

C Controller Applications

e-Factory



GLOBAL IMPACT OF MITSUBISHI ELECTRIC



Through Mitsubishi Electric's vision, "Changes for the Better" are possible for a brighter future.

Changes for the Better

We bring together the best minds to create the best technologies. At Mitsubishi Electric, we understand that technology is the driving force of change in our lives. By bringing greater comfort to daily life, maximizing the efficiency of businesses and keeping things running across society, we integrate technology and innovation to bring changes for the better.

Mitsubishi Electric is involved in many areas including the following:

Energy and Electric Systems

A wide range of power and electrical products from generators to large-scale displays.

Electronic Devices

A wide portfolio of cutting-edge semiconductor devices for systems and products.

Home Appliance

Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems

Commercial and consumer-centric equipment, products and systems.

Industrial Automation Systems

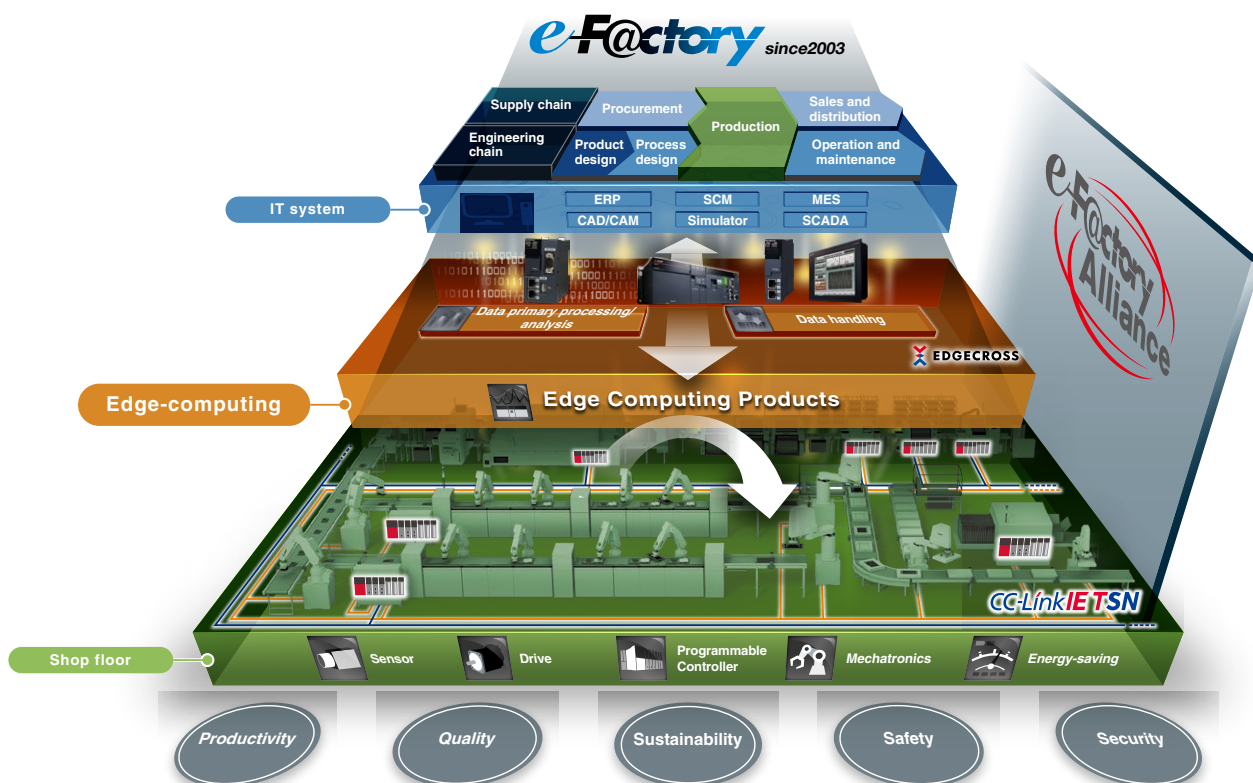
Maximizing productivity and efficiency with cutting-edge automation technology.

Maximizing productivity and reducing total cost while adding value across the manufacturing enterprise

e-F@ctory is the Mitsubishi Electric solution for adding value across the manufacturing enterprise by enhancing productivity, and reducing the maintenance and operations costs together with seamless information flow throughout the plant. e-F@ctory uses a combination of factory automation and IT technologies in combination with various best-in-class partner products through its alliance program, offering solutions to reduce total cost while improving operations, production yield, and efficient management of the supply chain.



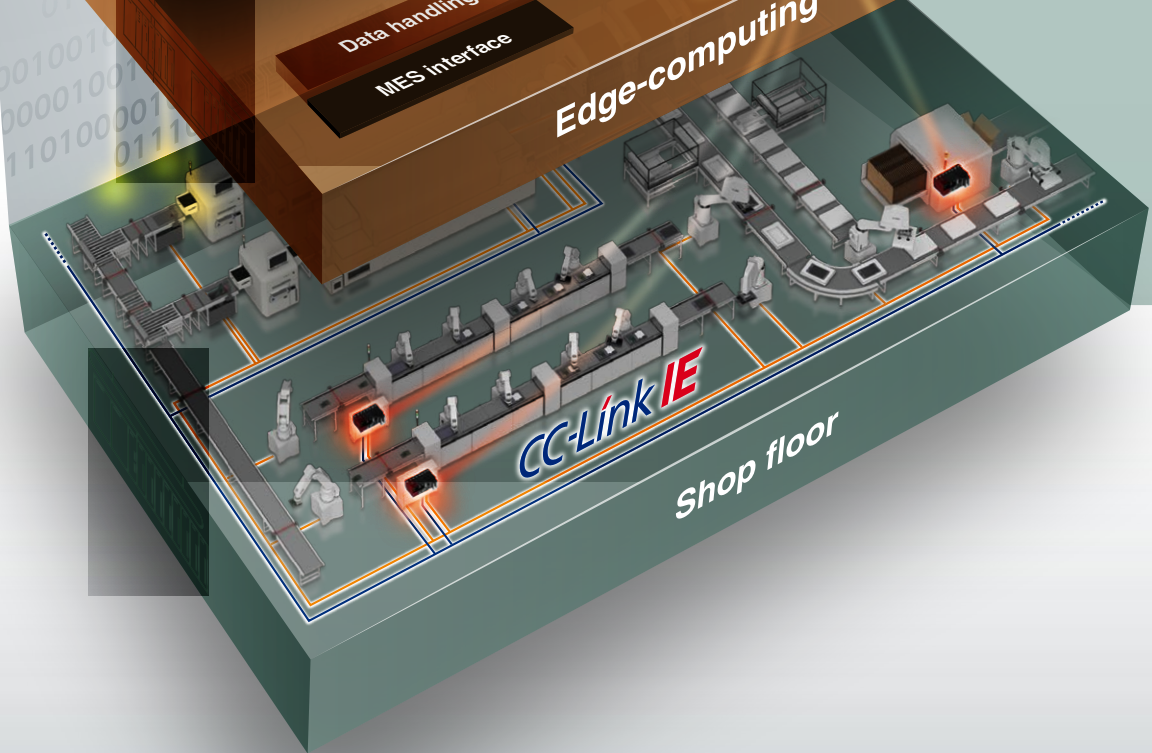
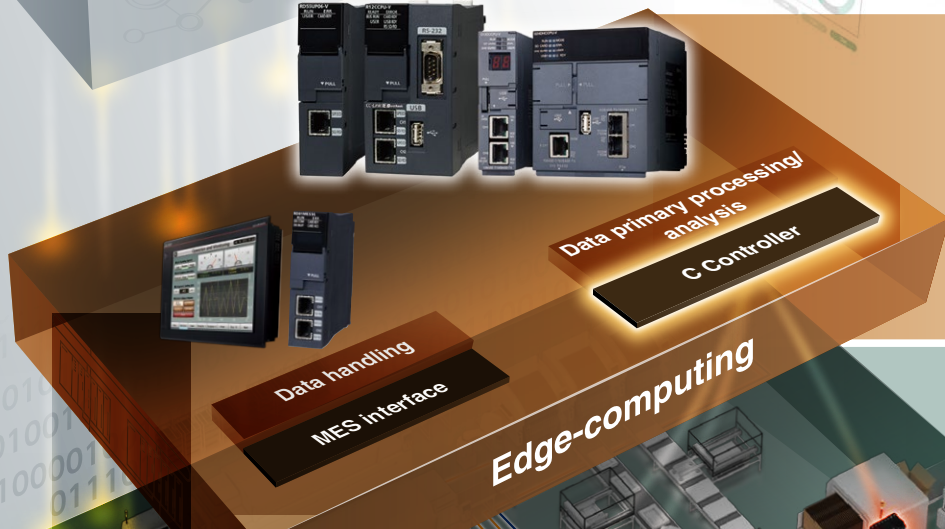
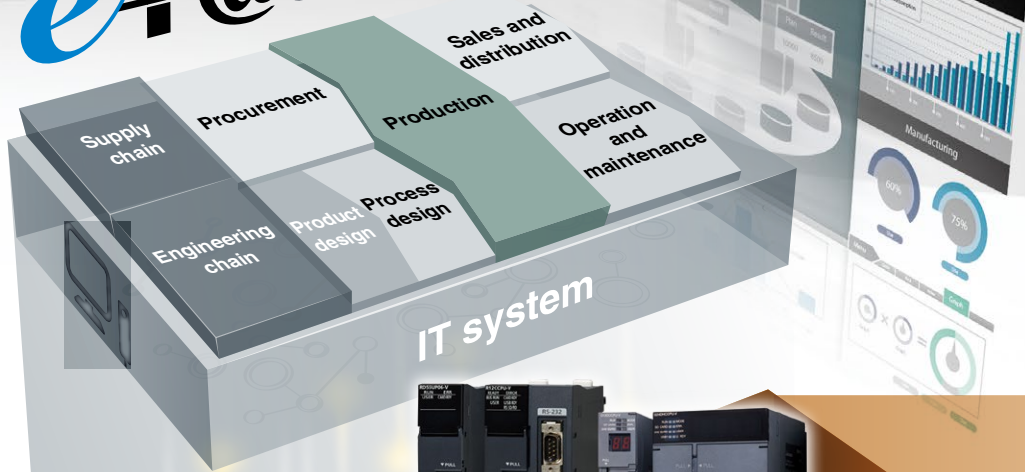
FA integrated solution reducing total cost



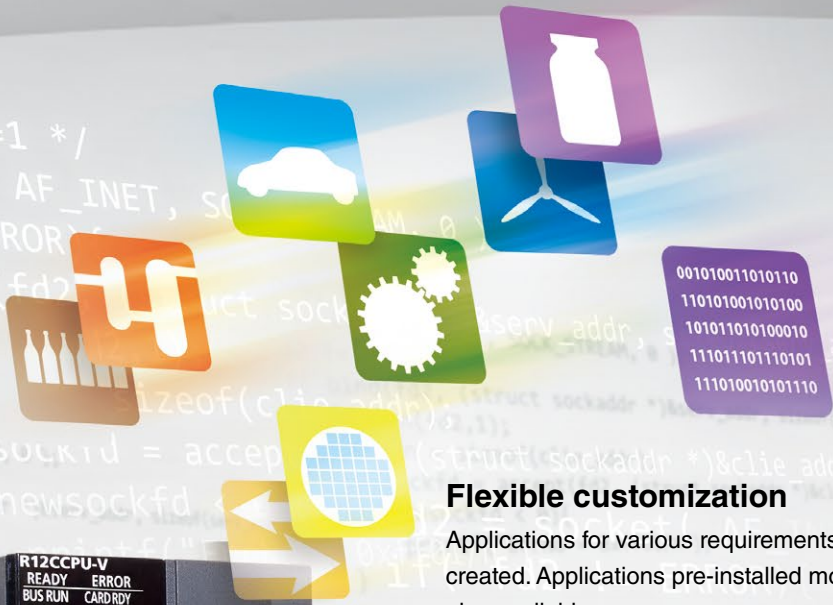
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e-Factory

