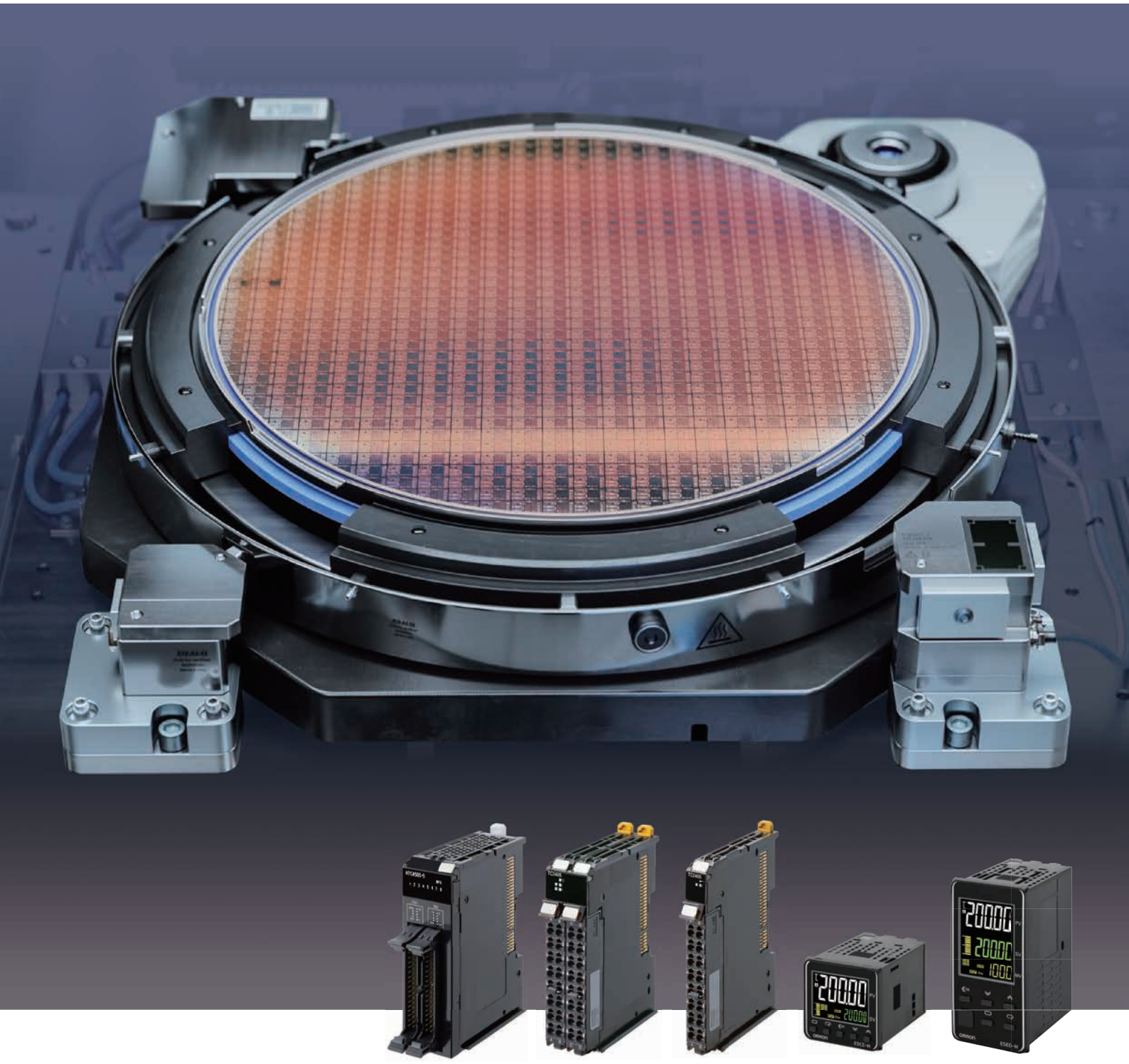
Temperature control units
NX-HTC/NX-TC/EJ1/E5DC-B/E5□D-H

OMRON

Advanced temperature control for sustainable manufacturing



Advanced temperature control technology leads to balance of quality and productivity improvements in increasingly complex manufacturing

There is a growing need for optimal temperature control that does not burden human workers at advanced manufacturing sites beset by labor shortages. OMRON offers wide-ranging temperature control technologies and an extensive product lineup which fits your needs. Those products including NX-HTC which delivers advanced temperature control to contribute quality improvement and better productivity.



Semiconductors

Adapting to precise temperature control for semiconductor innovation

NX-HTC controls multi points while keeps the footprint >P4

Higher resolution enables adaptation to fine process precision >P5

Supports universal input and works with infrared thermosensor >P5

Reduction of production yield by detecting minute temperature profile fluctuations due to changes in conditions such as workpieces, equipment and environment >P6

Maximize quality and production capacity by minimizing temperature fluctuations caused by routine disturbances >P8

Advanced Temperature Control Units
NX-HTC



Advanced Temperature Control Units
NX-HTC
Temperature Control Units
NX-TC
Digital Temperature Controller
E5□D-H





Flexible temperature control



Food and consumer product / Automotive

Adapting to changes in the production site environment and environmentally friendly materials

Maintain quality product production that adapts to changes in workpieces, usage environments and equipment >P10

Maintains stable quality regardless of packaging material >P12

Maximizes production capacity by suppressing temperature variations caused by changes in cooling water, etc. >P13

Semiconductors / Automotive

Easy configuration even for high-mix production

Enables easy batch configuration/ operation from touch panel >P14

Temperature Control Units
NX-TC



Modular Temperature Controllers **EJ1**
Digital Temperature Controller **E5DC-B**



Digital Temperature Controller **E5□D-H**



Adapting to precise temperature control for semiconductor innovation

Temperature has wide-ranging impacts on the quality of smaller and multilayered semiconductor products, which are essential to building a highly digitalized society. NX-HTC, with its ability to save space and visualize feature values, helps improving quality and productivity while delivering rigorous temperature control.

