

FACTORY AUTOMATION

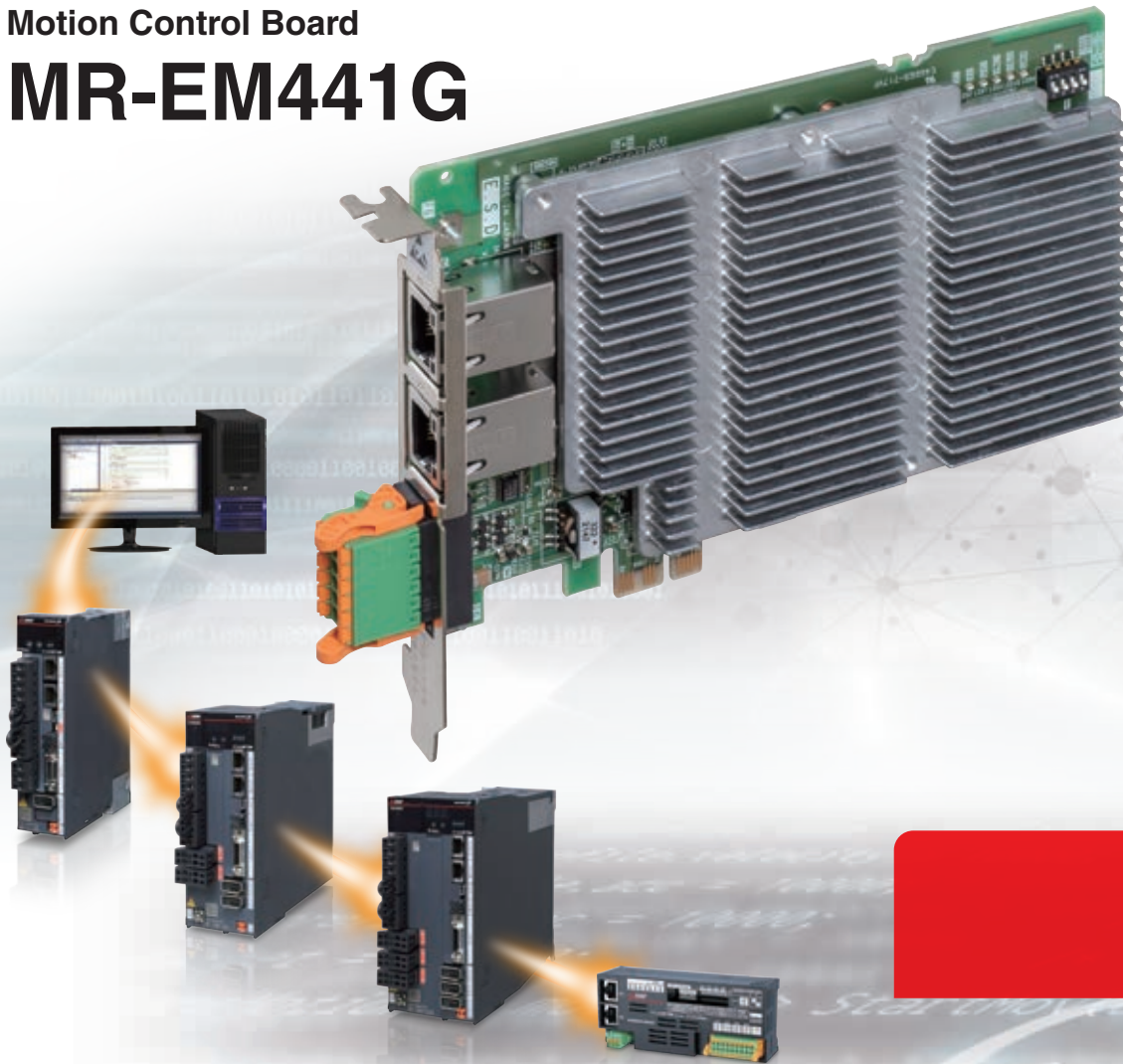
New Product Release

June 2024 [SV2406-1E]

Mitsubishi Electric AC Servo System Personal Computer Embedded Type Servo System Controller

Motion Control Board

MR-EM441G



MITSUBISHI ELECTRIC SERVO SYSTEM
MELSERVO-J5

CC-Link IE TSN

**High-speed motion control in an industrial
personal computer environment**

High-Speed, High-Precision Motion Control in an Industrial Personal Computer Environment

Motion control board MR-EM441G is a personal computer embedded type servo system controller for controlling servo amplifier MR-J5-G. Connected to the PCI Express® extended slot of an industrial personal computer, MR-EM441G realizes fast and accurate motion control.

