High-speed Field Network
MECHATROLINK-Ⅱ
Installation Guide

YASKAWA

MANUAL NO. SIEP S800000 30A

Visual Aids

The following aids are used to indicate certain types of information for easier reference.

IMPORTANT

- Indicates important information that should be memorized.

- Indicates supplemental information.

◀ EXAMPLE ▶

- Indicates application examples.

- Indicates definitions of difficult terms or terms that have not been previously explained in this manual.

Overview

■ Introduction

MECHATROLINK-II is a field network used for controlling several FA units such as servo amplifier, inverters, and input and output devices by a single FA controller.

This document describes how to install the system by using MECHATROLINK-II.

Read this manual in order to install the MECHATROLINK-II system correctly. Also, keep this manual in a safe place for future reference.

Using This Manual

■ Intended Audience

This manual is intended for the following users.

- Those considering using the MECHATROLINK-II
- Those designing a system using the MECHATROLINK-II
- Those designing the installation of MECHATROLINK-II on control devices

CONTENTS

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MECHATROLINK-II

1.1 General

MECHATROLINK-II is a field network used to control several Factory Automation (FA) units such as servo amplifiers, inverters, and I/O devices, with a single FA controller.

MECHATROLINK-II has the following features :

- High- speed transmission (10Mbps max.)
- Synchronous transmission
- Optimal Cycle time for the number of stations and the amount of data being transmitted. (Transmission cycle time:250μs to 8ms.)
- Reduced wiring.
- Error Detection and Retry functions with communication ASIC for highly reliable communications.
- FA-tool can be connected (C2 master station).

1.2 System Configuration

A MECHATROLINK-II system is a bus network in which one C1 master station and a maximum of 30 slave stations can be connected. One C2 master station can also be connected if necessary.

A termination resistor is needed on each end of the network to reduce signal reflection.

Figure 1.1 shows the configuration of the connected network.

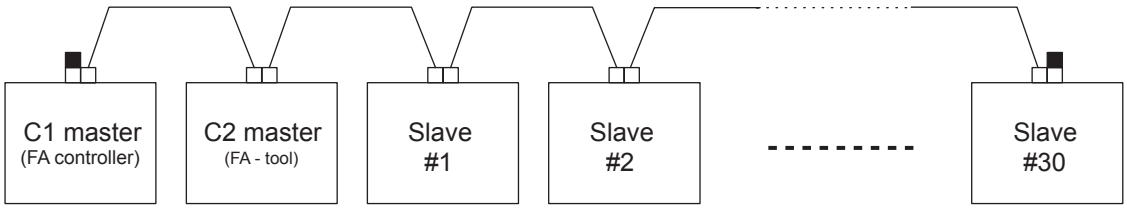

Fig. 1.1 MECHATROLINK-II system configuration

Note: 1. The black square (■) in Figure 1.1 on the C1 master station and on the slave station on the far right represents a termination resistor.
2. A repeater must be used if 16 slave stations are used in a network that is more than 30 meters long or if more than 17 slave stations are used.

TERMS

C1 master station

A network control station such as an FA controller. Each network must have one C1 master station.

C2 master station

An FA-tool. Only one C2 master station can be connected in each network.

Slave station

FA devices such as servo amplifiers or I/O devices. The C1 master controls the slave stations.

A maximum of 30 slave stations can be connected in one network.

1.3 Maximum number of slave stations

The maximum number of slave stations that can be used with MECHATROLINK-II is determined by the settings for the communication conditions, such as the transmission cycle time and the number of data bytes in a transmission.

Use the following equation to calculate the maximum number of slave stations that can be used.

- For 17 bytes of transmission data

$$N_{C17} = \frac{T_T - 11}{60} - 1 - C2 - N_r \quad \text{// round off after the decimal point}$$

- For 32 bytes of transmission data

$$N_{C32} = \frac{T_T - 11}{90} - 1 - C2 - N_r \quad \text{// round off after the decimal point}$$

Where,

N_{C17} : Maximum number of slaves for 17 bytes of transmission data

N_{C32} : Maximum number of slaves for 32 bytes of transmission data

T_T : Transmission cycle time (μs)

C2 : C2 master connection (Yes: C2 = 1 ; No: C2 = 0)

N_r : Number of retries if a communication error occurs (Max. 7)

Example

The maximum number of slaves = N_{C17},

$$N_{C17} = \frac{1000 - 11}{60} - 1 - 0 - 1 = 14$$

Where the transmission size is 17 bytes, the transmission cycle time is one millisecond, no C2 master is used, and one retry is possible.