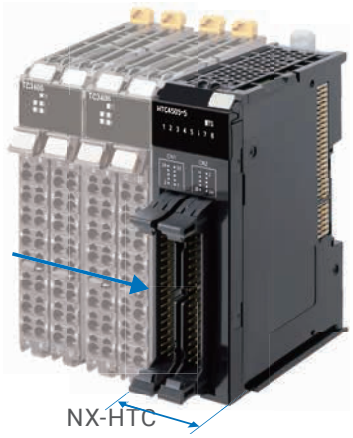
NX-HTC controls multi points while keeps the footprint

Issues Cannot maintain footprint because additional equipment is needed to increase in temperature control subjects

Delivers multipoint control within existing footprint

A single NX-HTC unit, which can control 8 channels,*1 takes up 40% less width than 2 units of our previous model, NX-TC, which has 4 channels per unit.

*1 When using standard control

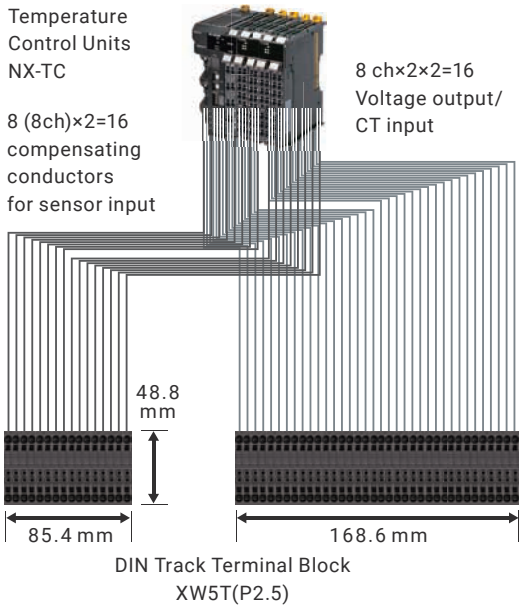


Approx. 40% less width

Save more space by using together with XW2K ultra-compact interface wiring system

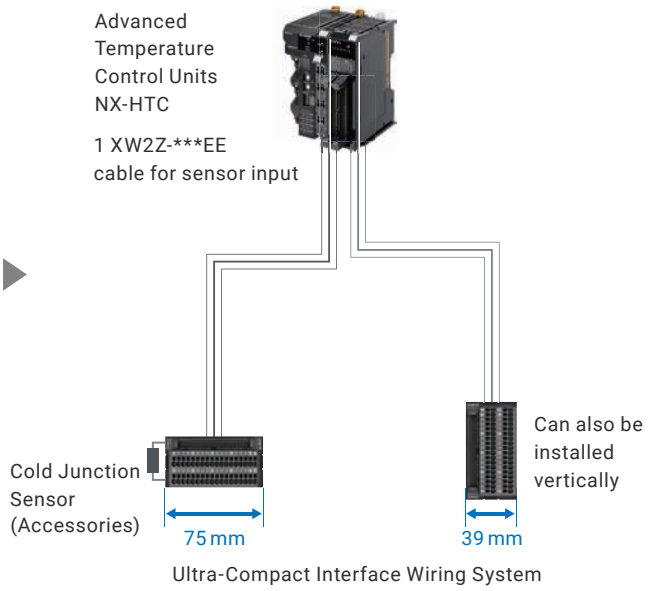
Save more in-panel space with the industry's smallest ultra-compact interface wiring system and cables that reduce wiring.

BEFORE



DIN Track Terminal Block
XW5T(P2.5)

AFTER



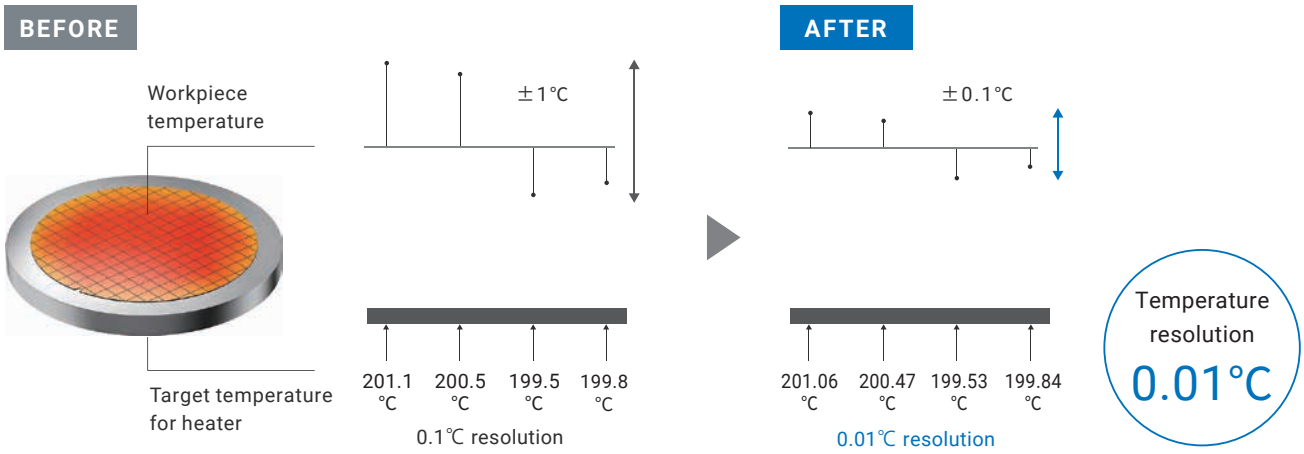
Ultra-Compact Interface Wiring System
XW2K-34G-T

Higher resolution enables adaptation to fine process precision

Issues Finer temperature control required for high-precision processing of smaller workpieces

Wide-range, high-resolution temperature control

High-resolution (0.01) control over wide temperature range enables high-precision temperature control, even in high temperatures.



Supports universal input and works with infrared thermosensor

Issues Because equipment mechanism temperatures impact quality in high-precision processing of smaller workpieces, temperatures of many different points (e.g., pipes and valves) must be measured

With Infrared thermosensors NX-HTC can control temperature and monitor equipment mechanism temperature



Infrared Thermosensor
ES1-N

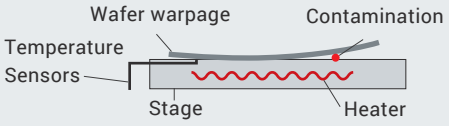
- Measurement temperature -50 to 500° C and -50 to 1,000° C types.
- High accuracy and fast measurement with ± 0.5° C reproducibility and a 0.14-second (95%) response time.
- You can use the ES1-TOOLS dedicated software (free download from our website) as a setting tool to monitor temperature and change the emissivity, moving average function, and output range.
- Full lineup of laser pointer types

Reduction of production yield by detecting slight temperature profile fluctuations due to changes in conditions such as workpieces, equipment and environment

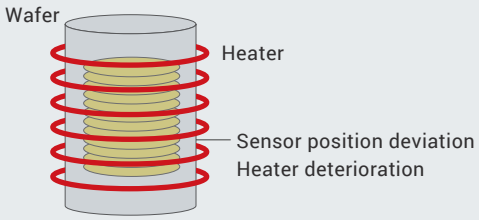
Issues

- Warping of wafers caused by unpredictable disturbances and othe changes in workpieces and equipment (e.g.,sensor position deviation or deterioration of heater) reduce yield
- When defect occurs, it takes time to identify the effect and investigate the cause.