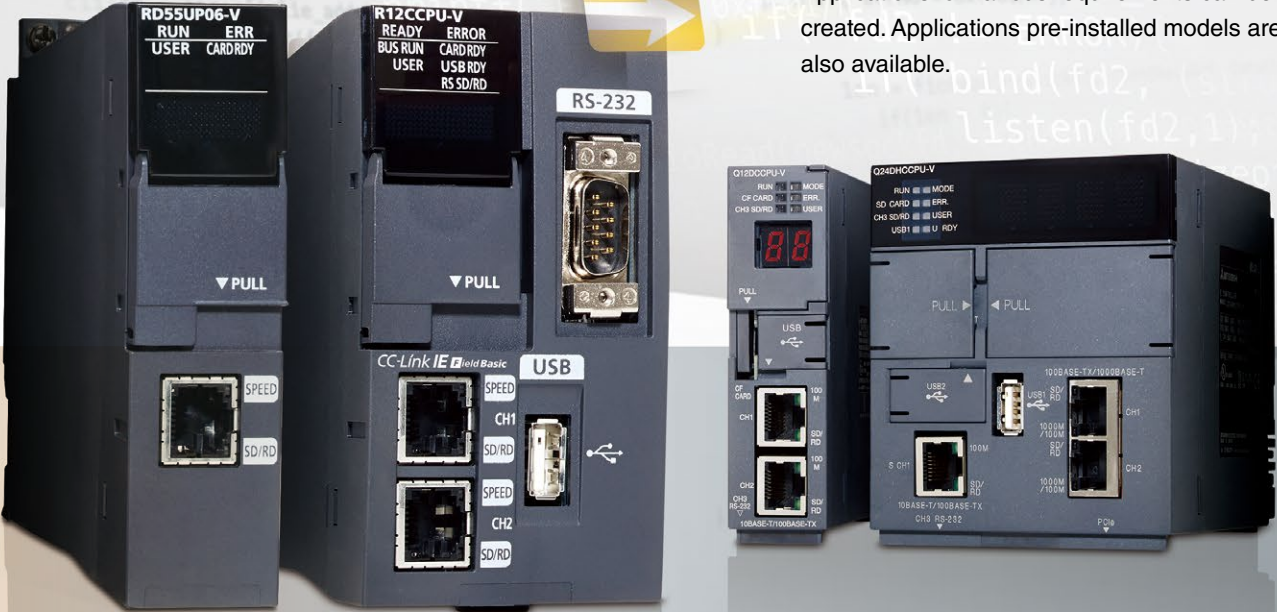


```
/* TCP=0, UDP=1 */
fd2 = socket( AF_INET, SOCK_DGRAM, IPPROTO_UDP );
if( fd2 != ERROR )
if( bind( fd2, (struct sockaddr *)&serv_addr, sizeof(serv_addr)) )
cli:
cli: sizeof(cli_addr), &cli_addr, &cli_addr, &cli_addr);
newsockid = accept( fd2, (struct sockaddr *)&cli_addr, &cli_addr);
if( newsockid != ERROR )
listen( fd2, 1 );
}
```



Flexible customization

Applications for various requirements can be created. Applications pre-installed models are also available.



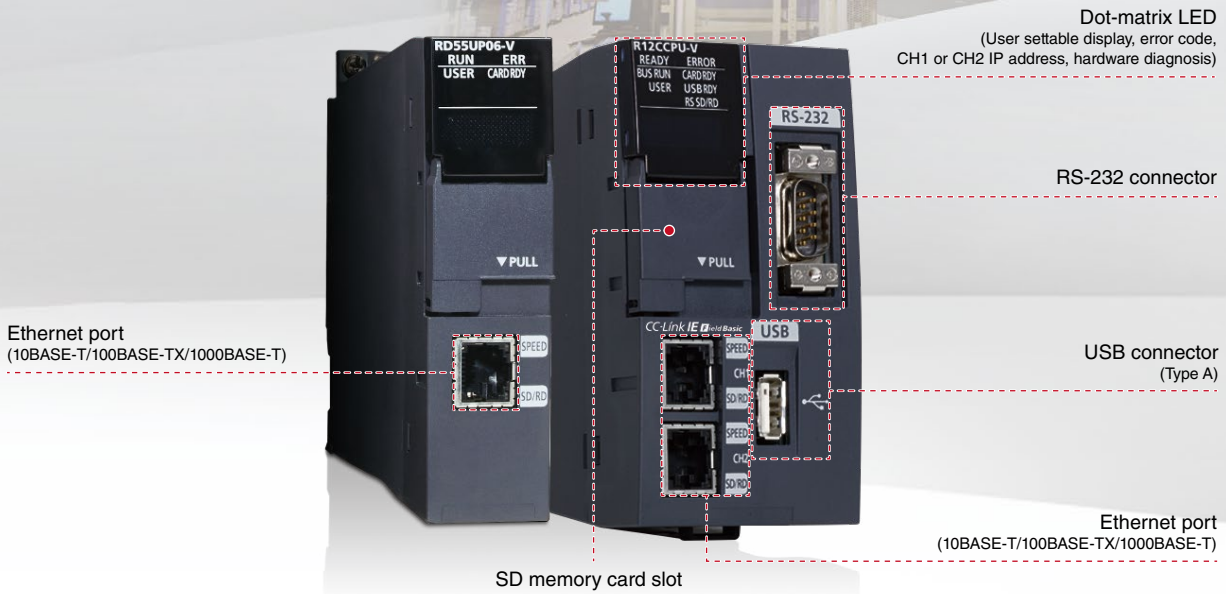
C Controller

Open platform controller utilized for production site innovation edge computing

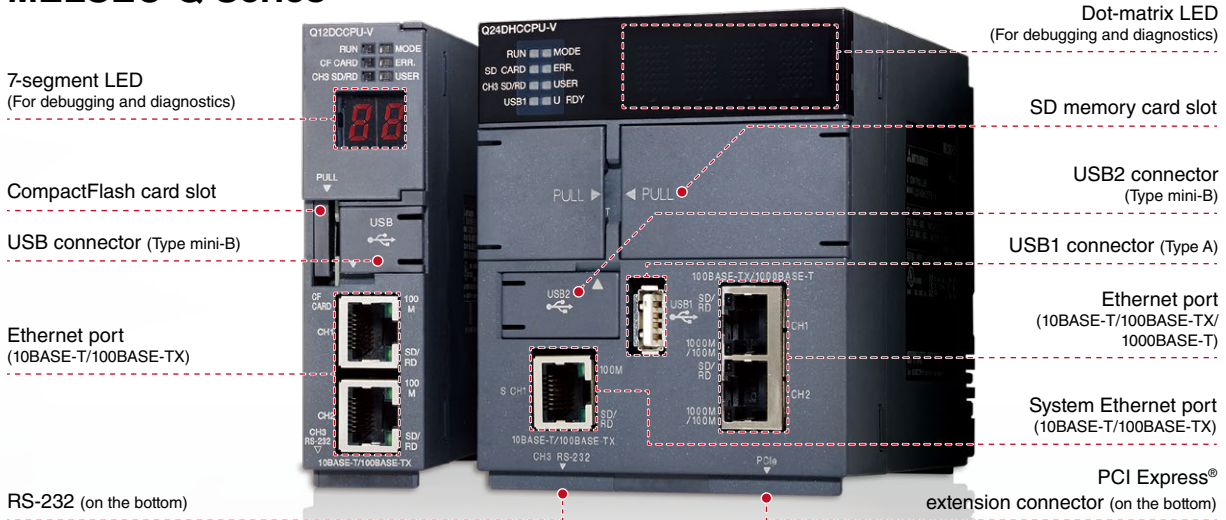
The C Controller and C Intelligent function modules are open platform controllers that can execute C language type programs, based on the MELSEC system architecture, and utilize long-term stable supply, high availability, advanced functionality, and flexible features.

High-speed processing that is not possible with a ladder program is realized while carrying out MELSEC Series module management and I/O control in the C/C++ language programs. These features are useful for a wide range of production site applications, including control, inspections, monitoring, conveyor, assembly, and communication gateways. Additionally, coordination with the IT system enables primary processing and analysis of data collected at the production site for real-time diagnosis. This makes it possible to detect the actual fault occurring, thereby enabling prompt troubleshooting, contributing to quality improvements and enhanced productivity.

MELSEC iQ-R Series

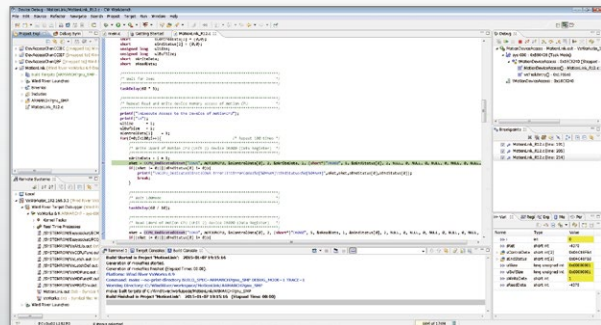


MELSEC-Q Series



C Controller module engineering tool CW Workbench

Development environments for embedded systems, which are usually expensive, are now easily realized using this tool. CW Workbench has all of the basic functionality such as a code editor, compiler, debugger, and simulator supporting user application development.



Reduced installation costs and easily develop applications

Resolve common drawbacks associated with embedded and industrial computers

The C Controller platform is a solution that realizes computer-level functionality without the burden of high maintenance costs usually associated with computers. In addition, by being based on the MELSEC control system, the C Controller has a robust design that is ideal for industrial environments.

Common drawbacks associated with embedded and industrial computers



- Discontinued production of boards & chips
- Limited developers
- Escalating maintenance costs due to failures
- Large physical space required
- Construction of an environment with network-connected external devices required

Old Platform (Micro computer/computer)

- Disrupted product supply due to discontinued production
- Escalating management and maintenance costs

Merits of using the C Controller



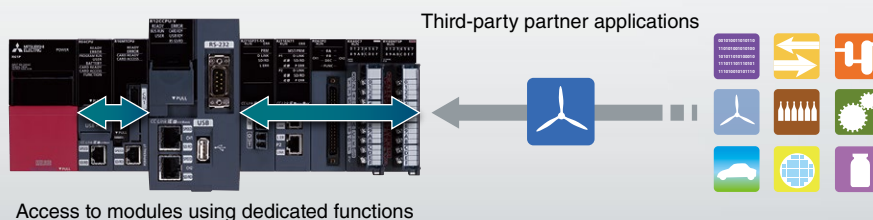
- Highly reliable, long-term stable supply
- Utilization of C language programs
- Significantly reduces maintenance costs
- Reduced equipment size
- Simple construction of a seamless environment with network-connected external devices

New Platform (C Controller)

- Stable product supply
- Lower maintenance and management costs allow resources to be focused on development

Easier to configure various control systems

Highly customizable solution enables the integration of partner products, open source applications, and OS-independent capabilities onto a generic open platform.

