Servo / Motion

Programmable Controllers

Quick-Start Guide

Motion Controller
MR-MQ100

Art. No.:
20.04.2010
Version A

Quick-Start Guide
Motion controller MR-MQ100
Art. no.:

Version			Revisions/Additions/Corrections	
A	04/2010	pdp - rw	—	

About This Manual

The texts, illustration, diagrams and examples in this manual are provided for information purposes only. They are intended as aids to help explain the installation, operation, programming and use of the Mitsubishi motion controllers.

If you have any questions about the installation and operation of any of the products described in this manual please contact your local sales office or distributor (see back cover). You can find the latest information and answers to frequently asked questions on our website at www.mitsubishi-automation.com.

MITSUBISHI ELECTRIC EUROPE BV reserves the right to make changes to this manual or the technical specifications of its products at any time without notice.

Related Manuals

The following manuals are also related to this Quick-Start Guide. These can be obtained free of charge from our website at www.mitsubishi-automation.com.

Device	Manual Name	Manual Number/ Art. No.
Motion controller	MR-MQ100 Motion controller Users Manual This manual describes the hardware specifications, the software specifications and handling methods of the Motion controller.	IB-0300150
	Q173DCPU/Q172DCPU Motion controller Programming Manual (COMMON) This manual explains the Multiple CPU system configuration, performance specifications, common parameters, auxiliary/applied functions, error lists and others.	IB-0300134
	Q173DCPU/Q172DCPU Motion controller (SV13/SV22) Programming Manual (Motion SFC) This manual explains the functions, programming, debugging, error lists for Motion SFC and others.	IB-0300135
	Q173DCPU/Q172DCPU Motion controller (SV13/SV22) Programming Manual (REAL MODE) This manual explains the servo parameters, positioning instructions, device lists, error lists and others.	IB-0300136
	Q173DCPU/Q172DCPU Motion controller (SV22) Programming Manual (VIRTUAL MODE) This manual explains the dedicated instructions to use the synchronous control by virtual main shaft, mechanical system program create mechanical module, servo parameters, positioning instructions, device lists, error lists and others.	IB-0300137
	Motion Controller Setup Guidance (for MR-MQ100) (MT Developer2 Version 1) This manual describes those items related to the setup of the motion controller programming software MT Developer2 (for MR-MQ100).	IB-0300152
Servo amplifier	SSCNET III Compatible MR-J3-□B Servo amplifier Instruction Manual This manual explains the I/O signals, parts names, parameters, start-up procedure and others for MR-J3-□B Servo amplifier.	SH-030051
	SSCNET III Compatible Linear Servo MR-J3-□B-RJ004 Servo amplifier Instruction Manual This manual explains the I/O signals, parts names, parameters, start-up procedure and others for Linear Servo MR-J3-□B-RJ004 Servo amplifier.	SH-030054
	SSCNET III Compatible Fully Closed Loop Control MR-J3-□B-RJ006 Servo amplifier Instruction Manual This manual explains the I/O signals, parts names, parameters, start-up procedure and others for Fully Closed Loop Control MR-J3-□B-RJ006 Servo amplifier.	SH-030056

Safety Guidelines

General safety information and precautions

For use by qualified staff only

This manual is only intended for use by properly trained and qualified electrical technicians who are fully acquainted with the relevant automation technology safety standards. All work with the hardware described, including system design, installation, configuration, maintenance, service and testing of the equipment, may only be performed by trained electrical technicians with approved qualifications who are fully acquainted with all the applicable automation technology safety standards and regulations. Any operations or modifications to the hardware and/or software of our products not specifically described in this manual may only be performed by authorised MITSUBISHI ELECTRIC staff.

Proper use of the products

The motion controller is only intended for the specific applications explicitly described in this manual. All parameters and settings specified in this manual must be observed. The products described have all been designed, manufactured, tested and documented in strict compliance with the relevant safety standards. Unqualified modification of the hardware or software or failure to observe the warnings on the products and in this manual may result in serious personal injury and/or damage to property. Only peripherals and expansion equipment specifically recommended and approved by MITSUBISHI ELECTRIC may be used in combination with programmable controllers of MELSEC System Q.

All and any other uses or application of the products shall be deemed to be improper.

Relevant safety regulations

All safety and accident prevention regulations relevant to your specific application must be observed in the system design, installation, configuration, maintenance, servicing and testing of these products. The regulations listed below are particularly important in this regard.

This list does not claim to be complete, however; you are responsible for being familiar with and conforming to the regulations applicable to you in your location.

- VDE Standards
  - VDE 0100
    Regulations for the erection of power installations with rated voltages below 1000 V
  - VDE 0105
    Operation of power installations
  - VDE 0113
    Electrical installations with electronic equipment
  - VDE 0160
    Electronic equipment for use in power installations
  - VDE 0550/0551
    Regulations for transformers
  - VDE 0700
    Safety of electrical appliances for household use and similar applications
  - VDE 0860
    Safety regulations for mains-powered electronic appliances and their accessories for household use and similar applications.

- Fire safety regulations
- Accident prevention regulations
  - VBG Nr.4
    Electrical systems and equipment

Safety warnings in this manual

In this manual warnings that are relevant for safety are identified as follows:

DANGER:

Failure to observe the safety warnings identified with this symbol can result in health and injury hazards for the user.

WARNING:

Failure to observe the safety warnings identified with this symbol can result in damage to the equipment or other property.

Specific safety information and precautions

The following safety precautions are intended as a general guideline for using PLC systems together with other equipment. These precautions must always be observed in the design, installation and operation of all control systems.

DANGER:

- ***Observe all safety and accident prevention regulations applicable to your specific application. Always disconnect all power supplies before performing installation and wiring work or opening any of the assemblies, components and devices.***
- ***Assemblies, components and devices must always be installed in a shockproof housing fitted with a proper cover and fuses or circuit breakers.***
- ***Devices with a permanent connection to the mains power supply must be integrated in the building installations with an all-pole disconnection switch and a suitable fuse.***
- ***Check power cables and lines connected to the equipment regularly for breaks and insulation damage. If cable damage is found immediately disconnect the equipment and the cables from the power supply and replace the defective cabling.***
- ***Before using the equipment for the first time check that the power supply rating matches that of the local mains power.***
- ***Take appropriate steps to ensure that cable damage or core breaks in the signal lines cannot cause undefined states in the equipment.***
- ***You are responsible for taking the necessary precautions to ensure that programs interrupted by brownouts and power failures can be restarted properly and safely. In particular, you must ensure that dangerous conditions cannot occur under any circumstances, even for brief periods.***
- ***EMERGENCY OFF facilities conforming to EN 60204/IEC 204 and VDE 0113 must remain fully operative at all times and in all PLC operating modes. The EMERGENCY OFF facility reset function must be designed so that it cannot ever cause an uncontrolled or undefined restart.***
- ***You must implement both hardware and software safety precautions to prevent the possibility of undefined control system states caused by signal line cable or core breaks.***
- ***When using modules always ensure that all electrical and mechanical specifications and requirements are observed exactly.***
- ***Residual current protective devices pursuant to DIN VDE Standard 0641 Parts 1-3 are not adequate on their own as protection against indirect contact for installations with PLC systems. Additional and/or other protection facilities are essential for such installations.***
- ***Do not install/remove the module onto/from base unit or terminal block more than 50 times, after the first use of the product (conforming to IEC 61131-2). Failure to do so may cause the module to malfunction due to poor contact of connector.***

Precautions to prevent damages by electrostatic discharge

Electronic devices and modules can be damaged by electrostatic charge, which is conducted from the human body to components of the controller. Always take the following precautions, when handling the controller or other electronic devices:

WARNING:

- ***Before touching the controller or other electronic devices, always touch grounded metal, etc. to discharge static electricity from human body.***
- ***Wear isolating gloves when touching the powered controller or other electronic devices, e. g. at maintenance during visual check.***
- ***You shouldn't wear clothing made of synthetic fibre at low humidity. This clothing gets a very high rate of electrostatic charge.***

Screenshots and Software version

All screenshots in this manual were captured with versions of the programming software listed in section 4.2.1 running under Windows XP.

Slight modifications could occur in case of newer software versions.

Typographic Conventions

Use of notes

Notes containing important information are clearly identified as follows:

NOTE | Note text

Use of examples

Examples containing important information are clearly identified as follows:

Beispiel ▽ Example text △

Numbering in figures and illustrations

Reference numbers in figures and illustrations are shown with white numbers in a black circle and the corresponding explanations shown beneath the illustrations are identified with the same numbers, like this:

❶ ❷ ❸ ❹

Procedures

In some cases the setup, operation, maintenance and other instructions are explained with numbered procedures. The individual steps of these procedures are numbered in ascending order with black numbers in a white circle, and they must be performed in the exact order shown:

① Text.

② Text.

③ Text.

Footnotes in tables

Footnote characters in tables are printed in superscript and the corresponding footnotes shown beneath the table are identified by the same characters, also in superscript.

If a table contains more than one footnote, they are all listed below the table and numbered in ascending order with black numbers in a white circle, like this:

① Text

② Text

③ Text

Table of Contents

1 Introduction

This english document is the original instruction.

This start-up guidance is intended for those who use the MR-MQ100 Single Axis Motion Controller (1.5 Axis Servo) for the first time. How to use programming tool MT Developer2 and MR Configurator will be explained.

Refer to our MR-MQ100 manuals for further information.

(For manual numbers see preamble of this quick start guide.)

1.1 Features of MR-MQ100

The MR-MQ100 allows a single axis to be completely controlled and synchronised to a separate encoder or virtual axis with no additional controller hardware. A complete range of essential functions are available, including encoder and virtual axis synchronization, mark registration, point to point positioning and user defined cam profiles. In addition, the hardware complements these powerful software features with built-in I/O and SSCNET III motion networking capability. The controller has as standard an Ethernet port for communication to HMI and PLC, like Q-PLC, FX-PLC and 3rd party products.

