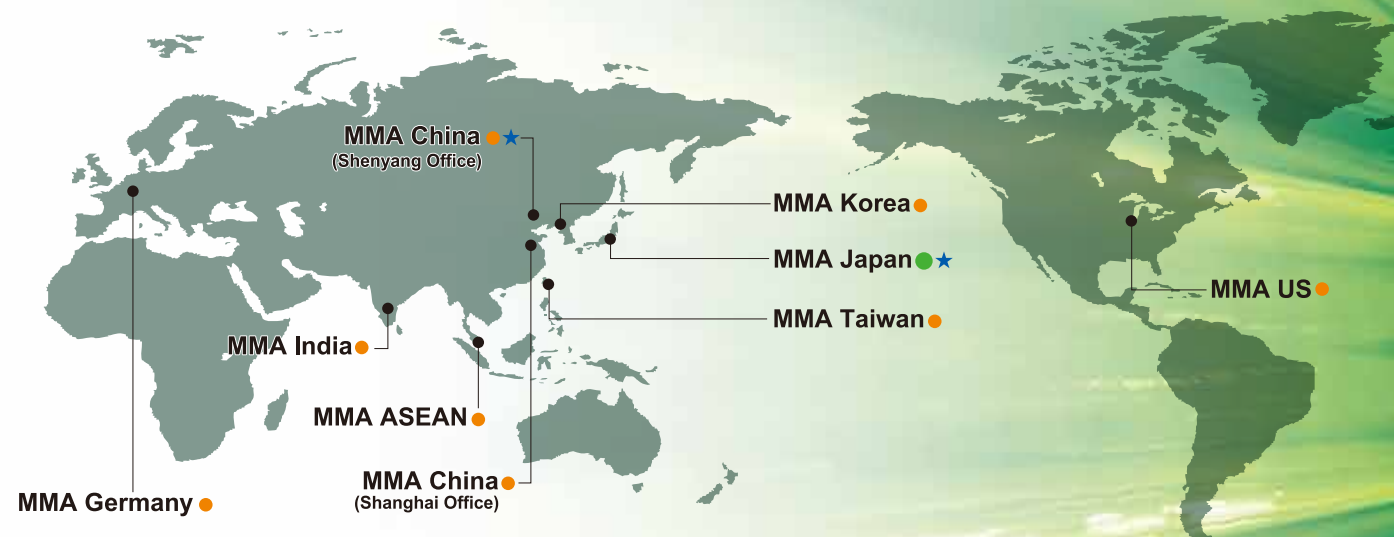




New Generation Industrial Networks

MECHATROLINK-4 / Σ-LINK II



● Head Office ● Branch Office ★ Certification Test Site

- MMA Japan** ● 480 Kamifujisawa, Iruma, Saitama, 358-0013 Japan
★ Tel: +81-4-2962-7920 / Fax +81-4-2962-6343 / E-mail: mma@mechatrolink.org
- MMA Germany** ● Philipp-Reis-Str. 6 65795 Hattersheim am Main Germany
Tel: +49-6196-569420 / e-mail: mma@mechatrolink.de
- MMA U.S.** ● 2121 Norman Drive South; Waukegan, IL 60085; U.S.A.
Tel: +1-847-887-7231 / e-mail: mma-us@mechatrolink.org
- MMA Korea** ● 6F, 112, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14118 Korea
Tel: +82-31-379-6228 / e-mail: mma-kr@mechatrolink.org
- MMA China** ● 〈Shanghai Office〉
22/F One Corporate Avenue No.222 Hubin Road, Huangpu District Shanghai, 200021 CHINA
Tel: +86-21-53852070 / e-mail: mma-sh@mechatrolink.org
● 〈Shenyang Office〉
★ No.16, East Nanping Road, Hunnan High-tech. Industrial Development Zone, Shenyang, 110171 CHINA
Tel: +86-24-24696008 / e-mail: mma-cn@mechatrolink.org
- MMA Taiwan** ● No. 33, Keyuan Rd., Xitun District, Taichung City, 40763 Taiwan
Tel: +886-4-2461-0553 / e-mail: mma-tw@mechatrolink.org
- MMA India** ● 17/A, 2nd Main, Electronic City, Phase-1, Hosur Road, Bengaluru - 560 100, INDIA
Tel: +91-80-4244-1920 / e-mail: mma-in@mechatrolink.org
- MMA ASEAN** ● 151 Lorong Chuan, #04-02A, New Tech Park, SINGAPORE 556741
Tel: +65-6488-8365 / e-mail: mma-sg@mechatrolink.org

BEYOND motion control.