Motion Control Board

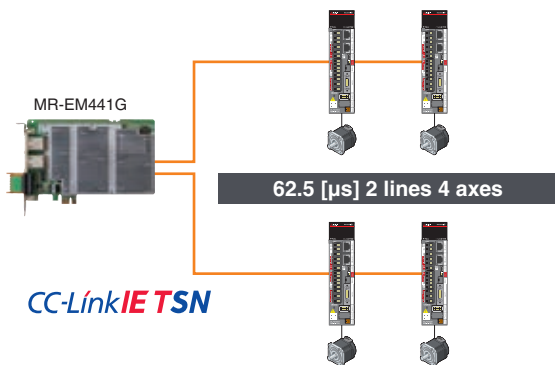
MR-EM441G



High-Speed, High-Precision Motion Control

62.5 μ s/4-axis control *1,2

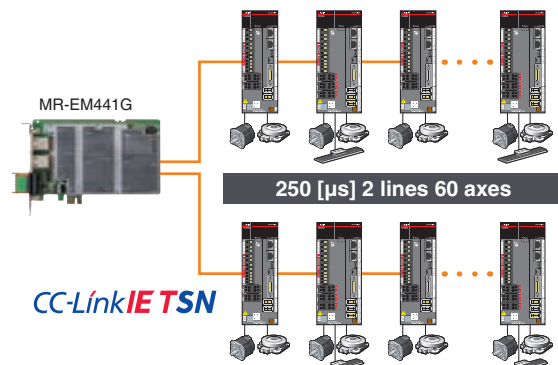
MR-EM441G enables 4-axis control with a minimum operation cycle of 62.5 μ s. Optimum for high-speed processing of the head part.



*1. When executing a trapezoidal command for all axes in the high-speed operation mode.
*2. When the operation cycle is 62.5 μ s, some functions are not available.

250 μ s/60-axis control *3

MR-EM441G enables 60-axis control with a minimum operation cycle of 250 μ s. Cycle time is shortened even for multi-axis equipment.



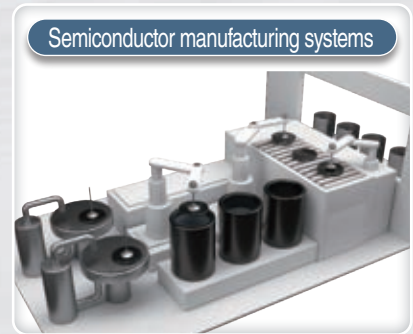
*3. When connecting only MR-J5W_-G and executing a trapezoidal command for all axes in the high-speed operation mode.

Load Distribution with a PC and a Motion Control Board

MR-EM441G has a built-in high-performance CPU and performs complicated and high-speed motion control. Therefore, even when the CPU of the PC is heavily loaded with a huge amount of data processing, the motor operation of MR-EM441G will not be affected, achieving high-speed and high-precision positioning.



High Performance



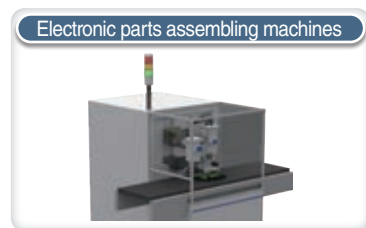
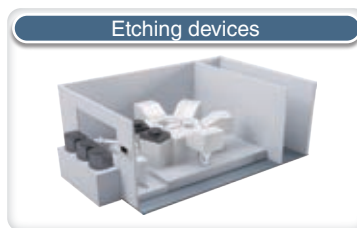
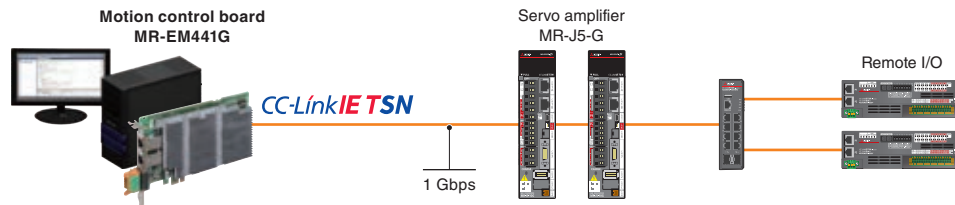
CC-Link IE TSN



MITSUBISHI ELECTRIC SERVO SYSTEM
MELSERVO-J5

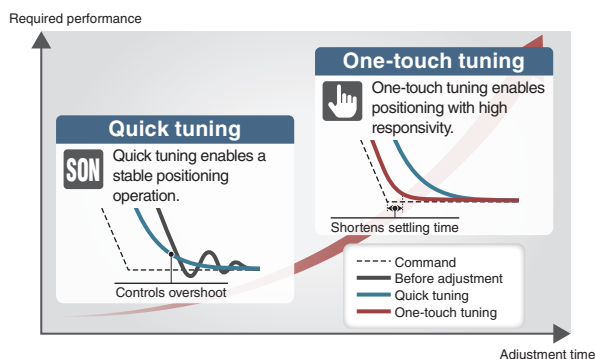
Configure a MELSERVO-J5 Servo System

MR-EM441G controls up to 64 axes of the CC-Link IE TSN-compatible servo amplifier, MR-J5-G. Combined with the high-performance, industry-leading servo amplifiers, MR-EM441G configures a high-performance servo system that improves machine capability.