With the intuitive MT Developer2 software abstract programming is replaced with graphical models of the actual mechanical system. It's easy to create virtual clutches, gears and cam profiles by simple drag and drop selection.

Main applications are:

- Flying saws
- Labelling
- Rotary cutters
- Form, fill & seal/pillow packaging
- Plus many more

1.1.1 Components of the motion control system with MR-MQ100

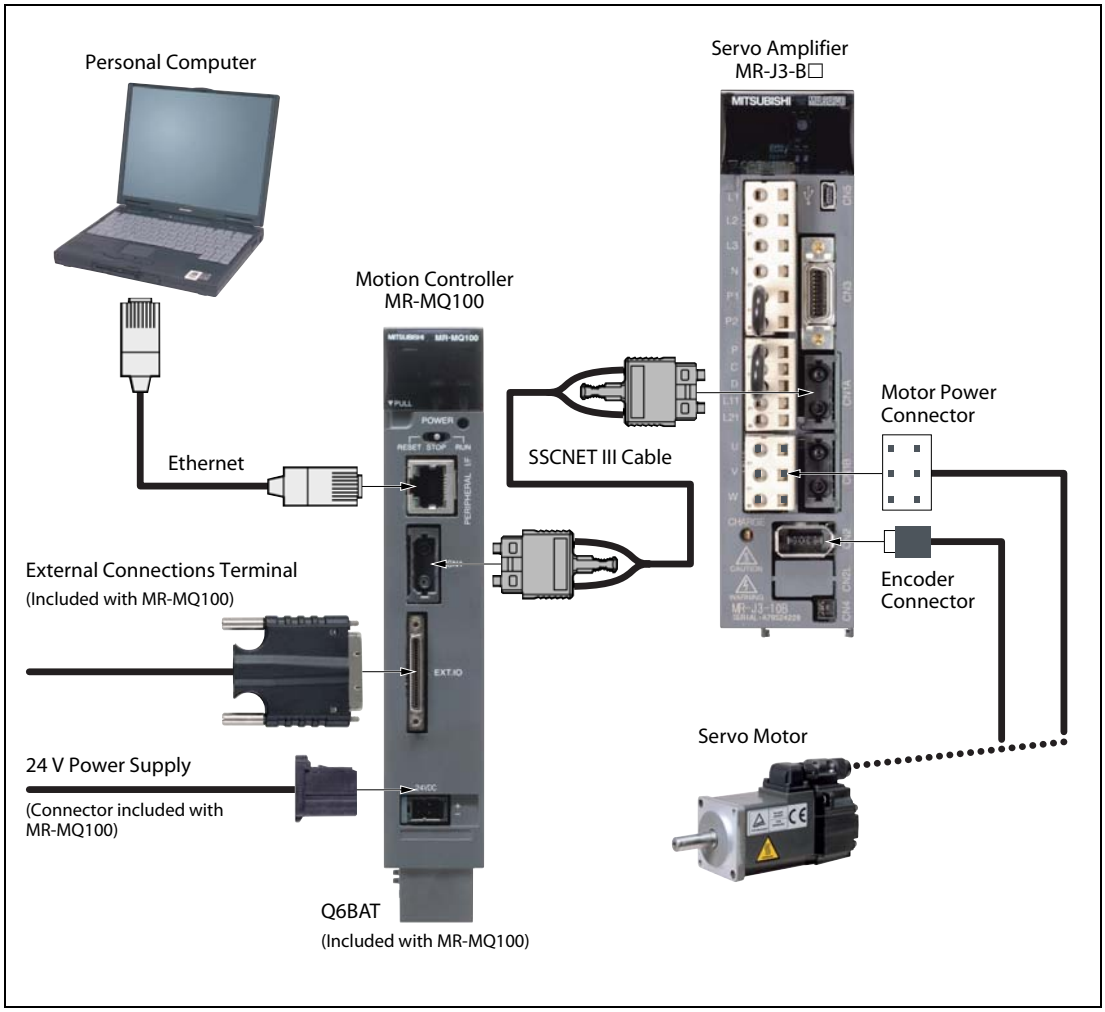


Fig. 1-1: *System components*

1.2 Specifications

Items	Specification
Power Supply	24V DC +/– 10 % (Required Current Capacity 400mA)
Max. input current	690 mA
Power consumption	16.6 W
Mass [kg]	0.7
Dimensions [mm]	178 (H) x30 (W) x 135 (D)
Digital Inputs (Mark detection)	4 Inputs (24V DC)
Digital Outputs	2 Outputs (24V DC)
Synchronous Encoder	• A/B-phase pulse train • Open-collector-type: up to 800 kpps, up to 10 m • Differential-type: up to 1 Mpps, up to 30 m
Peripheral Interface	100/10 Mbps Ethernet
Connectable servo amplifier	MR-J3-B Servo amplifier over SSCNET III
Memory back up	Q6BAT (included with MR-MQ100)

Tab. 1-1: *MR-MQ100 General specifications*

Item	Specification
Number of controlled axis	1 Axis
Operation cycle	0.44 ms/1 axis
Interpolation functions	None
Control modes	PTP (Point to Point) control, Speed control, Speed-position control①, Fixed-pitch feed, Constant speed control, Position follow-up control, Speed control with fixed position stop, Speed switching control, High-speed oscillation control, Synchronous control
Acceleration/deceleration control	Automatic trapezoidal acceleration/deceleration, S-curve acceleration/deceleration
Compensation	Backlash compensation, Electronic gear, Phase compensation
Programming language	Motion SFC, Dedicated instruction, Mechanical support language (SV22)
Servo program capacity	16k steps
Number of positioning points	3 200 points (Positioning data can be designated indirectly)
Home position return function	Proximity dog type (2 types), Count type (3 types), Data set type (2 types), Dog cradle type, Stopper type (2 types), Limit switch combined type (Home position return re-try function provided, home position shift function provided)
JOG operation function	Provided
Manual pulse generator operation function	Possible to connect 1 module②
Synchronous encoder operation function	Possible to connect 1 modules (incremental only)②
M-code function	M-code output function provided, M-code completion wait function provided
Limit switch output function	Number of output points 32 points Watch data: Motion control data/Word device
ROM operation function	Provided
Absolute position system	Made compatible by setting battery to servo amplifier. (Possible to select the absolute data method or incremental method for each axis)
Number of SSCNET III systems③	1 system
Motion related interface module	None
External input signal	The input signal of the servo amplifier is used. (FLS, RLS, DOG)
High-speed reading of specified data	Provided (Via internal I/F input module)
Mark detection function	Provided
Clock Function	Provided
Security function	"Write Protection" or "Read/Write Protection" can be set for "Motion SFC program", "Servo program", "Mechanical system program" and "CAM data".
All clear function	Provided
Remote Operation	Remote RUN/STOP, Remote latch clear
Digital Oscilloscope function	Provided
Mixed Function of Virtual Mode/ Real Mode	None

Tab. 1-2: *MR-MQ100 Motion Control specifications*

① "CHANGE" signal of Speed-position control comes from the servo amplifier.

② Either a "Manual pulse generator" or "Incremental synchronous encoder" can be used.

③ Only SSCNET III based MR-J3 series servo amplifier can be used.

Item				Specification
Motion SFC program capacity	Code total (Motion SFC chart + Operation control + Transition)			543k bytes
	Text total (Operation control + Transition)			484k bytes
Motion SFC program	Number of Motion SFC programs			256 (No. 0 to 255)
	Motion SFC chart size/program			Up to 64k bytes (Included Motion SFC chart comments)
	Number of Motion SFC steps/program			Up to 4 094 steps
	Number of selective branches/branch			255
	Number of parallel branches/branch			255
	Parallel branch nesting			Up to 4 levels
Operation control program (F/FS) / Transition program (G)	Number of operation control programs			4 096 with F (Once execution type) and FS(Scan execution type) combined. (F/FS0 to F/FS4 095)
	Number of transition programs			4 096 (G0 to G4 095)
	Code size/program			Up to approx. 64k bytes (32 766 steps)
	Number of blocks(line)/program			Up to 8 192 blocks (in the case of 4 steps(min)/blocks)
	Number of characters/block			Up to 128 (comment included)
	Number of operand/block			Up to 64 (operand: constants, word device, bit devices)
	( ) nesting/block			Up to 32 levels
	Descriptive expression	Operation control program		Calculation expression/bit conditional expression
		Transition program		Calculation expression/bit conditional expression/comparison conditional expression
Execute specification	Number of multi execute programs			Up to 256
	Number of multi active steps			Up to 256 steps/all programs
	Executed task	Normal task		Execute in main cycle of motion controller
		Event task (Execution can be masked.)	Fixed cycle	Execute in fixed cycle (0.44ms, 0.88ms, 1.77ms, 3.55ms, 7.11ms, 14.2ms)
I/O (X,Y) points				8 192 points
I/O (PX, PY) points				Internal I/F (Input 4 points, Output 2 points)
Number of devices (Devices in the Motion controller only) (Positioning dedicated devices are included)	Internal relays		(M)	12 288 points
	Link relays		(B)	8 192 points
	Annunciators relays		(F)	2 048 points
	Special relays		(SM)	2 256 points
	Data registers		(D)	8 192 points
	Link registers		(W)	8 192 points
	Special registers		(SD)	2 256 points
	Motion registers		(#)	12 288 points
	Coasting timers		(FT)	1 point (888 µs)
	Multiple CPU area device			None