Table 1-1 lists a number of stations at different combinations of transmission cycle times, and transmission sizes used in MECHATROLINK-II.

Table 1.1 Example of number of stations and transmission size / cycle time

Transmission size	Transmission cycle time								
	0.25 ms	0.5 ms	1.0 ms	1.5 ms	2.0 ms	2.5 ms	3.0 ms	3.5 ms	4.0 ms
17 bytes	1	6	14	22	30	30	30	30	30
30 bytes	0	3	8	14	20	25	30	30	30

Note: 1. The maximum number of allowable stations is always limited to 30.
2. If a retry is not required, one station can be added to increase the maximum number of stations. (Table 1.1 shows an example where the number of retries is one.)
3. If a C2 master station is required, the maximum number of stations needs to be reduced by one.
4. If the device to be connected has some limitations, observe the limitations outlined in the specifications for that device.

1.4 Wiring specifications

Wire the MECHATROLINK-II network according to the following specifications for the length of wiring between stations.

1.4.1 Without repeater

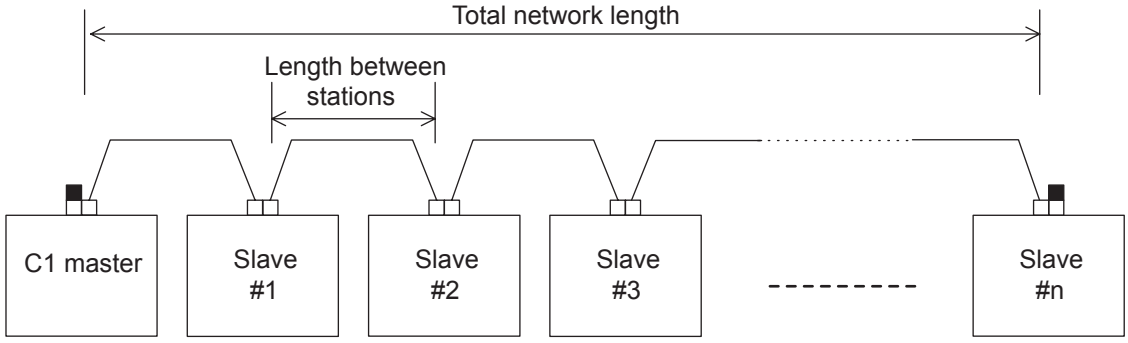

Fig. 1.2 MECHATROLINK-II system configuration (Without repeater)

Table 1.2 lists the total length of cables required for the network in accordance with the number of stations.

Table 1.2 MECHATROLINK-II number of slave stations and total network length (Without repeater)

Number of slaves (n)	Total network length
15 or less	50m or less
16	30m or less
17 or more	Repeater required

Note: The C2 master must be connected as a slave station because of the wiring specifications.

TERMS

Total network length

Denotes the end-to-end length of the cable installed.

Length between stations

Denotes the length of the cable installed between adjacent stations.
The cable length should be 0.5m or more.

1.4.2 With repeater

A repeater is installed to divide the MECHATROLINK-II system according to the specifications described in table 1.3 .

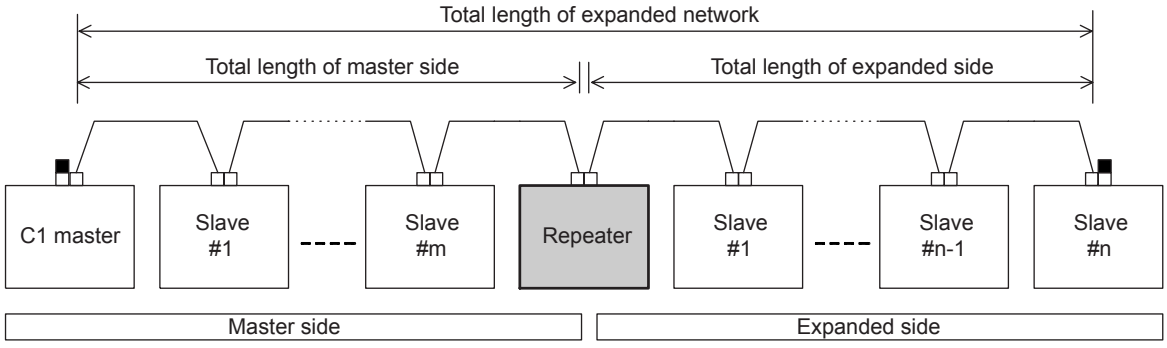

Fig. 1.3 MECHATROLINK-II System configuration (With repeater)

To expand the network with a repeater, refer to the specifications outlined in table 1.3.

