OMRON

EtherCAT

Network Solutions for Control Automation Technology

PLC

Vision

Servo

Inverter

Remote I/O Terminal

EtherCAT®

» A Single Integrated Network

» Ultimate Performance

» Advanced Functions

realizing

Machine Control Network

Achieving "high-speed and high-precision" machine control through the world's highest level network solution

Perfectly suited to rapidly advancing machine control
EtherCAT provides high speed, expandability and flexibility

With the need to reduce takt times, improve yields and ensure traceability, the requirements for manufacturing systems are expanding.
To respond to these requirements, devices in the system are increasingly connected with networks. However, for high-speed and high-precision applications such as motion control, it is necessary to adopt separate network in addition to the field networks.
EtherCAT, which can execute motion control in realtime, realizes high capacity communication required for field networks among a large number of nodes, while maintaining the high-speed synchronous-communication through its preeminent communication performance.
As an inter-system network that eliminates the barrier between motion networks and field networks, EtherCAT will contribute not only to a reduction of design works but also to a shortening of takt times.

World highest level network

EtherCAT with its strength in high speed control is a next-generation network able to achieve preeminent performance in motion control.

An Ethernet-based network with realtime control capability

▶ 5-times faster Motion network communications speed over existing (MECHATROLINK-II) networks
▶ Synchronization performance between the slaves: 1 µs max.

High-speed and high-precision communications

▶ High speed Ethernet 100BASE-TX (100 Mbps)
▶ Adoption of the On-the-Fly method that enables realtime control

Global open network

▶ With over 1,300 member companies worldwide

Network between systems
EtherNet/IP
• For use for high-capacity, high-speed data links

EtherNet/IP™

OMNUC G5 Series

Inter-system network
EtherCAT
• For high-speed and high-precision control

Note1. EtherCAT is a registered trademark of Beckhoff Automation GmbH.
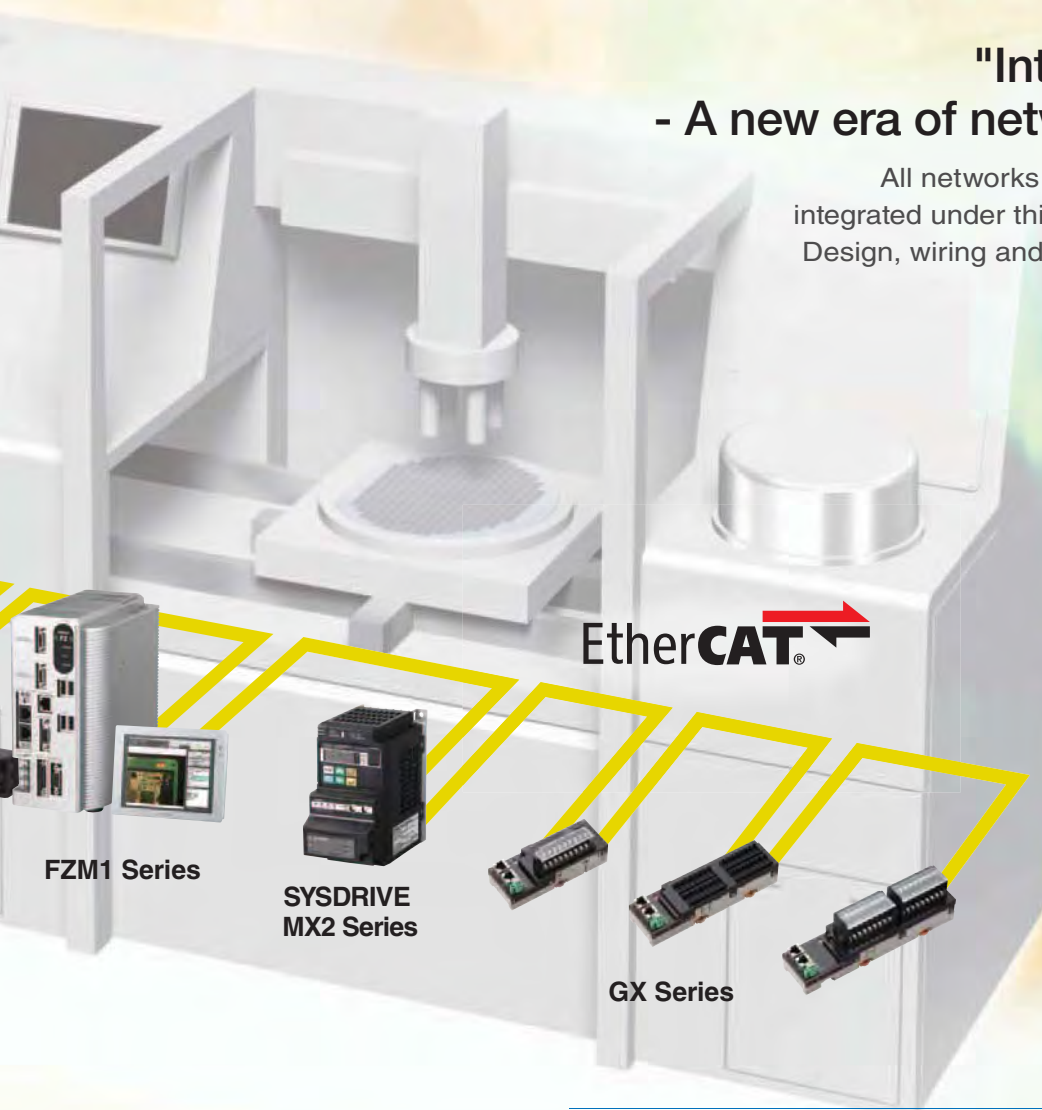Note2. CompoNet and EtherNet/IP are trademarks of ODVA.

Less network wiring

CompoNet

• For distribution of small
number of I/Os

CompoNet™

"Integrated Networks"
- A new era of networking in a system

All networks required for machine control are
integrated under this preeminent network capability.
Design, wiring and maintenance become simplified.

EtherCAT®

FZM1 Series

**SYSDRIVE
MX2 Series**

GX Series

Best in class

The world standard open network covers all layers
including factory management levels, system levels and component levels.
The EtherCAT realizes the world's top-class performing network at each layer.

Integrating field networks and motion networks
# A new dimension to network in the system

⟫ Features of the EtherCAT

The EtherCAT is a high-performance field network able to connect drive devices, intelligent sensors and I/O devices using Ethernet technologies

Network specifications

- Communication speed: 100 Mbps
- Communication standard: 100BASE-TX
- Communication media: cat.5 , RJ45
- Distance between nodes: 100 m max.

EtherCAT®
The Ethernet Field Network

High Performance

Open Network

Intelligence

Simple and Capable
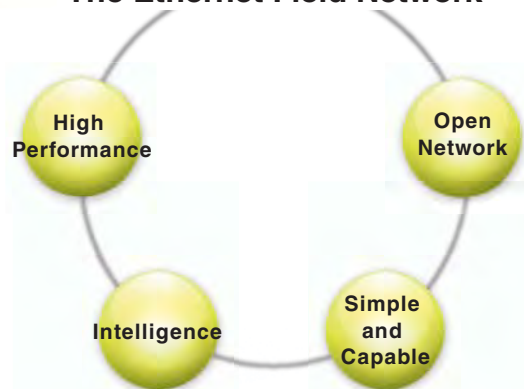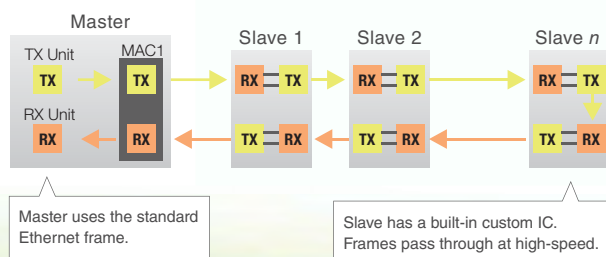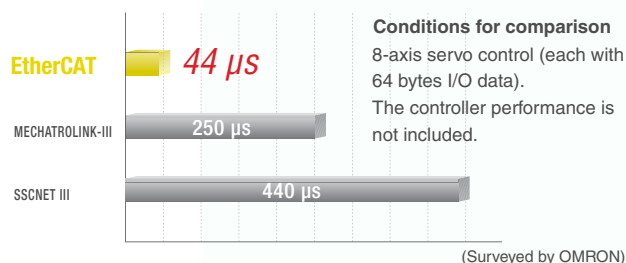
# High Performance

⟫ High-speed communications

- Preeminent high-speed communications
- Precise and smooth motion control achieved with the industry's fastest level communication cycle
- Over 5-times faster communications than other companies' motion networks

EtherCAT	*44 μs*
MECHATROLINK-III	250 μs
SSCNET III	440 μs

Conditions for comparison
8-axis servo control (each with 64 bytes I/O data).
The controller performance is not included.