MECHATROLINK MEMBERS ASSOCIATION

480 Kamifujisawa, Iruma, Saitama, 358-0013 Japan
<https://www.mechatrolink.org/> E-mail : mma@mechatrolink.org

TEL +81-4-2962-7920 FAX +81-4-2962-6343

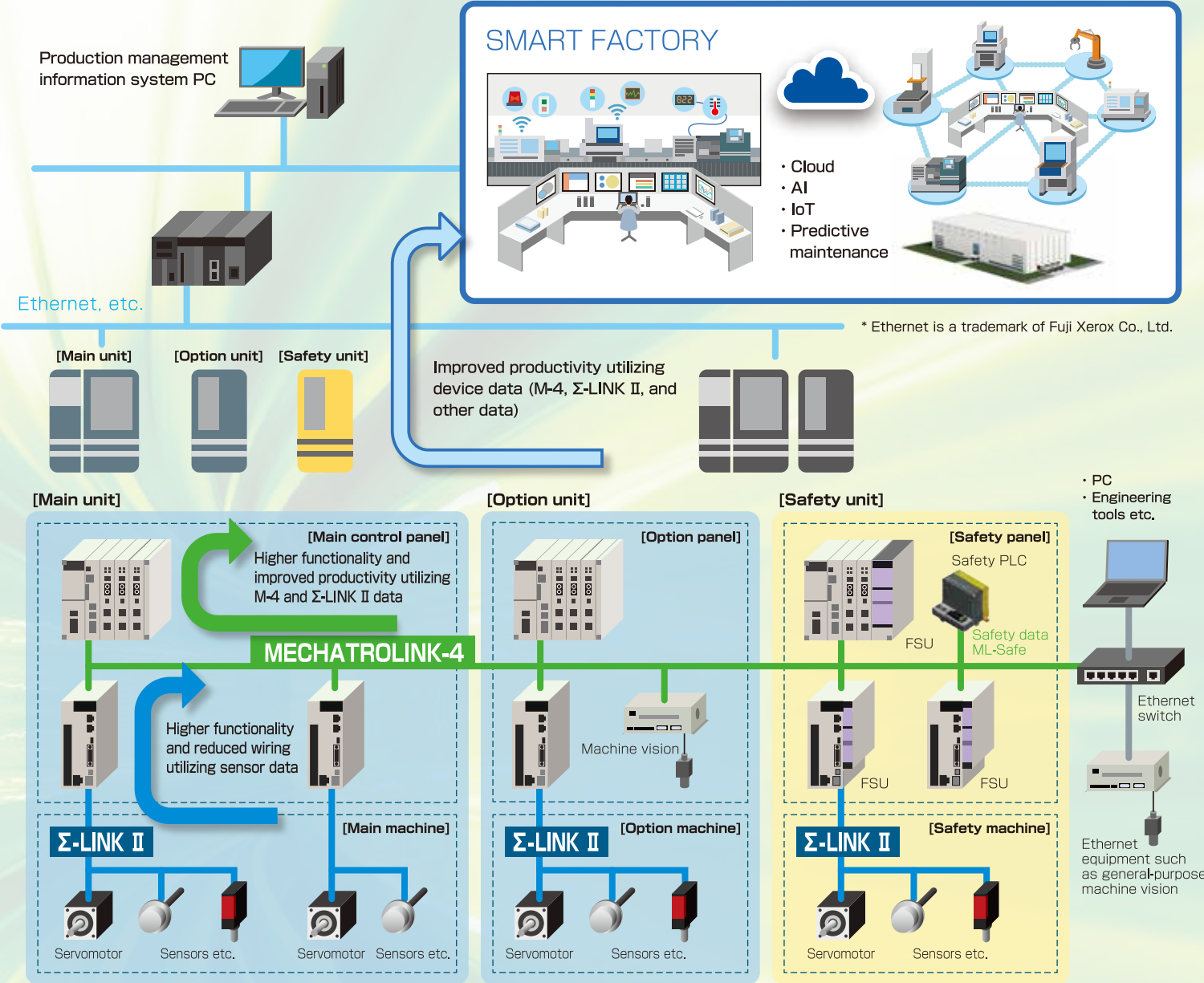


New Generation Industrial Networks

MECHATROLINK-4 / Σ-LINK II

BEYOND motion control.

■ In recent years, the industrial environment is changing significantly. An example is the introduction of smart production and operations, along with the achievement of flexible and stable production using IoT and AI. A variety of sensors are being used to ensure product quality and achieve predictive maintenance on machines and equipment at production sites, and the data generated by these sensors needs to be collected and utilized. ■ In order to meet these needs, MECHATROLINK-4 has been developed as the optimized network for motion control, along with Σ-LINK II to connect sensors and I/O devices. ■ Using the newly developed MECHATROLINK-4 and Σ-LINK II together, it is possible to easily acquire sensor and motion-related data, synchronize data and utilize the information for system control. This further raises productivity and contributes to new types of manufacturing utilizing IoT and AI.



MECHATROLINK-4

MECHATROLINK-4 has evolved into a new generation motion field network, while maintaining the high functionality, high performance, high reliability, and usability of its predecessor MECHATROLINK-III. It ensures application compatibility while achieving a performance improvement four times greater than the existing standard under the same conditions. Additionally, MECHATROLINK-4 supports distributed systems through the multiple control domain systems and implements a PC platform through a software protocol stack to improve performance, functionality and allow for diversified systems. MECHATROLINK-4 specifications make it possible to use 1000BASE-T in the physical layer for further performance improvements in the future. (The physical layer when using 1000BASE-T is called M-4G.)

Item	MECHATROLINK-III	MECHATROLINK-4
Command profile	Standard servo, standard stepper motor drivers, standard I/O, standard inverter	
Maximum number of stations	C1 MDevice: 1 station, C2 MDevice: 1 station, SDevice: 62 stations	128 stations max. (maximum number of MDevices: 8 stations, maximum number of SDevices: 127 stations)
Sync MDevice	Not supported	Supported
Sync jitter	≤±1μs (Limit of 19 hops maximum)	≤±1μs
Multiple control domain systems	Not supported	Supported
Communication with multiple transmission cycles	Not supported	Supported
Duplex	Half duplex	Full duplex
Internet protocol	Not supported	Supported
Ethernet compatibility	Only PHY layer	Compatible
Transmission speed	100 Mbps	100 Mbps (M-4)/1 Gbps (M-4G) Alternative
Transmission distance	100 m between stations	
Topology	Cascade/star	

Σ-LINK II

Σ-LINK II inherits the high functionality, high performance, and high reliability communications of previous encoder communications (Σ-LINK*). It allows sensors, I/O equipment, and other devices installed on the machine side to be connected to the encoder wiring, either by enabling cascade connections or, by using MECHATROLINK and other branch connectors. This improves the affinity between motion data and sensor data, reduces wiring, and helps to develop systems with higher functionality and performance.

Item	Σ-LINK	Σ-LINK II
Profile	Σ-LINK command profile	
Transmission mode	Cyclic transmission, acyclic transmission	
Maximum number of SDevices	1	14
Duplex	Half duplex	
Transmission speed	4 Mbps/8 Mbps	4 Mbps/8 Mbps/16 Mbps/24 Mbps/32 Mbps
Electrical specification	RS-485	
Network topology	Peer-to-peer (one-to-one)	Peer-to-peer (one-to-one), cascade (one-to-many)

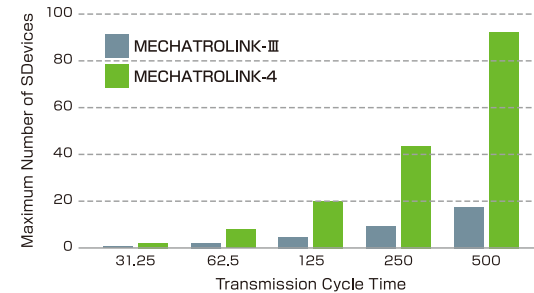
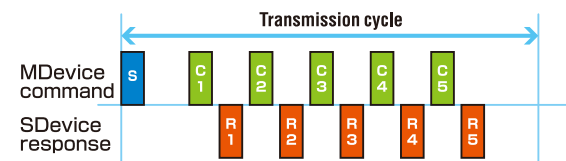
* Σ-LINK is a communications protocol developed by Yaskawa Electric Corporation for connections between servo amplifiers and encoders.