Tab. 1-3: *MR-MQ100 Motion SFC Performance specifications*

Item			Specification	
Number of control axes			1 axis	
Control method			Synchronous control, PTP (Point to Point) control, speed control, fixed-pitch feed, constant-speed control, position follow-up control, speed-switching control	
Control units	Drive module		Virtual servomotor	PLS
			Synchronous encoder	
	Output module		Roller	mm, inch
			Ball screw	
			Rotary table	Fixed as "degree"
			Cam	mm, inch, PLS
Program language			Dedicated instructions (Servo program + mechanical system program)	
Servo program	Capacity		16k steps (14 334 steps)①	
	Number of positioning points		Total of 3 200 points (It changes with programs, indirect specification is possible.)	
Mechanical system program			**Number of modules which can be set per CPU**	
	Drive modules	Virtual module	3 axes	
		Synchronous encoder	1 axis	
	Virtual axes	Main shaft	1	
		Auxiliary input axis	1	
	Transmission modules	Gear	2	
		Clutch	2	
		Speed change gear	2	
		Differential gear	1	
		Differential gear to main shaft	1	
	Output modules	Roller	1	Total of 1
		Ball screw	1	
		Rotary table	1	
		Cam	1	
Cam	Types		Up to 256②	
	Resolution per cycle		256 • 512 • 1 024 • 2 048②	
	Memory capacity		132k bytes	
	Storage memory for cam data		CPU internal RAM memory	
	Stroke resolution		32 767	
	Control mode		Two-way cam/feed cam	

Tab. 1-4: *MR-MQ100 Mechanical system program specifications (1)*

Item			Specification	
Virtual servomotor	Control methods		PTP (Point to Point) control, speed control, fixed-pitch feed, constant-speed control, position follow-up control	
	Positioning	Method	PTP control: Selection of absolute or incremental data method Fixed-pitch feed: Incremental data method Constant-speed control: Both absolute and incremental data method can be used together Position follow-up control: Absolute data method	
		Position command	Address setting range: –2 147 483 648 to 2 147 483 647 [PLS]	
		Speed command	Speed setting range: 1 to 2 147 483 647 [PLS/s]	
	Acceleration/ deceleration control	Automatic trapezoidal acceleration/ deceleration	**Acceleration-fixed acceleration/deceleration**	**Time-fixed acceleration/deceleration**
			Acceleration time: 1 to 65 535 [ms]	Acceleration/deceleration time: 1 to 5 000 [ms] (Only constant-speed control is possible.)
			Deceleration time: 1 to 65 535 [ms]	
		S-curve acceleration/ deceleration	S-curve ratio : 0 to 100 [%]	
	JOG operation function		Provided	
	M-function (with mode)		M-code output function provided, M-code complete wait function provided	
	Manual pulse generator operation function (Test mode only)		1 unit can be connected. Setting of magnification: 1 to 10 000 Setting of smoothing magnification provided.	

Tab. 1-4: *MR-MQ100 Mechanical system program specifications (2)*

① Capacity matching the servo program for real mode.

② Relation between a resolution per cycle of cam and type are shown below.

Resolution per cycle	Type
256	256
512	128
1 024	64
2 048	32

1.3 Terminology

The terms and abbreviations below are important for motion controllers and are used frequently in this guide.

Direction of rotation of electric motors

The direction (or sense) of rotation of electric motors is defined looking at the end of the motor shaft.

Direction of rotation is described as:

- Clockwise/Reverse

or

- Counterclockwise/Forward

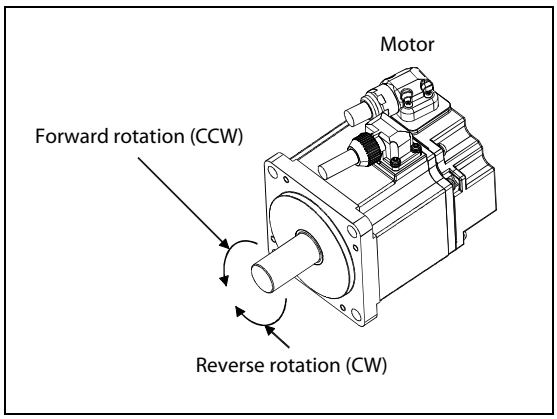


Fig. 1-2: *Direction of rotation*

Abbreviations

–	FLS	Upper stroke limit
–	RLS	Lower stroke limit
–	STOP	Stop signal
–	DOG	Proximity dog
–	EMI	Emergency signal input
–	CW	Clockwise
–	CCW	Counterclockwise
–	SSCNET III	Optical bus system for data communication

2 Details of the module

2.1 Overview

2.1.1 Frontview, sideview and partnames

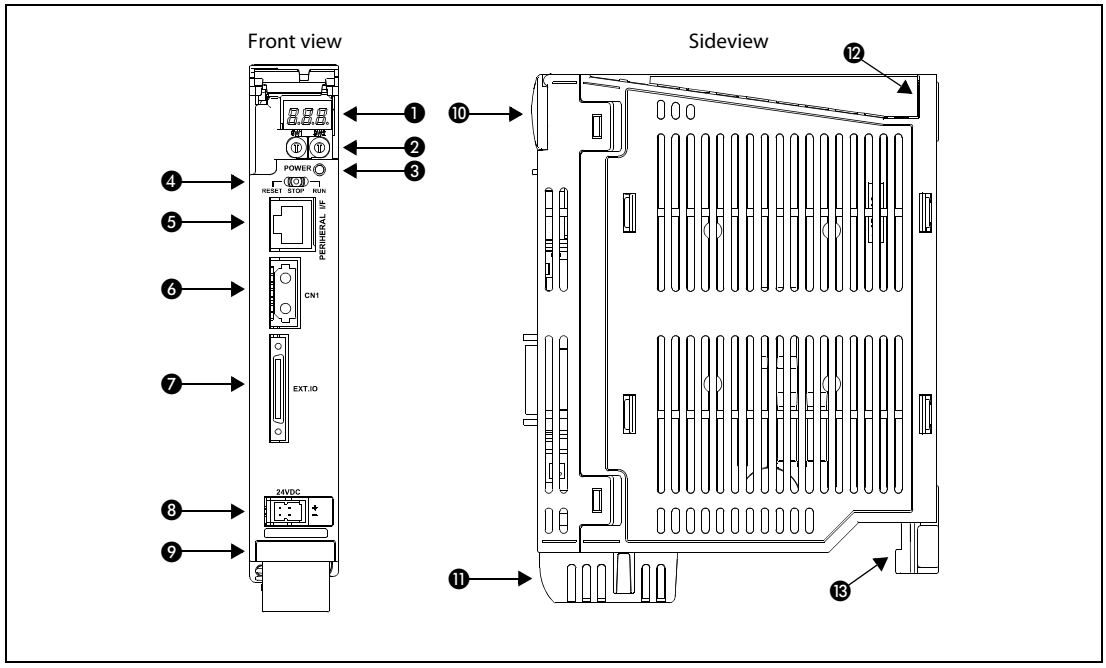


Fig. 2-1: *MR-MQ100*

WARNING:
Close the clear cover (⓾), after using the rotary switches.

No.	Name	Application
❶	7-segment LED	Indicates the operating status and error information.
❷	Rotary function select 1 switch (SW1) Rotary function select 2 switch (SW2)	• Set the operation mode. (Normal operation mode, Installation mode, Mode operated by ROM, etc) • Each switch setting is 0 to F. (Shipped from the factory in SW1 "0", SW2 "0" position)
❸	POWER LED	ON (Red): The internal power (5 V DC) is on. OFF: The internal power (5 V DC) is off.
❹	RUN/STOP/RESET switch	• Move to RUN/STOP RUN: Motion SFC program is started. STOP: Motion SFC program is stopped. • RESET (Momentary switch) Set the switch to the "RESET" position 1 second or more to reset the hardware
❺	PERIPHERAL I/F connector	For communication I/F with peripherals. (Ethernet connector) • The upper LED of the connector for PERIPHERAL I/F. Remains flashing: It communicates with the personal computer. OFF: It doesn't communicate with the personal computer. • The lower LED of the PERIPHERAL I/F connector ON: 100Mbps OFF: 10Mbps
❻	SSCNET III connector	Connector to connect the servo amplifier
❼	Internal I/F connector	Incremental synchronous encoder input, the signal is input, the signal is output. Incremental synchronous encoder input has Differential-output type, Voltage-output/ Open-collector type.
❽	24 V DC power supply connector	The DC power of 24 V DC is connected.
❾	Serial number display plate	The serial number written on the rating plate is displayed.
❿	Cover	Transparent cover for 7-segment LED and for rotary switches SW1 and SW2
⓫	Battery holder	Battery holder to set the Q6BAT/ Q7BAT
⓬	Hole for module fixing screw	Screw used to fix to the control box. (M5 screw)
⓭	FG terminal (Terminal for earth)	Earth terminal which is connected to shield patterns on the print circuit board.

Tab. 2-1: *Description of the partnames in fig. 2-1.*

NOTE

For more details of the partnames and status LEDs please refer to the user's manual of the motion controller MR-MQ100.