(Surveyed by OMRON)

Master

TX Unit   MAC1   Slave 1   Slave 2   Slave n
TX   TX   RX TX   RX TX   RX TX
RX Unit
RX   RX   TX RX   TX RX   TX RX

Master uses the standard Ethernet frame.

Slave has a built-in custom IC. Frames pass through at high-speed.

Intelligence

⟫ Management of on-site device data

- Message transmission can be handled while real-time control is executed. The operation of on-site devices can be monitored and parameters can be configured via the network.

Status monitoring/tracing   Parameter editing

CX-One

EtherCAT®
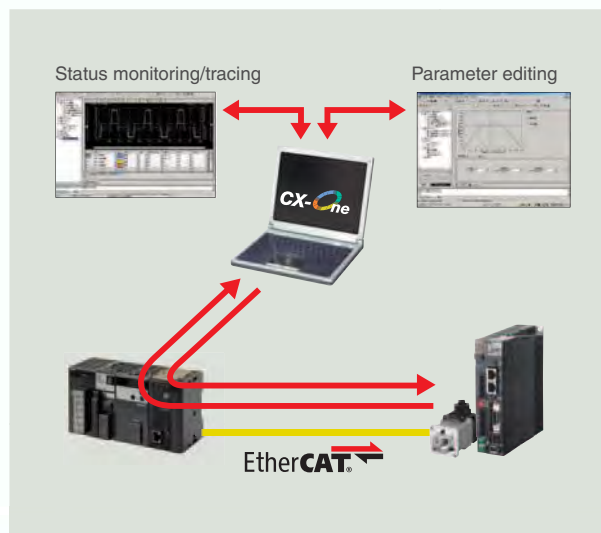
Simple and Capable

## » Expanding applications, not limited for motion control

- The large-capacity communication among multiple axes and multiple nodes can be handled at a high-speed. The feature is favorable for large-scale systems, too.
- The distance between nodes can be extended up to 100 m.
- Flexible communication specification allows a wide variety of devices to join the same network. The connectable devices involve drive devices such as Servo Drives and Inverters, I/O devices, and other intelligent devices, including Vision Sensors.

Distance between nodes: 100 m max.

EtherCAT.

Servo Drives

Vision Sensor | Encoder Input | Analog I/O | Digital I/O | Inverter
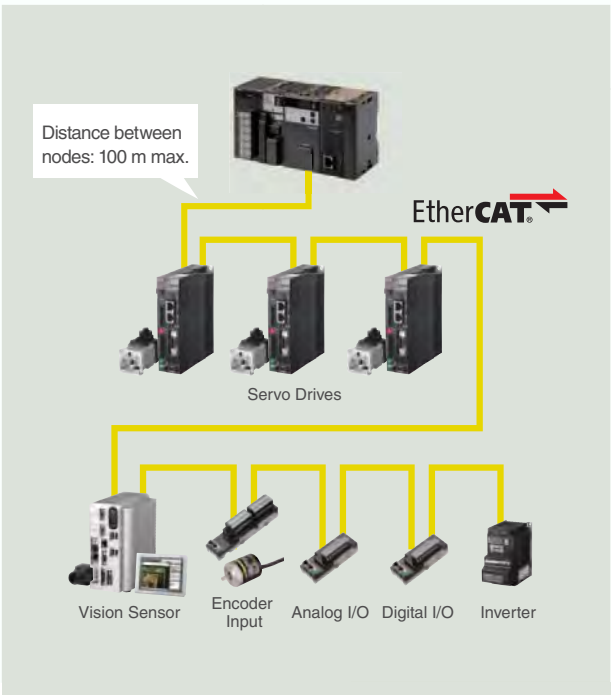
Open Network

» Global open network

- The EtherCAT Technology Group (ETG) is expanding the EtherCAT network on global scale.
  They are working in Germany where their headquarter is, and in Japan, the United States, China, and South Korea.
- Over 1,300 member companies worldwide have joined this activity.

The progress of expanding ETG members (worldwide)
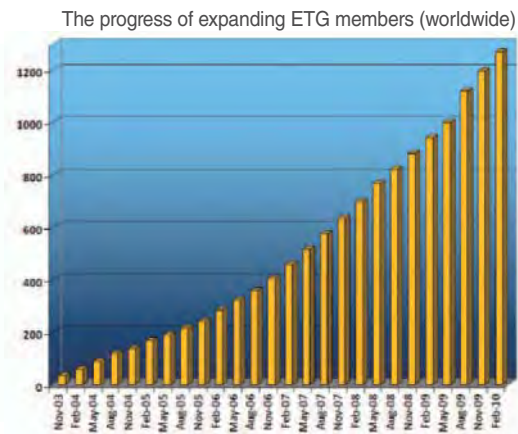
EtherCAT®

OMRON EtherCAT Product Lineup

≫ Products with EtherCAT communications

OMRON has ample product lineup for EtherCAT communications.
It is now possible to build a system with one network, without using multiple networks and dealing with complicated wirings.

• Ample product lineup selectable

Position Control Unit (2/4/8/16 axes)   N E W

CJ1W-NC□81

Industry's top-class performance in positioning control contributes to a reduction of takt times.

• 10-times faster speed over existing networks.
• High-speed start-up of 0.15 - 0.4 ms per axis.
• High-precision control achieved under the fastest control cycles of 0.5 ms.

Vision sensor for positioning   N E W

FZM1 Series

System productivity improvement through industry's top-class detection capabilities and a dedicated positioning menu

• Stable measurement under changing environment and workpiece conditions
• Built-in auto-calibration function
• High-speed camera for fast image capturing

P 12 - 13

Servomotor / Servo Drive   N E W

OMNUC G5 Series

Industry-fastest motion control servo system

• High-speed control through the high-speed EtherCAT motion network and the industry-best speed response frequency of 2 kHz.
• Damping control function to suppress system vibration.
• Safety function comes with standard functions

P 10 - 11

6

for each application

Position Control Unit (4/8 axes)   **N E W**

CJ1W-NC□82

Fast positioning control and less wiring works.

- Same performance in positioning control as NC□81
- Connection of 64 slaves, in addition to the connection with Servo Drives

P 8-9

Tools

CX-Programmer
CX-Drive

Inverter   **N E W**

SYSDRIVE MX2 Series

Control of multiple inverters under a single high-speed network

- Connection to EtherCAT becomes possible by attaching an optional communication device
- Sensorless vector control for powerful operation of 0.5 Hz/200% starting torque
- Shorter control cycle times
- Feedback pulse input for speed or position

P 14 - 15

Remote I/O Terminal   **N E W**

GX Series

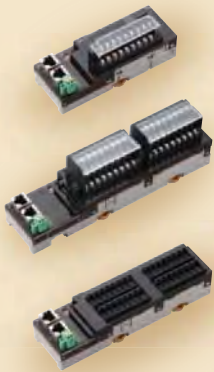**Ample I/O terminal lineup for high-speed communications**

Digital I/O
- 2-tier screw terminal block
- 3-tier screw terminal block
- e-CON connector

Analog I/O

Encoder input
- Open collector input
- Line drive input

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EtherCAT®

EtherCAT-compatible Position Control Unit

SYSMAC CJ Series

Conforming to Class B* of EtherCAT Master Specifications

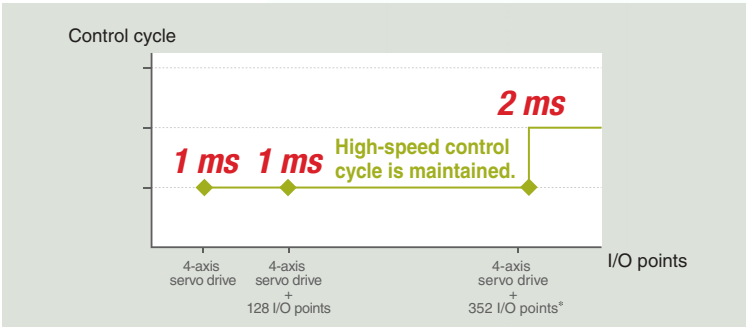∗ Minimum master-CoE compatible (no information service for SDO)

High Speed

CJ1W-NC281 (2 axes)
CJ1W-NC481 (4 axes)
CJ1W-NC881 (8 axes)
CJ1W-NCF81 (16 axes)
CJ1W-NC482 (4 axes + I/O communications with 64 slaves)
CJ1W-NC882 (8 axes + I/O communications with 64 slaves)

Position Control	Ladder (direct operation/memory operation)
Speed Control	Unit (pulse, mm, inch, degree)
Linear Interpolation	ABS Encoder Supported
Circular Interpretation	M Code
Infinite Axes	Memory Operation Data (500/task)

