The IT M@chine Controller
Introduction

- Product information in this document is current as of October 2009. For the latest product information, contact Yokogawa sales office.

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- Citation
  - This document contains information extracted from documentation published by the MECHATROLINK Members Association.

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  - Direct Drive Motor DYNASERV/LINEARSERV
## FA-M3R Positioning Module
### Product Lineup

<table>
<thead>
<tr>
<th>Single-function PTP (4, 8 and 15 axes)</th>
<th>Communication</th>
<th>Analog Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pulse Output</strong></td>
<td><strong>F3NC96-0N / F3NC97-0N</strong></td>
<td><strong>NEW</strong></td>
</tr>
<tr>
<td>F3YP14-0N / F3YP18-0N</td>
<td>- Built-in MECHATROLINK-II / -III interface</td>
<td>- Built-in pulse counter &amp; general I/O contacts</td>
</tr>
<tr>
<td>- 4 or 8 axes per module</td>
<td>- Up to 15 axes per module</td>
<td></td>
</tr>
<tr>
<td>- Max. pulse rate: 4Mpps</td>
<td>- High-speed, high-throughput communication</td>
<td></td>
</tr>
<tr>
<td>- Startup time: 0.09ms min.</td>
<td>- Transmission rate: 100Mbps</td>
<td></td>
</tr>
</tbody>
</table>

**Advanced PTP (1, 2 and 4 axes)**

<table>
<thead>
<tr>
<th><strong>F3NC32-0N / F3NC34-0N</strong></th>
<th><strong>F3NC31-0N / F3NC32-0N</strong></th>
<th><strong>F3NC51-0N / F3NC52-0N</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- 2 or 4 axes per module</td>
<td>- 2 or 4 axes per module</td>
<td>- 1 or 2 axes per module</td>
</tr>
<tr>
<td>- Max. pulse rate: 5Mpps</td>
<td>- Linear, circular, helical interpolation</td>
<td>- Speed reference voltage output</td>
</tr>
<tr>
<td>- Linear, circular, helical interpolation</td>
<td></td>
<td>- Linear/circular interpolation</td>
</tr>
</tbody>
</table>

**Motion**

<table>
<thead>
<tr>
<th>Techno’s PLMC40</th>
<th>Techno’s PLMC-M II EX</th>
<th>F3NC61-0N</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Up to 4 axes per module</td>
<td>- Built-in MECHATROLINK-II interface</td>
<td>- for torque control</td>
</tr>
<tr>
<td>- Precise motion control</td>
<td>- Up to 16 axes per module</td>
<td>- Analog output (2ch), analog input, built-in pulse counter</td>
</tr>
<tr>
<td>- Synchronous control, electronic cam, contour control, multi-axial interpolation</td>
<td>- Precise motion control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Synchronous control, electronic cam, contour control, multi-axial interpolation</td>
<td></td>
</tr>
</tbody>
</table>

### New Product Introduction

- **Positioning Module F3NC97-0N** (with MECHATROLINK-III Interface)
MECHATROLINK is a high performance, advanced, open-architecture motion field network standard published by the MECHATROLINK Members Association (MMA).

- Enables distributed control of multiple FA units (servo drives, inverters, I/O modules, etc.) by one FA controller.
- Certified as compliant with SEMI standard E54.19, and expected to be widely used in the semiconductor industry, especially for transfer, drive and I/O equipment control in semiconductor or LCD manufacturing machines.

- **Motion field network**
  - Focuses on precise, synchronous control of servo drives and fast response.
  - Examples: MECHATROLINK, SERCOS

- **I/O field network**
  - Focuses on connection of various I/O equipment rather than synchronization.
  - Examples: DeviceNet, Profinbus-DP

### MECHATROLINK Members Association (MMA)

- **Objectives**
  - MMA is a group of MECHATROLINK product developers and users committed to promoting worldwide use of MECHATROLINK, a motion field network.
  - All members support the construction and promotion of a larger MECHATROLINK family.

- **Executive Committee:**
  - Yaskawa Electric, Yokogawa Electric, Digital, Yaskawa Information Systems, OMRON

- **Membership:** 435 companies
  - (Japan: 239, Asia: 120, US: 29, EU: 47)

- **No. of nodes shipped:** 1.5 million

- **No. of MECHATROLINK products:** 201
  - (controllers, servo motors, stepping motors, inverters, I/O, sensors, etc.)

- **URL:** www.mechatrolink.org/
What is MECHATROLINK-III?