2.1.2 System configuration

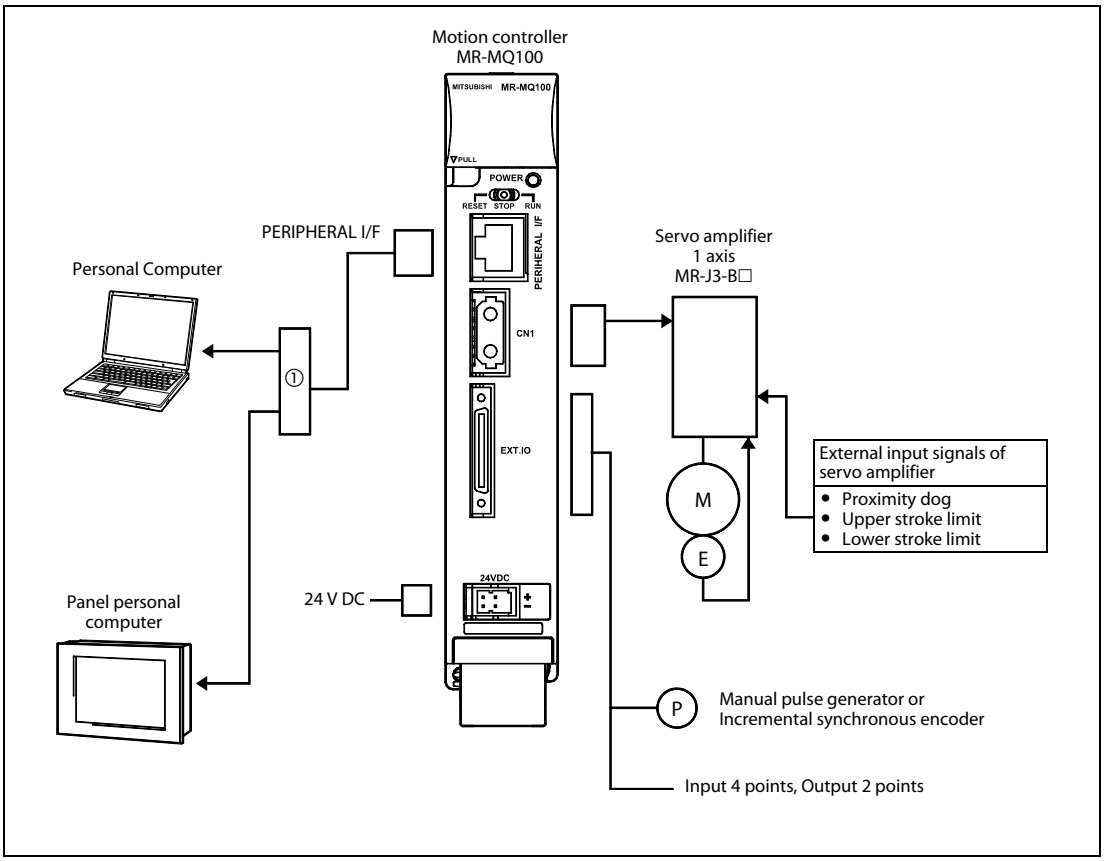


Fig. 2-2: *MR-MQ100 System overall configuration*

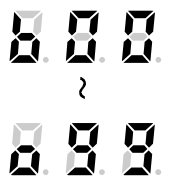
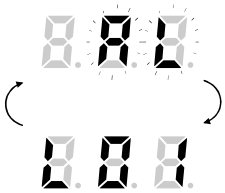
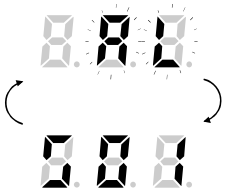
① Up to 16 different equipments can access to a single motion controller.

NOTE The latest operating system software "SW9DNC-SV22QW" is preinstalled in the MR-MQ100. There is no need for customer installation.

WARNING:

- ***Construct a safety circuit externally of the motion controller or servo amplifier if the abnormal operation of the motion controller or servo amplifier differ from the safety directive operation in the system.***
- ***The ratings and characteristics of the parts (other than motion controller, servo amplifier and servomotor) used in a system must be compatible with the motion controller, servo amplifier and servomotor.***
- ***Set the parameter values to those that are compatible with the motion controller, servo amplifier, servomotor and regenerative resistor model and the system application. The protective functions may not function if the settings are incorrect.***
- ***The motion controller does not have a forced stop input, therefore the forced stop function on the servo amplifier should be used.***

2.1.3 7-segment LED display

Item		7-segment LED		Remark
Start			Initializing	It takes about 10 seconds to initialize (RUN/STOP display). Execute the power cycle of the motion controller if the operation stopped at initializing. It may be motion controller's hardware fault when it is not improved. Explain the error symptom (LED display) and get advice from our sales representative for the modules with failure.
Normal			"∗" remains flashing	Normal operation
Installation mode			Steady "INS" display, "∗" remains flashing	Mode for installing operating system software via personal computer.
Operation mode	Mode operated by RAM		"∗" remains flashing	Mode for operating based on user programs and parameters stored in the SRAM built-in motion controller.
	Mode operated by ROM		Steady "INS" display, "∗" remains flashing	Mode for operating after the user programs and parameters stored in the FLASH ROM built-in motion controller are read to the SRAM built-in motion controller.
STOP			Steady "STP" display	Stopped the Motion SFC program.
RUN			Steady "RUN" display	Executed the Motion SFC program.
Battery error	Early stage warning (2.7 V or less)		Steady "BT1" display	Displayed at battery voltage 2.7 V or less.
	Final stage warning (2.5 V or less)		Steady "BT2" display	Displayed at battery voltage 2.5 V or less.
System setting error			"AL" flashes 3 times ↓ Steady "L01" display	System setting error of the motion controller. Refer to the "Q173DCPU/Q172DCPU Motion controller Programming Manual (COMMON)" for details.
Servo error			"AL" flashes 3 times ↓ Steady "S01" display	Motion controller servo error. Refer to the "Q173DCPU/Q172DCPU Motion controller (SV13/SV22) Programming Manual (REAL MODE)" or "Q173DCPU/Q172DCPU Motion controller (SV22) Programming Manual (VIRTUAL MODE)" for details.
WDT error			Steady "…" display	Hardware fault or software fault. Refer to the "Q173DCPU/Q172DCPU Motion controller (SV13/SV22) Programming Manual (REAL MODE)" or "Q173DCPU/Q172DCPU Motion controller (SV22) Programming Manual (VIRTUAL MODE)" for details.

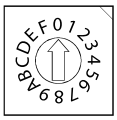
Tab. 2-2: *The LED displays/flashes in the combination with errors*

NOTES

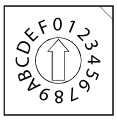
When an error is displayed on the 7-segment LED, confirm the error number etc. using MT Developer2.

Refer to the motion controller error batch monitor of MT Developer2 or error list of the programming manual for error details.

2.1.4 Rotary switch assignment

Rotary switch	Setting①	Mode	Description
	0	Normal mode	Normal operation mode
	A	Installation mode	When installing the operating system software using MT Developer2

Tab. 2-3: *Rotary function select switch 1 (SW1)*

Rotary switch	Setting①	Mode	Description
	0	Mode operated by RAM	Normal operation mode (Operation by the setting data and parameters stored in the motion controller's SRAM.)
	6	Mode operated by ROM	Mode to operate based on the setting data and the parameters written to the motion controller's FLASH ROM.
	8	Ethernet IP address display mode	Ethernet Internet Protocol address display mode.
	C	SRAM clear	SRAM "0" clear

Tab. 2-4: *Rotary function select switch 2 (SW2)*

NOTE

Be sure to turn OFF the motion controller power supply before the rotary switch setting change.

2.1.5 Operation mode

Rotary switch setting①		Operation mode
SW1	SW2	
A	Any setting (Except C)	Installation mode
0	0	Mode operated by RAM
0	6	Mode operated by ROM
0	8	Ethernet IP address display mode
Any setting	C	SRAM clear②

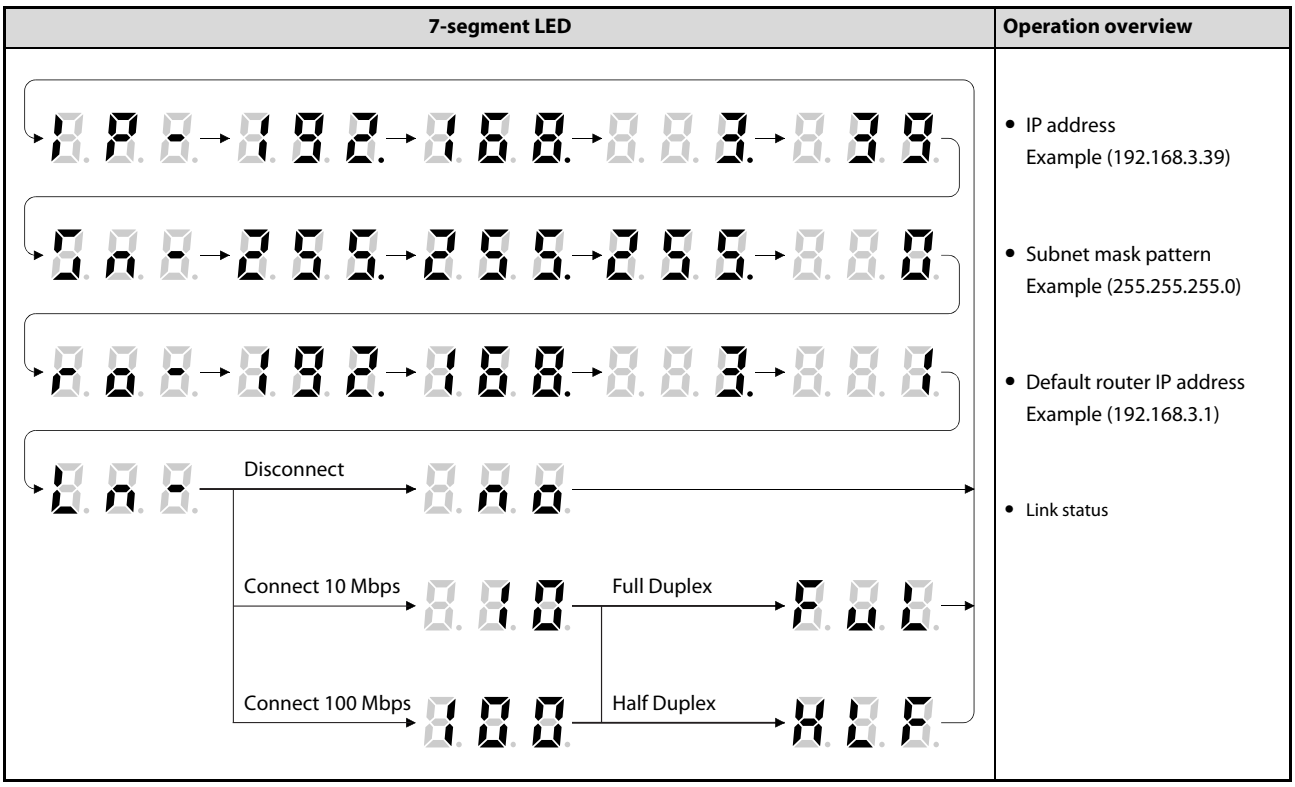
Tab. 2-5: *Rotary switch setting and operation mode*

① Not to be set except above setting.