High-speed control

The CJ1W-NC☐82 allows connection to the EtherCAT-compatible slaves up to 64 nodes besides the servo axes. Even when controlling multiple servo systems plus remote I/O terminals through the single EtherCAT network, the CJ1W-NC☐82 maintains as much performance as when controlling the servo systems only.*
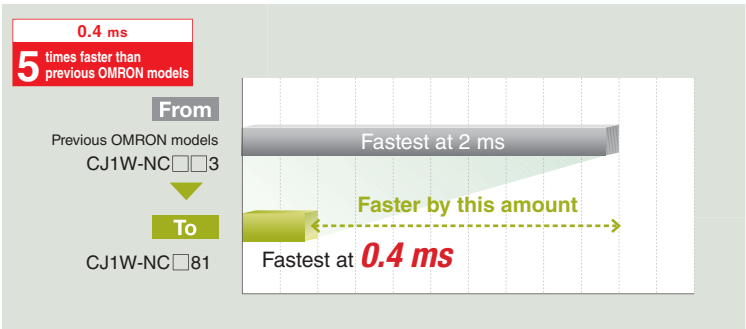
* Even when connecting the PLC with 4-axis servo systems and GX Series (352 I/O points max.), the control cycle of the 4-axis servo drive can be maintained at 1.0 ms. (A CJ1W-NC482 (with 4-axis servo systems) connected to a 16 I/O points type remote I/O terminal is used.)

Control cycle

2 ms

1 ms 1 ms High-speed control cycle is maintained.

4-axis servo drive

4-axis servo drive + 128 I/O points

4-axis servo drive + 352 I/O points*

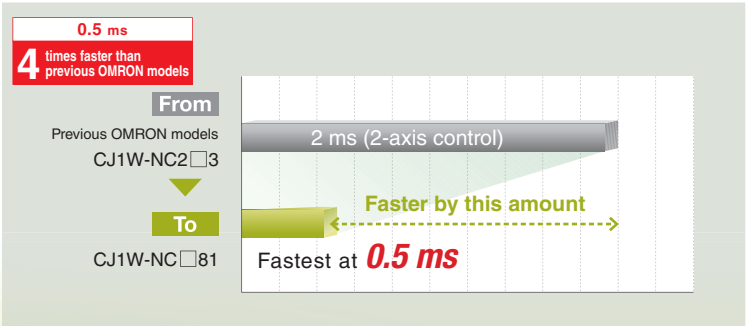I/O points

High-speed startup

Fastest time of 0.4 ms* achieved from start command sending by the PLC to startup of the servo system (transmission time included). High-speed startup, previously thought as only being possible using pulse train methods, is realized on a performance level that exceeds the pulse train method.

* CJ2H CPU Unit with unit version 1.3 or CJ2M CPU Unit used.

0.4 ms
5 times faster than previous OMRON models

From
Previous OMRON models
CJ1W-NC☐☐3

Fastest at 2 ms

To
CJ1W-NC☐81

Faster by this amount

Fastest at **0.4 ms**

High-speed processing

Shortest control cycle of 0.5 ms achieved for a position control unit. By shortening the command cycle to the servo drives, smoother control of the servo drives becomes possible as well as high-speed startup.
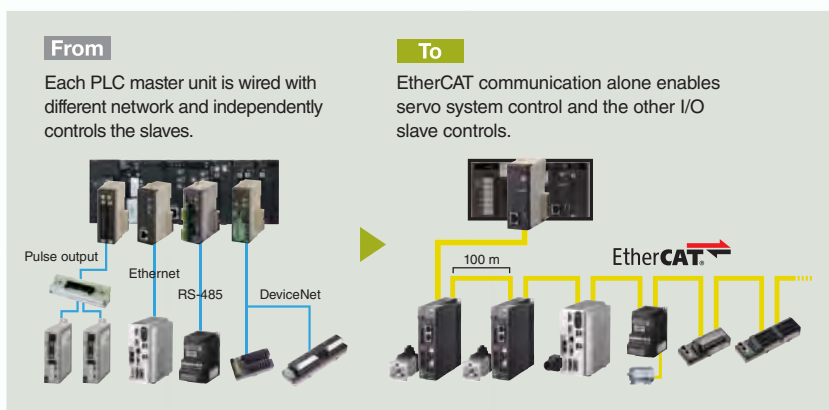
0.5 ms
4 times faster than previous OMRON models

From
Previous OMRON models
CJ1W-NC2☐3

2 ms (2-axis control)

To
CJ1W-NC☐81

Faster by this amount

Fastest at **0.5 ms**

Achieving a simplified system by integrating motion and field networks

Easy

Integrated network

In addition to servo drives, the SYSMAC CJ Series supports various other EtherCAT-compatible slaves such as inverters, vision sensors and I/O terminals. This has enabled the construction of integrated networks connected only by Ethernet cable from a EtherCAT-compatible position control unit, thus simplifying the entire system and reducing cost.

From

Each PLC master unit is wired with different network and independently controls the slaves.

Pulse output

Ethernet
RS-485
DeviceNet

To

EtherCAT communication alone enables servo system control and the other I/O slave controls.

100 m

EtherCAT

Common programming with the pulse train position control unit (high-speed model)

The EtherCAT-compatible position control unit shares its positioning functions* and interface when programming with the pulse train position control unit (high-speed model).
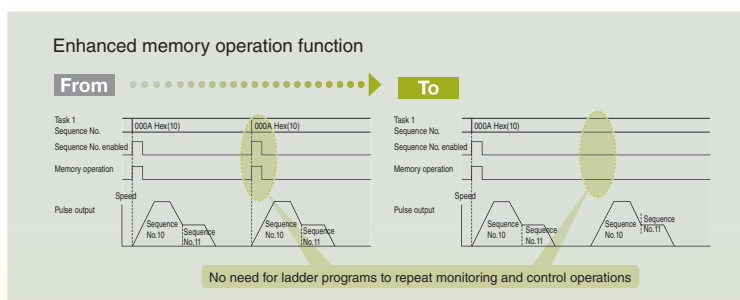This allows for easy selection of position control units according to the intended use.

* Synchronized control function excluded.

Common programming allows for easy implementation to existing systems

EtherCAT-compatible 2-axis Position Control Unit

Pulse Train 2-axis Position Control Unit
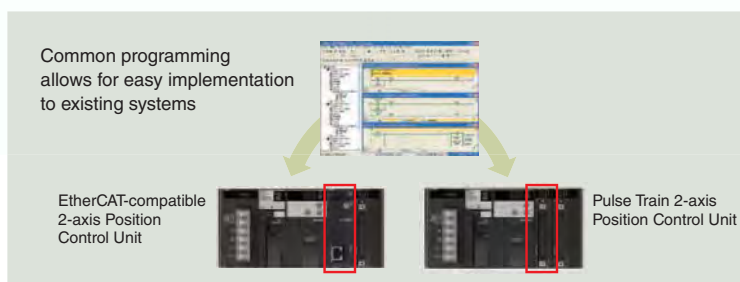
Supporting direct operation and memory operation

The PLC ladder program supports both direct operation that controls positioning and memory operation that executes positioning in the position control unit.
Built-in memory operation functions such as repeat and JUMP commands enable high-speed control independent of the ladder program and the PLC's scan time.

Enhanced memory operation function

From

Task 1
Sequence No.
Sequence No. enabled
Memory operation
Pulse output
Speed
000A Hex(10)
000A Hex(10)
Sequence No.10
Sequence No.11
Sequence No.10
Sequence No.11

To

Task 1
Sequence No.
Sequence No. enabled
Memory operation
Pulse output
Speed
000A Hex(10)
Sequence No.10
Sequence No.11
Sequence No.10
Sequence No.11

No need for ladder programs to repeat monitoring and control operations

9

Built-in EtherCAT Communication Model for AC Servomotor/Servo Drive
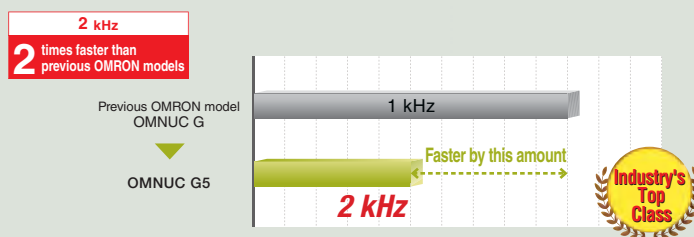
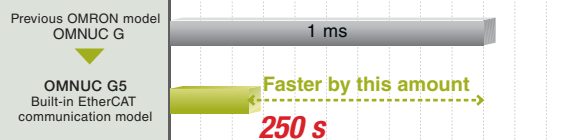# OMNUC G5 Series

High Speed

» High-speed response

EtherCAT communication-capable models of the industry's top class G5 Series Servo Drive is added to the product lineup.