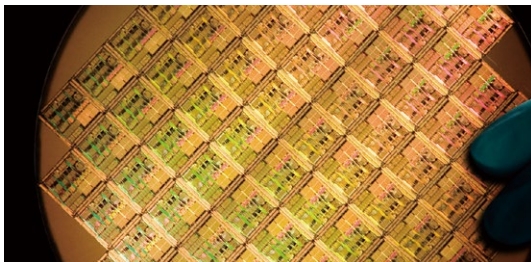


Easier to configure various control systems

Innovative open platform, C Controller

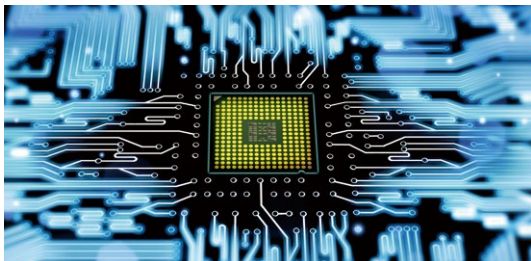
Highly customizable solution enables the integration of partner products, open source applications, and OS-independent capabilities onto a generic open platform.

Semiconductor manufacturing equipment



Semiconductor bonding machine can be migrated from computer or micro-computer based system to MELSEC platform system, enabling utilization of existing control programs by the C Controller.

Semiconductor manufacturing system



A system realizing SECS communications between a semiconductor manufacturing equipment and the MES server can be constructed using a dedicated software.

Conveyor



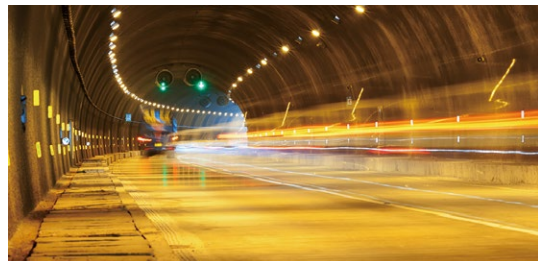
Effective conveyor management and conveyor control utilizing multiple modular feature. Installing in a panel near the conveyor can save space.

Injection molding



High-performance control is realized with the C Controller. Comparing to the prescribed injection patterns, the screw movement amount can be calculated at high speed.

Expressway monitoring and analysis



Monitors and analyzes expressway vibration and vehicle exhaust gases. With its robust feature, the C Controller can continuously and stably operate in harsh environments.

Automated warehouse



The C Controller can be connected with multiple automated warehouse controllers. Long-term stable supply and robust operation are ensured.



Inspection machine



Replacing a computer with the C Controller and GOT (HMI) increases durability and eliminates computer replacement costs.

Production data collection



Using "data collection software" realizes management, analysis, and utilization of production site data, assisting in optimization of manufacturing systems with e-F@ctory.

Bearing deterioration diagnosis



Bearing deterioration status can be diagnosed. High-speed data analysis processing such as FFT calculations can be realized.

Solar power measurement and display



The C Controller can be used for solar panel measurement unit. Power generation status is measured and displayed on a monitoring screen, etc.

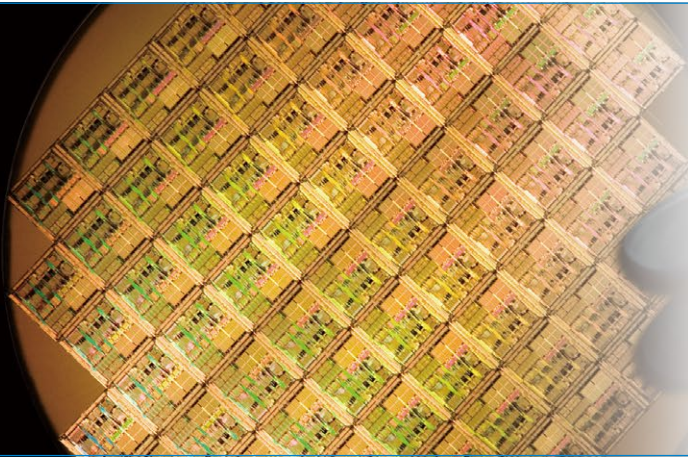
Assembly process data collection



Using the C Controller for communications in the assembly processing system enables smooth coordination with the IT system.

```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

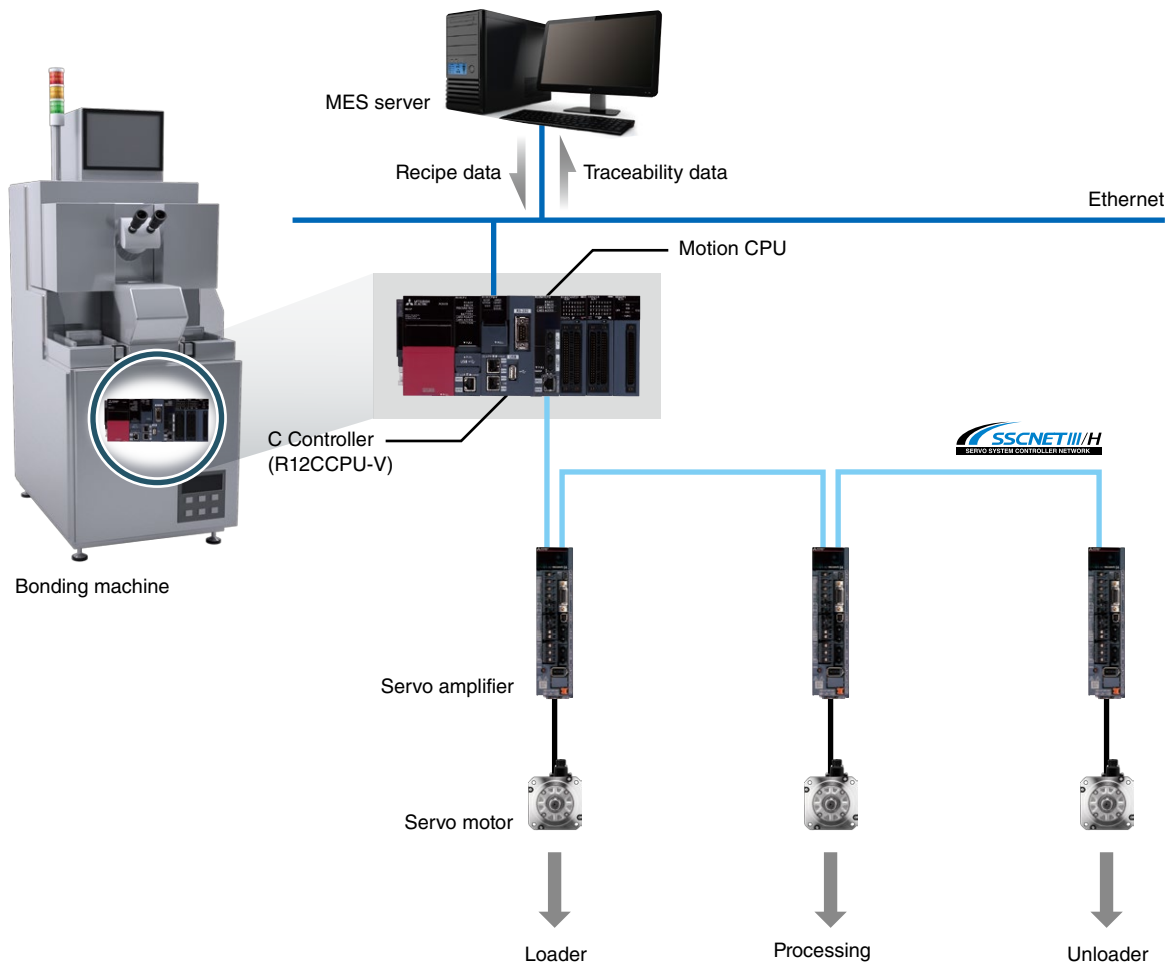
Semiconductor manufacturing equipment



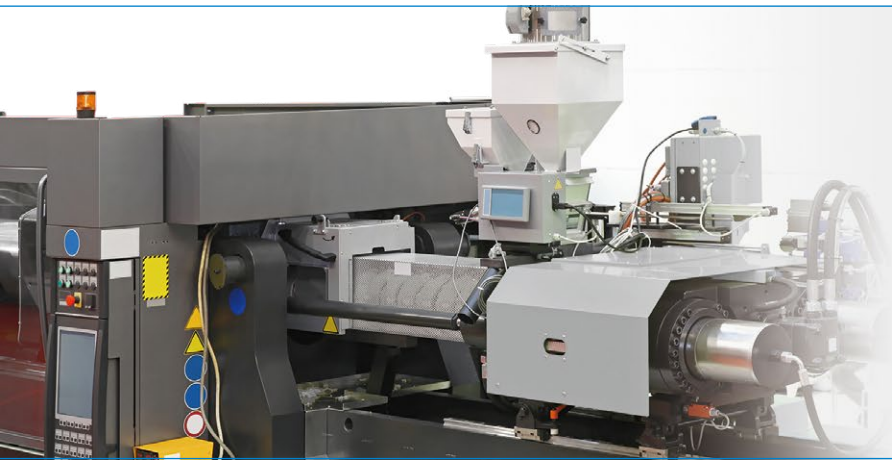
- Bonding processing utilizing control program executed by computer
- Reduces production cycle time per chip, realizing increased productivity

Conventional semiconductor bonding system uses a computer for executing control program for bonding processing. Using the C Controller enables bonding processing while executing multiple tasks such as camera alignment, bonding settings, and calculation routines. Since the C Controller can utilize control program without change, program modification is not necessary. Capable of high-speed instruction to the motion CPU (0.88 ms), the C Controller can reduce production cycle time per chip, realizing increased productivity. Stable product supply is guaranteed, reducing maintenance risks.

▶ System configuration



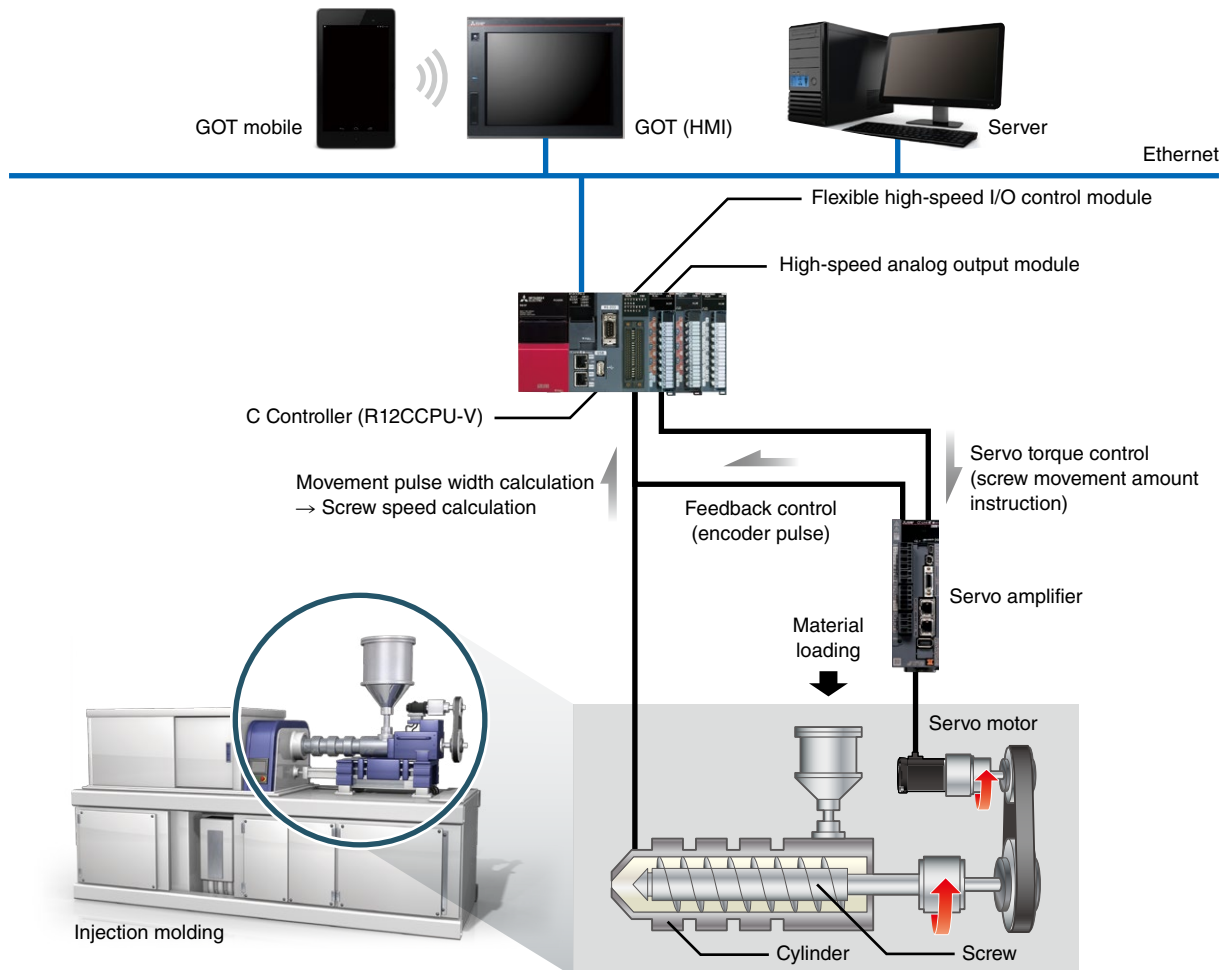
Injection molding



- High-performance control
- System construction with highly reliable, long-term stable supply MELSEC programmable controllers

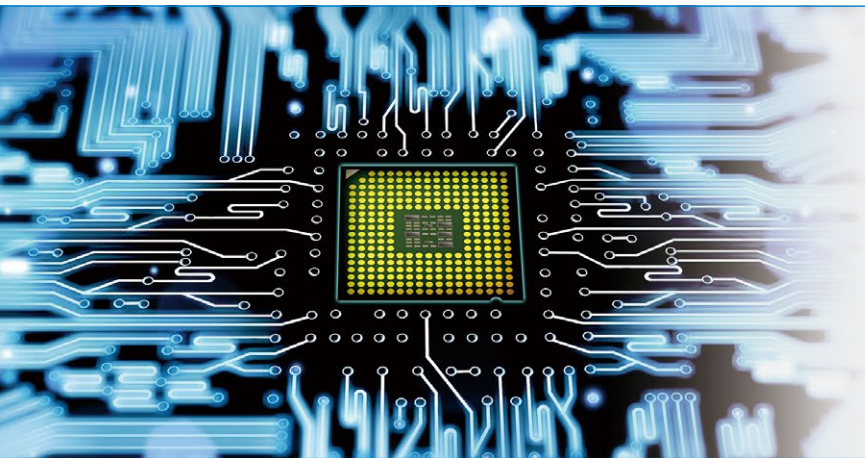
The C Controller can control the screw movement amount by comparing the screw speed calculated from the screw movement pulse width with the prescribed injection patterns. First, the flexible high-speed I/O control module processes microsecond fast pulse width measurement by hardware logic-driven control. Then the C Controller performs high-speed calculation of the screw movement amount by comparing the calculated screw speed and feedback encoder pulse with the prescribed injection patterns. The MELSEC iQ-R Series C Controller realizes higher performance control.

▶ System configuration