② The programs, parameters, absolute position data, and latch data built-in motion controller are cleared.

Operation mode	7-segment LED	Operation overview
Mode operated by RAM		• "∗" remains flashing in the first digit of 7-segment LED. • Operates based on the user program and parameters stored in the SRAM of the motion controller.
Mode operated by ROM		• "∗" remains flashing in the first digit and steady "•" display in the second digit of 7-segment LED. • Operation starts after the user programs and parameters stored in the motion controller's FLASH ROM are read to the SRAM built-in motion controller at power supply on or reset of the motion controller. • If the ROM writing is not executed, even if the user programs and parameters are changed using the MT Developer2 during mode operated by ROM, operation starts with the contents of the FLASH ROM at next power supply on or reset. • Also, If the ROM writing is not executed, even if the auto tuning data are reflected on the servo parameter of the motion controller by operation in the auto-tuning setting, operation starts with the contents of the FLASH ROM at next power on or reset.
Ethernet IP address display mode	—	• Refer to tab. 2-7 "Ethernet IP address display mode overview". • Digital oscilloscope function cannot be used.
SRAM clear		• "∗" remains flashing in the first digit and steady. • When rotary switch 2 is set to "C", and a power ON is done, the SRAM area is cleared. • The programs, parameters, absolute position data, and latch data in the motion controller are cleared.
Installation mode		• Steady "INS" display at the 7-segment LED. • Operating system software can be installed. • STOP status is maintained regardless of the RUN/STOP/RESET switch position on the front side of Motion controller. • Digital oscilloscope function cannot be used.

Tab. 2-6: *Operation mode overview*



Tab. 2-7: *Ethernet IP address display mode overview*

NOTES

When the Ethernet parameters are not written in the Motion controller , the address is displayed as follows.

- IP address: 192.168.3.39
- Subnet mask pattern: 255.255.255.0
- Default router IP address: 192.168.3.1

Be sure to turn OFF the Motion controller power supply before a rotary switch setting change.

3 Mounting and Wiring

3.1 Module mounting into cabinet

3.1.1 Mounting of MR-MQ100

Keep the clearances shown below between the top/bottom faces of the module and other structures or parts to ensure good ventilation and facilitate module replacement.

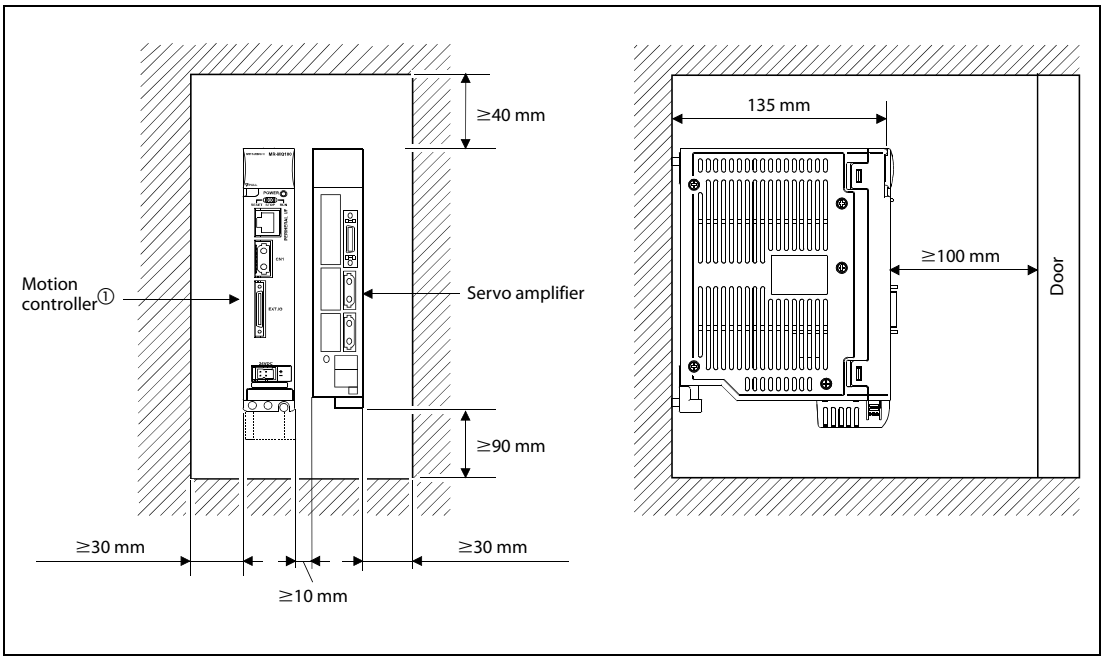


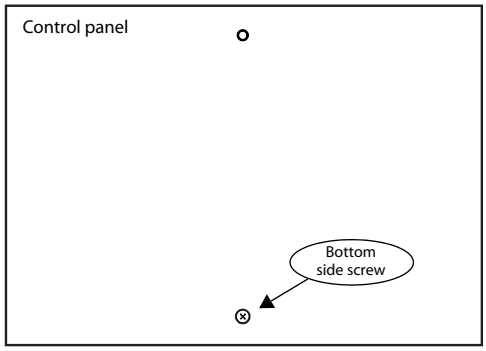
Fig. 3-1: *Module mounting position*

① Fit the Motion controller at the left side of the servo amplifier.

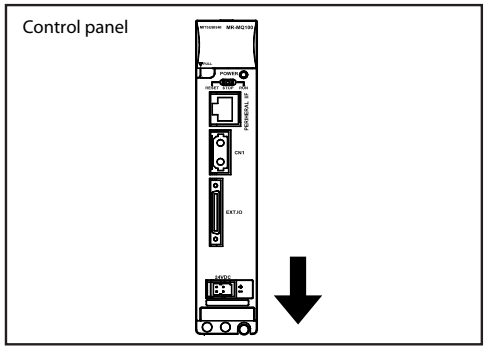
Mounting method for the motion controller

WARNING:

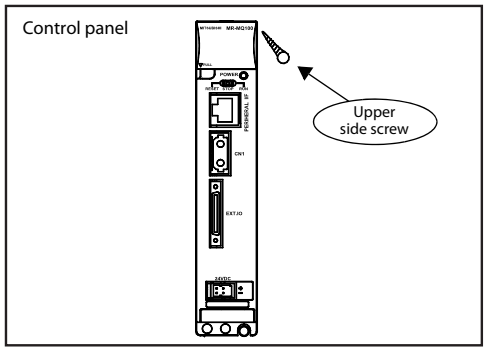
Completely turn off the externally supplied power used in the system before installation or removing the module. Not doing so could result in electric shock or damage to the product.



① Fit the holes for the bottom mounting screws of the Motion controller into the panel. Temporarily fasten the bottom side screw.



② Place the bottom side notch of the Motion controller onto the bottom side screw.

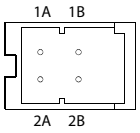


③ Fit the mounting screw into the upper side hole of the Motion controller.

④ Retighten all the mounting screws using the allowed torque.

3.2 Wiring

3.2.1 Power supply

Connector layout	Pin No.	Signal name	Pin No.	Signal name
	1A	Not connected	1B	24V(+)
	2A	Not connected	2B	24G