Examples of workpiece, equipment and environmental changes



Wafer warpage / Contamination

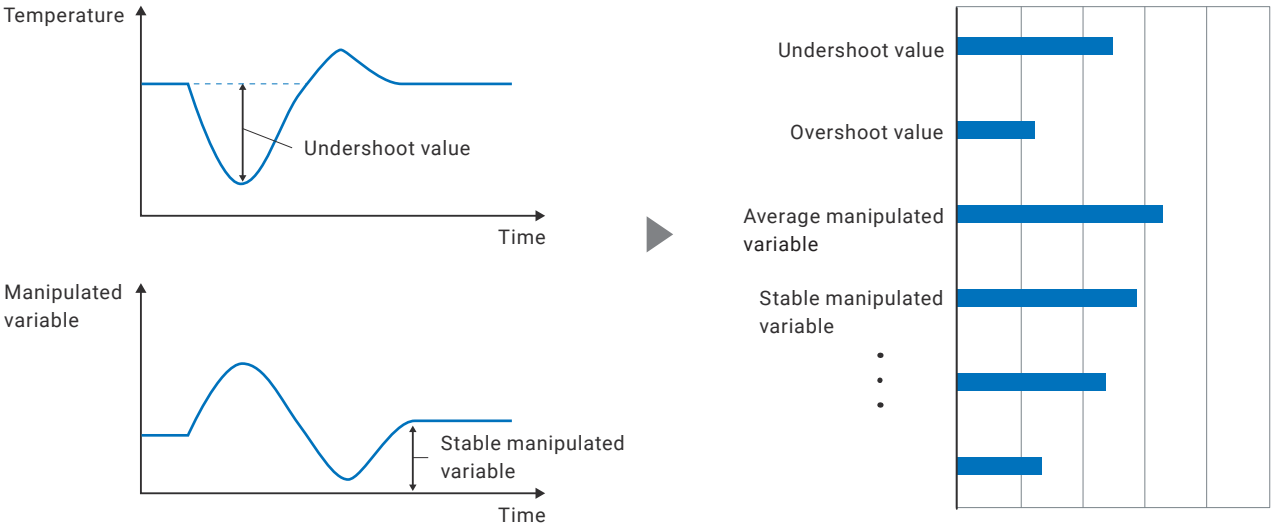


Insulation / furnace wall deterioration

About Feature Visualization function

Feature Visualization is a function which automatically calculates 12 types of feature values. Those values are based on Omron's knowledge garnered through our years of experience in temperature control experience, most strongly reflect workpiece, equipment, and environmental changes. The values are calculated from temperature and manipulated variable during production. Monitoring these values allows for detection of slight changes in temperature profile caused by workpiece, equipment and environmental changes.

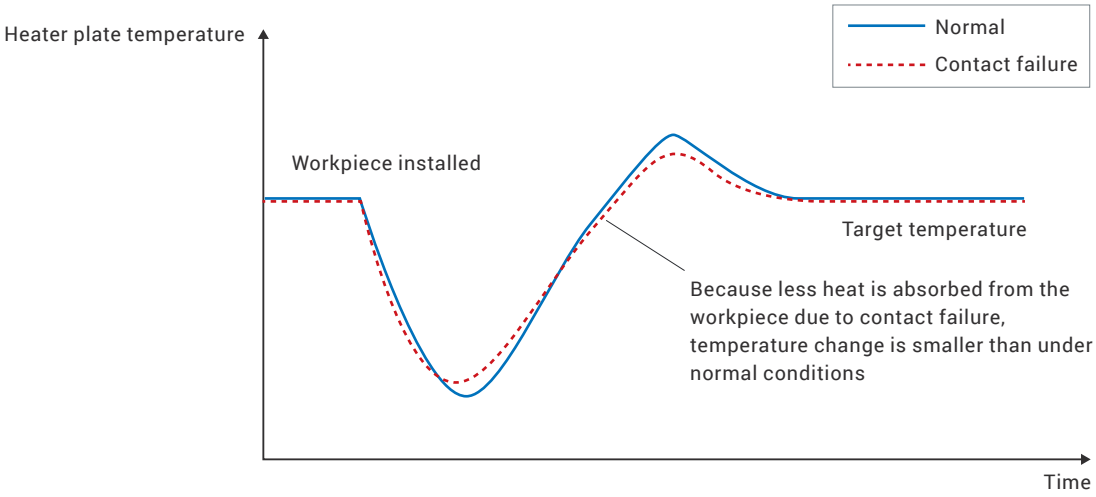
NX-HTC automatically converts temperature fluctuations and manipulated variables during temperature rise into feature values



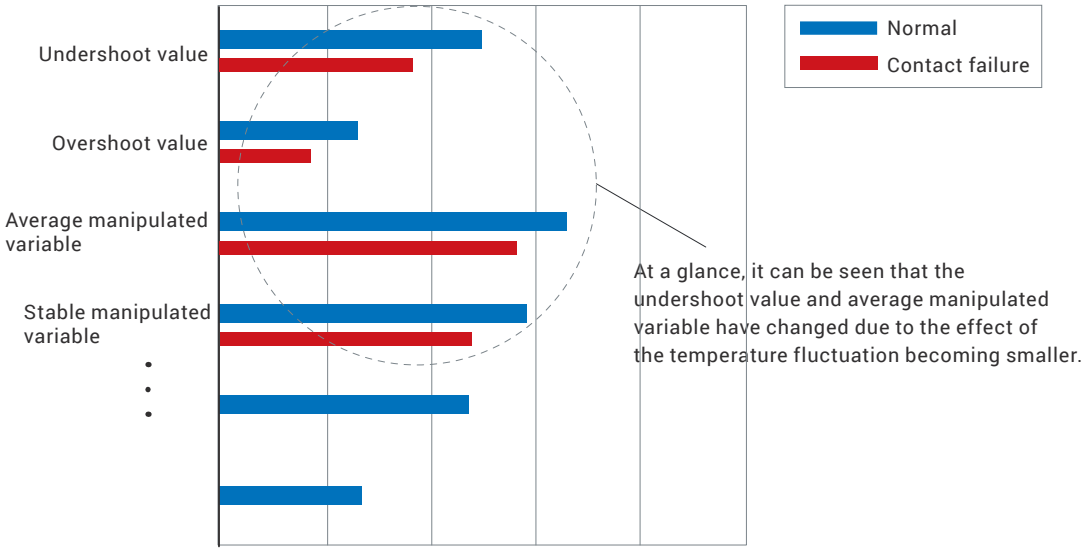
Monitors trends in feature value data to detect workpiece, equipment and environmental changes