- With higher communication spec. than MECHATROLINK-I (4Mbps) & MECHATROLINK-II (10Mbps), MECHATROLINK-III offers faster speed and more functions.

- Features
  - Ethernet as physical layer
  - Even higher-speed communication
    - Transmission rate: 10Mbps → 100Mbps
    - Min. cycle time: 250μs → 31.25μs
  - Better MECHATROLINK compatibility
    - Data size: 8, 16, 32, 48, 64 bytes (intermixing allowed)
  - Support for larger systems
    - Number of slaves: 30 → 62 max.
    - Transmission distance: 50 m total → 100 m inter-station distance
  - Topology: Cascade or star

- Overview
  - MECHATROLINK-III interface (C1 master) functions
    - Sends MECHATROLINK-III commands based on instructions from CPU module
    - Receives MECHATROLINK-III responses from external devices

- Functions
  - Independent axis motion using MECHATROLINK-III commands
  - Linear interpolation motion (start/stop axes simultaneously)
  - Read external device statuses
    - Reference position, current position, speed, torque, etc.
  - Read/write external device parameters
  - External device I/O

- Application examples
  - Extraction robot, handler
  - Semiconductor manufacturing machines
  - Electrical & electronic component assembly machines
Positioning Module F3NC97-0N (with MECHATROLINK-III Interface)

**Features**

- **Latest open motion field network**
  - Standard published by the MECHATROLINK Members Association
  - Latest, Ethernet-based, high-performance, advanced network

- **Reduced wiring, simpler configuration, lower cost**
  - Good cost performance: one module controls up to 15 axes
  - Easy connection using connectors

- **Fast, accurate position control thru’ high-speed, high-throughput communication**
  - Transmission rate: 100Mbps, cycle time: 0.25, 0.5 or 1 ms for 4-, 8-, or 15-axis control
  - Shorter control cycle and faster startup enable improved control performance, tact time and productivity
  - Up to 8 monitor data per axis can be read simultaneously for better external device operation monitoring.
  - Control by transmitted commands enables full exploitation of motor performance (high speed and high resolution).
  - Versatile position control includes linear interpolated motion of up to 15 axes, simultaneous linear interpolated motion of any combination of axes, and change of speed or target position during motion.

- **Flexible system configuration**
  - Supports star and cascade network topologies
  - Inter-station distance up to 100 m enables flexible system configuration.

- **More MECHATROLINK-III compliant devices upcoming**
  - Stepping motors, I/O equipment and inverters from more manufacturers supported in future.

**Specification**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>MECHATROLINK-III compliant</td>
</tr>
<tr>
<td>Physical layer</td>
<td>Ethernet</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>100 Mbps</td>
</tr>
<tr>
<td>Cycle time / No. of stations</td>
<td>0.25 ms for 4 axes, 0.5 ms for 8 axes, or 1.0 ms for 15 axes</td>
</tr>
<tr>
<td>Transmission bytes</td>
<td>16, 32, 48, or 64 bytes (intermixing allowed)</td>
</tr>
<tr>
<td>Communications method</td>
<td>Cyclic communication</td>
</tr>
<tr>
<td>Network topology</td>
<td>Cascade or star</td>
</tr>
<tr>
<td>Transmission media</td>
<td>Ethernet STP Cat5e (dedicated cable)</td>
</tr>
<tr>
<td>Max. transmission distance</td>
<td>100 m (between stations)</td>
</tr>
<tr>
<td>Min. distance between stations</td>
<td>0.2 m</td>
</tr>
<tr>
<td>Supported profiles</td>
<td>- Standard servo profile</td>
</tr>
<tr>
<td></td>
<td>- Standard I/O profile</td>
</tr>
<tr>
<td>Positioning functions</td>
<td>Position reference -2,147,483,648 to 2,147,483,647 (reference unit)</td>
</tr>
<tr>
<td></td>
<td>Functions - Independent axis motion using standard servo profile commands (availability dependent on connected external device and supported standard servo profile commands) - Linear interpolation motion (starting and stopping multiple axes simultaneously), speed/target position change during motion</td>
</tr>
<tr>
<td></td>
<td>Others - Status monitoring of external devices (target position, current position, speed, and torque) - Reading and writing of parameters of external devices - External device I/O using standard I/O profile commands</td>
</tr>
</tbody>
</table>

For more details, please refer to GS 34M06H60-03E.
Scope of MECHATROLINK-III Support (1)

