User's Manual

Positioning Module (with MECHATROLINK-III Interface)

IM 34M06H60-03E

Applicable Modules:

Model Code	Model Name
F3NC97-0N	Positioning Module (with MECHATROLINK-III Interface)

YOKOGAWA
Yokogawa Electric Corporation

IM 34M06H60-03E
1st Edition

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Applicable Product:

- **Range-free Multi-controller FA-M3**

  - Model code : F3NC97-0N
  - Name : Positioning Module (with MECHATROLINK-III Interface)

The document number and document model code for this manual are given below.

Refer to the document number in all communications; also refer to the document number and the document model code when purchasing additional copies of this manual.

- Document No. : IM 34M06H60-03E
- Document Model Code : DOCIM

Media No. IM 34M06H60-03E (CD) 1st Edition : Jan. 2010 (AR)

Important

■ About This Manual

- This Manual should be passed on to the end user.
- Before using the product, read this manual thoroughly to have a clear understanding of the product.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Precautions when Using/Maintaining the Product

- The following safety symbols are used on the product as well as in this manual.

Danger. This symbol on the product indicates that the operator must follow the instructions laid out in this instruction manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument. Where indicated by this symbol, the manual describes what special care the operator must exercise to prevent electrical shock or other dangers that may result in injury or the loss of life.

Protective Ground Terminal. Before using the instrument, be sure to ground this terminal.

Function Ground Terminal. Before using the instrument, be sure to ground this terminal.

Alternating current. Indicates alternating current.

Direct current. Indicates direct current.

The following symbols are used only in the instruction manual.

WARNING

Indicates a “Warning”.

Draws attention to information essential to prevent hardware damage, software damage or system failure.

CAUTION

Indicates a “Caution”

Draws attention to information essential to the understanding of operation and functions.

TIP

Indicates a “TIP”

Gives information that complements the present topic.

SEE ALSO

Indicates a “SEE ALSO” reference.

Identifies a source to which to refer.

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by Yokogawa.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, air navigation facilities, aviation facilities or medical equipment. If so used, it is the user’s responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

■ Software Supplied by the Company

- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.
- Use the software with one computer only. You must purchase another copy of the software for use with each additional computer.
- Copying the software for any purposes other than backup is strictly prohibited.
- Store the original media, such as CD-ROM, containing the software in a safe place.
- Reverse engineering, such as decompiling of the software, is strictly prohibited.
- No portion of the software supplied by Yokogawa Electric may be transferred, exchanged, sublet or leased for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3 Controller

- **Avoid installing the FA-M3 controller in the following locations:**
  - Where the instrument will be exposed to direct sunlight, or where the operating temperature exceeds the range 0°C to 55°C (32°F to 131°F).
  - Where the relative humidity is outside the range 10% to 90%, or where sudden temperature changes may occur and cause condensation.
  - Where corrosive or flammable gases are present.
  - Where the instrument will be exposed to direct mechanical vibration or shock.
  - Where the instrument may be exposed to extreme levels of radioactivity.

- **Use the correct types of wire for external wiring:**
  - Use copper wire with temperature ratings greater than 75°C (167°F).

- **Securely tighten screws:**
  - Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
  - Tighten terminal block screws with the correct tightening torque as given in this manual.

- **Securely lock connecting cables:**
  - Securely lock the connectors of cables, and check them thoroughly before turning on the power.

- **Interlock with emergency-stop circuitry using external relays:**
  - Equipment incorporating the FA-M3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

- **Low impedance grounding:**
  - For safety reasons, connect the [FG] grounding terminal to a Japanese Industrial Standards (JIS) Class D Ground[*1] (Japanese Industrial Standards (JIS) Class 3 Ground). For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

    *1 Japanese Industrial Standard (JIS) Class D Ground means grounding resistance of 100Ω max.

- **Configure and route cables with noise control considerations:**
  - Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

- **Configure for CE Marking Conformance:**
  - For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the “Hardware Manual” (IM34M06C11-01E).

- **Keep spare parts on hand:**
  - Stock up on maintenance parts including spare modules, in advance.

- **Discharge static electricity before operating the system:**
  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- **Never use solvents such as paint thinner for cleaning:**
  - Gently clean the surfaces of the FA-M3 controller with a cloth that has been soaked in water or a neutral detergent and wringed.
  - Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.

- **Avoid storing the FA-M3 controller in places with high temperature or humidity:**
  - Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.
  - Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage temperature should be from –20°C to 75°C).
  - There is a built-in lithium battery in a CPU module and temperature control module which serves as backup power supply for programs, device information and configuration information. The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.

- **Always turn off the power before installing or removing modules:**
  - Failing to turn off the power supply when installing or removing modules, may result in damage.

- **Do not touch components in the module:**
  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.

- **Do not wire unused terminals:**
  - Do not wire unused terminals of external connection terminal blocks or unused pins of connectors of the module. Doing so may affect the function of the module.

■ Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC

(This directive is only valid in the EU.)

This product complies with the WEEE Directive (2002/96/EC) marking requirement.
The following marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste.

When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

Introduction

■ Overview of the Manual

This manual describes the specifications and functions of the F3NC97-0N positioning module (with MECHATROLINK-III Interface), as well as information required for operating the module.

■ Related Instruction Manuals

The manuals to be read depend on the CPU module to be used.
You should read the latest versions of the following instructions manuals, as required.

- **For information on the functions of the F3SP66 or F3SP67 sequence CPU modules, refer to:**
  - Sequence CPU – Functions User's Manual (for F3SP66-4S, F3SP67-6S) (IM34M06P14-01E)
  - Sequence CPU – Network Functions User's Manual (for F3SP66-4S, F3SP67-6S) (IM34M06P14-02E)

- **For information on the functions of the F3SP28, F3SP38, F3SP53, F3SP58, or F3SP59 sequence CPU modules, refer to:**
  - Sequence CPU – Functions User' Manual (for F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S, F3SP59-7S) (IM34M06P13-01E)

- **For information on the functions of the F3SP21, F3SP25, F3SP35, F3SP05, or F3SP08 sequence CPU modules, refer to:**
  - Sequence CPU – Functions User's Manual (for F3SP21, F3SP25, and F3SP35) (IM34M06P12-02E)

- **For information on the instructions used with sequence CPUs, refer to:**
  - Sequence CPU – Instructions User’s Manual (IM34M06P12-03E)

- **When creating programs using ladder language, refer to:**
  - FA-M3 Programming Tool WideField2 User’s Manual (IM34M06Q15-01E)

- **For information common to all sequence CPU modules on the specifications*, configuration*, installation, wiring, trial operation, maintenance and inspection of the FA-M3, or system-wide limitation of module installation, refer to:**

  Hardware Manual (IM34M06C11-01E)

  * : For information on the specifications of products other than power supply modules, base modules, I/O modules, cables and terminal block units, refer to their respective user’s manuals.

- **For information on CPU modules for Windows CE (F3RP42-5P, F3RP44-5P, F3RP45-5P), refer to:**
  - Network CPU Module (IM34M06M51-04E)

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■ Copyrights

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FA-M3
Positioning Module (with MECHATROLINK-III Interface)

IM 34M06H60-03E 1st Edition

CONTENTS

1. Overview

This positioning module is to be installed in the base unit of a FA-M3 range free controller system, and supports MECHATROLINK-III communications.

■ What is MECHATROLINK-III Communications?

● Overview

MECHATROLINK-III communications is a high performance, advanced, open-architecture motion field network standard published by the MECHATROLINK Members Association. It enables distributed control of multiple FA units (servo drives, inverters, I/O modules, etc.) by one FA controller.

With higher communication specification than its predecessors, namely MECHATROLINK-I of 4 Mbps transmission rate and MECHATROLINK-II of 10 Mbps transmission rate, MECHATROLINK-III features higher speed and more functions.

MECHATROLINK-III has the following features:

- Synchronous communication through cyclic transmission
- High speed transmission at 100 Mbps
- Communication cycle time options allow optimization based on the number of connected stations and transmission data size. (This module provides three communication cycle time options: 0.25 ms for 4 axes, 0.5 ms for 8 axes and 1 ms for 15 axes.)
- Reduced wiring at low cost through the use of standard Ethernet cables between external devices.
- Lower FA controller load as transmission control by the proprietary Communication ASIC includes error detection and retransmission within a communication cycle.
- Allows a FA controller acting as master to connect to other FA support tools.

● Network Connection

MECHATROLINK-III communications allows one C1 master to be connected to a maximum of 62 slaves and an optional C2 master. (The positioning module itself supports connection to a maximum of 15 slaves.)

Figure 1.1 shows the network connection for MECHATROLINK-III communications.

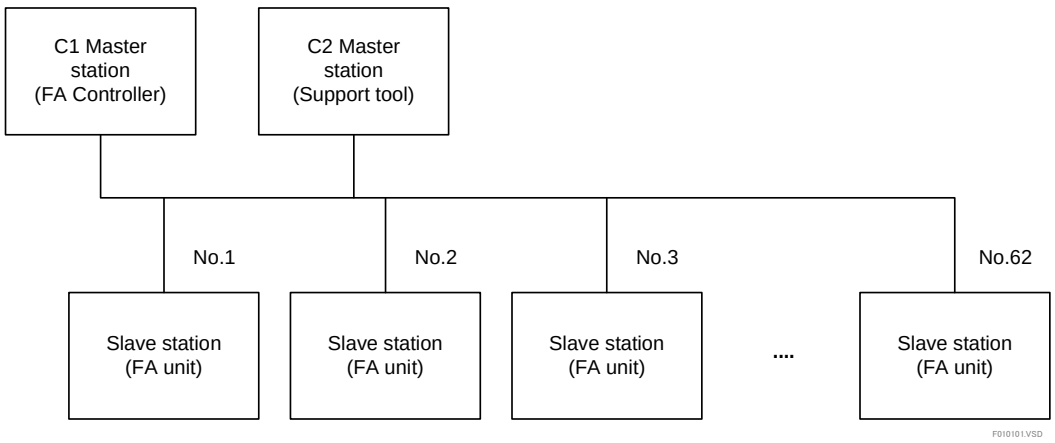

Figure 1.1 Network Connections for MECHATROLINK-III Communications

■ Module Features

The positioning module provides the C1 master function of the MECHATROLINK-III communications, transmitting MECHATROLINK-III commands to external devices (slaves) according to the instructions from a CPU module and receiving MECHATROLINK-III responses from external devices.

The module enables:

(1) Independent axis motion using MECHATROLINK-III commands

(2) Linear interpolation motion (starting and stopping multiple axes simultaneously)

(3) Reading target positions, current positions and other statuses of external devices

(4) Reading and writing parameters of external devices

(5) External device I/O

The module has the following features:

● Latest open motion field network

- MECHATROLINK-III is a high-performance, advanced, open-architecture motion field network standard published by the MECHATROLINK Members Association. It adopts proven Ethernet as its physical layer.

● Fewer cables, simpler configuration, lower wiring cost

- The module implements position control for up to 15 axes from a single slot. Controllers and motors can be connected using fewer cables terminated with easy-to-attach connectors, contributing to lower wiring cost.

● High-speed, accurate position control through high-speed, high-throughput communication

- High transmission rate of 100 Mbps and short cycle time of 0.25, 0.5, or 1 ms for 4-, 8-, or 15-axis control respectively enable shorter control cycle, faster startup, better control performance, shorter tact time, and higher productivity.
- Up to 8 monitor data (target position, current position, speed, torque, etc.) per axis can be read simultaneously for better monitoring of external device operation.
- Control by transmitted commands enables full exploitation of motor performance (high speed and high resolution) to achieve fast and accurate position control.
- Versatile position control includes linear interpolation motion of up to 15 axes (starting and stopping multiple axes simultaneously), simultaneous linear interpolation motion of any combination of axes, and change of speed or target position during motion.

● Flexible system configuration

- Cascade and star network topologies with inter-station distance up to 100 m are supported, enabling optimal system configuration.

● More compatible external devices upcoming

- In addition to AC servomotors from Yaskawa Electric Corporation, stepping motors, external I/O equipment, and inverters from other manufacturers will be supported in the future.

■ Module Operation

Figure 1.2 shows the principle behind the operation of the positioning module.

● Independent axis motion using MECHATROLINK-III commands

The procedure for initiating a positioning motion by sending a MECHATROLINK-III command is given below.

- From the CPU module, a program writes the command code ($35) for the positioning command (POSING: $35), as well as other command parameters such as target position (reference unit) and target speed (reference unit/s) to the command parameters area.
- After writing completes, the program turns on the Send Command output relay. The corresponding MECHATROLINK-III command is transmitted to the external device (e.g. servo drive) to initiate the desired positioning motion in the external device.
- The Response Received input relay turns on when a response to the transmitted MECHATROLINK-III command is received.
- The Positioning Completed input relay turns on subsequently when the positioning motion completes.

● Linear interpolation motion (starting and stopping multiples axes simultaneously)

The procedure for performing linear interpolation is given below.

- From the CPU module, a program writes the command code ($100) and other command parameters for the interpolation motion command such as acceleration time (in ms), deceleration time (in ms), and interpolation axes, as well as the target position (reference unit) and target speed (reference unit/s) of each motion axis to the command parameters area.
- After writing completes, the program turns on the Send Command output relay. The module computes the target position at each communication cycle, and transmits the computed target position to all external devices involved in the linear interpolation motion simultaneously using MECHATROLINK-III commands to initiate the desired positioning motion.
- The Response Received input relay turns on when positioning motion begins.
- The Positioning Completed input relay turns on subsequently when positioning motion completes.

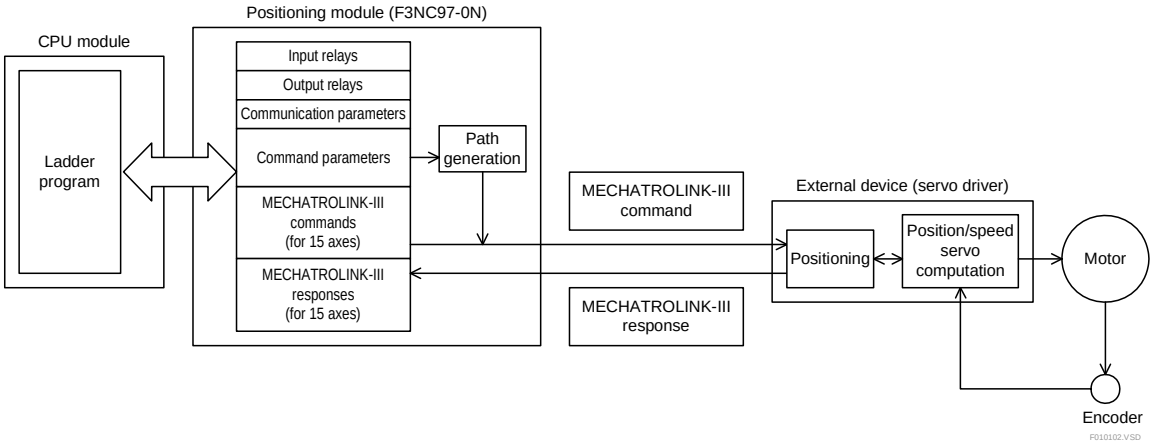

Figure 1.2 Operating Principle of the Positioning Module

WARNING

Machine fault or misoperation may cause a motor to behave in an unexpected manner. All motors should be wired according to manufacturers' recommendations to allow external power shutdown and emergency stop.

2. Overview of Positioning Functions

The positioning module (with MECHATROLINK-III Interface) provides positioning by MECHATROLINK-III standard servo profile commands and positioning by interpolation motion commands. The module implements the latter by computing and sending position references required for implementing an interpolation motion.

2.1 Positioning by Standard Servo Profile Commands

This section gives an overview of positioning by MECHATROLINK-III standard servo profile commands executable by the module.

For details on the operation of each of these commands, as well as other MECHATROLINK-III standard servo profile commands, refer to the technical documentation published by the MECHATROLINK Members Association (MMA) or user manuals published by Yaskawa Electric Corporation, as listed in the tables below.

Table 2.1 List of MECHATROLINK-III Technical Documents published by the MECHATROLINK Members Association

Document Name	Document Number	Description
MECHATROLINK-III Overview	MLC07-003	Gives an overview of MECHATROLINK-III.
MECHATROLINK-III Protocol Specifications	MMATDEP020A	Describes the physical layer, data link layer and application layer of MECHATROLINK-III.
MECHATROLINK-III Command Specifications for Standard Servo Profile	MMATDEP021A	Describes the MECHATROLINK-III command specifications for standard servo profile.
MECHATROLINK-III Command Specifications for Standard I/O Profile	MMATDEP022A	Describes the MECHATROLINK-III command specifications for standard I/O profile.

Note: MECHATROLINK Members Association (MMA) membership is required for accesing technical documentation published by MMA.

Table 2.2 List of Manuals for MECHATROLINK- III Compatible Products manufactured by Yaskawa Electric Corporation

Document Name	Document Number	Description
AC Servodrive Σ -V Series USER'S MANUAL: Design and Maintenance (Rotational Motor MECHATROLINK-III Command Option Type)	SIEP S800000 64A	Describes information required for design and maintenance for the Σ -V Series SERVOPACK (Rotational Motor MECHATROLINK-III Command Option Type)
AC Servodrive Σ -V Series USER'S MANUAL: Design and Maintenance (Linear Motor MECHATROLINK-III Command Option Type)	SIEP S800000 65A	Describes information required for design and maintenance for the Σ -V Series SERVOPACK (Linear Motor MECHATROLINK-III Command Option Type)
AC Servodrive Σ -V Series USER'S MANUAL: MECHATROLINK-III Standard Servo Profile Commands	SIEP S800000 63A	Describes the specifications of standard servo profile commands used in MECHATROLINK-III communication for the Σ -V Series SERVOPACK

■ Positioning Command (POSING: $35)

The POSING command is used to execute positioning to a specified position.

Positioning is executed to the target position (P1) at the positioning speed.

To cancel a POSING command execution, set SVCMD_CTRL.CMD_CANCEL (the CMD_CANCEL bit of the Servo Command Control Field) to 1 and re-execute the POSING command; to pause a POSING command execution, set SVCMD_CTRL.CMD_PAUSE to 1 and re-execute the POSING command.

Confirm the completion of motion reference output by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.PSET = 1.

To change the speed during motion or change the target position during motion, change the command value and re-execute the POSING command.

If the new position provides inadequate allowance for the deceleration distance, or if the new position is in the reverse direction relative to the current motion direction, the motion is decelerated to a stop before positioning to the new position.

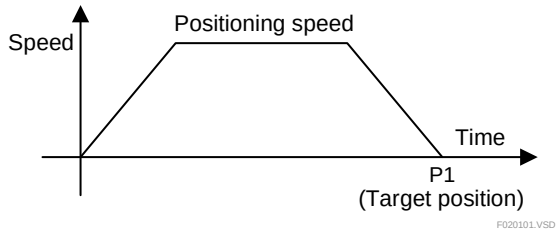

Figure 2.1 Operation Example for Positioning Command (POSING: $35)

■ Feed Command (FEED: $36)

The FEED command is used to perform constant speed feed control at a specified feed speed.

To cancel a FEED command execution, set SVCMD_CTRL.CMD_CANCEL (the CMD_CANCEL bit of the Servo Command Control Field) to 1 and re-execute the FEED command; to pause a FEED command execution, set SVCMD_CTRL.CMD_PAUSE to 1 and re-execute the FEED command.

Confirm the completion of motion reference output by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.PSET = 1.

To change the speed and/or direction during motion, change the feed speed setting and re-execute the FEED command. If a direction change is required, the motion is decelerated to a stop before operation is initiated in the reverse direction.

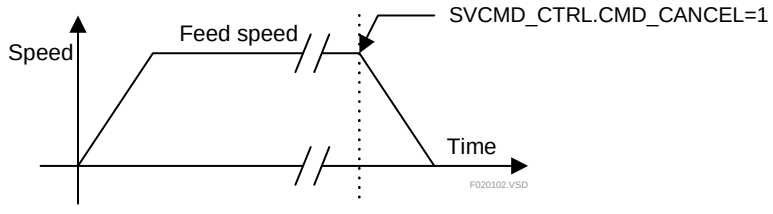

Figure 2.2 Operation Example for Feed Command (FEED：$36)

■ External Input Feed Command (EX_FEED: $37)

The EX_FEED command performs positioning in response to the input of the external positioning signal during constant speed feed at the specified feed speed.

When the external positioning signal is input during constant speed feed, the current position counter (P2) is latched, and motion is then decelerated to a stop at position P3 by traveling through the external positioning final travel distance specified by a parameter.

If the travel distance required for deceleration to a stop is longer than the specified external positioning final travel distance, the motion is first decelerated to a stop according to the deceleration pattern, and then a return to the target position is executed before command execution ends.

The external signal used to latch the current position is specified by SVCMD_CTRL.LT_SEL.

To cancel an EX_FEED command execution, set SVCMD_CTRL.CMD_CANCEL (the CMD_CANCEL bit of the Servo Command Control Field) to 1 and re-execute the EX_FEED command; to pause an EX_FEED command execution, set SVCMD_CTRL.CMD_PAUSE to 1 and re-execute the EX_FEED command.

Confirm the completion of motion reference output by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.PSET = 1.

To change the speed and/or direction during motion, change the speed feed setting and re-execute the EX_FEED command. If a direction change is required, the motion is decelerated to a stop before operation is initiated in the reverse direction.

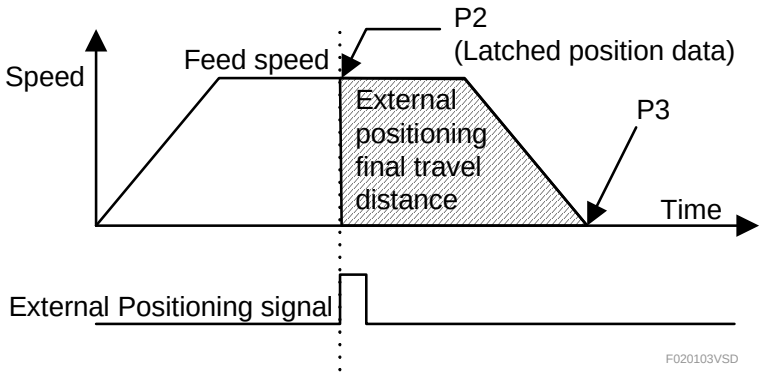

Figure 2.3 Operation Example for External Input Feed Command（EX_FEED: $37) (Positioning after Latching)

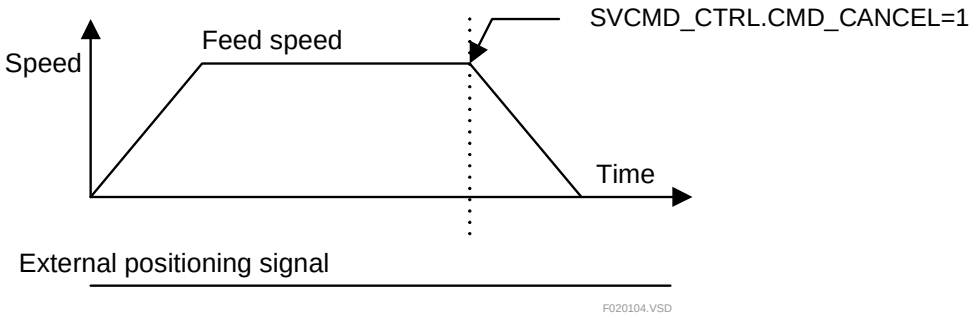

Figure 2.4 Operation Example for External Input Feed Command（EX_FEED: $37) (Interrupted Operation)

■ External Input Positioning Command (EX_POSING: $39)

The EX_POSING command performs positioning in response to the input of the external positioning signal during positioning to a specified position.

When the external positioning signal is input during positioning to a specified position (P1), the current position counter (P2) is latched, and motion is then decelerated to a stop at position P3 by traveling through the external positioning final travel distance specified by a parameter.

If the travel distance required for deceleration to a stop is longer than the specified external positioning final travel distance, the motion is first decelerated to a stop according to the deceleration pattern, and then a return to the target position is executed before command execution ends.

The external signal used to latch the current position is specified by SVCMD_CTRL.LT_SEL.

To cancel an EX_POSING command execution, set SVCMD_CTRL.CMD_CANCEL (the CMD_CANCEL bit of the Servo Command Control Field) to 1 and re-execute the EX_POSING command; to pause an EX_POSING command execution, set SVCMD_CTRL.CMD_PAUSE to 1 and re-execute the EX_POSING command.

Confirm the completion of motion reference output by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.PSET = 1.

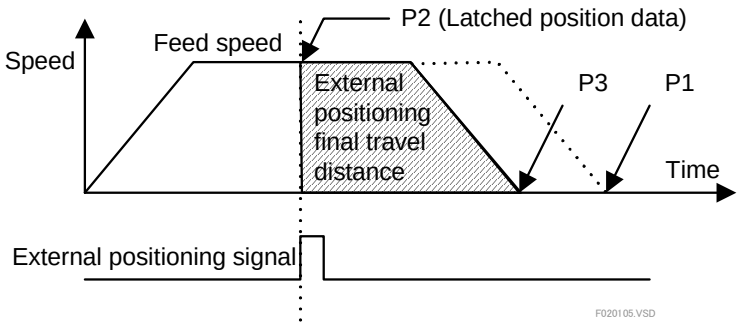

Figure 2.5 Operation Example for External Input Positioning Command (EX_POSING: $39) (Positioning after Latching)

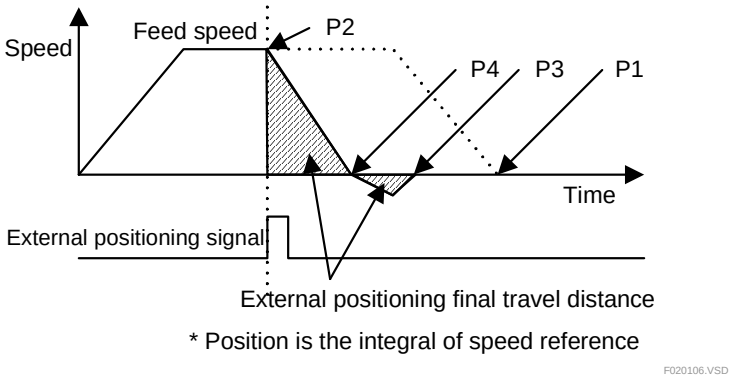

Figure 2.6 When Motion Cannot be Decelerated to a Stop Using the Specified External Positioning Final Travel

■ Zero Point Return Command (ZRET: $3A)

The ZRET command is used to perform a zero point return operation using the zero point limit switch and the position latch signal.

The signal used to latch the position is specified by SVCMD_CTRL.LT_SEL.

The zero point return direction and zero point return type is specified by MODE.

To cancel a ZRET command execution, set SVCMD_CTRL.CMD_CANCEL (the CMD_CANCEL bit of the Servo Command Control Field) to 1 and re-execute the ZRET command; to pause a ZRET command execution, set SVCMD_CTRL.CMD_PAUSE to 1 and re-execute the ZRET command.

Confirm the completion of motion reference output by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.ZPOINT=1 and SVCMD_IO.PSET = 1.

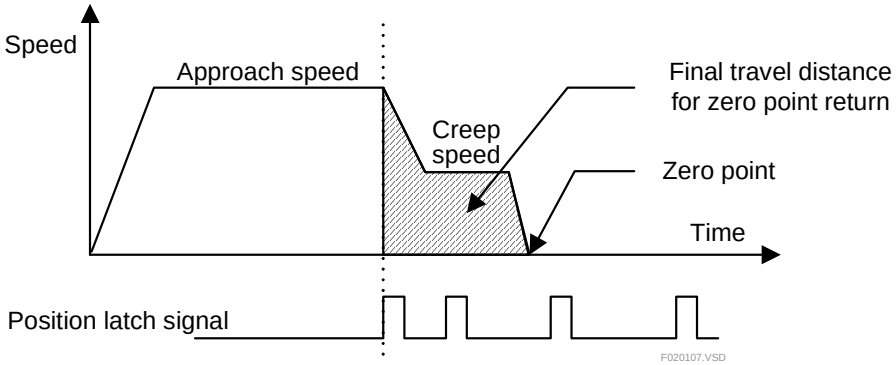

Figure 2.7 Operation Example for Zero Point Return Command (ZRET: $3A) (When MODE=0)

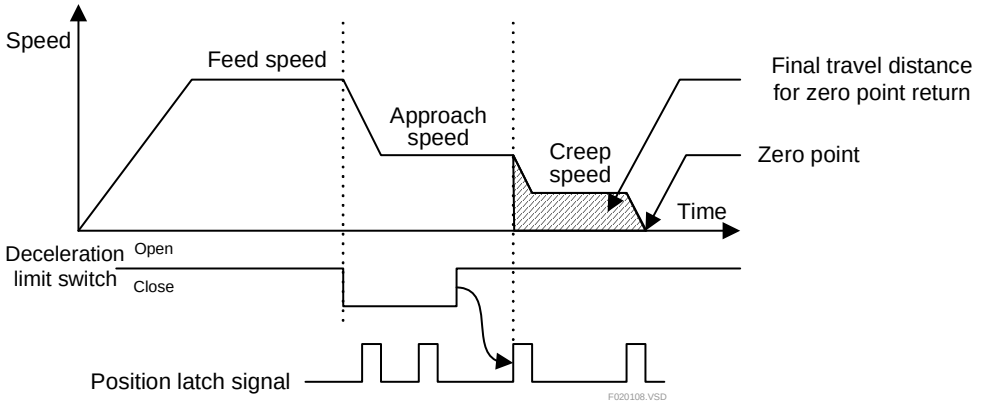

Figure 2.8 Operation Example for Zero Point Return Command (ZRET: $3A) (When MODE=1)

2.2 Positioning by Interpolation Motion Commands

This section describes positioning by interpolation motion commands executable by the module.

■ Start Positioning Command ($0100)

The Start Positioning command executes linear interpolation motion (starting and stopping multiples axes simultaneously) for up to 15 axes.

The axis from which the command is issued is known as the "reference axis" (or command axis), while the other axes involved in the interpolation motion are known as "interpolation axes".

Interpolation axes are specified using the Interpolation Axes parameter of the reference axis at the time of command execution.

While a linear interpolation motion is in progress, another linear interpolation motion can be executed using a different set of axes, which are at rest. Up to 15 axes can be made to move this way. Concurrent execution of two or more linear interpolation motions with overlapping sets of axes is, however, not allowed.

Target position and speed must be specified for each motion axis (reference axis and interpolation axes). In order that all motion axes can stop at the same time, this module computes the attained speed of each axis to accommodate the axis that requires the longest travel time (as detected by the module). Each axis then moves according to its attained speed, regardless of its preset speed.

To stop a linear interpolation motion, execute a Decelerate and Stop command ($0200) or a Stop Immediately command ($0300) against the reference axis, which is the axis from which the Start Positioning command was originally issued.

To change the speed or target position during a linear interpolation motion, execute a Change Speed command ($0400) or a Change Target Position command ($0500) against the reference axis, which is the axis from which the Start Positioning command was originally issued.

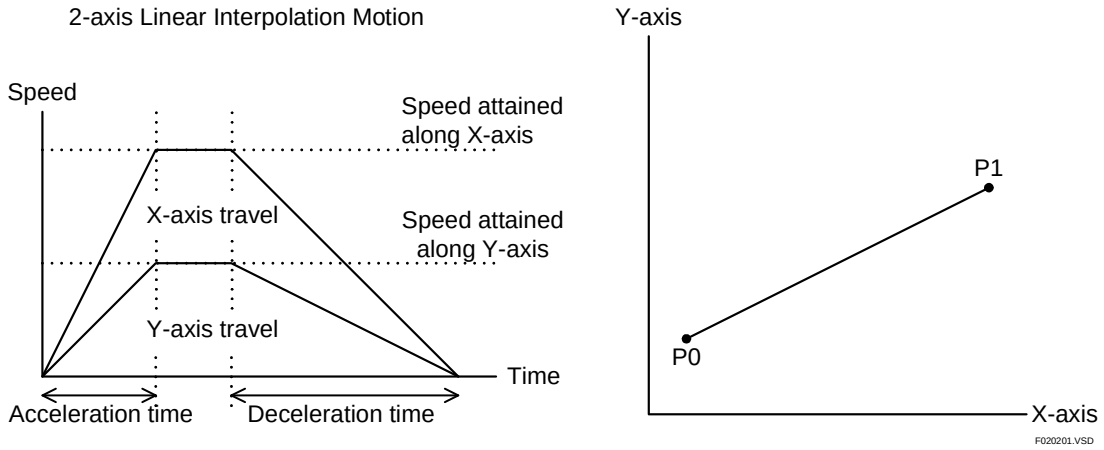

Figure 2.9 Linear Interpolation Motion Initiated by Start Positioning Command ($0100)

■ Change Speed command ($0400)

The Change Speed command can be executed to change the speeds of moving axes during a linear interpolation motion.

Changing the set of motion axes during linear interpolation motion is, however, not allowed. Executing a Change Speed command is also not allowed while a target position change is in progress.

When the axes approach the target position after a speed change, they decelerate to a stop according to the deceleration time specified in the Change Speed command.

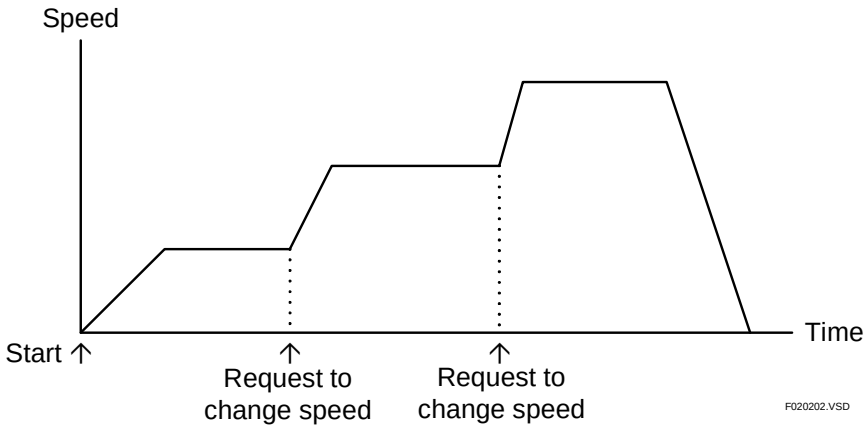

Figure 2.10 Operation Example fof Change Speed Command ($0400)

■ Change Target Position Command ($0500)

The Change Target Position command is executed to change the target positions of moving axes during a linear interpolation motion.

Changing the set of motion axes during linear interpolation motion is, however, not allowed. Execution of a Change Target Position command is also not allowed while a target position change is in progress.

The target speed can also be changed together with the target position using a Change Target Position Command.

If a Change Target Position command is executed in 'positioning completed' state, a Start Positioning sequence is executed.

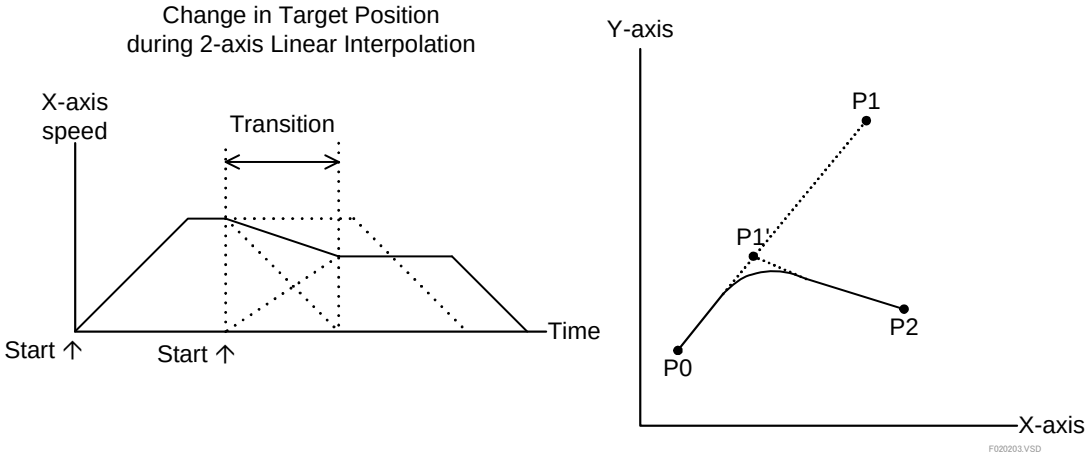

Figure 2.11 Operation Example for Change Target Position Command ($0500)

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3. Module Specifications

3.1 Specifications

■ Model Name and Suffix Code

Table 3.1 Model Name and Suffix Code

Model	Suffix Code	Style Code	Option Code	Description
F3NC97	-0N	.....	.....	Controls up to 15 axes with MECHATROLINK-III interface

■ Operating Environment

This module is compatible with the following CPU modules.

Table 3.2 CPU Module Restrictions

CPU Module	Style Code and ROM Version
F3SP28-3N, F3SP38-6N F3SP53-4H, F3SP58-6H	Rev. 7 or later
Other CPUs	No restriction

■ General Specifications

Table 3.3 General Specifications

Item		Specifications
Interface		MECHATROLINK-III compliant
Physical layer		Ethernet
Transmission rate		100 Mbps
Cycle time / No. of stations		0.25 ms for 4 axes, 0.5 ms for 8 axes, or 1.0 ms for 15 axes
Transmission bytes		16, 32, 48, or 64 bytes (intermixing allowed)
Communications method		Cyclic communication
Network topology		Cascade or star
Transmission media		Ethernet STP Cat5e (dedicated cable)
Maximum transmission distance		100 m (between stations)
Minimum distance between stations		0.2 m
Supported profiles		- Standard servo profile - Standard I/O profile
Positioning functions	Position reference	-2,147,483,648 to 2,147,483,647 (reference unit)
	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) and speed/target position change during motion
	Others	- Status monitoring of external devices (target position, current position, speed, and torque) - Reading and writing parameters of external devices - External device I/O using standard I/O profile commands
Number of installed modules		8 modules max. (controlling 120 axes max.)
Current consumption		530 mA (at 5 V DC)
External connection		Two MECHATROLINK-III connectors (industrial mini-connector)
External dimensions		28.9 (W) × 100 (H) × 83.2 (D) mm *
Weight		130 g
Operating ambient temperature		0 to 55°C
Operating ambient humidity		10 to 90% RH (non-condensing)
Operating ambient atmosphere		Must be free of corrosive gases, flammable gases and heavy dust
Storage ambient temperature		-20 to 75°C
Storage ambient humidity		10 to 90% RH (non-condensing)

*: Excluding protrusions (for details, see external dimensions drawing)

3.2 Compatible External Devices and Cables

■ Servo Drives, I/O Equipment

● Products from Yaskawa Electric Corporation

Table 3.4 Servo Drives, I/O Equipment

Product	Model	Description
AC Servo Drive Σ-V Series MECHATROLINK-III Command Option type SERVOPACK	SGDV-□□□□2□□	
64-point I/O module	JEPMC-MTD2310-E	

■ MECHATROLINK-III Communications Cable

● Products from Yaskawa Controls Co., Ltd.

Table 3.5 MECHATROLINK-III Communications Cable

Product	Model	Description
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

■ MECHATROLINK-III Dedicated Hub

● Products from Yaskawa Electric Corporation

Table 3.6 MECHATROLINK-III Dedicated Hub

Product	Model	Description
MECHATROLINK-III compatible hub module	JEPMC-MT2000-E	

3.3 Scope of MECHATROLINK-III Support

3.3.1 Profile Types

The profile types supported by the module and the corresponding data size in bytes are listed in the table below.

Table 3.7 Profile Type and Number of Data Bytes

Profile Code	Profile	Description	Data Size (bytes)
$10	Standard servo profile	Profile supported by MECHATROLINK-III compliant standard servo products	32 or 48
$30	Standard I/O profile	Profile supported by MECHATROLINK-III compliant standard I/O products	16, 32, 48 or 64

3.3.2 Standard Servo Profile Commands

This section lists the MECHATROLINK-III standard servo profile commands that are executable by the module.

◎: Executable by a user using MECHATROLINK-III command parameters of each axis.

○: Executable by a user using extended MECHATROLINK-III command parameters.

△: Not executable by a user but is executed automatically by the positioning module or external device.

×: Not supported

■ Standard Servo Profile Main Commands

Table 3.8 Standard Servo Profile Main Command List

Profile	Command Code	Command	Function	Communi-cation Type	Supported
Common commands	$00	NOP	No operation	A	◎
	$01	PRM_RD	Read parameter	A	×*1
	$02	PRM_WR	Write parameter	A	×*1
	$03	ID_RD	Read ID	A	○
	$04	CONFIG	Setup device	A	◎
	$05	ALM_RD	Read alarm or warning	A	○
	$06	ALM_CLR	Clear alarm or warning	A	◎
	$0D	SYNC_SET	Start synchronous communication	A	◎
	$0E	CONNECT	Establish connection	A	△
	$0F	DISCONNECT	Release connection	A	△
	$1B	PPRM_RD	Read stored parameter	A	×*1
	$1C	PPRM_WR	Write stored parameter	A	×*1
	$1D	MEM_RD	Read memory	A	○
	$1E	MEM_WR	Write memory	A	○
Standard servo	$20	POS_SET	Set coordinates	A	◎
	$21	BRK_ON	Apply brake	A	◎*2
	$22	BRK_OFF	Release brake	A	◎*2
	$23	SENS_ON	Turn sensor ON	A	◎
	$24	SENS_OFF	Turn sensor OFF	A	◎
	$30	SMON	Servo status monitor	A	◎
	$31	SV_ON	Servo ON	A	◎
	$32	SV_OFF	Servo OFF	A	◎
	$34	INTERPOLATE	Interpolation	S	△
	$35	POSING	Positioning	A	◎
	$36	FEED	Feed	A	◎
	$37	EX_FEED	External input feed	A	◎
	$39	EX_POSING	External input positioning	A	◎
	$3A	ZRET	Zero point return	A	◎
	$3C	VELCTRL	Velocity control	A	◎
	$3D	TRQCTRL	Torque control	A	◎
	$40	SVPRM_RD	Read servo parameter	A	◎
	$41	SVPRM_WR	Write servo parameter	A	◎

*1: The standard servo command profile does not use PRM_RD, PRM_WR, PPRM_RD and PPRM_WR, but uses SVPRM_RD and SVPRM_WR instead.

*2: Brake ON/OFF should be controlled by an external device n tandem with Servo ON/OFF commands.

Table 3.9 Communication Type

Symbol	Communication Type
S	Synchronous communication command
A	Asynchronous communication command

■ Standard Servo Profile Subcommands

Table 3.10 Standard Servo Profile Subcommand List

Profile	Command Code	Command	Function	Supported
Standard servo	$00	NOP	No operation	△
	$01	PRM_RD	Read parameter	×*1
	$02	PRM_WR	Write parameter	×*1
	$05	ALM_RD	Read alarm or warning	×
	$06	ALM_CLR	Clear alarm or warning	×
	$1B	PPRM_RD	Read stored parameter	×*1
	$1C	PPRM_WR	Write stored parameter	×*1
	$1D	MEM_RD	Read memory	×
	$1E	MEM_WR	Write memory	×
	$30	SMON	Servo status monitor	△
	$40	SVPRM_RD	Read servo parameter	×
	$41	SVPRM_WR	Write servo parameter	×

*1: The standard servo command profile does not use PRM_RD, PRM_WR, PPRM_RD and PPRM_WR, but uses SVPRM_RD and SVPRM_WR instead.

3.3.3 Standard I/O Profile Commands

This section lists the MECHATROLINK-III standard I/O profile commands that are executable by the module.

◎: Executable by a user using MECHATROLINK-III command parameters of each axis.

○: Executable by a user using extended MECHATROLINK-III command parameters.

△: Not executable by a user but is executed automatically by the positioning module or external devices.