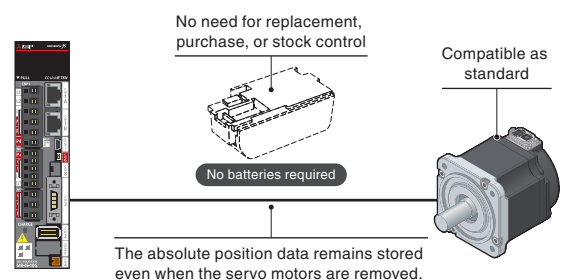
MR-J5-G servo amplifiers

- Shortens settling time with advanced vibration suppression
- Quick startup with servo tuning functions

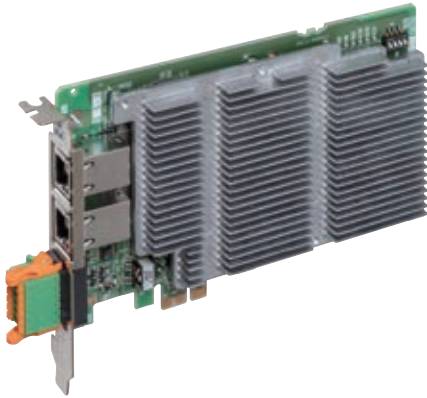


HK series rotary servo motors

- Equipped with a 26-bit resolution batteryless absolute position encoder as standard
- Reduces maintenance costs as a result of eliminating battery purchase, replacement, and stock control



Product Lines



CC-Link I^E TSN
Motion Control Board
MR-EM441G

Maximum number of control axes: 64 axes
 Minimum operation cycle*1: 62.5 [μs]*2
 Program: Visual C++®/C#®

- Drives the servo amplifier with high-speed motion control at 62.5 μs/4 axes*3 and 250 μs/60 axes*4.
- Line and star connections are supported, realizing flexibility in topology and reducing wiring cost.
- An event-driven user application, which uses interrupts generated from MR-EM441G to the industrial PC, can be configured.

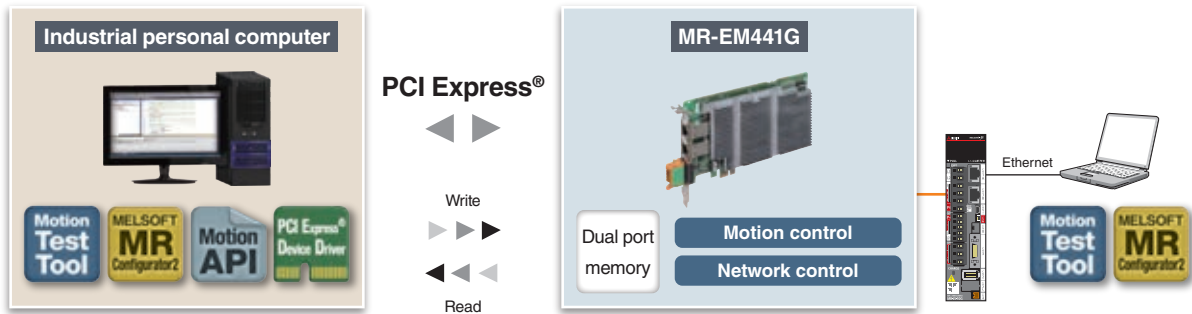
*1. The minimum operation cycle varies by the number of control axes.
 *2. When the operation cycle is 62.5 μs, some functions are not available.
 *3. When executing a trapezoidal command for all axes in the high-speed operation mode.
 *4. When connecting only MR-J5W_-G and executing a trapezoidal command for all axes in the high-speed operation mode.

Development Environment MELSOFT EM Motion SDK



MELSOFT EM Motion SDK is a software development kit that supports Motion control boards from parameter settings, debug, to maintenance.

- To create an application*1, use a motion API running on Windows®.