### Standard Servo Profile

- **Main Commands**
  - **$00** NOP (No Operation)
  - **$01** PRM_RD (Read Parameter)
  - **$02** PRM_WR (Write Parameter)
  - **$03** ID_RD (Read ID)
  - **$04** CONFD (Configure)
  - **$05** ALM_RD (Read Alarm or Warning)
  - **$06** ALM_CLR (Clear Alarm or Warning)
  - **$0D** SYNC_SET (Start Synchronous Communication)
  - **$0E** CONNECT (Establish Connection)
  - **$0F** DISCONNECT (Release Connection)

- **Profile Commands**
  - Common commands
    - **$00** NOP: Executable by user using MECHATROLINK-III command parameters for each axis.
    - **$01** PRM_RD: Executable by user using extended MECHATROLINK-III command parameters.
    - **$02** PRM_WR: Not executable by user but executed automatically by the positioning module or external device.
    - **$05** ALM_RD: Not executable by user but executed automatically by the positioning module or external device.
    - **$06** ALM_CLR: Not supported
    - **$0D** SYNC_SET: Not executable by user but executed automatically by the positioning module or external device.
    - **$0E** CONNECT: Not executable by user but executed automatically by the positioning module or external device.
    - **$0F** DISCONNECT: Not executable by user but executed automatically by the positioning module or external device.
  - Standard servo commands
    - **$30** POS_SET (Set Coordinates)
    - **$31** BRK_ON (Apply Brake)
    - **$32** BRK_OFF (Release Brake)
    - **$33** SENS_ON (Turn Sensor ON)
    - **$34** SENS_OFF (Turn Sensor OFF)
    - **$35** INTERPOLATE (Interpolation)
    - **$36** TIFEST (Test)
    - **$37** EX_PXM (External Input Read)
    - **$38** EX_PWS (External Input Write)
    - **$39** EMPOS (Encoder Positioning)
    - **$3A** ECTL (Velocity Control)
    - **$3B** TDECTL (Torque Control)
    - **$3C** SVPRM_RD (Read Servo Parameter)
    - **$3D** SVPRM_WR (Write Servo Parameter)

### Scope of MECHATROLINK-III Support (2)

- **Standard I/O Profile**
  - **Common commands**
    - **$00** NOP: No operation
    - **$01** PRM_RD: Read parameter
    - **$02** PRM_WR: Write parameter
    - **$03** ID_RD: Read ID
    - **$04** CONFD: Setup device
    - **$05** ALM_RD: Read alarm or warning
    - **$06** ALM_CLR: Clear alarm or warning
    - **$0D** SYNC_SET: Start synchronous communication
    - **$0E** CONNECT: Establish connection
    - **$0F** DISCONNECT: Release connection
    - **$18** PRMP_RD: Read stored parameter
    - **$1C** PRMP_WR: Write stored parameter
    - **$1E** MEM_RD: Read memory
    - **$1E** MEM_WR: Write memory
    - **$30** SMON: Servo status monitor
    - **$32** DATA_RW: Data Read/Write
    - **$33** DATA_W: Data Write

- **Subcommands**
  - **Standard servo commands**
    - **$30** POS_SET: Set coordinates
    - **$31** BRK_ON: Apply brake
    - **$32** BRK_OFF: Release brake
    - **$33** SENS_ON: Turn sensor ON
    - **$34** SENS_OFF: Turn sensor OFF
    - **$35** INTERPOLATE: Interpolation
    - **$36** TIFEST: Test
    - **$37** EX_PXM: External Input Read
    - **$38** EX_PWS: External Input Write
    - **$39** EMPOS: Encoder Positioning
    - **$3A** ECTL: Velocity Control
    - **$3B** TDECTL: Torque Control
    - **$3C** SVPRM_RD: Read Servo Parameter
    - **$3D** SVPRM_WR: Write Servo Parameter

- **Standard I/O commands**
  - **$30** NOP: No operation
  - **$01** PRM_RD: Read parameter
  - **$02** PRM_WR: Write parameter
  - **$03** ID_RD: Read ID
  - **$04** CONFD: Setup device
  - **$05** ALM_RD: Read alarm or warning
  - **$06** ALM_CLR: Clear alarm or warning
  - **$0D** SYNC_SET: Start synchronous communication
  - **$0E** CONNECT: Establish connection
  - **$0F** DISCONNECT: Release connection
  - **$18** PRMP_RD: Read stored parameter
  - **$1C** PRMP_WR: Write stored parameter
  - **$1E** MEM_RD: Read memory
  - **$1E** MEM_WR: Write memory
  - **$30** SMON: Servo status monitor
  - **$32** DATA_RW: Data Read/Write