Streamlining the Transmission Sequence

MECHATROLINK-4 has greatly improved transmission efficiency by switching the communication mode from half duplex to full duplex. This allows MECHATROLINK-4 to support the creation of systems with improved functionality and higher performance.

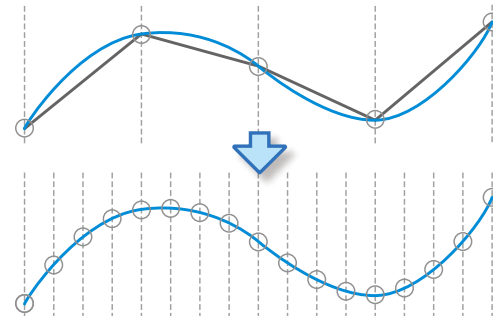
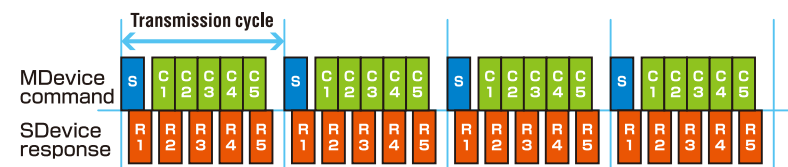
- Improved control performance: The transmission cycle for the same number of devices has been shortened to approximately 1/4 that of the previous version. This achieves more accurate control.
- Support for large-scale systems (equipment): The number of SDevice devices that can be connected to the same transmission cycle is approximately 4 times that of MECHATROLINK-III.
- Setting aside the transmission cycle, idle time can be used for Internet protocol, message, and retry communications.

MECHATROLINK-III



Note: The graph shows theoretical values based on the protocol specifications. The values for implementation in a communication ASIC or the like will differ from the product specifications.

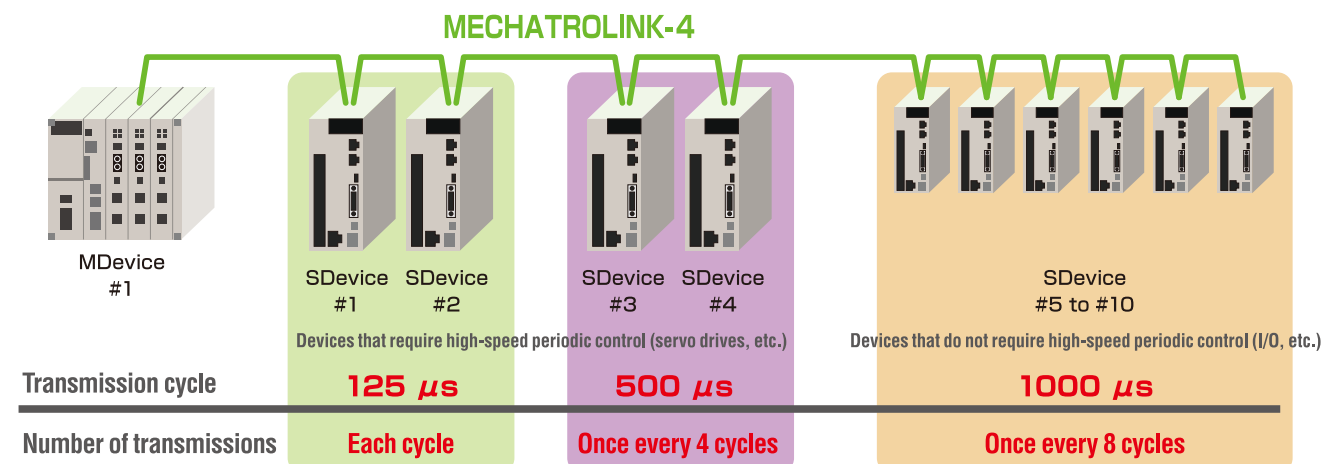
MECHATROLINK-4



Multiple Transmission Cycles

With MECHATROLINK-4, different cycle settings can be set for each SDevice. Multiple transmission cycles can exist on the same network, allowing SDevice devices to be controlled with the optimal transmission cycle.

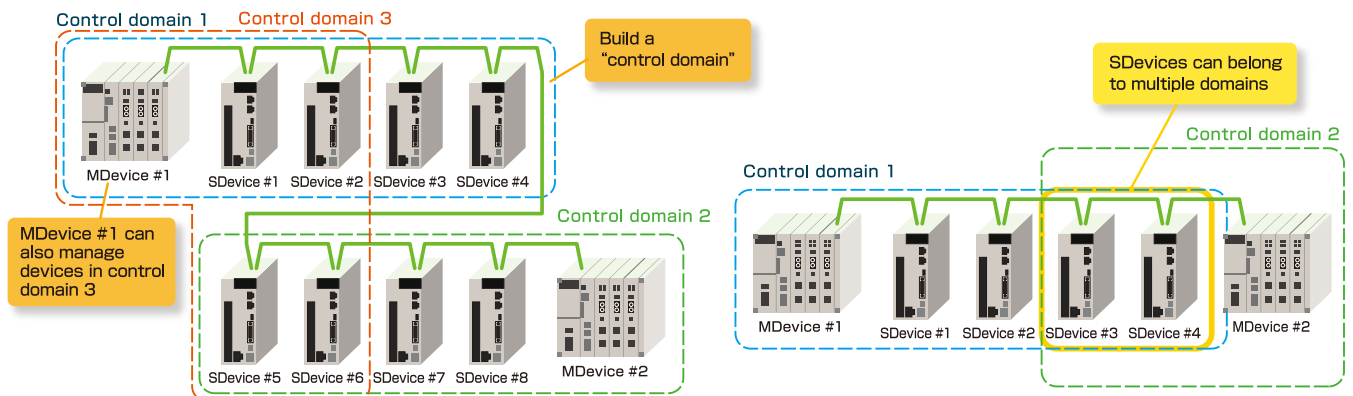
- Fast transmission cycles and slow transmission cycles can be set on the same network.
- I/O devices that do not require fast periodic control can be connected to high-speed networks without increasing the communications load.
- More SDevice devices can be connected by distributing the communications timing of devices that communicate using a slow cycle.
- The MDevice program can be created more efficiently by setting the optimal transmission cycle for each SDevice.