By combining the G5 Series response speed frequency of 2 kHz with a faster data update cycle of 250 µs (four times faster than the previous OMRON product at 1 ms), positioning control takt times can be further reduced.

Speed response frequency

2 kHz
2 times faster than previous OMRON models

Previous OMRON model OMNUC G — 1 kHz

OMNUC G5 — **2 kHz** — Faster by this amount

Industry's Top Class

Data updating cycles

Previous OMRON model OMNUC G — 1 ms

OMNUC G5 Built-in EtherCAT communication model — Faster by this amount **250 s**

Motion control accurately follows commands, contributes to improved takt time.
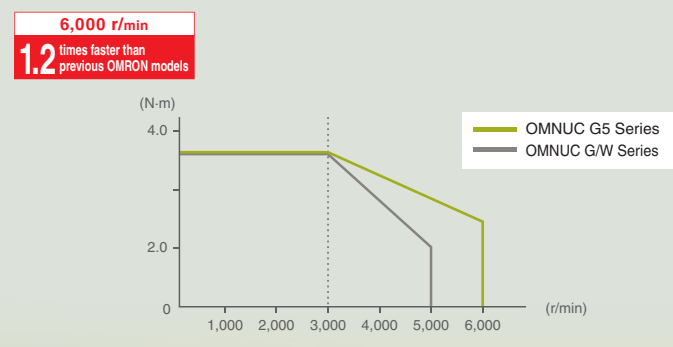
* Combination of R88D-KT10L Servo Drive with R88M-KT10030L Servomotor. Example of actual measurements taken with gain adjusted for ball screw inertia ratio of x3 by a CX-Drive.

Command speed to motor
Actual motor movement
Approx 0.3 ms stabilization time*
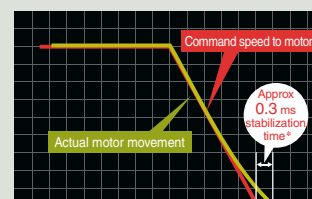
» High-speed rotation

The G5 Series Servo Motor supports rotational speeds of up to 6000 r/min (1.2 times faster than the previous OMRON model). In combination with the high-speed startup enabled by EtherCAT, positioning time can be further shortened.

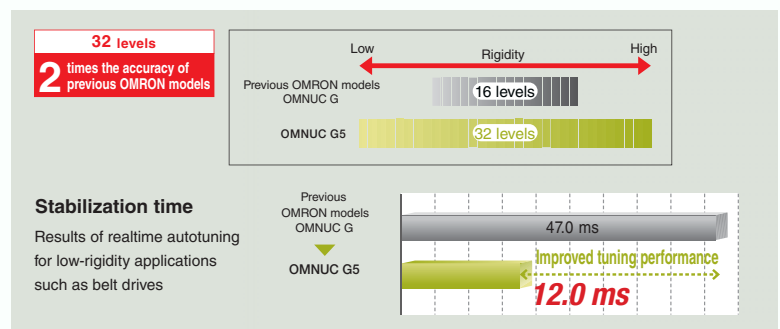* Applicable to 100 V/200 V models with 750 W or less.

6,000 r/min
1.2 times faster than previous OMRON models

(N·m)
4.0

——— OMNUC G5 Series
——— OMNUC G/W Series

2.0

0   1,000 2,000 3,000 4,000 5,000 6,000   (r/min)

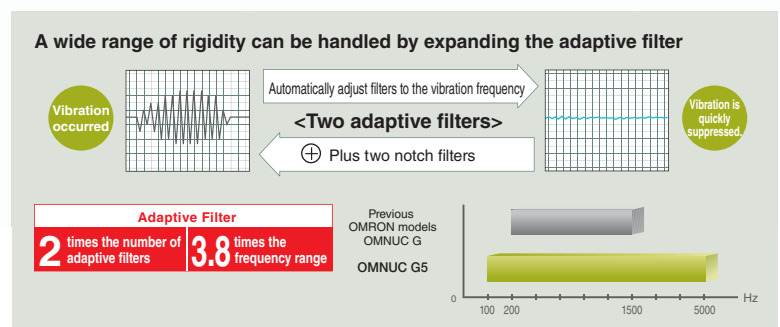# Easy adjustment on startup and easier safety implementation with STO as standard function

Easy

Easy gain tuning

Real-time autotuning has doubled the application range allowing for more accurate estimation of a machine's load inertia ratio. By widening the rigidity range from both high-end to low-end, the applicable range for the system can be increased. Furthermore, the settings can be made via EtherCAT.

32 levels

2 times the accuracy of previous OMRON models

	Low	Rigidity	High
Previous OMRON models OMNUC G		16 levels	
OMNUC G5		32 levels	

Stabilization time

Results of realtime autotuning for low-rigidity applications such as belt drives

Previous OMRON models OMNUC G → OMNUC G5

47.0 ms

Improved tuning performance

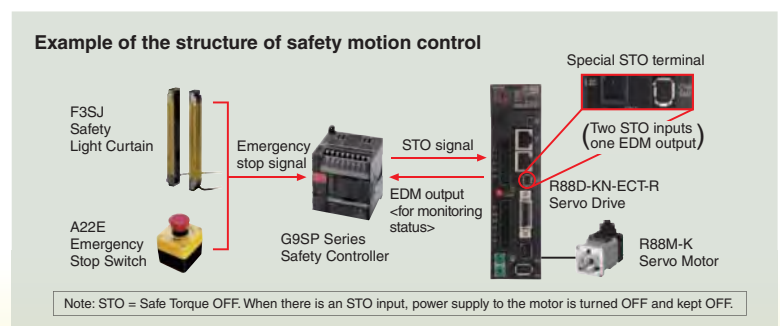**12.0 ms**

Easy tuning of resonance suppression filter

The filter is automatically set to the resonance frequency while multiple adaptive filters reduce vibration. With an even wider frequency range, vibration can be reduced from drive shafts with low rigidity such as conveyor belts, to drive shafts with high rigidity. Also, the settings can be made via EtherCAT.

A wide range of rigidity can be handled by expanding the adaptive filter

Vibration occurred

Automatically adjust filters to the vibration frequency

<Two adaptive filters>

⊕ Plus two notch filters

Vibration is quickly suppressed.

Adaptive Filter

2 times the number of adaptive filters   **3.8** times the frequency range

Previous OMRON models OMNUC G

OMNUC G5

0   100 200   1500   5000   Hz

Conforms to the latest international standards

The OMNUC G5 is the first to acquire international standard IEC 61800-5-2 (STO) for motion control in the industry within Japan. It also conforms to the European Directives ISO 13849-1 (Plc,d) *and EN 61508 (SIL2). Safety control circuits can be constructed with the Servo Drive, delivering both safety and productivity.

* For information on conforming standards of the G5 Series, refer to G5-Series Data Sheet (I818-E1).

Example of the structure of safety motion control

Special STO terminal

F3SJ Safety Light Curtain

Emergency stop signal

STO signal

(Two STO inputs one EDM output)

EDM output <for monitoring status>

R88D-KN-ECT-R Servo Drive

A22E Emergency Stop Switch

G9SP Series Safety Controller

R88M-K Servo Motor

Note: STO = Safe Torque OFF. When there is an STO input, power supply to the motor is turned OFF and kept OFF.

# Vision Sensors for Pick and Place
FZM1 Series

Stable

Selectable dedicated processing items

Existing models were ill-equipped in dealing with changes and deformation in the measurement object. To address this problem, the FZM1 Series is equipped with a dedicated positioning image-processing algorithm, highly capable of dealing with such changes or deformation. Just by selecting the menu for the target object, positioning detection is executed without calculations or complicated settings.

Positioning with alignment marks

The FZM1 precisely detects alignment marks which are commonly used in manufacturing of LCD panels and PCBs. The FZM1 accurately detects the marks, even if some dirt adheres to the marks or the mark is partly hidden.

**Cross**   **Circle**

Dirty   Overlapping
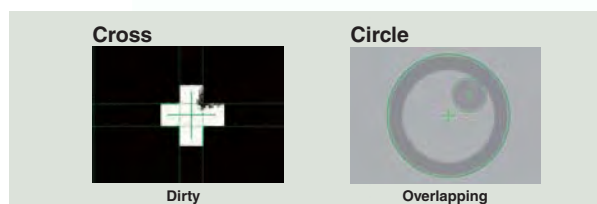
Positioning with corner detection

Positioning can be performed by detecting a corner of the measurement object. Now, stable detection is possible even for rounded corners or when the edge is broken. This is ideal for LCD glass substrates and other objects on which alignment marks cannot be printed.