- **Scope of MECHATROLINK-III Support**

- **Standard servo commands**
  - **$00** NOP: No operation
  - **$01** PRM_RD: Read parameter
  - **$02** PRM_WR: Write parameter
  - **$03** ID_RD: Read ID
  - **$04** CONFD: Setup device
  - **$05** ALM_RD: Read alarm or warning
  - **$06** ALM_CLR: Clear alarm or warning
  - **$0D** SYNC_SET: Start synchronous communication
  - **$0E** CONNECT: Establish connection
  - **$0F** DISCONNECT: Release connection
  - **$18** PRMP_RD: Read stored parameter
  - **$1C** PRMP_WR: Write stored parameter
  - **$1E** MEM_RD: Read memory
  - **$1E** MEM_WR: Write memory
  - **$30** SMON: Servo status monitor

- **I/O commands**
  - **$00** NOP: No operation
  - **$01** PRM_RD: Read parameter
  - **$02** PRM_WR: Write parameter
  - **$03** ID_RD: Read ID
  - **$04** CONFD: Setup device
  - **$05** ALM_RD: Read alarm or warning
  - **$06** ALM_CLR: Clear alarm or warning
  - **$0D** SYNC_SET: Start synchronous communication
  - **$0E** CONNECT: Establish connection
  - **$0F** DISCONNECT: Release connection
  - **$18** PRMP_RD: Read stored parameter
  - **$1C** PRMP_WR: Write stored parameter
  - **$1E** MEM_RD: Read memory
  - **$1E** MEM_WR: Write memory
  - **$30** SMON: Servo status monitor

*1: The standard servo command profile uses SVPRM_RD and SVPRM_WR instead of PRM_RD, PRM_WR, PRMP_RD, and PRMP_WR.
*2: Brake On/Off should be controlled by an external device in tandem with Servo ON/OFF commands.
Positioning Function Overview (1) — Interpolation motion commands

- Start Positioning Command ($0100)
  - Performs positioning according to specified target position, target speed, acceleration time and deceleration time
  - Allows linear interpolation motion of up to 15 axes and linear interpolation motion of any combination of axes (starting and stopping axes simultaneously)
  - Allows change of speed or target position during positioning.

- Change Speed Command ($0400)
  - Change of speed during positioning

Positioning Function Overview (2) — Interpolation motion commands

- Change Target Position Command ($0500)
  - Change of target position during positioning
  - Target position change involving direction change is also allowed.

- Decelerate and Stop Command ($0200)
  - Decelerates and stops positioning motion

- Stop Immediately Command ($0300)
  - Stops positioning motion immediately
**Positioning Function Overview (3) — MECHATROLINK-III commands**

- **Positioning Command (POISING: $35)**
  - Positioning to specified position
    - Electronic gear
      - Set electronic gear ratio in driver
    - Acceleration/deceleration: trapezoidal, 2-segment, index, simple S-shaped
      - Set acceleration/deceleration parameter in driver
    - Allows change of target position or speed during motion
      - Target position change involving direction change is also allowed.
  - Acceleration, deceleration, torque limit can be specified concurrently
  - Up to 8 monitor data per axis can be read concurrently

### MECHATROLINK-III commands

<table>
<thead>
<tr>
<th>Byte</th>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>POSING</td>
<td>POSING</td>
</tr>
<tr>
<td>2-3</td>
<td>CMD_CTRL</td>
<td>CMD_STAT</td>
</tr>
<tr>
<td>4-7</td>
<td>Servo Command Control Field (SVCMD_CTRL)</td>
<td>Servo Command Status Field (SVCMD_STAT)</td>
</tr>
<tr>
<td>8-11</td>
<td>Servo Command Output Signal (SVCMD_OC)</td>
<td>Servo Command Input Signal (SVCMD_IC)</td>
</tr>
<tr>
<td>12-15</td>
<td>Target Position (TPOS)</td>
<td>Feed Monitor (CPRM_SEL_MON1)</td>
</tr>
<tr>
<td>16-19</td>
<td>Target Speed (TSPD)</td>
<td>Feed Monitor (CPRM_SEL_MON2)</td>
</tr>
<tr>
<td>20-23</td>
<td>Acceleration (ACCR)</td>
<td>MONITOR1</td>
</tr>
<tr>
<td>24-27</td>
<td>Deceleration (DECR)</td>
<td>MONITOR2</td>
</tr>
<tr>
<td>28-31</td>
<td>Torque Limit (TLIM)</td>
<td>MONITOR3</td>
</tr>
<tr>
<td>32</td>
<td>SMON ($30)</td>
<td>SMON ($30)</td>
</tr>
<tr>
<td>33-35</td>
<td>Subcommand Control (SUB_CTRL)</td>
<td>Subcommand Status (SUB_STAT)</td>
</tr>
<tr>
<td>36-39</td>
<td>Reserved</td>
<td>MONITOR4</td>
</tr>
</tbody>
</table>