Multiple Control Domain System

MECHATROLINK-4 enables system configurations which allow up to eight MDevices on the same network. Use the multiple control domain system to improve equipment performance and support safety systems.

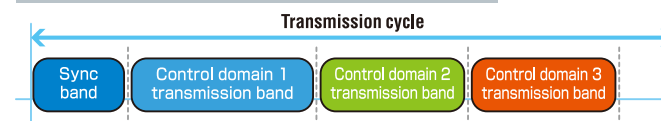
- Build logical groups called "control domains" for each MDevice and the SDevices under its control.
- One MDevice can manage multiple control domains.
- SDevices can belong to multiple control domains.



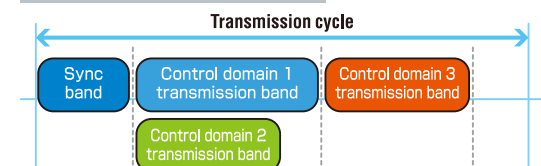
[Parallel I/O transmission]

With MECHATROLINK-4, control communications within a control domain can also be simultaneously performed in parallel according to the communications settings.

On the Normal transmission (Serial I/O transmission)



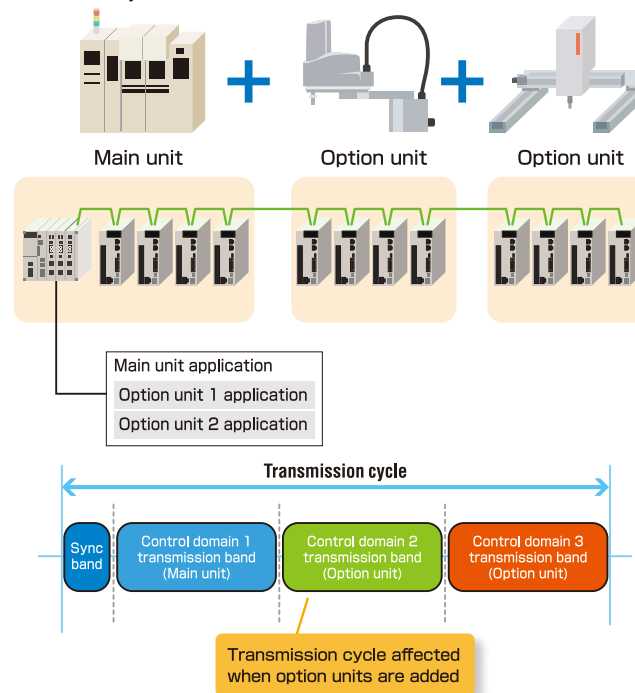
On the Parallel I/O transmission



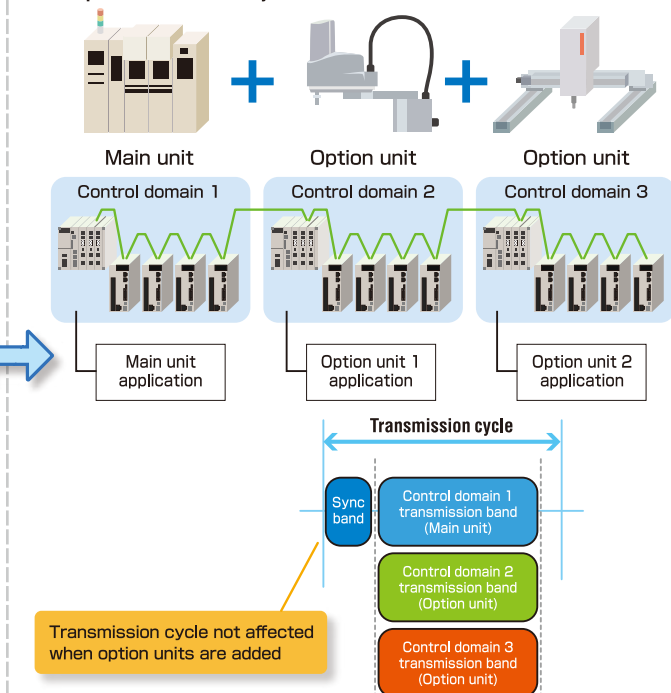
[Example of a Distributed Control System Using the Multiple Control Domain System and Parallel I/O transmission]

In a typical single MDevice configuration, there have been cases where the transmission cycle of the overall equipment has been affected by adding option units. This factor can lead to increased costs in some instances. An example would be when the overall application must be updated due to the change in transmission cycle. By using the multiple control domain system and parallel I/O transmission in MECHATROLINK-4, impact on the overall transmission cycle can be avoided when these kinds of units must be added to the equipment. Core components and optional devices can be developed, produced, and maintained in units, which allows for effective management of systems.