NX-HTC contributes to reduce defects by providing feature values which users can use for managing equipment conditions quantitatively and catching unusual equipment conditions early.

BEFORE Slight changes cannot be noticed just by monitoring raw temperature waveforms



AFTER Monitoring feature values enables detection of slight changes



Maximize quality and production capacity by minimizing temperature fluctuations caused by routine disturbances

Issues

- The advanced packaging and high integration of semiconductors have made stringent temperature control a must; temperature variations caused by routine disturbance impact quality
- Wait time until temperature variations caused by routine disturbances stabilize hampers improvements in production capacity

Automatically suppresses temperature variations caused by routine disturbances

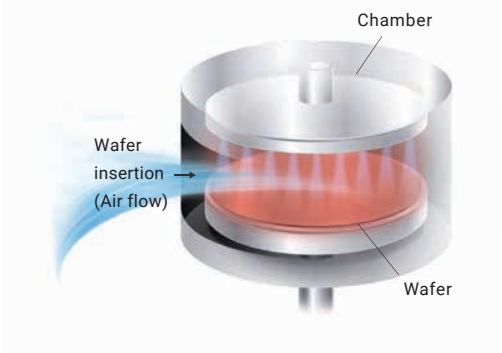
NX-HTC and NX-TC provide stable automatic control against foreseeable temperature variations, e.g. those caused by outside air infiltration when doors are opened and closed. NX-HTC and NX-TC contribute to quality improvement and help boost production capacity by reducing the wait time until temperature stabilization.

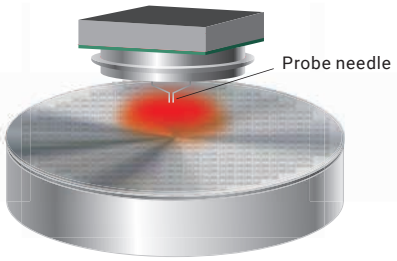


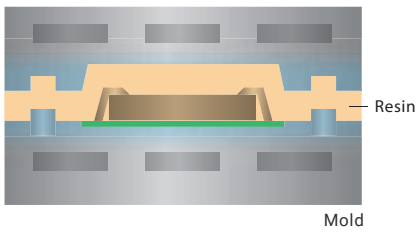
Deposition equipment
Chamber temperature falls when doors are opened/closed or when gas is injected