### MECHATROLINK-II commands

<table>
<thead>
<tr>
<th>Byte</th>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>POSING</td>
<td>POSING</td>
</tr>
<tr>
<td>1</td>
<td>OPTION</td>
<td>Option</td>
</tr>
<tr>
<td>2-3</td>
<td>CMD_CTRL</td>
<td>CMD_STAT</td>
</tr>
<tr>
<td>4-7</td>
<td>Target Position (TPOS)</td>
<td>MONITOR1</td>
</tr>
<tr>
<td>8-11</td>
<td>Target Speed (TSPD)</td>
<td>MONITOR2</td>
</tr>
<tr>
<td>12</td>
<td>MON_SEL 1, 2</td>
<td>MON_SEL 1, 2</td>
</tr>
<tr>
<td>13-14</td>
<td>I/O Signal Monitor (I/O)</td>
<td>I/O Status (OCC)</td>
</tr>
<tr>
<td>15</td>
<td>WDT</td>
<td>WDT</td>
</tr>
<tr>
<td>16-19</td>
<td>SMON ($30)</td>
<td>SMON ($30)</td>
</tr>
<tr>
<td>19</td>
<td>MON_SEL 3, 4</td>
<td>MON_SEL 3, 4</td>
</tr>
<tr>
<td>20-23</td>
<td>I/O Signal Monitor (I/O)</td>
<td>I/O Status (OCC)</td>
</tr>
<tr>
<td>24-27</td>
<td>SUBSTATUS</td>
<td>MONITOR4</td>
</tr>
<tr>
<td>28-31</td>
<td>Reserved</td>
<td>0</td>
</tr>
</tbody>
</table>

---

**Positioning Function Overview (4) — MECHATROLINK-III commands**

- **Feed Command (FEED: $36)**
  - Performs constant speed feed at a specified feed speed
    - Allows change of speed during motion
      - Speed change involving direction change is also allowed.
  - Acceleration, deceleration, torque limit can be specified concurrently
  - Up to 8 monitor data per axis can be read concurrently

- **External Input Feed (EX_FEED: $37)**
  - Performs positioning in response to the input of the external positioning signal during constant speed feed at the specified feed speed.
    - Allows change of speed during motion
      - Speed change involving direction change is also allowed.

- **External Input Positioning (EX_POSING: $39)**
  - Performs positioning in response to the input of the external positioning signal during positioning to a specified position.
    - When external positioning signal is input, decelerates to rest by traveling through travel distance set in driver.
Positioning Function Overview (5)
— MECHATROLINK-III commands

- Zero Point Return Command (ZRET: $3A)
  - Performs zero point return operation using deceleration limit switch and position latch signal (Z-phase, external input)
    - Zero Point Return Mode
      - Uses position latch signal
      - Uses deceleration limit switch + latch signal

- Velocity Control Command (VELCTRL: $3C)
  - Sends speed reference to perform speed control.

- Torque Control Command (TRQCTRL: $3D)
  - Sends torque reference to perform torque control.

Positioning Function Overview (6)
— MECHATROLINK-III commands

- Servo Status Monitor Command (SMON: $30)
  - Select 8 out of 13 data types (command position, current position, speed, torque, etc.) to be read