[Previous System]



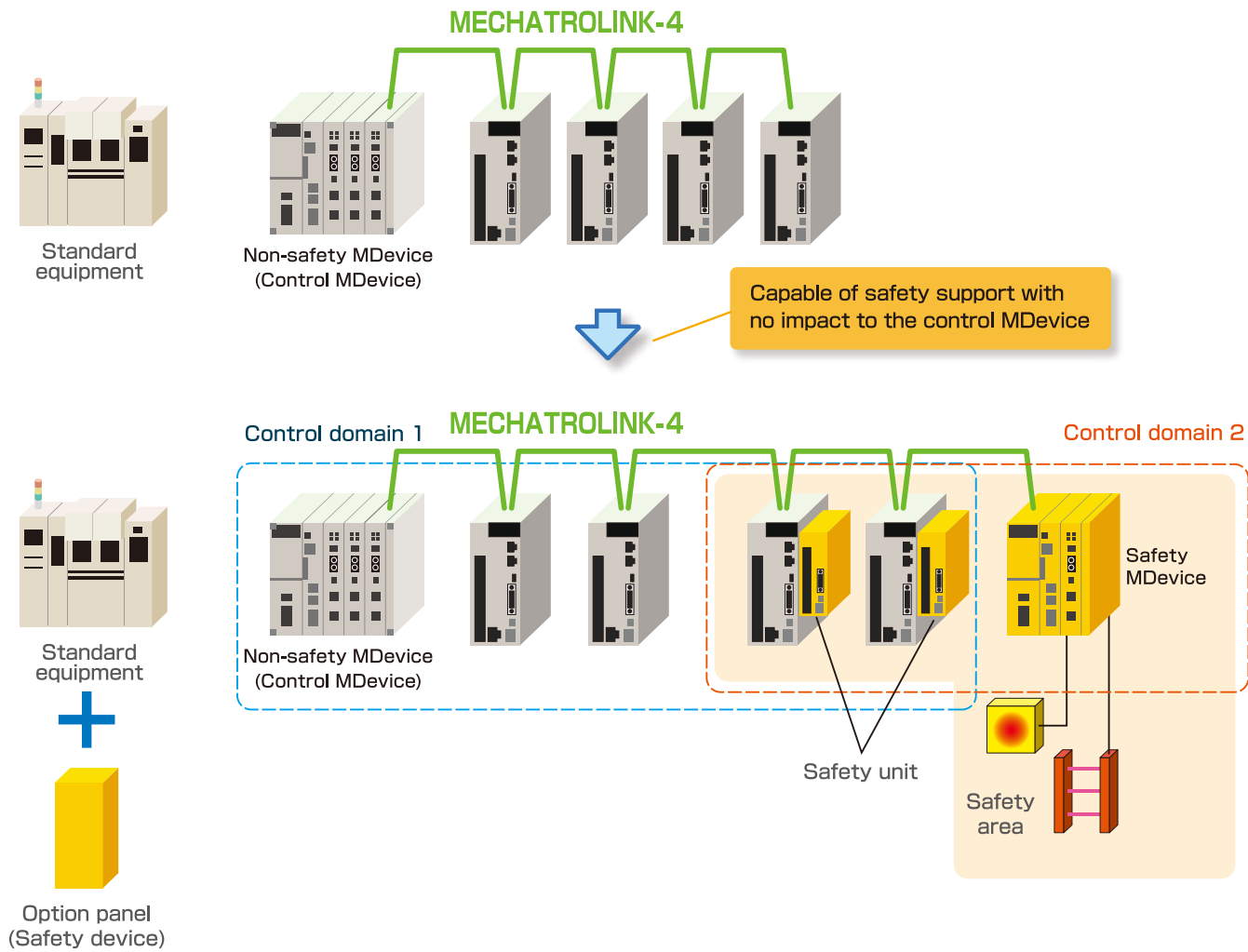
[Multiple Control Domain System]



Support for Safety Systems

MECHATROLINK-4 is capable of supporting safety systems by using the multiple control domain system (in the future). Since SDevices in the multiple control domain system can belong to multiple control domains, a safety system may be built by assigning safety SDevices to both control domains of the control MDevice and safety MDevice.

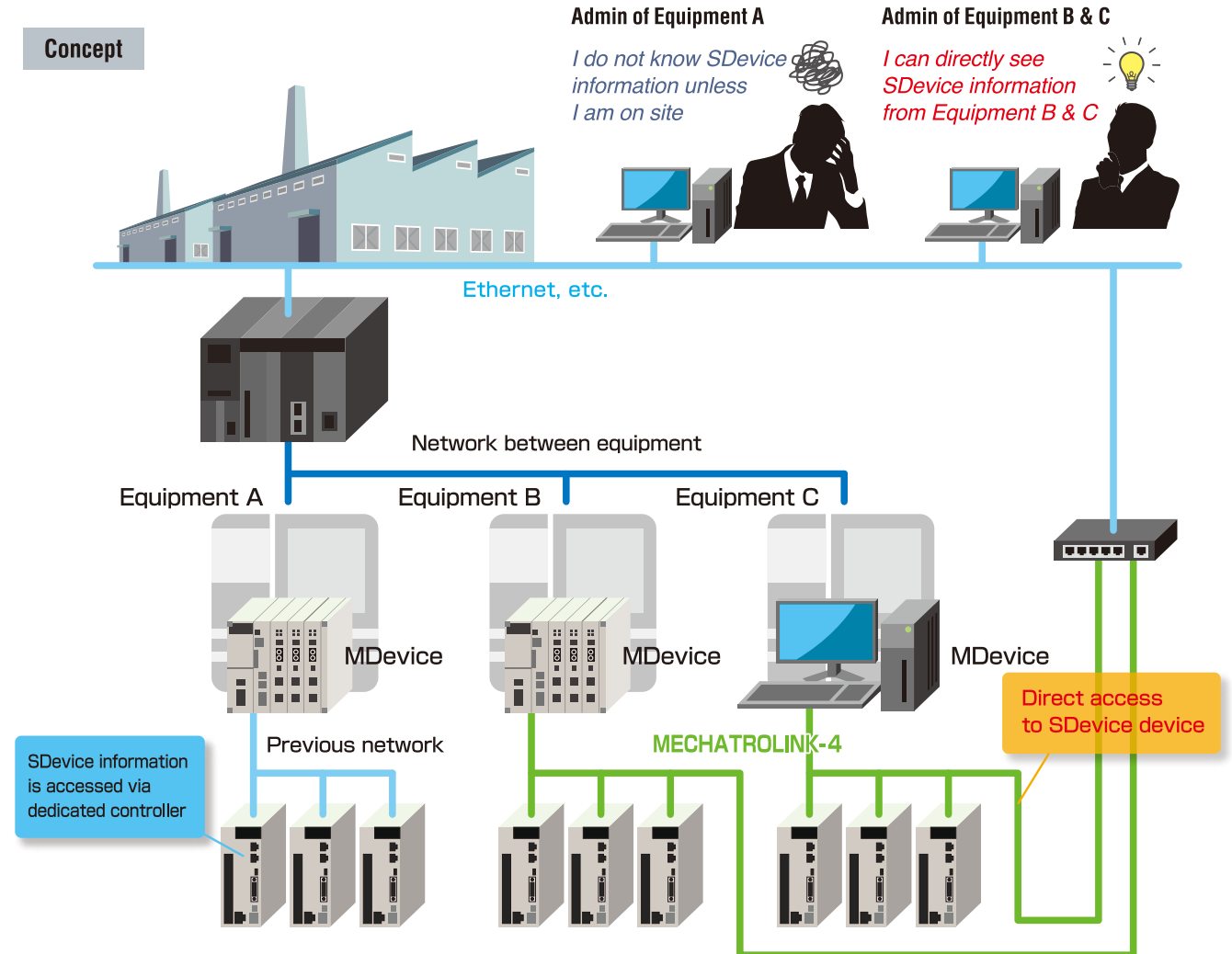
- Safety devices (safety MDevice and safety units) can be added without impact to the controlled side.
- Safety support can be enabled and disabled.