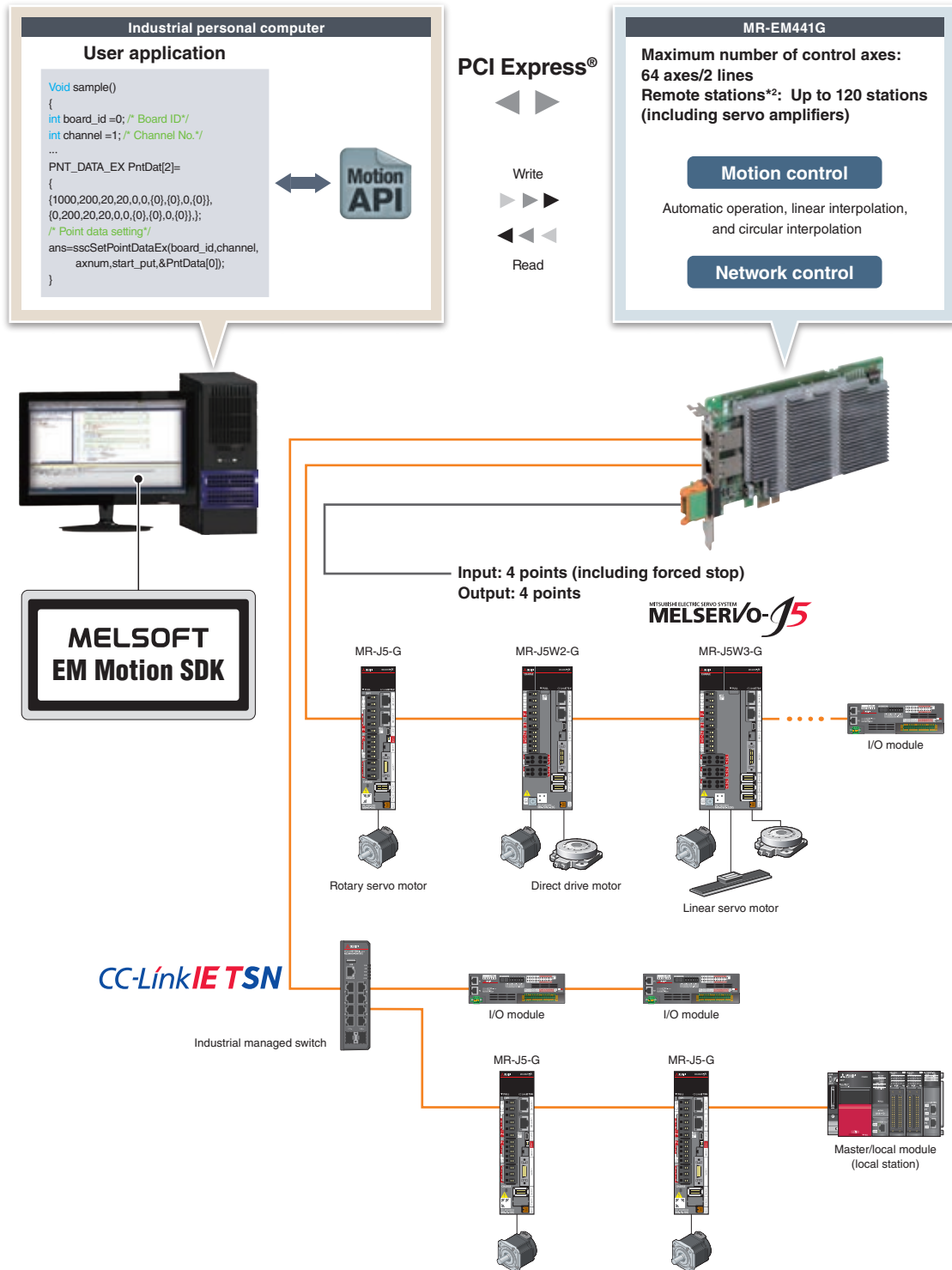
MELSOFT EM Motion SDK		
	Motion test tool	The operation of MR-EM441G and the status of the connected devices can be checked regardless of the user application.
	Motion API	Motion API provides easy access to MR-EM441G.
	Motion control board device driver	This software provides access to MR-EM441 via PCI Express® from a user application.
	MR Configurator2	Servo adjustment, monitoring, diagnosis, etc. are easily performed.

*1. OS and the development environment are not included and must be prepared by the user.

System Configuration

MR-EM441G can function as a master station of CC-Link IE TSN.*1

This feature enables users to create a system more flexibly by connecting various devices, such as servo amplifiers and remote I/O modules.



*1. The following functions are not supported: sub-master station and safety communication.

*2. CC-Link IE TSN Class A devices cannot be connected.

Positioning Control

Positioning data such as speed and travel distance is set to each point, and positioning control is executed from the start point No. to the end point No.

Use the motion API for setting the point data and starting operations.

In the high-speed operation mode, there are restrictions on the combinations of the linear interpolation group, circular interpolation group, and tandem operation group.

Automatic operation

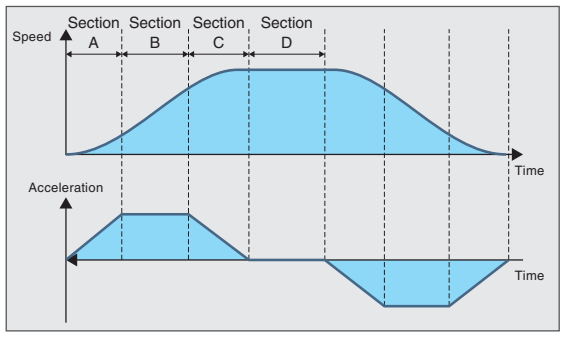
Linear interpolation

Circular interpolation

Jerk ratio acceleration/deceleration

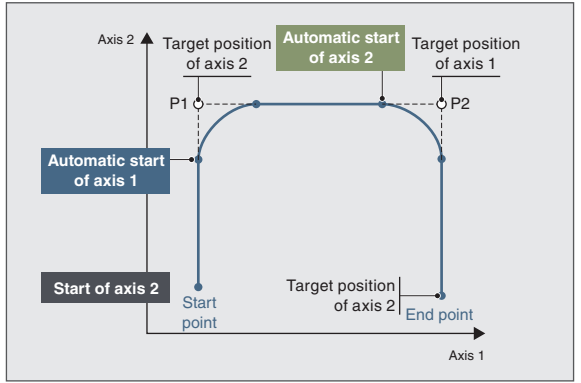
Vibration is suppressed with smooth speed changes
 Set a section where acceleration rate changes smoothly and a section where the maximum acceleration rate is maintained. This reduces the total acceleration time without losing smoothness.