<table>
<thead>
<tr>
<th>Selection Code</th>
<th>Monitor Name</th>
<th>Contents</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>APOS</td>
<td>Feedback Position Current position of the motor</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CPSH</td>
<td>Command Position</td>
<td>Command position after acceleration/deceleration filter</td>
</tr>
<tr>
<td>2</td>
<td>PERR</td>
<td>Position Error</td>
<td>Position error of the control loop</td>
</tr>
<tr>
<td>3</td>
<td>LPOS1</td>
<td>Latched Position 1 Motor position 1 latched by the latch signal</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>LPOS2</td>
<td>Latched Position 2 Motor position 2 latched by the latch signal</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>FSPD</td>
<td>Feedback Speed</td>
<td>Current speed of the motor</td>
</tr>
<tr>
<td>6</td>
<td>CSPD</td>
<td>Reference Speed</td>
<td>Command speed of the motor</td>
</tr>
<tr>
<td>7</td>
<td>TRQ</td>
<td>Torque (Force) Reference Command torque (force) of the motor</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>ALARM</td>
<td>Detailed Information of the Current Alarm Current alarm/warning</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>MPOS</td>
<td>Command Position Input command position of the position control loop</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>B</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C</td>
<td>CMN1</td>
<td>Common Monitor 1 Selects the monitor data specified by parameter of the external device</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>CMN2</td>
<td>Common Monitor 2 Selects the monitor data specified by parameter of the external device</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>OMN1</td>
<td>Optional Monitor 1 Selects the monitor data specified by parameter</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>OMN2</td>
<td>Optional Monitor 2 Selects the monitor data specified by parameter</td>
<td></td>
</tr>
</tbody>
</table>

- Servo ON Command (SV_ON: $31)
- Servo OFF Command (SV_OFF: $32)
- Set Coordinates Command (POS_SET: $20)
- Clear Alarm or Warning Command (ALM_CLR: $06)
Compatible External Devices (1)

- Servo drives
  - Yaskawa Electric Corporation
    - AC Servo Drive Σ-V Series
      - SGDV-□□□2□ SERVOPACK

- I/O equipment
  - Yaskawa Electric Corporation
    - 64-point I/O module
      - JEPMC-MTD2310-E (upcoming)

Compatible External Devices (2)

- MECHATROLINK-III communications cable
  - Yaskawa Controls Co., Ltd.
    - MECHATROLINK-III communications cable
      - JEPMC-W6012-□□-E (no core)
      - JEPMC-W6013-□□-E (with core)
      - JEPMC-W6014-□□-E (no core, no connector on the other end)

- Others
  - Yaskawa Electric Corporation
    - MECHATROLINK-III compatible hub module
      - JEPMC-MT2000-E
Application Examples

- Most suited for systems having many axes such as semiconductor manufacturing machines, electronic component assembly machines

New Products Summary

- Module for FA-M3

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positioning Module (with MECHATROLINK-III Interface)</td>
<td>F3NC97-0N</td>
<td>Controls up to 15 axes with MECHATROLINK-III interface</td>
</tr>
</tbody>
</table>

- User Manual for FA-M3

<table>
<thead>
<tr>
<th>Name</th>
<th>Document No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positioning Module (with MECHATROLINK-III Interface) User’s Manual</td>
<td>IM 34M06H60-03E</td>
</tr>
</tbody>
</table>
Differences from Positioning Module F3NC96-0N
(with MECHATROLINK-II Interface) (1)