Connections to Ethernet Devices

Ethernet devices can be connected directly to MECHATROLINK-4. Idle bands within the transmission cycle created by improved transmission efficiency are used as Internet protocol bands. Internet protocol bands that are used have no impact on control communications. Using the Internet protocol allows PCs and engineering tools to be directly connected to MECHATROLINK-4 to establish parameter settings and to read and write data.

- Reduces the processing load of the MDevice application.
- Allows operations from PCs and engineering tools without affecting the MDevice application.



Development and Implementation Methods for MECHATROLINK-4

For developing and implementing MECHATROLINK-4, platforms are being prepared that support multiple protocols so they can be easily applied to various types of communications. A new software protocol stack is also being prepared to enhance support for PC platforms and to handle a variety of implementation needs.

- Multi-protocol ASIC
 - Yaskawa Europe GmbH : ANTAIOS / TRITON (MDevice/SDevice)
 - YASKAWA Electric Corporation : JL-L000A (MDevice/SDevice)
 - Texas Instruments Inc., : Sitara™ Arm® Processor (SDevices)
- Software protocol stack (MDevice)
 - for INtime / for RTX (under development)
- FPGA IP core (MDevice)
 - for AMD / for Altera (under development)

MECHATROLINK-4 is compliance with standard Ethernet, general-purpose ethernet analyzers are available as development tools.

Yaskawa Europe GmbH

Multi-protocol
ASIC (MDevice/SDevice)



ANTAIOS

YASKAWA Electric Corporation

MECHATROLINK-4/III
ASIC (MDevice/SDevice)



JL-L000A

Sitara™ Arm® Processor
Access Driver for SDevices



Hilscher Japan

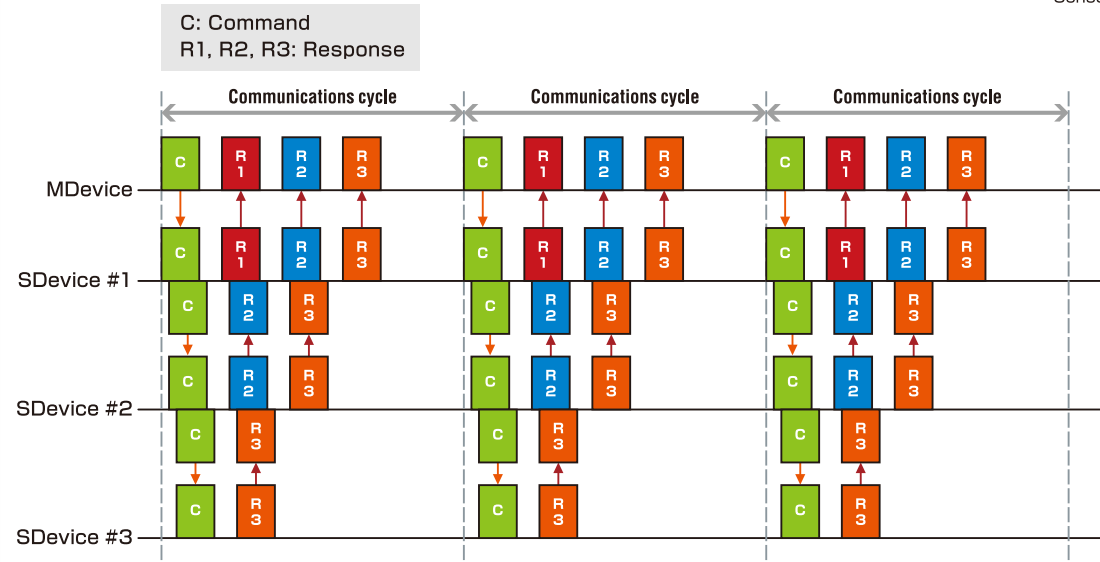
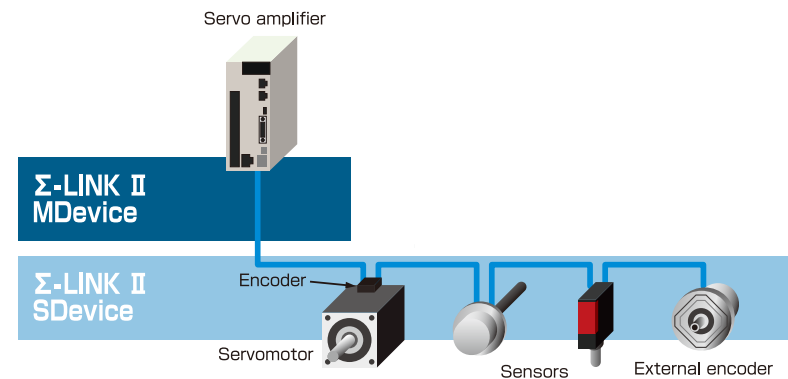
netANALYZER NANL-B500G-RE