```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

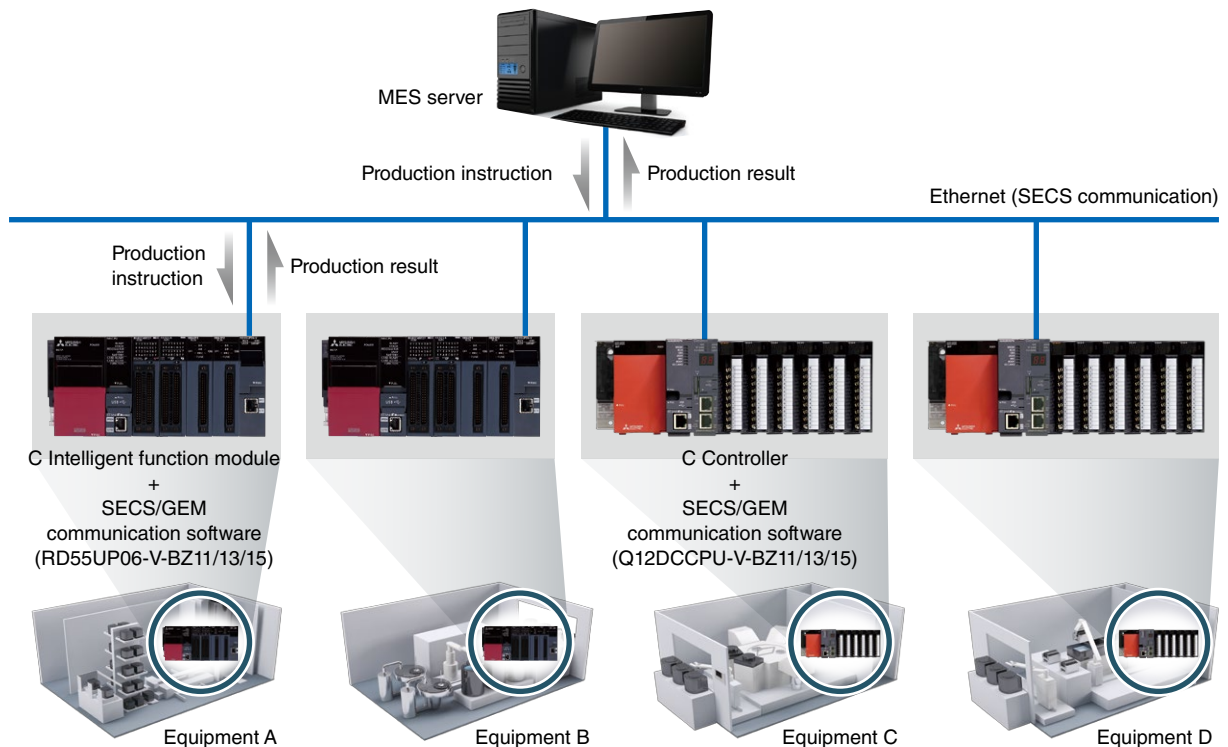
Semiconductor manufacturing system



- Realizing SECS/GEM communication without a computer nor program
- Standardization of communication specifications realizes early start-up

Installing the C Controller or C Intelligent function module “SECS/GEM communication software” pre-installed model in each equipment and distributing the setting files of the communication specifications for the “SECS/GEM communication software” to equipment manufacturers result in early production line start-up. SECS/GEM communications can be realized without a computer nor program, dramatically reducing engineering costs. Issues in the existing system such as increase in online test times due to errors in reflecting communication specifications can be solved.

▶ System configuration



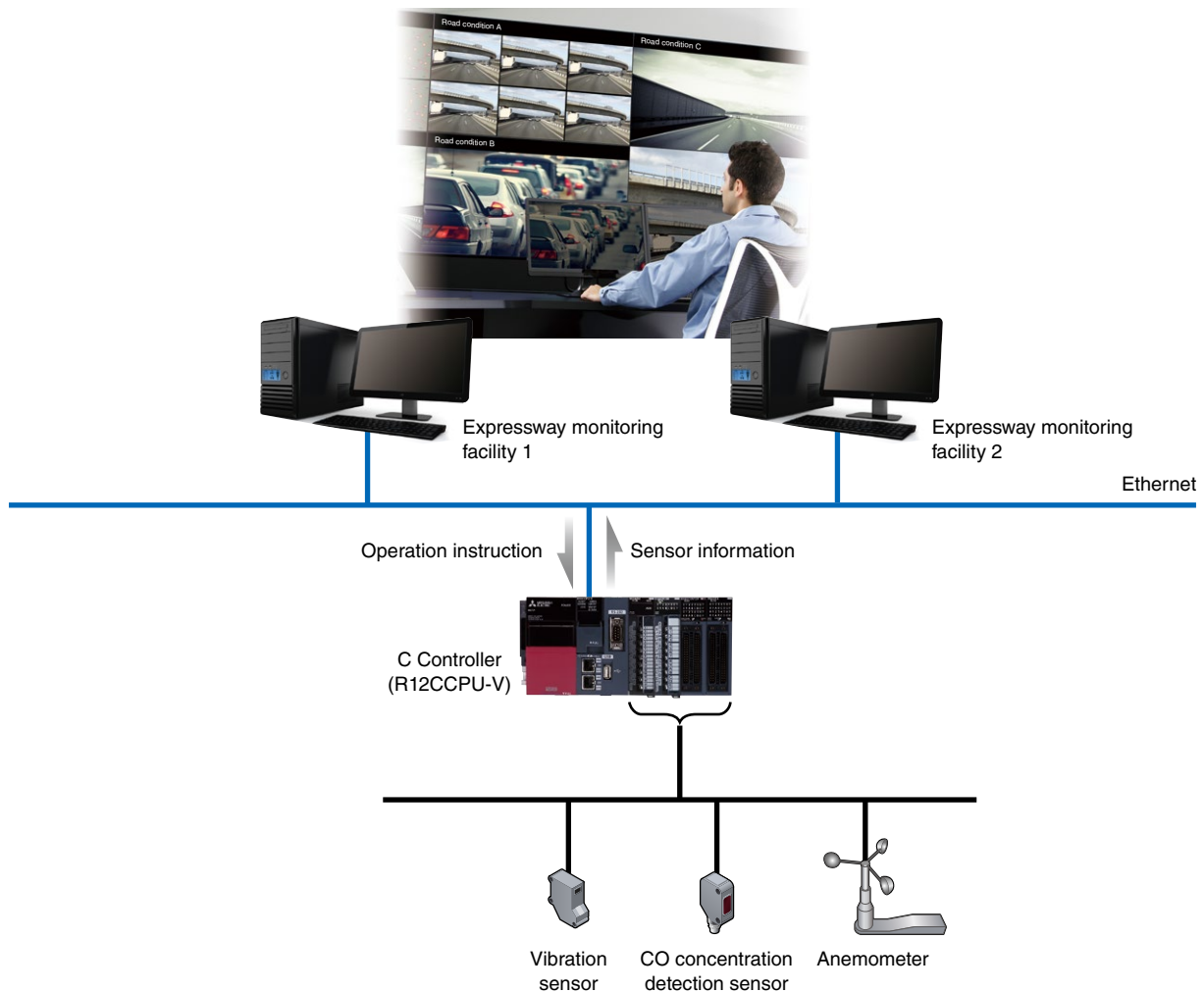
Expressway monitoring and analysis



- Robust operation in hazardous environments (vibration, exhaust gases, and high temperatures)
- Lower maintenance costs with no micro computer required

Monitoring and analysis of expressway vibration and vehicle exhaust gases require robust equipment that can collect data from vibration sensors and CO concentration detection sensors. The C Controller can stably and continuously operate in such harsh environments. Furthermore, as compared to micro computer-based system, reduction in power consumption, installation space, and maintenance costs is realized.