Corner

Rounded or Broken Corner
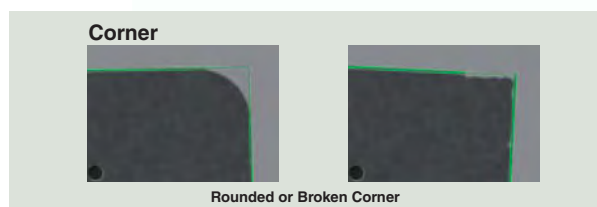
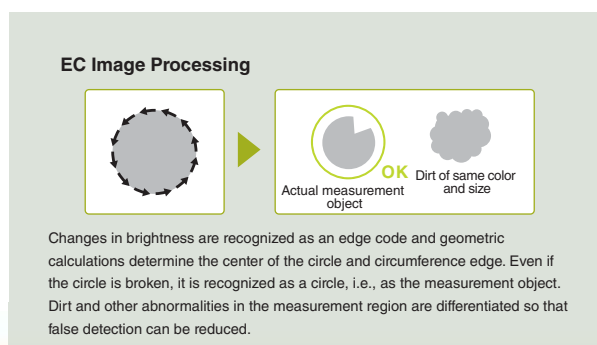### Positioning by shape of object

When picking electronic components or food items, unclear printing or dirt can make stable inspections impossible. FZM1 uses the ECM search processing method and can identify the position and angle of objects from their shapes. The use of ECM search processing enables precise position and attitude measurements without being affected by surface conditions.

Shape

Printing Mistake   Dirt
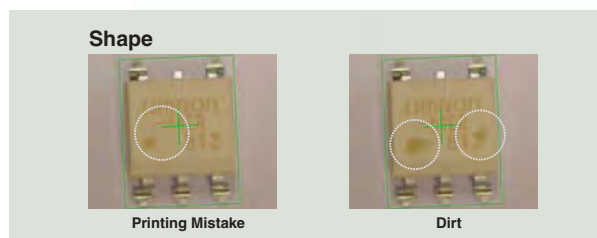
Superior performance under severe conditions Edge Code (EC) image processing technique
Patent number: 11-550303

Conventional search operation and pattern matching detect objects based on density differences or feature points registered on model images. This may cause unstable detection when the measurement object was changed or the shape was not consistent. With EC image processing, the workpiece is recognized as a geometric shape to minimize the effect of light interference or dirt. This achieves stable, accurate position detection without being affected by the surface of the workpiece.

EC Image Processing

OK   Dirt of same color and size

Actual measurement object

Changes in brightness are recognized as an edge code and geometric calculations determine the center of the circle and circumference edge. Even if the circle is broken, it is recognized as a circle, i.e., as the measurement object. Dirt and other abnormalities in the measurement region are differentiated so that false detection can be reduced.

High precision position control
with stable detection and easy operation

Easy

≫ Simple auto calibration

The Vision Sensor provides a coordinate conversion function for each stage and robots. Coordinates can be converted for the Vision Sensor and output device without complex calculations.

Adaptable stages and robots

| Robot control	XY, XYθ
Stage control	XYθ, θXY, UVW, UVWR

Flexible camera installation

There are no Camera installation restrictions even with alignment systems that use two Cameras. Differences between Camera angles and fields of vision can be calculated and coordinates converted without performing complex calculations in a PLC or other external device.

Use different fields of vision

Install at any angle

Easy setup and configuration by an Application Wizard

Calibration between the Cameras and stage or robot can be easily set up using a wizard. Simply select the type of inspection to easily generate the calibration parameters. Sampling data can be automatically input from an external device via EtherCAT to eliminate mistakes that occur through manual input. Fine tuning can also be quickly and accurately performed for production changes or adjustments of the setup as required on-site.

STEP 1 Communications Setup
STEP 2 Camera Setup
STEP 3 External Device Setup
STEP 4 Sampling
STEP 5 Calibration Parameter Creation

Automatically input these with communications

≫ Less Wiring with Ethernet Cables

All trigger inputs and result outputs are connected using only an Ethernet cable. This eliminates excess wiring work and helps prevent wiring mistakes when launching the system. Additionally, with EtherCAT, wiring for up to 100 m can be made without a repeater allowing for easier installation of Vision Sensors and Servo Drives.

Wiring with one cable

EtherCAT

100 m
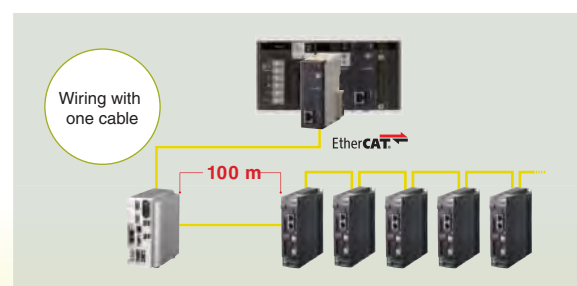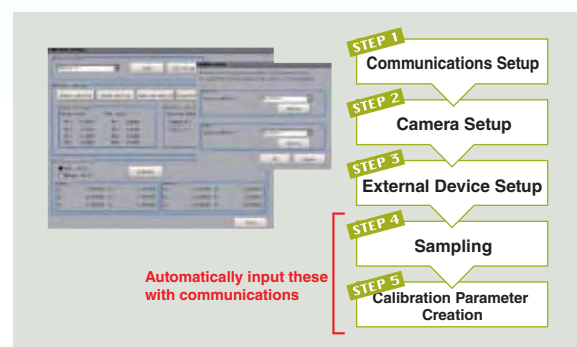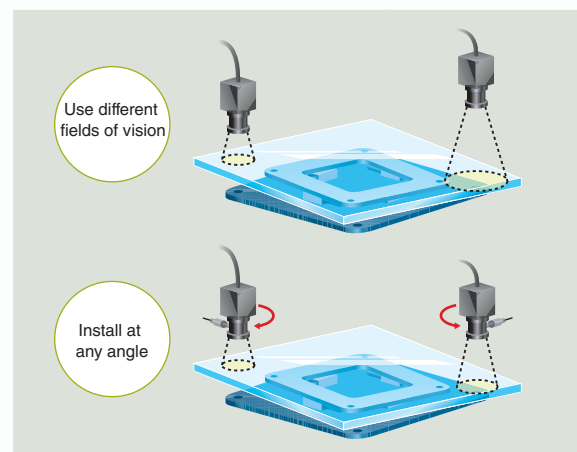
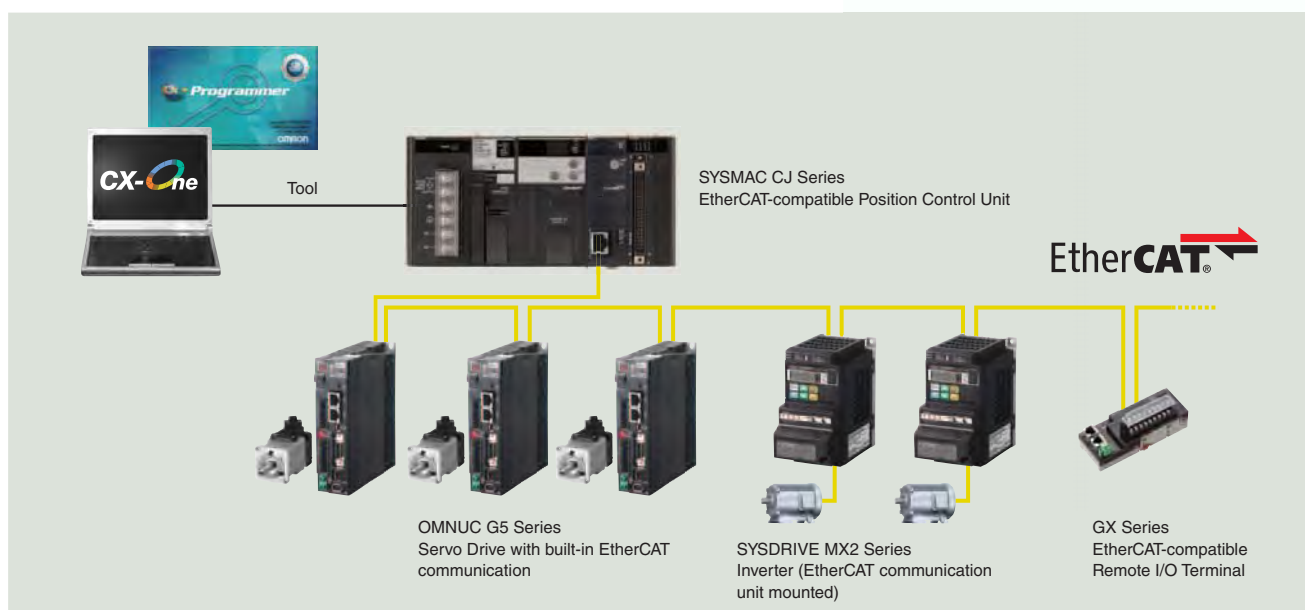Multi-function Compact Inverter

SYSDRIVE MX2 Series

3G3AX-MX2-ECT EtherCAT Communication Unit

The EtherCAT communication unit is used to connect the MX2 Series to EtherCAT.