Network analyzer

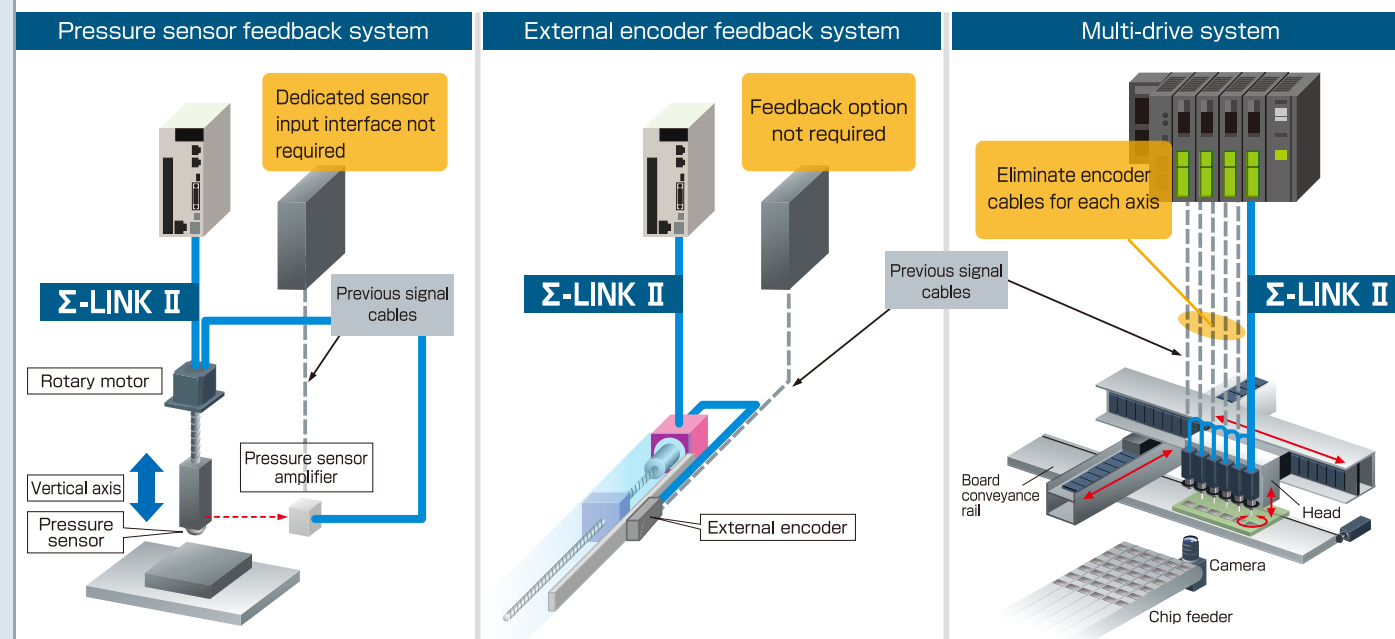
Introduction to Σ-LINK II

Σ-LINK II inherits the high functionality, superior performance and exceptionally reliable communications of previous encoder communications (Σ-LINK), while also allowing other devices installed on the machine side (including sensors and I/O equipment) to be connected to the encoder wiring, either by enabling cascade connections or, by using MECHATROLINK and other branch connectors.



Reducing Wiring

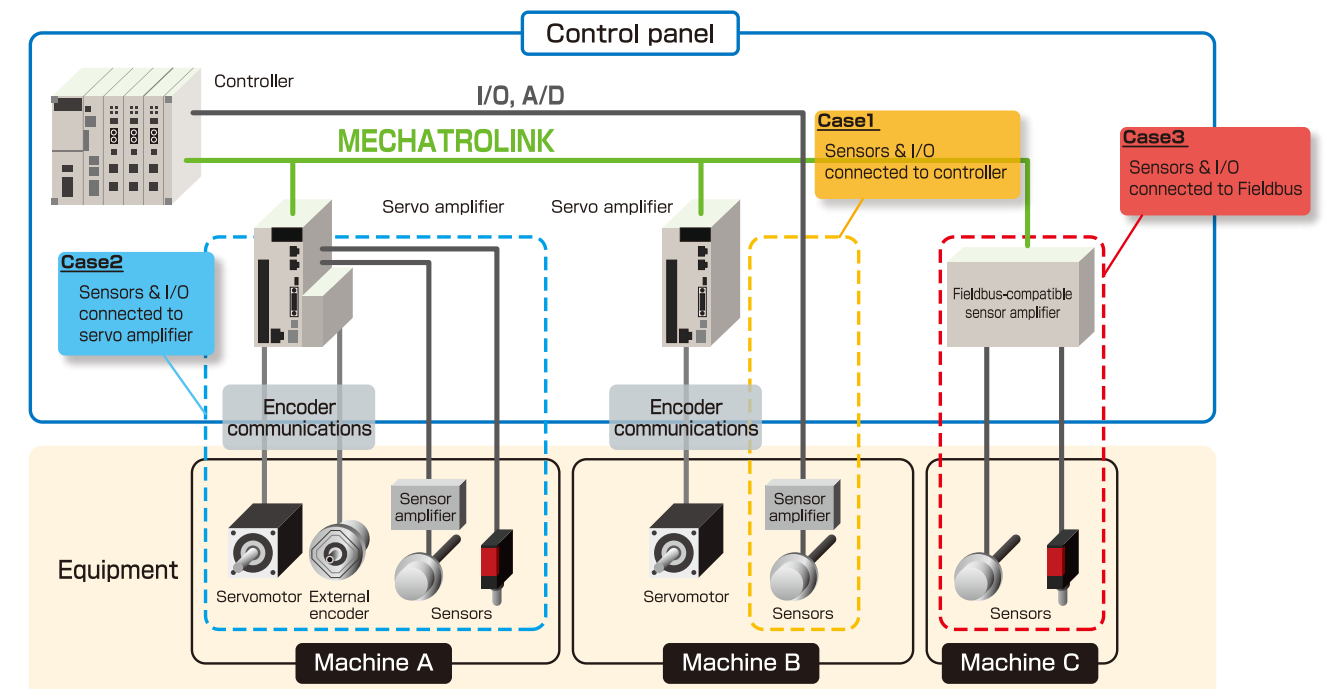
The wiring between the control section (servo amplifier: Σ-LINK II MDevice) and equipment (servomotor and sensors: Σ-LINK II SDevice) can be reduced by using Σ-LINK II. Dedicated sensor input interfaces and feedback option units will not be required.