Tab. 3-1: *Power supply 24 V (Pin layout from front view)*

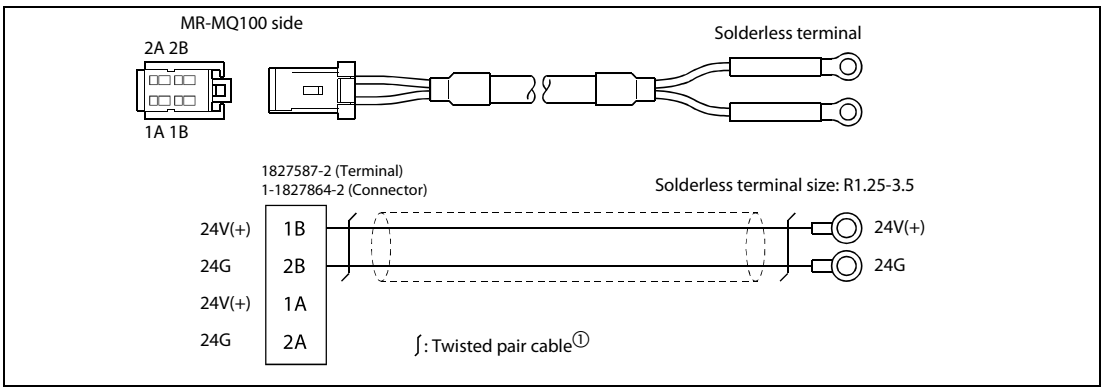


Fig. 3-2: *24 V DC power supply cable without EMI connector (Q170MPWCBL2M)*

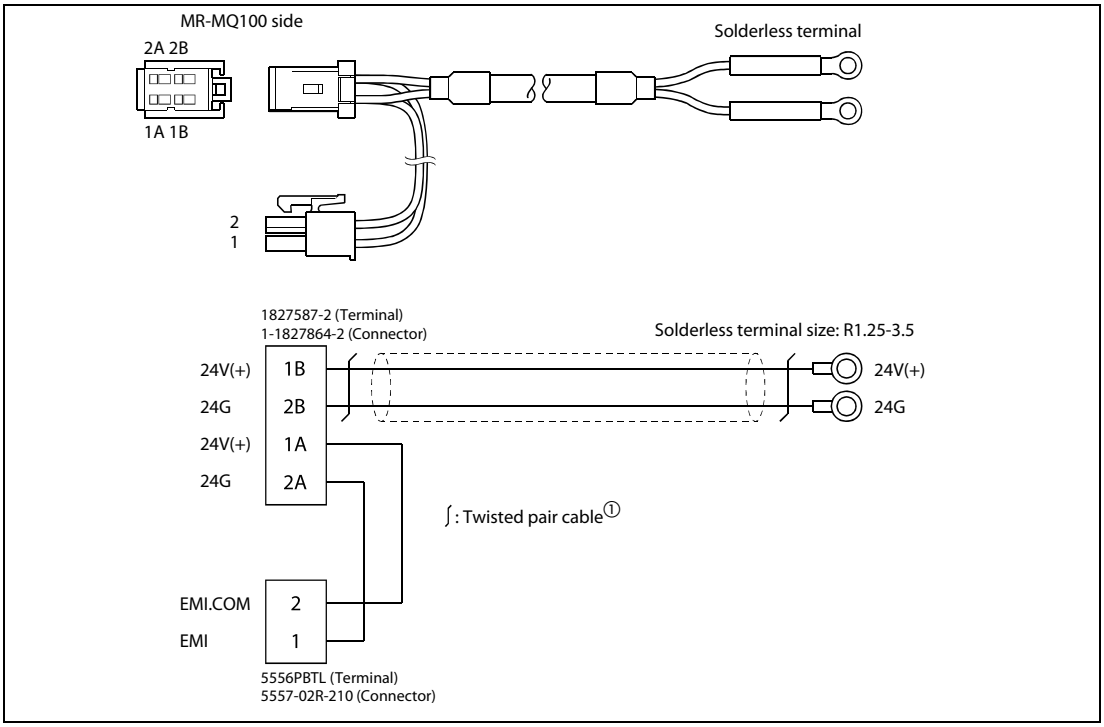


Fig. 3-3: *24 V DC power supply cable with EMI connector (Q170MPWCBL2M-E)*

① Use a cable of wire size AWG22.

Connecting the power supply

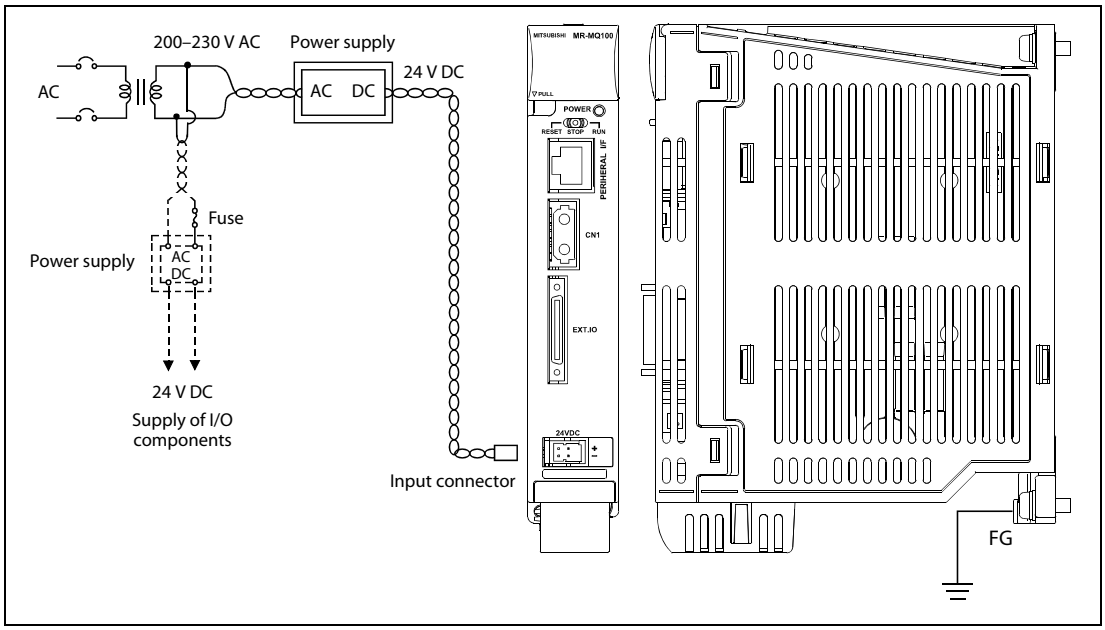


Fig. 3-4: *Wiring of the power supply for MR-MQ100*

NOTES

Use a different 24 V DC power supply for MR-MQ100 and for I/O components.

Use different 24 V DC power supplies for the MR-MQ100 and the electromagnetic brake of the servomotor.

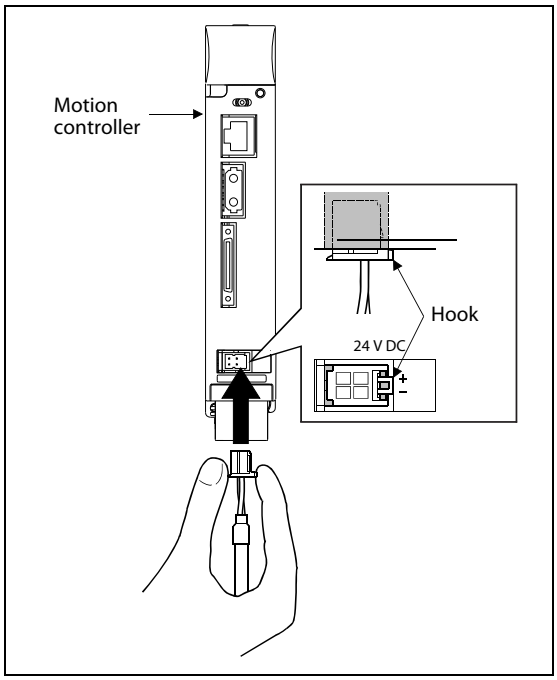


Fig. 3-5: *Connection and removal of the 24 V DC power supply cable*

NOTE

Forcibly removal the 24VDC power supply cable from the Motion controller will damage the Motion controller or 24VDC power supply cable.

3.2.2 Grounding

- Perform a grounding resistance of 100 Ω or less.
- Position the grounding point as close to the motion controller as possible to decrease the length of the ground wire.
- Ground the motion controller independently if possible. If it cannot be grounded independently, ground it jointly as shown below.

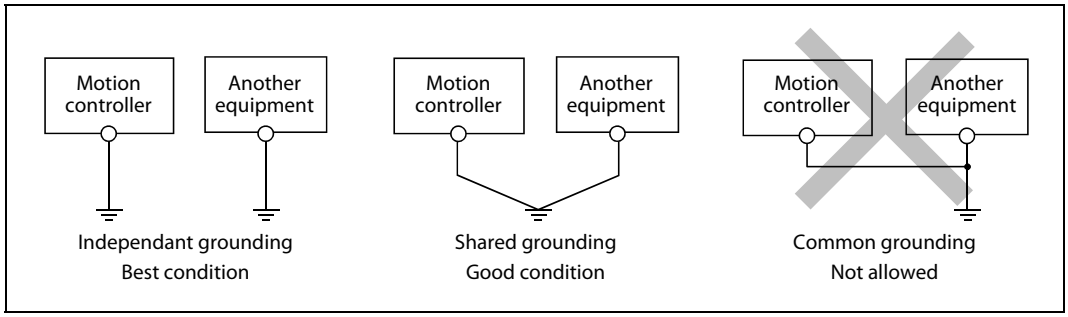
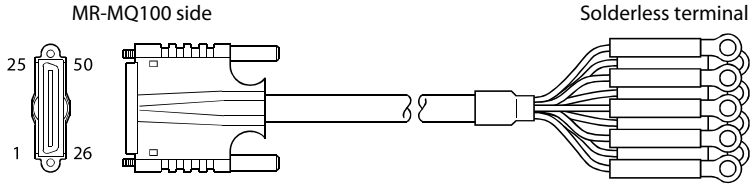


Fig. 3-6: *Types of grounding*

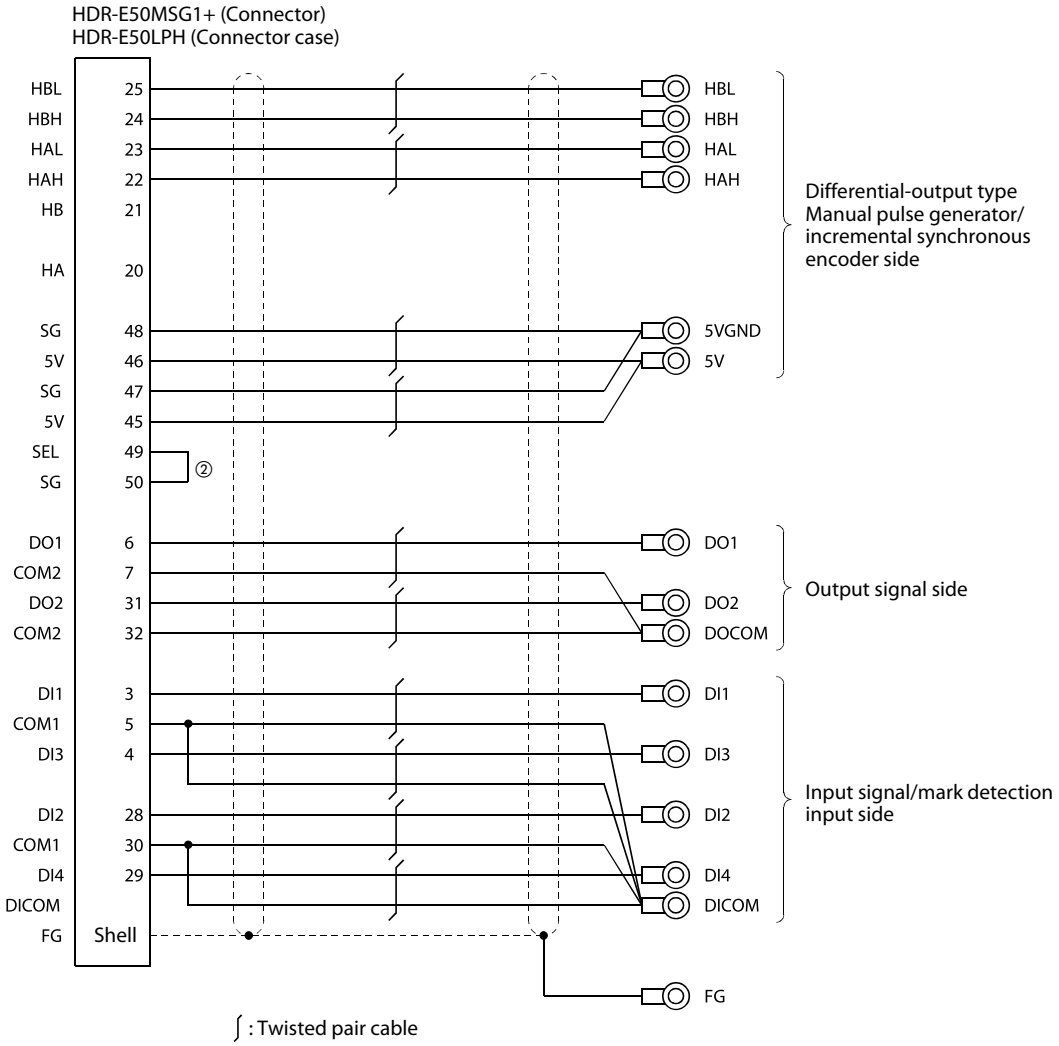
- The ground wire size should be at least 2 mm^2.