<table>
<thead>
<tr>
<th>Item</th>
<th>F3NC96-0N</th>
<th>F3NC97-0N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>MECHATROLINK-II compliant</td>
<td>MECHATROLINK-II compliant</td>
</tr>
<tr>
<td>Physical layer</td>
<td>RS-485-equivalent</td>
<td>Ethernet</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>1.0 Mbps</td>
<td>1.0 Mbps</td>
</tr>
<tr>
<td>Cycle time / No. of stations</td>
<td>1.0 ms for 8 axes or 2.0 ms for 15 axes</td>
<td>0.25 ms for 4 axes, 0.5 ms for 8 axes, or 1.0 ms for 15 axes</td>
</tr>
<tr>
<td>Transmission pins</td>
<td>32 pins with subcommand</td>
<td>16, 32, 48, or 64 pins (intermixing allowed)</td>
</tr>
<tr>
<td>Communications method</td>
<td>Cyclic communication</td>
<td>Cyclic communication</td>
</tr>
<tr>
<td>Network topology</td>
<td>Bus</td>
<td>Cascade or star</td>
</tr>
<tr>
<td>Transmission media</td>
<td>2-wire shielded twisted pair cable (dedicated cable)</td>
<td>Ethernet STP Cat5e (dedicated cable)</td>
</tr>
<tr>
<td>Max. transmission distance</td>
<td>50 m (total length)</td>
<td>100 m (between stations)</td>
</tr>
<tr>
<td>Min. distance between stations</td>
<td>0.5 m</td>
<td>0.2 m</td>
</tr>
<tr>
<td>Supported profiles</td>
<td>- Devices supporting comm. commands for servo drives</td>
<td>- Standard servo profile</td>
</tr>
<tr>
<td>Positioning functions</td>
<td>- Devices supporting comm. commands for stepping motors</td>
<td>- Standard I/O profile</td>
</tr>
<tr>
<td>Position reference</td>
<td>2,147,483,648 to 2,147,483,647 (reference unit)</td>
<td>2,147,483,648 to 2,147,483,647 (reference unit)</td>
</tr>
<tr>
<td>Functions</td>
<td>- Independent axis motion using MECHATROLINK-II commands (availability dependent on connected external device and supported MECHATROLINK-II commands)</td>
<td>- Independent axis motion using standard servo profile commands (availability dependent on connected external device and supported standard servo profile commands)</td>
</tr>
<tr>
<td></td>
<td>- Linear interpolation motion starting &amp; stopping multiple axes simultaneously</td>
<td>- Linear interpolation motion starting &amp; stopping multiple axes simultaneously</td>
</tr>
<tr>
<td></td>
<td>- Speed/target position change during motion</td>
<td>- Speed/target position change during motion</td>
</tr>
<tr>
<td>Others</td>
<td>- Status monitoring of external devices (target position, current position, speed, and torque)</td>
<td>- Status monitoring of external devices (target position, current position, speed, and torque)</td>
</tr>
<tr>
<td></td>
<td>- Reading and writing of parameters of external devices</td>
<td>- Reading and writing parameters of external devices</td>
</tr>
<tr>
<td></td>
<td>- External device I/O using standard I/O profile commands</td>
<td>- External device I/O using standard I/O profile commands</td>
</tr>
<tr>
<td>Number of installed modules</td>
<td>8 modules max. (controlling 120 axes max.)</td>
<td>8 modules max. (controlling 120 axes max.)</td>
</tr>
<tr>
<td>Current consumption</td>
<td>870 mA (at 5 V DC)</td>
<td>830 mA (at 5 V DC)</td>
</tr>
<tr>
<td>External dimensions</td>
<td>28.9 (W) x 100 (H) x 83.2 (D) mm</td>
<td>28.9 (W) x 100 (H) x 83.2 (D) mm</td>
</tr>
<tr>
<td>Weight</td>
<td>120 g</td>
<td>135 g</td>
</tr>
</tbody>
</table>

Differences from Positioning Module F3NC96-0N
(with MECHATROLINK-II Interface) (2)

MECHATROLINK commands

**For standard servo profile**

<table>
<thead>
<tr>
<th>Profile</th>
<th>Command Code</th>
<th>Command</th>
<th>Function</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard servo commands (command motion commands)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common commands</td>
<td>$00$</td>
<td>NOP</td>
<td>No operation</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$01$</td>
<td>PRM RD</td>
<td>Read parameter</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$02$</td>
<td>PRM WR</td>
<td>Write parameter</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$03$</td>
<td>ID RD</td>
<td>Read ID</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$04$</td>
<td>CONFIG</td>
<td>Set up device</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$05$</td>
<td>ALM RD</td>
<td>Read alarm or warning</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$06$</td>
<td>ALM CLR</td>
<td>Clear alarm or warning</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$07$</td>
<td>SYNC_SET</td>
<td>Start synchronous communication</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$08$</td>
<td>CONNECT</td>
<td>Establish connection</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$09$</td>
<td>DISCONNECT</td>
<td>Release connection</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$10$</td>
<td>PRM RD</td>
<td>Read stored parameter</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$11$</td>
<td>PRM WR</td>
<td>Write stored parameter</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$12$</td>
<td>MEM RD</td>
<td>Read memory</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$13$</td>
<td>MEM WR</td>
<td>Write memory</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$20$</td>
<td>POS SET</td>
<td>Set coordinates</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$21$</td>
<td>BK ON</td>
<td>Apply brake</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$22$</td>
<td>BK OFF</td>
<td>Release brake</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$23$</td>
<td>SENS ON</td>
<td>Input sensor ON</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$24$</td>
<td>SENS OFF</td>
<td>Input sensor OFF</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$25$</td>
<td>MLOCK ON</td>
<td>Machine lock ON</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>$26$</td>
<td>MLOCK OFF</td>
<td>Machine lock OFF</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>$27$</td>
<td>LTMOD ON</td>
<td>Request latch mode</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$28$</td>
<td>LTMOD OFF</td>
<td>Release latch mode</td>
<td>○</td>
<td>×</td>
</tr>
</tbody>
</table>