×: Not supported

■ Standard I/O Profile Commands

Table 3.11 List of Standard I/O Profile Commands

Profile	Command Code	Command	Function	Communi-cation Type	Supported
Common commands	$00	NOP	No operation	A	◎
	$01	PRM_RD	Read parameter	A	×
	$02	PRM_WR	Write parameter	A	×
	$03	ID_RD	Read ID	A	○
	$04	CONFIG	Setup device	A	◎
	$05	ALM_RD	Read alarm or warning	A	○
	$06	ALM_CLR	Clear alarm or warning	A	◎
	$0D	SYNC_SET	Start synchronous communication	A	×
	$0E	CONNECT	Establish connection	A	△
	$0F	DISCONNECT	Release connection	A	△
	$1B	PPRM_RD	Read stored parameter	A	×
	$1C	PPRM_WR	Write stored parameter	A	×
	$1D	MEM_RD	Read memory	A	×
	$1E	MEM_WR	Write memory	A	×
Standard I/O	$20	DATA_RWA	Data Read/write_a	A	◎
	$21	DATA_RWS	Data Read/write_s	S	×

Table 3.12 Communication Type

Symbol	Communication Type
S	Synchronous communication command
A	Asynchronous communication command

3.4 Components and Their Functions

■ Appearance and Construction

The outer appearance of the module is shown in the figure below.

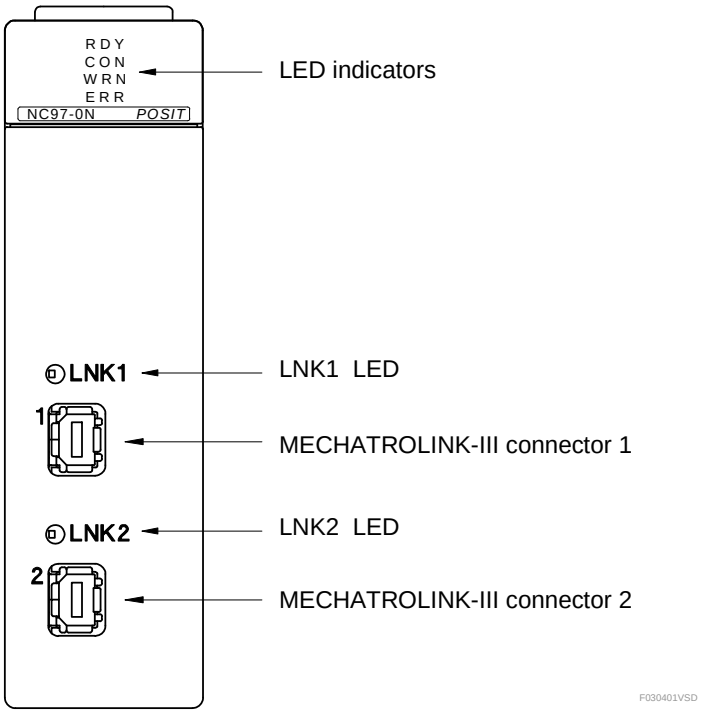


Figure 3.1 Appearance and Part Names

■ Component Functions

● LED Indicators

The various LED indicators turn on or turn off to indicate the operating status of the module.

Table 3.13 LED Indicators

Name (color)	Description	Lit	Not Lit
RDY (green)	Status of internal circuitry	Normal	Error
CON (green)	MECHATROLINK-III communication status	Communicating	Not communicating
WRN (yellow)	Warning status	Warning detected	No warning
ALM (red)	Error status	Error detected	No error

● LNK1 LED, LNK2 LED

The LNK1 and LNK2 LED indicators are lit when an external device is connected to the LNK1 and LNK2 connectors respectively.

● MECHATROLINK-III Connectors 1 and 2

These connectors are used for connecting MECHATROLINK-III compliant external devices.

The table below shows the pin assignments for the module's MECHATRONLINK IIII connectors used for attaching MECHATROLINK-III compliant external devices.

Table 3.14 MECHATROLINK-III Connector Specifications

Pin No.	Signal	Function
1	TXP	Send data (+)
2	TXN	Send data (-)
3	RXP	Receive data (+)
4	–	
5	–	
6	RXN	Receive data (-)
7	–	
8	–	

Note: The connector shell is connected to the FG terminal.
These signal lines are isolated from the internal circuitry by pulse transformers.

3.5 External Dimensions

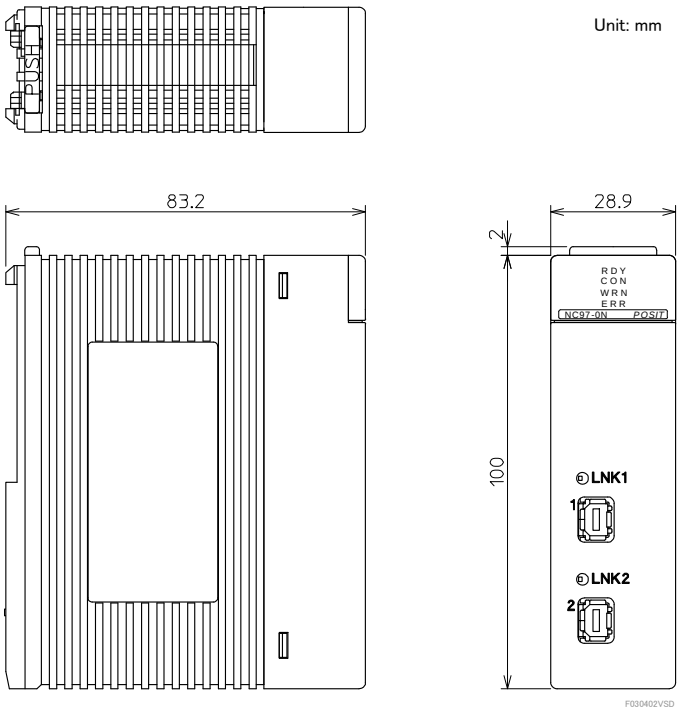


Figure 3.2 External Dimensions Drawing

3.6 Attaching/Detaching the Module

■ Attaching the Module

Figure 3.3 shows how to attach this module to the base module. First hook the anchor slot at the bottom of the module to be attached onto the anchor pin on the bottom of the base module. Push the top of the module toward the base module until the anchor/release button clicks into place.

CAUTION

Always switch off the power before attaching or detaching the module.

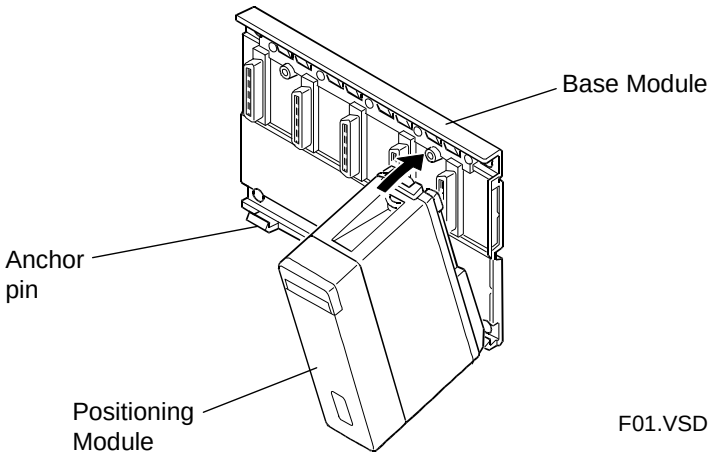


Figure 3.3 Attaching/Detaching the Module

CAUTION

Do not bend the connector on the rear of the module by force during the above operation. If the module is pushed with improper force, the connector may bend causing an error.

■ Detaching the Module

To remove this module from the base module, reverse the above operation.

Press the anchor/release button on the top of this module to unlock it and tilt the module away from the base module.

■ Attaching the Module in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the module with a screw.

Use screws of type listed in the table below.

Insert these screws into the screw holes on top of the module and tighten them with a Phillips screwdriver.

Required Screw
Binding head machine screw M4 of 12 to 15 mm long (washer screw of 14-15 mm long)

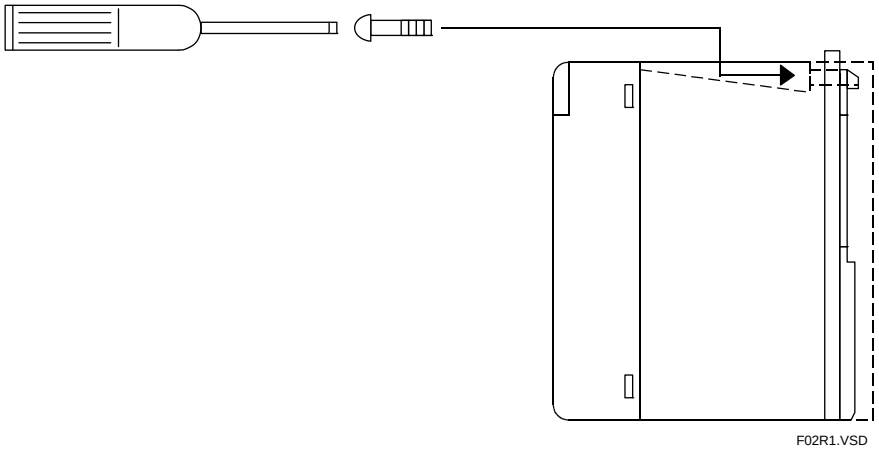


Figure 3.4 Securing Module Using Screws

3.7 Connecting to External Devices

The positioning module uses MECHATROLINK-III dedicated cables for connecting MECHATROLINK-III compliant external devices.

Attach the connector of a MECHATROLINK-III cable to the MECHATROLINK-III connector 1 or MECHATROLINK-III connector 2 of the module.

■ Network Topology

Both cascade and star network configurations are supported.

● Cascade topology

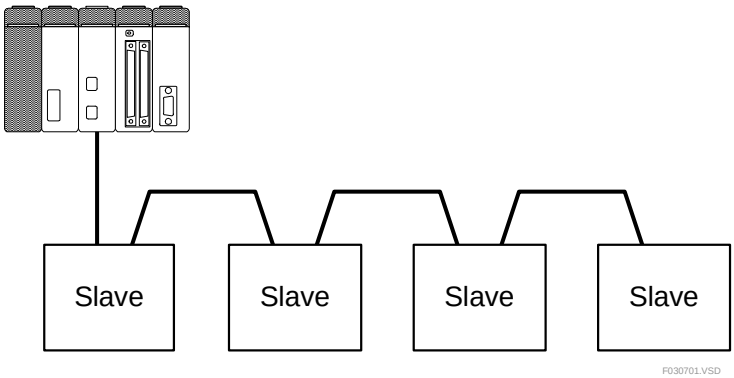


Figure 3.5 Cascade Network Configuration for MECHATROLINK-III Communications

● Star topology

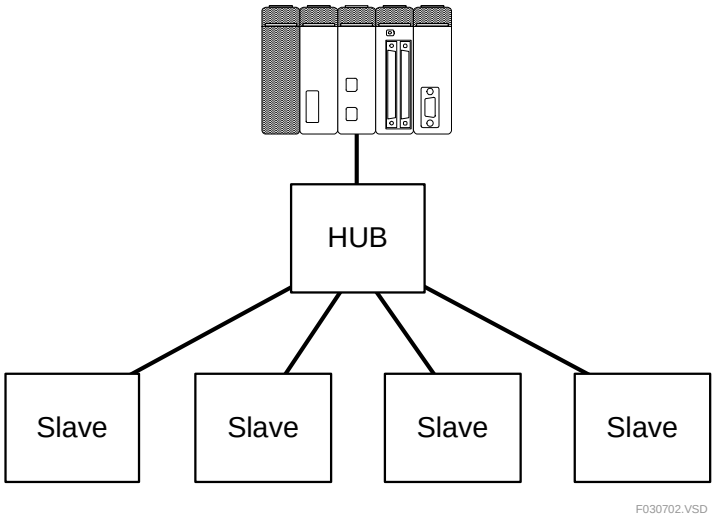


Figure 3.6 Star Network Configuration for MECHATROLINK-III Communications

WARNING

Machine fault or misoperation may cause a motor to behave in an unexpected manner. All motors should be wired according to manufacturers' recommendations to allow external power shutdown and emergency stop.

■ Precautions on Wiring of MECHATROLINK-III Cable

Observe the following precautions when wiring MECHATROLINK-III communication cables.

● Cable

Always use a MECHATROLINK-III dedicated cable for connection.

● Inter-station cable length

All cables between stations must be kept within 0.2 m and 100 m long.

● Detaching a MECHATROLINK-III communication cable

Follow the procedure shown in the figure below when detaching a cable connector. Always slide the lock injector of the connector towards the module to release the lock before pulling out the connector.

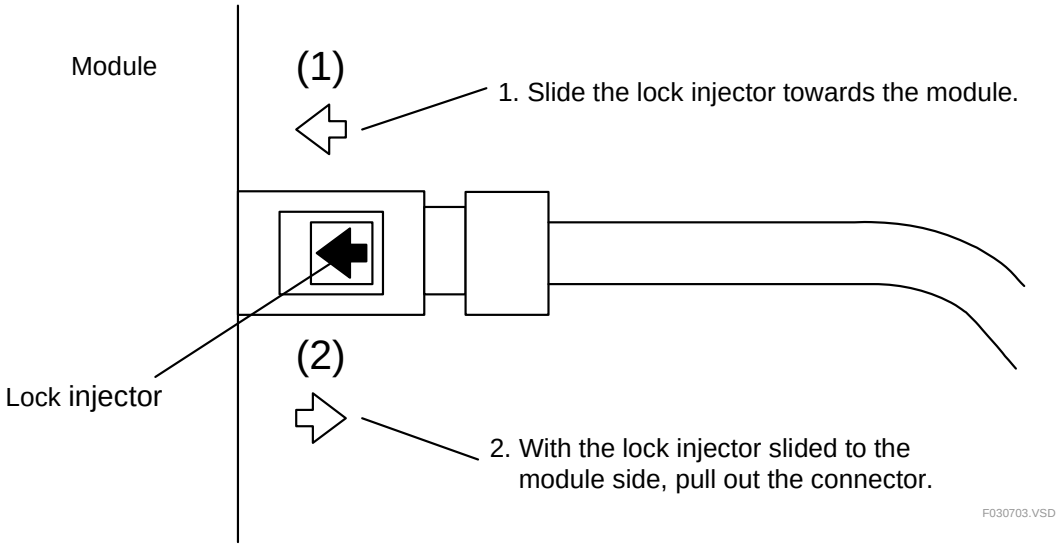


Figure 3.7 How to Detach MECHATROLINK-III Communication Cables

CAUTION

Pulling out a cable connector without first releasing its lock may damage the connector.

4. Input/Output Relays, Parameters and Statuses

4.1 List of Input/Output Relays

This module provides 32 input relays and 32 output relays for interfacing with the CPU module of a FA-M3 system.

4.1.1 Input Relays

Figure 4.1 shows a list of input relays that are provided with the module.

Each input relay can be made to raise an interrupt signal to the CPU module when it switches from OFF to ON.

In the table, "□□□" denotes the FA-M3 slot number where the module is mounted.

Table 4.1 List of Input Relays

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□01	AX1 Response Received	Turns on when a MECHATROLINK-III response for axis 1 is received.	Turning off Y□□□33 also turns off this relay.
X□□□02	AX2 Response Received	Turns on when a MECHATROLINK-III response for axis 2 is received.	Turning off Y□□□34 also turns off this relay.
X□□□03	AX3 Response Received	Turns on when a MECHATROLINK-III response for axis 3 is received.	Turning off Y□□□35 also turns off this relay.
X□□□04	AX4 Response Received	Turns on when a MECHATROLINK-III response for axis 4 is received.	Turning off Y□□□36 also turns off this relay.
X□□□05	AX5 Response Received	Turns on when a MECHATROLINK-III response for axis 5 is received.	Turning off Y□□□37 also turns off this relay.
X□□□06	AX6 Response Received	Turns on when a MECHATROLINK-III response for axis 6 is received.	Turning off Y□□□38 also turns off this relay.
X□□□07	AX7 Response Received	Turns on when a MECHATROLINK-III response for axis 7 is received.	Turning off Y□□□39 also turns off this relay.
X□□□08	AX8 Response Received	Turns on when a MECHATROLINK-III response for axis 8 is received.	Turning off Y□□□40 also turns off this relay.
X□□□09	AX9 Response Received	Turns on when a MECHATROLINK-III response for axis 9 is received.	Turning off Y□□□41 also turns off this relay.
X□□□10	AX10 Response Received	Turns on when a MECHATROLINK-III response for axis 10 is received.	Turning off Y□□□42 also turns off this relay.
X□□□11	AX11 Response Received	Turns on when a MECHATROLINK-III response for axis 11 is received.	Turning off Y□□□43 also turns off this relay.
X□□□12	AX12 Response Received	Turns on when a MECHATROLINK-III response for axis 12 is received.	Turning off Y□□□44 also turns off this relay.
X□□□13	AX13 Response Received	Turns on when a MECHATROLINK-III response for axis 13 is received.	Turning off Y□□□45 also turns off this relay.
X□□□14	AX14 Response Received	Turns on when a MECHATROLINK-III response for axis 14 is received.	Turning off Y□□□46 also turns off this relay.
X□□□15	AX15 Response Received	Turns on when a MECHATROLINK-III response for axis 15 is received.	Turning off Y□□□47 also turns off this relay.
X□□□16	Communication Status	Turns on while MECHATROLINK-III communication is in progress; turns off otherwise.	Turning on Y□□□48 to initiate communication turns on this relay when communication begins. Turning off Y□□□48 also turns off this relay.
X□□□17	AX1 Positioning Completed	Turns on when axis 1 is in positioning completed state.	
X□□□18	AX2 Positioning Completed	Turns on when axis 2 is in positioning completed state.	
X□□□19	AX3 Positioning Completed	Turns on when axis 3 is in positioning completed state.	
X□□□20	AX4 Positioning Completed	Turns on when axis 4 is in positioning completed state.	
X□□□21	AX5 Positioning Completed	Turns on when axis 5 is in positioning completed state.	
X□□□22	AX6 Positioning Completed	Turns on when axis 6 is in positioning completed state.	
X□□□23	AX7 Positioning Completed	Turns on when axis 7 is in positioning completed state.	
X□□□24	AX8 Positioning Completed	Turns on when axis 8 is in positioning completed state.	
X□□□25	AX9 Positioning Completed	Turns on when axis 9 is in positioning completed state.	
X□□□26	AX10 Positioning Completed	Turns on when axis 10 is in positioning completed state.	
X□□□27	AX11 Positioning Completed	Turns on when axis 11 is in positioning completed state.	
X□□□28	AX12 Positioning Completed	Turns on when axis 12 is in positioning completed state.	
X□□□29	AX13 Positioning Completed	Turns on when axis 13 is in positioning completed state.	
X□□□30	AX14 Positioning Completed	Turns on when axis 14 is in positioning completed state.	
X□□□31	AX15 Positioning Completed	Turns on when axis 15 is in positioning completed state.	
X□□□32	Error/Warning Detected	Turns on when an error or warning is detected by the module or any axis.	Turning on Y□□□64 to clear all errors and warnings turns off this relay if errors and warnings are successfully cleared.

4.1.2 Output Relays

Figure 4.2 shows a list of output relays that are provided with the module.

In the table, "□□□" denotes the FA-M3 slot number where the module is mounted.

Table 4.2 List of Output Relays

Output Relay No.	Signal Name	Description	Relation with Other Relays
Y□□□33	AX1 Send Command	Request to send MECHATROLINK-III command for axis 1.	Turn off this relay after verifying that X□□□01 has turned on.
Y□□□34	AX2 Send Command	Request to send MECHATROLINK-III command for axis 2	Turn off this relay after verifying that X□□□02 has turned on.
Y□□□35	AX3 Send Command	Request to send MECHATROLINK-III command for axis 3	Turn off this relay after verifying that X□□□03 has turned on.
Y□□□36	AX4 Send Command	Request to send MECHATROLINK-III command for axis 4	Turn off this relay after verifying that X□□□04 has turned on.
Y□□□37	AX5 Send Command	Request to send MECHATROLINK-III command for axis 5	Turn off this relay after verifying that X□□□05 has turned on.
Y□□□38	AX6 Send Command	Request to send MECHATROLINK-III command for axis 6	Turn off this relay after verifying that X□□□06 has turned on.
Y□□□39	AX7 Send Command	Request to send MECHATROLINK-III command for axis 7	Turn off this relay after verifying that X□□□07 has turned on.
Y□□□40	AX8 Send Command	Request to send MECHATROLINK-III command for axis 8	Turn off this relay after verifying that X□□□08 has turned on.
Y□□□41	AX9 Send Command	Request to send MECHATROLINK-III command for axis 9	Turn off this relay after verifying that X□□□09 has turned on.
Y□□□42	AX10 Send Command	Request to send MECHATROLINK-III command for axis 10	Turn off this relay after verifying that X□□□10 has turned on.
Y□□□43	AX11 Send Command	Request to send MECHATROLINK-III command for axis 11	Turn off this relay after verifying that X□□□11 has turned on.
Y□□□44	AX12 Send Command	Request to send MECHATROLINK-III command for axis 12	Turn off this relay after verifying that X□□□12 has turned on.
Y□□□45	AX13 Send Command	Request to send MECHATROLINK-III command for axis 13	Turn off this relay after verifying that X□□□13 has turned on.
Y□□□46	AX14 Send Command	Request to send MECHATROLINK-III command for axis 14	Turn off this relay after verifying that X□□□14 has turned on.
Y□□□47	AX15 Send Command	Request to send MECHATROLINK-III command for axis 15	Turn off this relay after verifying that X□□□15 has turned on.
Y□□□48	Start/Stop Communication	Request to start or stop MECHATROLINK-III communication	X□□□16 shows the current communication status.

Output Relay No.	Signal Name	Description	Relation with Other Relays
Y□□□49	(system reserved)		
Y□□□50	(system reserved)		
Y□□□51	(system reserved)		
Y□□□52	(system reserved)		
Y□□□53	(system reserved)		
Y□□□54	(system reserved)		
Y□□□55	(system reserved)		
Y□□□56	(system reserved)		
Y□□□57	(system reserved)		
Y□□□58	(system reserved)		
Y□□□59	(system reserved)		
Y□□□60	(system reserved)		
Y□□□61	(system reserved)		
Y□□□62	(system reserved)		
Y□□□63	(system reserved)		
Y□□□64	Clear Error/warning	Request to clear all errors and warnings	Turn off this relay after verifying that X□□□32 has turned off.

CAUTION

In a multi-CPU system, only one CPU module can be configured to use the positioning module. For details on CPU configuration, see "FA-M3 Programming Tool WideField2 User's Manual" (IM34M06Q15-01E).

4.1.3 Operation of Input/Output Relays

■ Input Relays

● Response Received relays (X□□□01 to X□□□15)

(1) When sending MECHATROLINK-III (standard servo profile) commands

The Response Received relay of an axis turns on when a MECHATROLINK-III response is received for a MECHATROLINK-III command, whose transmission is initiated by a rising edge of the Send Command relay (Y□□□33 to Y□□□47) of the axis.

To confirm that a response has been received, check that the command code (RCMD) stored in the received MECHATROLINK-III response tallies with the command code (CMD) of the transmitted MECHATROLINK-II command, and that the axis is ready to receive commands (CMDRDY bit of CMD_STAT = 1).

Turning off the Send Command relay of an axis (Y□□□33 to Y□□□47) turns off the corresponding Response Received relay.

(2) When sending MECHATROLINK-III (standard I/O profile) commands

If the command code (CMD) of the MECHATROLINK-III command parameters of an axis is set to DATA_RWA ($20) for the Data Read/Write_A command and transmission of the command is initiated by a rising edge of the Send Command relay (Y□□□33 to Y□□□47) of the axis, the Response Received relay of the axis turns on when a MECHATROLINK-III response is received for the transmitted MECHATROLINK-III command.

While the Response Received relay is ON, output data (OUTPUT) is sent and input data (INPUT) is received continually.

Turning off the Send Command relay of an axis (Y□□□33 to Y□□□47) turns off the corresponding Response Received relay and stops sending of output data (OUTPUT). However, receiving of input data (INPUT) continues until another MECHATROLINK-III command is sent.

(3) When executing interpolation motion commands

The Response Received relay of an axis turns on to indicate normal processing of an interpolation motion command, whose execution was initiated by a rising edge in the Send Command relay (Y□□□33 to Y□□□47) of the axis.

Turning off the Send Command relay of an axis (Y□□□33 to Y□□□47) turns off the corresponding Response Received relay.

● Communication Status relay (X□□□16)

The Communication Status relay turns on when MECHATROLINK-III communication initialization, which was initiated by a rising edge in the Start/Stop Communication relay (Y□□□48), is successfully completed to indicate that the module is ready to send and receive MECHATROLINK-III commands.

Turning off the Start/Stop Communication relay (Y□□□48) to stop MECHATROLINK-III communication also turns off this relay.

If MECHATROLINK-III communication initialization is not successful, this relay does not turn on. If this happens, check the configuration and wiring of external devices, as well as communication parameter values.

● Positioning Completed relays (X□□□17 to X□□□31)

These relays are valid only for MECHATROLINK-III standard servo profile compliant external devices. These relays are always OFF for MECHATROLINK-III standard I/O profile compliant external devices.

(1) When sending MECHATROLINK-III commands

The Positioning Completed relay for an axis turns on when the axis is in Positioning Completed state.

This relay turns off when a positioning motion, which is initiated by a MECHATROLINK-III command, begins.

The relay turns on or turns off according to the Positioning Completed Status (PSET) bit of SVCMD_IO of a MECHATROLINK-III response.

(2) When executing interpolation motion commands

The Positioning Completed relay for an axis turns on when the axis is in Positioning Completed state.

This relay turns off when a positioning motion, which is initiated by an interpolation motion command, begins.

After a positioning motion, which is initiated by an interpolation motion command, is completed, the relay turns on or turns off according to the Positioning Completed Status (PSET) bit of SVCMD_IO of the MECHATROLINK-III response.

● Error/Warning Detected relay (X□□□32)

The Error/Warning Detected relay turns on when an error or warning is detected by the module or any axis.

The relay turns off when all errors and warnings are cleared.

The relay turns on when CMD_STAT of a MECHATROLINK-III response received from an external device indicates an alarm (CMD_STAT.D_ALM bit =1), a warning (CMD_STAT.D_WAR bit =1), a command error code (CMD_STAT.CMD_ALM code ≠0) or a communication error code (CMD_STAT.COMM_ALM code ≠0). It also turns on when the module detects a MECHATROLINK-III communication initialization related error, a MECHATROLINK-III communication related error, or an interpolation motion command execution related error.

To clear all reported errors and warnings, turn on the Clear Error/Warning relay (Y□□□64). If an error or warning condition persists even after the Clear Error/Warning relay (Y□□□64) is turned on, the Error/Warning Detected relay remains ON.

For details on how to find out the cause of an error or warning when the Error/Warning Detected relay is ON, see Section 5.6, "Detecting Errors, Warnings and Communication Alarms".

■ Output Relays

● Send Command relays (Y□□□33 to Y□□□47)

(1) When sending MECHATROLINK-III (standard servo profile) commands

Turning on the Send Command relay for an axis after setting the Command Code (CMD) axis MECHATROLINK-III command parameter to a MECHATROLINK-III command code transmits the specified MECHATROLINK-III command. Extended MECHATROLINK-II command parameter data is transmitted as is if the command code (CMD) is specified as -1.

The corresponding Response Received input relay (X□□□01 to X□□□15) turns on when a MECHATROLINK-III response to the transmitted MECHATROLINK-III command is received.

Turning off the Send Command output relay thereafter also turns off the corresponding Response Received input relay (X□□□01 to X□□□15).

MECHATROLINK-III response data is stored in axis MECHATROLINK-III response parameters, axis statuses and common statuses.

MECHATROLINK-III response data is stored as is in the Extended MECHATROLINK-III response parameter area if the command code (CMD) was specified as -1.

(2) When sending MECHATROLINK-III (standard I/O profile) commands

Turning on the Send Command relay for an axis after setting the Command Code (CMD) axis MECHATROLINK-III command parameter to the command code (DATA_RWA: $20) of the Data Read/Write_A command transmits the specified MECHATROLINK-III command.

The corresponding Response Received input relay (X□□□01 to X□□□15) turns on when a MECHATROLINK-III response to the transmitted MECHATROLINK-III command is received.

To send output data (OUTPUT) and receive input data (INPUT) continually, keep the Send Command output relay ON.

Turning off the Send Command output relay of an axis (Y□□□33 to Y□□□47) turns off the corresponding Response Received relay and stops sending of output data (OUTPUT). However, receiving of input data (INPUT) continues until another MECHATROLINK-III command is sent.

(3) When executing interpolation motion commands

Turning on the Send Command relay for an axis after setting the Command Code (CMD) axis MECHATROLINK-III command parameter to an interpolation motion command code executes the specified interpolation motion command.

The Response Received relay (X□□□01 to X□□□15) turns on when the executed command is successfully processed.

Turning off the Send Command output relay thereafter also turns off the corresponding Response Received input relay (X□□□01 to X□□□15).

● Start/Stop Communication relay (Y□□□48)

Turning on the Start/Stop Communication relay initializes MECHATROLINK-III communication for the axes specified in the MECHATROLINK-III communication parameters area.

The Communication Status relay (X□□□16) turns on when MECHATROLINK-III communication initialization is successfully completed to indicate that the module is ready to send and receive MECHATROLINK-III commands.

Always keep the Start/Stop Communication relay ON while operating the module. Turning off this relay stops MECHATROLINK-III communication, and turns off the Communication Status relay. It also stops the operation of connected external devices.

● Clear Error/Warning relay (Y□□□64)

Turning on the Clear Error/Warning relay clears warnings and errors on all axes. It also clears all reported MECHATROLINK-III communication initialization related errors, MECHATROLINK-III communication related errors and interpolation motion command execution related errors.

The Error/Warning Detected relay (X□□□32) turns off if all errors and warnings are cleared successfully.

If an error/warning condition persists even after turning on the Clear Error/Warning relay, the Error/Warning Detected relay (X□□□32) remains ON.

4.2 List of Parameters and Statuses

Table 4.3 shows the layout of the parameter areas and the status areas provided for interfacing with the module. A CPU module writes parameters to the parameter areas and reads status values from the status areas. For details of individual parameters and statuses, see Subsections 4.2.1 to 4.2.7.

Table 4.3 Layout of Parameter and Status Areas

Data Position Number	Description	See Also
0001 to 0008	Module information statuses	4-10
0009 to 0030	(System reserved)	–
0031 to 0100	MECHATROLINK-IIII communication parameters	4-11
0101 to 0150 0151 to 0160 0161 to 0200	Axis 1: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	4-14 4-26 4-28
0201 to 0300	Axis 2: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0301 to 0400	Axis 3: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0401 to 0500	Axis 4: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0501 to 0600	Axis 5: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0601 to 0700	Axis 6: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0701 to 0800	Axis 7: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0801 to 0900	Axis 8: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
0901 to 1000	Axis 9: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1001 to 1100	Axis 10: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1101 to 1200	Axis 11: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1201 to 1300	Axis 12: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1301 to 1400	Axis 13: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1401 to 1500	Axis 14: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1501 to 1600	Axis 15: MECHATROLINK-III command parameters MECHATROLINK-III response parameters Statuses	
1601 to 2000	Common statuses	4-35
2001 to 2750 3001 to 3750	Extended MECHATROLINK-III command parameters Extended MECHATROLINK-III response parameters	4-38
3751 & above	(System reserved)	–

■ System of Units

MECHATROLINK-III standard servo profile compliant external devices allow units for position, speed, acceleration/deceleration and torque to be selected using parameters of the external device.

Check the respective user's manuals of external devices connected to the module for the units to be used when writing MECHATROLINK-III command parameter data, as well as reading MECHATROLINK-III response parameter data and axis statuses for each axis from the CPU module.

● Position

Unit	Remarks
reference unit (default)	Can be defined as $\times 10^n$ [reference unit].

● Speed

Unit	Remarks
Reference unit/s (default)	Can be defined as $\times 10^n$ [reference unit/s].
Reference unit/min	Can be defined as $\times 10^n$ [reference unit/min].
% of rated speed	Can be defined as $\times 10^n$ [%].
min^{-1} (rpm)	Can be defined as $\times 10^n$ [min^{-1}].
Max. motor speed/$40000000	

● Acceleration/deceleration

Unit	Remarks
Reference unit/s^2 (default)	Can be defined as $\times 10^n$ [reference unit/s^2].
ms	Can be defined as $\times 10^n$ [ms].

● Torque

Unit	Remarks
N (N· m)	Can be defined as $\times 10^n$ [N].
% of rated torque (default)	Can be defined as $\times 10^n$ [%].
Max. torque/$40000000	

■ Reading and Writing 2-word Data

In Tables 4.6, 4.10 and 4.12, a parameter or status that is listed with two position data numbers stores two-word data. The smaller position data number represents the low word, while the larger position data number represents the high word.

The leading "□□" in a 4-digit data position number denotes an axis number ranging from 01 to 15 for axes 1 to 15.

Each data position number represents one data word. Always use word-based WRITE and READ instructions when accessing the module from a sequence program. Using long word-based instructions will result in incorrect access. Similarly, always use word-based instructions when accessing the module from a BASIC program.

CAUTION

When the CPU module reads 2-word status data from the positioning module, concurrency of the high-order word and low-order word of 2-word data is not assured due to conflicts between the timing of reading from the CPU module and the data update cycle of the positioning module.

To ensure that the high-order word and low-order word of 2-word data are concurrent when reading from a sequence CPU, use the READ instruction to read the data twice consecutively and verify that the data read are the same in both instances. If the HRD instruction is used, data concurrency is not assured even if you had verified that the data are the same.

Data concurrency cannot be assured when reading from a BASIC CPU.

For details on how to check that data read twice consecutively by a sequence CPU are the same in both instances, see Section 6.3, “Precautions When Reading 2-word Data.”

4.2.1 Module Information Statuses

This subsection lists and describes module information statuses.

Do not write any data to Module Information Statuses as it will overwrite and result in loss of module information data.

■ List of Module Information Statuses

Table 4.4 List of Module Information Statuses

Data Position Number	Parameter Name	Data Description	See Also
0001	Module information	"F3"	4-10
0002	Module information	"NC"	
0003	Module information	"97"	
0004	Module information	"0N"	
0005	Module information	" "	
0006	Module information	" "	
0007	Module information	"RV"	
0008	Module information	"□□" (□□ denotes the module revision)	
0009 to 0030	(System reserved)	Always 0	–

■ Description of Module Information Statuses

● Module Information

[Data position number] **0001 to 0008**
[Data description] **Module Model Name: "F3NC970N"**
Revision: "RV□□"

Returns the model name and revision of the module as module information.

4.2.2 MECHATROLINK-III Communication Parameters

This subsection lists and describes MECHATROLINK-III communication parameters.

For details on the profile type supported by an external device to be connected and its communication specification (communication cycle, communication data size in bytes, etc.), as well as how to set its station address, read the user's manual of the external device.

■ List of MECHATROLINK-III Communication Parameters

Table 4.5 List of MECHATROLINK-III Communication Parameters

Data Position Number	Data Name	Data Description	See Also
0031	AX1 Device Type	- For standard servo profile compliant external device: High-byte : Profile type code ($10: standard servo profile) Bit 0 : Subcommand setting (0: Enabled, 1: Disabled) - For standard I/O profile compliant external device: High-byte : Profile type code ($30: standard I/O profile) Bits 3 to 0 : Communication data size in bytes (0: 16, 1: 32, 2: 48, 3: 64)	4-12
0032	AX1 Station Address	0: unconnected, $03 to $EF	
0033	AX2 Device Type		
0034	AX2 Station Address		
0035	AX3 Device Type		
0036	AX3 Station Address		
0037	AX4 Device Type		
0038	AX4 Station Address		
0039	AX5 Device Type		
0040	AX5 Station Address		
0041	AX6 Device Type		
0042	AX6 Station Address		
0043	AX7 Device Type		
0044	AX7 Station Address		
0045	AX8 Device Type		
0046	AX8 Station Address		
0047	AX9 Device Type		
0048	AX9 Station Address		
0049	AX10 Device Type		
0050	AX10 Station Address		
0051	AX11 Device Type		
0052	AX11 Station Address		
0053	AX12 Device Type		
0054	AX12 Station Address		
0055	AX13 Device Type		
0056	AX13 Station Address		
0057	AX14 Device Type		
0058	AX14 Station Address		
0059	AX15 Device Type		
0060	AX15 Station Address		
0061	(System reserved)	Always 0	–
0062	Communication Cycle	0: 2 ms, 1: 1 ms, 2: 0.5 ms (8 axes max.), 3: 0.25 ms (4 axes max)	4-13
0063 to 0100	(System reserved)	Always 0	–

■ Description of MECHATROLINK-III Communication Parameters

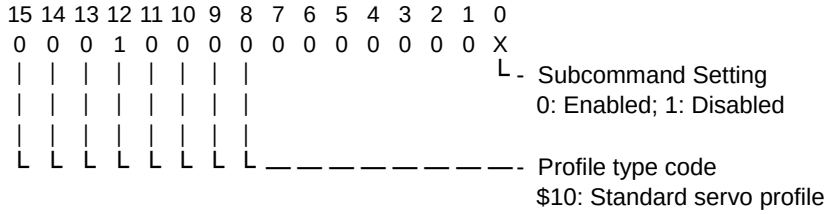
● Device Type of each axis

[Data Range] **Profile type code (high-byte)**
$10: Standard servo profile
$30: Standard I/O profile
Detailed setting for profile type (low-byte)

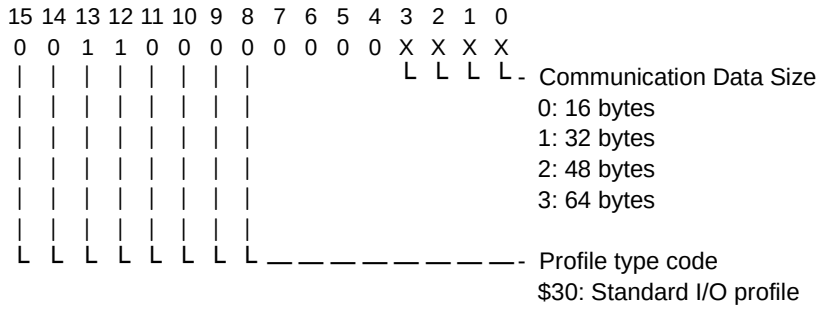
[Data Position No.] **Axis 1: 0031; Axis 2: 0033; Axis 3: 0035; Axis 4: 0037**
Axis 5: 0039; Axis 6: 0041; Axis 7: 0043; Axis 8: 0045
Axis 9: 0047; Axis 10: 0049; Axis 11: 0051; Axis 12: 0053
Axis 13: 0055; Axis 14: 0057; Axis 15: 0059

The Device Type of each axis (axes 1 to 15) specifies the profile type code of the corresponding external device and detailed information of each profile type.

- For standard servo profile compliant external device:



- For standard servo I/O compliant external device:



● Station Address of each axis

[Data Range] **0: Unconnected**
$03 to $EF: Station address

[Data Position No.] **Axis 1: 0032; Axis 2: 0034; Axis 3: 0036; Axis 4: 0038**
Axis 5: 0040; Axis 6: 0042; Axis 7: 0044; Axis 8: 0046
Axis 9: 0048; Axis 10: 0050; Axis 11: 0052; Axis 12: 0054
Axis 13: 0056; Axis 14: 0058; Axis 15: 0060

The Station Address of each axis (axes 1 to 15) specifies the station address of the corresponding external device.

● Communication Cycle

[Data Range] **0: 2 ms**
1: 1 ms
2: 0.5 ms (8 axes max.)
3: 0.25 ms (4 axes max.)

[Data Position No.] **0062**

This parameter specifies the communication cycle time.

If communication cycle time is specified as 0.5 ms, no more than eight axes can be connected. If it is specified as 0.25 ms, no more than four axes can be connected.

4.2.3 Axis MECHATROLINK-III Command Parameters

This subsection lists and describes MECHATROLINK-III command parameters for each axis.

The MECHATROLINK-III command parameters of an axis depend on the profile type supported by the connected external device.

The content and setting data of each MECHATROLINK-III command parameter depends on the connected external device. For details on individual parameters, see the user's manual of the connected external device.

■ List of Axis MECHATROLINK-III Command Parameters

● For standard servo profile compliant device:

Table 4.6 List of Axis MECHATROLINK-III Command Parameters (1/2)

Data Position Number	Data Name	Data Description	See Also
□□01	Command Code (CMD)	$0000 to $00FF (MECHATROLINK-III commands) $FFFF (Extended MECHATROLINK-III commands) $0100 to $FF00 (Interpolation motion commands)	4-16
□□02	Command Control (CMD_CTRL)	Bit data: Bits 15 to 0	4-16
□□03 / □□04	Servo Command Control Field (SVCMD_CTRL)	Bit data: Bits 31 to 0	4-17
□□05 / □□06	Servo Command Output Signal (SVCMD_IO)	Bit data: Bits 31 to 0	4-18
□□07 / □□08	Target Position (TPOS) / Zero Point Return Mode (MODE)	- For target position (TPOS): -2,147,483,648 to 2,147,483,647 - For Zero Point Return Mode (MODE): Bits 0 to 3 : Zero point return type (0 or 1) Bit 7 : Zero point return direction (0 or 1)	4-19
□□09 / □□10	Target Speed (TSPD)	- For POSING, EX_POSING or ZRET command: 0 to 2,147,483,647 - For FEED or EX_FEED command: -2,147,483,648 to 2,147,483,647	4-19
□□11 / □□12	Acceleration (ACCR)	-1: Maximum acceleration 1 to 2,147,483,647	4-19
□□13 / □□14	Deceleration (DECR)	-1: Maximum deceleration 1 to 2,147,483,647	4-20
□□15 / □□16	Torque Limit (TLIM)	-1: No torque limit (Maximum torque limit value) 0 to 2,147,483,647	4-20
□□17 / □□18	Speed Reference (VREF)	-2,147,483,648 to 2,147,483,647	4-20
□□19 / □□20	Speed Limit (VLIM)	-1: No speed limit (Maximum speed limit value) 0 to 2,147,483,647	4-20
□□21 / □□22	Torque Reference (TQREF)	-2,147,483,648 to 2,147,483,647	4-20
□□23 / □□24	Speed Feed Forward (VFF)	0: No speed feed forward -2,147,483,648 to 2,147,483,647	4-20
□□25 / □□26	Torque Feed Forward (TFF)	0: No torque feed forward -2,147,483,648 to 2,147,483,647	4-20

Table 4.6 List of Axis MECHATROLINK-III Command Parameters (2/2)

Data Position Number	Data Name	Data Description	See Also
□□27 / □□28	Coordinates Setting Mode (POS_SET_MOD)	Bits 0 to 3 : Coordinate system selection (0 to $F) Bit 7 : Reference point enable/disable (0 or 1)	4-21
□□29 / □□30	Coordinates Set Value (POS_DATA)	-2,147,483,648 to 2,147,483,647	4-21
□□31 to □□32	(System reserved)	Always 0	–
□□33	Configuration Mode (CONFIG_MOD)	0: Parameter re-calculation and setup 1: Batch writing to retentive memory 2: Initialization to the factory parameter settings	4-21
□□34	Alarm Clear Mode (ALM_CLR_MOD)	0: Clear current alarm / warning state; 1: Clear alarm history	4-21
□□35	Servo Parameter Number (NO)	$0000 to $FFFF	4-22
□□36	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)	Low byte: Servo Parameter Data Size [byte] 2, 4 High byte: Servo Parameter Read/Write Mode $00: Common parameter (RAM area) $01: Common parameter (Retentive memory area) $10: Device parameter (RAM area) $11: Device parameter (Retentive memory area)	4-22
□□37 / □□38	Servo Parameter Data (PARAMETER)	-2,147,483,648 to 2,147,483,647	4-22
□□39 to □□40	(System reserved)	Always 0	–
□□41 / □□42	Subcommand Control (SUB_CTRL)	Bit data: Bits 31 to 0	4-23
□□43 / □□44	Target Position (for interpolation motion commands)	-2,147,483,648 to 2,147,483,647	4-23
□□45 / □□46	Target Speed (for interpolation motion commands)	1 to 2,147,483,647	4-23
□□47	Interpolation Axes (for interpolation motion commands)	Bit data: $0000 to $7FFF	4-24
□□48	Acceleration Time (for interpolation motion commands)	0 to 32767 [ms]	4-24
□□49	Deceleration Time (for interpolation motion commands)	0 to 32767 [ms]	4-24
□□50	(System reserved)	Always 0	–

Note: □□ denotes an axis number (01 to 15).