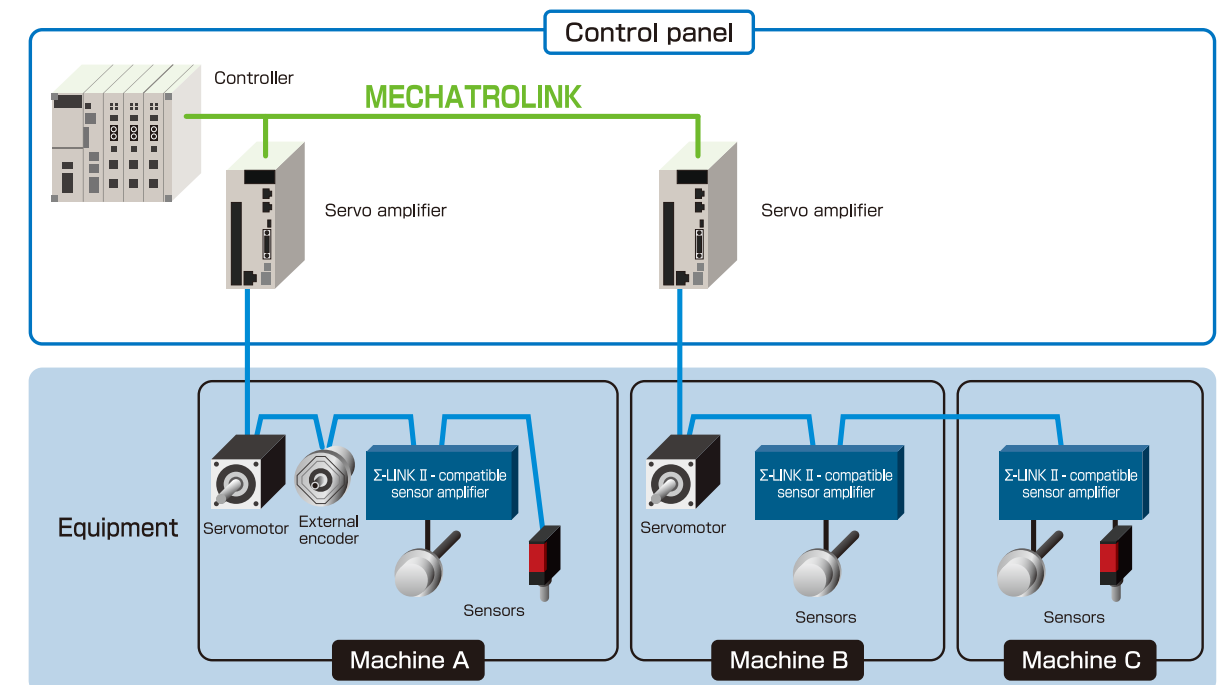
Unified control of sensor data and motion data (data synchronization)

Σ-LINK II MDevice devices and MECHATROLINK MDevice devices can synchronize sensor data and motion data. Control performance and productivity can be improved, and predictive and preventative maintenance can be supported through unified control of sensor data and motion data.

Configuration of Previous Connections



Configuration of Σ-LINK Connections



MECHATROLINK-4 Compliant Products

CONTROLLER

YASKAWA ELECTRIC CORPORATION

YRM1000 Series



YASKAWA ELECTRIC CORPORATION

MPX1000 Series



YASKAWA ELECTRIC CORPORATION

MP3000 Series
CPU Unit CPU-203F



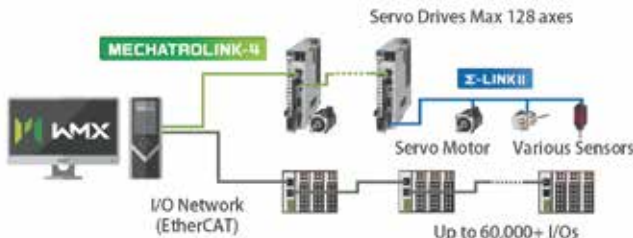
YASKAWA ELECTRIC CORPORATION

MP3000 Series
Motion Module SVF-01



MOVENSYS Inc.

Software based controller
WMX3



SERVO DRIVE

YASKAWA ELECTRIC CORPORATION

Σ-X Series



Σ-XS



Σ-XW



Σ-XT

I/O

YASKAWA ELECTRIC CORPORATION

SLIO I/O Series



Shinko Technos Co., Ltd.

Remote I/O RG Series



INVERTER

YASKAWA ELECTRIC CORPORATION

GA500

GA700



OTHERS

Moxa Inc.

Industrial 8-port smart Ethernet switches
SDS-3008 Series



Phoenix Contact K.K.

Contactless power and data transmission
NEARFI



*Option Card Built-in Unit : JOHB-SMP3-MB is necessary.

Technical Document



We publish technical information materials (PDF) regarding MECHATROLINK on our website. Any company that is a member of the MMA can download it.



Download Technical Data
for registered users only



No.	Document Title
1	MECHATROLINK-4 Protocol User's Manual
2	MECHATROLINK-4 Command Specifications for Standard Servo Profile
3	MECHATROLINK-4 Command Specifications for Standard Stepping Motor Drivers Profile
4	MECHATROLINK-4 Command Specifications for Standard I/O Profile
5	MECHATROLINK-4 Command Specifications for Standard Inverter Profile
6	MECHATROLINK-4 Communication Command Specifications for Message
7	MECHATROLINK-4 Specifications for MECHATROLINK Device Information(MDI) file
8	MECHATROLINK-4 Specifications for MECHATROLINK Network Information(MNI) file
9	MECHATROLINK-4 Command Specifications for ID Information Acquisition Profile in Event Driven Communication
10	MECHATROLINK-4/III Communication ASIC JL-L000 Hardware Manual
11	Standard circuit for MECHATROLINK-4/III Communication ASIC JL-L000 Driver for MDevice User's Manual
12	MECHATROLINK-4 Communication ASIC JL-L000 Access Driver for MDevice User's Manual
13	MECHATROLINK-4 Communication ASIC JL-L000 Access Driver for SDevice User's Manual

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480 Kamifujisawa, Iruma, Saitama, 358-0013 Japan
Tel: +81-4-2962-7920 <https://www.mechatrolink.org/>