Prober
When a current is applied wafer heat generation rises stage temperature

Molding system
Mold temperature falls upon resin injection

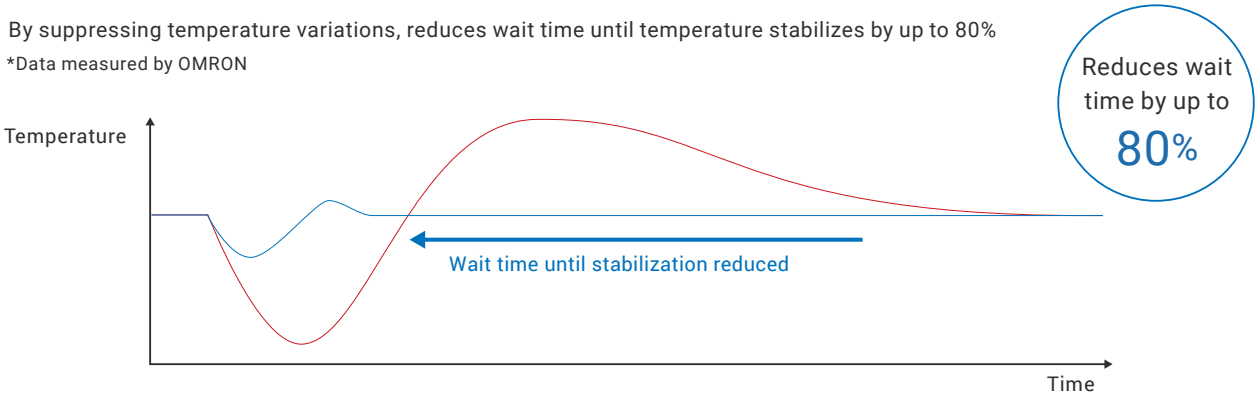






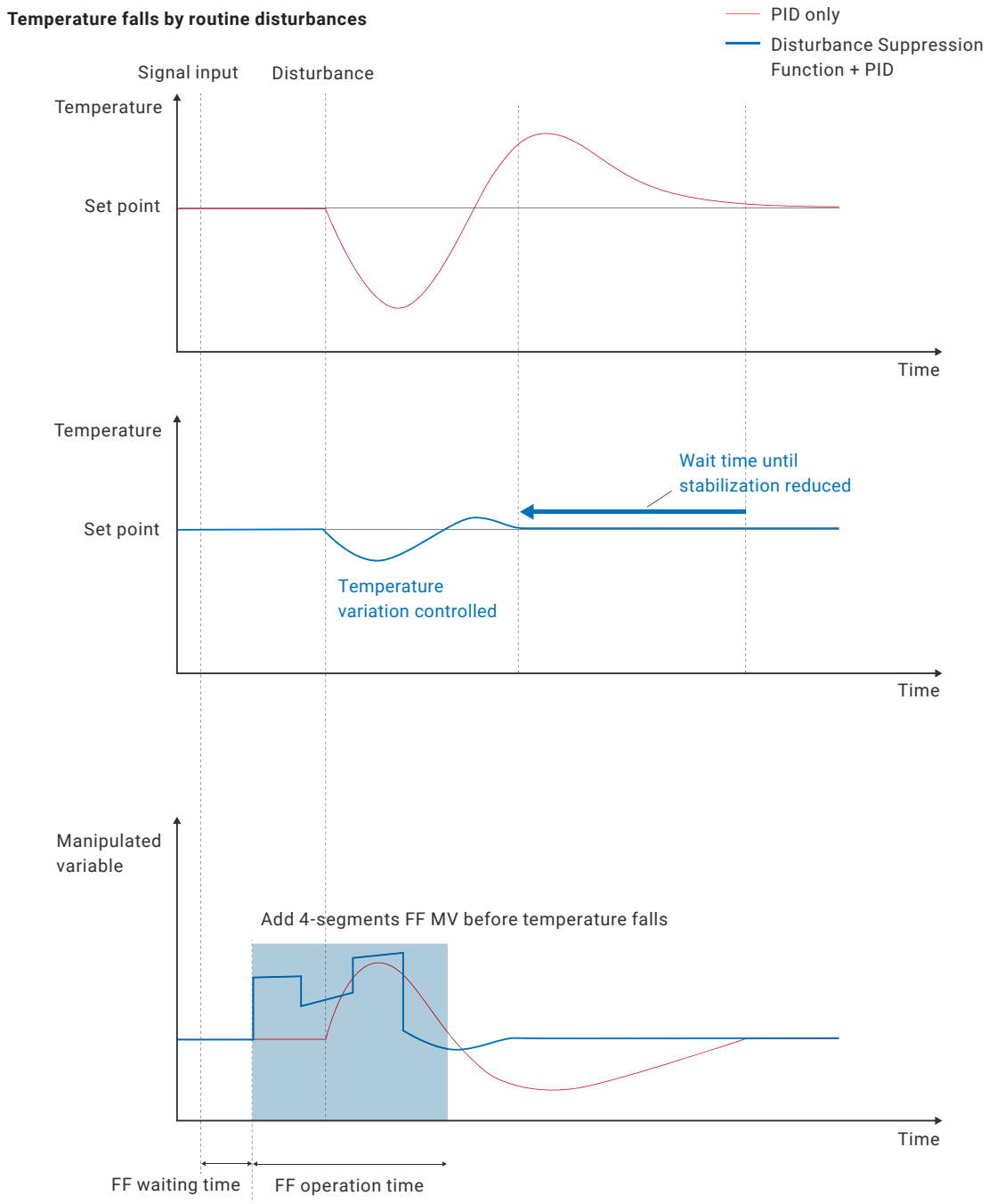
Helps boost production capacity

By suppressing temperature variations, reduces wait time until temperature stabilizes by up to 80%
*Data measured by OMRON



Disruption Suppression Feature minimizes temperature deviations

The Disturbance Suppression Function is a control function that automatically suppresses temperature variations that are expected to be caused by foreseeable disturbances. Trigger signals input to the temperature controller before these disturbances occur turn the function on, which adds to or subtracts from the manipulated variable (MV). Disturbance autotuning automatically adjusts the FF (feedforward) MV, FF operation time, and FF waiting time.



Adapting to changes in the production site environment and environmentally friendly materials

With previous temperature controllers, experience and intuition were key to making optimal adjustments when configuring commissioning settings or adjusting for changes, and therefore critical to achieving quality.
NX-TC captures changes in conditions that can impact quality, like a skilled worker would, to deliver automatic temperature control that constantly maintains optimal conditions.

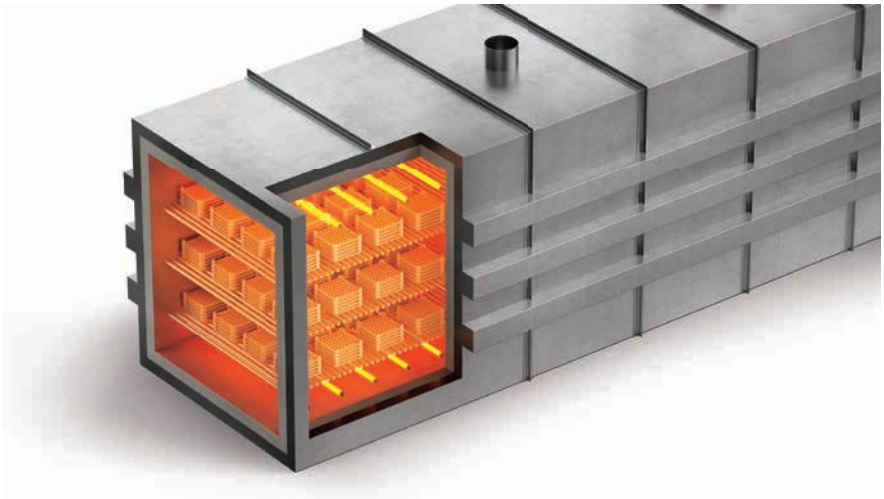
Maintain quality product production that adapts to changes in workpieces, usage environments, and equipment

Issues

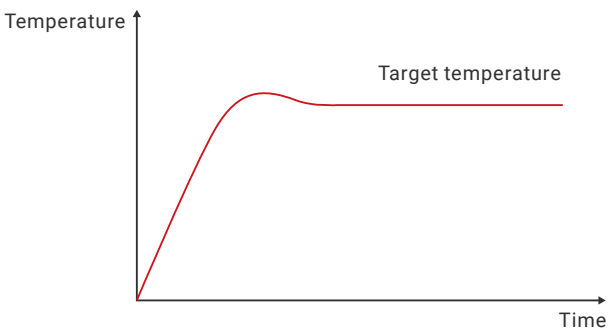
- Environment is different at equipment shipping destination and PID adjustments must be made again on-site
- PID adjustment needed for each workpiece type, and it makes changeover time-consuming

Automatically makes PID adjustments upon commissioning to reduce onerous adjustment work

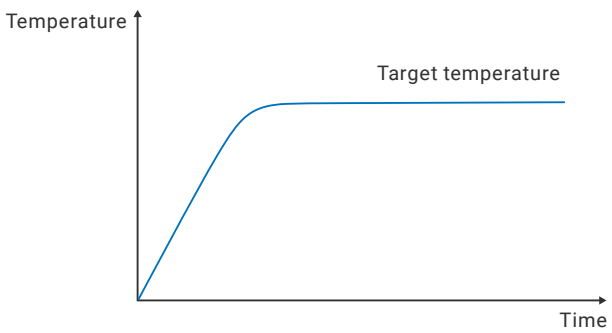
NX-TC frees production sites from onerous commissioning and adjustment work. It captures changes in conditions that can impact quality, like a skilled worker would, and automatically makes PID adjustments to deliver temperature control that constantly maintains optimal conditions.



