Digital Temperature Controllers/ NX-series Temperature Control Unit

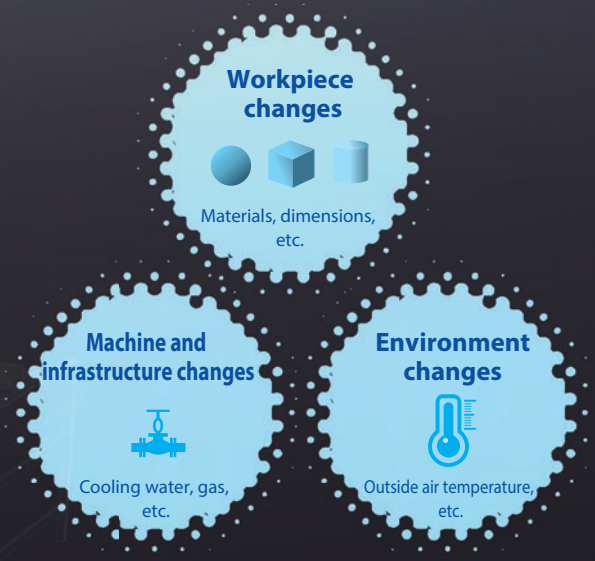
E5□D/NX-TC

The adjustments made by skilled workers are automated using AI. The innovation of production sites has begun.

Optimal and automatic temperature control without human intervention easily achieves both productivity and quality.

Previous temperature controllers have not only required a long time for start-up settings and variation adjustments, it has also been difficult to make the optimal adjustments without having experience and intuition. There were therefore some effects on quality.
In response to this situation, OMRON developed temperature controllers that includes "adaptive control technology."
This makes it possible to detect the changes in the status which will have an effect on quality and to automatically control the temperature so that the optimal state is always maintained, in the same way as a skilled worker would.
This frees production sites from troublesome start-up and adjustment work.

Causes of temperature variations on production lines



Previously
Production speed: Slow
Failure rate: High
Adjustment by workers: Necessary

E5□D/ NX-TC
It is possible to continue producing good products without making set point changes or PID adjustments

The answer was

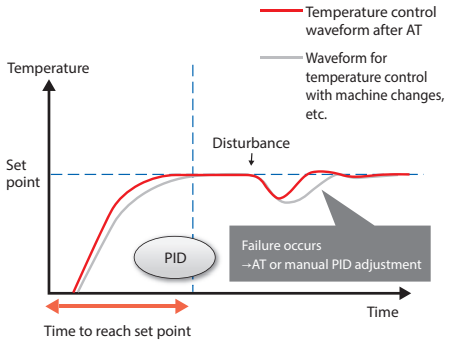
the industry's first inclusion* of "adaptive control technology"

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.

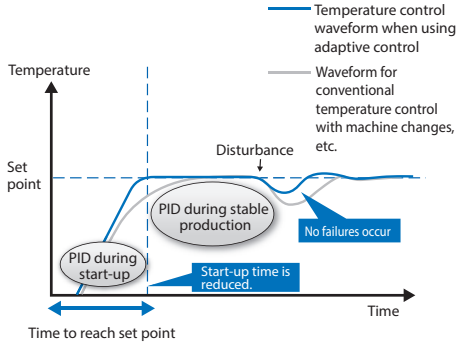
Previously There is one type of PID and after failures occur due to reasons such as machine changes, PID adjustment is performed with AT or manually.

E5□D/ NX-TC 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 up until now.



Conceptual image of temperature control waveform when using adaptive control.



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

New values to drive the evolution of **semiconductor equipment**

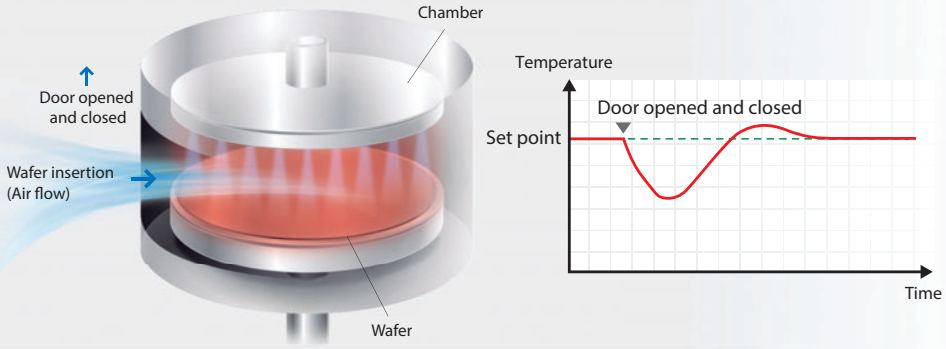
Empower your semiconductor equipment to maximize quality deviations caused by disturbance.