● For standard I/O profile compliant external device:

Table 4.7 List of Axis MECHATROLINK-III Command Parameters

Data Position Number	Data Name	Data Description	See Also
□□01	Command Code (CMD)	$0000 to $00FF : MECHATROLINK-III command $FFFF : Extended MECHATROLINK-III command	4-16
□□02	Command Control (CMD_CTRL)	Bit data: Bits 15 to 0	4-16
□□03 to □□32	Output Data (OUTPUT)	Bit data: Bits 15 to 0	4-25
□□33	Configuration Mode (CONFIG_MOD)	0: Parameter re-calculation and setup 1: Batch writing to retentive memory 2: Initialization to the factory parameter settings	4-21
□□34	Alarm Clear Mode (ALM_CLR_MOD)	0: Clear current alarm / warning state 1: Clear alarm history	4-21
□□35 to □□50	(System reserved)	Always 0	–

Note: □□ denotes an axis number (01 to 15).

■ Description of Axis MECHATROLINK-III Command Parameters

● Command Code (CMD)

STD SERVO / STD IO

[Data Range] **$0000 to $00FF : Transmits MECHATROLINK-III command parameter data for an axis.**
$FFFF : Transmits extended MECHATROLINK-III command parameter data.
$0100 to $0500 : Executes interpolation motion command (standard servo only)
$0100: Start positioning
$0200: Decelerate & stop
$0300: Stop immediately
$0400: Change speed
$0500: Change target position

[Data Position No.] □□01 (□□ denotes an axis number from 01 to 15)

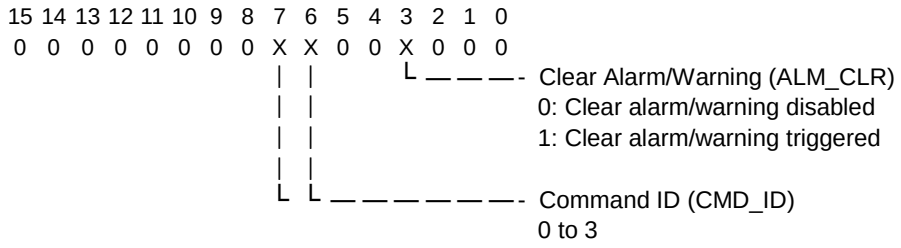
Specify the command code for the MECHATROLINK-III command to be transmitted or the interpolation motion command to be executed.

● Command Control (CMD_CTRL)

STD SERVO / STD IO

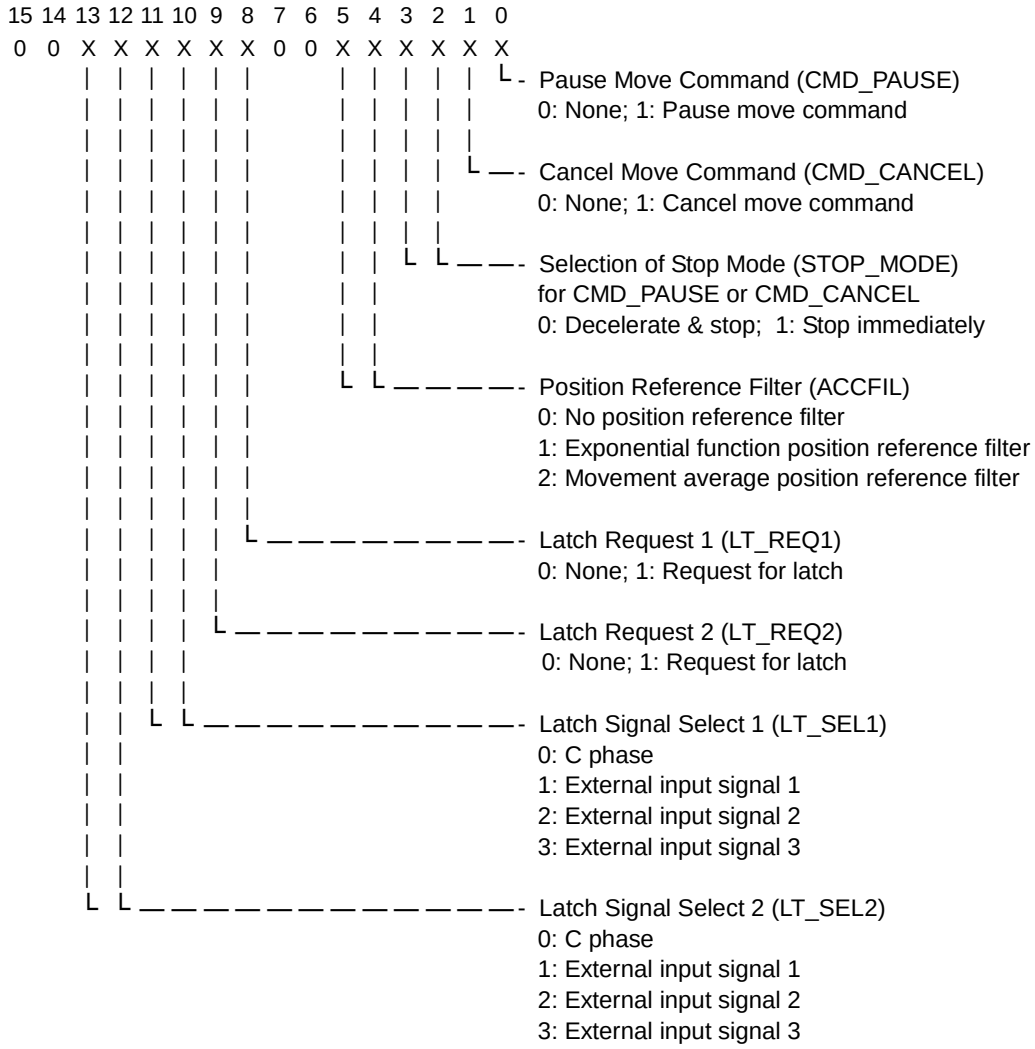
[Data Range] **Bit data: Bits 15 to 0**
[Data Position No.] □□02 (□□ denotes an axis number from 01 to 15)

Specify the Command Control (CMD_CTRL) as 16-bit data.



● Servo Command Control Field (SVCMD_CTRL) STD SERVO

[Data Range] **Bit data: Bits 31 to 0**
[Data Position No.] **□□03 / □□04 (□□ denotes an axis number from 01 to 15)**
Specify the Servo Command Control Field (SVCMD_CTRL) as 16-bit data. For details on monitor data selection codes, see Table 4.8.



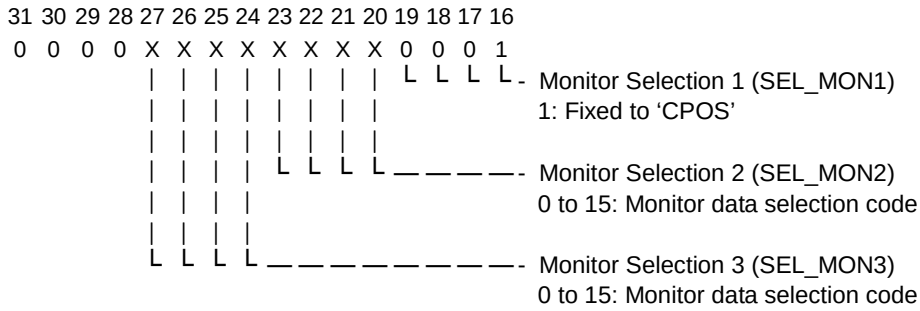
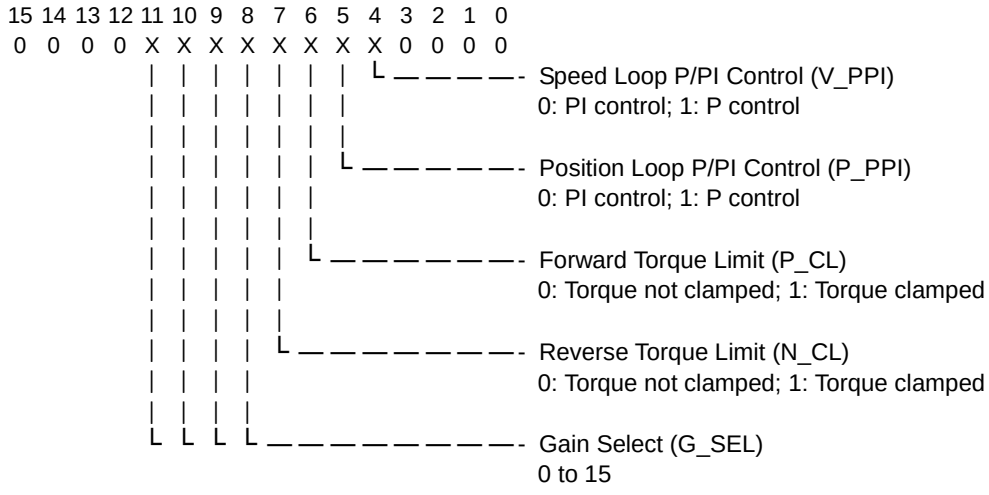


Table 4.8 List of Monitor Data Selection Codes

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

● Servo Command Output Signal (SVCMD_IO) STD SERVO

[Data Range] Bit data: Bits 31 to 0
[Data Position No.] □□05 / □□06 (□□ denotes an axis number from 01 to 15)
Specify the Servo Command Output Signal as 16-bit data.



● Target Position (TPOS) / Zero Point Return Mode (MODE) STD SERVO

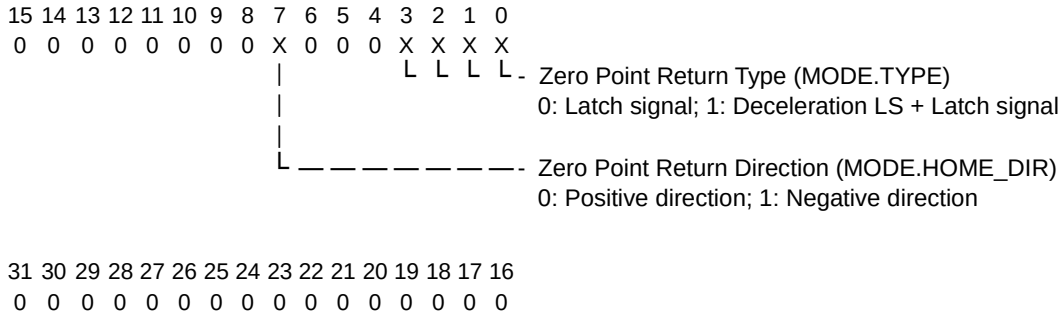
[Data Range] **- For Target Position (TPOS):**
-2,147,483,648 to 2,147,483,647
- For Zero Point Return Mode (MODE):
Bit data: Bits 15 to 0

[Data Position No.] **□□07 / □□08 (□□ denotes an axis number from 01 to 15)**

For POSING (CMD=$35) or EX_POSING (CMD=$39) command, specify the target position (TPOS).

For ZRET command (CMD=$3A), specify the zero point return mode (MODE).

- Zero Point Return Mode (MODE)



31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

● Target Speed (TSPD) STD SERVO

[Data Range] **- For POSING ($35), EX_POSING ($39)**
or ZRET ($3A) command:
0 to 2,147,483,647
- For FEED ($36) or EX_FEED ($37) command,
-2,147,483,648 to 2,147,483,647

[Data Position No.] **□□09 / □□10 (□□ denotes an axis number from 01 to 15)**

Specify the target speed (TSPD).

For FEED (CMD=$36) or EX_FEED (CMD=$37) command, the direction of motion is specified by the sign of the TSPD value.

● Acceleration (ACCR) STD SERVO

[Data Range] **-1: Maximum acceleration**
0 to 2,147,483,647

[Data Position No.] **□□11 / □□12 (□□ denotes an axis number from 01 to 15)**

Specify the acceleration (ACCR).

● Deceleration (DECR) STD SERVO

[Data Range] **-1: Maximum deceleration**
0 to 2,147,483,647
[Data Position No.] **□□13 / □□14 (□□ denotes an axis number from 01 to 15)**
Specify the deceleration (DECR).

● Torque Limit (TLIM) STD SERVO

[Data Range] **-1: No torque limit (Maximum torque limit)**
0 to 2,147,483,647
[Data Position No.] **□□15 / □□16 (□□ denotes an axis number from 01 to 15)**
Specify the torque limit (TLIM).

● Speed Reference (VREF) STD SERVO

[Data Range] **-2,147,483,648 to 2,147,483,647**
[Data Position No.] **□□17 / □□18 (□□ denotes an axis number from 01 to 15)**
Specify the torque reference (TQREF) with the sign indicating the direction of rotation.

● Speed Limit (VLIM) STD SERVO

[Data Range] **-1: No speed limit (Maximum speed limit)**
0 to 2,147,483,647
[Data Position No.] **□□19 / □□20 (□□ denotes an axis number from 01 to 15)**
Specify the speed limit (VLIM).

● Torque Reference (TQREF) STD SERVO

[Data Range] **-2,147,483,648 to 2,147,483,647**
[Data Position No.] **□□21 / □□22 (□□ denotes an axis number from 01 to 15)**
Specify the torque reference (TQREF) with the sign indicating the direction of output torque.

● Speed Feed Forward (VFF) STD SERVO

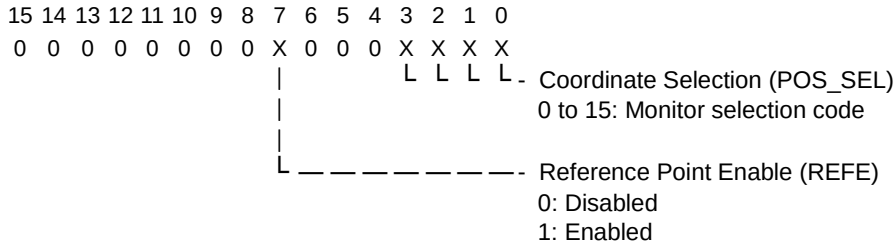
[Data Range] **0: No speed feed forward**
-2,147,483,648 to 2,147,483,647
[Data Position No.] **□□23 / □□24 (□□ denotes an axis number from 01 to 15)**
Specify the speed feed forward (VFF).

● Torque Feed Forward (TFF) STD SERVO

[Data Range] **0: No torque feed forward**
-2,147,483,648 to 2,147,483,647
[Data Position No.] **□□25 / □□26 (□□ denotes an axis number from 01 to 15)**
Specify the torque feed forward (TFF).

● Coordinates Setting Mode (POS_SET_MOD) STD SERVO

[Data Range] **Bit data: Bits 31 to 0**
[Data Position No.] **□□27 / □□28 (□□ denotes an axis number from 01 to 15)**
For POS_SET command (CMD=$20), specify whether to enable or disable the reference point (REFE), and select the coordinate system (POS_SEL).



31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

● Coordinates Set Value (POS_DATA) STD SERVO

[Data Range] **-2,147,483,648 to 2,147,483,647**
[Data Position No.] **□□29 / □□30 (□□ denotes an axis number from 01 to 15)**
For POS_SET command (CMD=$20), specify set values for the selected coordinate system (POS_DATA).

● Configuration Mode (CONFIG_MOD) STD SERVO / STD IO

[Data Range] **0: Parameter re-calculation and setup**
1: Batch writing to retentive memory
2: Initialization to the factory-set parameter setting values
[Data Position No.] **□□33 (□□ denotes an axis number from 01 to 15)**
For CONFIG command (CMD=$04), specify the Configuration Mode (CONFIG_MODE).

● Alarm Clear Mode (ALM_CLR_MOD) STD SERVO / STD IO

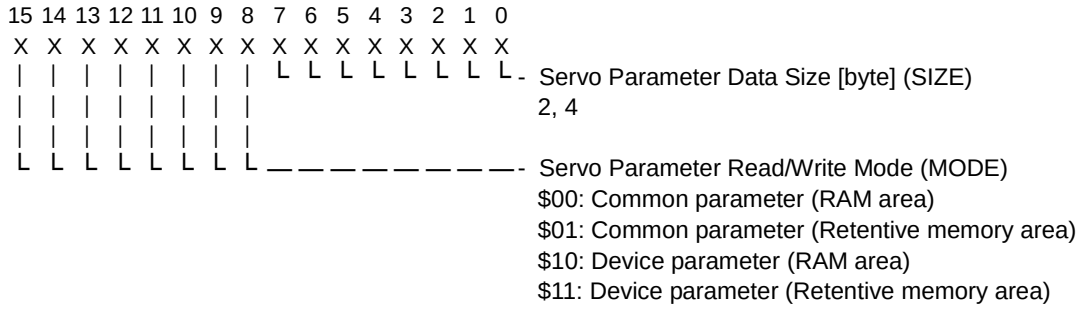
[Data Range] **0: Clear current alarm / warning state**
1: Clear alarm history
[Data Position No.] **□□34 (□□ denotes an axis number from 01 to 15)**
For ALM_CLR command (CMD=$06), specify the Alarm Clear Mode (ALM_CLR_MOD).

● Servo Parameter Number (NO) STD SERVO

[Data Range] **$0000 to $FFFF**
[Data Position No.] **□□35 (□□ denotes an axis number from 01 to 15)**
For SVPRM_RD command (CMD=$40) or SVPRM_WR command (CMD=$41), specify the Servo Parameter Number (NO).

● Servo Parameter Data Size [byte] (SIZE) Servo Parameter Read/Write Mode (MODE) STD SERVO

[Data Range] **Servo Parameter Data Size [byte] (SIZE)**
2, 4
Servo Parameter Read/Write Mode（MODE)
$00: Common parameter (RAM area)
$01: Common parameter (Retentive memory area)
$10: Device parameter (RAM area)
$11: Device parameter (Retentive memory area)
[Data Position No.] **□□36 (□□ denotes an axis number from 01 to 15)**
For SVPRM_RD command (CMD=$40) or SVPRM_WR command (CMD=$41), specify the Servo Parameter Data Size [byte] (SIZE) and Servo Parameter Read/Write Mode (MODE).

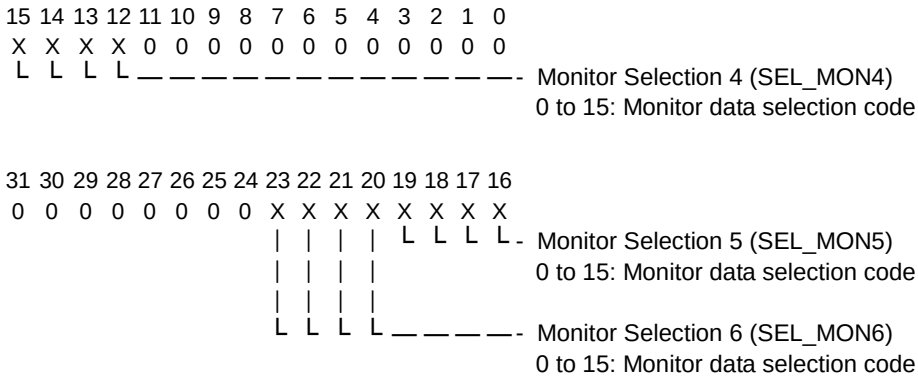


● Servo Parameter Data (PARAMETER) STD SERVO

[Data Range] **-2,147,483,648 to 2,147,483,647**
[Data Position No.] **□□37 / □□38 (□□ denotes an axis number from 01 to 15)**
For SVPRM_WR command (CMD=$41), specify the Servo Parameter Data (PARAMETER).

● Subcommand Control (SUB_CTRL) STD SERVO

[Data Range] **Bit data: Bits 31 to 0**
[Data Position No.] **□□41 / □□42 (□□ denotes an axis number from 01 to 15)**
Specify the Subcommand Control Field (SUB_CTRL) as 32-bit data. For details on monitor data selection codes, see Table 4.8.



● Target Position (for interpolation motion commands) STD SERVO

[Data Range] **-2,147,483,648 to 2,147,483,647**
[Data Position No.] **□□43 / □□44 (□□ denotes an axis number from 01 to 15)**
Specify the target position when executing an interpolation motion command.

This parameter must be specified for the reference axis, as well as each interpolation axis.

● Target Speed (for interpolation motion commands) STD SERVO

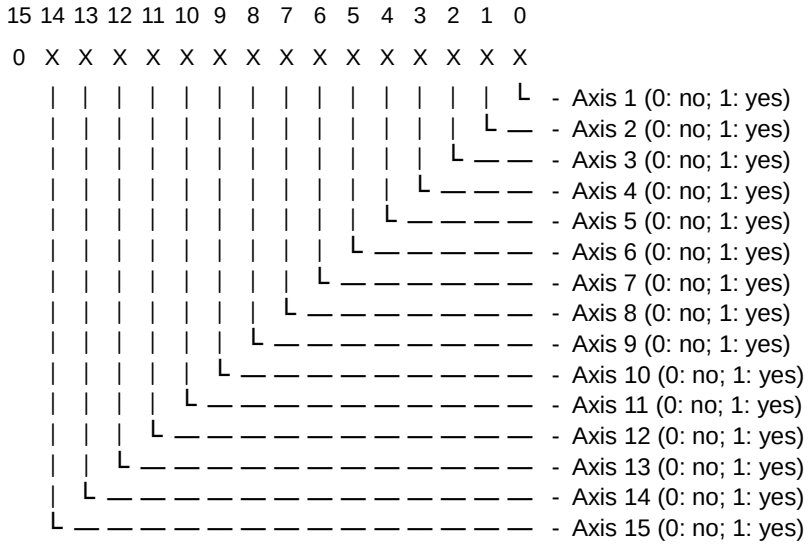
[Data Range] **1 to 2,147,483,647**
[Data Position No.] **□□45 / □□46 (□□ denotes an axis number from 01 to 15)**
Specify the target speed when executing an interpolation motion command.

This parameter must be specified for the reference axis, as well as each interpolation axis.

● Interpolation Axes (for interpolation motion commands) STD SERVO

[Data Range] **Bit data: Bits 15 to 0**
[Data Position No.] **□□47 (□□ denotes an axis number from 01 to 15)**
Specify the set of axes to be moved in tandem with the reference axis during interpolation motion as bit data.

This parameter is only valid when specified for the reference axis. It is ignored when specified for an interpolation axis.



● Acceleration Time (for interpolation motion commands) STD SERVO

[Data Range] **0 to 32,767[ms]**
[Data Position No.] **□□48 (□□ denotes an axis number from 01 to 15)**
Specify the acceleration time for an interpolation motion.

This parameter is only valid when specified for the reference axis. It is ignored when specified for an interpolation axis.

● Deceleration Time (for interpolation motion commands) STD SERVO

[Data Range] **0 to 32,767[ms]**
[Data Position No.] **□□49 (□□ denotes an axis number from 01 to 15)**
Specify the deceleration time for an interpolation motion.

This parameter is only valid when specified for the reference axis. It is ignored when specified for an interpolation axis.

● Output Data (OUTPUT)

STD I/O

[Data Range] **Bit data: Bits 15 to 0**
[Data Position No.] **□□03 to □□32 (□□ denotes an axis number from 01 to 15)**

For a DATA_RWA command (CMD=$20), specify the Output Data (OUTPUT) to a standard I/O profile compliant external device.

Output data (OUTPUT) is sent continually for an axis while its Send Command relay (Y□□□33 to Y□□□47) remains ON. Turning OFF the Send Command relay (Y□□□33 to Y□□□47) of an axis stops transmission of output data (OUTPUT) for the axis.

Table 4.9 Output Data (OUTPUT) Map

Data Position No.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
□□03	O_{16}	O_{15}	O_{14}	O_{13}	O_{12}	O_{11}	O_{10}	O_{9}	O_{8}	O_{7}	O_{6}	O_{5}	O_{4}	O_{3}	O_{2}	O_{1}
□□04	O_{32}	O_{31}	O_{30}	O_{29}	O_{28}	O_{27}	O_{26}	O_{25}	O_{24}	O_{23}	O_{22}	O_{21}	O_{20}	O_{19}	O_{18}	O_{17}
□□05	O_{48}	O_{47}	O_{46}	O_{45}	O_{44}	O_{43}	O_{42}	O_{41}	O_{40}	O_{39}	O_{38}	O_{37}	O_{36}	O_{35}	O_{34}	O_{33}
□□06	O_{64}	O_{63}	O_{62}	O_{61}	O_{60}	O_{59}	O_{58}	O_{57}	O_{56}	O_{55}	O_{54}	O_{53}	O_{52}	O_{51}	O_{50}	O_{49}
□□07																
:																
□□31																
□□32																

4.2.4 Axis MECHATROLINK-III Response Parameters

This subsection lists and describes MECHATROLINK-III response parameters for each axis.

The MECHATROLINK-III response parameters of an axis depend on the profile type supported by the connected external device.

The content and reference data of each MECHATROLINK-III response parameter depends on the connected external device. For details on individual parameters, see the user's manual of the connected external device.

■ List of Axis MECHATROLINK-III Response Parameters

● For standard servo profile compliant external device:

Table 4.10 List of Axis MECHATROLINK-III Response Parameters

Data Position Number	Data Name	Data Description	See Also
□□51	Servo Parameter Number (NO)	$0000 to $FFFF	4-27
□□52	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)	Low byte: Servo Parameter Data Size [byte] 2, 4 High byte: Servo Parameter Read/Write Mode $00: Common parameter (RAM area) $01: Common parameter (Retentive memory area) $10: Device parameter (RAM area) $11: Device parameter (Retentive memory area)	4-27
□□53 / □□54	Servo Parameter Data (PARAMETER)	-2,147,483,648 to 2,147,483,647	4-27
□□55 to □□60	(System reserved)		–

Note: □□ denotes an axis number (01 to 15).

● For standard I/O profile compliant external device:

Table 4.11 List of Axis MECHATROLINK-III Response Parameters

Data Position Number	Data Name	Data Description	See Also
□□51 to □□60	(System reserved)		–

Note: □□ denotes an axis number (01 to 15).

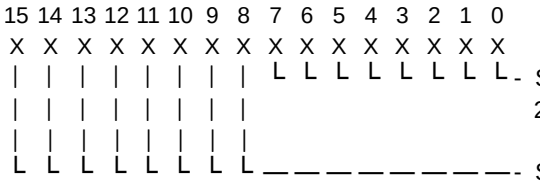
■ Description of Axis MECHATROLINK-III Response Parameters

● Servo Parameter Number (NO) STD SERVO

[Data Position No.] **□□51 (□□ denotes an axis number from 01 to 15)**
[Data Range] **$0000 to $FFFF**
For SVPRM_RD command (CMD=$40) or SVPRM_WR command (CMD=$41), returns the Servo Parameter Number (NO).

● Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE) STD SERVO

[Data Position No.] **□□52 (□□ denotes an axis number from 01 to 15)**
[Data Range] **Servo Parameter Data Size [byte] (SIZE)**
2, 4
Servo Parameter Read/Write Mode（MODE)
$00: Common parameter (RAM area)
$01: Common parameter (Retentive memory area)
$10: Device parameter (RAM area)
$11: Device parameter (Retentive memory area)
For SVPRM_RD command (CMD=$40) or SVPRM_WR command (CMD=$41), returns the Servo Parameter Data Size [byte] (SIZE) and Servo Parameter Read/Write Mode (MODE).



● Servo Parameter Data (PARAMETER) STD SERVO

[Data Position No.] **□□53 / □□54 (□□ denotes an axis number from 01 to 15)**
[Data Range] **-2,147,483,648 to 2,147,483,647**
For SVPRM_RD command (CMD=$40) or SVPRM_WR command (CMD=$41), returns the Servo Parameter Data (PARAMETER).

4.2.5 Axis Statuses

This subsection lists and describes the axis statuses.

The statuses of an axis depend on the profile type supported by the connected external device.

The content and reference data of each status depends on the connected external device. For details on individual statuses, see the user's manual of the connected external device.

■ List of Axis Statuses

● For standard servo profile compliant external device:

Table 4.12 List of Axis Statuses

Data Position Number	Data Name	Data Description	See Also
□□61	(System reserved)		–
□□62	Command Status (CMD_STAT)	Bit data: Bits 15 to 0	4-29
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)	Bit data: Bits 31 to 0	4-30
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)	Bit data: Bits 31 to 0	4-31
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)	Fixed monitor 1 data	4-32
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)	Fixed monitor 2 data	4-32
□□71 / □□72	Monitor 1 (MONITOR1)	Monitor 1 data (Fixed to CPOS data)	4-32
□□73 / □□74	Monitor 2 (MONITOR2)	Monitor 2 data	4-32
□□75 / □□76	Monitor 3 (MONITOR3)	Monitor 3 data	4-32
□□77 / □□78	Monitor 4 (MONITOR4)	Monitor 4 data	4-32
□□79 / □□80	Monitor 5 (MONITOR5)	Monitor 5 data	4-33
□□81 / □□82	Monitor 6 (MONITOR6)	Monitor 6 data	4-33
□□83 / □□84	Subcommand Status (SUB_STAT)	Bit data: Bits 15 to 0	4-33
□□85 / □□86	Remaining Travel Status	-2,147,483,648 to 2,147,483,647	4-33
□□87	Interpolation Status	Bit data: Bits 15 to 0	4-34
□□88 to ■■00	(System reserved)		–

Note: □□ denotes an axis number (01 to 15). ■■ denotes the value of □□ + 1.

● For standard I/O profile compliant external device:

Table 4.13 List of Axis Statuses

Data Position Number	Data Name	Data Description	See Also
□□61	(System reserved)		–
□□62	Command Status (CMD_STAT)	Bit data: Bits 15 to 0	4-29
□□63 to □□92	Input Data (INPUT)	Bit data: Bits 15 to 0	4-34
□□93 to ■■00	(System reserved)		–

Note: □□ denotes an axis number (01 to 15). ■■ denotes the value of □□ + 1.

■ Description of Axis Statuses

● Command Status (CMD_STAT)

STD SERVO / STD IO

[Data Position No.] **□□62 (□□ denotes an axis number from 01 to 15)**
[Data Range] **Bit data: Bits 15 to 0**

Returns the Command Status (CMD_STAT). For details on command error codes and communication error codes, see Table 4.14 and Table 4.15 respectively.

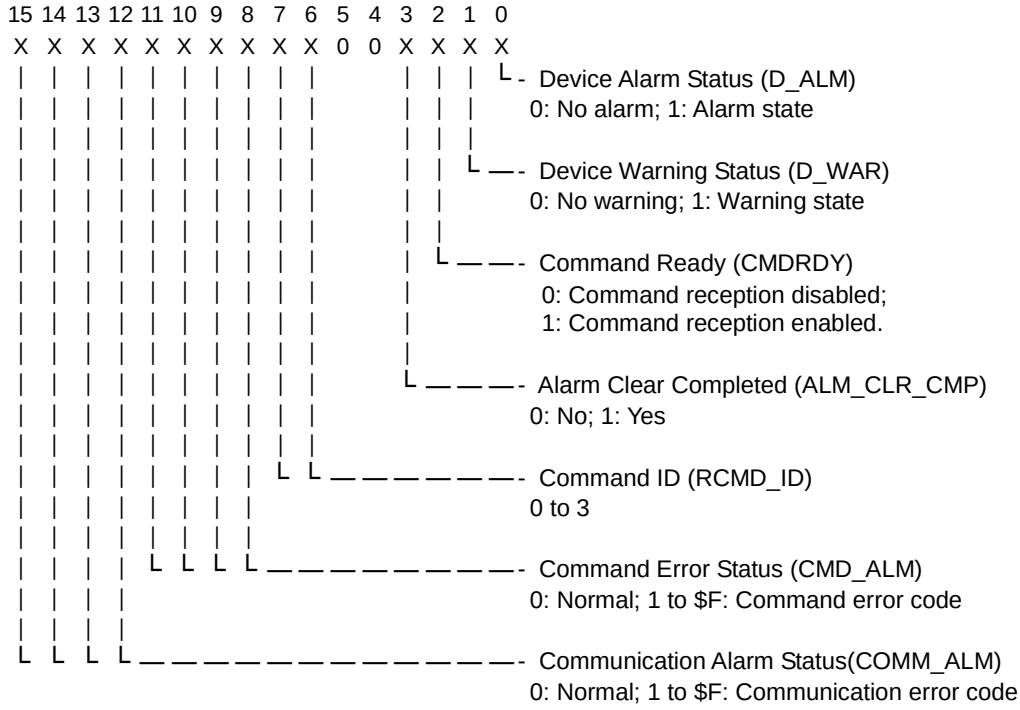


Table 4.14 Command Error Codes

Code		Description
	0	Normal
Warning	1	Invalid data
	2	
	3	
	4	
	5	
	6	
	7	
Alarm	8	Unsupported command received
	9	Invalid data
	A	Command execution condition error
	B	Subcommand combination error
	C	Phase error
	D	
	E	
	F	

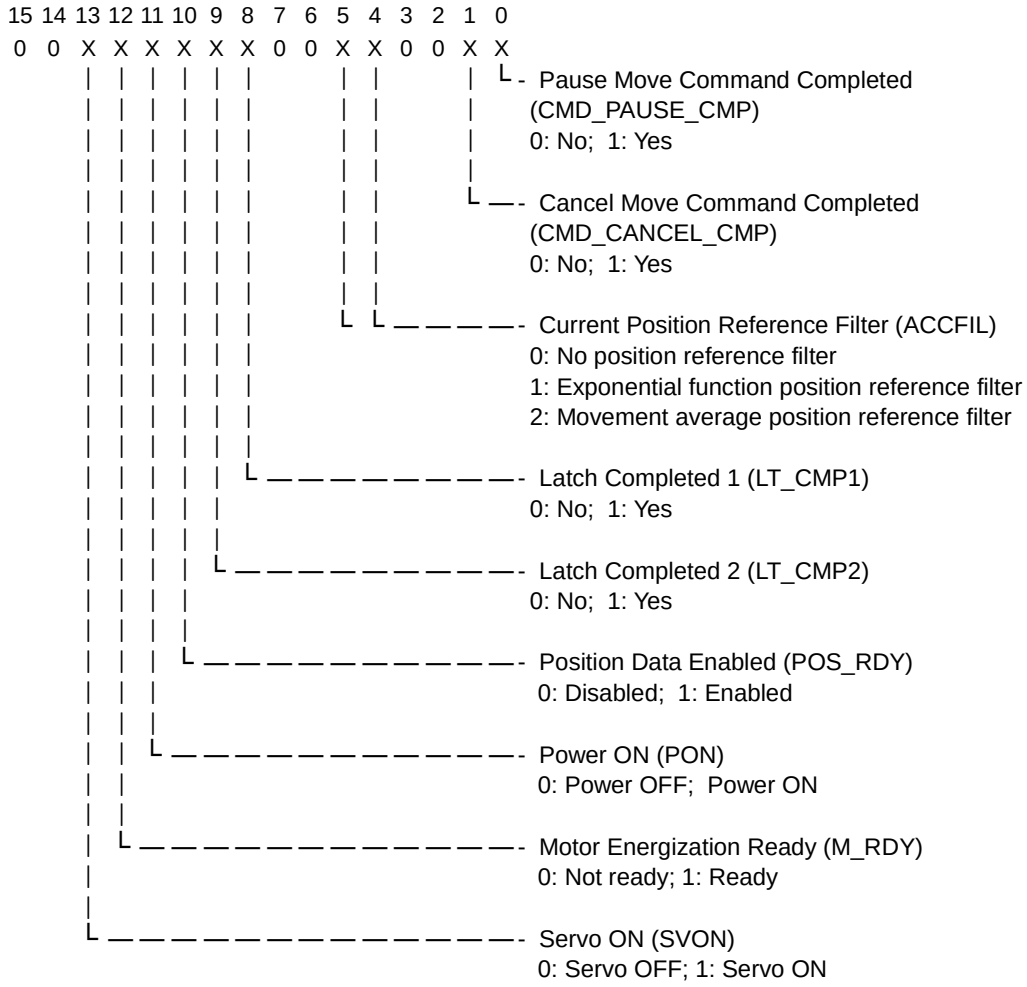
Table 4.15 Communication Error Codes

Code		Description
	0	Normal
Warning	1	FCS error
	2	Command data not received
	3	Synchronous frame not received
	4	
	5	
	6	
	7	
Alarm	8	FCS error
	9	Command data not received
	A	Synchronous frame not received
	B	Synchronization interval error
	C	WDT error
	D	
	E	
	F	

● Servo Command Status Field (SVCMD_STAT) STD SERVO

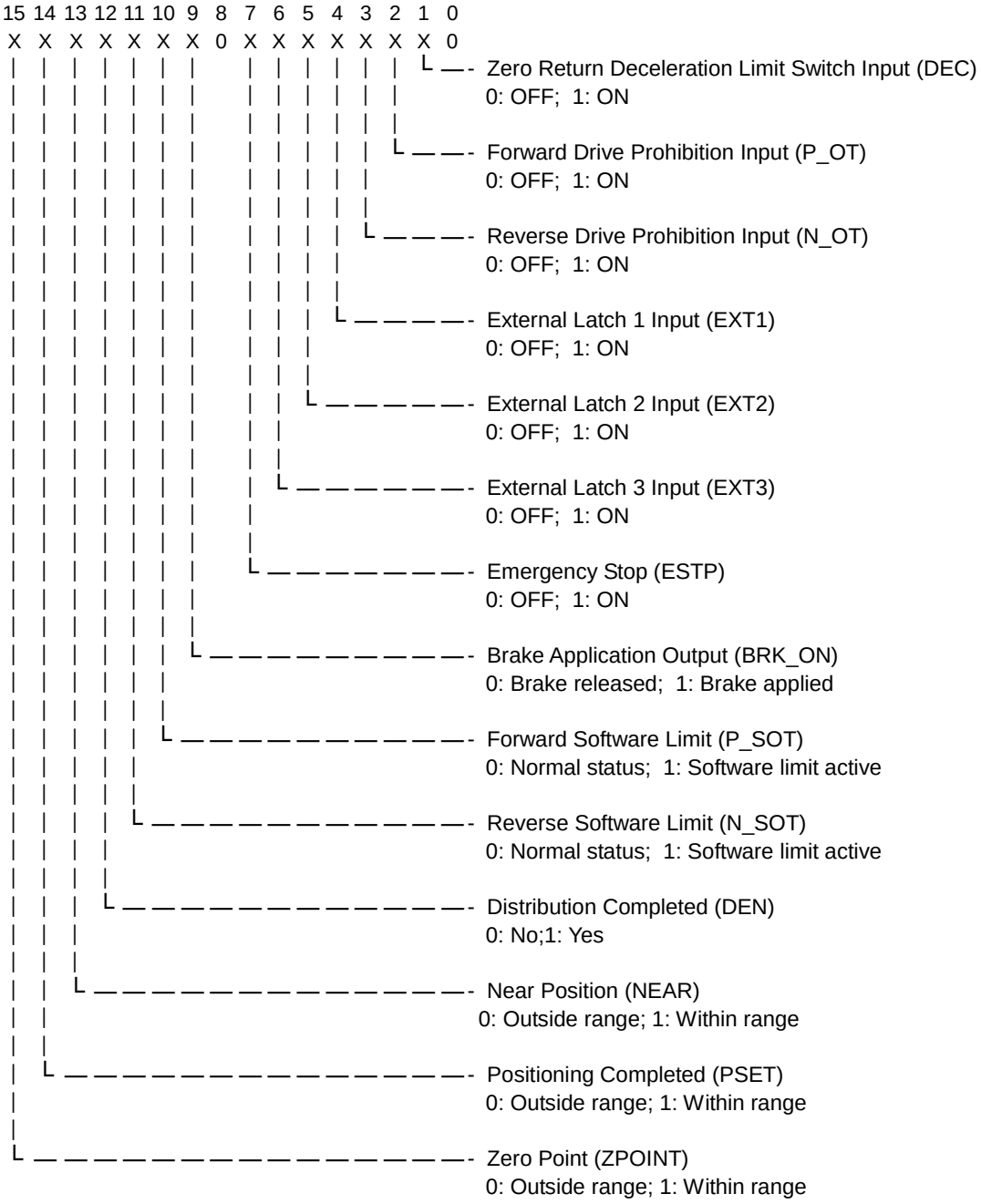
[Data Position No.] □□63 / □□64 (□□ denotes an axis number from 01 to 15)
[Data Range] Bit data: Bits 31 to 0

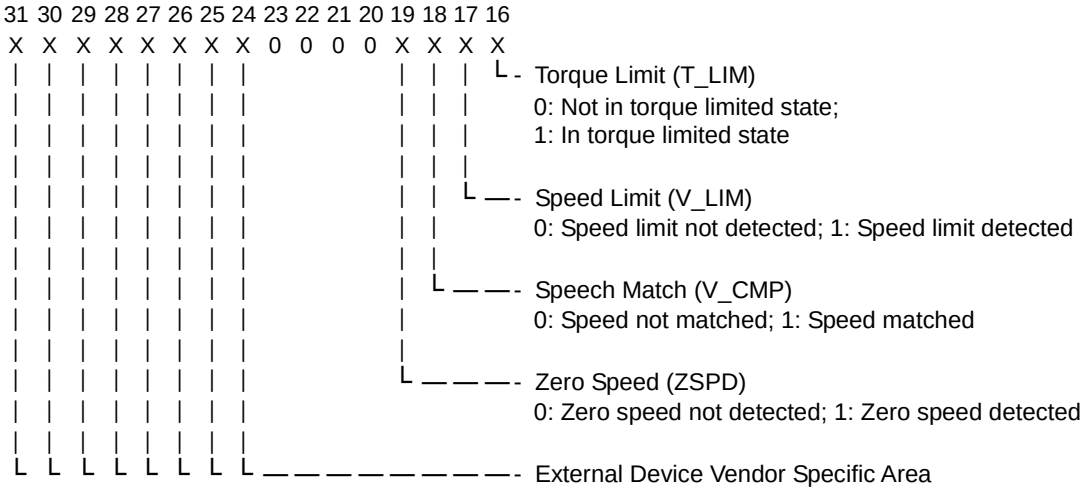
Returns the Servo Command Status Field（SVCMD_STAT）. For details on monitor data selection codes, see Table 4.8.



● Servo Command Input Signal (SVCMD_IO) STD SERVO

[Data Position No.] **□□65 / □□66 (□□ denotes an axis number from 01 to 15)**
[Data Range] **Bit data: Bits 31 to 0**
Returns Servo Command Input Signal (SVCMD_IO) data.





● Fixed Monitor 1 (CPRM_SEL_MON1) STD SERVO

[Data Position No.] □□67 / □□68 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of Fixed Monitor 1（CPRM_SEL_MON1）.

● Fixed Monitor 2 (CPRM_SEL_MON2) STD SERVO

[Data Position No.] □□69 / □□70 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of Fixed Monitor 2（CPRM_SEL_MON2）.

● Monitor 1 (MONITOR1) STD SERVO

[Data Position No.] □□71 / □□72 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns Command Position (CPOS) data.

● Monitor 2 (MONITOR2) STD SERVO

[Data Position No.] □□73 / □□74 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of monitor 2 (MONITOR2）.

● Monitor 3 (MONITOR3) STD SERVO

[Data Position No.] □□75 / □□76 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of monitor 3 (MONITOR3）.

● Monitor 4 (MONITOR4) STD SERVO

[Data Position No.] □□77 / □□78 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of monitor 4 (MONITOR4）.

● Monitor 5 (MONITOR5) STD SERVO

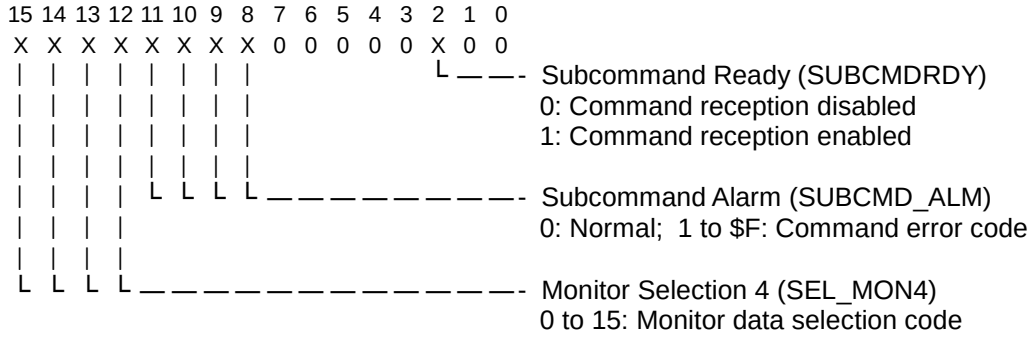
[Data Position No.] □□79 / □□80 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of monitor 5 (MONITOR5).