Temperature overshoots upon its rise because heater power supply at equipment shipping destination is of different voltage



PID adjustments made automatically based on new heater power supply voltage to optimize temperature rise



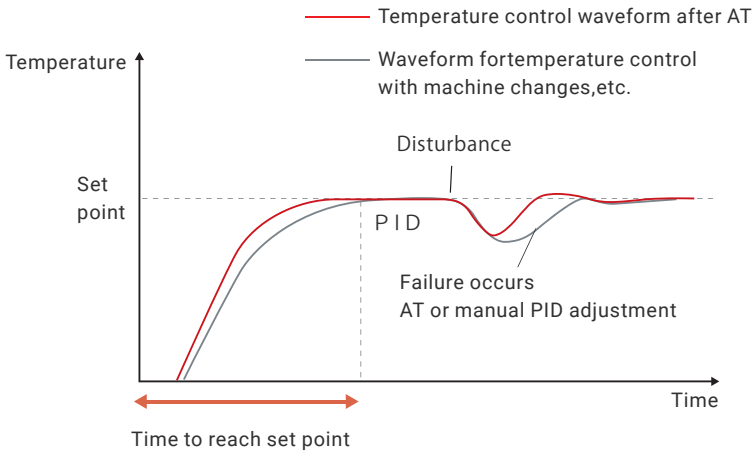
Automatically adjusts PID using the industry-first adaptive control technology[*1]

With the "adaptive control" incorporated into this product, the optimal PID value is calculated automatically for both the time of the start-up and for during stable production. Furthermore, it is possible to monitor the temperature control status of the machine to automatically adjust the PID value to obtain the optimal temperature control in response to changes such as workpiece changes and machine changes.

*1 According to an investigation by OMRON of general-purpose temperature controllers for FA as of March 2017.

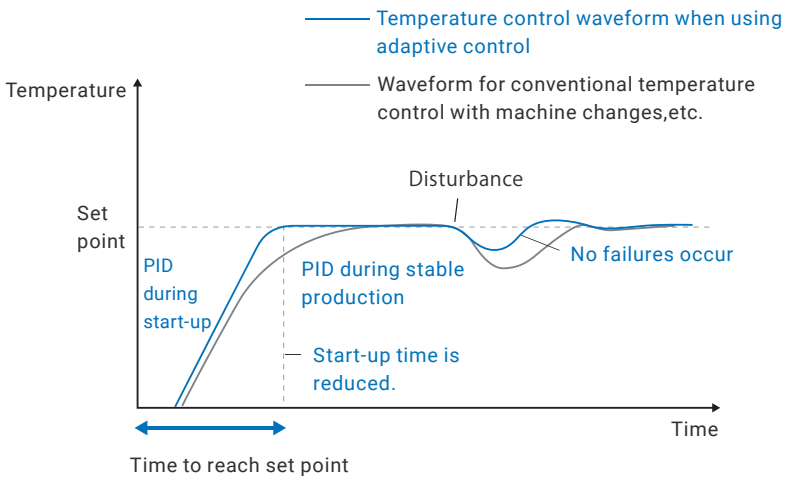
BEFORE There is one type of PID and after failures occurdue to reasons such as machine changes, PID adjustment is performed with AT or manually.

Conceptual image of temperature control waveform up until now.



AFTER Higher speeds become possible with the PID during start-up and also the optimal temperature control status is maintained with automatic adjustment of the PID value following changes such as machine changes.

Conceptual image of temperature control waveform when using adaptive control.



Packaging machines

Maintains stable quality regardless of packaging material

Issues

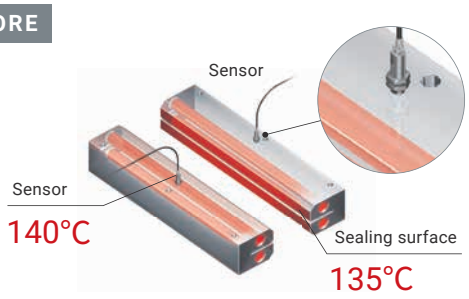
- Sustainable/thinner packaging materials for reducing plastic use have narrower temperature control margins, leading to higher defect rates
- Temperature adjustments upon equipment startup and upon defect occurrence are extremely time-consuming

NX-TC enables stable automatic adjustment by measuring sealing surface temperatures and capturing variation characteristics

"Temperature sensors for packaging machines" to measure the temperature of the sealing surface

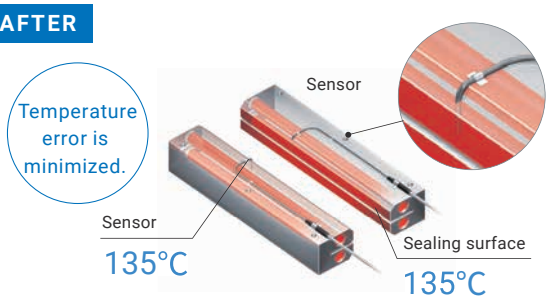
The temperature of the heating bar surface is measured accurately and there is no effect from factors causing temperature variations, such as the speed of the packaging machine and changes to the packaging materials.

BEFORE



On a conventional sealing machine, temperature sensors can often be located too far away from the sealing surface, so a difference occurred between the temperature of the sealing surface and the temperature that was actually being controlled. This temperature difference and resulting sealing failures increase as the packaging speed increases.

AFTER

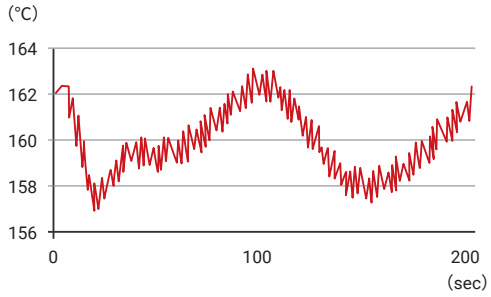


The installation position of the temperature sensor for packaging machines has been brought closer to the sealing surface to bring the temperature of the sensor closer to the temperature of the sealing surface. This minimizes the effects from variation in the surface temperature of the packaging materials.