Issues at production sites

- The miniaturization and 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

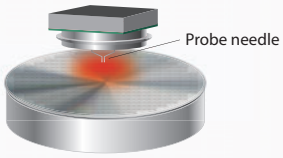
Disturbance examples deposition equipment

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



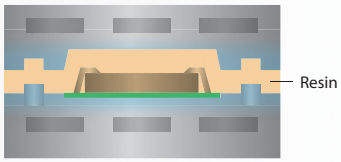
Prober

Current application generates heat in the wafer, causing the stage temperature to rise



Molding system

Mold temperature falls upon resin injection



Solution: NX-TC

Automatically suppresses temperature variations caused by routine disturbances

Provides stable automatic control against foreseeable temperature variations, e.g. those caused by outside air infiltration when doors are opened and closed. Contributes to quality improvement and helps boost production capacity by reducing the wait time until temperature stabilization.

*This function is available only with NX-TC.

Helps boost production capacity

By suppressing temperature variations, reduces wait time until temperature stabilizes by 80%.

*Data measured by OMRON.

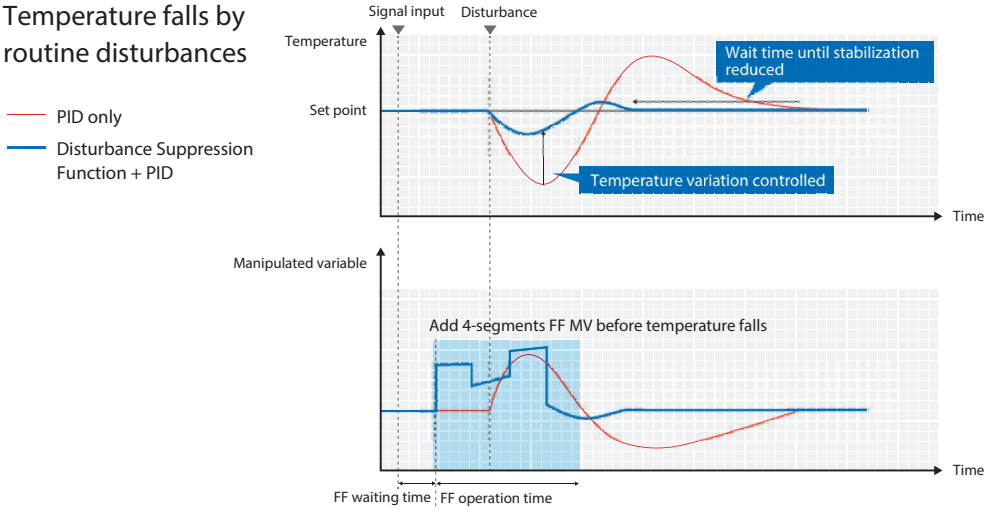
and production capacity by minimizing temperature

Control performance that achieves new value

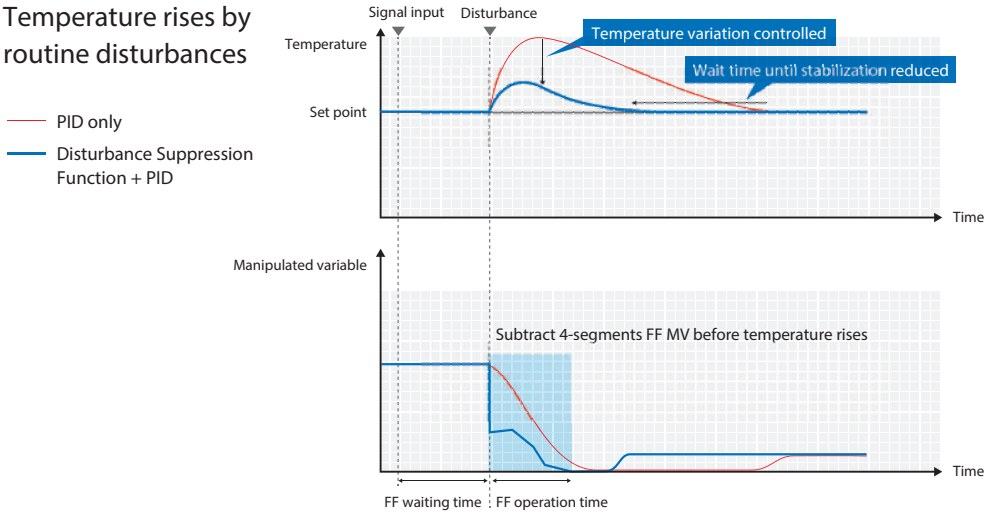
Disruption Suppression Feature minimizes temperature deviations

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.