One repeater can be installed in one MECHATROLINK-II system.

More than one repeater is not allowed in a system.

Table 1.3 MECHATROLINK-II number of slave stations and total network length (With repeater)

Master side	Number of slaves (m)	Max. length
	14 or less	50m
	15	30m
	16 or more	Can not connect
Expanded side	Number of slaves (n)	Max. length
	15 or less	50m
	16	30m
	17 or more	Can not connect

Note: The C2 master must be connected as a slave station because of the wiring specifications.

TERMS

Total length of master side

Denotes the length of the cable from the C1 master station to the repeater on the master side of the network.

Total length of expanded side

Denotes the length of the cable from the repeater to the last slave station which has a termination resistor on the expanded side of the network.

Total length of expanded network

Denotes the length of the cable on both the master side and the expanded side of the network.

Length between stations

Denotes the length of the cable installed between adjacent stations. The cable length should be 0.5m or more.
The minimum length of the cable that is connected to the repeater should be 0.5m, which is the same as that of the cable connected to the other slave stations.

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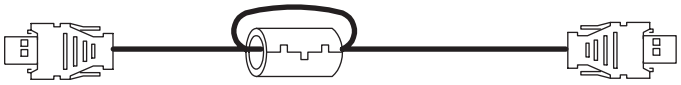
Cables and Peripheral Devices

2.1 Cables

A MECHATROLINK-II network requires cables that are especially for use with MECHATROLINK-II.

Table 2.1 Cable model and application

Model	Application
JEPMC-W6002-□□	Used to connect MECHATROLINK-II modules. 
JEPMC-W6003-□□*	Used to connect MECHATROLINK-II modules, for connection between MECHATROLINK-II same as JEPMC-W6002 with a ferrite core. Used in environments where noise is a problem. 

* JEPMC-W6003-□□ is not effective where electromagnetic compatibility (EMC) is a problem. For EMC, apply the measures recommended for each product.

Note: 1. □□ shows the cable length.

ex : JEPMC-W6002-01 comes with a 1m cable.

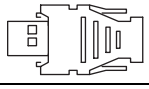
JEPMC-W6002-03 comes with a 3m cable.

2. These cables are not flexible. Do not connect to any moving parts.

2.2 Termination resistor

A termination resistor must be used at both ends of the network to reduce signal reflection.

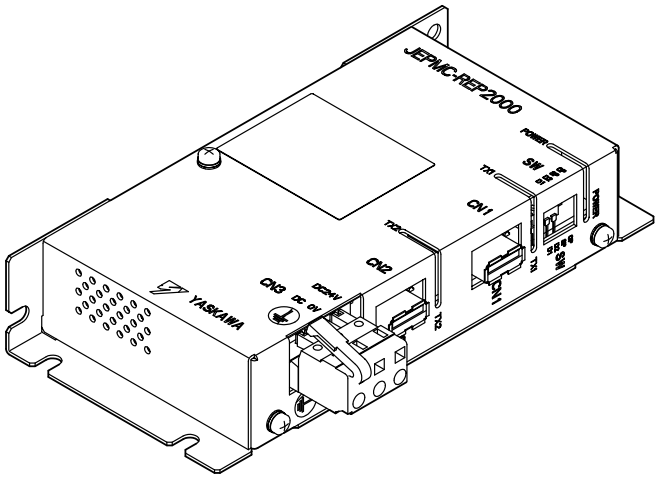
Table 2.2 Model and external view of termination resistor

Model	Appearance
JEPMC-W6022	

2.3 Repeater

A repeater is used to connect 16 stations in a network that is 30 meters or more in length or to connect 17 or more stations in one MECHATROLINK-II network.

Table 2.3 Model and external view of repeater

Model	Appearance
JEPMC-REP2000	

3

Wiring

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3.1 MECHATROLINK Connector

Figure3.1 shows the connector pin assignment for MECHATROLINK-II networks.
In this figure, the pins are viewed from the side of the cable connector that is inserted.

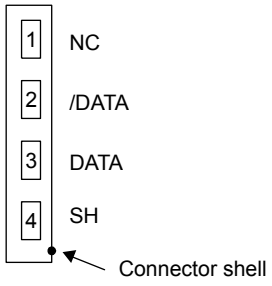

Fig. 3.1 MECHATROLINK connector pin assignment

3.2 Wiring

- Use the recommended cable (JEPMC-W6002-□□ or JEPMC-W6003-□□) to connect the connectors of each station. Figure 3.2 shows an example of wiring.