▶ System configuration



```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

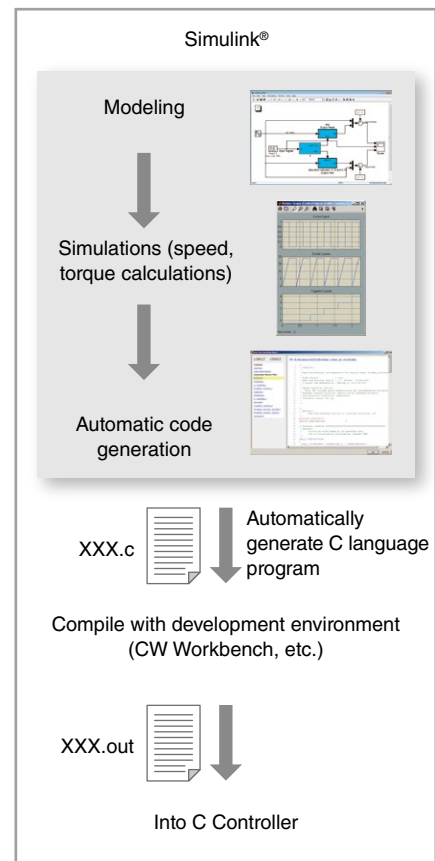
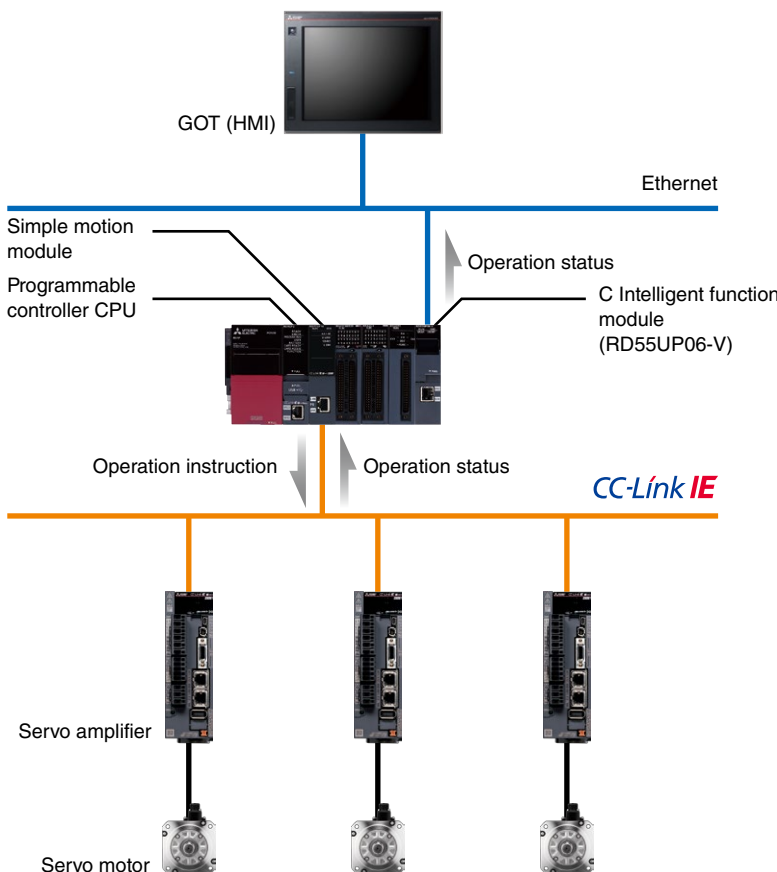
Conveyor



- Conveyor management and conveyor control effectively done utilizing multiple modular feature
- Robust and installable within a small panel near the conveyor

Conveyor destination management requires calculation of optimal conveyor routes to the destination as instructed through communications with the IT system, acquisition of conveyor control status in accordance with calculated results, and conveyor control instructions. To realize this, high-speed communications with conveyor controlling products in addition to data processing in highly versatile C and C++ programming languages are necessary. The system can be configured with the programmable controller CPU, simple motion module, and C Intelligent function module. In the conveyor control system with a GOT (HMI) installed, conveyor operation is enabled even when communications with the IT system are not enabled. These robust modules can be installed within a control panel together with a GOT (HMI), resulting in minimum use of space. Furthermore, speed and torque required for conveyor control can be calculated in model based design environment using MATLAB®/Simulink®, realizing high-speed conveyor control system.

▶ System configuration



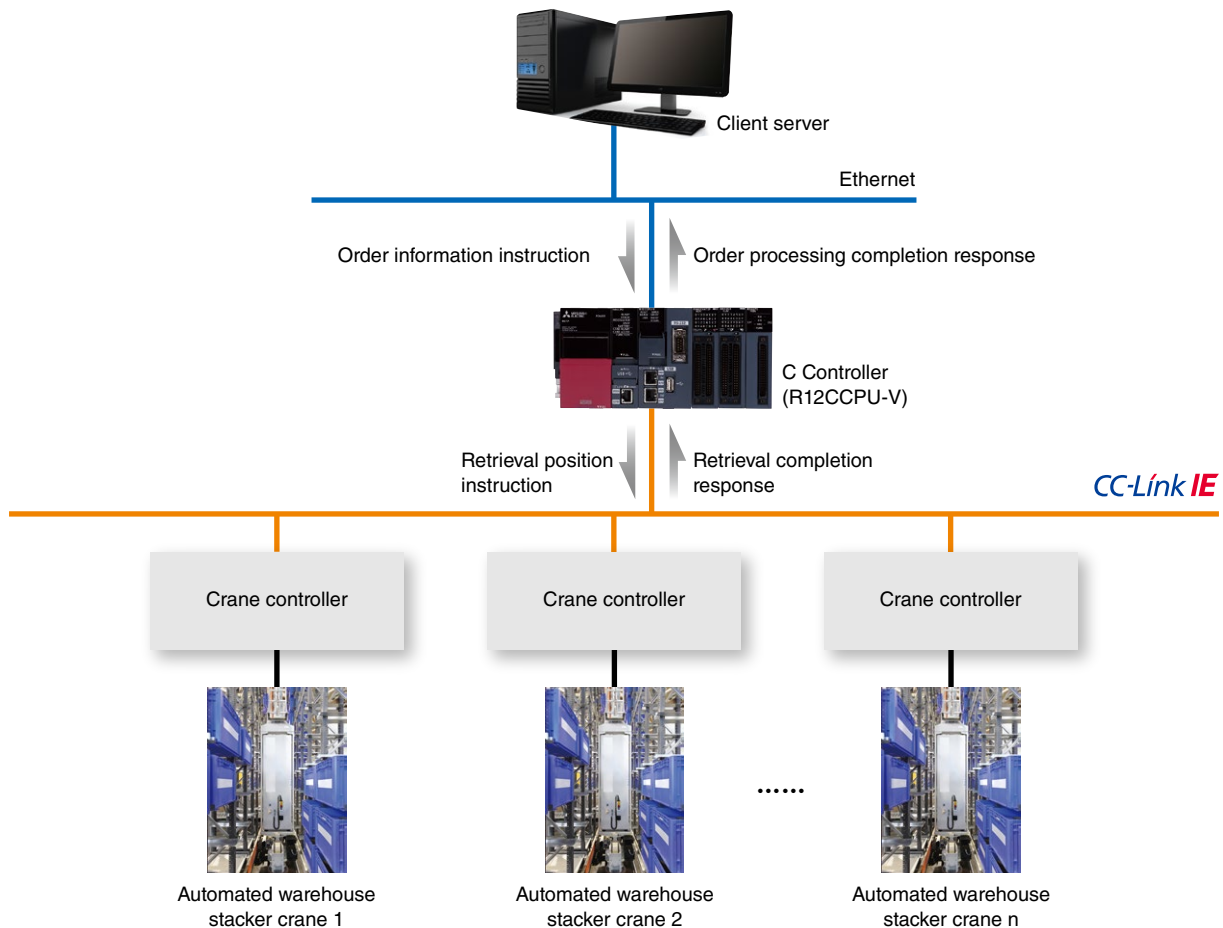
Automated warehouse



- Long-term stable supply and continuous operation significantly reduce maintenance costs
- Connection with multiple automated warehouse controllers

In the conventional system, production information, inventory information, and entering and dispatching from warehouse are managed using a process computer, and the information is conveyed to the automated warehouse controllers to control the stacker cranes and storage retrieval vehicles. Continuous operation of the process computer can lead to faults, requiring significant time and costs for system restoration. Replacing the process computer with the robust C Controller enables stable and continuous operation, significantly reducing maintenance costs.

▶ System configuration



```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

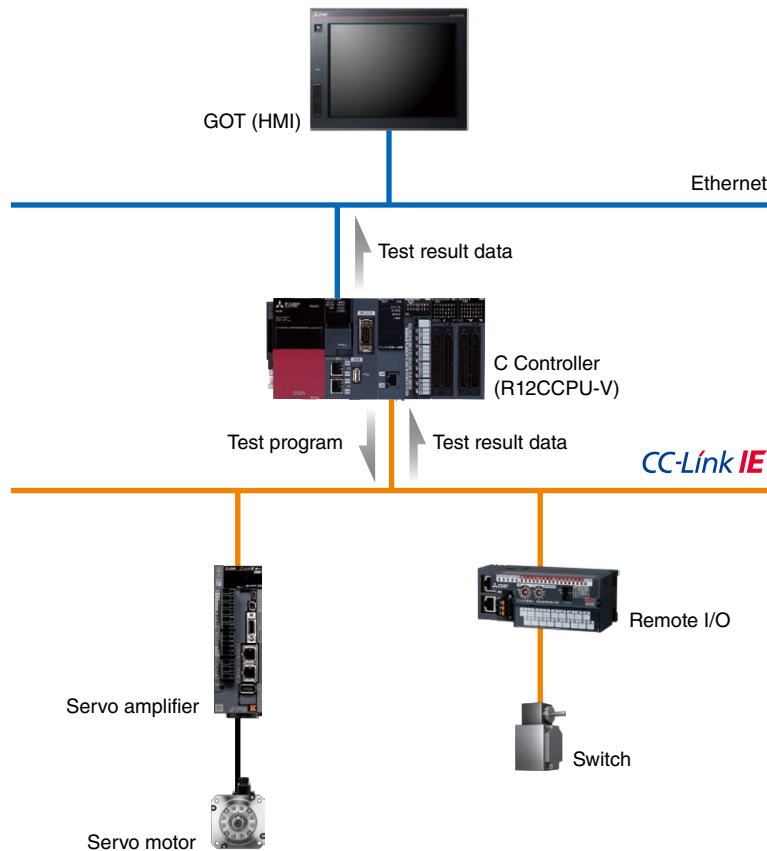
Inspection machine



- Increased durability and reduced downtime
- Eliminates periodic computer setup costs associated with computer replacement

The conventional system can suffer from down-time resulting from computer faults and require periodic setup associated with computer replacement (OS version updates not resulting from faults), leading to low operating rate of test equipment as well as increased cost. Replacing a computer with the C Controller and GOT (HMI) increases durability, reducing downtime. Computer replacement is no longer necessary, reducing periodic setup cost.