High Speed

High-speed positioning and speed control

The SYSDRIVE MX2 Series inverter with EtherCAT interface provides high-speed position and speed control. By connecting servo drives, inverters and remote I/O terminals to the position control unit, overall system performance will be improved.
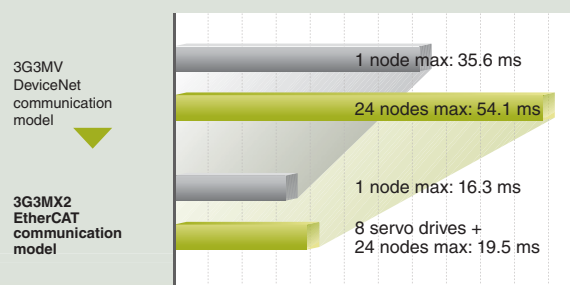
CX-One

Tool

SYSMAC CJ Series
EtherCAT-compatible Position Control Unit

EtherCAT®

OMNUC G5 Series
Servo Drive with built-in EtherCAT
communication

SYSDRIVE MX2 Series
Inverter (EtherCAT communication
unit mounted)

GX Series
EtherCAT-compatible
Remote I/O Terminal

High-speed network greatly improves multi-axis control performance

In comparison to the conventional DeviceNet, response time for single-axis startup (from PLC startup to inverter current output) has been reduced by half.
The difference of response time for single-axis control and 24-axis control is only 3ms in an EtherCAT network.
The EtherCAT is advantageous in multi-axis control applications.

3G3MV
DeviceNet
communication
model

1 node max: 35.6 ms

24 nodes max: 54.1 ms

3G3MX2
EtherCAT
communication
model

1 node max: 16.3 ms

8 servo drives +
24 nodes max: 19.5 ms

EtherCAT provides high-speed control with multi-function MX2 Series

Easy

❯ Easy operation after network allocation

In the initial setup of the EtherCAT communication unit, the inverter parameters are allocated to the CIO area in the PLC as shown in the right tables. The allocation can be understood and operated as easily as inverter terminal block. It is not necessary to issue command or deal with complex communication handling. There are no troublesome processes such as in the handling of communications or in issuing commands.

* Command processing is required to change parameters.

Control data (master to slave)

Word	Contents
n	Control command
n+1	Frequency command
n+2	Multi-step position command 0 (LSB)
n+3	Multi-step position command 0 (MSB)
n+4	Multi-step function input

Status data (slave to master)

Word	Contents
m	Status data
m+1	Frequency monitor
m+2	Current position monitor (LSB)
m+3	Current position monitor (MSB)
m+4	Multi-function output monitor

Multi-function

❯ Simple Position Control Function

The MX2 Series is equipped with simple position control function as standard.
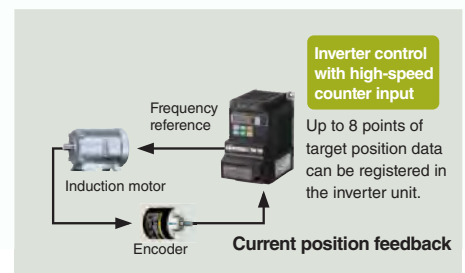
Cost Saving
Encoder signals can be directly input to an inverter without using accessories such as a high-speed counter.

Simple Adjustment
Positioning can be performed with a target value. Conventional sensor adjustment for positioning is not necessary.

No Additional Programming
Positioning can be controlled by rewriting the target positions or the target values at 8 points in the inverter via EtherCAT without additional programming.
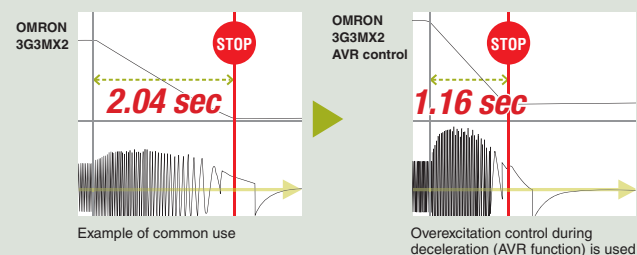
Inverter control with high-speed counter input
Up to 8 points of target position data can be registered in the inverter unit.

Frequency reference

Induction motor

Encoder

Current position feedback

❯ Shortening deceleration time with over-excitation control during deceleration (AVR function)

By using the over-excitation control during deceleration (AVR function) of the MX2 Series, deceleration times can be shortened without the use of braking options.

* Over-excitation control during deceleration can be achieved through the setting of the AVR (Automatic Voltage Regulator).

Shortest deceleration time without detecting overvoltage (Example: 0.2 kW)

OMRON 3G3MX2
STOP
2.04 sec
Example of common use

OMRON 3G3MX2 AVR control
STOP
1.16 sec
Overexcitation control during deceleration (AVR function) is used

❯ Various functions such as torque control and torque limit are also supported.

The MX2 Series sensorless vector control provides torque control and torque limit function, thus enabling simple contact stopping control and press control. Other functions including brake control, energy saving control and PID control are also provided.

* When changing a torque reference value or torque limit value via EtherCAT communications, directly change the parameter that sets the reference command value.

EtherCAT®

Remote I/O Terminal for EtherCAT communications

GX Series

Versatile
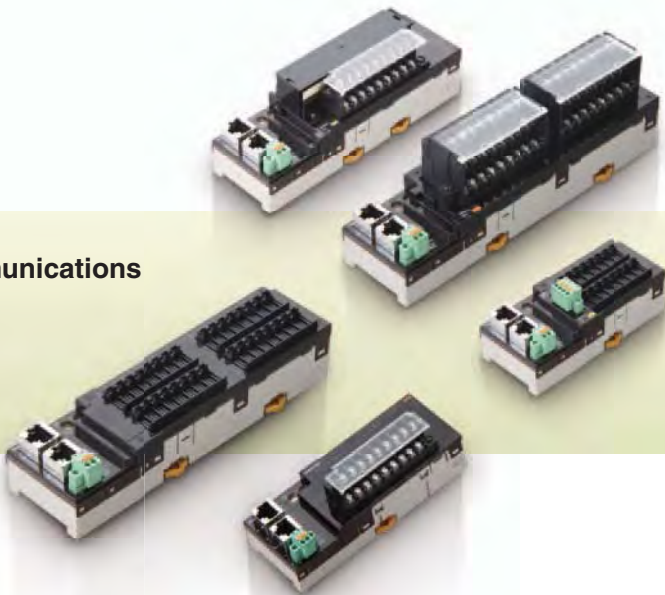
Wide selection of products

An extensive lineup of digital I/O terminals, analog I/O terminals and encoder input terminal are available for EtherCAT. The wiring type of the digital I/O terminal can be selected from either a unit with a screw terminal block or with an e-CON connector.

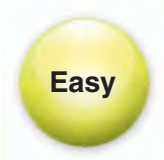|	2-tier screw terminal block type	3-tier screw terminal block type	e-CON connector type
IN NPN/PNP **Digital input**	16 points — • 8 or 16 points can be added with an expansion unit (32 points max) • Detachable terminal block is used.	16 points — • Common terminals are provided for every contact so that a 3-wire sensor can be easily connected.	16 points / 32 points — • Industry-standard e-CON connector is installed. Easy wiring without using special tools.
OUT NPN/PNP **Digital output**			
I/O NPN/PNP **Digital input/output**			
OUT **Relay output**	16 points — • Embedded relays can be replaced easily. • Detachable terminal block is used.		
IN **Analog input**	4 points — • Input/output range can be easily selected by simply changing the switch.		
OUT **Analog output**	2 points		
Encoder input		2 points — • High-speed pulse counting Line drive input: 4 MHz Open collector input: 500 kHz	

Easy

Easy startup

Simple setup

In the fixed allocation mode of CJ1W-NC☐82, the remote I/O system settings can be made by simply setting the node address.
• Node addresses can be easily set with a simple rotary switch using decimal numbers.
• The allocation area of the remote I/O terminal is automatically decided by simply setting the node address.

Node address setting (×10)
Node address setting (×1)

Easy wiring

EtherCAT connects the master and remote I/O terminal with an Ethernet cable.
One-touch wiring is possible using an RJ45 connector.
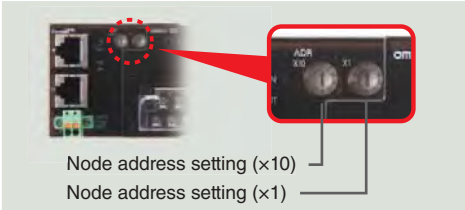
Ample product line-up
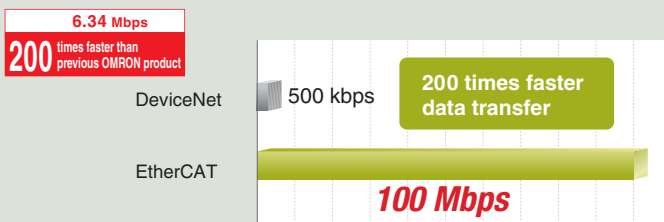# including digital I/O, analog I/O and encoder input

High Speed

High-speed communications

EtherCAT supports high-speed communications at a speed of 100 Mbps.
The communication cycle is largely shortened by overwhelming EtherCAT communication performance.
The communication cycle of EtherCAT network with CJ1W-NC□82 which executes position control and remote I/O control is shorter than that of DeviceNet.