Section A: Acceleration rate changes smoothly
 Section B: The maximum acceleration rate is maintained
 Section C: Acceleration rate changes smoothly
 Section D: Constant speed



Other axes start

Less cycle time with internal operation start
 Other axes start is a function that is started by MR-EM441G internally, not by a user application. Operation of other axes can be started at a specified position of the self axis, reducing cycle time. Startup conditions of other axes and their operation patterns must be set in advance. Output signals can also be turned ON or OFF based on the other axes start condition.



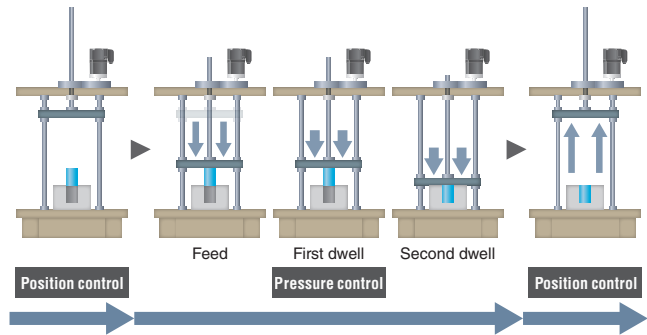
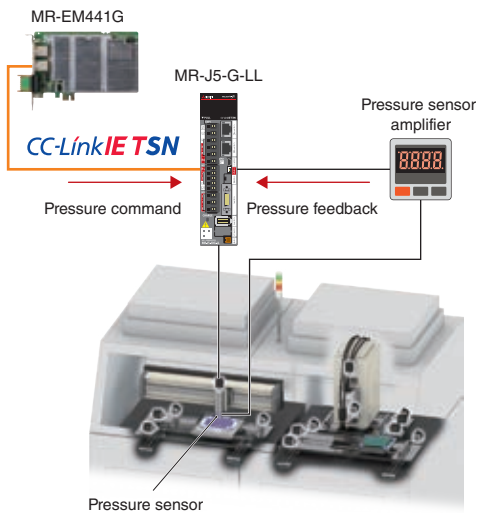
- Start of axis 2 Operation start with user application
- Automatic start of axis 1 Operation start with other axes start
- Automatic start of axis 2 Operation start with other axes start

Pressure control

Pressure control is performed so that the pressure command and the pressure sensor value are matched, enabling the pressure to be kept constant even while the load is changing.

Combined with an MR-J5-G-LL pressure control compatible servo amplifier, MR-EM441G can perform feed, dwell, and pressure release operations, achieving advanced pressure control.

Up to 16 axes can execute pressure control simultaneously.



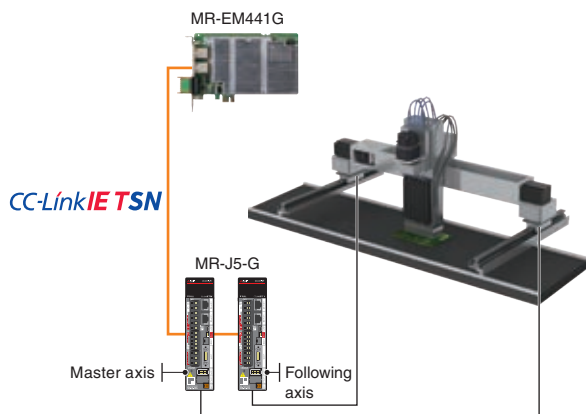
The pressure command can be easily set and adjusted with motion test tool.

Tandem operation

Tandem operation is a function that controls two axes (master axis and following axis) set in the tandem operation group to perform the exact same positioning operation.

It is used when two mechanically coupled motors drive a single machine, such as gantry systems.

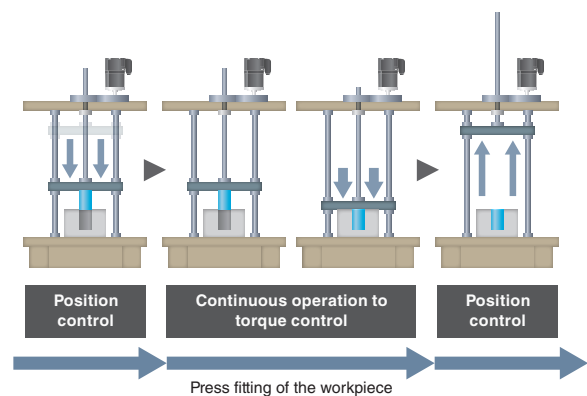
Point data settings and operation start are performed on the master axis.



Continuous operation to torque control

The axes are controlled to run at the constant torque by following the torque command while the current position is being tracked.