► System configuration



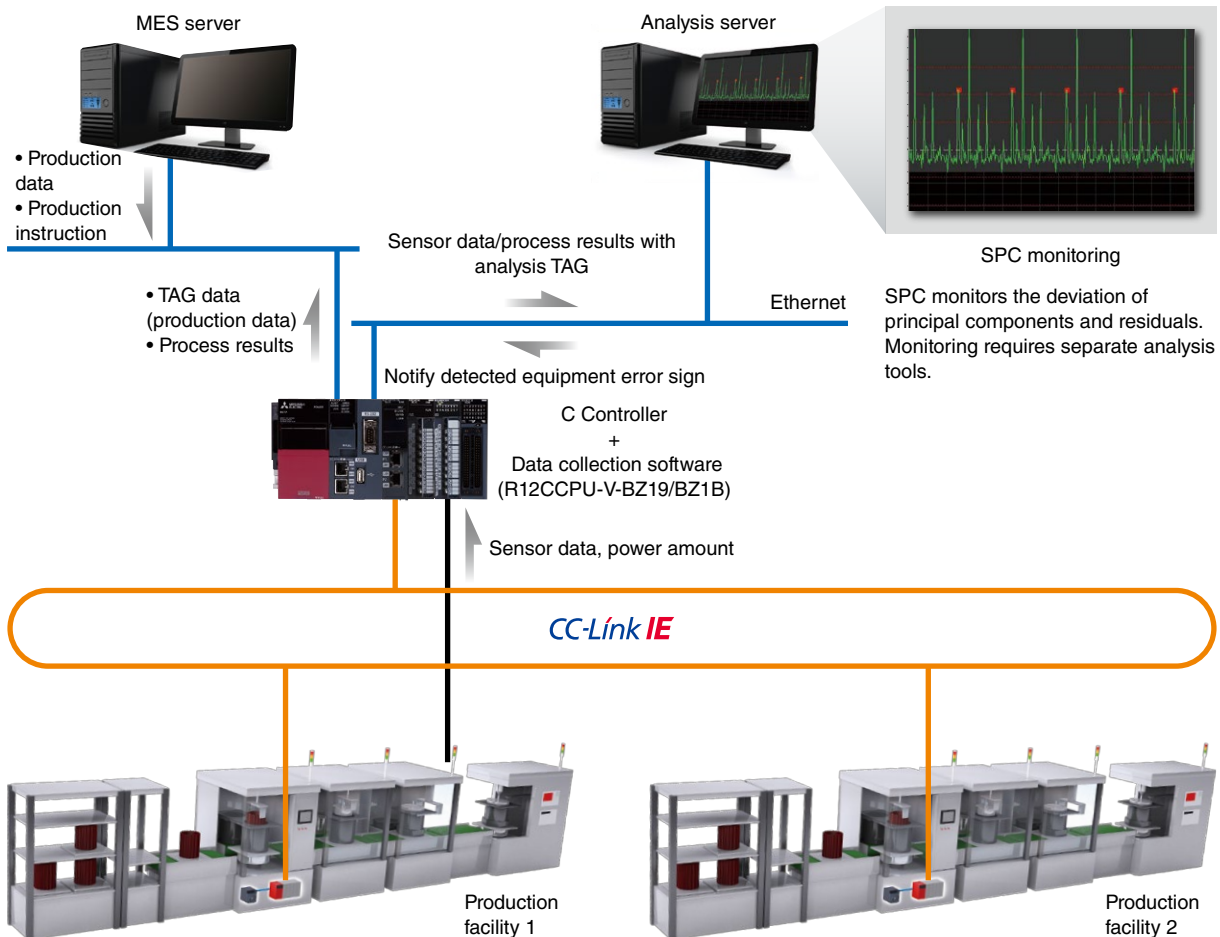
Production data collection



- Management and analysis of shop floor data for optimization of manufacturing with e-F@ctory
- Predicts production equipment failures using collected sensor data

The conventional system has a potential risk for tremendous loss resulting from a production stop due to sudden equipment failures. Periodic inspections are also required, increasing repair and maintenance costs. The C Controller “data collection software” pre-installed model can monitor signs of equipment abnormalities using collected sensor data, reducing repair and maintenance costs. Implementing this system can be done easily as the existing equipment can be used.

► System configuration



```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

Bearing deterioration diagnosis

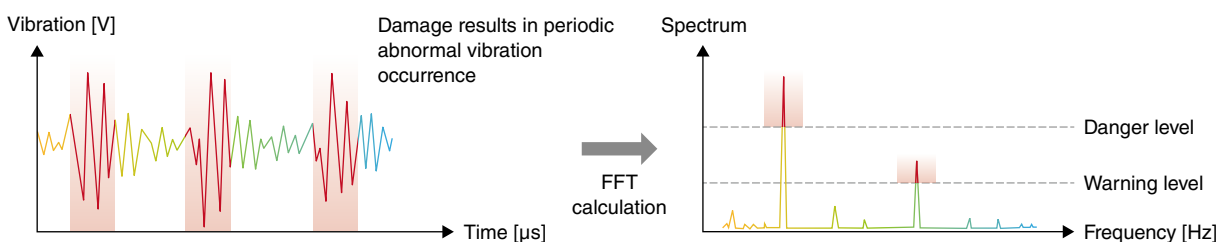
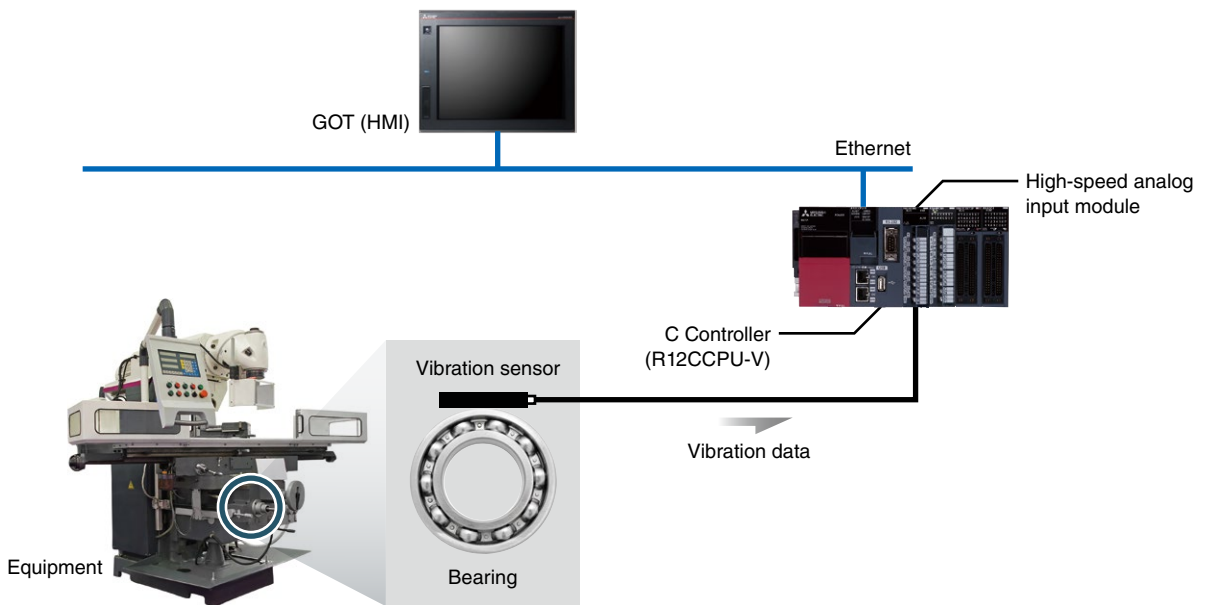


- Diagnosis of deterioration status
- Easy data analysis processing such as FFT*1 calculations

Abnormal vibrations occur when balls (rolling elements) contact with the inner or outer race due to damage of bearings. Vibration sensor (acceleration pick-up sensors) data is sampled at high speed (max. 5 μs sampling cycle) by the MELSEC iQ-R Series high-speed analog I/O module, and the collected vibration data is processed for frequency analysis (FFT analysis) by the C Controller. This is useful for monitoring equipment deterioration and detecting any fault developing, allowing condition-based maintenance including part replacement, repair, and update before the equipment stops. Implementing this system provides reduced failure rates and improved equipment reliability, reducing overall maintenance costs.

*1. Fast Fourier Transform: A high-speed processing for converting time-based data into frequency-based data to calculate frequency components in the collected data

▶ System configuration



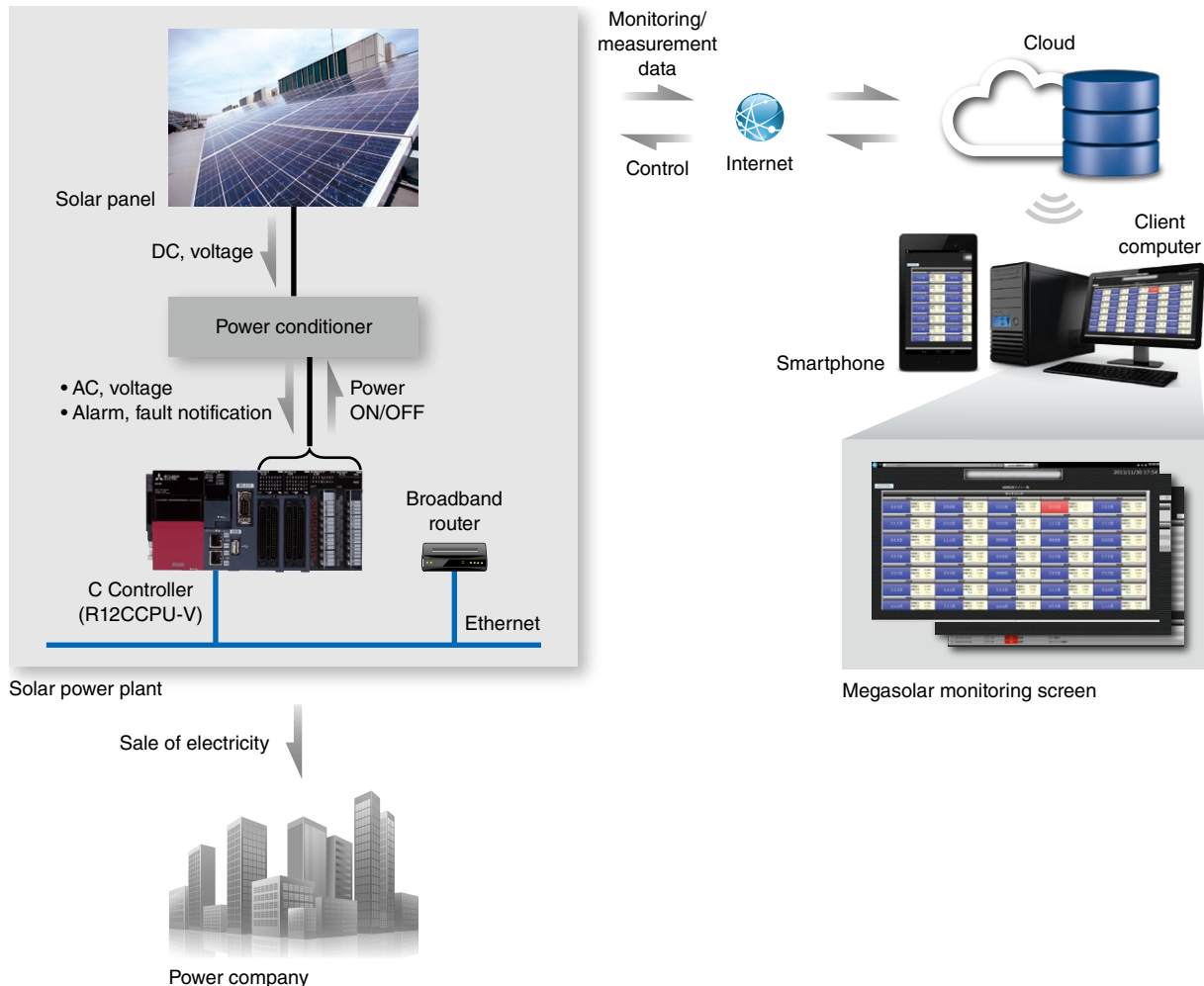
Solar power measurement and display



- Real-time monitoring of solar power plant status and measurements
- Integrated monitoring of multiple power plants
- Remote control

Solar power plants require high-reliability infrastructure and equipment that should not stop by failure or other impacts. Implementation of the C Controller enables stable and continuous operation and also allows real-time data collection by string monitoring, camera-based monitoring, and weather monitoring. Additionally, even if a power failure occurs due to lightning and such, the system can be restored by remote operation via a cloud server. The C Controller can be installed within a control panel where measuring equipment, power conditioner, and other equipment are stored, realizing minimum use of space.

► System configuration