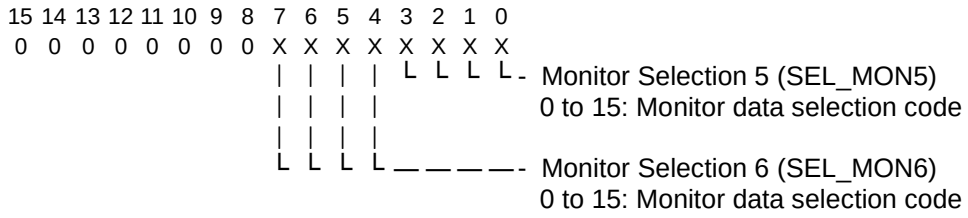
● Monitor 6 (MONITOR6) STD SERVO

[Data Position No.] □□81 / □□82 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns data of monitor 6 (MONITOR6).

● Subcommand Status (SUB_STAT) STD SERVO

[Data Position No.] □□83 / □□84 (□□ denotes an axis number from 01 to 15)
[Data Range] Bit data: Bits 31 to 0
Returns Subcommand Status (SUB_STAT). For details on monitor data selection codes, see Table 4.8.





● Remaining Travel Status STD SERVO

[Data Position No.] □□85 / □□86 (□□ denotes an axis number from 01 to 15)
[Data Range] -2,147,483,648 to 2,147,483,647
Returns the remaining distance to the target position for an interpolation motion.

If a Decelerate & Stop motion was executed during motion, this status returns the remaining distance to the position for deceleration to a stop.

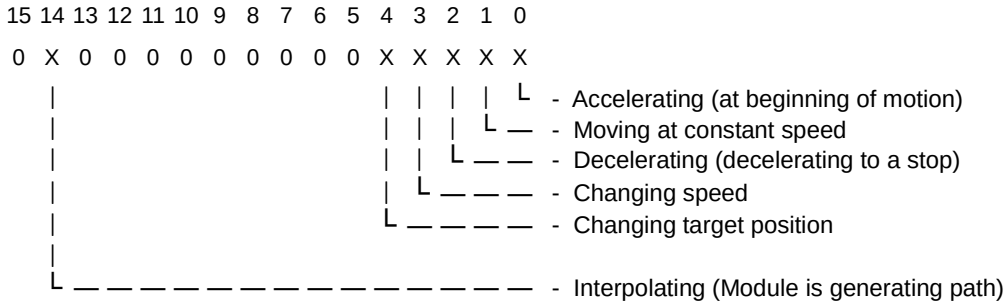
If a change in target position was executed during motion, this status returns the remaining travel distance to the new target position after the target position change completes execution.

● Interpolation Status

STD SERVO

[Data Position No.] **□□87 (□□ denotes an axis number from 01 to 15)**
[Data Range] **Bit data: Bits 15 to 0**

Returns the status of an interpolation motion in progress.



● Input Data (INPUT)

STD I/O

[Data Position No.] **□□63 to □□92 (□□ denotes an axis number from 01 to 15)**
[Data Range] **Bit data: Bits 15 to 0**

Returns input data (INPUT) from standard I/O profile compliant external devices.

Input data (INPUT) is received continually while the Send Command relay (Y□□□33 to Y□□□47) remains ON. Even after (Y□□□33 to Y□□□47) is turned off, input data (INPUT) continues to be received until another MECHATROLINK-III command is sent.

Table 4.16 Input Data (INPUT Map

Data Position Number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
□□63	I_{16}	I_{15}	I_{14}	I_{13}	I_{12}	I_{11}	I_{10}	I_{9}	I_{8}	I_{7}	I_{6}	I_{5}	I_{4}	I_{3}	I_{2}	I_{1}
□□64	I_{32}	I_{31}	I_{30}	I_{29}	I_{28}	I_{27}	I_{26}	I_{25}	I_{24}	I_{23}	I_{22}	I_{21}	I_{20}	I_{19}	I_{18}	I_{17}
□□65	I_{48}	I_{47}	I_{46}	I_{45}	I_{44}	I_{43}	I_{42}	I_{41}	I_{40}	I_{39}	I_{38}	I_{37}	I_{36}	I_{35}	I_{34}	I_{33}
□□66	I_{64}	I_{63}	I_{62}	I_{61}	I_{60}	I_{59}	I_{58}	I_{57}	I_{56}	I_{55}	I_{54}	I_{53}	I_{52}	I_{51}	I_{50}	I_{49}
□□67																
:																
□□91																
□□92																

CAUTION

When the CPU module reads 2-word status data from the positioning module, concurrency of the high-order word and low-order word of 2-word data is not assured due to conflicts between the timing of reading from the CPU module and the data update cycle of the positioning module.

To ensure that the high-order word and low-order word of 2-word data are concurrent when reading from a sequence CPU, use the READ instruction to read the data twice consecutively and verify that the data read are the same in both instances. If the HRD instruction is used, data concurrency is not assured even if you had verified that the data are the same.

Data concurrency cannot be assured when reading from a BASIC CPU.

For details on how to check that data read twice consecutively by a sequence CPU are the same in both instances, see Section 6.3, “Precautions When Reading 2-word Data.”

4.2.6 Common Statuses

This subsection lists and describes the common statuses.

■ List of Common Statuses

Table 4.17 List of Common Statuses

Data Position Number	Data Name	Data Description	See Also
1601	Alarm Axis Bits	Bit data for module, AX15, AX14, …, AX2 and AX1	4-35
1602	Warning Axis Bits	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-36
1603	Module Alarm Code	MECHATROLINK-III communication initialization related errors, MECHATROLINK-III communication related errors, interpolation motion command execution related errors, etc.	4-36
1604	Module Detailed Alarm Code	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-37
1605 to 2000	(System reserved)		–

■ Description of Common Statuses

● Alarm Axis Bits

[Data Position No.] 1601
[Data Range] Bit data: Bits 15 to 0

Returns bit data that indicates the alarm status of the positioning module and each axis.

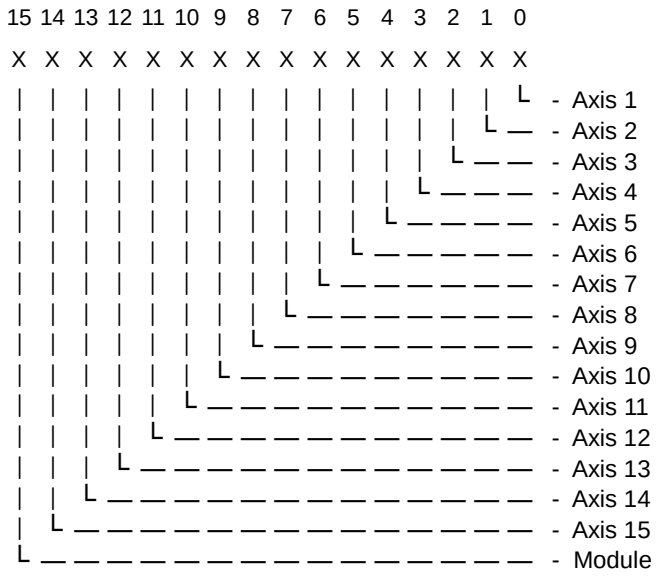
The alarm module bit turns on when a MECHATROLINK-III communication initialization related error, a MECHATROLINK-III communication related error or an interpolation motion command execution related error is detected.

The alarm bit for an axis turns on when an external device detects an alarm for an axis, and notifies the positioning module through a MECHATROLINK-III response.

For more details, see Section 5.6, "Detecting Errors, Warnings and Communication Alarms".

1: Alarm detected

0: No alarm detected



● Warning Axis Bits

[Data Position No.] 1602
[Data Range] Bit data: Bits 15 to 0

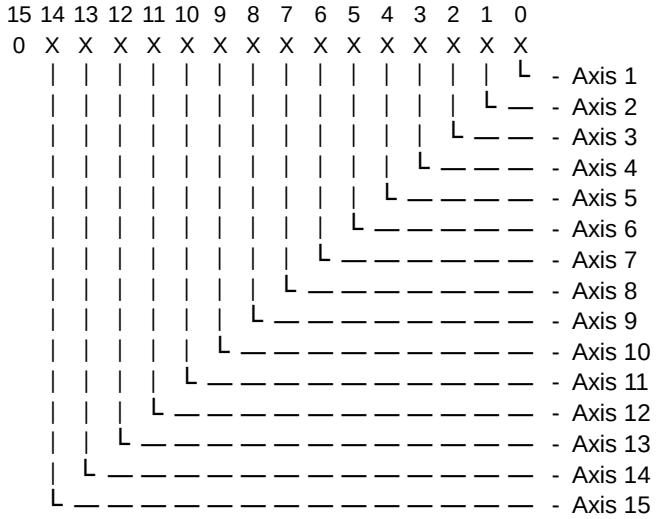
Returns bit data that indicates the warning status of each axis.

The warning bit for an axis turns on when an external device detects a warning for an axis, and notifies the positioning module through a MECHATROLINK-III response.

For more details, see Section 5.6, "Detecting Errors, Warnings and Communication Alarms".

1: Warning detected

0: No warning detected



● Module Alarm Code

[Data Position No.] 1603
[Data Range] 0: No module alarm detected
$0000 to $FFFF: Alarm code

Returns the alarm code when a module alarm is detected.

This status is meaningful only when the module bit of Alarm Axis Bits has value 1. If multiple alarms are detected concurrently, the alarm code of the first detected alarm is stored.

The alarm code may indicate a MECHATROLINK-III communication initialization related error, a MECHATROLINK-III communication related error or an interpolation motion command execution related error.

For more details, see Section 5.6, "Detecting Errors, Warnings and Communication Alarms" and Section 7.2.1, “Module Alarms.”

● Module Detailed Alarm Code

[Data Position No.] 1604
[Data Range] Bit data: Bits 15 to 0

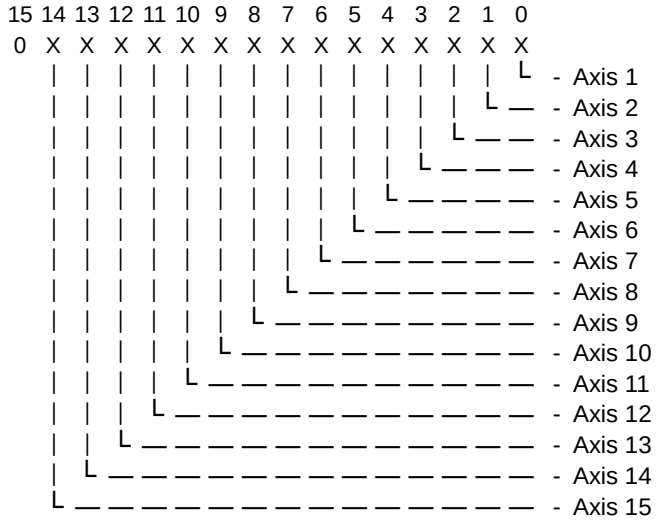
Returns bit data that indicates the axes where a module alarm is encountered.

This status is meaningful only when the module bit of Alarm Axis Bits has value 1.

For more details, see Section 5.6, "Detecting Errors, Warnings and Communication Alarms".

1: Module alarm detected

0: No module alarm detected



4.2.7 Extended MECHATROLINK-III Command and Response Parameters

This subsection lists and describes extended MECHATROLINK-III command and response parameters.

These parameters are used when a ladder program is used to directly write a MECHATROLINK-III command to be transmitted to an external device.

The data of each MECHATROLINK-III command and MECHATROLINK-III response depend on the external device that is connected. For details on individual MECHATROLINK-III commands and responses, see the user's manual of the connected external device.

■ List of Extended MECHATROLINK-III Command and Response Parameters

Table 4.18 List of Extended MECHATROLINK-II Command and Response Parameters

Data Position Number	Data Name	Data Description	See Also
2001 to 2050	AX1 Extended MECHATROLINK-III command parameters		4-39
2051 to 2100	AX2 Extended MECHATROLINK-III command parameters		
2101 to 2150	AX3 Extended MECHATROLINK-III command parameters		
2151 to 2200	AX4 Extended MECHATROLINK-III command parameters		
2201 to 2250	AX5 Extended MECHATROLINK-III command parameters		
2251 to 2300	AX6 Extended MECHATROLINK-III command parameters		
2301 to 2350	AX7 Extended MECHATROLINK-III command parameters		
2351 to 2400	AX8 Extended MECHATROLINK-III command parameters		
2401 to 2450	AX9 Extended MECHATROLINK-III command parameters		
2451 to 2500	AX10 Extended MECHATROLINK-III command parameters		
2501 to 2550	AX11 Extended MECHATROLINK-III command parameters		
2551 to 2600	AX12 Extended MECHATROLINK-III command parameters		
2601 to 2650	AX13 Extended MECHATROLINK-III command parameters		
2651 to 2700	AX14 Extended MECHATROLINK-III command parameters		
2701 to 2750	AX15 Extended MECHATROLINK-III command parameters		

Data Position Number	Data Name	Data Description	See Also
3001 to 3050	AX1 Extended MECHATROLINK-III response parameters		4-39
3051 to 3100	AX2 Extended MECHATROLINK-III response parameters		
3101 to 3150	AX3 Extended MECHATROLINK-III response parameters		
3151 to 3200	AX4 Extended MECHATROLINK-III response parameters		
3201 to 3250	AX5 Extended MECHATROLINK-III response parameters		
3251 to 3300	AX6 Extended MECHATROLINK-III response parameters		
3301 to 3350	AX7 Extended MECHATROLINK-III response parameters		
3351 to 3400	AX8 Extended MECHATROLINK-III response parameters		
3401 to 3450	AX9 Extended MECHATROLINK-III response parameters		
3451 to 3500	AX10 Extended MECHATROLINK-III response parameters		
3501 to 3550	AX11 Extended MECHATROLINK-III response parameters		
3551 to 3600	AX12 Extended MECHATROLINK-III response parameters		
3601 to 3650	AX13 Extended MECHATROLINK-III response parameters		
3651 to 3700	AX14 Extended MECHATROLINK-III response parameters		
3701 to 3750	AX15 Extended MECHATROLINK-III response parameters		

■ Description of Extended MECHATROLINK-III Command and Response Parameters

● Axis Extended MECHATROLINK-III Command Parameters

Specify the parameters for a MECHATROLINK-III command to be transmitted.

The specified extended MECHATROLINK-III command parameter data is transmitted as is if the Command Code (CMD) axis MECHATROLINK-III command parameter is specified as -1.

● Axis Extended MECHATROLINK-III Response Parameters

These parameters return the response for a transmitted MECHATROLINK-III command.

These parameters return the response to a MECHATROLINK-III command transmitted according to the extended MECHATROLINK-III command parameter values.

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5. Using the Positioning Module

5.1 Startup Preparation

Figure 5.1 shows a flowchart for commissioning the positioning module in an FA-M3 system.

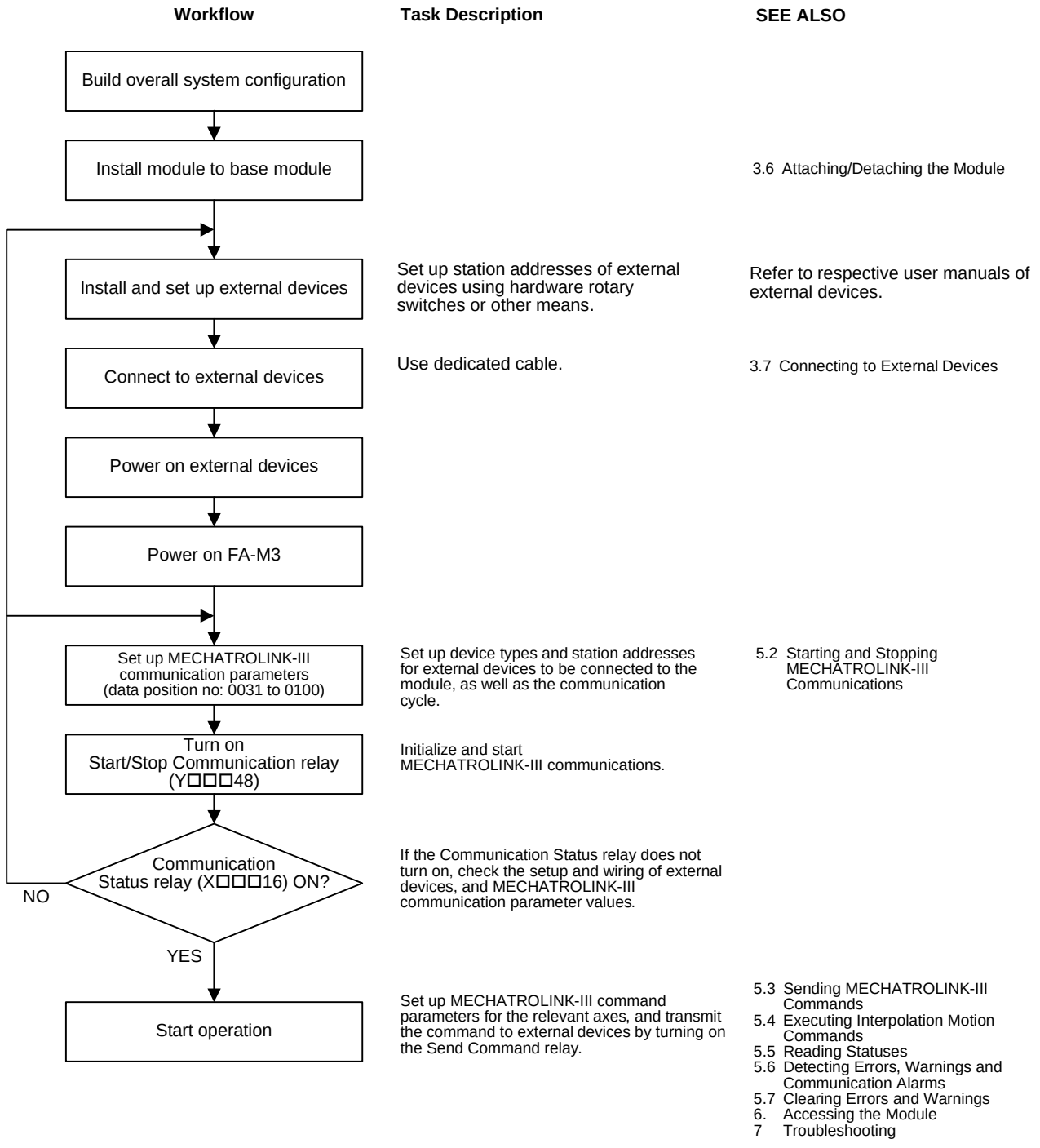


Figure 5.1 Startup Preparation Flowchart

5.2 Starting and Stopping MECHATROLINK-III Communications

This section describes how to set up the device types and station addresses of external devices corresponding to axes 1 to 15 of the positioning module and the communication cycle in the MECHATROLINK-III communication parameters area, initialize MECHATROLINK-III communications, and begin communications.

The positioning command automatically sends the MECHATROLINK-III commands listed below in sequence to begin communications.

- **For standard servo profile compliant external device:**
  No operation command（NOP: $00）
  Release connection command（DISCONNECT: $0F）
  Establish connection command（CONNECT: $0E）
  Turn sensor ON command（SENS_ON: $23）
  Servo status monitor command（SMON: $30）

- **For standard I/O profile compliant external device:**
  No operation command（NOP: $00）
  Release connection command（DISCONNECT: $0F）
  Establish connection command（CONNECT: $0E）

■ Starting Communications

● Procedure for Starting Communications

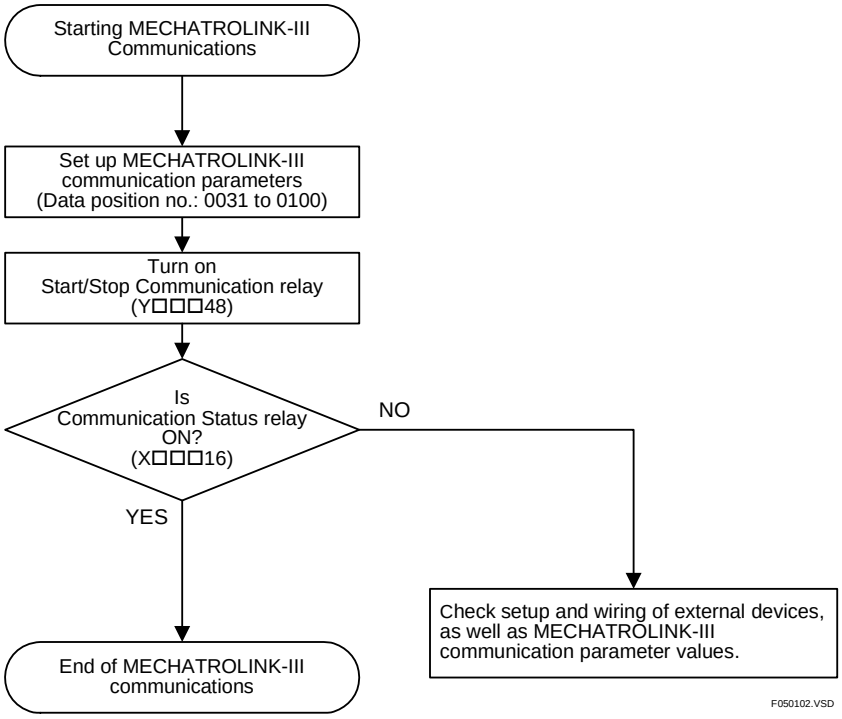


Figure 5.2 Procedure for Starting MECHATROLINK-III Communications

● Writing MECHATROLINK-III Communication Parameters

You can write MECHATROLINK-III communication parameters to the module using a WRITE instruction in a ladder program. Always set the station addresses of unconnected axes to 0.

Table 5.1 MECHATROLINK-III Communication Parameters

Data Position Number	Data Name	Data Description	See Also
0031	AX1 Device Type	- For standard servo profile compliant external device: High-byte : Profile type code ($10: standard servo profile) Bit 0 : Subcommand setting (0: Enabled, 1: Disabled) - For standard I/O profile compliant external device: High-byte : Profile type code ($30: standard I/O profile) Bits 3 to 0 : Communication data size in bytes (0: 16, 1: 32, 2: 48, 3: 64)	4-12
0032	AX1 Station Address	0: unconnected, $03 to $EF	
0033	AX2 Device Type		
0034	AX2 Station Address		
0035	AX3 Device Type		
0036	AX3 Station Address		
0037	AX4 Device Type		
0038	AX4 Station Address		
0039	AX5 Device Type		
0040	AX5 Station Address		
0041	AX6 Device Type		
0042	AX6 Station Address		
0043	AX7 Device Type		
0044	AX7 Station Address		
0045	AX8 Device Type		
0046	AX8 Station Address		
0047	AX9 Device Type		
0048	AX9 Station Address		
0049	AX10 Device Type		
0050	AX10 Station Address		
0051	AX11 Device Type		
0052	AX11 Station Address		
0053	AX12 Device Type		
0054	AX12 Station Address		
0055	AX13 Device Type		
0056	AX13 Station Address		
0057	AX14 Device Type		
0058	AX14 Station Address		
0059	AX15 Device Type		
0060	AX15 Station Address		
0061	(System reserved)	Always 0	–
0062	Communication Cycle	0: 2 ms, 1: 1 ms, 2: 0.5 ms (8 axes max.), 3: 0.25 ms (4 axes max)	4-13
0063 to 0100	(System reserved)	Always 0	–

● Start/Stop Communication relay

Turning on the Start/Stop Communication relay (Y□□□48) after writing MECHATROLINK-III communication parameter values initializes MECHATROLINK-III communications. The Communication Status relay (X□□□16) turns on when MECHATROLINK-III communication initialization is successfully completed to indicate that the module is ready to send and receive MECHATROLINK-III commands.

Always keep the Start/Stop Communication relay (Y□□□48) ON while operating the module. Turning off this relay stops MECHATROLINK-III communications, and turns off the Communication Status (X□□□16) relay. It also stops the operation of connected external devices.

Table 5.2 Relays for Issuing Request to Start or Stop MECHATROLINK-III Communication

Output Relay No.	Signal Name	Description	Relation with Other Relays
Y□□□48	Start/stop Communication	Request to start or stop MECHATROLINK-III communications	X□□□16 shows the current communication status.

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□16	Communication Status	Turns on while MECHATROLINK-III communications is in progress; turns off otherwise.	Turning on Y□□□48 to initiate communications turns on this relay when communication begins. Turning off Y□□□48 turns off this relay.

Note: In the table, "□□□" denotes the slot number of the FA-M3 unit where the module is mounted.

■ Communication Parameters Setup Example

● Procedure

(1) Specify the device type and station addresses of external devices to be connected in data position numbers 0031 to 0060.

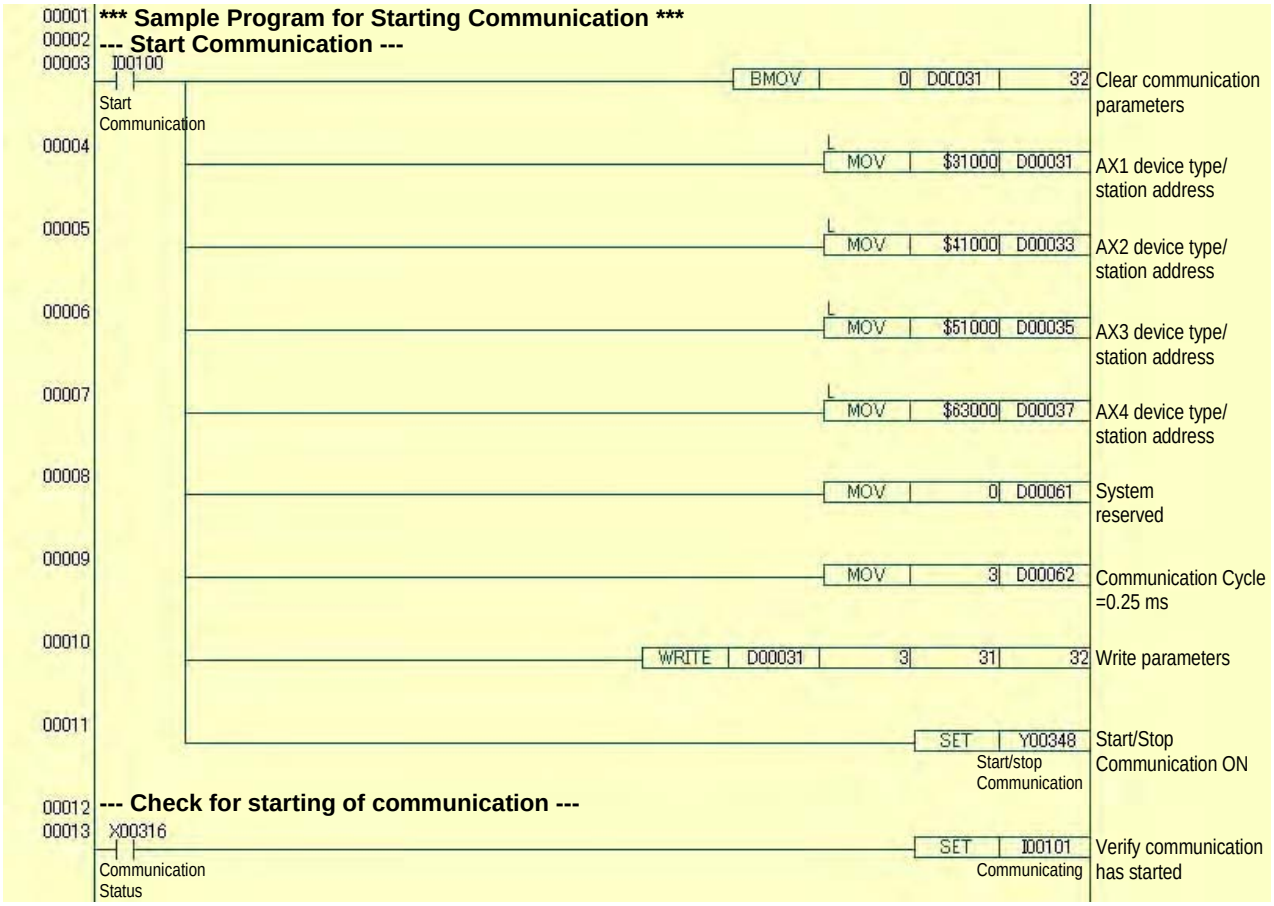
(2) Specify the communication cycle time in data position number 0062.

(3) Turn on the Start/Stop Communication relay (Y□□□48).

(4) Check that the Communication Status relay (X□□□16) has turned on.

● Sample Program

This sample program issues a request to the positioning module installed in slot 3 to initiate communication with three standard servo profile compliant external devices having station addresses $03, $04 and $05, as well as one standard I/O profile compliant device having station address $06. It verifies whether MECHATROLINK-III communication is successfully initiated by checking whether the Communication Status (X□□□16) relay has turned on.



5.3 Sending MECHATROLINK-III Commands

This section describes how to send MECHATROLINK-III commands to external devices corresponding to axes 1 to 15 of the positioning module. It also describes how to receive MECHATROLINK-III responses for transmitted MECHATROLINK-III commands.

The positioning module performs no error and other status checks of the destination external device and no range checking of the parameter values to be transmitted.

You should therefore check the execution status of a transmitted command by checking the MECHATROLINK-III response received subsequently.

■ Sending a MECHATROLINK-III Command

● Procedure for sending a MECHATROLINK-III command

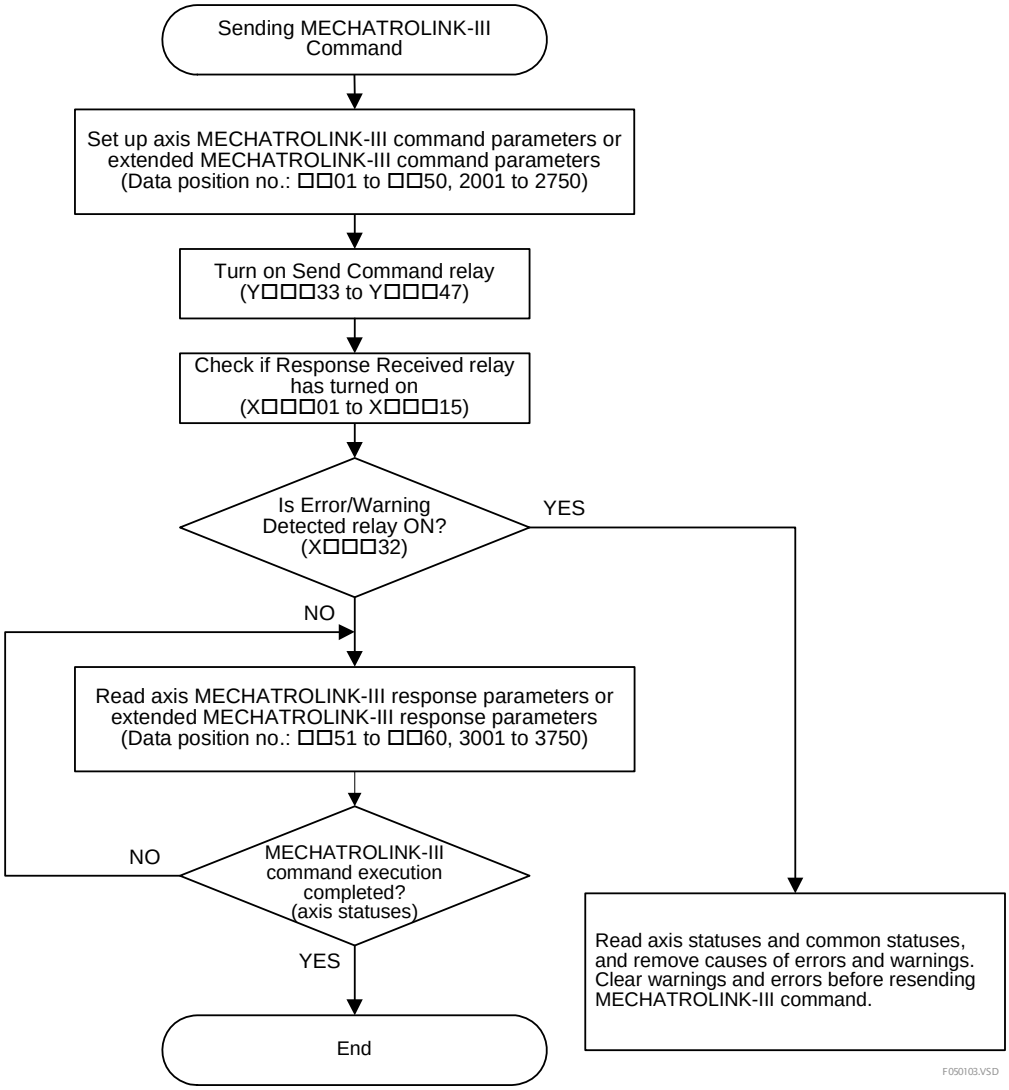


Figure 5.3 Procedure for Sending a MECHATROLINK-III Command

● Acceptance conditions for MECHATROLINK-III commands

- MECHATROLINK-III communication is in progress.
- Send Command relay is OFF.
- Response Received relay is OFF.
- No interpolation motion in progress.

A command is ignored if any of the above conditions is not true.

● Writing MECHATROLINK-III command parameters

Axis MECHATROLINK-III command parameters and extended MECHATROLINK-III command parameters can be written to the module using a WRITE instruction in a ladder program.

For details on the required command parameters of each MECHATROLINK-III command, see Subsection 5.3.1, "Parameters and Statuses of MECHATROLINK-III Commands". For details on the format conversion performed on a MECHATROLINK-III command before actual transmission, see Subsection 5.3.2, "Example of MECHATROLINK-III Command Format Conversion".

● Turning on Send Command relay and checking for Response Received relay turning on

Turning on the Send Command relay (Y□□□33 to Y□□□47) of an axis after writing MECHATROLINK-III command parameter values sends a MECHATROLINK-III command. The Response Received input relay (X□□□01 to X□□□15) for the axis turns on when a MECHATROLINK-III response to the transmitted MECHATROLINK-III command is received.

Verify that the Response Received relay (X□□□01 to X□□□15) has turned on before turning off the Send Command relay (Y□□□33 to Y□□□47). Turning off the Send Command relay (Y□□□33 to Y□□□47) for an axis also turns off the corresponding Response Received relay (X□□□01 to X□□□15).

Table 5.3 Relays for Sending MECHATROLINK-III Commands

Output Relay No.	Signal Name	Description	Relation with Other Relays
Y□□□33	AX1 Send Command	Request to send MECHATROLINK-III command for axis 1	Turn off this relay after verifying that X□□□01 has turned on.
Y□□□34	AX2 Send Command	Request to send MECHATROLINK-III command for axis 2	Turn off this relay after verifying that X□□□02 has turned on.
Y□□□35	AX3 Send Command	Request to send MECHATROLINK-III command for axis 3	Turn off this relay after verifying that X□□□03 has turned on.
Y□□□36	AX4 Send Command	Request to send MECHATROLINK-III command for axis 4	Turn off this relay after verifying that X□□□04 has turned on.
Y□□□37	AX5 Send Command	Request to send MECHATROLINK-III command for axis 5	Turn off this relay after verifying that X□□□05 has turned on.
Y□□□38	AX6 Send Command	Request to send MECHATROLINK-III command for axis 6	Turn off this relay after verifying that X□□□06 has turned on.
Y□□□39	AX7 Send Command	Request to send MECHATROLINK-III command for axis 7	Turn off this relay after verifying that X□□□07 has turned on.
Y□□□40	AX8 Send Command	Request to send MECHATROLINK-III command for axis 8	Turn off this relay after verifying that X□□□08 has turned on.
Y□□□41	AX9 Send Command	Request to send MECHATROLINK-III command for axis 9	Turn off this relay after verifying that X□□□09 has turned on.
Y□□□42	AX10 Send Command	Request to send MECHATROLINK-III command for axis 10	Turn off this relay after verifying that X□□□10 has turned on.
Y□□□43	AX11 Send Command	Request to send MECHATROLINK-III command for axis 11	Turn off this relay after verifying that X□□□11 has turned on.
Y□□□44	AX12 Send Command	Request to send MECHATROLINK-III command for axis 12	Turn off this relay after verifying that X□□□12 has turned on.
Y□□□45	AX13 Send Command	Request to send MECHATROLINK-III command for axis 13	Turn off this relay after verifying that X□□□13 has turned on.
Y□□□46	AX14 Send Command	Request to send MECHATROLINK-III command for axis 14	Turn off this relay after verifying that X□□□14 has turned on.
Y□□□47	AX15 Send Command	Request to send MECHATROLINK-III command for axis 15	Turn off this relay after verifying that X□□□15 has turned on.

To be continued on next page

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□01	AX1 Response Received	Turns on when a MECHATROLINK-III response for axis 1 is received.	Turning off Y□□□33 also turns off this relay.
X□□□02	AX2 Response Received	Turns on when a MECHATROLINK-III response for axis 2 is received.	Turning off Y□□□34 also turns off this relay.
X□□□03	AX3 Response Received	Turns on when a MECHATROLINK-III response for axis 3 is received.	Turning off Y□□□35 also turns off this relay.
X□□□04	AX4 Response Received	Turns on when a MECHATROLINK-III response for axis 4 is received.	Turning off Y□□□36 also turns off this relay.
X□□□05	AX5 Response Received	Turns on when a MECHATROLINK-III response for axis 5 is received.	Turning off Y□□□37 also turns off this relay.
X□□□06	AX6 Response Received	Turns on when a MECHATROLINK-III response for axis 6 is received.	Turning off Y□□□38 also turns off this relay.
X□□□07	AX7 Response Received	Turns on when a MECHATROLINK-III response for axis 7 is received.	Turning off Y□□□39 also turns off this relay.
X□□□08	AX8 Response Received	Turns on when a MECHATROLINK-III response for axis 8 is received.	Turning off Y□□□40 also turns off this relay.
X□□□09	AX9 Response Received	Turns on when a MECHATROLINK-III response for axis 9 is received.	Turning off Y□□□41 also turns off this relay.
X□□□10	AX10 Response Received	Turns on when a MECHATROLINK-III response for axis 10 is received.	Turning off Y□□□42 also turns off this relay.
X□□□11	AX11 Response Received	Turns on when a MECHATROLINK-III response for axis 11 is received.	Turning off Y□□□43 also turns off this relay.
X□□□12	AX12 Response Received	Turns on when a MECHATROLINK-III response for axis 12 is received.	Turning off Y□□□44 also turns off this relay.
X□□□13	AX13 Response Received	Turns on when a MECHATROLINK-III response for axis 13 is received.	Turning off Y□□□45 also turns off this relay.
X□□□14	AX14 Response Received	Turns on when a MECHATROLINK-III response for axis 14 is received.	Turning off Y□□□46 also turns off this relay.
X□□□15	AX15 Response Received	Turns on when a MECHATROLINK-III response for axis 15 is received.	Turning off Y□□□47 also turns off this relay.

Note: In the table, "□□□" denotes the slot number of the FA-M3 unit where the module is mounted.

● Reading MECHATROLINK-III response parameters and statuses

The Response Received relay (X□□□01 to X□□□15) for an axis turns ON when a MECHATROLINK-III response is received for a transmitted MECHATROLINK-III command. Axis MECHATROLINK-III response parameters, axis statuses, common statuses or extended MECHATROLINK-III response parameters can then be read using READ instructions in a ladder program.

For details on the response parameters and statuses that are returned for each transmitted MECHATROLINK-III command, see Subsection 5.3.1, "Parameters and Statuses of MECHATROLINK-III Commands".

● Checking for completion of MECHATROLINK-III command execution

Some MECHATROLINK-III commands such as SV_ON ($31), SV_OFF ($32), POSING ($35), FEED ($36), EX_FEED ($37), EX_POSING ($39) and ZRET ($3A) commands continue execution even after the Response Received relay X□□□01 to X□□□15) has turned ON.

You can check the completion of these MECHATROLINK-III commands by reading the following relays and statuses in a ladder program and checking the values of the relevant status bits.

- Positioning Completed relay (X□□□17 to X□□□31)
- Error/Warning Detected relay (X□□□32)
- Axis statues and common statuses

■ Examples for Sending MECHATROLINK-III Commands

● Procedure

(1) Specify the MECHATROLINK-III command code and required parameter values in data position numbers □□01 to □□50. To transmit an extended MECHATROLINK-III command, specify value –1 for the command code (CMD) and specify the data to be transmitted in the extended MECHATROLINK-III command parameters area.

(2) Turn on the Send Command relay (Y□□□33 to Y□□□47).

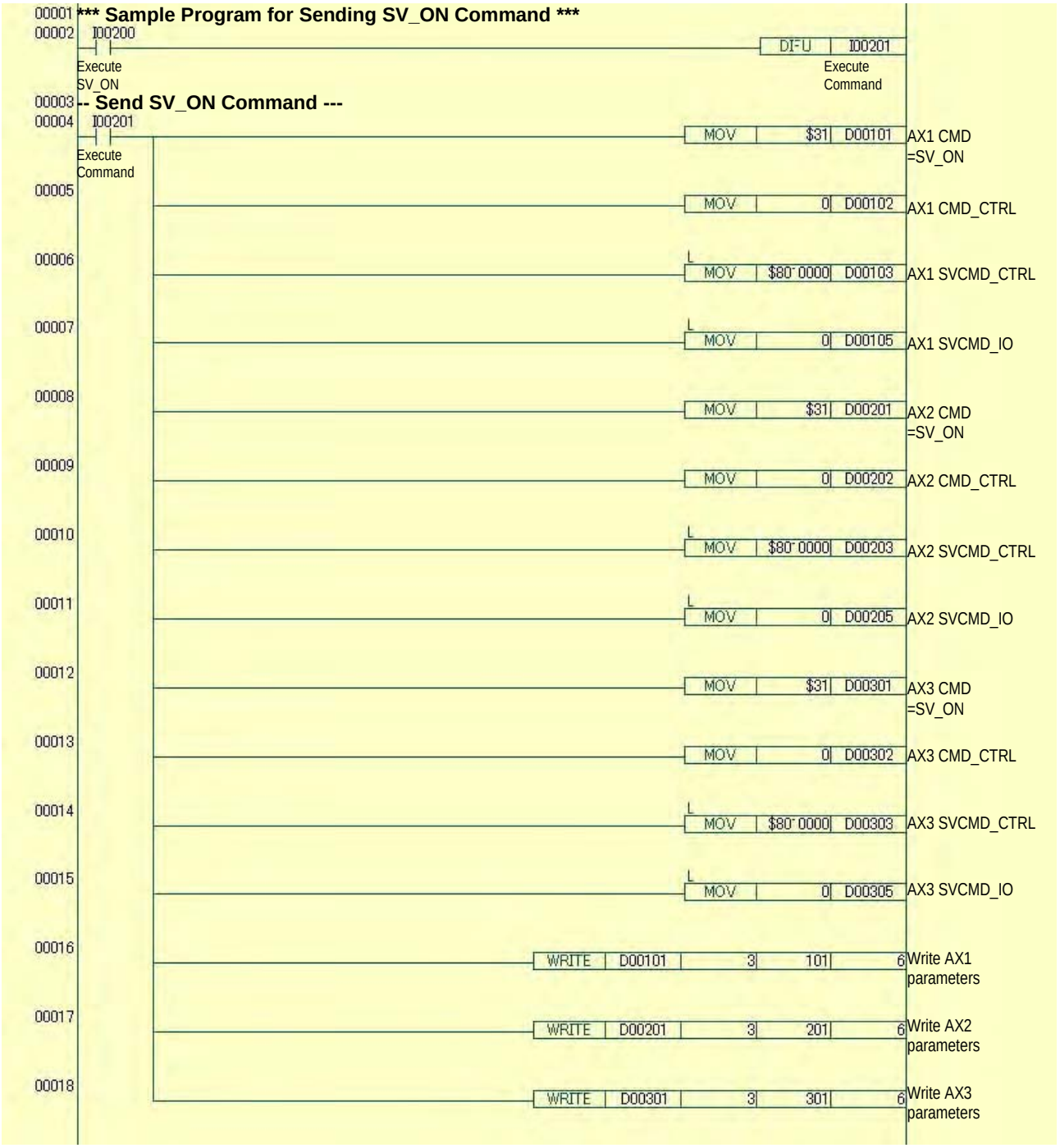
(3) Verify that the Response Received relay (X□□□01 to X□□□15) has turned on.