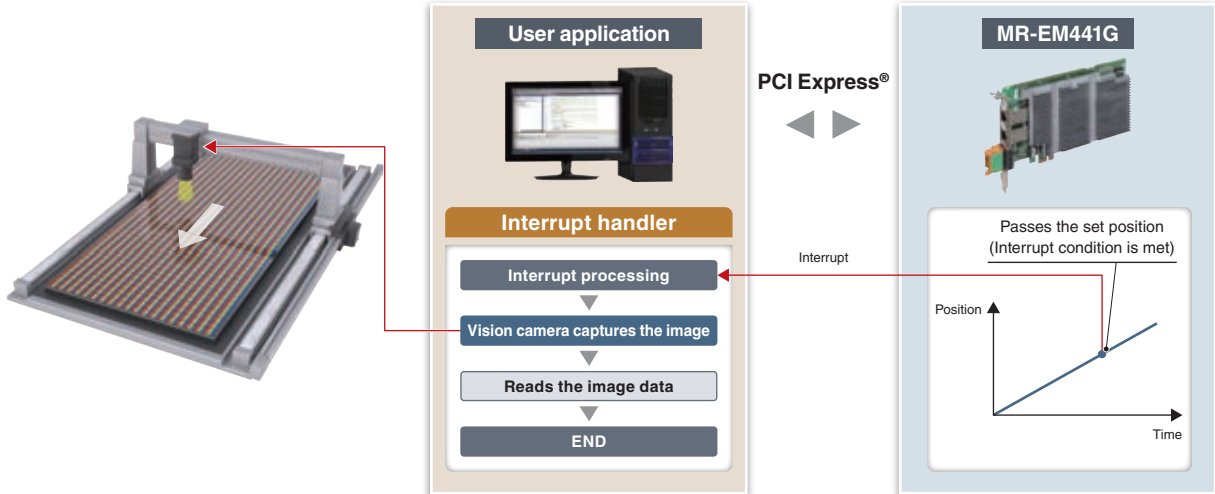
The position control can be switched smoothly to the torque control without stopping the servo motor.



Pass Position Interrupt

Pass position interrupt is a function that generates interrupts to the industrial personal computer when axes pass the specified position. In addition to interrupts at the rising edge detection of signals such as operation completion, user applications that utilize interrupts by position can be configured.

[Example of vision camera imaging of pass position interrupt]



A Wide Variety of Features

JOG operation

When the movement direction is specified and the start operation signal is inputted, JOG operation is started in the designated direction and the movement continues until the start operation signal is turned off. JOG operation can be used without completing home position return.

Incremental feed

A fixed feed distance is implemented for each start operation signal. The amount of feed is set using the incremental feed travel distance. Incremental feed can be used without completing the home position return.

Home position return

This function establishes the reference position (home position) for positioning control. The driver home position return method (home position return with a servo amplifier) is available. Various methods are available, such as dog method, data set method, and stopper method.

Electronic gear

This function adjusts the number of pulses outputted to the servo amplifiers so that a machine moves by the specified command unit in a program.

Stop functions

Forced stop, operation stop, and rapid stop are available. These stop functions are used to stop a machine when detecting a machine error.

Acceleration/deceleration

Various acceleration/deceleration methods, such as linear acceleration/deceleration, smoothing filter, and S-curve acceleration/deceleration, are available. Select the suitable method for your machine.

Command change

Commands for speed/time constant/position can be changed, even during the operation.

Servo amplifier disconnect

The servo amplifier disconnect function enables an operation without connecting a servo amplifier. User programs can be debugged without servo amplifiers.

Absolute position detection system

In the absolute position detection system, if the home position is determined at the system startup, the absolute position is restored when the power is turned on. There is no need to execute the home position return again.

Products Compatible with Motion Control Board MR-EM441G

MELSERVO-J5 series servo amplifiers



MR-J5-G MR-J5W2-G MR-J5W3-G

Supports Ethernet-based CC-Link IE TSN, featuring high-speed, large-capacity communication (1 Gbps).
Speed frequency response of 3.5 kHz enables advanced motion control.

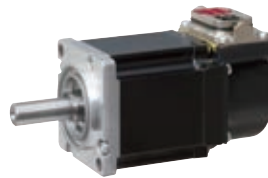


Rotary servo motors, linear servo motors, and direct drive motors

Rotary Servo Motors

HK Series

The HK series rotary servo motors are equipped with a 26-bit resolution batteryless absolute position encoder as standard.

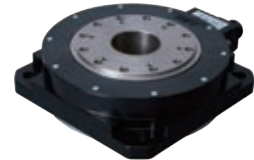


Linear Servo Motors

LM Series

Direct Drive Motors

TM Series



Block-type remote module

Block-type remote modules are recognized as device stations on the CC-Link IE TSN. These modules are useful when installation positions close to I/O devices are required.