```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

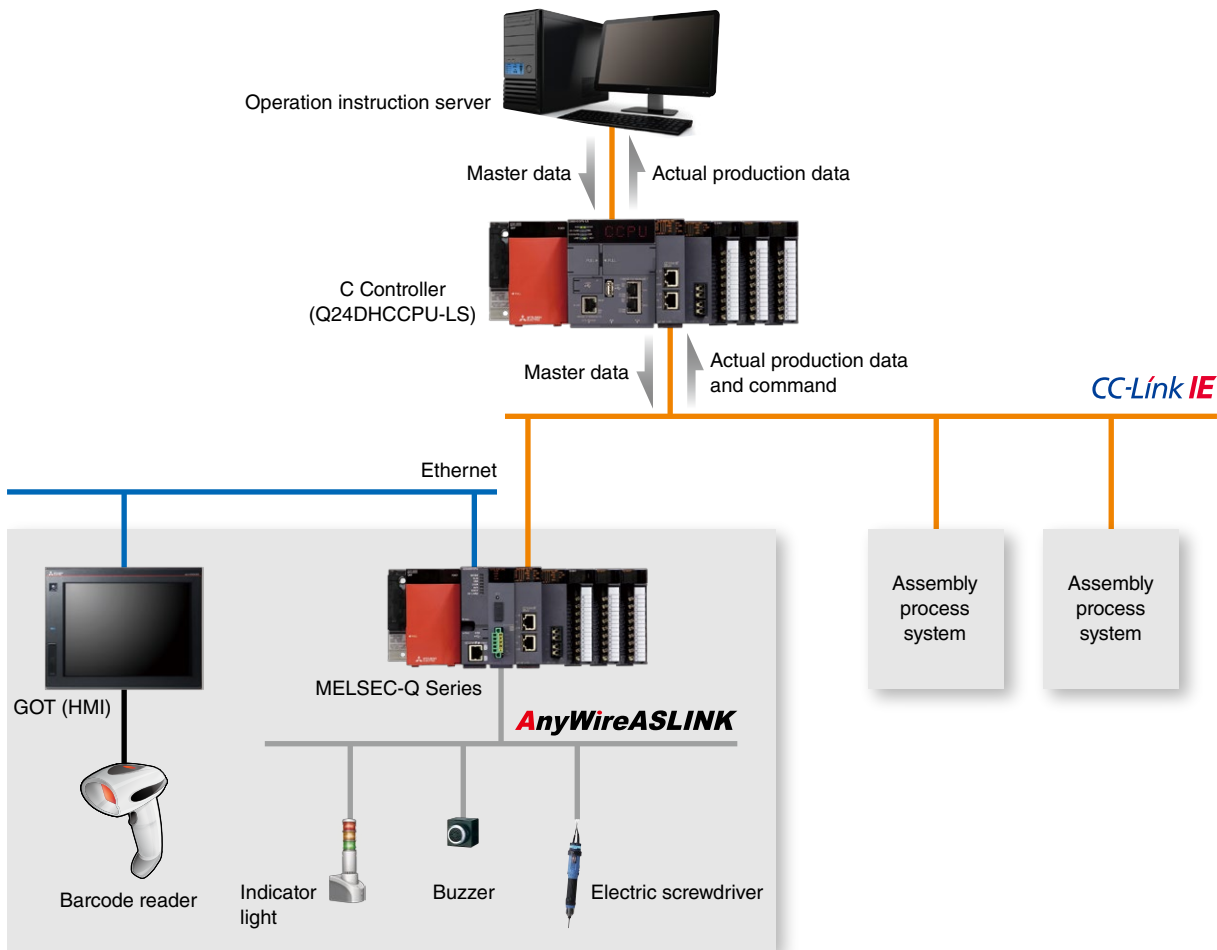
Assembly process data collection



- Gateway computer is no longer necessary, reducing maintenance costs
- Real-time processing of multiple PLCs data and data coordination with IT system

The C Controller can be used for assembly process system communications in place of a gateway computer. Conventional computer-based production information management systems require frequent OS replacement and troubleshooting, resulting in significant costs and maintenance. The C Controller, however, can play multiple roles with a single module and reduce maintenance costs owing to its feature requiring no OS replacement and robust design. The C Controller can also process multiple programmable controllers data in real time and send the data to the IT system. Smooth coordination with the IT system contributes to improve work efficiency.

▶ System configuration



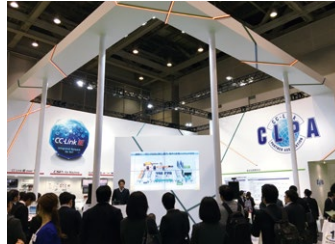
CC-Link Partner Association (CLPA) - Actively promoting worldwide adoption of CC-Link networks

Proactively supporting CC-Link, from promotion to specification development

The CC-Link Partner Association (CLPA) was established to promote the worldwide adoption of the CC-Link open-field network. By conducting promotional activities such as organizing trade shows and seminars, conducting conformance tests, and providing catalogs, brochures and website information, CLPA activities are successfully increasing the number of CC-Link partner manufacturers and CC-Link-compatible products. As such, CLPA is playing a major role in the globalization of CC-Link.



Seminar



Trade show



Conformance testing lab

Visit the **CLPA website for the latest CC-Link information.**

URL: www.cc-link.org

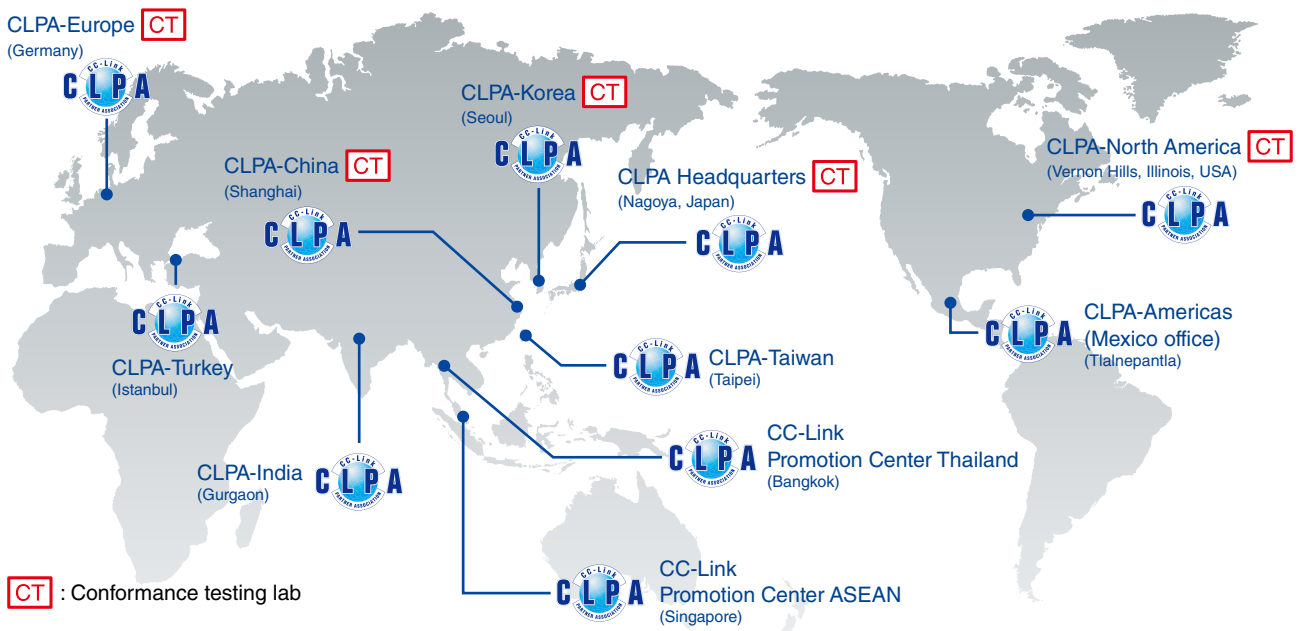


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Global influence of CC-Link continues to spread

CC-Link is supported globally by CLPA. With offices throughout the world, support for partner companies can be found locally. Each regional CLPA office undertakes various support and promotional activities to further the influence of CC-Link/CC-Link IE in that part of the world. For companies looking to increase their presence in their local area, CLPA is well placed to assist these efforts through offices in all major regions.



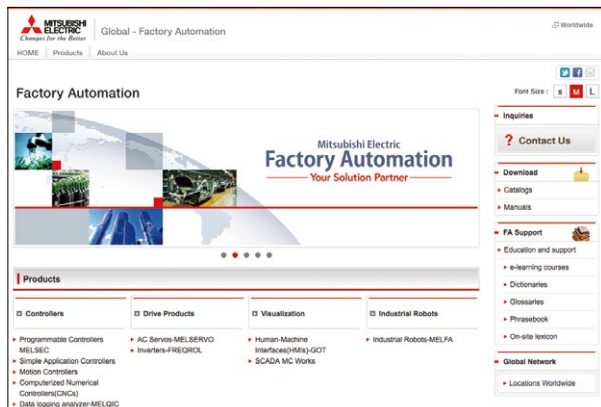
Factory Automation Global website

Mitsubishi Electric Factory Automation provides a mix of services to support its customers worldwide. A consolidated global website is the main portal, offering a selection of support tools and a window to its local Mitsubishi Electric sales and support network.