Temperature falls by routine disturbances



Temperature rises by routine disturbances



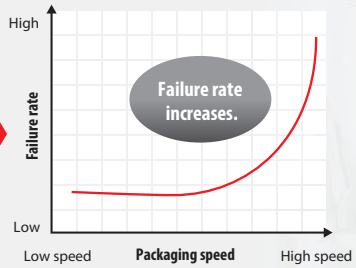
New value that supports advances in **packaging machines**

Packaging machines that can maintain quality even at higher speeds.

Issues at production sites

- Faster packaging to respond to the demand for foodstuffs arising due to the population increases in emerging nations
- Increase in speed even when performing multiple-product production using a wide variety of packaging materials
- At higher speeds, the temperature difference between the sealing surface and the control temperature widens, so the failure rate rises…

The temperature difference widens due to higher speeds

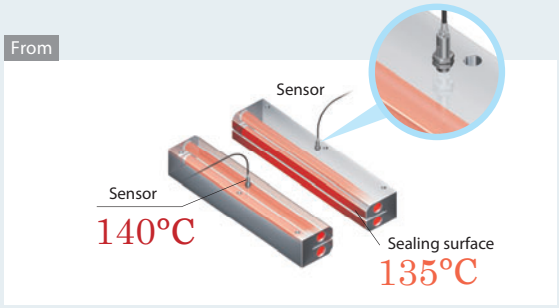


The temperature of the sealing surface is stably controlled automatically with measurement of the sealing surface temperature and algorithms to suppress variations.

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

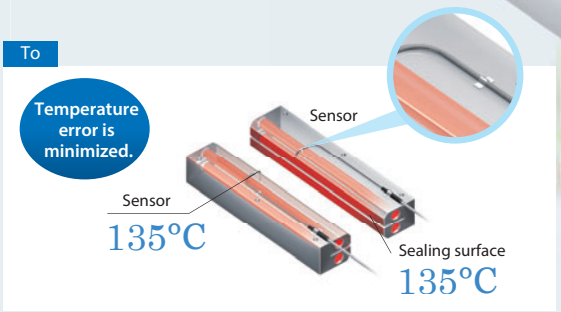
The temperature of the heating bar surface is measured accurately and there is no effect from factors causing temperature variations, such as the speed of the packaging machine and changes to the packaging materials.

From



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.

To

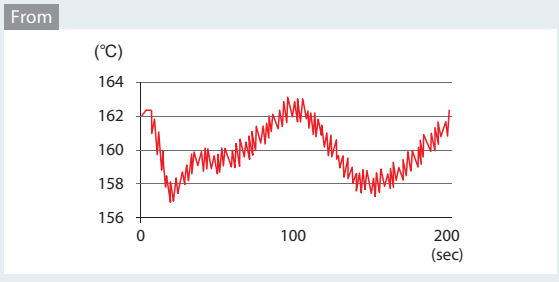


The installation position of the temperature sensor for packaging machines has been brought closer to the sealing surface to bring the temperature of the sensor closer to the temperature of the sealing surface. This minimizes the effects from variation in the surface temperature of the packaging materials.

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

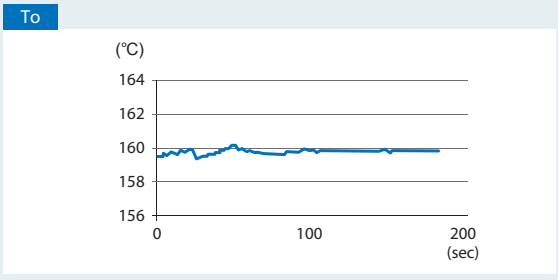
By using the temperature sensor for packaging machines and the automatic filter adjustment function, it becomes possible to control the quality with the sealing temperature while also suppressing variation in the temperature with just a temperature controller, without relying on adjustments by workers.

From



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.

To



When the automatic filter adjustment function of the E5□D /NX-TC is used, this periodic temperature variation is suppressed automatically. It becomes possible to perform stable temperature control.

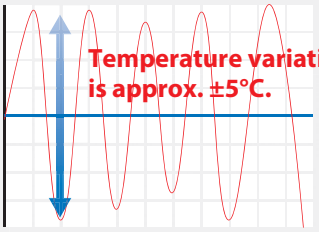
* Data measured by OMRON on a vertical flow packer.

New value that supports advances in **molding machines**

Molding machines that can maximize production capacity.