* Thanks to EtherCAT's extremely high-speed in communications, performance of the microcomputer embedded in the master unit is improved, making possible a faster communication cycle.

6.34 Mbps
200 times faster than previous OMRON product

DeviceNet   500 kbps

200 times faster data transfer

EtherCAT

100 Mbps

Comparison with previous network

Communication cycle/ control cycle

— DeviceNet (communication cycle)
— EtherCAT (control cycle: CJ1W-NC482 used, 4-axis servo drives, 16-point I/O terminal connected)

Total points	64 pt	128 pt	256 pt	352 pt	512 pt	1024 pt

(Y-axis: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20)
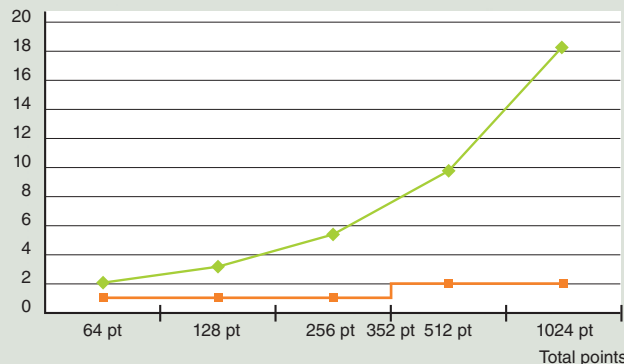
Even when connecting the 4-axis servo drives and the GX Series (352 I/O points max.), the control cycle of the 4-axis servo drives can be maintained at 1.0 ms.

High-speed input

The digital I/O terminals are equipped with high-speed input functionality (ON/OFF delay of 200 µs max.).
Short communication cycle of EtherCAT and minimum wiring are highly advantageous for the applications that require high-speed signal input.
By increasing the digital input filter value for contacts where the status is unstable due to chattering or noise, malfunction can be prevented. Available input filter values are 0 ms, 0.5 ms, 1 ms (default), 2 ms, 4 ms, 8 ms, 16 ms and 32 ms.

Sensor inputs   ON   OFF

Previous OMRON product   0.5 ms   1.5 ms

High-speed input   **0.1 ms**   **0.2 ms**

Input response time (OFF to ON)   Input response time (ON to OFF)
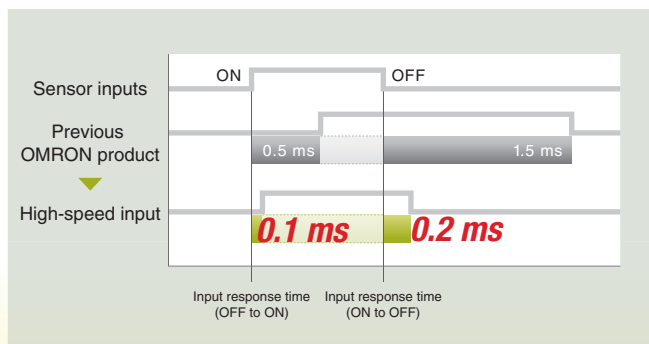
Case Study 1 for Higher Productivity

Oven furnace

Effect from implementing EtherCAT

☐ **Reduces design, setup and startup work-hours**
☐ **Contributes to higher productivity and quality**

Before implementation

Selection of a network for each control pathway

Position Control Unit
Communication Unit
Temperature Controller
Servo Drives
Servomotors
Remote I/O Terminal
Field Network
RS-485
Inverters

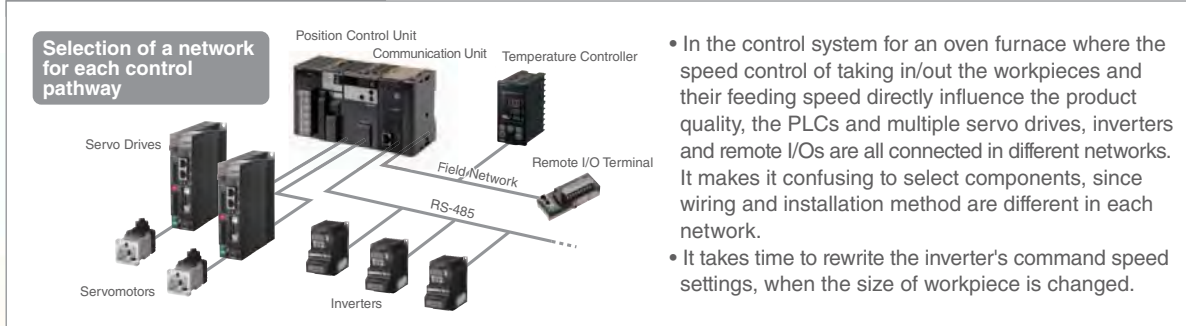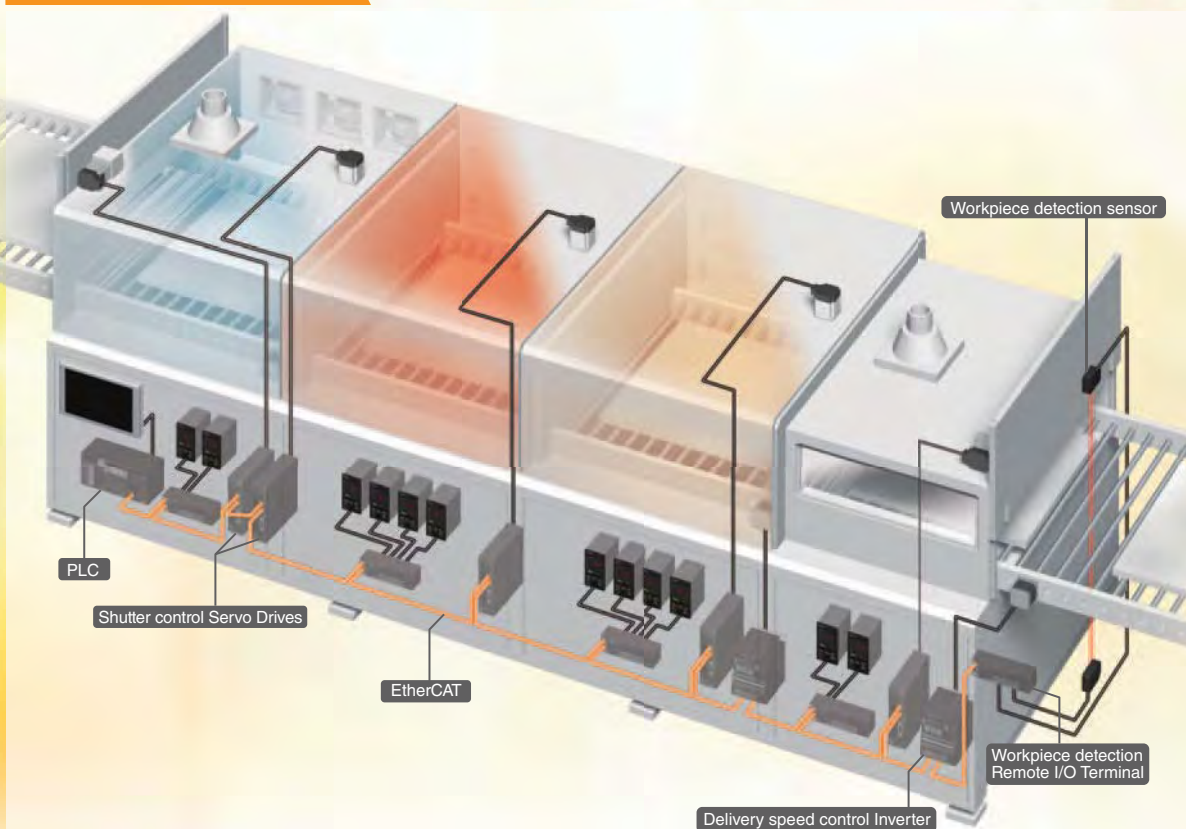- In the control system for an oven furnace where the speed control of taking in/out the workpieces and their feeding speed directly influence the product quality, the PLCs and multiple servo drives, inverters and remote I/Os are all connected in different networks. It makes it confusing to select components, since wiring and installation method are different in each network.
- It takes time to rewrite the inverter's command speed settings, when the size of workpiece is changed.