"Automatic filter adjustment function" to suppress the instability in surface temperature measurements

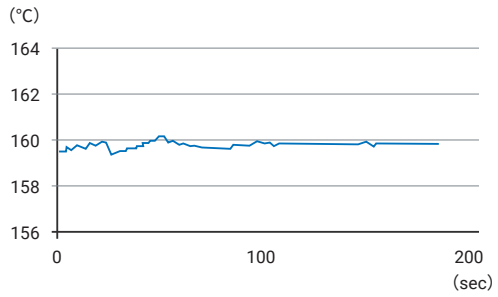
By using the temperature sensor for packaging machines and the automatic filter adjustment function, it becomes possible to control the quality with the sealing temperature while also suppressing variation in the temperature with just a temperature controller, without relying on adjustments by workers.

BEFORE



When a temperature sensor for a packaging machines is used, there is sometimes periodic temperature variation generated when there is a marked effect from the heat on the packaging materials side.

AFTER



When the automatic filter adjustment function of the NX-TC is used, this periodic temperature variation is suppressed automatically. It becomes possible to perform stable temperature control.

Molding machines

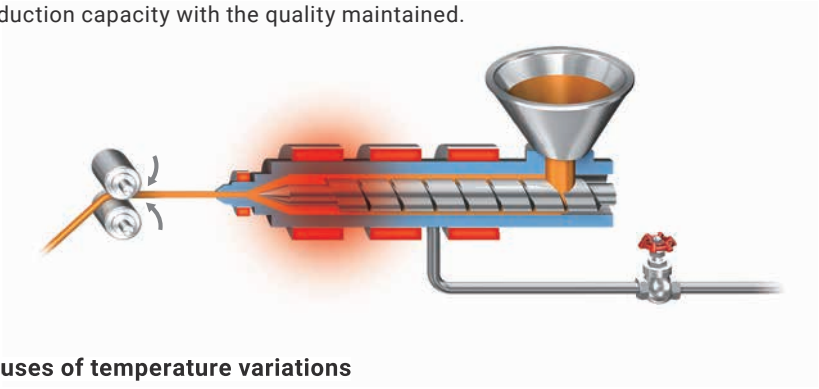
Maximizes production capacity by suppressing temperature variations caused by changes in cooling water, etc.

Issues

- Increased productivity to respond to demand expansion related to infrastructure as a result of the economic development of the emerging nations and the transfer of production bases overseas.
- At higher speeds, adjustments by the workers become necessary to respond to temperature variations arising due to factors such as the materials compounding and cooling water
- It is difficult to achieve high speed production while also maintaining the quality

Temperature variations due to speed changes and changes in the status of machines are suppressed without adjustments by the workers.

On a water-cooled extrusion molding machine, increased speed leads to temperature variations due to various causes and it was previously necessary for the workers to repeatedly make valve adjustments to stabilize the quality. With the NX-TC, the water-cooling output adjustment function suppresses the temperature variations to a minimum and raises the production capacity with the quality maintained.



BEFORE **Causes of temperature variations**

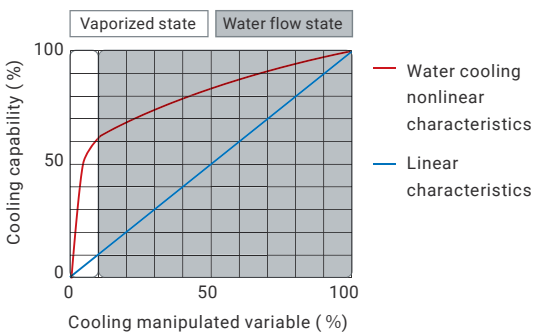
Nonlinear characteristics of water cooling
In the type of cooling that uses the heat of evaporation, the cooling performance is nonlinear, so temperature variation occurs.

Variations in cooling water
When there are variations in the cooling water system, temperature variations occur with the conventional auto-tuning because it is not possible to respond to changes in the status during operations.

"Water-cooling output adjustment function" to simultaneously suppress the causes of temperature variations and maintain stable performance

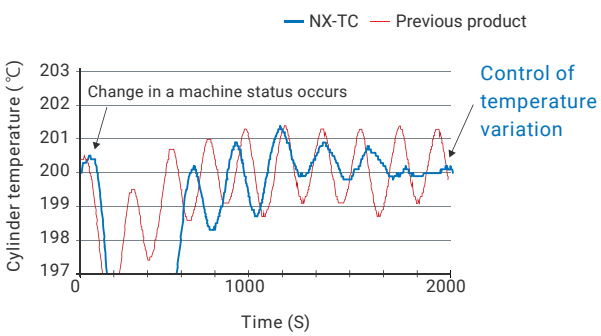
AFTER **Auto-tuning (Water cooling)**

It is possible to suppress the temperature variations that occur due to the cooling output by using the auto-tuning (water cooling) before the materials are input to gain an understanding of the cooling characteristics.



Water-cooling output adjustment function

During the production after the materials have been input, the water-cooling output adjustment function constantly detects changes in the temperature and suppresses the temperature variation by automatically adjusting the proportional band (cooling).



* Data measured by OMRON on a water-cooled twin screw extrusion molding machine.

Configuration even for high-mix production

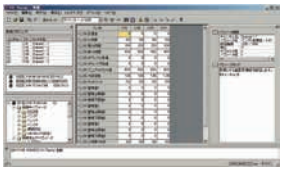
Configuration and operation in high-mix production can be complex, even when using the panel recipe. EJ1 and E5DC-B allow you to easily set multiple equipment settings at once, and can be connected to programmable terminals without effort.