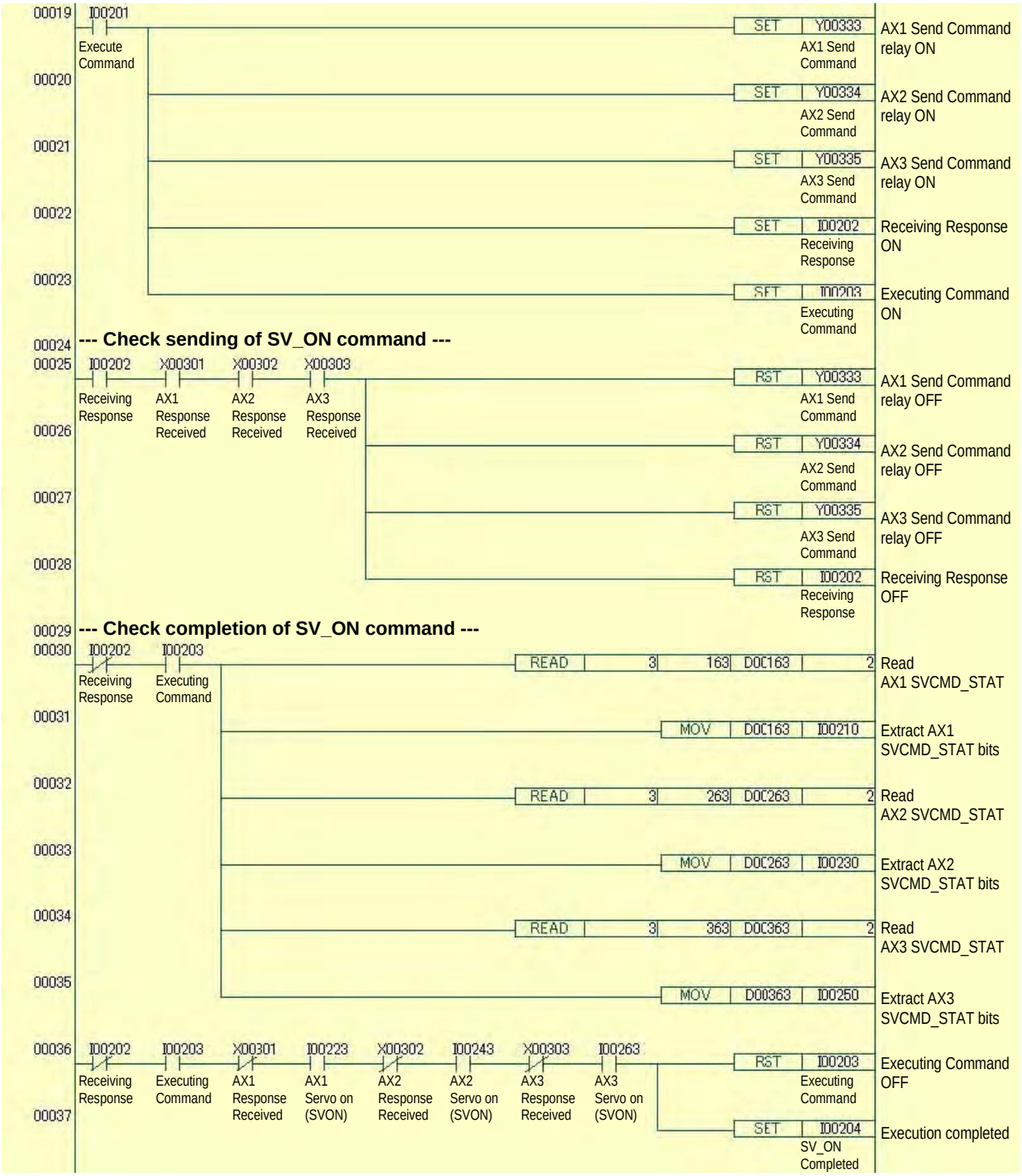
(4) Verify that command execution has completed by checking the Positioning Completed relay (X□□□17 to X□□□31), Error/Warning Detected relay (X□□□32), axis statuses and common statuses as required for each command.

● Sample Program for Sending Servo ON (SV_ON: $31) Command

This sample program issues a SV_ON ($31) command for axes 1 to 3 to the positioning module mounted in slot 3.

After issuing the command, it verifies completion of the command execution by checking that the SVON bit of each corresponding SVCMD_STAT axis status has turned ON.

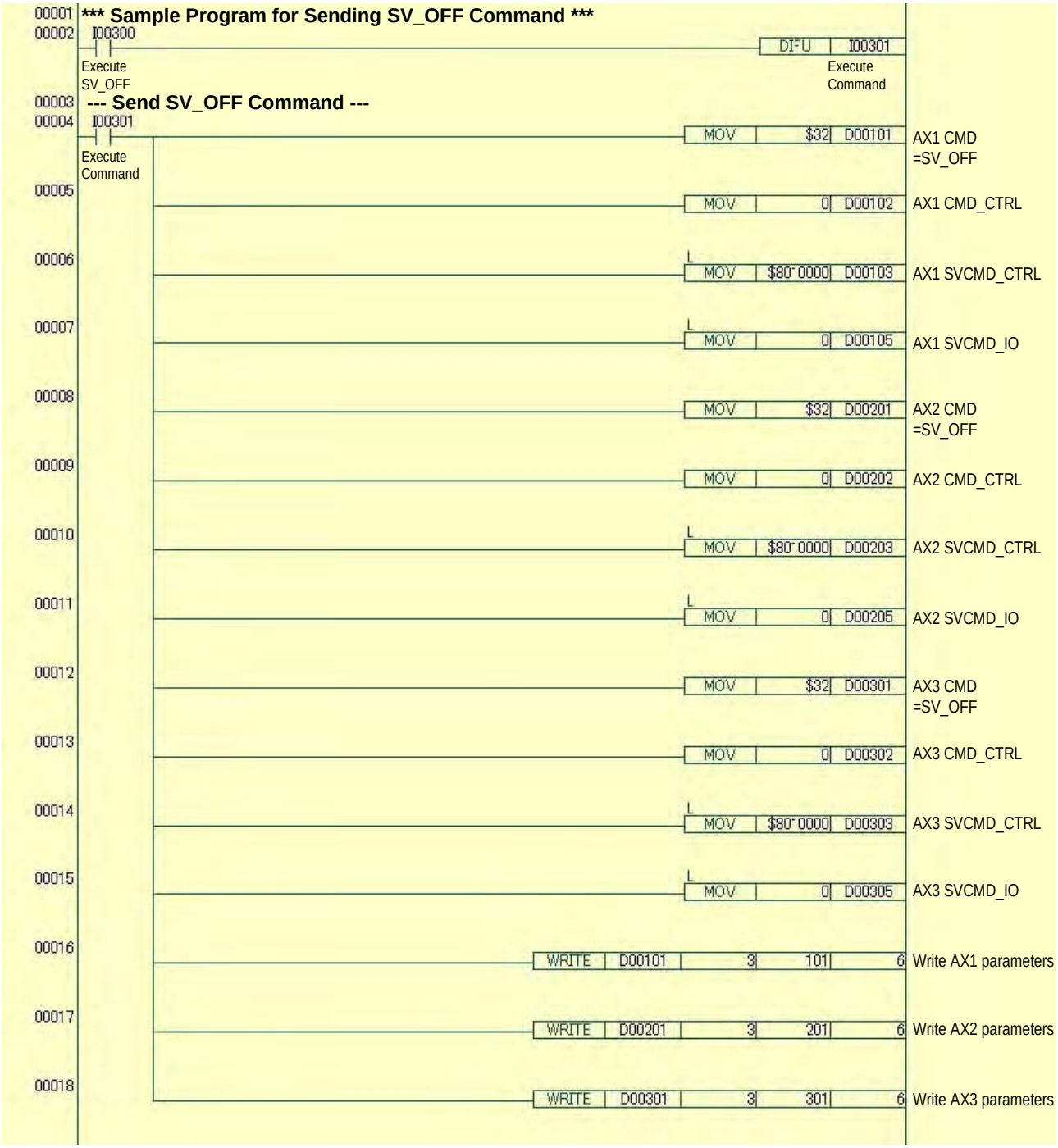


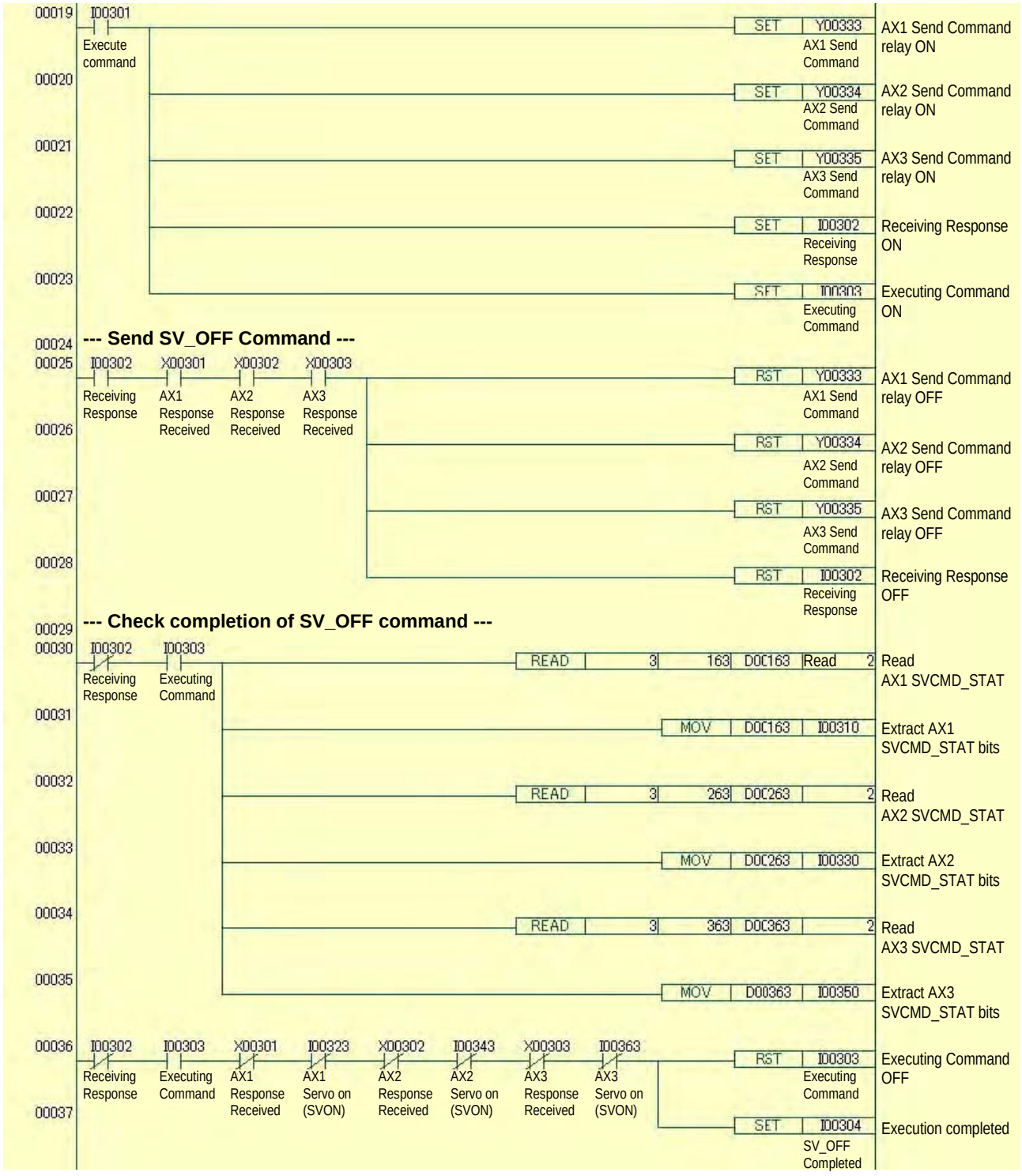

00019
I00201
Execute Command
SET Y00333 AX1 Send Command
AX1 Send Command relay ON
00020
SET Y00334 AX2 Send Command
AX2 Send Command relay ON
00021
SET Y00335 AX3 Send Command
AX3 Send Command relay ON
00022
SET I00202 Receiving Response
Receiving Response ON
00023
SET I00203 Executing Command
Executing Command ON
00024
--- Check sending of SV_ON command ---
00025
I00202 Receiving Response
X00301 AX1 Response Received
X00302 AX2 Response Received
X00303 AX3 Response Received
RST Y00333 AX1 Send Command
AX1 Send Command relay OFF
00026
RST Y00334 AX2 Send Command
AX2 Send Command relay OFF
00027
RST Y00335 AX3 Send Command
AX3 Send Command relay OFF
00028
RST I00202 Receiving Response
Receiving Response OFF
00029
--- Check completion of SV_ON command ---
00030
I00202 Receiving Response
I00203 Executing Command
READ 3 163 D0C163 2
Read AX1 SVCMD_STAT
00031
MOV D0C163 I00210
Extract AX1 SVCMD_STAT bits
00032
READ 3 263 D0C263 2
Read AX2 SVCMD_STAT
00033
MOV D0C263 I00230
Extract AX2 SVCMD_STAT bits
00034
READ 3 363 D0C363 2
Read AX3 SVCMD_STAT
00035
MOV D00363 I00250
Extract AX3 SVCMD_STAT bits
00036
I00202 Receiving Response
I00203 Executing Command
X00301 AX1 Response Received
I00223 AX1 Servo on (SVON)
X00302 AX2 Response Received
I00243 AX2 Servo on (SVON)
X00303 AX3 Response Received
I00263 AX3 Servo on (SVON)
RST I00203 Executing Command
Executing Command OFF
00037
SET I00204 SV_ON Completed
Execution completed

● Sample Program for Sending Servo OFF (SV_OFF: $32) Command

This sample program issues a SV_OFF ($32) command for axes 1 to 3 to the positioning module mounted in slot 3.

After issuing the command, it verifies completion of the command execution by checking that the SVON bit of each corresponding SVCMD_STAT axis status has turned OFF

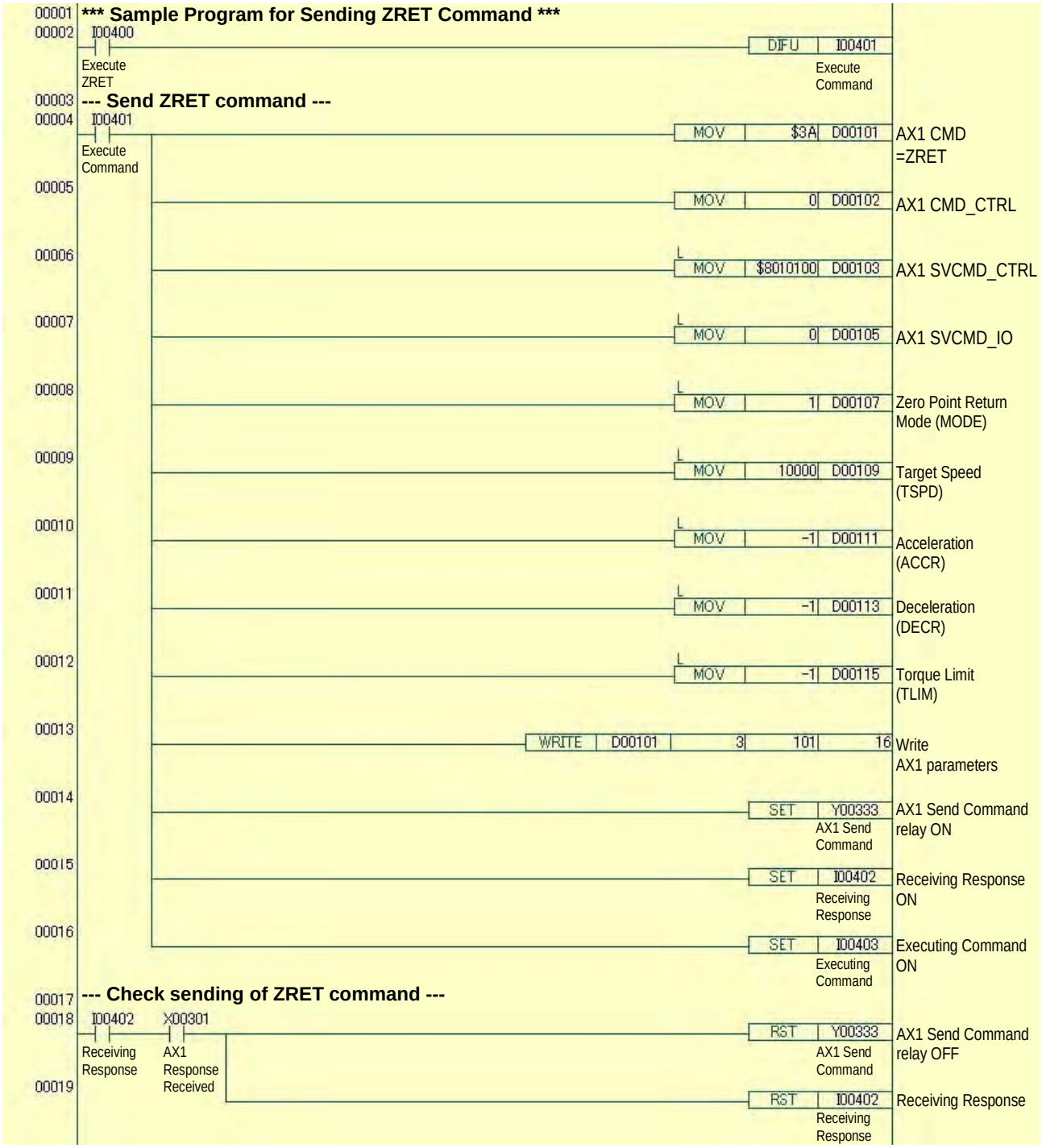


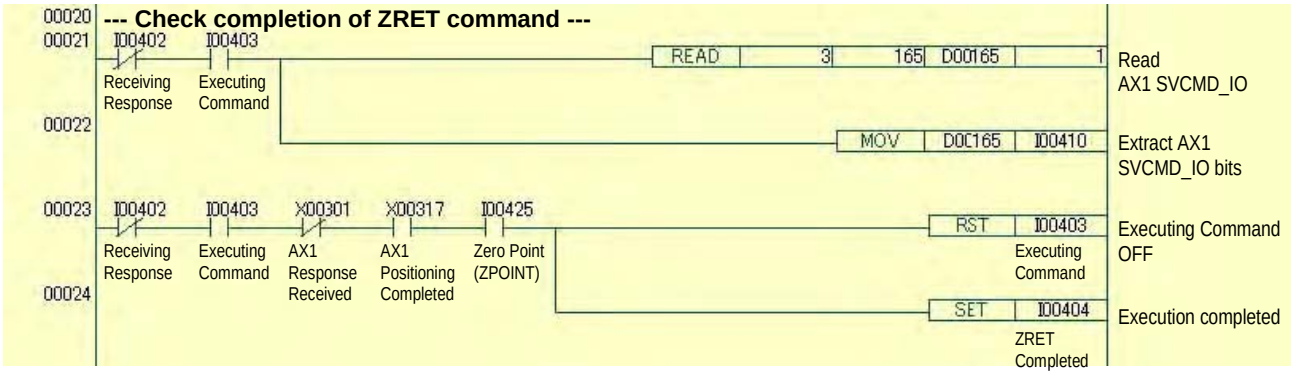

00019
I00301
Execute command
SET Y00333
AX1 Send Command
AX1 Send Command relay ON
00020
SET Y00334
AX2 Send Command
AX2 Send Command relay ON
00021
SET Y00335
AX3 Send Command
AX3 Send Command relay ON
00022
SET I00302
Receiving Response
Receiving Response ON
00023
SET I00303
Executing Command
Executing Command ON
00024
--- Send SV_OFF Command ---
00025
I00302 Receiving Response
X00301 AX1 Response Received
X00302 AX2 Response Received
X00303 AX3 Response Received
RST Y00333
AX1 Send Command
AX1 Send Command relay OFF
00026
RST Y00334
AX2 Send Command
AX2 Send Command relay OFF
00027
RST Y00335
AX3 Send Command
AX3 Send Command relay OFF
00028
RST I00302
Receiving Response
Receiving Response OFF
00029
--- Check completion of SV_OFF command ---
00030
I00302 Receiving Response
I00303 Executing Command
READ 3 163 D0C163 Read 2
Read AX1 SVCMD_STAT
00031
MOV D0C163 I00310
Extract AX1 SVCMD_STAT bits
00032
READ 3 263 D0C263 2
Read AX2 SVCMD_STAT
00033
MOV D0C263 I00330
Extract AX2 SVCMD_STAT bits
00034
READ 3 363 D0C363 2
Read AX3 SVCMD_STAT
00035
MOV D00363 I00350
Extract AX3 SVCMD_STAT bits
00036
I00302 Receiving Response
I00303 Executing Command
X00301 AX1 Response Received
I00323 AX1 Servo on (SVON)
X00302 AX2 Response Received
I00343 AX2 Servo on (SVON)
X00303 AX3 Response Received
I00363 AX3 Servo on (SVON)
RST I00303
Executing Command
Executing Command OFF
00037
SET I00304
SV_OFF Completed
Execution completed

● Sample Program for Sending Zero Point Return (ZRET: $3A) Command

This sample program issues a ZRET ($3A) command for axis 1 to the positioning module mounted in slot 3.

After issuing the command, it verifies completion of the command execution by checking that both the corresponding Positioning Completed relay and the ZPOINT bit of the corresponding SVCMD_IO axis status have turned on.

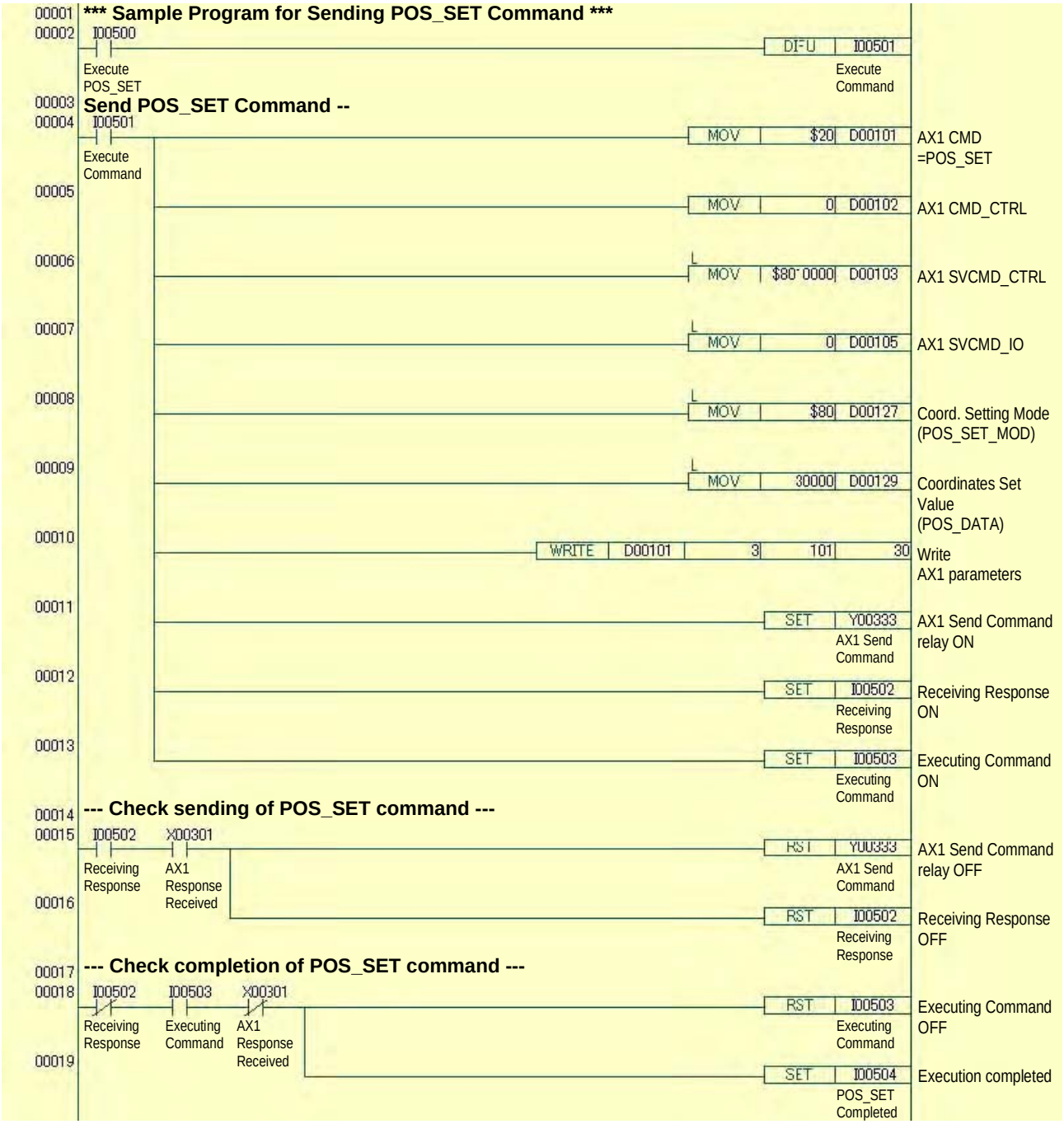



00020
--- Check completion of ZRET command ---
00021
I00402
Receiving Response
I00403
Executing Command
READ
3
165
D00165
1
Read AX1 SVCMD_IO
00022
MOV
D0C165
I00410
Extract AX1 SVCMD_IO bits
00023
I00402
Receiving Response
I00403
Executing Command
X00301
AX1 Response Received
X00317
AX1 Positioning Completed
I00425
Zero Point (ZPOINT)
RST
I00403
Executing Command
Executing Command OFF
00024
SET
I00404
ZRET Completed
Execution completed

● Sample Program for Sending Set Coordinates (POS_SET: $20) Command

This sample program issues a POS_SET ($20) command for axis 1 to the positioning module mounted in slot 3.

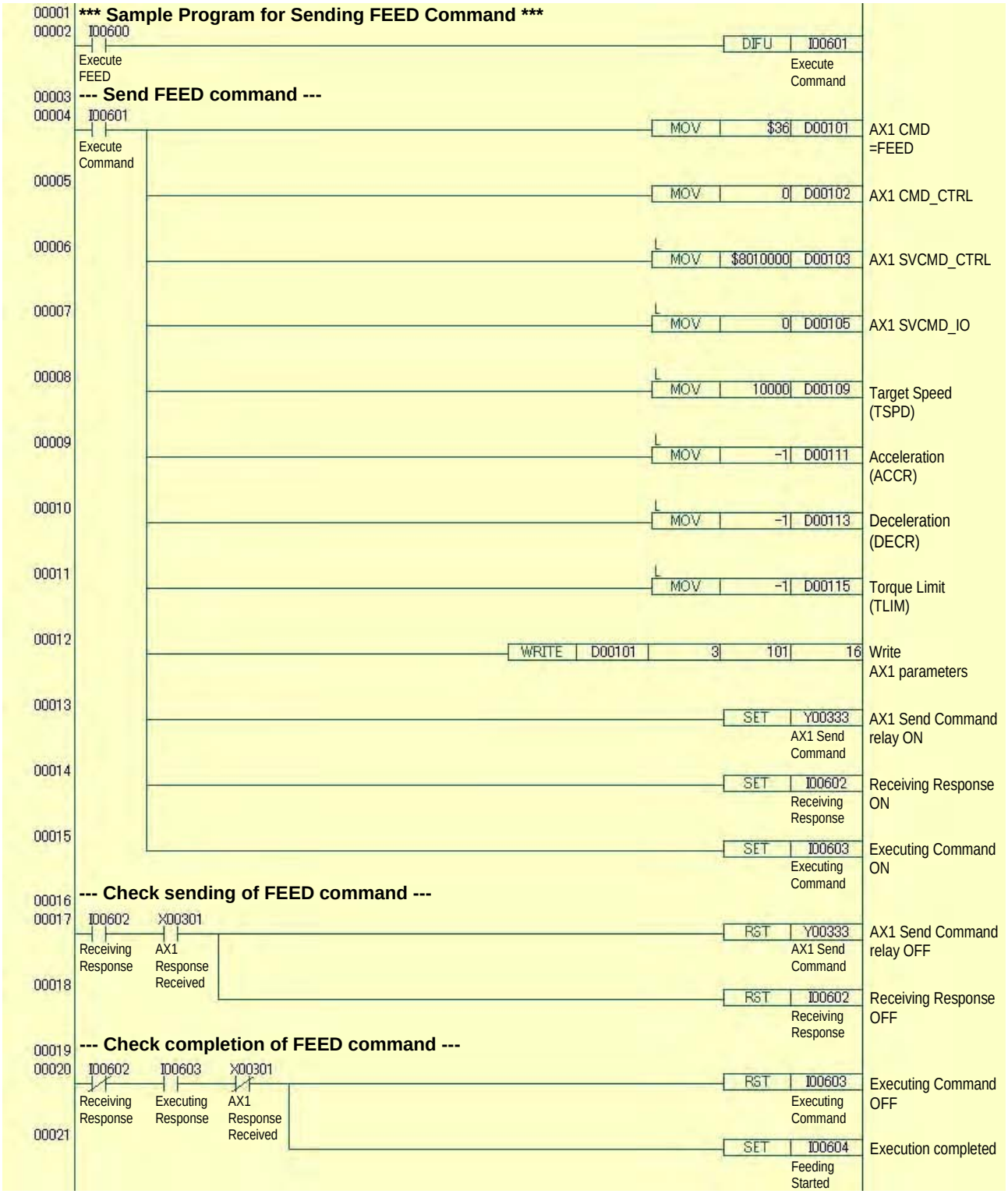
After issuing the command, it verifies completion of the command execution by checking that the corresponding Response Received relay has turned on.



● Sample Program for Sending Feed (FEED: $36) Command

This sample program issues a FEED ($36) command for axis 1 to the positioning module mounted in slot 3.

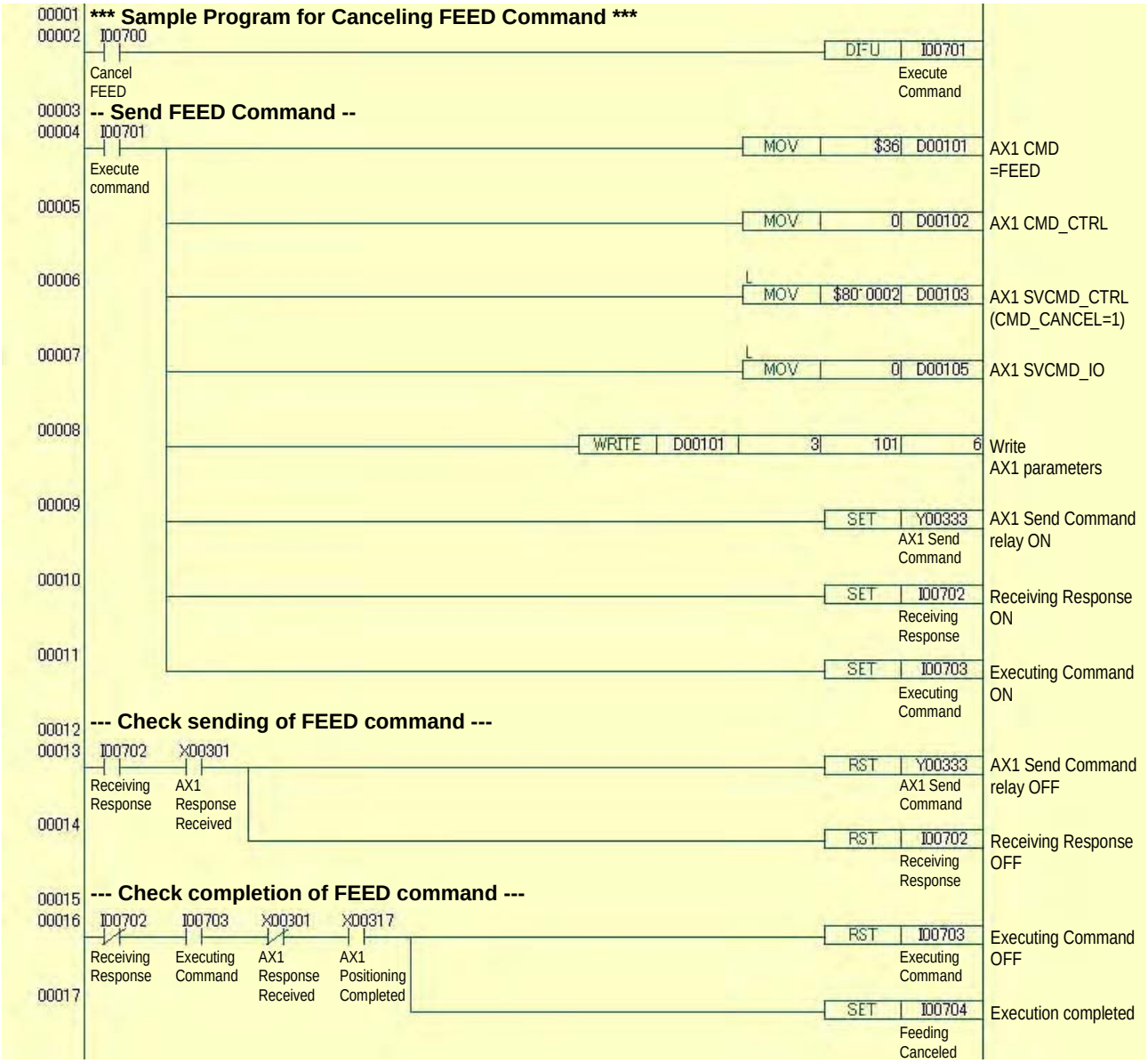
After the command is issued, motion continues until a command cancellation is issued using the CMD_CANCEL bit.



● Sample Program for Canceling a Feed (FEED: $36) Command

This sample program cancels FEED command execution of axis 1, which is moving, by reissuing to the positioning module mounted in slot 3 a FEED ($36) command with the SVCMD_CTRL.CMD_CANCEL bit set to 1.

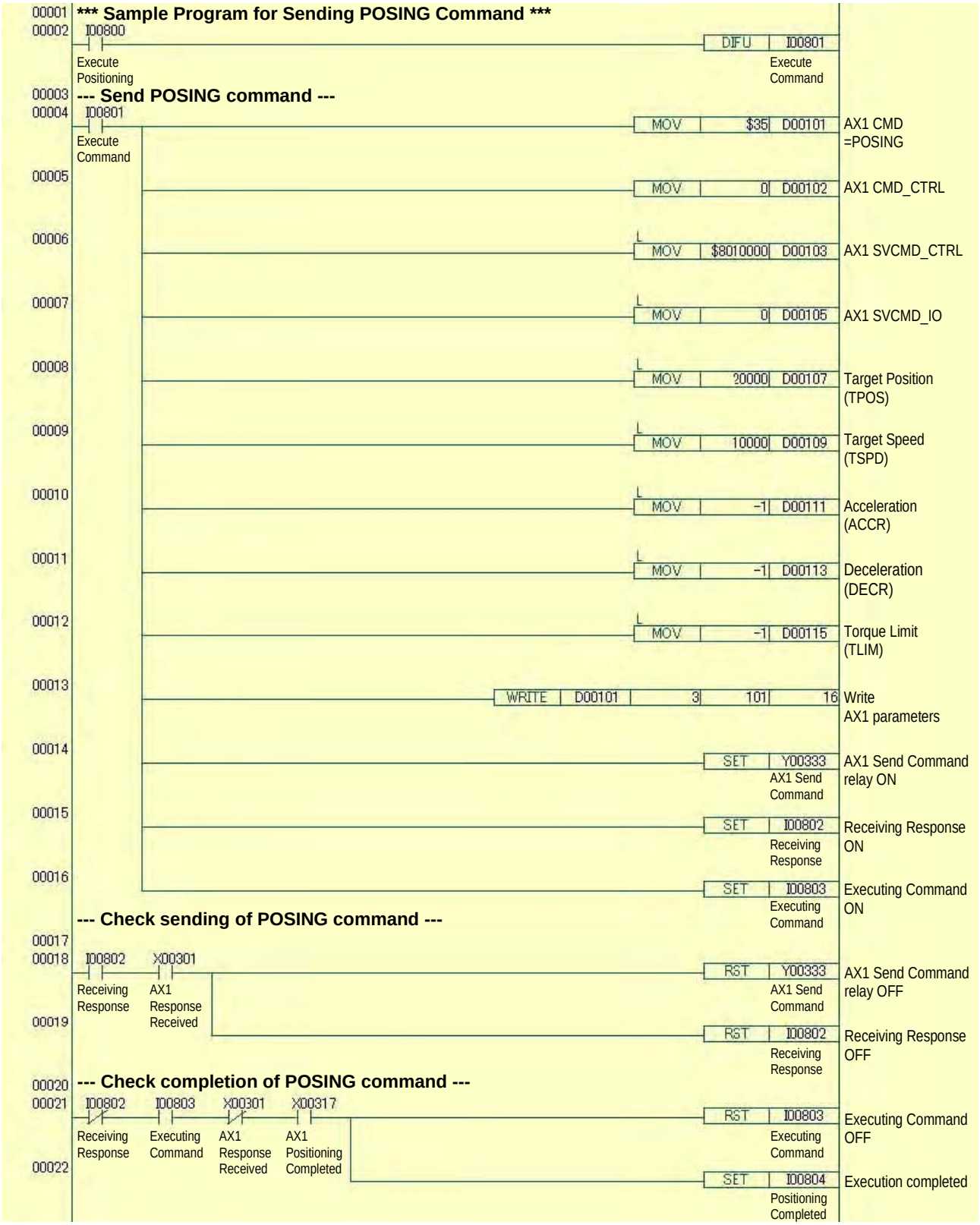
After issuing the command, it verifies completion of positioning by checking that the corresponding Positioning Completed relay has turned on.



● Sample Program for Sending Positioning (POSING: $35) Command

This sample program issues a POSING ($35) command for axis 1 to the positioning module mounted in slot 3.

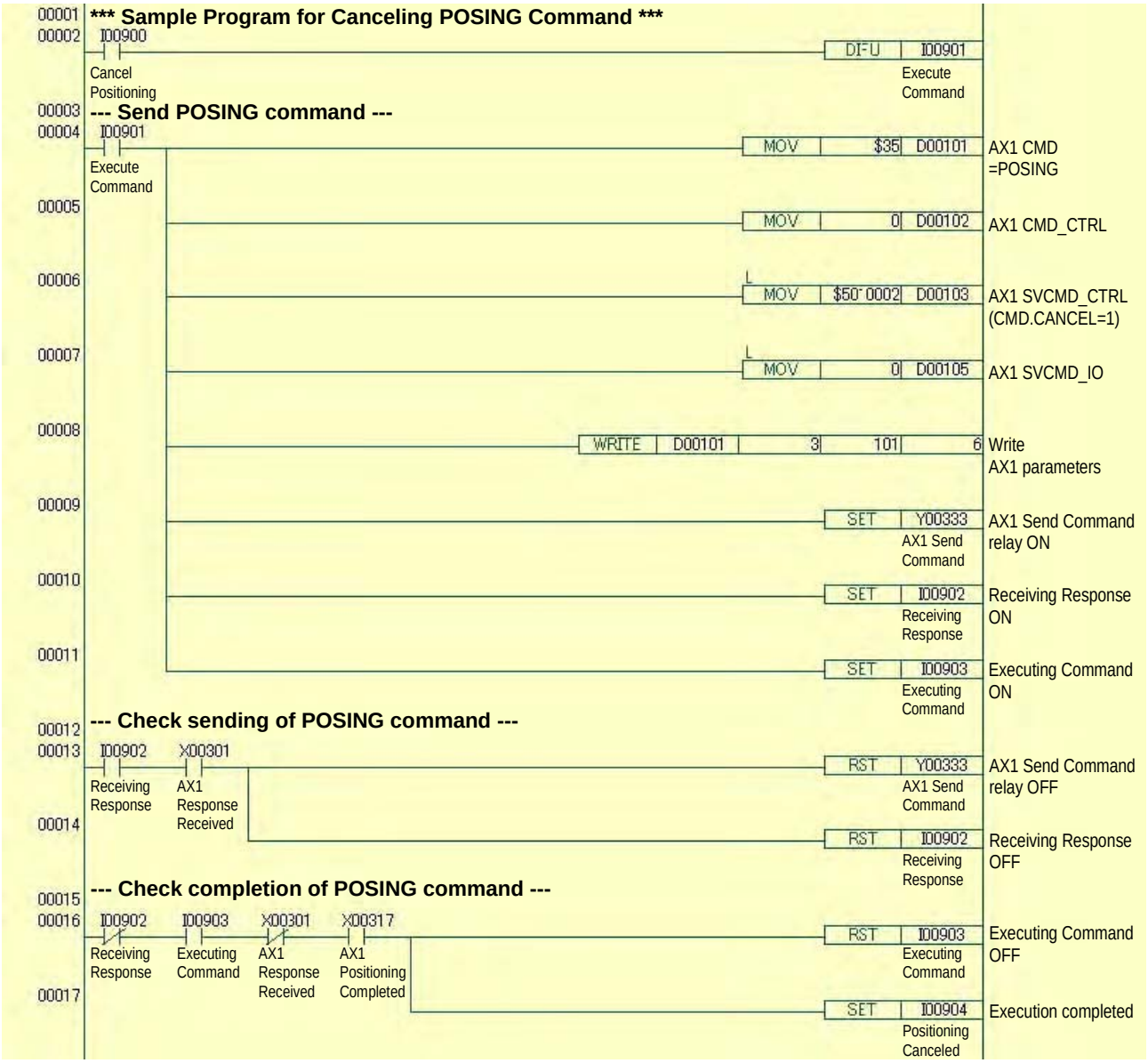
After issuing the command, it verifies completion of the command execution by checking that the corresponding Positioning Completed relay has turned on.



● Sample Program for Canceling a Positioning (POSING: $35) Command

This sample program cancels POSING command execution of axis 1, which is moving, by reissuing to the positioning module mounted in slot 3 a POSING ($35) command with the SVCMD_CTRL.CMD_CANCEL bit set to 1.

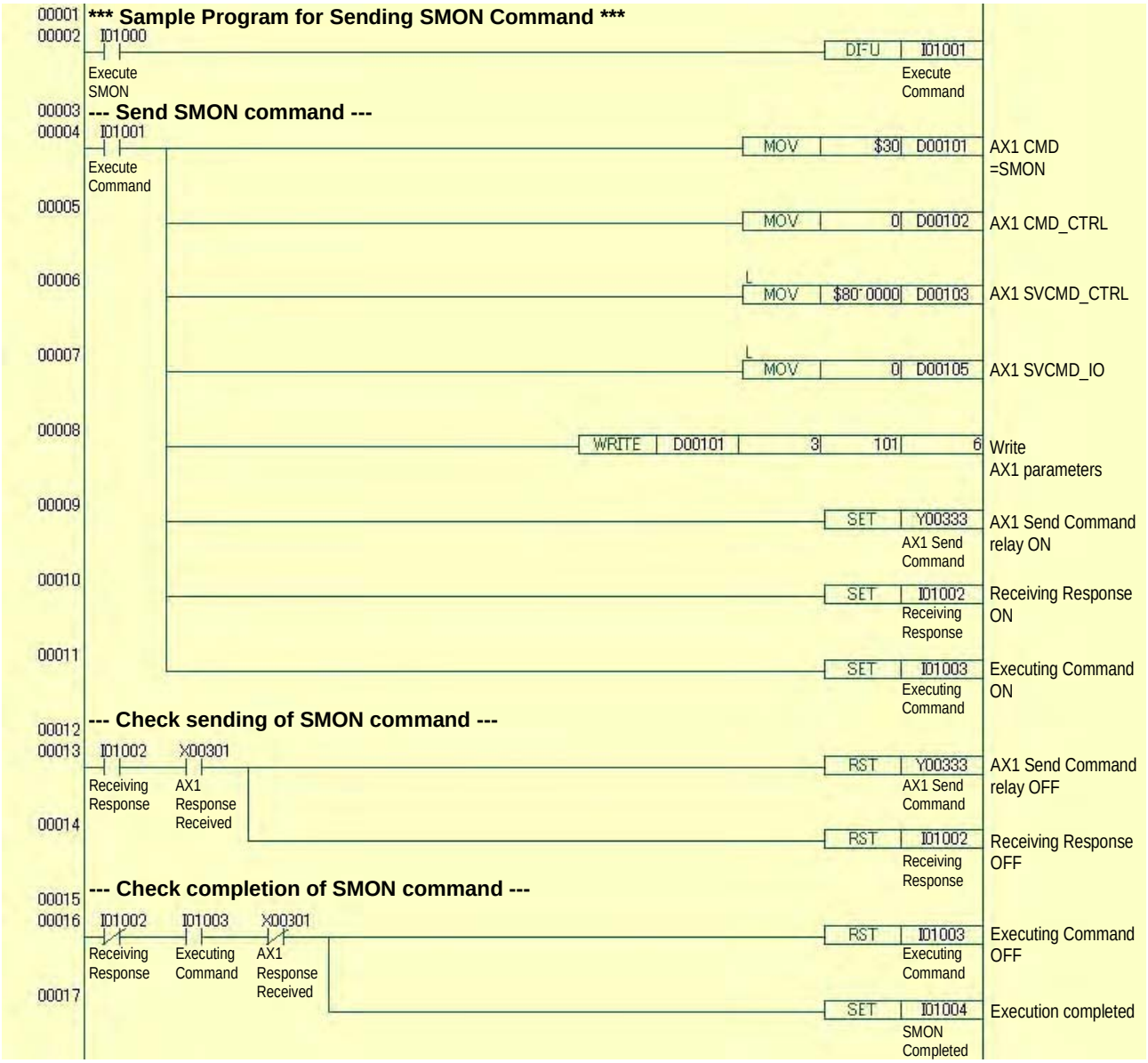
After issuing the command, it verifies completion of positioning by checking that the corresponding Positioning Completed relay has turned on.