3.2.3 Digital I/O

Cable①



Connection diagram

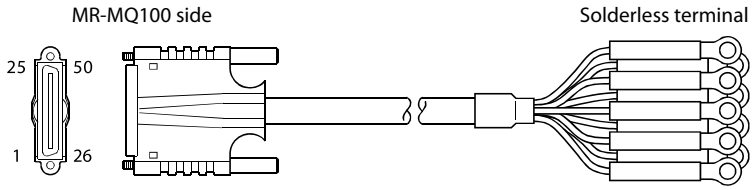


Tab. 3-2: *Differential-output type cable for internal I/F connector*

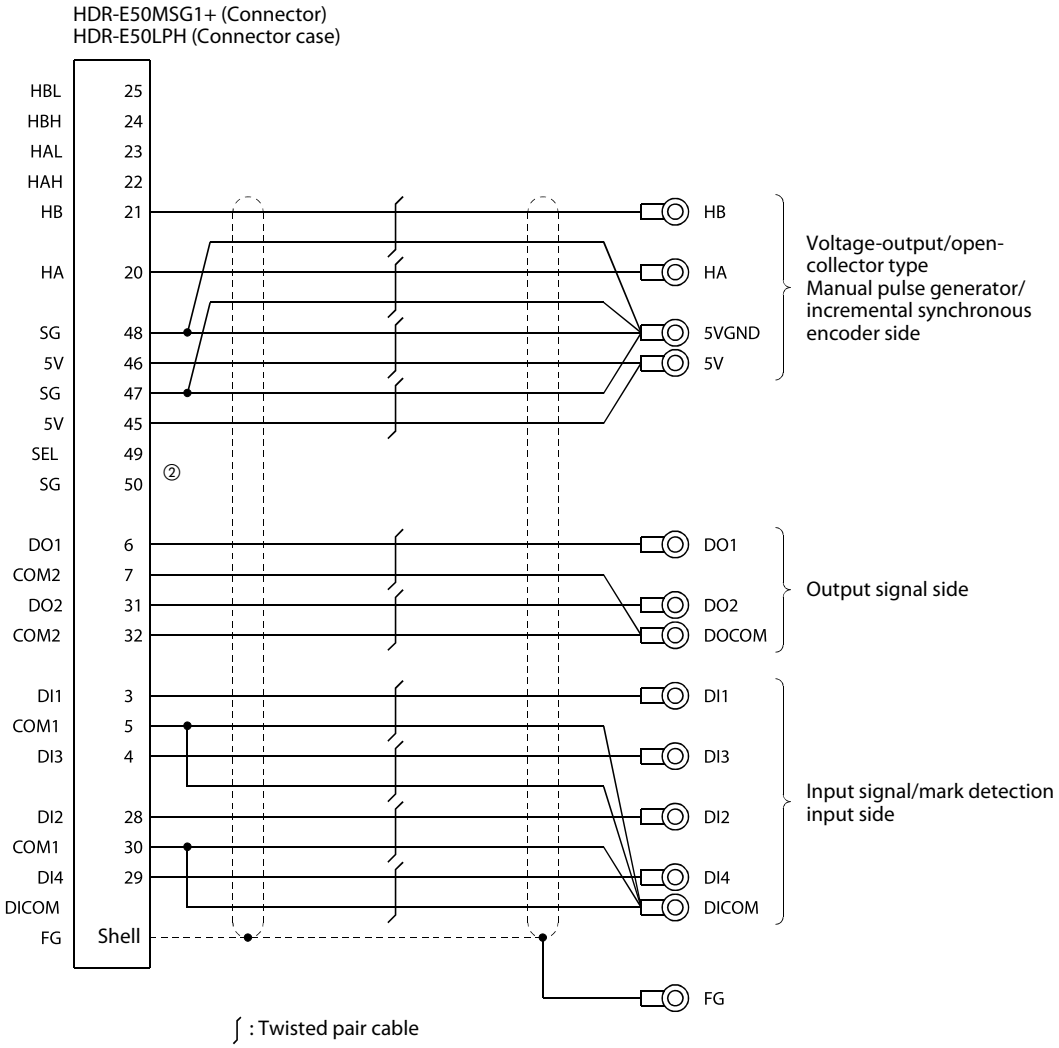
① The maximum length of the cable should be 30 m.

② Connect SEL to the SG terminal if differential-output type is used.

Cable①



Connection diagram



Tab. 3-3: *Voltage-output/open-collector type cable for internal I/F connector*

① The maximum length of the cable should be 10 m.

② When voltage-output/open-collector type is used, open between SEL and SG.

3.3 SSCNET III connection

3.3.1 SSCNET III cable

The cables in the following table are applicable for the connection between the MR-MQ100 motion controller and the servo amplifier MR-J3-□B.

Cable	Symbol for cable length (□)										
	0,15 m	0,3 m	0,5 m	1 m	3 m	5 m	10 m	20 m	30 m	40 m	50 m
MR-J3BUS□M	015	03	05	1	3	—	—	—	—	—	—
MR-J3BUS□M-A	—	—	—	—	—	5	10	20	—	—	—
MR-J3BUS□M-B	—	—	—	—	—	—	—	—	30	40	50

Tab. 3-4: *SSCNET III cable identification*

3.3.2 Connection between the MR-MQ100 and the servo amplifier

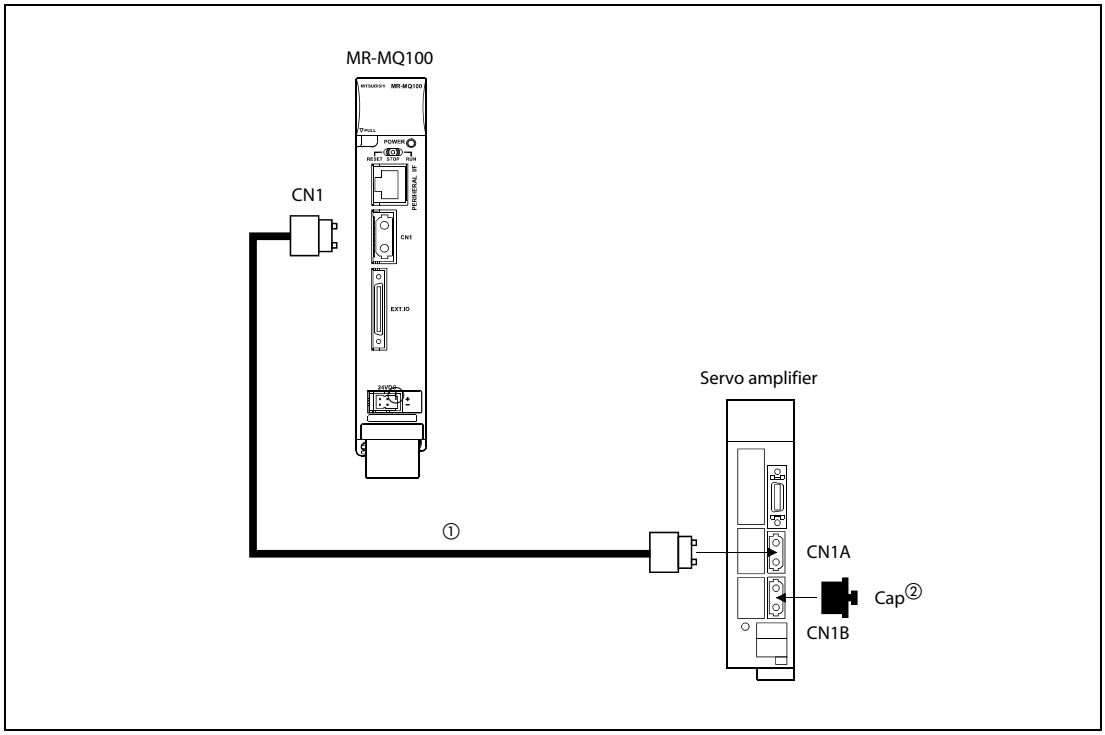


Fig. 3-7: *SSCNET III connection method with MR-MQ100*

① Chose the right SSCNET III cable type in tab. 3-4 depending on the cable length for your system configuration.

② Attach a cap to the SSCNET III connector of the system not being used.

NOTE If the connectors CN1A und CN1B are mixed up at the servo amplifier, no communication is possible.

3.3.3 Setting the axis No. and axis select switch of servo amplifier

Axis No. is used in the program to set the axis numbers of any servo amplifiers connected to the motion controller via SSCNET III.