- Both ends of the network must have a termination resistor installed (JEPMC-W6022) to reduce signal reflection.
  If C1 master has a built-in termination resistor, only one end of the network must have a termination resistor. Figure 3.2 shows an example where the C1 master has a built-in termination resistor.

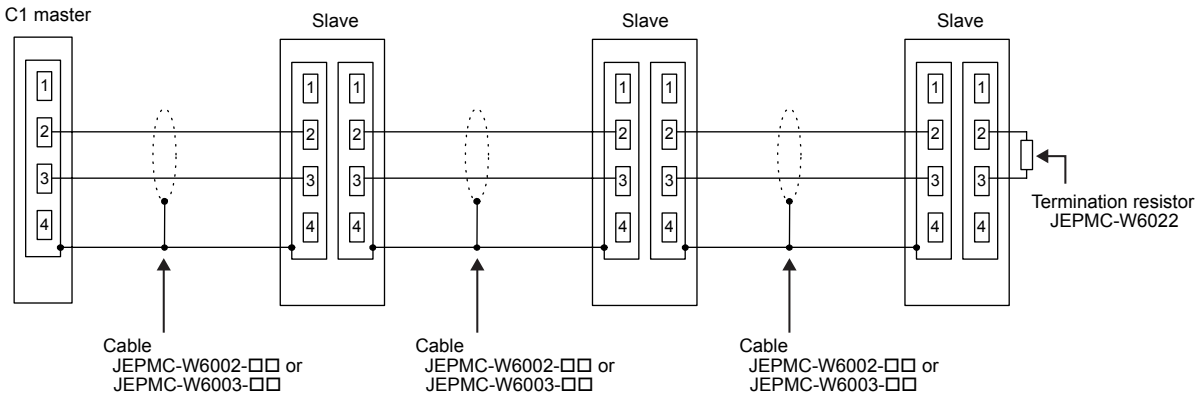

Fig. 3.2 Wiring example

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Notice

4.1 Vibration and shock

- Be sure to firmly insert the MECHATROLINK cable connector.
  Because the MECHATROLINK connectors (USB type) are the locking type, be sure to insert the connector until a clicking sound is heard.

- Check and confirm that the other devices in the system or nearby do not cause any vibrations or shock.
  If vibration or shock is observed, take some measures such as providing an enclosure to protect the system. Vibration or shock will also affect other equipment besides the system.

- If any stress is applied to the bundled cable, remove the stress.
  Extreme stress may cause the cable to disconnect.

4.2 Anti-noise measures

Make sure that the device has been correctly installed and wired.

The same anti-noise measures for general factory-automation (FA) devices can also be applied to devices in a MECHATROLINK network.

Observe the following precautions regarding noise.

(1) Noise sources

Noise from instruments or equipment can be transferred to other instruments or equipment through power circuit cables. This noise may cause some trouble. Possible sources of noise may include the following items:

- Variation in voltage caused by turning the power switch or the circuit breaker of the power distribution panel on and off.
- Spark noise during opening and closing of the relay contact points when the power switch or contactor is turned on or off. Ex. Nearby machinery, air conditioners, blinking lights, etc.
- Switching noise from motor-driven equipment. Ex. Air conditioners and cranes.
- Electrical discharge and noise from electronic equipment and lights. Ex. Electric welding, neon lights, and fluorescent lights.
- Variation in ground level when large-capacity equipment is turned on and off.

(2) Anti-noise measures

(a) Power

A noise filter or noise-cut transformer should be provided to isolate each power circuit and to prevent noise from flowing to other instruments or equipment.

Observe the following precautions when installing the dedicated power circuit.

- Use the power circuit only with the MECHATROLINK-II network system (and not with any other system).
- Use cables with a low voltage loss for wiring from the power-distribution panel to the system. Keep the length of the power cables as short as possible.
- Route the cables in a separate conduit so they are isolated from the wiring for other systems.
- Connect the ground wire on the secondary side of the dedicated transformer to a ground terminal that is used for grounding only the MECHATROLINK system.
- Consider the power capacity of the sub-circuit breaker that branches out from the power-distribution panel.

(b) Wiring

- Wire the communication cables separately from the power cables to prevent inductive noise. Keep them at least 30 cm apart.
- Enclose the power cables inside a grounded conduit.
- Do not wire the communication cables in parallel with the power cables.
- Do not bundle the communication cables together with the power cables.

(c) Grounding

Grounding can be used to reduce or eliminate noise, but the methods will vary in accordance with the kind of noise.