● Sample Program for Sending Servo Status Monitor (SMON: $30) Command

This sample program issues a SMON ($30) command for axis 1 to the positioning module mounted in slot 3.

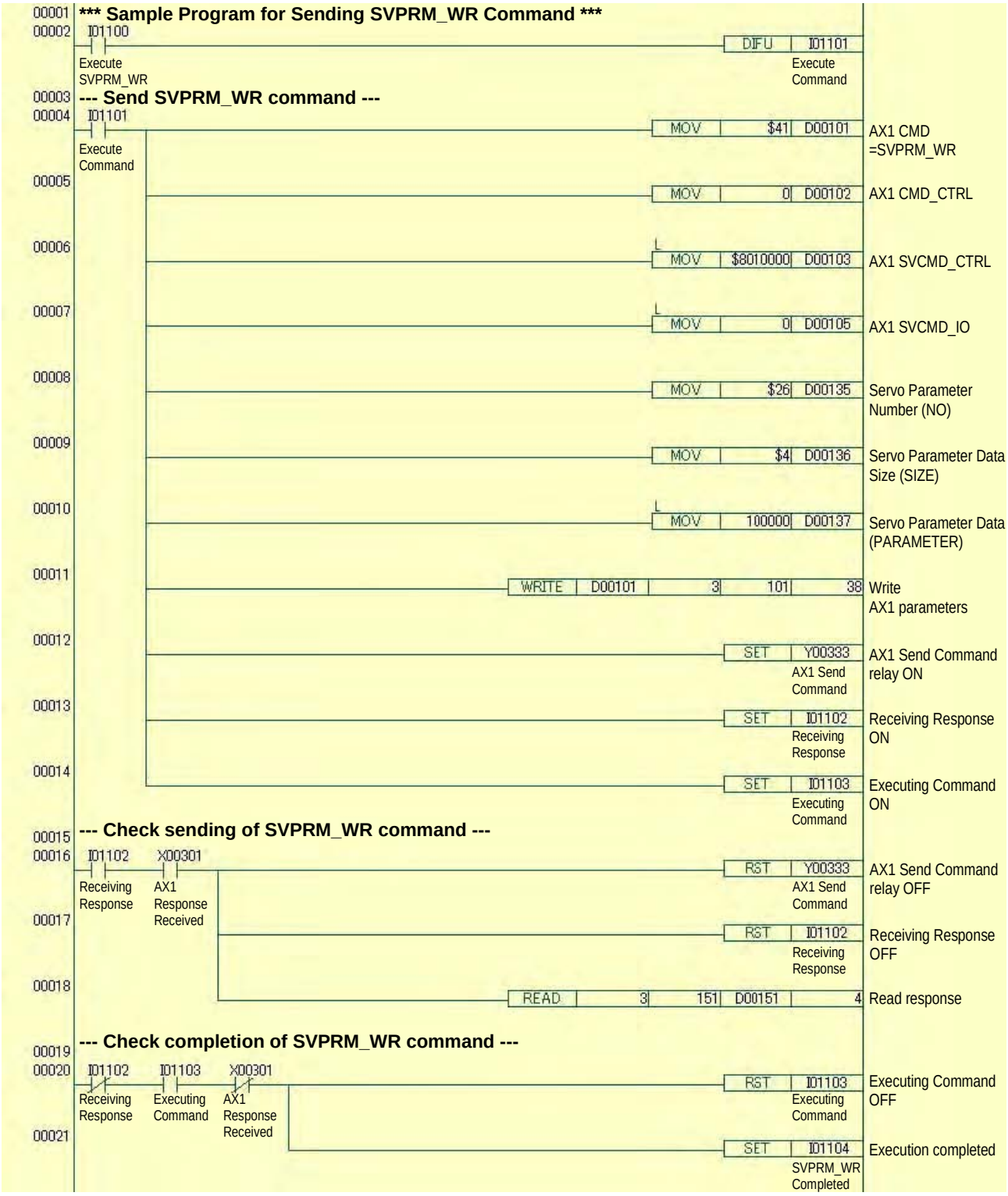
After issuing the command, it verifies completion of the command execution by checking that the corresponding Response Received relay has turned on.



● Sample Program for Sending Write Servo Parameter (SVPRM_WR: $41) Command

This sample program issues a SVPRM_WR ($41) command for axis 1 to the positioning module mounted in slot 3.

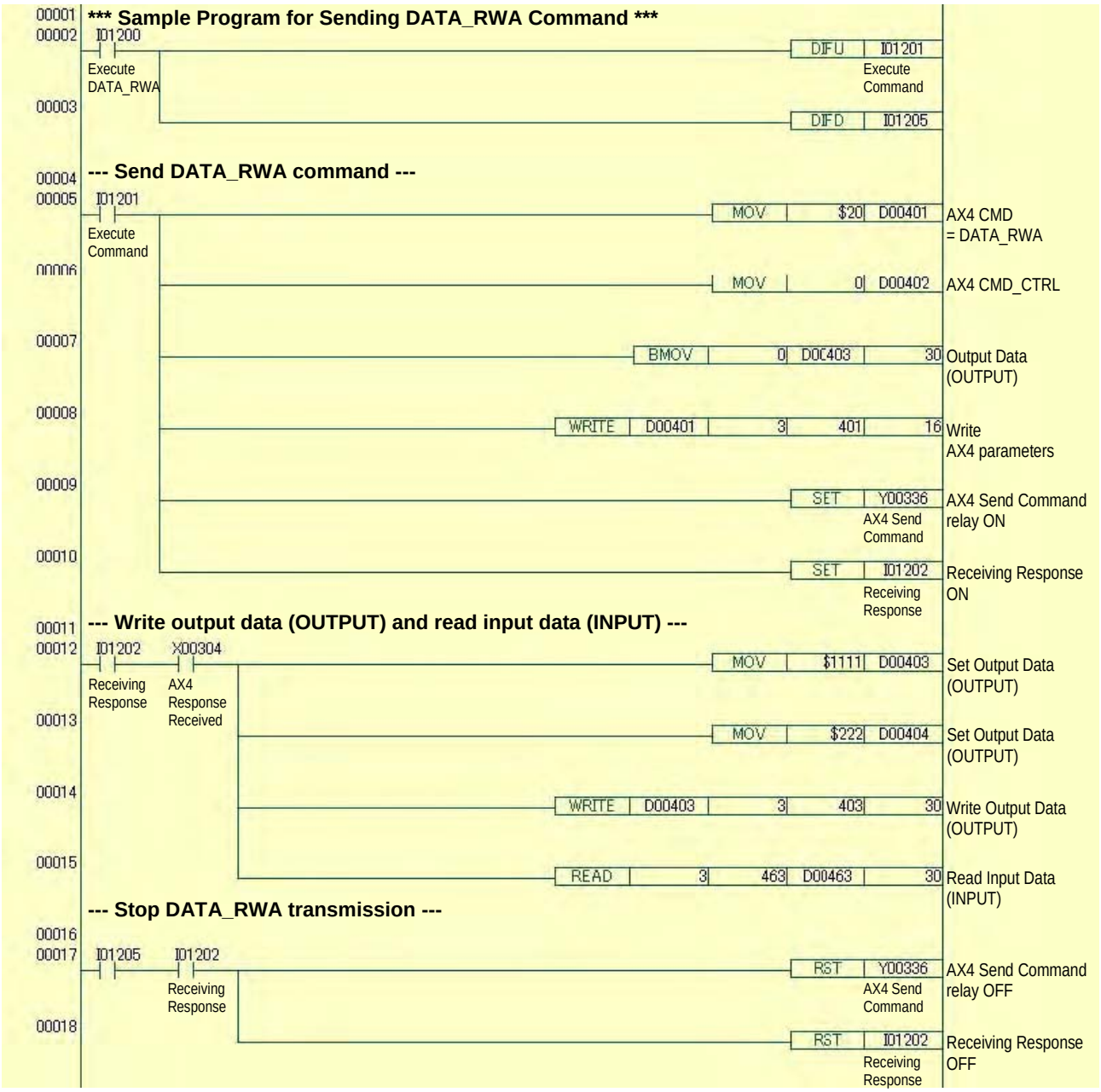
After issuing the command, it verifies completion of the command execution by checking the response received.



● Sample Program for Sending Data Read/Write_A (DATA_RWA: $20) Command

This sample program issues a DATA_RWA ($20) command for axis 4 to the positioning module mounted in slot 3.

After the command is issued, output data (OUTPUT) is sent continually and input data (INPUT) is received continually while the Send Command relay remains ON.



● Sample Program for Sending Read ID (ID_RD: $03) Command

This sample program issues an ID_RD ($03) command for axis 1 to the positioning module mounted in slot 3.

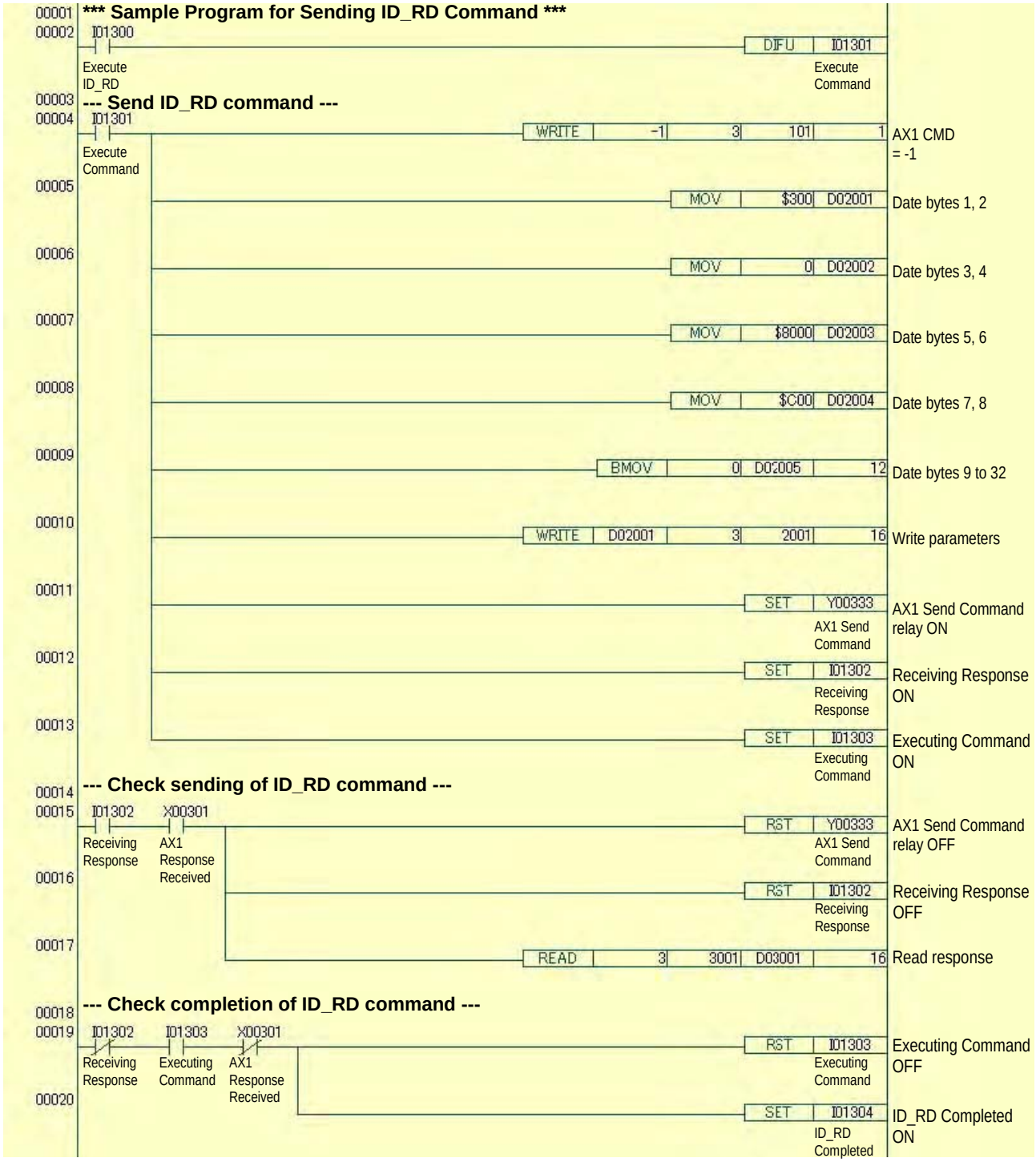
After issuing the command, it verifies completion of the command execution by checking the extended MECHATROLINK-III response parameters.

To read the device name, the program writes the following ID_RD ($03) MECHATROLINK-III command directly to the extended MECHATROLINK-III command parameter area, and then transmits the extended command.

Table 5.4 Send Data for ID_RD ($03) Command

Byte	1 Byte (8 bits)
1	$03
2	WDT
3	$00
4	$00
5	$80
6	$00
7	$0C
8	$00
9	$00
10	$00
11	$00
12	$00
13	$00
14	$00
15	$00
16	$00
17	$00
18	$00
19	$00
20	$00
21	$00
22	$00
23	$00
24	$00
25	$00
26	$00
27	$00
28	$00
29	$00
30	$00
31	$00
32	$00

Data Position Number	Data Size	
	1 word (16 bits)	
2001	$03	0
2002	0	0
2003	$80	0
2004	$0C	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0


*** Sample Program for Sending ID_RD Command ***
I01300
DIFU I01301
Execute ID_RD
Execute Command
--- Send ID_RD command ---
I01301
WRITE -1 3 101 1
AX1 CMD = -1
Execute Command
MOV $300 D02001
Date bytes 1, 2
MOV 0 D02002
Date bytes 3, 4
MOV $8000 D02003
Date bytes 5, 6
MOV $C00 D02004
Date bytes 7, 8
BMOV 0 D02005 12
Date bytes 9 to 32
WRITE D02001 3 2001 16
Write parameters
SET Y00333
AX1 Send Command relay ON
AX1 Send Command
I01302
SET I01302
Receiving Response ON
Receiving Response
I01303
SET I01303
Executing Command ON
Executing Command
--- Check sending of ID_RD command ---
I01302 X00301
RST Y00333
AX1 Send Command relay OFF
Receiving Response
AX1 Response Received
AX1 Send Command
RST I01302
Receiving Response OFF
Receiving Response
READ 3 3001 D03001 16
Read response
--- Check completion of ID_RD command ---
I01302 I01303 X00301
RST I01303
Executing Command OFF
Receiving Response
Executing Command
AX1 Response Received
Executing Command
SET I01304
ID_RD Completed ON
ID_RD Completed

● Sample Program for Sending Read Alarm or Warning (ALM_RD: $05) Command

This sample program issues an ALM_RD ($05) command for axis 1 to the positioning module mounted in slot 3.

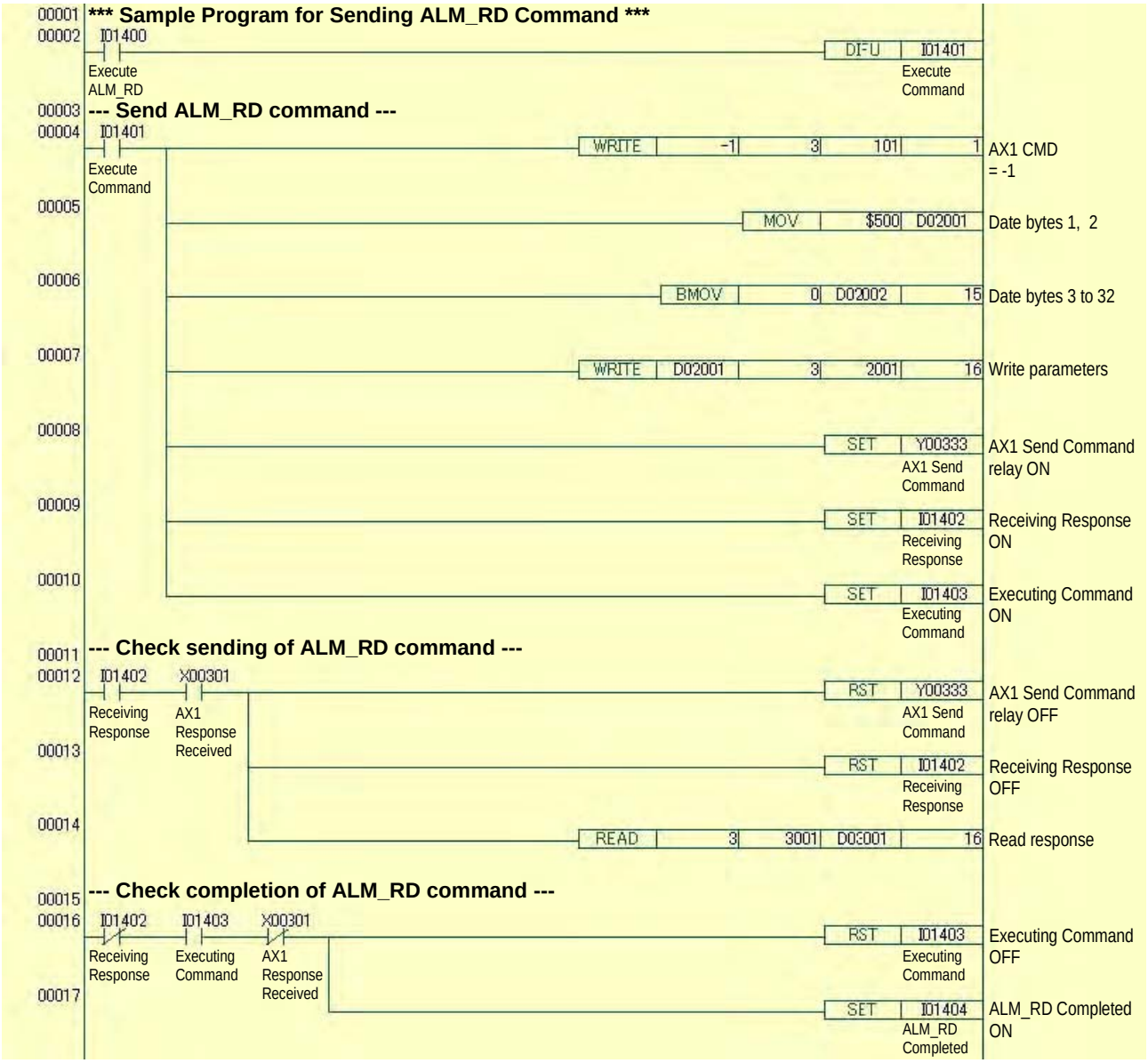
After issuing the command, it verifies completion of the command execution by checking the extended MECHATROLINK-III response parameters.

To read the current alarm/warning state, the program writes the following ALM_RD ($05) MECHATROLINK-III command directly to the extended MECHATROLINK-III command parameter area, and then sends the extended command.

Table 5.5 Send Data for ALM_RD ($05) Command

Byte	1 Byte (8 bits)
1	$05
2	WDT
3	$00
4	$00
5	$00
6	$00
7	$00
8	$00
9	$00
10	$00
11	$00
12	$00
13	$00
14	$00
15	$00
16	$00
17	$00
18	$00
19	$00
20	$00
21	$00
22	$00
23	$00
24	$00
25	$00
26	$00
27	$00
28	$00
29	$00
30	$00
31	$00
32	$00

Data Position Number	Data Size	
	1 word (16 bits)	
2001	$05	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0


00001 *** Sample Program for Sending ALM_RD Command ***
00002 I01400
DIFU I01401
Execute ALM_RD
Execute Command
00003 --- Send ALM_RD command ---
00004 I01401
WRITE -1 3 101 1
AX1 CMD = -1
Execute Command
00005
MOV $500 D02001
Date bytes 1, 2
00006
BMOV 0 D02002 15
Date bytes 3 to 32
00007
WRITE D02001 3 2001 16
Write parameters
00008
SET Y00333
AX1 Send Command relay ON
AX1 Send Command
00009
SET I01402
Receiving Response ON
Receiving Response
00010
SET I01403
Executing Command ON
Executing Command
00011 --- Check sending of ALM_RD command ---
00012 I01402 X00301
RST Y00333
AX1 Send Command relay OFF
Receiving Response
AX1 Response Received
AX1 Send Command
00013
RST I01402
Receiving Response OFF
Receiving Response
00014
READ 3 3001 D03001 16
Read response
00015 --- Check completion of ALM_RD command ---
00016 I01402 I01403 X00301
RST I01403
Executing Command OFF
Receiving Response
Executing Command
AX1 Response Received
Executing Command
00017
SET I01404
ALM_RD Completed ON
ALM_RD Completed

5.3.1 Parameters and Statuses of MECHATROLINK-III Commands

The following tables list the required command parameters that must be written, as well as the response parameters and statuses that are returned for each MECHATROLINK-III command. The command parameters and returned response parameters and statuses depend on the profile type supported by the connected external device.

In the table, "□□" denotes an axis number (01 to 15), while "■■" denotes the value of "□□ + 1".

The MECHATROLINK-III commands that are executable by the positioning module are listed with the following indications:

◎: Executable by a user using MECHATROLINK-III command parameters of each axis.

○: Executable by a user using extended MECHATROLINK-III command parameters.

△: Not executable by a user but is executed automatically by the positioning module or external device.

×: Not supported

■ Standard Servo Profile Commands (1 of 3)

● Command parameters

Data Position Number	Data Name	NOP	PRM_RD	PRM_WR	ID_RD	CONFIG	ALM_RD	ALM_CLR	SYNC_SET	CONNECT	DISCONNECT	PPRM_RD	PPRM_WR	MEM_RD	MEM_WR
		◎	×	×	○	◎	○	◎	◎	△	△	×	×	○	○
□□01	Command Code (CMD)	$00	$01	$02	-1	$04	-1	$06	$0D	$0E	$0F	$1B	$1C	-1	-1
□□02	Command Control (CMD_CTRL)	✓				✓		✓	✓	✓					
□□03 / □□04	Servo Command Control Field (SVCMD_CTRL)														
□□05 / □□06	Servo Command Output Signal (SVCMD_IO)														
□□07 / □□08	Target Position (TPOS) / Zero Point Return Mode (MODE)														
□□09 / □□10	Target Speed (TSPD)														
□□11 / □□12	Acceleration (ACCR)														
□□13 / □□14	Deceleration (DECR)														
□□15 / □□16	Torque Limit (TLIM)														
□□17 / □□18	Speed Reference (VREF)														
□□19 / □□20	Speed Limit (VLIM)														
□□21 / □□22	Torque Reference (TQREF)														
□□23 / □□24	Speed Feed Forward (VFF)														
□□25 / □□26	Torque Feed Forward (TFF)														
□□27 / □□28	Coordinates Setting Mode (POS_SET_MOD)														
□□29 / □□30	Coordinates Set Value (POS_DATA)														
□□31 to □□32	(System reserved)														
□□33	Configuration Mode (CONFIG_MOD)					✓									
□□34	Alarm Clear Mode (ALM_CLR_MOD)							✓							
□□35	Servo Parameter Number (NO)														
□□36	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)														
□□37 / □□38	Servo Parameter Data (PARAMETER)														
□□39 to □□40	(System reserved)														
□□41 / □□42	Subcommand Control (SUB_CTRL)														
□□43 / □□44	Target Position (for interpolation motion commands)														
□□45 / □□46	Target Speed (for interpolation motion commands)														
□□47	Interpolation Axes (for interpolation motion commands)														
□□48	Acceleration Time (for interpolation motion commands)														
□□49	Deceleration Time (for interpolation motion commands)														
□□50	(System reserved)														
2001 to 2750	Extended MECHATROLINK-III Command Parameters				✓		✓							✓	✓

● Response parameters

Data Position Number	Data Name	NOP	PRM_RD	PRM_WR	ID_RD	CONFIG	ALM_RD	ALM_CLR	SYNC_SET	CONNECT	DISCONNECT	PPRM_RD	PPRM_WR	MEM_RD	MEM_WR
		◎	×	×	○	◎	○	◎	◎	△	△	×	×	○	○
□□51	Servo Parameter Number (NO)														
□□52	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)														
□□53 / □□54	Servo Parameter Data (PARAMETER)														
□□55 to □□60	(System reserved)														
3001 to 3750	Extended MECHATROLINK-III Response Parameters				✓		✓							✓	✓

● Statuses

Data Position Number	Data Name	NOP	PRM_RD	PRM_WR	ID_RD	CONFIG	ALM_RD	ALM_CLR	SYNC_SET	CONNECT	DISCONNECT	PPRM_RD	PPRM_WR	MEM_RD	MEM_WR
		◎	×	×	○	◎	○	◎	◎	△	△	×	×	○	○
□□61	(System reserved)														
□□62	Command Status (CMD_STAT)	✓			✓	✓	✓	✓	✓	✓				✓	✓
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)														
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)														
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)														
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)														
□□71 / □□72	Monitor 1 (MONITOR1)														
□□73 / □□74	Monitor 2 (MONITOR2)														
□□75 / □□76	Monitor 3 (MONITOR3)														
□□77 / □□78	Monitor 4 (MONITOR4)														
□□79 / □□80	Monitor 5 (MONITOR5)														
□□81 / □□82	Monitor 6 (MONITOR6)														
□□83 / □□84	Subcommand Status (SUB_STAT)	✓			✓	✓	✓	✓	✓	✓				✓	✓
□□85 / □□86	Remaining Travel Status														
□□87	Interpolation Status														
□□88 to ■■00	(System reserved)														
1601 to 2000	Common Statuses	✓			✓	✓	✓	✓	✓	✓				✓	✓

■ Standard Servo Profile Commands (2 of 3)

● Command parameters

Data Position Number	Data Name	POS_SET	BRK_ON	BRK_OFF	SENS_ON	SENS_OFF	SMON	SV_ON	SV_OFF	INTERPOLATE	POSING	FEED	EX_FEED	EX_POSING	ZRET
		◎	◎	◎	◎	◎	◎	◎	◎	△	◎	◎	◎	◎	◎
□□01	Command Code (CMD)	$20	$21	$22	$23	$24	$30	$31	$32	$34	$35	$36	$37	$39	$3A
□□02	Command Control (CMD_CTRL)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□03 / □□04	Servo Command Control Field (SVCMD_CTRL)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□05 / □□06	Servo Command Output Signal (SVCMD_IO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□07 / □□08	Target Position (TPOS) / Zero Point Return Mode (MODE)										✓			✓	✓
□□09 / □□10	Target Speed (TSPD)										✓	✓	✓	✓	✓
□□11 / □□12	Acceleration (ACCR)										✓	✓	✓	✓	✓
□□13 / □□14	Deceleration (DECR)										✓	✓	✓	✓	✓
□□15 / □□16	Torque Limit (TLIM)									✓	✓	✓	✓	✓	✓
□□17 / □□18	Speed Reference (VREF)														
□□19 / □□20	Speed Limit (VLIM)														
□□21 / □□22	Torque Reference (TQREF)														
□□23 / □□24	Speed Feed Forward (VFF)									✓					
□□25 / □□26	Torque Feed Forward (TFF)									✓					
□□27 / □□28	Coordinates Setting Mode (POS_SET_MOD)	✓													
□□29 / □□30	Coordinates Set Value (POS_DATA)	✓													
□□31 to □□32	(System reserved)														
□□33	Configuration Mode (CONFIG_MOD)														
□□34	Alarm Clear Mode (ALM_CLR_MOD)														
□□35	Servo Parameter Number (NO)														
□□36	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)														
□□37 / □□38	Servo Parameter Data (PARAMETER)														
□□39 to □□40	(System reserved)														
□□41 / □□42	Subcommand Control (SUB_CTRL)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□43 / □□44	Target Position (for interpolation motion commands)														
□□45 / □□46	Target Speed (for interpolation motion commands)														
□□47	Interpolation Axes (for interpolation motion commands)														
□□48	Acceleration Time (for interpolation motion commands)														
□□49	Deceleration Time (for interpolation motion commands)														
□□50	(System reserved)														
2001 to 2750	Extended MECHATROLINK-III Command Parameters														

● Response parameters

Data Position Number	Data Name	POS_SET	BRK_ON	BRK_OFF	SENS_ON	SENS_OFF	SMON	SV_ON	SV_OFF	INTERPOLATE	POSING	FEED	EX_FEED	EX_POSING	ZRET
		◎	◎	◎	◎	◎	◎	◎	◎	△	◎	◎	◎	◎	◎
□□51	Servo Parameter Number (NO)														
□□52	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)														
□□53 / □□54	Servo Parameter Data (PARAMETER)														
□□55 to □□60	(System reserved)														
3001 to 3750	Extended MECHATROLINK-III Response Parameters														

● Statuses

Data Position Number	Data Name	POS_SET	BRK_ON	BRK_OFF	SENS_ON	SENS_OFF	SMON	SV_ON	SV_OFF	INTERPOLATE	POSING	FEED	EX_FEED	EX_POSING	ZRET
		◎	◎	◎	◎	◎	◎	◎	◎	△	◎	◎	◎	◎	◎
□□61	(System reserved)														
□□62	Command Status (CMD_STAT)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□71 / □□72	Monitor 1 (MONITOR1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□73 / □□74	Monitor 2 (MONITOR2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□75 / □□76	Monitor 3 (MONITOR3)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□77 / □□78	Monitor 4 (MONITOR4)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□79 / □□80	Monitor 5 (MONITOR5)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□81 / □□82	Monitor 6 (MONITOR6)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□83 / □□84	Subcommand Status (SUB_STAT)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
□□85 / □□86	Remaining Travel Status														
□□87	Interpolation Status														
□□88 to ■■00	(System reserved)														
1601 to 2000	Common Statuses	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

■ Standard Servo Profile Commands (3 of 3)

● Command parameters

Data Position Number	Data Name	VELCTRL	TRQCTRL	SVPRM_RD	SVPRM_WR										
		◎	◎	◎	◎										
□□01	Command Code (CMD)	$3C	$3D	$40	$41										
□□02	Command Control (CMD_CTRL)	✓	✓	✓	✓										
□□03 / □□04	Servo Command Control Field (SVCMD_CTRL)	✓	✓	✓	✓										
□□05 / □□06	Servo Command Output Signal (SVCMD_IO)	✓	✓	✓	✓										
□□07 / □□08	Target Position (TPOS) / Zero Point Return Mode (MODE)														
□□09 / □□10	Target Speed (TSPD)														
□□11 / □□12	Acceleration (ACCR)	✓													
□□13 / □□14	Deceleration (DECR)	✓													
□□15 / □□16	Torque Limit (TLIM)	✓													
□□17 / □□18	Speed Reference (VREF)	✓													
□□19 / □□20	Speed Limit (VLIM)		✓												
□□21 / □□22	Torque Reference (TQREF)		✓												
□□23 / □□24	Speed Feed Forward (VFF)														
□□25 / □□26	Torque Feed Forward (TFF)	✓													
□□27 / □□28	Coordinates Setting Mode (POS_SET_MOD)														
□□29 / □□30	Coordinates Set Value (POS_DATA)														
□□31 to □□32	(System reserved)														
□□33	Configuration Mode (CONFIG_MOD)														
□□34	Alarm Clear Mode (ALM_CLR_MOD)														
□□35	Servo Parameter Number (NO)			✓	✓										
□□36	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)			✓	✓										
□□37 / □□38	Servo Parameter Data (PARAMETER)				✓										
□□39 to □□40	(System reserved)														
□□41 / □□42	Subcommand Control (SUB_CTRL)	✓	✓												
□□43 / □□44	Target Position (for interpolation motion commands)														
□□45 / □□46	Target Speed (for interpolation motion commands)														
□□47	Interpolation Axes (for interpolation motion commands)														
□□48	Acceleration Time (for interpolation motion commands)														
□□49	Deceleration Time (for interpolation motion commands)														
□□50	(System reserved)														
2001 to 2750	Extended MECHATROLINK-III Command Parameters														

● Response parameters

Data Position Number	Data Name	VELCTRL	TRQCTRL	SVPRM_RD	SVPRM_WR									
		◎	◎	◎	◎									
□□51	Servo Parameter Number (NO)			✓	✓									
□□52	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)			✓	✓									
□□53 / □□54	Servo Parameter Data (PARAMETER)			✓	✓									
□□55 to □□60	(System reserved)													
3001 to 3750	Extended MECHATROLINK-III Response Parameters													

● Statuses

Data Position Number	Data Name	VELCTRL	TRQCTRL	SVPRM_RD	SVPRM_WR									
		◎	◎	◎	◎									
□□61	(System reserved)													
□□62	Command Status (CMD_STAT)	✓	✓	✓	✓									
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)	✓	✓	✓	✓									
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)	✓	✓	✓	✓									
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)	✓	✓											
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)	✓	✓											
□□71 / □□72	Monitor 1 (MONITOR1)	✓	✓											
□□73 / □□74	Monitor 2 (MONITOR2)	✓	✓											
□□75 / □□76	Monitor 3 (MONITOR3)	✓	✓											
□□77 / □□78	Monitor 4 (MONITOR4)	✓	✓											
□□79 / □□80	Monitor 5 (MONITOR5)	✓	✓											
□□81 / □□82	Monitor 6 (MONITOR6)	✓	✓											
□□83 / □□84	Subcommand Status (SUB_STAT)	✓	✓	✓	✓									
□□85 / □□86	Remaining Travel Status													
□□87	Interpolation Status													
□□88 to ■■00	(System reserved)													
1601 to 2000	Common Statuses	✓	✓	✓	✓									

■ Standard I/O Profile Commands (1 of 2)

● Command parameters

Data Position Number	Data Name	NOP	PRM_RD	PRM_WR	ID_RD	CONFIG	ALM_RD	ALM_CLR	SYNC_SET	CONNECT	DISCONNECT	PPRM_RD	PPRM_WR	MEM_RD	MEM_WR
		◎	×	×	○	◎	○	◎	×	△	△	×	×	×	×
□□01	Command Code (CMD)	$00	$01	$02	-1	$04	-1	$06	$0D	$0E	$0F	$1B	$1C	$1B	$1C
□□02	Command Control (CMD_CTRL)	✓				✓		✓		✓					
□□03 to □□32	Output Data (OUTPUT)														
□□33	Configuration Mode (CONFIG_MOD)					✓									
□□34	Alarm Clear Mode (ALM_CLR_MOD)							✓							
□□35 to □□50	(System reserved)														
2001 to 2750	Extended MECHATROLINK-III Command Parameters				✓		✓								

● Response parameters

Data Position Number	Data Name	NOP	PRM_RD	PRM_WR	ID_RD	CONFIG	ALM_RD	ALM_CLR	SYNC_SET	CONNECT	DISCONNECT	PPRM_RD	PPRM_WR	MEM_RD	MEM_WR
		◎	×	×	○	◎	○	◎	×	×	△	×	×	×	×
□□51 to □□60	(System reserved)														
3001 to 3750	Extended MECHATROLINK-III Response Parameters				✓		✓							✓	✓

● Statuses

Data Position Number	Data Name	NOP	PRM_RD	PRM_WR	ID_RD	CONFIG	ALM_RD	ALM_CLR	SYNC_SET	CONNECT	DISCONNECT	PPRM_RD	PPRM_WR	MEM_RD	MEM_WR
		◎	×	×	○	◎	○	◎	×	×	△	×	×	×	×
□□61	(System reserved)														
□□62	Command Status (CMD_STAT)	✓			✓	✓	✓	✓		✓					
□□63 to □□92	Input Data (INPUT)														
□□93 to ■■00	(System reserved)														
1601 to 2000	Common Statuses	✓			✓	✓	✓	✓		✓					

■ Standard I/O Profile Commands (2 of 2)

● Command parameters

Data Position Number	Data Name	DATA_RWA	DATA_RWS												
		◎	×												
□□01	Command Code (CMD)	$20	$21												
□□02	Command Control (CMD_CTRL)	✓													
□□03 to □□32	Output Data (OUTPUT)	✓													
□□33	Configuration Mode (CONFIG_MOD)														
□□34	Alarm Clear Mode (ALM_CLR_MOD)														
□□35 to □□50	(System reserved)														
2001 to 2750	Extended MECHATROLINK-III Command Parameters														

● Response parameters

Data Position Number	Data Name	DATA_RWA	DATA_RWS												
		◎	×												
□□51 to □□60	(System reserved)														
3001 to 3750	Extended MECHATROLINK-III Response Parameters														

● Statuses

Data Position Number	Data Name	DATA_RWA	DATA_RWS												
		◎	×												
□□61	(System reserved)														
□□62	Command Status (CMD_STAT)	✓													
□□63 to □□92	Input Data (INPUT)	✓													
□□93 to ■■00	(System reserved)														
1601 to 2000	Common Statuses	✓													

5.3.2 Example of MECHATROLINK-III Command Format Conversion

■ MECHATROLINK-III Command

Axis MECHATROLINK-III command parameters or extended MECHATROLINK-III command parameters that are written to the positioning module are converted into a MECHATROLINK-III command as shown below before transmission to an external device. The following example illustrates the conversion for the POSING ($35) command.

● Conversion of axis MECHATROLINK-III command parameter data to a MECHATROLINK-III command

Table 5.6 Axis MECHATROLINK-III Command Parameters

Data Position Number	Data Name	Long Word Data			
		Low-word (16 bits)		High-word (16 bits)	
□□01	Command Code (CMD)	00	$35		
□□02	Command Control (CMD_CTRL)	A1	A2		
□□03 / □□04	Servo Command Control Field (SVCMD_CTRL)	B1	B2	B3	B4
□□05 / □□06	Servo Command Output Signal (SVCMD_IO)	C1	C2	C3	C4
□□07 / □□08	Target Position (TPOS) / Zero Point Return Mode (MODE)	D1	D2	D3	D4
□□09 / □□10	Target Speed (TSPD)	E1	E2	E3	E4
□□11 / □□12	Acceleration (ACCR)	F1	F2	F3	F4
□□13 / □□14	Deceleration (DECR)	G1	G2	G3	G4
□□15 / □□16	Torque Limit (TLIM)	H1	H2	H3	H4

Table 5.7 MECHATROLINK-III Command

Byte	Command	Byte Data (8 bits)
1	CMD	$35
2	WDT	WDT
3	CMD_CTRL	A2
4		A1
5	SVCMD_CTRL	B2
6		B1
7		B4
8		B3
9	SVCMD_IO	C2
10		C1
11		C4
12		C3
13	TPOS	D2
14		D1
15		D4
16		D3
17	TSPD	E2
18		E1
19		E4
20		E3
21	ACCR	F2
22		F1
23		F4
24		F3
25	DECR	G2
26		G1
27		G4
28		G3
29	TLIM	H2
30		H1
31		H4
32		H3

● Conversion of extended MECHATROLINK-III command parameter data to a MECHATROLINK-III command

Table 5.8 Extended MECHATROLINK-III Command Parameters

Data Position Number	Word Data (16 bits)	
2001	A1	A2
2002	B1	B2
2003	C1	C2
2004	D1	D2
2005	E1	E2
2006	F1	F2
2007	G1	G2
2008	H1	H2
2009	I1	I2
2010	J1	J2
2011	K1	K2
2012	L1	L2
2013	M1	M2
2014	N1	N2
2015	O1	O2
2016	P1	P2

MECHATROLINK-III Command

Byte	Byte Data (8 bits)
1	A1
2	WDT
3	B1
4	B2
5	C1
6	C2
7	D1
8	D2
9	E1
10	E2
11	F1
12	F2
13	G1
14	G2
15	H1
16	H2
17	I1
18	I2
19	J1
20	J2
21	K1
22	K2
23	L1
24	L2
25	M1
26	M2
27	N1
28	N2
29	O1
30	O2
31	P1
32	P2

■ MECHATROLINK-III Response

MECHATROLINK-III response data received from an external device can be read from axis statuses or extended MECHATROLINK-III response parameters as shown below. The following example illustrates the case for the POSING ($35) command.

● Conversion of MECHATROLINK-III response to axis statuses and axis MECHATROLINK-III response parameter data

Table 5.9 MECHATROLINK-III Response

Byte No.	Command	Byte Data (8 bits)
1	RCMD	$35
2	RWDT	RWDT
3	CMD_STAT	A1
4		A2
5	SVCMD_STAT	B1
6		B2
7		B3
8		B4
9	SVCMD_IO	C1
10		C2
11		C3
12		C4
13	CPRM_SEL_MON1	D1
14		D2
15		D3
16		D4
17	CPRM_SEL_MON2	E1
18		E2
19		E3
20		E4
21	MONITOR1	F1
22		F2
23		F3
24		F4
25	MONITOR2	G1
26		G2
27		G3
28		G4
29	MONITOR3	H1
30		H2
31		H3
32		H4

Table 5.10 Axis Statuses

Data Position Number	Data Name	Long Word Data			
		Low-word (16 bits)		High-word (16 bits)	
□□61	(System reserved)	0			
□□62	Command Status (CMD_STAT)	A2	A1		
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)	B2	B1	B4	B3
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)	C2	C1	C4	C3
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)	D2	D1	D4	D3
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)	E2	E1	E4	E3
□□71 / □□72	Monitor 1 (MONITOR1)	F2	F1	F4	F3
□□73 / □□74	Monitor 2 (MONITOR2)	G2	G1	G4	G3
□□75 / □□76	Monitor 3 (MONITOR3)	H2	H1	H4	H3

● Conversion of MECHATROLINK-III response to extended MECHATROLINK-III response parameter data

Table 5.11 MECHATROLINK-III Response Extended MECHATROLINK-III Response Parameters

Byte No.	Byte Data (8 bits)
1	A1
2	RWDT
3	B1
4	B2
5	C1
6	C2
7	D1
8	D2
9	E1
10	E2
11	F1
12	F2
13	G1
14	G2
15	H1
16	H2
17	I1
18	I2
19	J1
20	J2
21	K1
22	K2
23	L1
24	L2
25	M1
26	M2
27	N1
28	N2
29	O1
30	O2
31	P1
32	P2

Data Position Number	Word Data (16 bits)	
2001	A1	RWDT
2002	B1	B2
2003	C1	C2
2004	D1	D2
2005	E1	E2
2006	F1	F2
2007	G1	G2
2008	H1	H2
2009	I1	I2
2010	J1	J2
2011	K1	K2
2012	L1	L2
2013	M1	M2
2014	N1	N2
2015	O1	O2
2016	P1	P2

5.4 Executing Interpolation Motion Commands

When an interpolation motion command is executed from an axis, the positioning module sends a MECHATROLINK-III INTERPOLATE ($34) command to the external device corresponding to the axis number (1 to 15).

Only interpolation motion commands can be executed during interpolation motion. Other MECHATROLINK-III commands cannot be transmitted during interpolation motion. Therefore, always verify that an interpolation motion initiated by an interpolation motion command has stopped by checking that the Positioning Completed input relay has turned on before sending the next MECHATROLINK-III command.

If an alarm such as a communication error is detected on an axis involved in interpolation motion, the positioning module automatically sends a SV_OFF ($32) command to all axes to turn off servo for all axes.