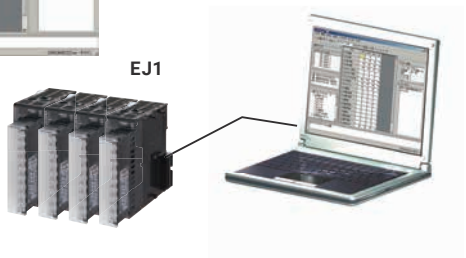
Issues

- To meet growing requirements for recipe management driven by the trend toward high-mix production, batch operation via programmable terminal is a must
- Transition to programmable terminal requires programs for configuring temperature controllers and for connecting them to programmable terminals, which can be difficult to prepare

Specialized tool allows for easy configuration

EJ1
Specialized setup tool CX-Thermo enables batch configuration of multiple channels



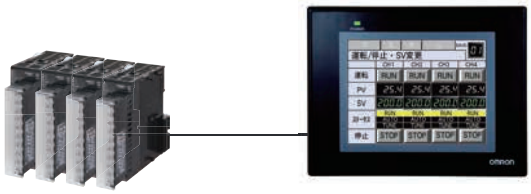


E5DC-B/E5□D-H
Can be set using specialized setup tool CX-Thermo
Power can be fed from PC using specialized cable; no power supply wiring necessary



Can be directly connected to programmable terminal

EJ1
Can be connected to programmable terminal; sample program provided



*Images are for illustration only.

E5DC-B/E5□D-H
Can be connected to programmable terminal



*Images are for illustration only.

Voltage output (for driving SSR)

NX-HTC

Model	NX-HTC3510-5 	NX-HTC4505-5 
Size (mm)	Front panel：30 × 100 Depth：71	Front panel：30 × 100 Depth：71
Sensor input	Thermocouple,Platinum resistance Linear current output (Cooling)	
Reference Accuracy	For details, refer to the "NX-series Advanced Temperature Control UnitsUser’s Manual (Man.No. H238)".	
Input sampling period	50 ms	
Control output	Voltage output (for driving SSR) (Heating), Linear current output(Cooling)	Voltageoutput (for dr iving SSR)
Terminal type	MIL connector	
Approved standards	cULus, CE, RCM, KC, UKCA	

NX-TC

Model	NX-TC24 □□ Value Design for Panel 	NX-TC34 □□ Value Design for Panel 
Size (mm)	Front panel：12 × 100 Depth：71	Front panel：24 × 100 Depth：71
Sensor input	Thermocouple, platinum resistance thermometer	
Reference Accuracy	For details, refer to the "NX-series Temperature Control Units User’s Manual (Man.No. H228)".	
Input sampling period	50 ms	
Control output	Voltageoutput (for driving SSR), Linear current outpu	
Terminal type	Push-In Plus terminal block (Screwless clamping terminal block)	
Approved standards	cULus, CE, RCM, KC, NK, LR, BV, DNV-GL,UKCA	

E5CD-H　E5ED-H

Model	E5CD-H Value Design for Panel 	E5ED-H Value Design for Panel 
Size（mm）	Front panel： 48 × 48 Depth：66	Front panel： 48 × 96 Depth：66
Sensor input	Thermocouple, platinum resistance thermometer, infrared temperature sensor (ES1B), or analog input (voltage/current).	
Indication accuracy	For details,refer to the E5□D-H Digital Temperature Controllers User's Manual(Cat. No. H239)	
Input sampling period	50 ms	
Control outoput	Relay output, voltage output (for driving SSR), Linear current output	
Terminal type	Push-In Plus terminal block	
Approved standards	cULus,KC,RCM,CE	

Temperature Sensors for Packaging Machines

Model	E52-CA□A□S□ 
Type	Lead wire type
Element type	K
Temperature range (Temperature rangeof sleeve)	0 ～ 650℃ (0 ～ 260℃)
Protective tubing length (mm)	60/120
Protective tubing diameter (mm)	ϕ 1
Compensating conductor	7 core/30 core
Temperature measuring junction	Grounded type
Terminal type	Y(Y terminal), F(Ferrule terminal)

EJ1

Model	Basic Unit ＊1						End Unit ＊1	
	EJ1N-TC2A-QNHB 	EJ1N-TC2B-QNHB 	EJ1N-TC4A-QQ 	EJ1N-TC4B-QQ 	EJ1N-TC2A-CNB 	EJ1N-TC2B-CNB 	EJ1C-EDUA-NFLK 	EJ1C-EDUC-NFLK 
Size (mm)	Front panel：31 × 90 Depth：109	Front panel：31 × 90 Depth：104.85	Front panel：31 × 90 Depth：109	Front panel：31 × 90 Depth：104.85	Front panel：31 × 90 Depth：109	Front panel：31 × 90 Depth：104.85	Front panel：15.7 × 90 Depth：76.2	Front panel：15.7 × 90 Depth：79.7
Sensor input	Thermocouple, platinum resistance thermometer, analog voltage, and analog current selectable for each channel						—	
Indication accuracy	Thermocouple:(± 0.3% of indication value or ± 1° C, whichever is greater) ± 1 digit max. Platinum resistance thermometer:(± 0.2% of indication value or ± 0.8° C, whichever is greater) ± 1 digit max. Analog input: ± 0.2% FS ± 1 digit max. CT input: ± 5% FS ± 1 digit max.						—	
Input sampling period	250 ms						—	
Control output	Voltageoutput (for driving SSR),Transistor output		Voltageoutput (for driving SSR)		Current output,Transistor output		—	
Terminal type	M3 terminal	Screw-less clamp	M3 terminal	Screw-less clamp	M3 terminal	Screw-less clamp	M3 terminal	Screw-less clamp
Approved standards	cULus, CE, RCM, KC, NK, LR, BV, DNV-GL							

*1. An End Unit is always required for connection to a Basic Unit or an HFU. An HFU cannot operate without a Basic Unit. External communications cannot be performed when using a Basic Unit only.

E5DC-B

Model	E5DC-B 
Size (mm)	Front panel：22.5 × 90 Depth：86
Sensor input	Thermocouple, platinum resistance thermometer, infrared temperature sensor (ES1B), or analog input (voltage/current).
Sensor input Indication accuracy (at the ambient temperature of 23° C)	Thermocouple:(± 0.3% of indication value or ± 1° C, whichever is greater) ± 1 digit max. Platinum resistance thermometer:(± 0.2% of indication value or ± 0.8° C, whichever is greater) ± 1 digit max. Analog input: ± 0.2% FS ± 1 digit max. CT input: ± 5% FS ± 1 digit max.
Input sampling period	50 ms
Control output	Relay output, voltage output (for driving SSR), Linear current output
Terminal type	Push-In Plus terminal block
Approved standards	cULus, KC, RCM, CE

Value Design for Panel

Our shared Value Design for Panel (herein after referred to as "Value Design") concept for the specifications ofproducts used in control panels will create new value to our customer’ s control panels.

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Note: Do not use this document to operate the Unit.

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