- Input module
- Output module
- I/O combined module
- Analog input module
- Analog output module



Industrial managed switch

- Star topology can be configured with an industrial managed switch.
- Disruptions to the control system are kept to a minimum when an error occurs such as remote device failure and a cable disconnection.
- Wiring distance between devices can be shortened, thereby reducing wiring cost. In addition, layout modification and addition/replacement of remote devices can be efficiently completed.

NZ2MHG-TSNT8F2 NZ2MHG-TSNT4



This product was developed and manufactured by Moxa Inc. Please note that the specifications and guarantee conditions of the products are different from the MELSEC Series products.

Control specifications

Function		Specifications
System function	Maximum number of control axes	64 axes
	Maximum number of connectable stations	120 stations
	Operation cycle settings [μs]	62.5 ^(Note 1) , 125, 250, 500, 1000, 2000
	Operation mode settings	High-speed operation mode, normal operation mode
Command interface		CC-Link IE TSN
Servo amplifier		MR-J5-G, MR-J5W2-G, MR-J5W3-G
Operation function	JOG operation	Provided
	Incremental feed	Provided
	Automatic operation	Point table method
	Linear interpolation	Point table method (up to 4 axes)
	Circular interpolation	Point table method (2 axes)
	Home position return	Driver home position return (the home position return method set in a servo amplifier)
Home position reset		Provided
Application function	Electronic gear	Electronic gear numerator: 1 to 5242879 Electronic gear denominator: 1 to 589823
	Speed units	Command unit/min, command unit/s
	Acceleration/deceleration	Linear acceleration/deceleration, smoothing filter, S-curve acceleration/deceleration, jerk ratio acceleration/deceleration, vibration suppression command filter 1
	Stop	Forced stop (select the signal in the parameters), operation stop, rapid stop Hardware stroke limit, software stroke limit, interlock, rough match output, torque limit, command change (position/speed/time constant), backlash, position switch, absolute position detection system, other axes start, pass position interrupt, I/O device, pressure control ^(Note 2) , continuous operation to torque control, etc.
Auxiliary function	Parameter read/write	Provided
	Alarm/system error	Provided
	Monitor	Current position, feedback position, speed command, position droop, electrical current command, alarm number, external signal status, etc.
	High speed monitor	Current position, feedback position, moving speed, feedback moving speed, external signal, electrical current feedback, position droop
	Interrupt	During start operation, operation stoppage, when alarm occurs (servo alarm/operation alarm), etc. User watchdog function, software reboot function, sampling, operation cycle monitor function, servo amplifier disconnect, file control, time management, link-down detection function, event history
Tandem operation		Up to 2 axes × 8 groups
Board ID		0 to 3

Notes: 1. When the operation cycle is 62.5 μs, some functions are not available.
2. Use pressure control by combining MR-EM441G with MR-J5-G-LL.

Motion control board specifications

Item	Specifications
Maximum number of control axes	64 axes
Maximum number of connectable stations	121 stations (including the master station)
Servo amplifier connection method	CC-Link IE TSN
CC-Link IE TSN Class	B
Number of CC-Link IE TSN lines	2 lines
Maximum distance between stations [m]	100
PERIPHERAL I/F	Ethernet
Number of input points	4 points
Input response time [μs]	200
Number of output points	4 points
Output response time [μs]	1
Number of Motion control boards for one personal computer	4
Bus specification	PCI Express® 2.0 × 1
Operating ambient temperature [°C]	0 to 55 (secure an air flow)
Cooling method	Air cooling (cooling fan required)
Current consumption	3.3 V DC ± 9 % 1.0 A or less 12 V DC ± 8 % 1.4 A or less
Exterior dimensions [mm]	Half-length (167.65 × 111.15)

CC-Link IE TSN Network specifications

Item	Specifications
Communication speed [bps]	1 G
Maximum number of connectable stations per network	121 stations (including the master station)
Connection cable	Ethernet cable (category 5e or higher, double shielded/STP), straight cable
Maximum distance between stations [m]	100
Topology ^(Note 1)	Line, star, line/star mixed
Communications method	Time-sharing method
Maximum transient transmission capacity	1920 bytes

Notes: 1. Use class B Ethernet switch when configuring a star topology with class B devices.

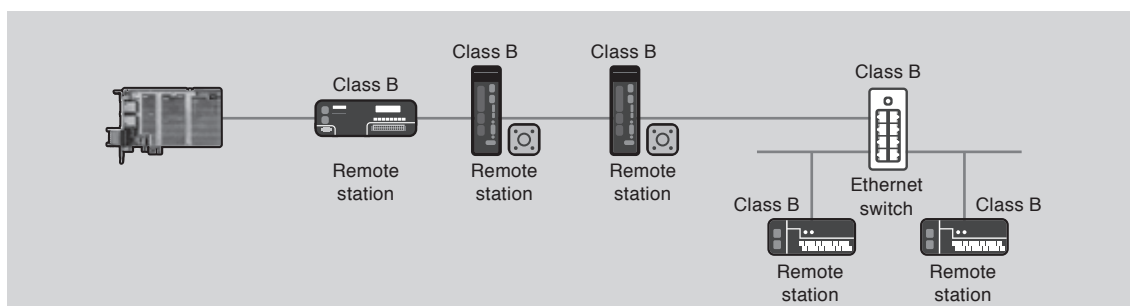
[Note when connecting devices]

The Motion control board MR-EM441G cannot be connected to the CC-Link IE TSN Class A devices.