■ Executing Interpolation Motion Command

● Procedure for executing an interpolation motion command

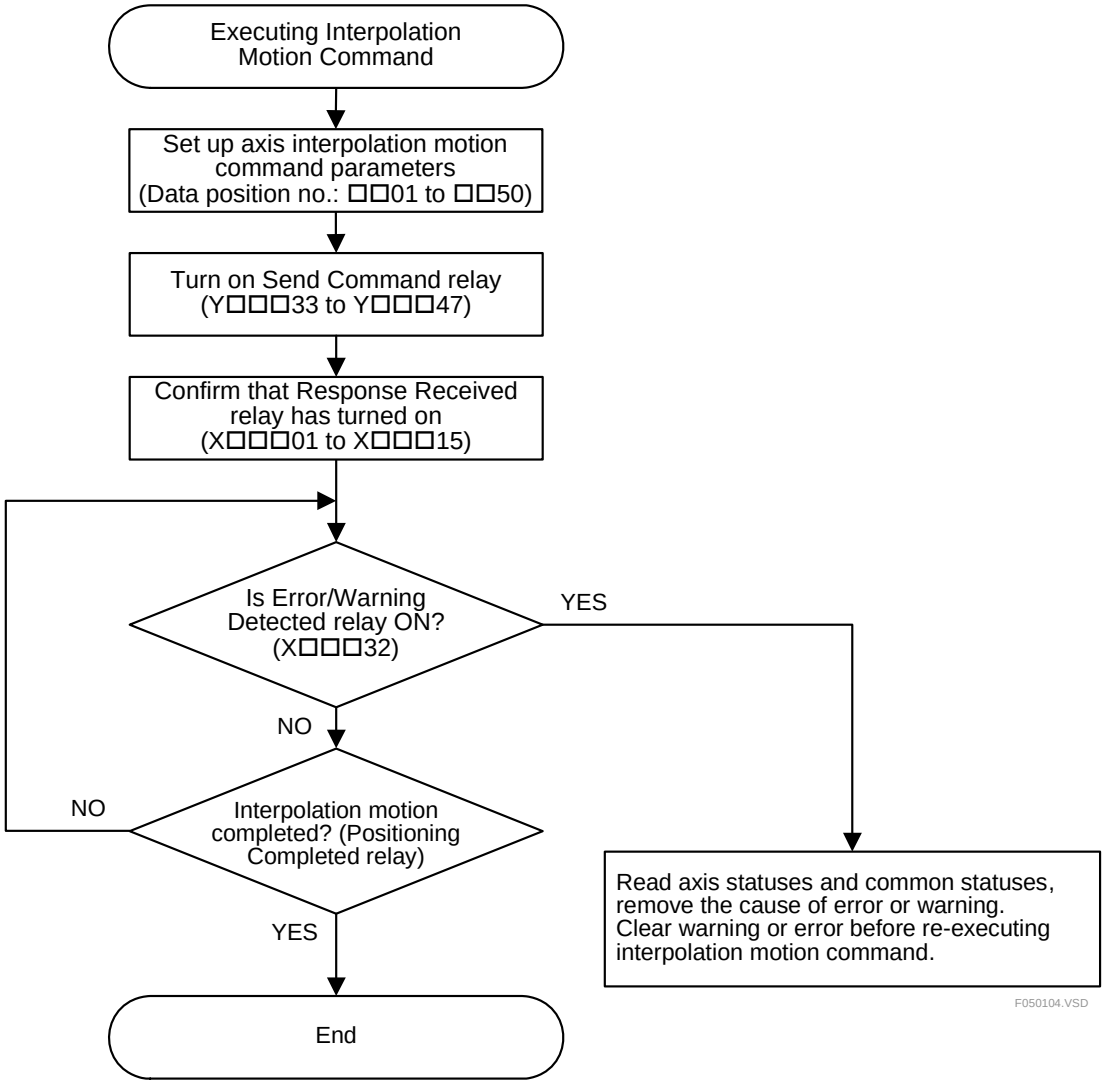


Figure 5.4 Procedure for Executing Interpolation Motion Command

● Acceptance conditions for interpolation motion commands

- MECHATROLINK-III communication is in progress.
- Send Command relay is OFF.
- Response Received relay is OFF.
- Error/Warning Detected relay is OFF.
- Servo is ON
- Axes are in Positioning Completed state if the interpolation motion command is the Start Positioning command ($0100).

An interpolation motion command is ignored if any of the above conditions is not true.

● Writing parameters for interpolation motion commands

Axis command parameters for an interpolation motion command can be written to the module using a WRITE instruction in a ladder program.

For details on the required parameters of each interpolation motion command, see Subsection 5.4.1, "Parameters and Statuses of Interpolation Motion Commands".

● Turning on Send Command relay and checking for Response Received relay turning on

Turning on the Send Command relay of an axis (Y□□□33 to Y□□□47) after writing interpolation motion command parameter values executes the interpolation motion command. The Response Received relay (X□□□01 to X□□□15) of the axis turns on if the executed command is processed normally.

Verify that the Response Received relay has turned on before turning off the Send Command relay. Turning off the Send Command relay (Y□□□33 to Y□□□47) for an axis also turns off the corresponding Response Received relay (X□□□01 to X□□□15).

Table 5.12 Relays for Sending Interpolation Motion Commands

Output Relay No.	Signal Name	Description	Relation with Other Relays
Y□□□33	AX1 Send Command	Request to send MECHATROLINK-III command for axis 1.	Turn off this relay after verifying that X□□□01 has turned on.
Y□□□34	AX2 Send Command	Request to send MECHATROLINK-III command for axis 2	Turn off this relay after verifying that X□□□02 has turned on.
Y□□□35	AX3 Send Command	Request to send MECHATROLINK-III command for axis 3	Turn off this relay after verifying that X□□□03 has turned on.
Y□□□36	AX4 Send Command	Request to send MECHATROLINK-III command for axis 4	Turn off this relay after verifying that X□□□04 has turned on.
Y□□□37	AX5 Send Command	Request to send MECHATROLINK-III command for axis 5	Turn off this relay after verifying that X□□□05 has turned on.
Y□□□38	AX6 Send Command	Request to send MECHATROLINK-III command for axis 6	Turn off this relay after verifying that X□□□06 has turned on.
Y□□□39	AX7 Send Command	Request to send MECHATROLINK-III command for axis 7	Turn off this relay after verifying that X□□□07 has turned on.
Y□□□40	AX8 Send Command	Request to send MECHATROLINK-III command for axis 8	Turn off this relay after verifying that X□□□08 has turned on.
Y□□□41	AX9 Send Command	Request to send MECHATROLINK-III command for axis 9	Turn off this relay after verifying that X□□□09 has turned on.
Y□□□42	AX10 Send Command	Request to send MECHATROLINK-III command for axis 10	Turn off this relay after verifying that X□□□10 has turned on.
Y□□□43	AX11 Send Command	Request to send MECHATROLINK-III command for axis 11	Turn off this relay after verifying that X□□□11 has turned on.
Y□□□44	AX12 Send Command	Request to send MECHATROLINK-III command for axis 12	Turn off this relay after verifying that X□□□12 has turned on.
Y□□□45	AX13 Send Command	Request to send MECHATROLINK-III command for axis 13	Turn off this relay after verifying that X□□□13 has turned on.
Y□□□46	AX14 Send Command	Request to send MECHATROLINK-III command for axis 14	Turn off this relay after verifying that X□□□14 has turned on.
Y□□□47	AX15 Send Command	Request to send MECHATROLINK-III command for axis 15	Turn off this relay after verifying that X□□□15 has turned on.

To be continued on the next page

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□01	AX1 Response Received	Turns on when a MECHATROLINK-III response for axis 1 is received.	Turning off Y□□□33 also turns off this relay.
X□□□02	AX2 Response Received	Turns on when a MECHATROLINK-III response for axis 2 is received.	Turning off Y□□□34 also turns off this relay.
X□□□03	AX3 Response Received	Turns on when a MECHATROLINK-III response for axis 3 is received.	Turning off Y□□□35 also turns off this relay.
X□□□04	AX4 Response Received	Turns on when a MECHATROLINK-III response for axis 4 is received.	Turning off Y□□□36 also turns off this relay.
X□□□05	AX5 Response Received	Turns on when a MECHATROLINK-III response for axis 5 is received.	Turning off Y□□□37 also turns off this relay.
X□□□06	AX6 Response Received	Turns on when a MECHATROLINK-III response for axis 6 is received.	Turning off Y□□□38 also turns off this relay.
X□□□07	AX7 Response Received	Turns on when a MECHATROLINK-III response for axis 7 is received.	Turning off Y□□□39 also turns off this relay.
X□□□08	AX8 Response Received	Turns on when a MECHATROLINK-III response for axis 8 is received.	Turning off Y□□□40 also turns off this relay.
X□□□09	AX9 Response Received	Turns on when a MECHATROLINK-III response for axis 9 is received.	Turning off Y□□□41 also turns off this relay.
X□□□10	AX10 Response Received	Turns on when a MECHATROLINK-III response for axis 10 is received.	Turning off Y□□□42 also turns off this relay.
X□□□11	AX11 Response Received	Turns on when a MECHATROLINK-III response for axis 11 is received.	Turning off Y□□□43 also turns off this relay.
X□□□12	AX12 Response Received	Turns on when a MECHATROLINK-III response for axis 12 is received.	Turning off Y□□□44 also turns off this relay.
X□□□13	AX13 Response Received	Turns on when a MECHATROLINK-III response for axis 13 is received.	Turning off Y□□□45 also turns off this relay.
X□□□14	AX14 Response Received	Turns on when a MECHATROLINK-III response for axis 14 is received.	Turning off Y□□□46 also turns off this relay.
X□□□15	AX15 Response Received	Turns on when a MECHATROLINK-III response for axis 15 is received.	Turning off Y□□□47 also turns off this relay.

Note: In the table, "□□□" denotes the slot number of the FA-M3 unit where the module is mounted.

● Reading statuses

After verifying that the Response Received relay (X□□□01 to X□□□15) for the axis has turned on, indicating that the executed interpolation motion command has been processed normally, read the axis statuses and common statuses using READ instructions in a ladder program.

For details on the statuses that can be read for each executed interpolation motion command, see Subsection 5.4.1, "Parameters and Statuses of Interpolation Motion Commands".

● Checking completion of interpolation motion command execution

Interpolation motion commands (Start positioning ($0100), Decelerate & stop ($0200), Stop immediately ($0300), Change speed ($0400) and Change target position ($0500)) continue execution even after the Response Received relay turns on.

You can check the completion of these interpolation motion commands by reading the following relays and statuses in a ladder program and checking the values of the relevant status bits.

Positioning Completed relay (X□□□17 to X□□□31)

Error/Warning Detected relay (X□□□32)

Axis statuses and common statuses

■ Example for Executing Interpolation Motion Command

● Procedure

(1) Specify the command code and required parameter values of the interpolation motion command in data position numbers □□01 to □□50.

(2) Turn on the Send Command relay (Y□□□33 to Y□□□47).

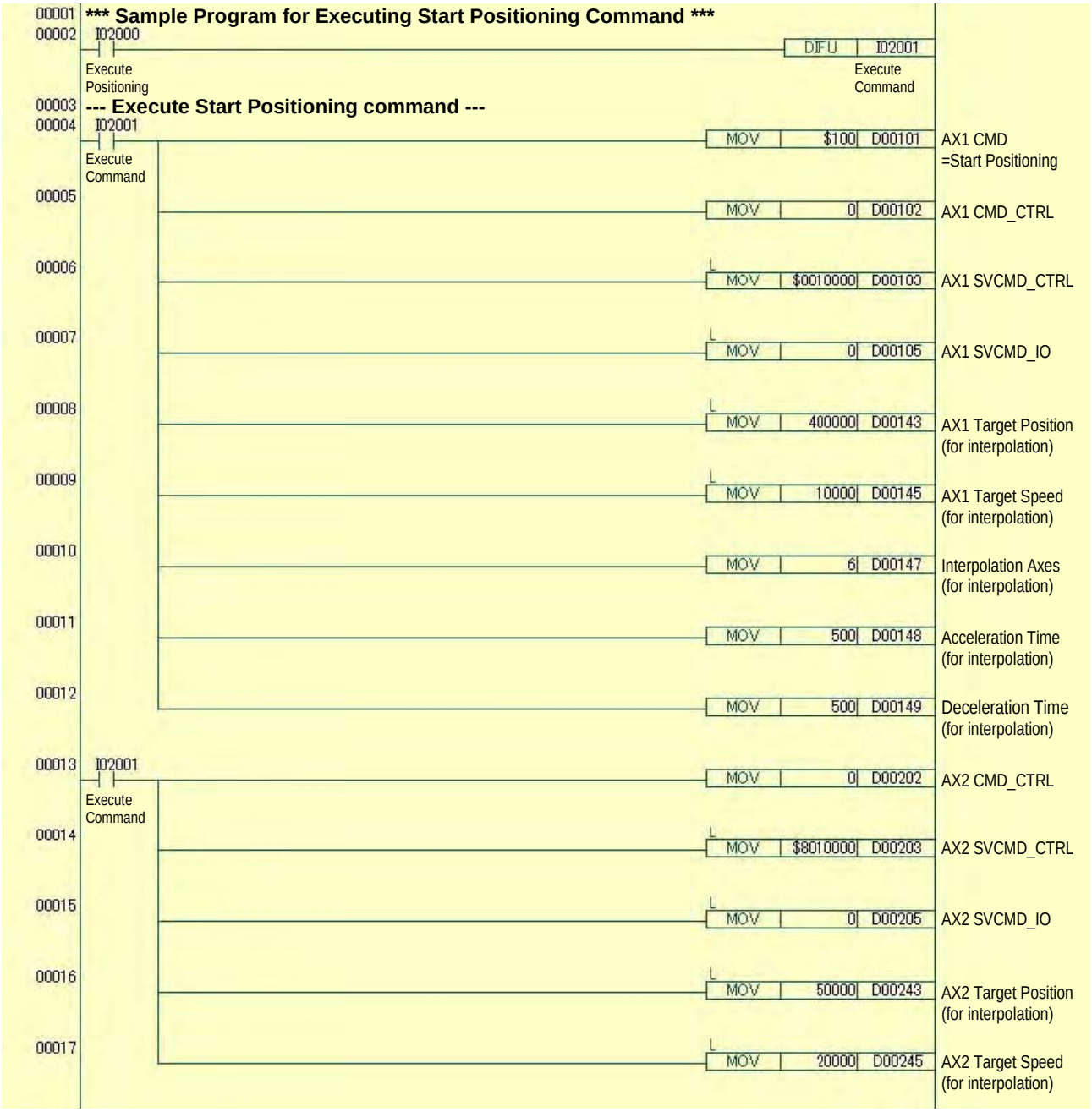
(3) Verify that the Response Received relay (X□□□01 to X□□□15) has turned on.

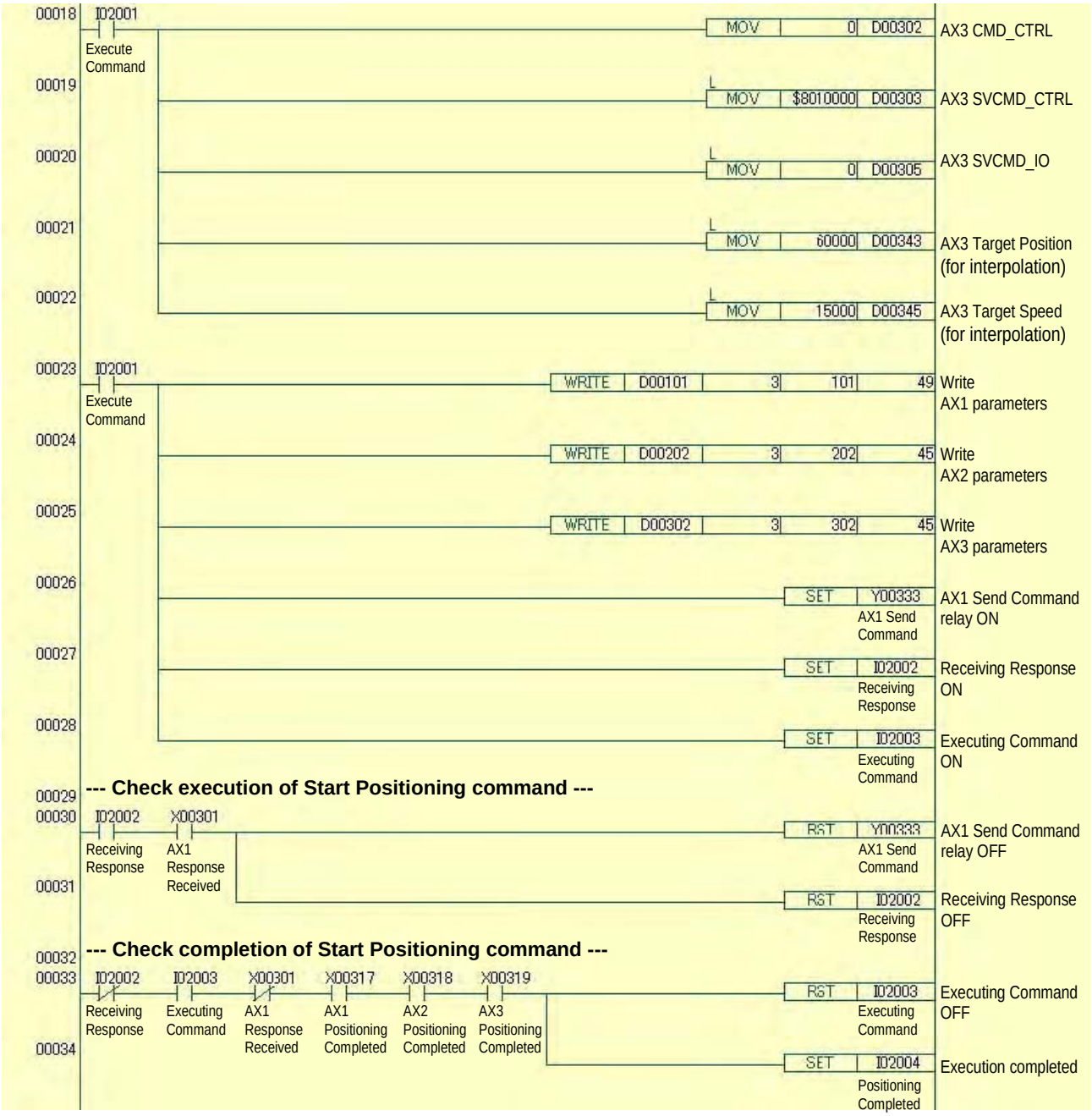
(4) Verify that positioning has completed by checking the Positioning Completed relay, Error/Warning Detected relay (X□□□32), axis statuses and common statuses.

● Sample Program for Executing Start Positioning Command

This sample program issues a Start Positioning command ($0100) to the positioning module mounted in slot 3 specifying axis 1 as reference axis and axes 2 and 3 as interpolation axes.

After issuing the command, it verifies completion of the command execution by checking that the corresponding Positioning Completed relays have turned on.

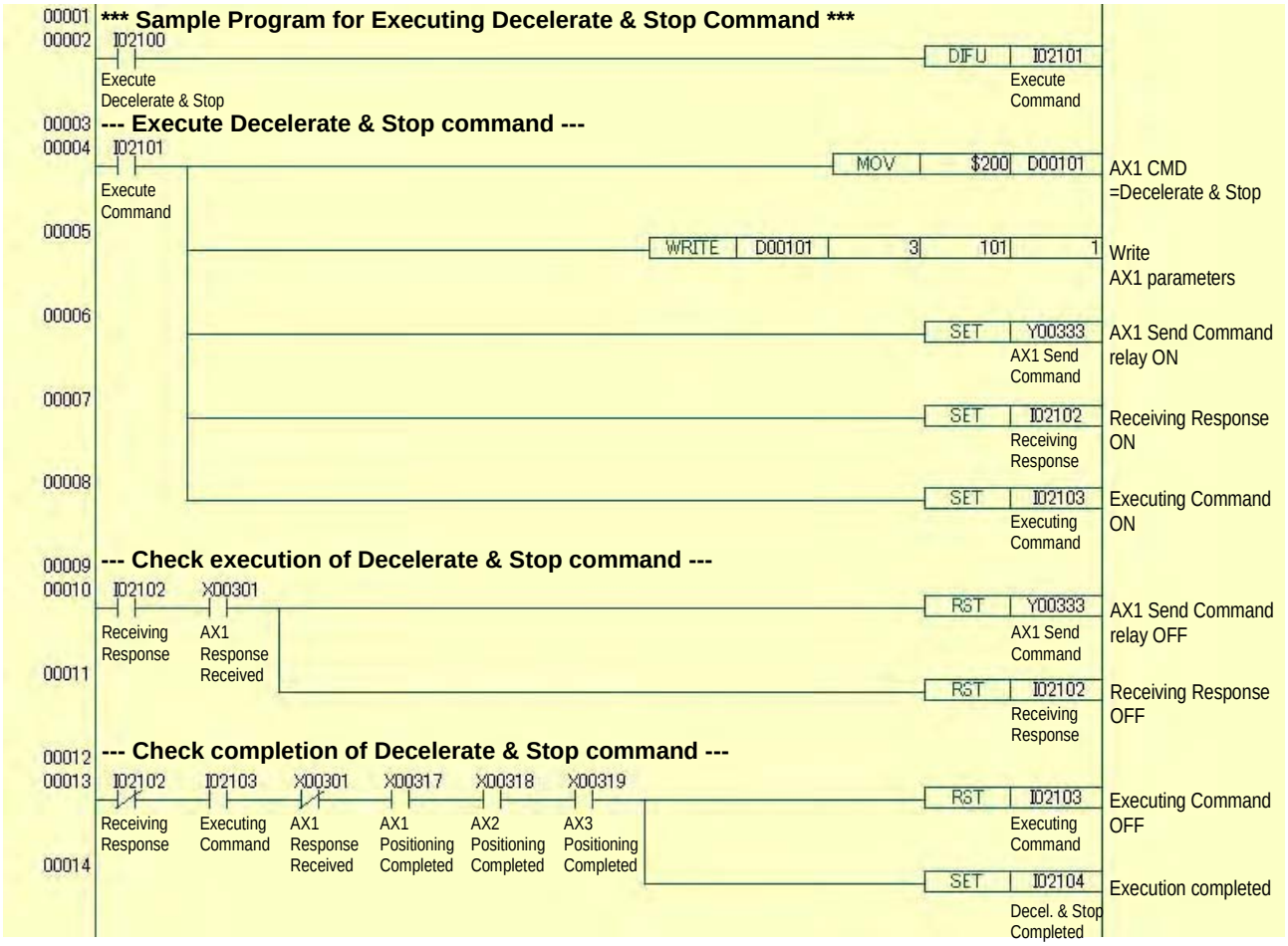



00018
ID2001
Execute Command
MOV 0 D00302
AX3 CMD_CTRL
00019
MOV $8010000 D00303
AX3 SVCMD_CTRL
00020
MOV 0 D00305
AX3 SVCMD_IO
00021
MOV 60000 D00343
AX3 Target Position (for interpolation)
00022
MOV 15000 D00345
AX3 Target Speed (for interpolation)
00023
ID2001
Execute Command
WRITE D00101 3 101 49
Write AX1 parameters
00024
WRITE D00202 3 202 45
Write AX2 parameters
00025
WRITE D00302 3 302 45
Write AX3 parameters
00026
SET Y00333
AX1 Send Command
AX1 Send Command relay ON
00027
SET ID2002
Receiving Response
Receiving Response ON
00028
SET ID2003
Executing Command
Executing Command ON
00029
--- Check execution of Start Positioning command ---
00030
ID2002
Receiving Response
X00301
AX1 Response Received
RST Y00333
AX1 Send Command
AX1 Send Command relay OFF
00031
RST ID2002
Receiving Response
Receiving Response OFF
00032
--- Check completion of Start Positioning command ---
00033
ID2002
Receiving Response
ID2003
Executing Command
X00301
AX1 Response Received
X00317
AX1 Positioning Completed
X00318
AX2 Positioning Completed
X00319
AX3 Positioning Completed
RST ID2003
Executing Command
Executing Command OFF
00034
SET ID2004
Positioning Completed
Execution completed

● Sample Program for Executing Decelerate & Stop Command

This sample program issues a Decelerate & Stop command ($0200) against axis 1 to the positioning module mounted in slot 3 to decelerate and stop axes 1, 2 and 3 during interpolation motion with axis 1 as reference axis and axes 2 and 3 as interpolation axes.

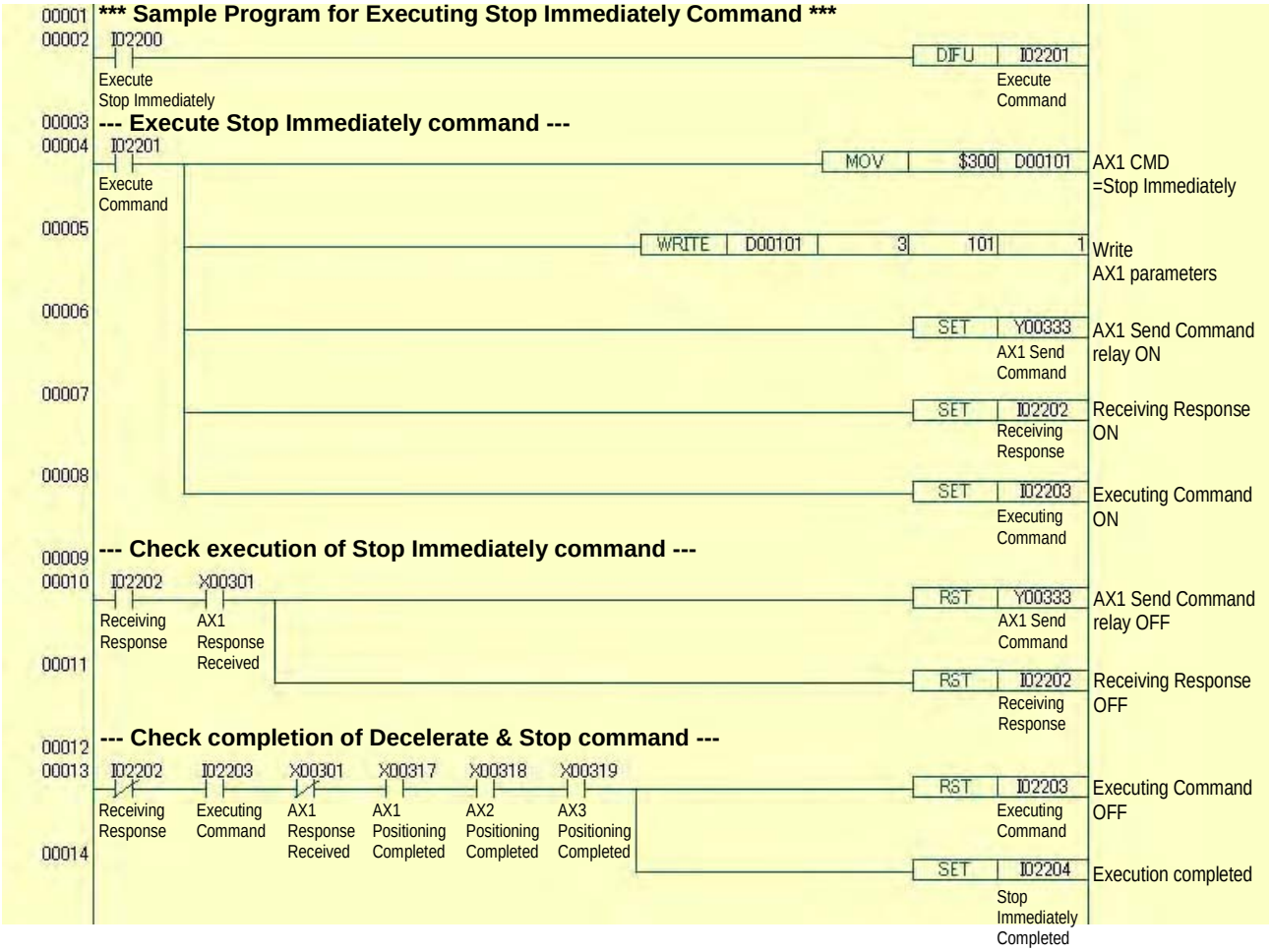
After issuing the command, it verifies completion of the command execution by checking that the corresponding Positioning Completed relays have turned on.



● Sample Program for Executing Stop Immediately Command

This sample program issues a Stop Immediately command ($0300) against axis 1 to the positioning module mounted in slot 3 to stop the motion of axes 1, 2 and 3 immediately during interpolation motion with axis 1 as reference axis and axes 2 and 3 as interpolation axes.

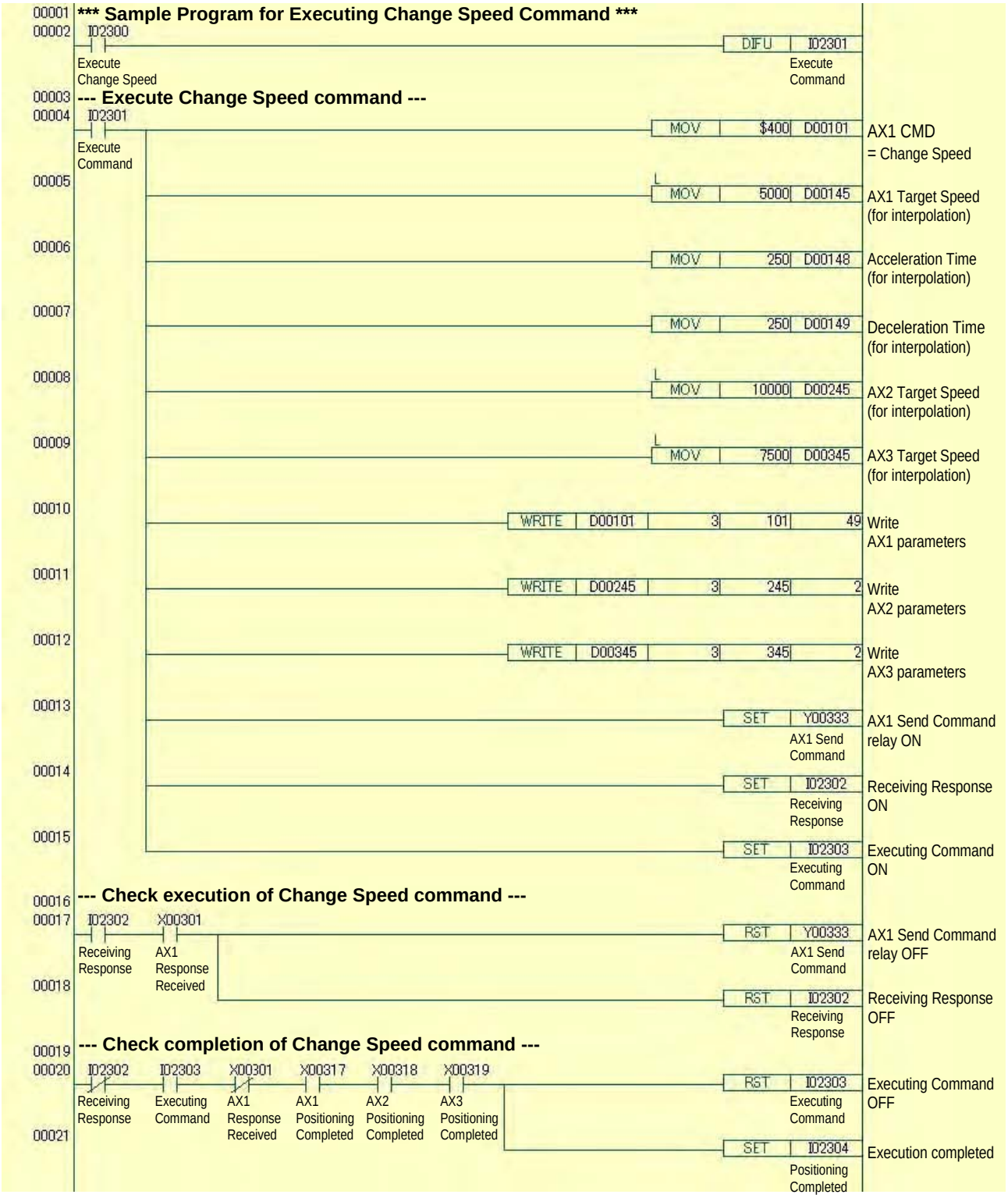
After issuing the command, it verifies completion of the command execution by checking that the corresponding Positioning Completed relays have turned on.



● Sample Program for Executing Change Speed Command

This sample program issues a Change Speed command ($0400) to the positioning module mounted in slot 3 to change the speeds of axes 1, 2 and 3 during interpolation motion with axis 1 as reference axis and axes 2 and 3 as interpolation axes.

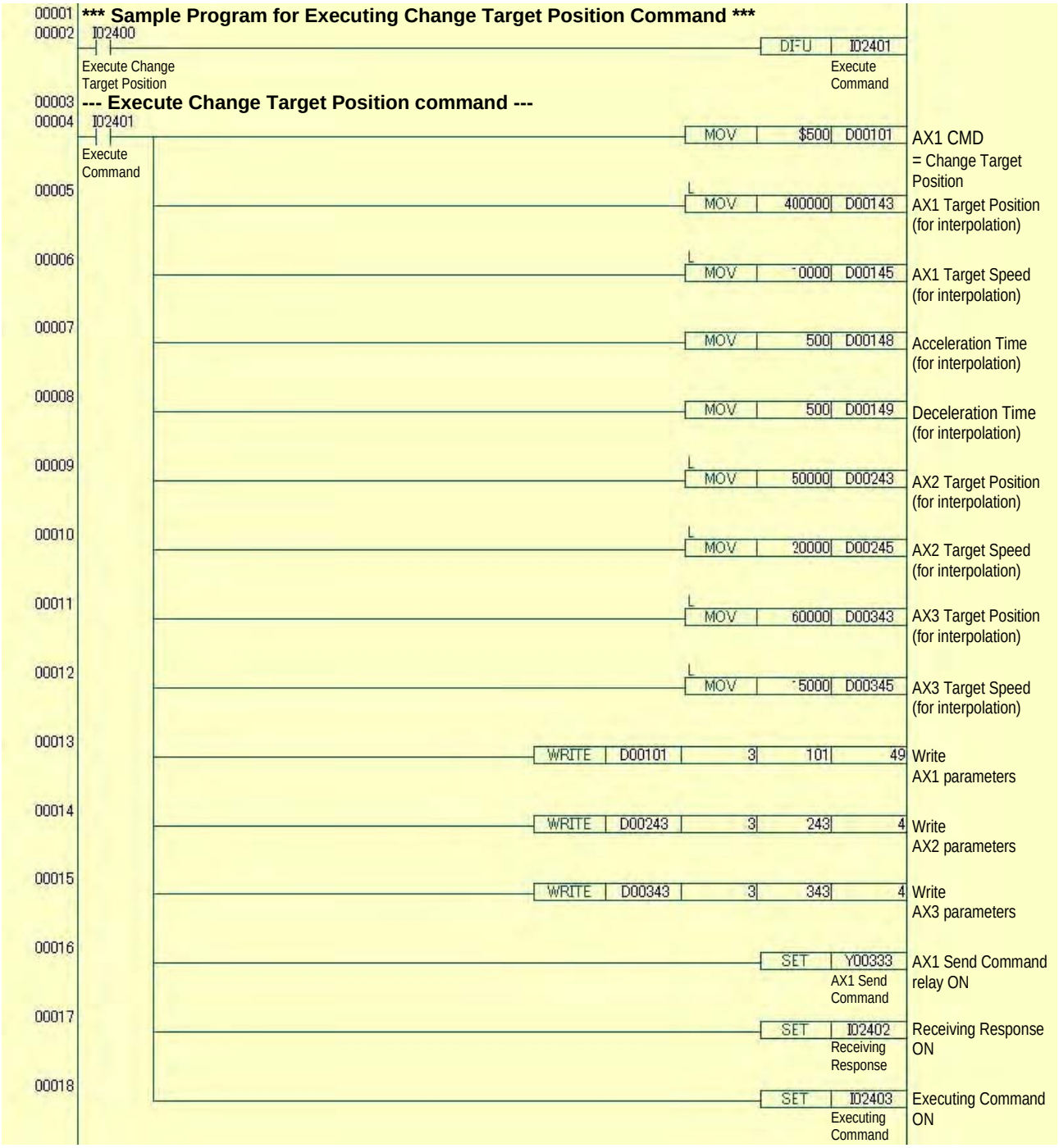
After issuing the command, it verifies completion of the command execution by checking that the corresponding Positioning Completed relays have turned on.

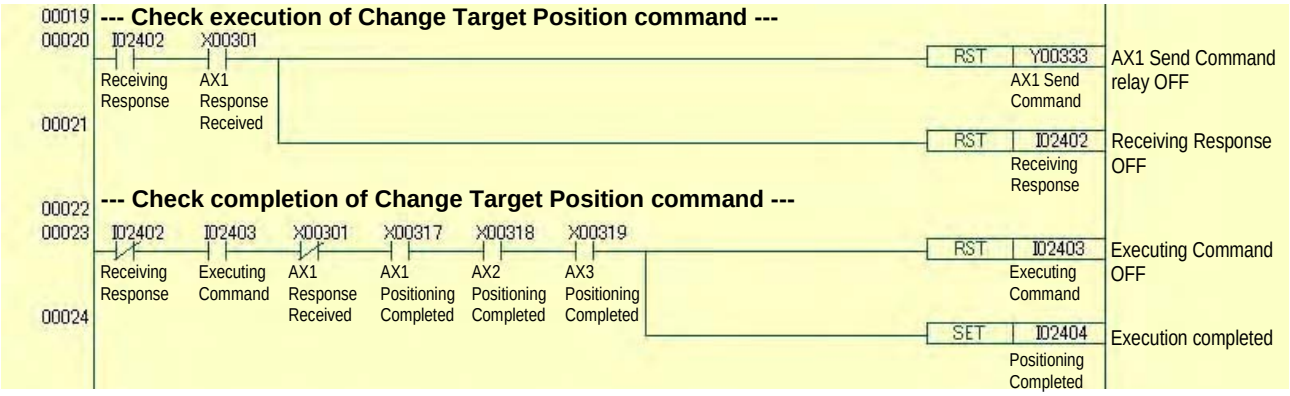


● Sample Program for Executing Change Target Position Command

This sample program issues a Change Target Position command ($0500) to the positioning module mounted in slot 3 to change the target positions of axes 1, 2 and 3 during interpolation motion with axis 1 as reference axis and axes 2 and 3 as interpolation axes.

After issuing the command, it verifies completion of the command execution by checking that the corresponding Positioning Completed relays have turned on.




00019
--- Check execution of Change Target Position command ---
00020
ID2402
Receiving Response
X00301
AX1 Response Received
RST
Y00333
AX1 Send Command
AX1 Send Command relay OFF
00021
RST
ID2402
Receiving Response
Receiving Response OFF
00022
--- Check completion of Change Target Position command ---
00023
ID2402
Receiving Response
ID2403
Executing Command
X00301
AX1 Response Received
X00317
AX1 Positioning Completed
X00318
AX2 Positioning Completed
X00319
AX3 Positioning Completed
RST
ID2403
Executing Command
Executing Command OFF
00024
SET
ID2404
Positioning Completed
Execution completed

5.4.1 Parameters and Statuses of Interpolation Motion Commands

The following tables list the required command parameters that must be written, as well as the statuses that are returned for each interpolation motion command.

Throughout interpolation motion initiated by an interpolation motion command, the positioning module automatically sends MECHATROLINK-III INTERPOLATE commands ($34) to constantly update the status values.

In the table, "□□" denotes an axis number (01 to 15), while "■■" denotes the value of "□□ + 1".

The parameters for each command are listed with the following indications:

◎: This parameter must be wirtten for the reference axis, as well as each interpolation axis.

○: This parameter must be written only for the reference axis.

△: This parameter must be written only if the command is executed in Positioning Completed state.

● Command parameters

Data Position Number	Data Name	Start Positioning	Decelerate & Stop	Stop Immediately	Change Speed	Change Target Position
□□01	Command Code (CMD)	$0100	$0200	$0300	$0400	$0500
□□02	Command Control (CMD_CTRL)	◎				△
□□03 / □□04	Servo Command Control Field (SVCMD_CTRL)	◎				△
□□05 / □□06	Servo Command Output Signal (SVCMD_IO)	◎				△
□□07 / □□08	Target Position (TPOS) / Zero Point Return Mode (MODE)					
□□09 / □□10	Target Speed (TSPD)					
□□11 / □□12	Acceleration (ACCR)					
□□13 / □□14	Deceleration (DECR)					
□□15 / □□16	Torque Limit (TLIM)					
□□17 / □□18	Speed Reference (VREF)					
□□19 / □□20	Speed Limit (VLIM)					
□□21 / □□22	Torque Reference (TQREF)					
□□23 / □□24	Speed Feed Forward (VFF)					
□□25 / □□26	Torque Feed Forward (TFF)					
□□27 / □□28	Coordinates Setting Mode (POS_SET_MOD)					
□□29 / □□30	Coordinates Set Value (POS_DATA)					
□□31 to □□32	(System reserved)					
□□33	Configuration Mode (CONFIG_MOD)					
□□34	Alarm Clear Mode (ALM_CLR_MOD)					
□□35	Servo Parameter Number (NO)					
□□36	Servo Parameter Data Size [byte] (SIZE), Servo Parameter Read/Write Mode (MODE)					
□□37 / □□38	Servo Parameter Data (PARAMETER)					
□□39 to □□40	(System reserved)					
□□41 / □□42	Subcommand Control (SUB_CTRL)	◎				△
□□43 / □□44	Target Position (for interpolation motion commands)	◎				◎
□□45 / □□46	Target Speed (for interpolation motion commands)	◎			◎	◎
□□47	Interpolation Axes (for interpolation motion commands)	○				△
□□48	Acceleration Time (for interpolation motion commands)	○			○	○
□□49	Deceleration Time (for interpolation motion commands)	○			○	○
□□50	(System reserved)					
2001 to 2750	Extended MECHATROLINK-III Command Parameters					

● Statuses

Data Position Number	Data Name	Start Positioning	Decelerate & Stop	Stop Immediately	Change Speed	Change Target Position
□□61	(System reserved)					
□□62	Command Status (CMD_STAT)	○	○	○	○	○
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)	○	○	○	○	○
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)	○	○	○	○	○
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)	○	○	○	○	○
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)	○	○	○	○	○
□□71 / □□72	Monitor 1 (MONITOR1)	○	○	○	○	○
□□73 / □□74	Monitor 2 (MONITOR2)	○	○	○	○	○
□□75 / □□76	Monitor 3 (MONITOR3)	○	○	○	○	○
□□77 / □□78	Monitor 4 (MONITOR4)	○	○	○	○	○
□□79 / □□80	Monitor 5 (MONITOR5)	○	○	○	○	○
□□81 / □□82	Monitor 6 (MONITOR6)	○	○	○	○	○
□□83 / □□84	Subcommand Status (SUB_STAT)	○	○	○	○	○
□□85 / □□86	Remaining Travel Status	○	○	○	○	○
□□87	Interpolation Status	○	○	○	○	○
□□88 to ■■00	(System reserved)					
1601 to 2000	Common Statuses	○	○	○	○	○

5.5 Reading Statuses

The positioning module allows statuses of external devices corresponding to axes 1 to 15 to be read from input relays, axis statuses and common statuses. Status data is updated at each communication cycle.

The statuses that are updated depend on the transmitted MECHATROLINK-III commands.

For details on the statuses that are updated for each MECHATROLINK-III command, see Subsection 5.3.1, "Parameters and Statuses of MECHATROLINK-III Commands" and Subsection 5.4.1, "Parameters and Statuses of Interpolation Motion Commands".

After the module receives a response from a standard servo profile compliant external device for a transmitted MECHATROLINK-III command (but not an extended MECHATROLINK-III command) for which status data is not updated, it automatically sends a Servo Status Monitor (SMON :$30) command. In this way, status data is updated automatically.

■ How to Read Status

● Reading statuses

Input relays can be read as input relays in a ladder program. Axis statuses and common statuses can be read using READ instructions in a ladder program.

● Input relays

Table 5.13 lists the input relays.