**Standard servo commands**

<table>
<thead>
<tr>
<th>Profile</th>
<th>Command Code</th>
<th>Command</th>
<th>Function</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$30$</td>
<td>SVMON</td>
<td>Servo status monitor</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$31$</td>
<td>SV ON</td>
<td>Servo ON</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>$32$</td>
<td>SV OFF</td>
<td>Servo OFF</td>
<td>×</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>$33$</td>
<td>INTERPOLATE</td>
<td>Interpolation</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$34$</td>
<td>POSING</td>
<td>Positioning</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$35$</td>
<td>FEED</td>
<td>Feed</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$36$</td>
<td>EX FEED</td>
<td>External input feed</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$38$</td>
<td>LATCH</td>
<td>Interpolation feed with position latch function</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$39$</td>
<td>EX POSING</td>
<td>External input positioning</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$40$</td>
<td>SVPRM RD</td>
<td>Read servo parameter</td>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td>$41$</td>
<td>SVPRM WR</td>
<td>Write servo parameter</td>
<td>○</td>
<td>×</td>
</tr>
</tbody>
</table>

- ○: Executable by user using MECHATROLINK-III command parameters for each axis.
- △: Executable by user using extended MECHATROLINK-III command parameters.
- ×: Not executable by user but executed automatically by positioning module or external devices.
- ×: Not supported

*1: The standard servo command profile uses SVPRM_RD and SVPRM_WR instead of PRM_RD, PRM_WR, PRPRM_RD and PRPRM_WR.

*2: Brake On/Off should be controlled by an external device in tandem with Servo ON/OFF commands.
Differences from Positioning Module F3NC96-0N (with MECHATROLINK-II Interface) (3)

**MECHATROLINK Commands**

- **Positioning Command (POISING: $35)**
  For MECHATROLINK-III, acceleration, deceleration & torque limit can also be specified. Moreover, up to 8 monitor data per axis can be read concurrently.

  - **MECHATROLINK-II command**
    - Byte 0: Command
      - 0: POSING ($35)
    - Byte 1: Response
      - 0: POSING ($35)
    - Byte 2-3: OPTION Status
      - 1-2: Command Control (CMD_CTRL)
      - 3-4: Command Status (CMD_STAT)
    - Byte 5: Target Position (TPOS)
      - Byte 6: Subcommand Control (SUB_CTRL)
    - Byte 7: Reserved

  - **MECHATROLINK-III command**
    - Byte 0: Command
      - 0: POSING ($35)
    - Byte 1: Response
      - 0: POSING ($35)
    - Byte 2-3: Command Control (CMD_CTRL)
      - 1-2: Command Status (CMD_CTRL)
    - Byte 4: Sensor Command Control Field (SVCMD_CTRL)
      - Byte 5: Sensor Command Status Field (SVCMD_STAT)
    - Byte 6-7: Target Position (TPOS)
      - Byte 8: Target Speed (TSPD)
      - Byte 9-10: Subcommand Control (SUB_CTRL)
      - Byte 11-12: Reserved

- **To stop positioning:**
  - For MECHATROLINK-II:
    Send the Stop Motion command (HOLD: $25)
  - For MECHATROLINK-III:
    Set the CMD_CANCEL bit of the Servo Command Control Field (SVCMD_CTRL.CMD_CANCEL) to 1 and re-execute the POSING ($35) command.

Differences from Positioning Module F3NC96-0N (with MECHATROLINK-II Interface) (4)

**Appearance (connector and cable)**

- F3NC96-0N
- F3NC97-0N

**Compatibility**

- **Hardware**
  - MECHATROLINK-II and MECHATROLINK-III differ and are incompatible in terms of communication media, connector, cable and compatible external devices.

- **Programs**
  - Both have basically similar operations but in MECHATROLINK III, some commands have been changed and some have additional parameters so program modification is required.
Direct Drive Motor
DYNASERV / LINEARSERV

- Direct drive motor featuring improved accuracy, torque, stiffness with lower heat generation.
  - DYNASERV rotational motor: Encoder resolution 4,096,000 pulse/rev max.
  - LINEARSERV linear motor: Encoder resolution 0.05 μm/pulse max.
- MECHATROLINK-II compliant DrvG III Intelligent Drive
  - High resolution coupled with high-speed position reference enables multi-axis synchronization and reduced wiring
  - Allows advanced position control, as well as higher-level driver parameter management and operation status monitoring
- Complete product lineup to suit different needs
  - Extensive application
    - Semiconductor and LCD manufacture, automatic assembly, printing, machine tool, etc.

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E-mail: ddmsales@cs.jp.yokogawa.com