After implementation

Workpiece detection sensor
PLC
Shutter control Servo Drives
EtherCAT
Delivery speed control Inverter
Workpiece detection Remote I/O Terminal

The Solution

EtherCAT network covers the Servo Drives, Inverters, and Remote I/O Terminals. The assembly and wiring time is shortened and user can improve the system productivity through the operation.

- To connect the PLCs, Servo Drives and Inverters with EtherCAT, only one Ethernet cable is required for detection of the workpiece, shatter control to take in/out the workpiece and conveyer speed control. Wiring can be carried out with simple construction directions.
- When a workpiece type is changed, the command speed settings of the inverter can be rewritten through EtherCAT. It reduces the time required for changing the settings.
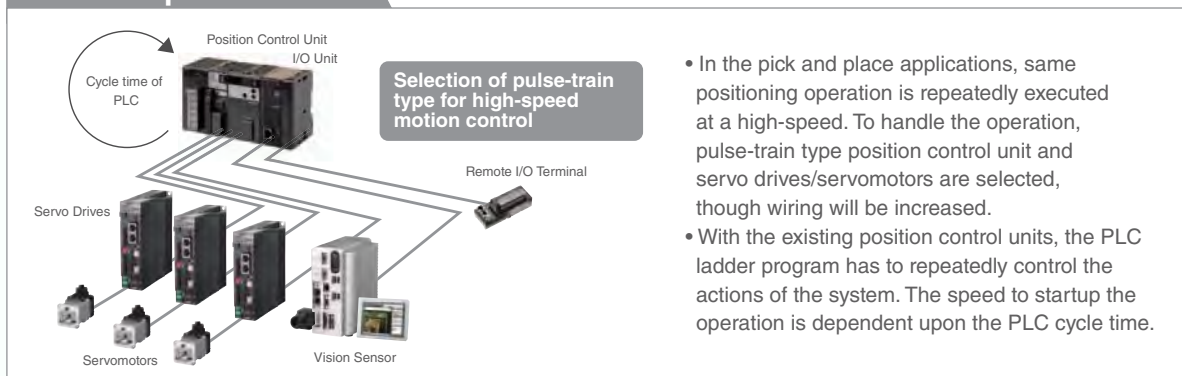
Case Study 2 for Higher Productivity
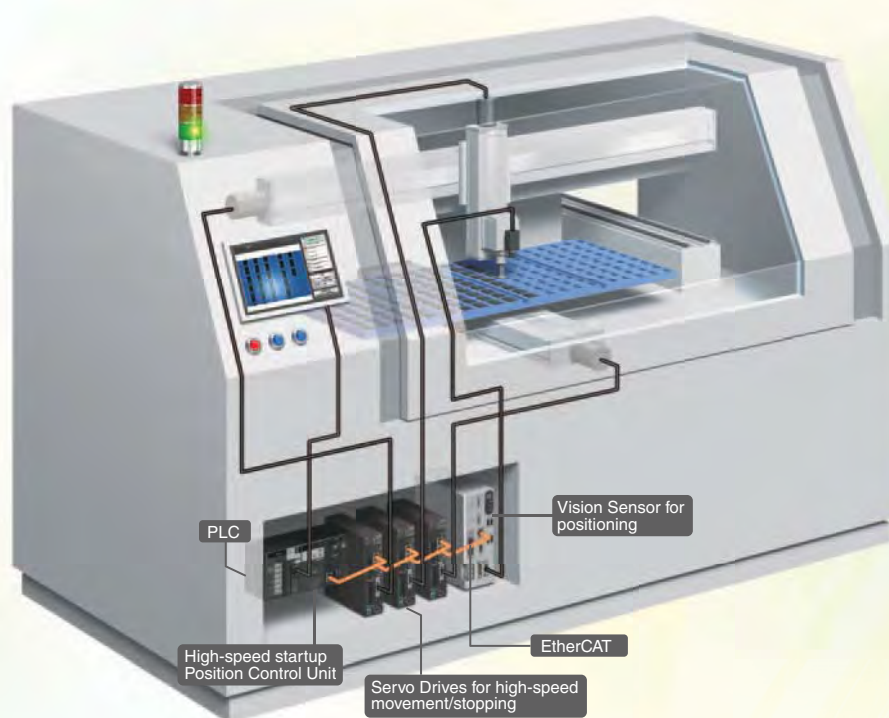
Pick and Place System

Effects from implementing EtherCAT

☐ **Reduces cost**
☐ **Reduces design work-hours**

Before implementation

Cycle time of PLC

Position Control Unit
I/O Unit

Selection of pulse-train type for high-speed motion control

Remote I/O Terminal

Servo Drives

Servomotors

Vision Sensor

• In the pick and place applications, same positioning operation is repeatedly executed at a high-speed. To handle the operation, pulse-train type position control unit and servo drives/servomotors are selected, though wiring will be increased.
• With the existing position control units, the PLC ladder program has to repeatedly control the actions of the system. The speed to startup the operation is dependent upon the PLC cycle time.

After implementation

PLC

Vision Sensor for positioning

EtherCAT

High-speed startup Position Control Unit

Servo Drives for high-speed movement/stopping

The Solution

Position Control Unit and Servo Drives with EtherCAT communications ensures high-speed control from startup to stopping. The positioning time can be shortened, thus improving the productivity of the system. EtherCAT simplifies the wiring in the system, too.

• With the Position Control Unit and Servo Drives with EtherCAT communications, control speed as fast as that of conventional pulse-train type system can be achieved. The devices can be connected with one Ethernet cable.
• The Position Control Unit with EtherCAT interface has the memory operation function. It can handle the repeated operation without being affected by the cycle time of the PLC. It also enables startup, movement, and stopping at a high speed, which contributes to reduction of the takt time.
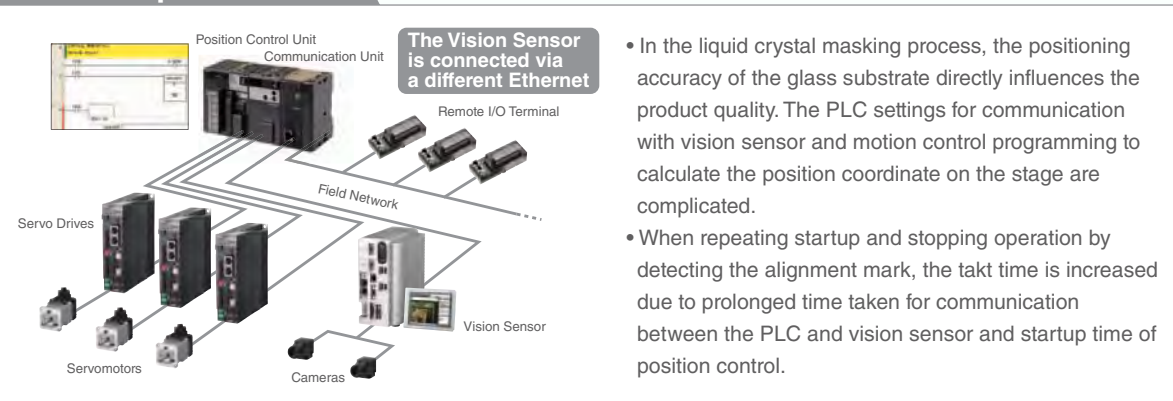
Case Study 3 for Higher Productivity

FPD Liquid Crystal Masking System

Effects from implementing EtherCAT

☐ **Increases productivity**

☐ **Reduces ladder design work**

Before implementation

Position Control Unit
Communication Unit

The Vision Sensor is connected via a different Ethernet

Remote I/O Terminal

Field Network

Servo Drives

Servomotors

Cameras

Vision Sensor

- In the liquid crystal masking process, the positioning accuracy of the glass substrate directly influences the product quality. The PLC settings for communication with vision sensor and motion control programming to calculate the position coordinate on the stage are complicated.
- When repeating startup and stopping operation by detecting the alignment mark, the takt time is increased due to prolonged time taken for communication between the PLC and vision sensor and startup time of position control.

After implementation

PLC

EtherCAT

Vision Sensor for positioning

Servo Drives for high-speed movement/stopping

The Solution

By connecting the Vision Sensors, PLC and Servo Drives under one EtherCAT network, a high-precision and high-speed glass substrate alignment system is achieved. Additionally, system designing work is largely reduced.

- By connecting the PLC and vision sensors via EtherCAT, the communication settings are simplified. The vision sensor can handle the calculation of moving distance on the stage, thus reducing the programming work for PLC.
- The EtherCAT enables reduction of time taken for communication between the vision sensor and PLC. The Servo Drives with EtherCAT communications improve the takt time of position control by reducing the time required for executing startup - movement - stopping operation.