For example:

- Prepare a ground with a resistance of 100Ω or less to be used only for the MECHATROLINK system.
- To eliminate common impedance, ground each device in the system to the framing ground or protective earth (PE) so that the entire system is connected in a star pattern.

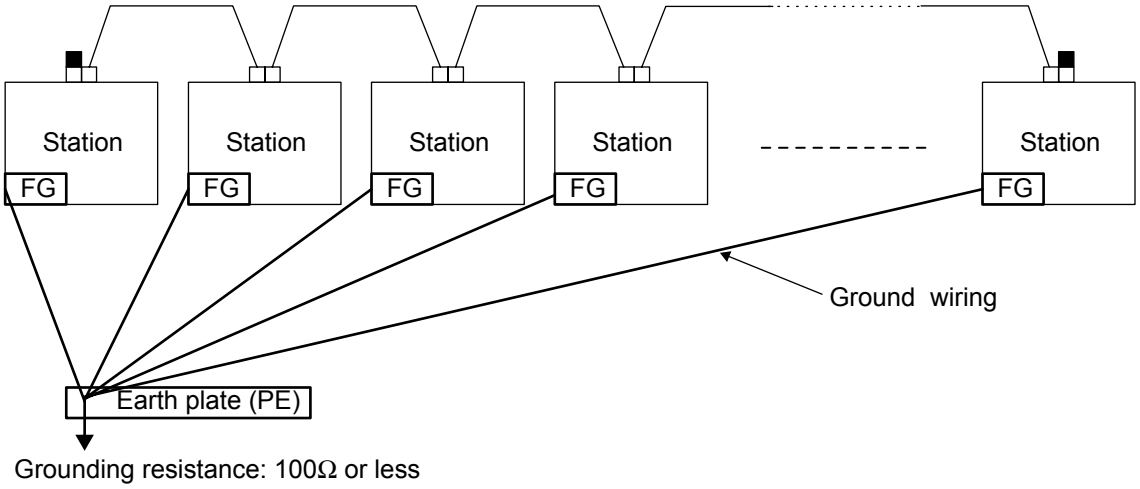

Fig. 4.1 Example of grounding

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Troubleshooting

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5.1 Troubleshooting

MECHATROLINK-II transmits and receives data at 10 MHz. If the waveform of the communication signal deteriorates and the pulse width of the received signal between the rising edges is greater than the allowed variation or if the received data logic is reversed, a communication error will occur at the receiving station devices. Table 5.1 lists the main causes and what should be done to prevent reoccurrences.

Table 5.1 Communication errors

Problem	Probable Causes	Description	Recommendation
Communication error occurred in one or more station devices.	Element in the communication circuit is broken.	Pulse transformer, interface driver/receiver, or MECHATROLINK-II communication ASIC is considered as broken.	Replace the station device.
Communication error occurred in one or more station devices a few minutes after the MECHATROLINK system was turned on.	Ambient temperature.	Waveform of the MECHATROLINK-II communication signal is affected by the temperature characteristics of the circuit element for MECHATROLINK-II communications.	• Check if the ambient temperature is within the allowable range. If it is out of this range, adjust the temperature so it falls within this range. • Replace the station device.
Communication error or warning occurred in one or more station devices.	False alarm	Waveform of the MECHATROLINK-II communication signal is affected by noise.	• Be sure to ground the station device. • Isolate the power cable from the communication cable. • Eliminate noise if possible. • Use a JEPMC-W6003 cable with a ferrite core. • Increase number of retry attempts in settings for communication conditions.
Communication error occasionally occurred in one or more station devices when equipment was subject to vibrations.	Loosen connector or cable.	Communications are interrupted because of a loose connection for the connector or cable.	• Be sure to use a connector. • Remove any stress on the cable.
Problems in communications occurred after installing or adding a station device, or replacing a cable.	Reflection caused by mismatching characteristic impedances.	Noise from signal reflection may increase, and then the pulse waveform will deteriorate if: • A cable other than the ones recommended by Yaskawa is used. • A JEPMC-W6022 termination resistor is not used. • Loose connection in system.	• Use a recommended cable. • Be sure to connect a termination resistor (JEPMC-W6022).
Communication error occurred after installing or adding a station device.	Signal damping in cable.	Cable other than the ones recommended by Yaskawa is used, cable is too long, or too many station devices are connected.	• Use a recommended cable. • Be sure to keep the cable length within the allowable range. • Use a repeater for the allowable number of units to expand the system.

Revision History

The revision dates and numbers of the revised manuals are given at the bottom of the back cover.

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