Table 5.13 List of Input Relays

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□01	AX1 Response Received	Turns on when a MECHATROLINK-III response for axis 1 is received.	Turning off Y□□□33 also turns off this relay.
X□□□02	AX2 Response Received	Turns on when a MECHATROLINK-III response for axis 2 is received.	Turning off Y□□□34 also turns off this relay.
X□□□03	AX3 Response Received	Turns on when a MECHATROLINK-III response for axis 3 is received.	Turning off Y□□□35 also turns off this relay.
X□□□04	AX4 Response Received	Turns on when a MECHATROLINK-III response for axis 4 is received.	Turning off Y□□□36 also turns off this relay.
X□□□05	AX5 Response Received	Turns on when a MECHATROLINK-III response for axis 5 is received.	Turning off Y□□□37 also turns off this relay.
X□□□06	AX6 Response Received	Turns on when a MECHATROLINK-III response for axis 6 is received.	Turning off Y□□□38 also turns off this relay.
X□□□07	AX7 Response Received	Turns on when a MECHATROLINK-III response for axis 7 is received.	Turning off Y□□□39 also turns off this relay.
X□□□08	AX8 Response Received	Turns on when a MECHATROLINK-III response for axis 8 is received.	Turning off Y□□□40 also turns off this relay.
X□□□09	AX9 Response Received	Turns on when a MECHATROLINK-III response for axis 9 is received.	Turning off Y□□□41 also turns off this relay.
X□□□10	AX10 Response Received	Turns on when a MECHATROLINK-III response for axis 10 is received.	Turning off Y□□□42 also turns off this relay.
X□□□11	AX11 Response Received	Turns on when a MECHATROLINK-III response for axis 11 is received.	Turning off Y□□□43 also turns off this relay.
X□□□12	AX12 Response Received	Turns on when a MECHATROLINK-III response for axis 12 is received.	Turning off Y□□□44 also turns off this relay.
X□□□13	AX13 Response Received	Turns on when a MECHATROLINK-III response for axis 13 is received.	Turning off Y□□□45 also turns off this relay.
X□□□14	AX14 Response Received	Turns on when a MECHATROLINK-III response for axis 14 is received.	Turning off Y□□□46 also turns off this relay.
X□□□15	AX15 Response Received	Turns on when a MECHATROLINK-III response for axis 15 is received.	Turning off Y□□□47 also turns off this relay.
X□□□16	Communication Status	Turns on while MECHATROLINK-III communication is in progress; turns off otherwise.	Turning on Y□□□48 to initiate communication turns on this relay when communication begins. Turning off Y□□□48 also turns off this relay.

To be continued on the next page

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□17	AX1 Positioning Completed	Turns on when axis 1 is in positioning completed state.	
X□□□18	AX2 Positioning Completed	Turns on when axis 2 is in positioning completed state.	
X□□□19	AX3 Positioning Completed	Turns on when axis 3 is in positioning completed state.	
X□□□20	AX4 Positioning Completed	Turns on when axis 4 is in positioning completed state.	
X□□□21	AX5 Positioning Completed	Turns on when axis 5 is in positioning completed state.	
X□□□22	AX6 Positioning Completed	Turns on when axis 6 is in positioning completed state.	
X□□□23	AX7 Positioning Completed	Turns on when axis 7 is in positioning completed state.	
X□□□24	AX8 Positioning Completed	Turns on when axis 8 is in positioning completed state.	
X□□□25	AX9 Positioning Completed	Turns on when axis 9 is in positioning completed state.	
X□□□26	AX10 Positioning Completed	Turns on when axis 10 is in positioning completed state.	
X□□□27	AX11 Positioning Completed	Turns on when axis 11 is in positioning completed state.	
X□□□28	AX12 Positioning Completed	Turns on when axis 12 is in positioning completed state.	
X□□□29	AX13 Positioning Completed	Turns on when axis 13 is in positioning completed state.	
X□□□30	AX14 Positioning Completed	Turns on when axis 14 is in positioning completed state.	
X□□□31	AX15 Positioning Completed	Turns on when axis 15 is in positioning completed state.	
X□□□32	Error/Warning Detected	Turns on when an error or warning is detected by the module or any axis.	Turning on Y□□□64 to clear all errors and warnings turns off this relay if errors and warnings are successfully cleared.

Note: In the table, "□□□" denotes the FA-M3 slot number where the module is mounted.

● Axis statuses

Table 5.14 and Table 5.15 list the axis statuses. The axis statuses depend on the profile type supported by the connected external device. For details of axis statuses, see Subsection 4.2.5, "Axis Statuses".

Table 5.14 List of Axis Statuses (for standard servo profile compliant external devices)

Data Position Number	Data Name	Data Description	See Also
□□61	(System reserved)		–
□□62	Command Status (CMD_STAT)	Bit data: Bits 15 to 0	4-29
□□63 / □□64	Servo Command Status Field (SVCMD_STAT)	Bit data: Bits 31 to 0	4-30
□□65 / □□66	Servo Command Input Signal (SVCMD_IO)	Bit data: Bits 31 to 0	4-31
□□67 / □□68	Fixed Monitor 1 (CPRM_SEL_MON1)	Fixed monitor 1 data	4-32
□□69 / □□70	Fixed Monitor 2 (CPRM_SEL_MON2)	Fixed monitor 2 data	4-32
□□71 / □□72	Monitor 1 (MONITOR1)	Monitor 1 data (Fixed to CPOS data)	4-32
□□73 / □□74	Monitor 2 (MONITOR2)	Monitor 2 data	4-32
□□75 / □□76	Monitor 3 (MONITOR3)	Monitor 3 data	4-32
□□77 / □□78	Monitor 4 (MONITOR4)	Monitor 4 data	4-32
□□79 / □□80	Monitor 5 (MONITOR5)	Monitor 5 data	4-33
□□81 / □□82	Monitor 6 (MONITOR6)	Monitor 6 data	4-33
□□83 / □□84	Subcommand Status (SUB_STAT)	Bit data: Bits 15 to 0	4-33
□□85 / □□86	Remaining Travel Status	−2,147,483,648 to 2,147,483,647	4-33
□□87	Interpolation Status	Bit data: Bits 15 to 0	4-34
□□88 to ■■00	(System reserved)		–

Note: □□ denotes an axis number (01 to 15). ■■ denotes the value of □□+1.

Table 5.15 List of Axis Statuses (for standard I/O profile compliant external devices)

Data Position Number	Data Name	Data Description	See Also
□□61	(System reserved)		–
□□62	Command Status (CMD_STAT)	Bit data: Bits 15 to 0	4-29
□□63 to □□92	Input Data (INPUT)	Bit data: Bits 15 to 0	4-34
□□93 to ■■00	(System reserved)		–

Note: □□ denotes an axis number (01 to 15). ■■ denotes the value of □□+1.

● Common statuses

Table 5.16 lists the common statuses. For details of common statuses, see Subsection 4.2.6, "Common Statuses".

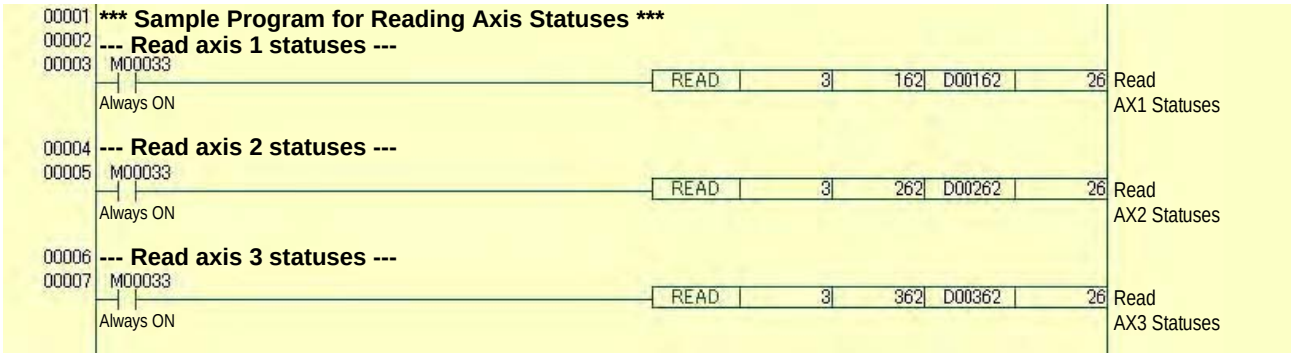
Table 5.16 List of Common Statuses

Data Position Number	Data Name	Data Description	See Also
1601	Alarm Axis Bits	Bit data for module, AX15, AX14, …, AX2 and AX1	4-35
1602	Warning Axis Bits	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-36
1603	Module Alarm Code	MECHATROLINK-III communication initialization related errors, MECHATROLINK-III communication related errors, interpolation motion command execution related errors, etc.	4-36
1604	Module Detailed Alarm Code	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-37
1605 to 2000	(System reserved)		–

■ Example for Reading Statuses

● Sample program

This sample program reads axis statuses for axes 1 to 3 for the positioning module mounted in slot 3.



CAUTION

When the CPU module reads 2-word status data from the positioning module, concurrency of the high-order word and low-order word of 2-word data is not assured due to conflicts between the timing of reading from the CPU module and the data update cycle of the positioning module.

To ensure that the high-order word and low-order word of 2-word data are concurrent when reading from a sequence CPU, use the READ command to read the data twice consecutively and verify that the data read are the same in both instances. If the HRD command is used, data concurrency is not assured even if had verified that the data are the same.

Data concurrency cannot be assured when reading from a BASIC CPU.

For details on how to check that data read twice consecutively by a sequence CPU are the same in both instances, see Section 6.3, “Precautions When Reading 2-word Data.”

5.6 Detecting Errors, Warnings and Communication Alarms

Errors and warnings reported by the positioning module can be classified into two types. The first type of errors and warnings is detected by the module itself, while the second type of errors and warnings is detected by external devices and reported to the module via MECHATROLINK-III communications. The Error/Warning Detected relay turns on for both types of errors and warnings.

Error and warnings detected by external devices may be caused by communication errors during MECHATROLINK-III communication (communication error, watchdog data error, transmission cycle error and synchronous command error), command errors and external device faults. These errors are reported to the positioning module via CMD_STAT (specifically, its D_ALM bit, D_WAR bit, CMD_ALM code and COMM_ALM code) of the MECHATROLINK-III response returned from the external device.

■ MECHATROLINK-III Communication Initialization Related Errors

● Communication parameter error

A communication parameter error is generated when starting MECHATROLINK-III communication if a specified MECHATROLINK-III communication parameter value is out of the valid data range.

● Disconnected external device

A disconnected external device error is generated if an external device defined in MECHATROLINK-III communication parameters is not connected or powered off.

● Station address error

A station address setup error is generated if two or more connected external devices have the same station address.

■ MECHATROLINK-III Communication Related Errors

● Communication error

In MECHATROLINK-III communications, data exchange with external devices is carried out at each communication cycle.

A communication error is generated if the data receive status for received data read from an external device is not normal for two or more consecutive cycles.

● Watchdog data error

In MECHATROLINK-III communications, the master station and slave stations exchange synchronization data (WDT/RWDT) during each communication cycle. This data exchange allows the master and its slaves to establish synchronous communication, as well as detect any synchronization lag.

A watchdog data error is generated if the watchdog data value in received data read from an external device is not equal to the previous watchdog data value plus 1.

● Command timeout error

A command timeout error is generated if no MECHATROLINK-III response for a MECHATROLINK-III command is received within ten seconds after command transmission. It is assumed that a command processing error is detected by the external device.

■ Interpolation Motion Command Execution Related Errors

● Parameter setup error

A parameter setup error is generated when an invalid parameter value is specified for an interpolation motion command.

For instance, this may happen when a Start Positioning command is executed with a specified parameter value that is out of valid range.

If a parameter setup error is detected during motion, the motion is decelerated to a stop.

● Motion axis error

A motion axis error is generated if an interpolation motion is executed against a moving axis using a different set of interpolation axes.

Some examples include executing a Start Positioning command for a moving axis or executing a Change Target Position command for a moving axis using a MECHATROLINK-III command. Other examples include executing a Change Speed command or Change Target Position command while a target position change is in progress. Bit 4 of Interpolation Status of axis statuses is ON while a target position change is in progress.

● Internal computation error

An internal computation error is generated when internal computation by the positioning module produces an invalid value.

Internal computation errors do not normally happen.

■ Errors and Warnings Detected by External Devices

For details on errors and warnings that may be reported by a connected external device, see its user's manual.

■ Checking for Errors and Warnings

● Error/Warning Detected relay

The Error/Warning Detected relay turns on when the positioning module or an external device detects an error or warning.

Table 5.17 Relays for Checking Errors or Warnings

Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□32	Error/Warning Detected	Turns on when an error or warning is detected by the module or any axis.	Turning on Y□□□64 to clear all errors and warnings also turns off this relay.

Note: In the table, "□□□" denotes the slot number of the FA-M3 unit where the module is mounted.

● Errors and Warnings detected by the module

When the positioning module detects a warning or an error, the module bit of Alarm Axis Bits of common statuses turns on, and alarm information is stored in Module Alarm Code and Module Detailed Alarm Code.

The Module Alarm Code and Module Detailed Alarm Code are meaningful only when the module bit of Alarm Axis Bits has value 1.

Table 5.18 List of Statuses for Checking (Module) Errors or Warnings

Data Position Number	Data Name	Data Description	See Also
1601	Alarm Axis Bits	Bit data for module, AX15, AX14, …, AX2 and AX1	4-35
1602	Warning Axis Bits	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-36
1603	Module Alarm Code	MECHATROLINK-III communication initialization related errors , MECHATROLINK-III communication related errors, interpolation motion command execution related errors, etc.	4-36
1604	Module Detailed Alarm Code	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-37

● Errors and Warnings detected by external devices

When an error or warning is detected by an external device, the corresponding bit of the Alarm Axis Bits or Warning Axis Bits of common statuses turns on.

When an error or warning is detected by an external device, read the error/warning code using the ALM_RD ($05) command. By pre-setting SEL_MON2 or SEL_MON3 of SVCMD_CTRL to 8 (for ALARM monitor), the warning/alarm code will be stored in MONITOR2 or MONITOR3 of axis statuses respectively.

Table 5.18 List of Statuses for Checking (External Device) Errors or Warnings

Data Position Number	Data Name	Data Description	See Also
1601	Alarm Axis Bits	Bit data for module, AX15, AX14, …, AX2 and AX1	4-35
1602	Warning Axis Bits	'0' and bit data for AX15, AX14, …, AX2 and AX1	4-36

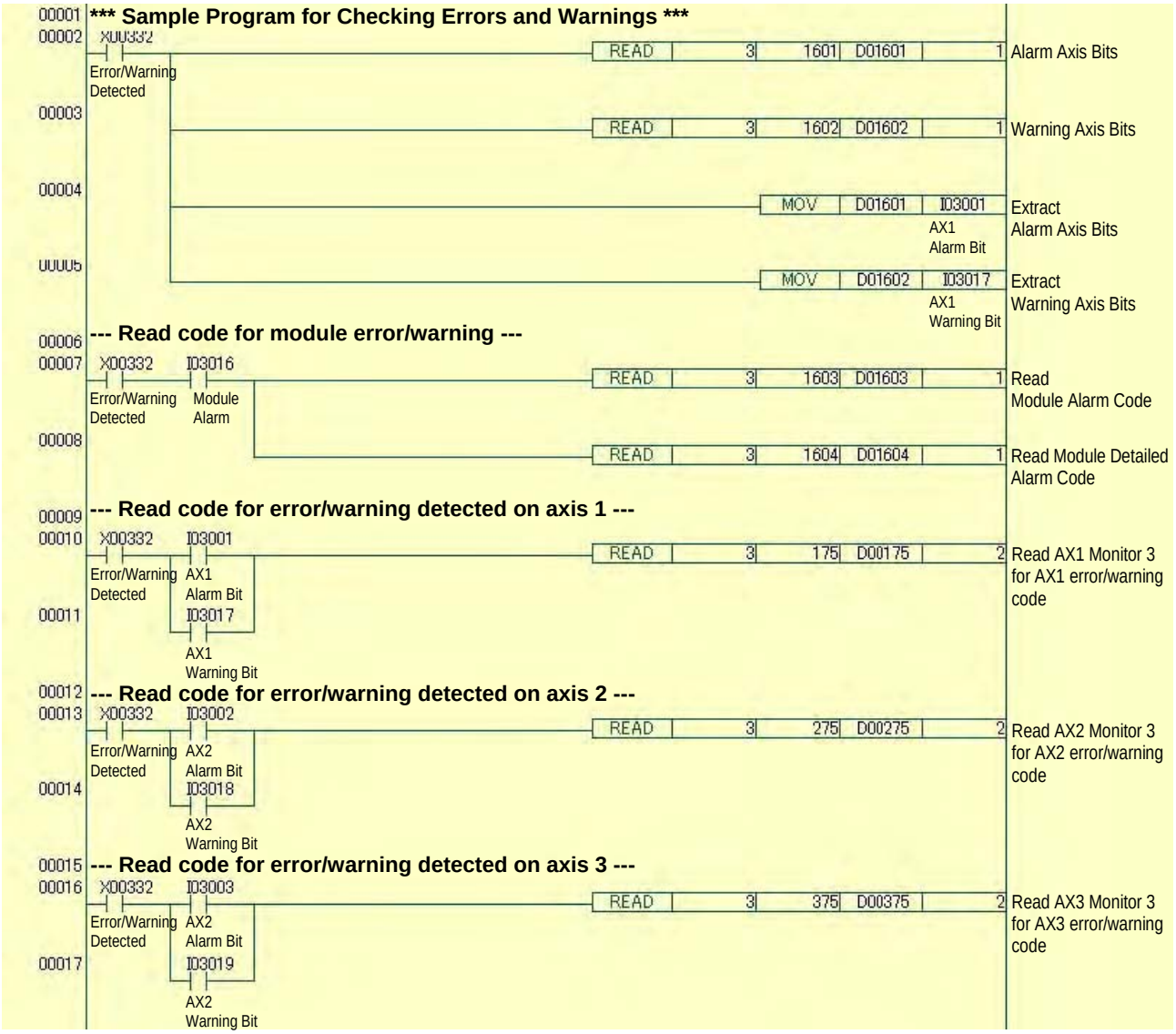
Data Position Number	Data Name	Data Description	See Also
□□62	Command Status (CMD_STAT)	Bit data: Bits 15 to 0	4-29

■ Example of Checking for Errors and Warnings

● Sample Program

This sample program checks for errors and warnings of axes 1 to 3 for the positioning module mounted in slot 3.

It is assumed that SEL_MON3 of SVCMD_CTRL of each axis is set to 8 (for ALARM monitor) beforehand so that any warning/alarm codes are stored in the respective MONITOR3 axis statuses.



5.7 Clearing Errors and Warnings

This section describes how to clear MECHATROLINK-III communication initialization related errors, MECHATROLINK-III communication related errors, and interpolation motion command execution related errors detected by the module, as well as errors and warnings reported by external devices.

Errors and warnings reported by external devices can be cleared only while MECHATROLINK-III communication is in progress.

The positioning module clears errors and warnings by automatically sending the following sequence of MECHATROLINK-III commands.

- **For standard servo profile compliant external device:**
  Clear alarm or warning command (ALM_CLR: $06)

  Start synchronous communication command (SYNC_SET: $0D)

- **For standard I/O profile compliant external device:**
  Clear alarm or warning command (ALM_CLR: $06)

■ Procedure for Clearing Errors and Warnings

● Procedure for clearing errors and warnings

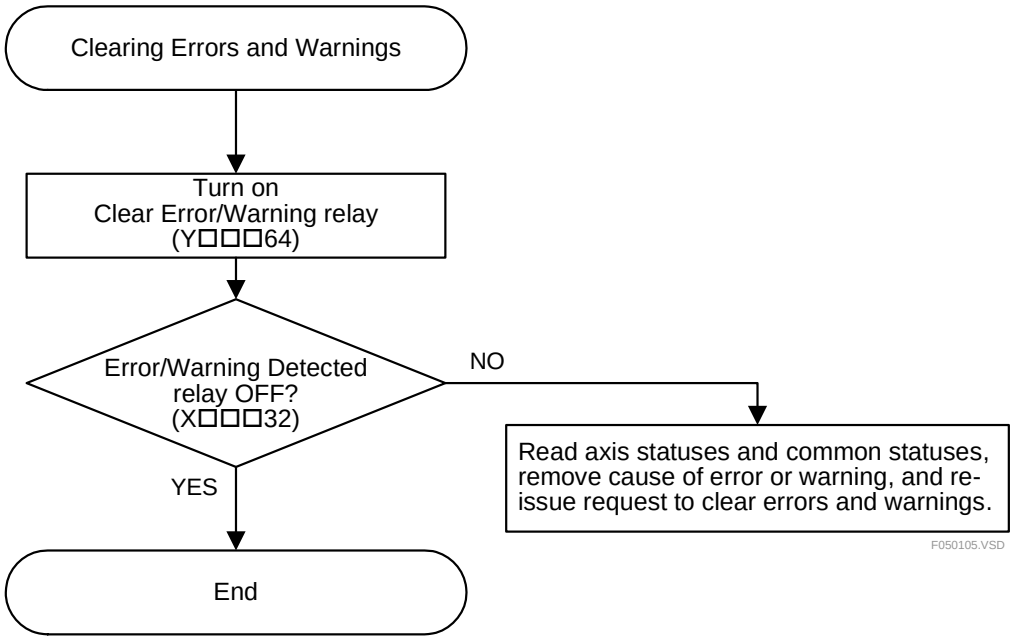


Figure 5.5 Procedure for Clearing Errors and Warnings

● Turning on the Clear Error/Warning relay

Turning on the Clear Error/Warning relay clears all reported errors and warnings. The Error/Warning Detected relay turns off if all errors and warnings are cleared successfully.

Verify that the Error/Warning Detected relay has turned off before turning off the Clear Error/Warning relay. If an error/warning condition persists even after turning on the Clear Error/Warning relay, the Error/Warning Detected relay remains ON.

Table 5.20 Relays for Clearing Errors and Warnings

Output Relay No.	Signal Name	Description	Relation with Other Relays
Y□□□64	Clear Error/warning	Request to clear all errors and warnings	Turn off this relay after verifying that X□□□32 has turned off.

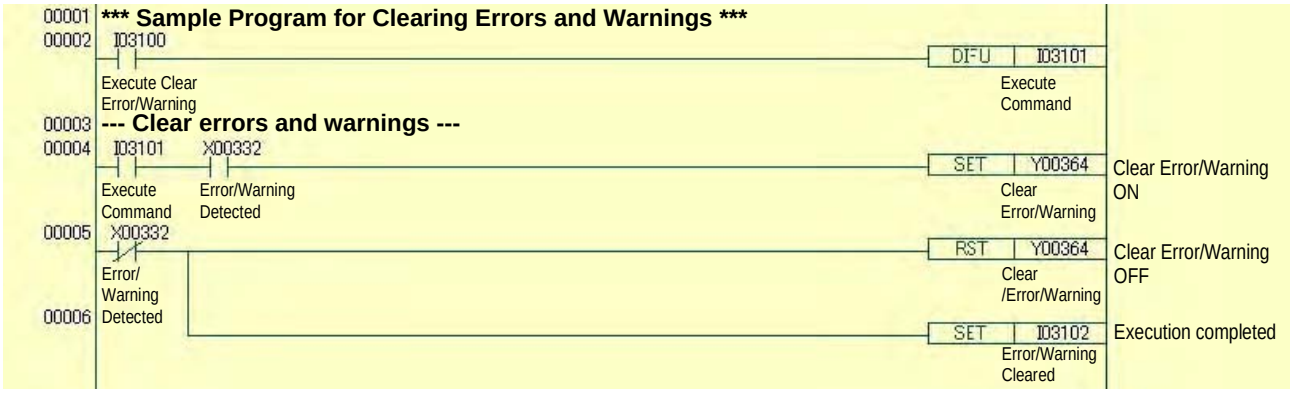
Input Relay No.	Signal Name	Description	Relation with Other Relays
X□□□32	Error/Warning Detected	Turns on when an error or warning is detected by the module or any axis.	Turning on Y□□□64 to clear all errors and warnings turns off this relay if errors and warnings are successfully cleared.

Note: In the table, "□□□" denotes the slot number of the FA-M3 unit where the module is mounted.

■ Example for Clearing Errors and Warnings

● Sample Program

This sample program clears all errors and warnings for the positioning module mounted in slot 3.



6. Accessing the Module

6.1 Accessing from Sequence CPU

The following instructions can be used for accessing the module from a sequence CPU using a ladder sequence program. For more information on each instruction, see “Sequence CPU Modules — Instructions” (IM34M06P12-03E).

● Reading and Writing Parameters and Statuses

Reading and writing must be performed using word-based instructions. Long word based instructions cannot be used.

- Special Module Read Instruction (READ Instruction)

READ	SL	n1	D	k

SL: number of slot where the module is installed
n1: data position number for the first word of data to be read
D: first device for storing the read data
k: number of words of data to be read

- Special Module Write Instruction (WRITE Instruction)

WRITE	S	SL	n2	k

S: first device storing the write data
SL: number of slot where the module is installed
n2: first data position number for writing
k: number of words of data to be written

- Special Module High-Speed Read Instruction (HRD Instruction)

HRD	SL	n1	D	k

SL: number of slot where the module is installed
n1: data position number for the first word of data to be read
D: first device for storing the read data
k: number of words of data to be read

- Special Module High-Speed Write Instruction (HWR Instruction)

HWR	S	SL	n2	k

S: first device for storing the write data
SL: number of slot where the module is installed
n2: first data position number for writing
k: number of words of data to be written

● Interrupt Handling

All input relays (X□□□01 to X□□□32) of the module can be used in interrupt processing. A rising edge in an interrupt input triggers execution of an interrupt program sandwiched between an INTP instruction and an IRET instruction.

INTP	S

IRET

S: input relay raising interrupt

6.2 Accessing from BASIC CPU

The following instructions can be used for accessing the module from a BASIC CPU. For details of each instruction, see “Basic CPU Modules and YM-BASIC/FA Programming Language” (IM 34M06Q22-01E).

Function	Statement Format	Description
Declare use of module	`ASSIGN NC93=SL` SL : slot number	Declares use of a module or CPU module.
Read parameter or status	`ENTER SL,n NOFORMAT;I` SL : slot number n : data position number I : Name of integer or integer array variable for storing read data	Reads the parameter or status at a data position number (n) of the module installed in a slot (SL), and stores it in a variable (I).
Write parameter	`OUTPUT SL,n NOFORMAT;I` SL : slot number n : data position number I : Name of integer or integer array variable storing write data	Overwrites the parameter at a data position number (n) of the module installed in a slot (SL) with the value stored in a variable (I).
Read input relays *1	`STATUS SL,n;P` SL : slot number n : data position no. (101 or 102) P : Name of integer variable for storing read data	Reads the status of input relays of a module that is installed in a slot (SL), and stores it in a variable (P).
Write output relays *2	`CONTROL SL,n;P,M` SL : slot number n : data position no. (101 or 102) P : output data M : mask pattern	Overwrites output relays of a module installed in a slot (SL) with a value stored in a variable (P). The mask pattern (M) allows writing only to selected output relays.

Declare interrupt	`ON INT SL,nn GOSUB {label}`
	`ON INT SL,nn CALL {subprogram}`
	`ON INT SL,nn GOTO {label}`
	SL : slot number
	nn : input relay no.
		Declares branch destination for handling interrupt request from the CPU module.

Clear interrupt declaration	`OFF INT SL,nn` SL : slot number nn : input relay no.	Clears an ON INT statement.

*1: 101 and 102 refer to input relays having data position numbers (X□□□01 to X□□□16) and (X□□□17 to X□□□32) respectively.
*2: 101 and 102 refer to output relays having data position numbers (Y□□□33 to Y□□□48) and (Y□□□49 to Y□□□64) respectively.

● How To Handle 2-Word Data

Before writing long word parameter data to the positioning module, you need to convert it into two words of integer data. Similarly, after reading a two-word parameter from the positioning module into two integer variables, you may need to convert it into long word data. A sample program for these conversions is shown below.

`LDAT` : long-word integer variable to be converted

`IDD, IDU` : integer variables for storing the data after conversion (low word/high word order)

```
100 IDD=VAL("$"+RIGHT$(LHEX$(LDAT),4))
110 IDU=VAL("$"+LEFT$(LHEX$(LDAT),4))
```

`ISD,ISU` : Integer variables storing the two words read (low word/high word order)

`LST` : long-word integer variable after conversion

```
100 LST=VAL(HEX$(ISU)+HEX$(ISD))
```

6.3 Precautions When Reading 2-word Data

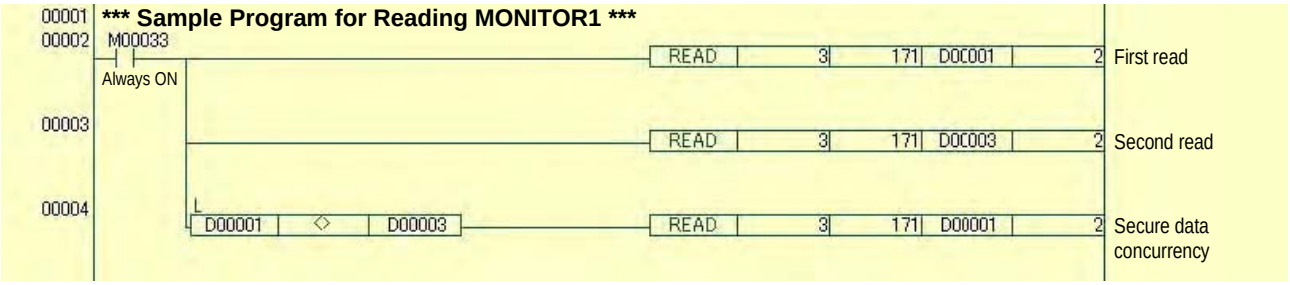
When the CPU module reads 2-word status data (such as MONITOR1) from the positioning module, concurrency of the high-order word and low-order word of 2-word data is not assured due to conflicts between the timing of reading from the CPU module and the data update cycle of the positioning module.

To ensure that the high-order word and low-order word of 2-word data are concurrent when reading from a sequence CPU, use the READ instruction to read the data twice consecutively and verify that the data read are the same in both instances. If the HRD instruction is used, data concurrency is not assured even if you had verified that the data are the same.

Data concurrency cannot be assured when reading from a BASIC CPU.

● Sample Program

This sample program reads MONITOR1 of axis statuses for axis 1 from the positioning module installed in slot 3.



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7. Troubleshooting

This chapter describes how to troubleshoot problems involving the positioning module. The description assumes that the FA-M3 is powered on and the module is correctly mounted.

7.1 Troubleshooting Flowchart

The flowcharts below show how to troubleshoot problems when using the positioning module for different scenarios.

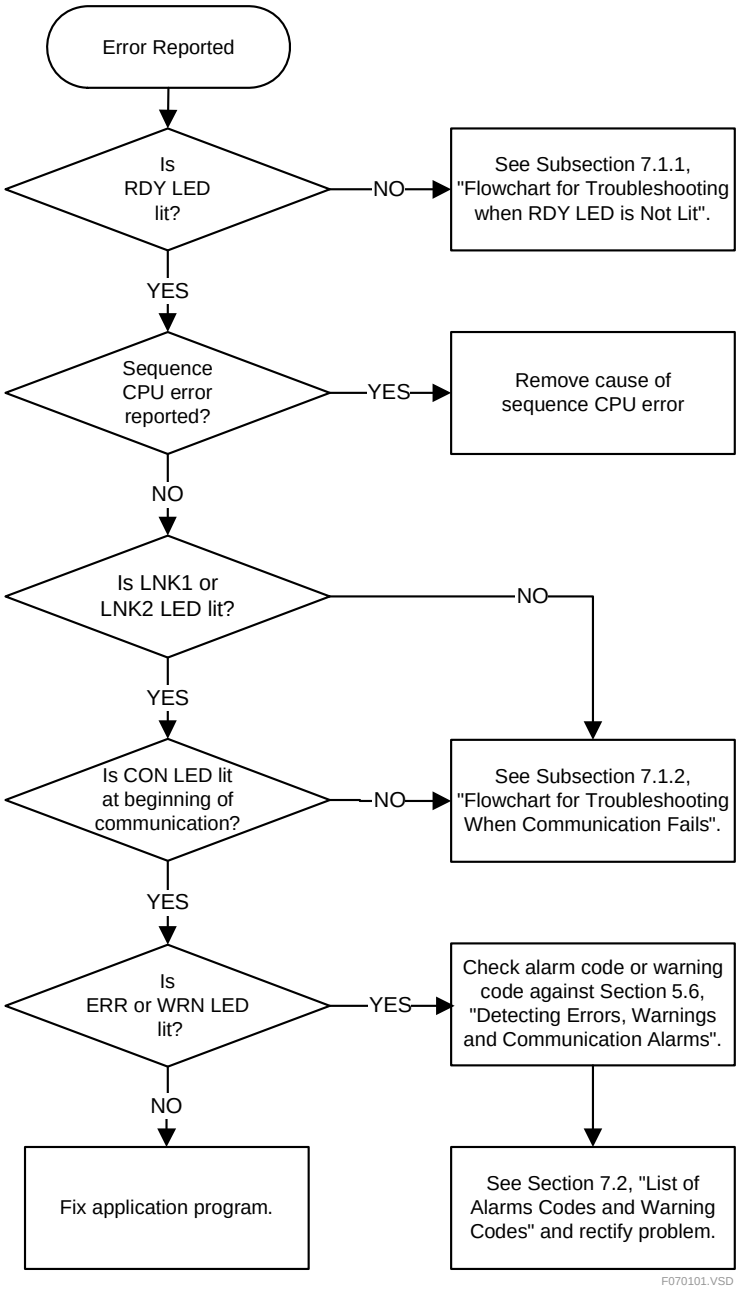

Figure 7.1 Troubleshooting Flowchart

7.1.1 Flowchart for Troubleshooting When RDY LED is Not Lit

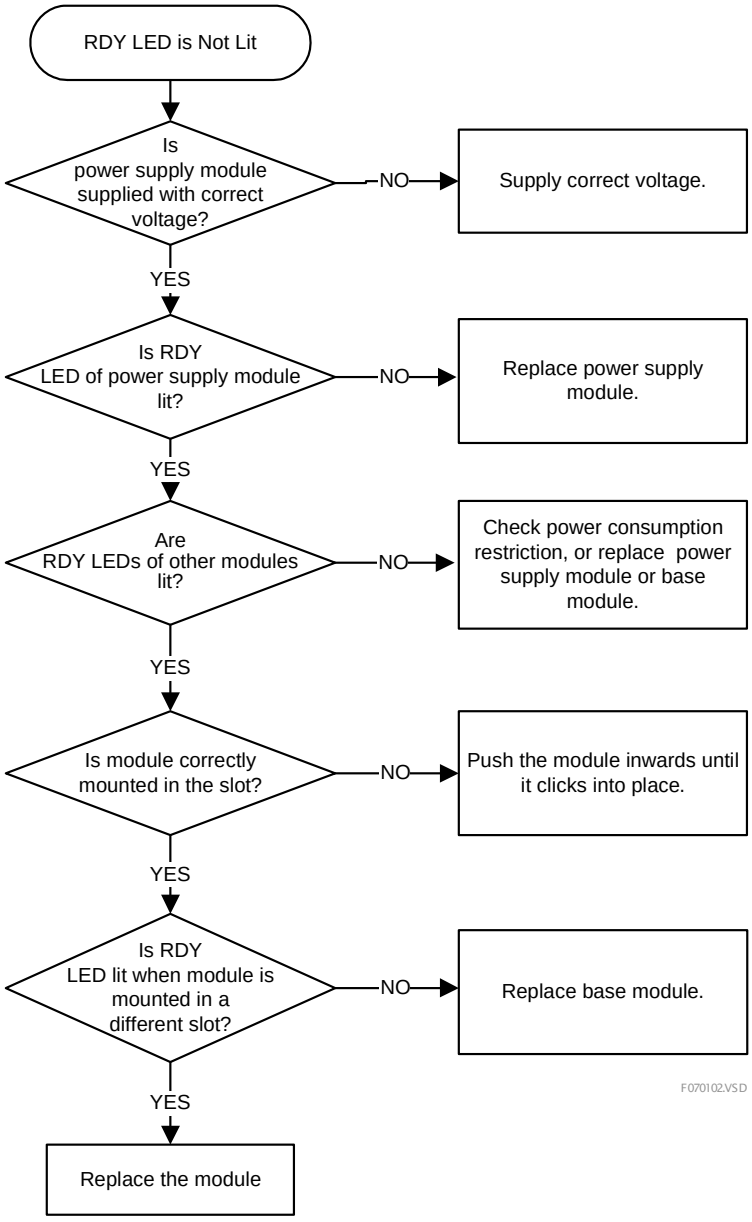

Figure 7.2 Flowchart for Troubleshooting When RDY LED is Not Lit

7.1.2 Flowchart for Troubleshooting When Communication Fails

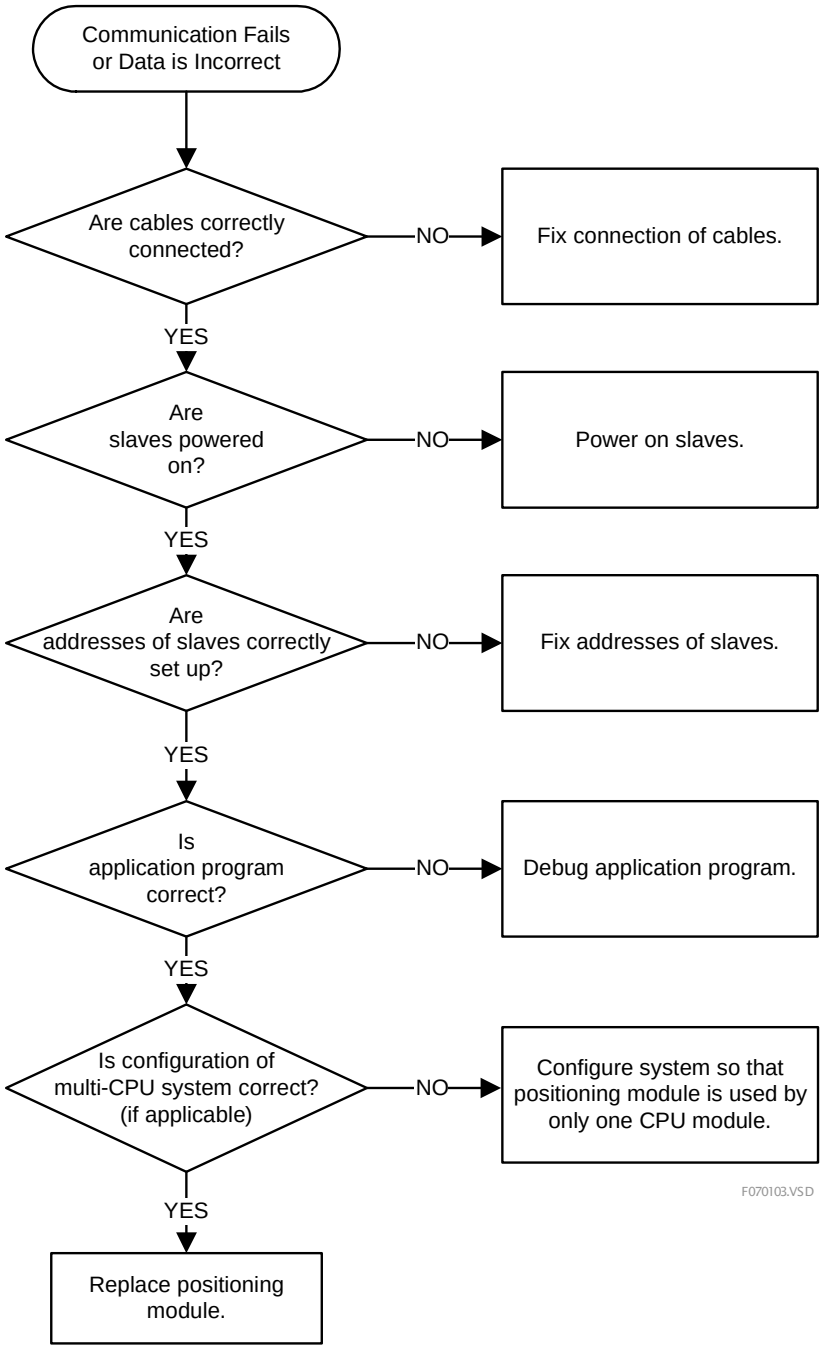

Figure 7.3 Flowchart for Troubleshooting When Communication Fails

7.2 List of Alarm Codes and Warning Codes

7.2.1 Module Alarms

The table below lists codes for alarms and warnings that may be detected by the positioning module.

Table 7.1 List of Module Alarm Codes

Alarm Code (Hex.)	Alarm Name	Possible Causes and Description	Troubleshooting
$80E0	Access driver error	An error was reported by the access driver for MECHATROLINK-III communication.	Check the connection with the external device and its status. (This error normally should not happen.)
$80E1	Disconnected external device	An external device specified in the MECHATROLINK-III communication parameter area is not connected or powered off.	Check the connection of the external device. If no external device is connected, specify it as such in the MECHATROLINK-III communication parameter area.
$80E4	Station address error	The connected external device has the same station address as another external device.	Check the station addresses of connected external devices.
$80E5	Watchdog data error	MECHATROLINK-III synchronization error - WDT data mismatch	Update WDT data at each communication cycle. (This error normally should not happen.)
$80E6	Communication error	MECHATROLINK-III communication error was detected for two consecutive cycles. - Bad contact of cables or connector - Operation error due to noise	- Check connector wiring. - Check communication parameter values. - Adopt measures against noise.
$8095	Command timeout error	MECHATROLINK-III command timeout error - No response was received within the timeout interval (about 10 seconds) after a command was transmitted.	- Check status of external device. - Make sure no unsupported command is sent.
$8101	Parameter setup error	A parameter value specified for an interpolation motion command is out of range.	- Correct invalid parameter value.
$8102	Motion axis error	An interpolation motion command was executed against a moving axis. A Change Speed command or Change Target Position command was executed for an axis while target position change was in progress.	Wait for positioning to complete before executing the Starting Positioning command. Wait for target position change to complete before executing a Change Speed command or Change Target Position command.
$8201	Communication parameter error	MECHATROLINK-III communication parameter setup error	Check MECHATROLINK-III communication parameter settings.

7.2.2 External Device Communication Alarms and Warnings

The table below lists the codes of common communication related alarms and warnings, which may be detected by external devices.

For details of other alarm codes and warning codes, see the respective user's manuals of the external devices.

Table 7.2 List of MECHATROLINK-III Communication Related Alarm Codes

Alarm Code (Hex.)	Alarm Name	Possible Causes and Description	Troubleshooting
$0E50	MECHATROLINK synchronization error	MECHATROLINK-III synchronization error - WDT data mismatch	Update WDT data at each communication cycle. (This error normally should not happen.)
$0E60	MECHATROLINK communication error	MECHATROLINK-III communication error was detected for two consecutive cycles. - Bad contact of cables or connector - Operation error due to noise	- Check connector wiring. - Adopt measures against noise.

Table 7.3 List of MECHATROLINK-III Communication Related Warning Codes

Warning Code (Hex.)	Warning Name	Possible Causes and Description	Troubleshooting
$094☐	Data setup warning	Value specified for MECHATROLINK-III communication is out of range.	Fix specified value.
$095☐	command warning	- Some acceptance condition of a transmitted command is not satisfied. - Transmitted command is not supported.	- Ensure that all acceptance conditions for a transmitted command are satisfied. For details on the acceptance conditions, see the description of each command. - Make sure that no unsupported command is sent.
$0960	MECHATROLINK communication warning	MECHATROLINK-III communication error was detected for one cycle. - Bad cable or connector contact - Operation error due to noise	- Check connector wiring. - Adopt measures against noise.

Note: ☐ denotes a detailed code ($0 to $0F), detailing the cause of a warning.

CAUTION

When the positioning module is notified of an alarm or warning that has been detected by an external machine, it performs no error handling such as issuing a Decelerate & Stop, Stop Immediately or Servo Off command. Such error handling should be implemented by a user application program as required.

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FA-M3
Positioning Module
(with MECHATROLINK-III Interface)

IM 34M06H60-03E 1st Edition

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