CC-Link IE TSN Class

CC-Link IE TSN certifies nodes and switches to a specific class level according to its functionality and performance classification. Products can be classified as either class A or B. For the CC-Link IE TSN Class of each product, please check the CC-Link Partner Association website or the relevant product catalog or manual. Supported functions and system configuration may differ according to the CC-Link IE TSN Class of products used. For example, products compatible with class B are necessary to configure a high-speed motion control system. For details of configuring systems with both class A and class B devices, please refer to relevant master product manual.

System configuration



- Synchronous accuracy of a system varies relative to the combination of connected devices and switches CC-Link IE TSN Class.
- Use class B devices when configuring a system within $\pm 1 \mu\text{s}$ high-accuracy synchronization.
- Use class B Ethernet switch when configuring a star topology with class B devices.

EM Motion SDK operating environment

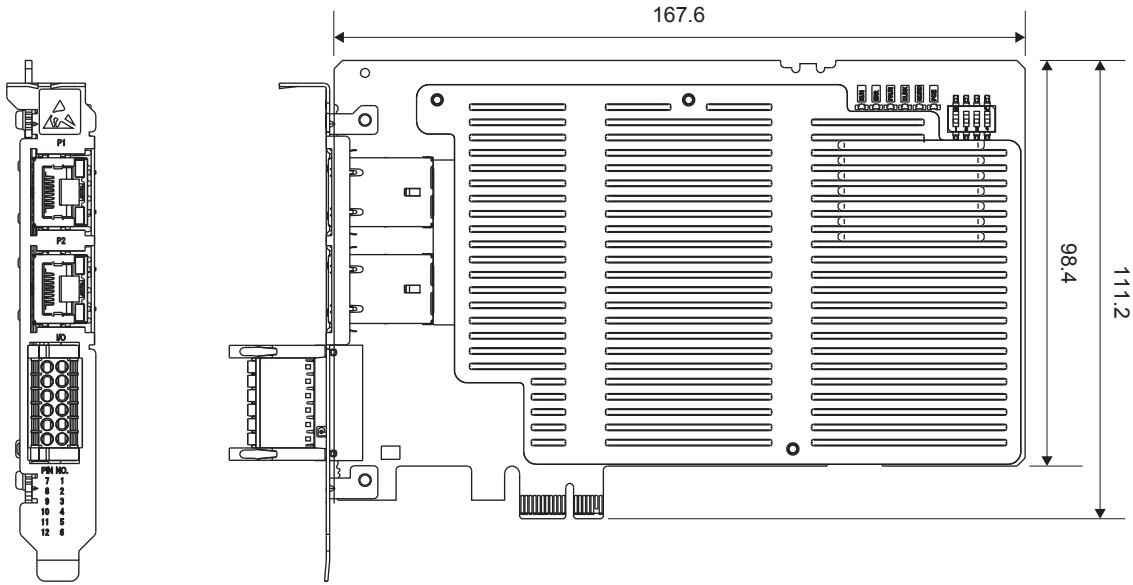
Item	Specifications		
Personal computer	Personal computer	Microsoft® Windows® supported personal computer	
	CPU	Windows® 11	2 or more cores on a compatible 64-bit processor or System on a Chip (SoC)
		Windows® 10	Desktop PC: Intel® Celeron® processor 2.8 GHz or more recommended Laptop PC: Intel® Pentium® M processor 1.7 GHz or more recommended
	Required memory	Windows® 11	4 GB or more recommended
Windows® 10		For 64-bit OS: 2 GB or more recommended, For 32-bit OS: 1 GB or more recommended	
Required hard disk space	3 GB or more		
Monitor	Resolution 1024 × 768 or more		
OS	Microsoft® Windows® 11 (Pro, Enterprise, IoT Enterprise) Microsoft® Windows® 10 (Pro, Enterprise, IoT Enterprise 2016 LTSB *1) *1: Only 64-bit version is supported		
Communication interface	PCI Express® bus, Ethernet port		

Development environment

Item	Specifications
User program OS	Microsoft® Windows® 11 (Pro, Enterprise, IoT Enterprise) Microsoft® Windows® 10 (Pro, Enterprise, IoT Enterprise)
Software development environment	Microsoft® Visual C++® 2022/2019/2017/2015/2013/2012 Microsoft® Visual C#® 2022/2019/2017/2015/2013/2012

Mitsubishi Electric AC Servo System Personal Computer Embedded Type Servo System Controller

Exterior dimensions



[Unit: mm]

Product list

Item	Model	Specifications
Motion control board	MR-EM441G	Up to 64 axes
MELSOFT EM Motion SDK	SW1DND-EMMSDK-B	<ul style="list-style-type: none"> • Motion test tool • MR Configurator2 • Motion API • Motion control board device driver

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