Issues at production sites

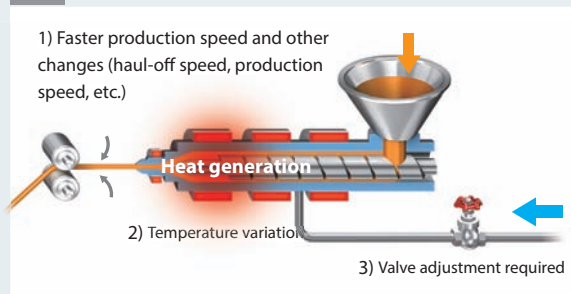
- Increased productivity to respond to demand expansion related to infrastructure as a result of the economic development of the emerging nations and the transfer of production bases overseas.
- At higher speeds, adjustments by the workers become necessary to respond to temperature variations arising 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 E5□D/NX-TC, the water-cooling output adjustment function suppresses the temperature variations to a minimum and raises the production capacity with the quality maintained.

From



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.

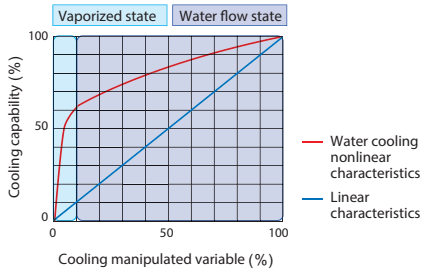
Variations in cooling water

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

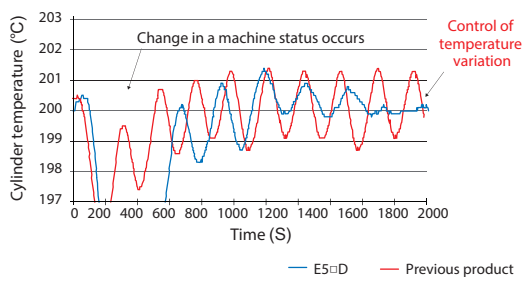
To Auto-tuning (Water cooling)

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).



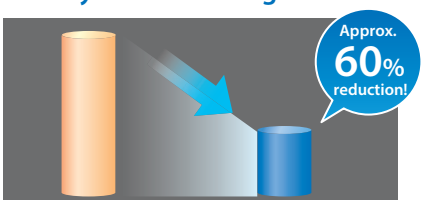
* Data measured by OMRON on a water-cooled twin screw extrusion molding machine.

Push-In Plus Technology for Easy Wiring

E5□D-B/NX-TC

Just Insert Wires: No Tools Required
Now you can use Push-In Plus technology to reduce the time and work involved in wiring.

Greatly Reduce Wiring Work



Conventional screw terminal blocks OMRON Push-In Plus terminal blocks

*Information for Push-In Plus and screw terminal blocks is based on OMRON's actual measurement value data.

Easy to Insert

OMRON's Push-In Plus technology are as easy as inserting to an earphone jack. They help reduce the work load and improve wiring quality.

Value Design for Panel

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

Main specifications

E5□D/E5□D-B

Model	E5CD	E5CD-B	E5ED	E5ED-B
Size (mm)	Front panel: 48 × 48, Depth: 60	Front panel: 48 × 48, Depth: 67.4	Front panel: 48 × 96, Depth: 60	Front panel: 48 × 96, Depth: 67.4
Sensor input	Thermocouple, platinum resistance thermometer, infrared temperature sensor (ES1B), or analog input (voltage/current).			
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	M3 screw terminal block	Push-In Plus terminal block	M3 screw terminal block	Push-In Plus terminal block
Approved standards	UL, KC, CE			

NX-TC

Model	NX-TC24□□	NX-TC34□□
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	50ms	
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	

Temperature Sensors for Packaging Machines

Model	E52-CA□AY S□
Type	Lead wire type
Element type	K
Temperature range (Temperature range of sleeve)	0 to 650°C (0 to 260°C)
Protective tubing length (mm)	60/120
Protective tubing diameter (mm)	1 dia.
Compensating conductor	7 core/30 core
Temperature measuring junction	Grounded type
Terminal type	Y(Y terminal), F(Ferrule terminal)

Main functions of E5□D/NX-TC

- Disturbance suppression function (Pre-boost)*
- Adaptive Control
- Automatic Filter Adjustment
- Water-cooling Output Adjustment
- Indication Data

*NX-TC Unit Versions 1.2 and later

* For details of the specifications, refer to "E5CD/E5ED Digital Temperature Controllers and Temperature Sensors for Packaging Machines Datasheet (Cat. No. H223)" and "NX - TC NX Series Temperature Control Unit Datasheet" on our website (www.fa.omron.co.jp)

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

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