■ From here you can find:

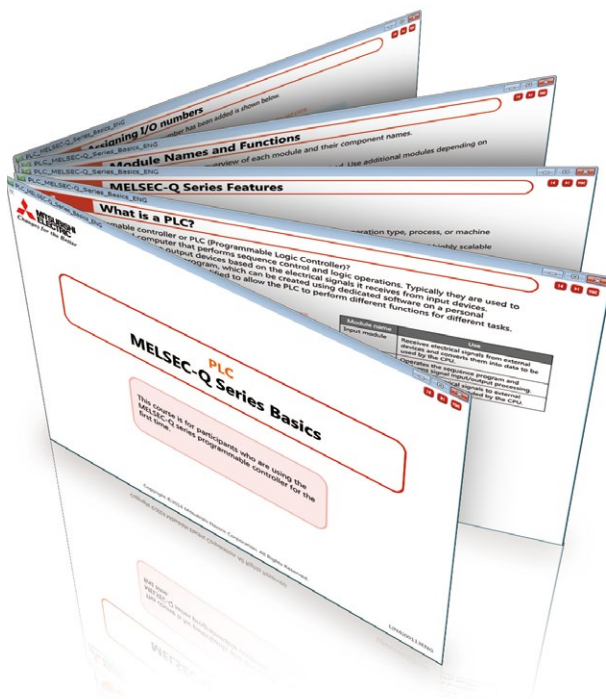
- Overview of available factory automation products
- Library of downloadable literature
- Support tools such as online e-learning courses, terminology dictionary, etc.
- Global sales and service network portal
- Latest news related to Mitsubishi Electric factory automation

**Mitsubishi Electric Factory Automation
Global website:
www.MitsubishiElectric.com/fa**



Online e-learning

An extensive library of e-learning courses covering the factory automation product range has been prepared. Courses from beginner to advanced levels of difficulty are available in various languages.



■ Beginner level

Designed for newcomers to Mitsubishi Electric Factory Automation products gaining a background of the fundamentals and an overview of various products related to the course.

■ Basic to Advanced levels

These courses are designed to provide education at all levels. Various different features are explained with application examples providing an easy and informative resource for in-house company training.

Innovative next-generation, e-Manual

The e-Manual viewer is a next-generation digital manual offered by Mitsubishi Electric that consolidates all manuals into an easy-to-use package with various useful features integrated into the viewer. The e-Manual is modeled around a centralized database allowing multiple manuals to be cross-searched at once, further reducing the time for reading individual product manuals when setting up a control system.



Key features include

- One-stop database containing all required manuals, with local file cache
- Included with GX Works3 engineering software
- Also available in tablet version
- Easily download manuals all at once
- Automatic update of manual versions
- Search information across multiple manuals
- Visual navigation from hardware diagram showing various specifications
- Customizable by adding user notes and bookmarks
- Directly port sample programs within manuals to GX Works3

MITSUBISHI ELECTRIC FA e-Manual (tablet version)



The e-Manual application is available on iOS and Android™ tablets. e-Manual files are provided as in-app downloads.



iOS
Version 8.1 or later

Download on the
App Store





Android™
Version 4.3/4.4/5.0

GET IT ON
Google Play






Supported versions

OS	OS version	Model
iOS	iOS 8.1 or later	Apple iPad 2, iPad (3rd generation), iPad (4th generation), iPad Air, iPad Air 2, iPad mini, iPad mini 2, iPad mini 3, iPad mini 4, iPad Pro (12.9 inch), iPad Pro (9.7 inch)
Android™	Android™ 4.3/4.4/5.0	ASUS Nexus7™ (2013)*1

*1. When using a tablet not listed above, 7-inch (resolution of 1920 x 1200 dots (WUXGA)) or better is recommended.

```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

Performance specifications

Item	MELSEC iQ-R Series		
			
Model	C Controller (standard model) R12CCPU-V	C Intelligent function module RD55UP06-V	C Controller (standard model) Q12DCCPU-V
Hardware			
Endian format	Little endian		Little endian
MPU	Arm® Cortex®-A9 Dual Core		SH-4A
Working RAM	256 MB	128 MB	128 MB
Standard ROM	16 MB	12 MB	12 MB*1
Built-in SSD	-	-	-
Backup RAM	4 MB	-	512 KB*2
Software			
OS	VxWorks® 6.9*4 (installed by default)		VxWorks® 6.4*4 (installed by default)
Programming language	C language (C/C++)		C language (C/C++)
Programming development environment	CW Workbench (SW1DND-CWWR-E/EZ/EVZ)/ Wind River® Workbench 3.3*4		CW Workbench (SW1DND-CWWLQ12-E/EZ/EVZ)/ Wind River® Workbench 2.6.1*4
Setting/monitoring tool	CW Configurator (SW1DND-RCCPU-E)	GX Works3*9 (SW1DND-GXW3-E)	Basic mode: SW3PVC-CCPU-E Extended mode: SW4PVC-CCPU-E
Communication interface			
Ethernet*10	2CH (10BASE-T/100BASE-TX/ 1000BASE-T)	1CH (10BASE-T/100BASE-TX/ 1000BASE-T)	2CH (10BASE-T/100BASE-TX)
Memory card	SD memory card (1 slot)		CompactFlash card (1 slot)*11
Display interface	-		-

*1. Specifications when using the extended mode. Extended mode is available with the product with first five serial number digits 15102 or later.

*2. 128 KB for products with first five serial number digits 12041 or before, 512 KB to 3,584 KB for products with first five serial number digits 15102 or later.

*3. Specify a memory capacity of standard RAM (1 to 4 MB) in a battery backup RAM using parameter.

*4. VxWorks® 6.9, VxWorks® 6.8.1, VxWorks® 6.4, Wind River® Workbench 3.3, Wind River® Workbench 3.2, and Wind River® Workbench 2.6.1 are products of Wind River Systems, Inc. Refer to the Wind River Systems, Inc. product manuals or contact Wind River Co., Ltd. (Japan office) for service and specifications of Wind River Systems products. Refer to the following website for contact information of Wind River Co., Ltd.
<http://www.windriver.com>

*5. Must be separately purchased from Lineo Solutions, Inc.

*6. Must be separately purchased from eSOL Co., Ltd.

*7. Q26DHCCPU-LS does not support.

*8. When Lineo uLinux is used. The program language depends on the specifications of the 3rd Party partner OS.

*9. Setting and monitoring of the module is integrated within the GX Works3 engineering software.

*10. Please refer to the relevant manufacturer for details on the number of connectable stages when using a switching hub.

*11. TYPE I cards are supported. A TYPE II card cannot be used. I/O cards such as modem cards cannot be used.


```
fd2 = socket( AF_INET, SOCK_STREAM, 0 );
if( fd2 != ERROR){
    if( bind(fd2, (struct sockaddr *)&serv_ad
        listen(fd2,1);
```

General specifications

Item	Specifications*1					
	MELSEC iQ-R Series			MELSEC-Q Series		
Operating ambient temperature	0...55°C (when a base unit other than an extended temperature range base unit is used)			0...55°C		
	0...60°C (when an extended temperature range base unit is used)*2					
Storage ambient temperature	-25...75°C					
Operating ambient humidity	5...95% RH, non-condensing					
Storage ambient humidity						
Vibration resistance	Compliant with JIS B 3502 and IEC 61131-2	Under intermittent vibration	Frequency	Constant acceleration	Half amplitude	Sweep count
			5...8.4 Hz	-	3.5 mm	
		Under continuous vibration	8.4...150 Hz	9.8 m/s ²	-	10 times each in X, Y, Z directions
			5...8.4 Hz	-	1.75 mm	
8.4...150 Hz	4.9 m/s ²	-	-			
Shock resistance	Compliant with JIS B 3502 and IEC 61131-2 (147 m/s ² , 3 times each in directions X, Y, Z)					
Operating atmosphere	No corrosive gases*3, no flammable gases, no excessive conductive dust					
Operating altitude*4	0...2000 m*5					
Installation location	Inside a control panel					
Overvoltage category*6	≤ II					
Pollution degree*7	≤ 2					
Equipment class	Class 1					

- *1. When inserting a commercially available SD memory card or CompactFlash card into the C Controller, follow the lower specifications of the C Controller or the SD memory card/CompactFlash card.
- *2. Enables standard MELSEC iQ-R Series modules to support extended operating ambient temperature of 0 to 60°C, ensuring the same performance as the standard operating ambient temperature (0 to 55°C). When requiring to use in an ambient temperature environment higher than 60°C, please consult your local Mitsubishi Electric representative.
- *3. The special coated product, which meets the regulation (JIS C 60721-3-3/IEC 60721-3-3 3C2) related to corrosive gas, is available for the use in a corrosive gas environment. No special coated product is available for Q24DHCCPU-V, Q24DHCCPU-LS, or Q26DHCCPU-LS.
- *4. Do not use or store the programmable controller under pressure higher than the atmospheric pressure of altitude 0 m. Doing so may cause malfunction. When using the programmable controller under pressure, please consult your local Mitsubishi Electric representative.
- *5. When used at an altitude higher than 2000 m, the upper limits of the permissible voltage and the operating ambient temperature become lower. Please consult your local Mitsubishi Electric representative.
- *6. This indicates the section of the power supply to which the equipment is assumed to be connected between the public electrical power distribution network and the machinery within premises. Category II applies to equipment for which electrical power is supplied from fixed facilities. The surge voltage withstand level for up to the rated voltage of 300 V is 2500 V.
- *7. This index indicates the degree to which conductive material is generated in terms of the environment in which the equipment is used. Pollution level 2 is when only non-conductive pollution occurs. A temporary conductivity caused by condensing must be expected occasionally.

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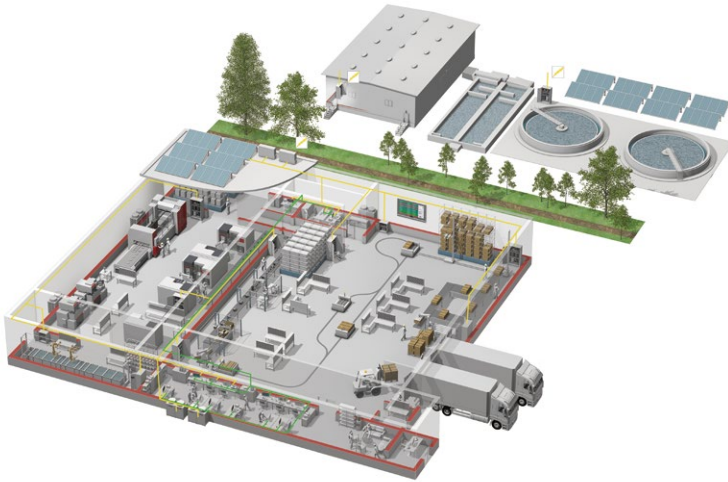
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- The products have been manufactured under strict quality control. However, when installing the products where major accidents or losses could occur if the products fail, install appropriate backup or fail-safe functions in the system.

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Low voltage: MCCB, MCB, ACB



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Power monitoring, energy management



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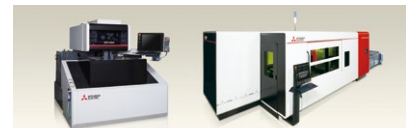
Visualisation: HMIs



Numerical Control (NC)



Robots: SCARA, Articulated arm



Processing machines: EDM, Lasers, IDS

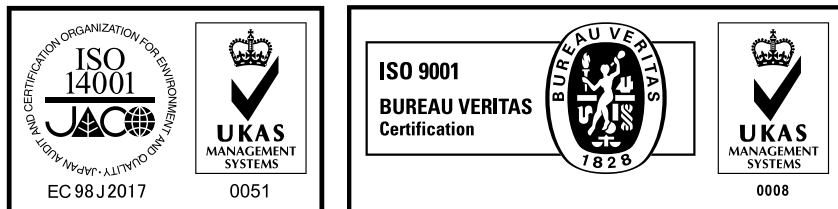


Transformers, Air conditioning, Photovoltaic systems

* Not all products are available in all countries.

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