Set the axis select rotary switch of the servo amplifier to "0", because the axis number is fixed in the "system structure" display as "d01".
(The default setting of the axis select rotary switch of servo amplifier is "0".).

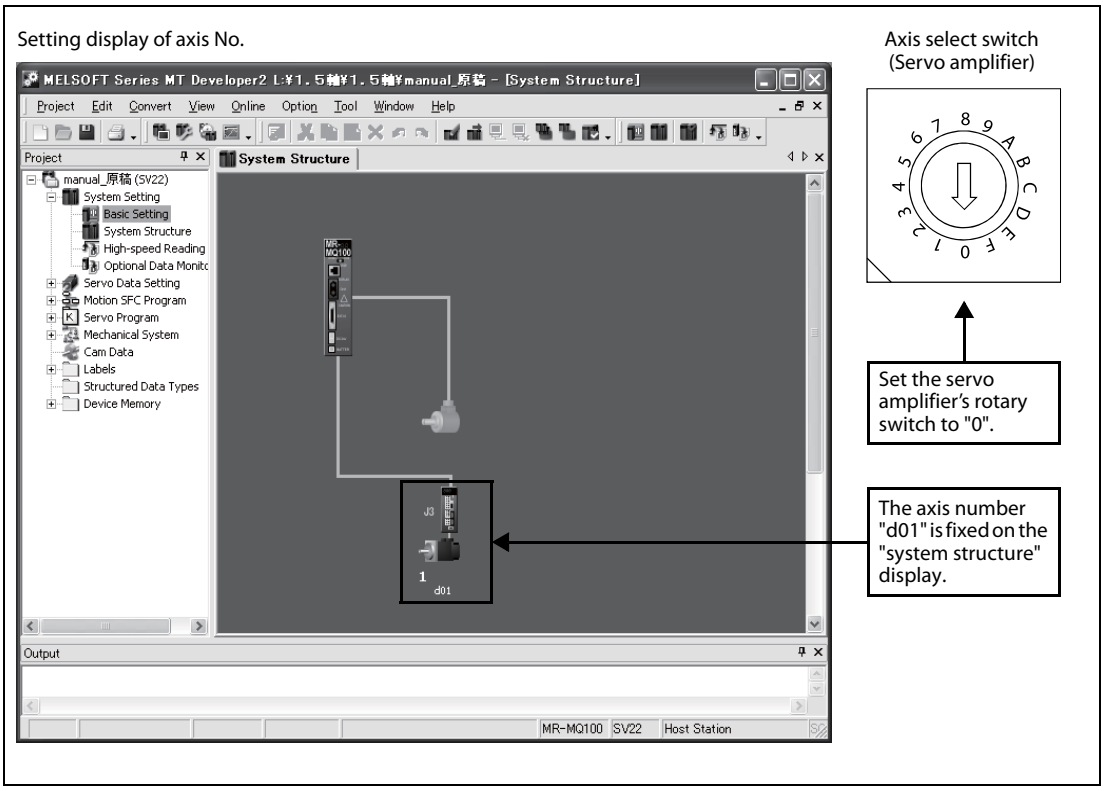


Fig. 3-8: *Setting the axis No.*

4 Start-up and trial operation

DANGER:

- ***Be sure to ground the Motion controllers, servo amplifiers and servomotors (Ground resistance: 100 Ω or less). Do not ground commonly with other devices.***
- ***Never open the front case or terminal cover at times other than wiring work or periodic inspections even if the power is OFF. The insides of the Motion controller and servo amplifier are charged and may lead to electric shocks.***
- ***When performing wiring work or inspections, turn the power OFF, wait at least ten minutes, and then check the voltage with a tester, etc. Failing to do so may lead to electric shocks.***
- ***Wire the units after mounting the Motion controller, servo amplifier and servomotor. Failing to do so may lead to electric shocks or damage.***

WARNING:

- ***Check that the combination of modules are correct. Wrong combination may damage the modules.***
- ***When using a regenerative resistor, shut the power OFF with an error signal. The regenerative resistor may abnormally overheat due to a fault in the regenerative transistor, etc. and may lead to fires.***
- ***Always take heat measure such as flame proofing for the inside of the control panel where the servo amplifier or regenerative resistor is mounted and for the wires used. Failing to do so may lead to fires.***
- ***Do not mount a phase advancing capacitor, surge absorber or radio noise filter (option FR-BIF) on the output side of the servo amplifier.***
- ***Correctly connect the output side (terminal U, V, W). Incorrect connections will lead the servo motor to operate abnormally.***
- ***Set parameter values to those that are compatible with the Motion controller, servo amplifier, servo motor and regenerative resistor model name and the system name application. The protective functions may not function if the settings are incorrect.***
- ***Always mount a leakage breaker on the Motion controller and servo amplifier power source.***
- ***Install emergency stop circuit externally so that operation can be stopped immediately and the power shut off.***
- ***Use the program commands for the program with the conditions specified in the instruction manual.***
- ***Some devices used in the program have fixed applications, so use these with the conditions specified in the programming manual.***
- ***If safety standards (ex., robot safety rules, etc.,) apply to the system using the Motion controller, servo amplifier and servo motor, make sure that the safety standards are satisfied.***
- ***Construct a safety circuit externally of the Motion controller or servo amplifier if the abnormal operation of the Motion controller or servo amplifier differ from the safety directive operation in the system.***
- ***The system must have a mechanical allowance so that the machine itself can stop even if the stroke limits switch is passed through at the max. speed.***
- ***Execute the test operation in the system that it is low-speed as much as possible and put forced stop and confirm the operation and safety.***

4.1 Start-up procedure

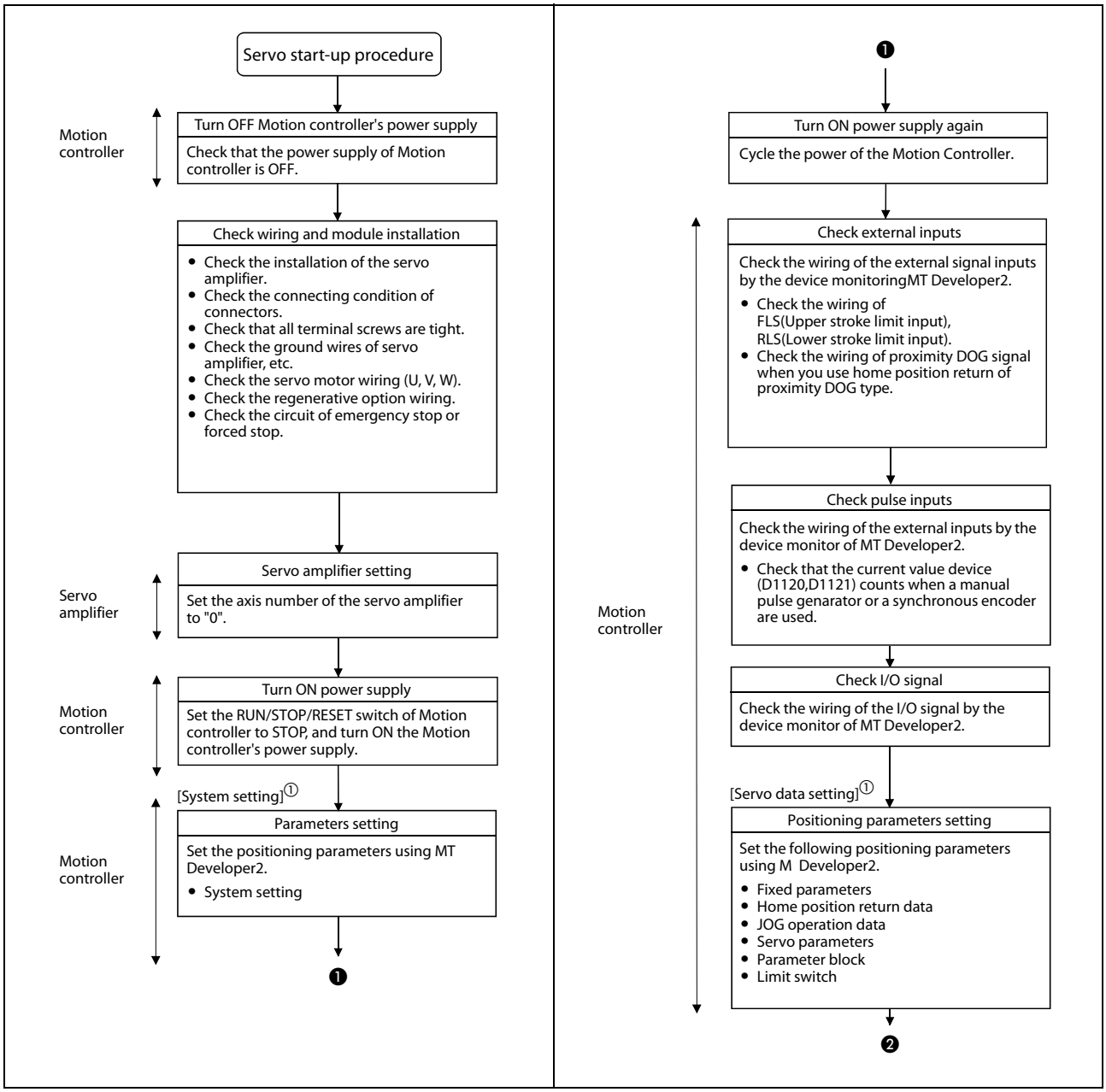


Fig. 4-1: *Start-up procedure (1)*

① The mode indicated in the brackets [ ] at top left of each step is the mode for checking or setting using MT Developer2.

NOTE

An error may occur if the power is turned on before system setting. In the case, reset the Multiple CPU system after system setting. Refer to the "Q173DCPU/Q172DCPU Motion controller Programming Manual (COMMON)" at the system setting error occurrence.

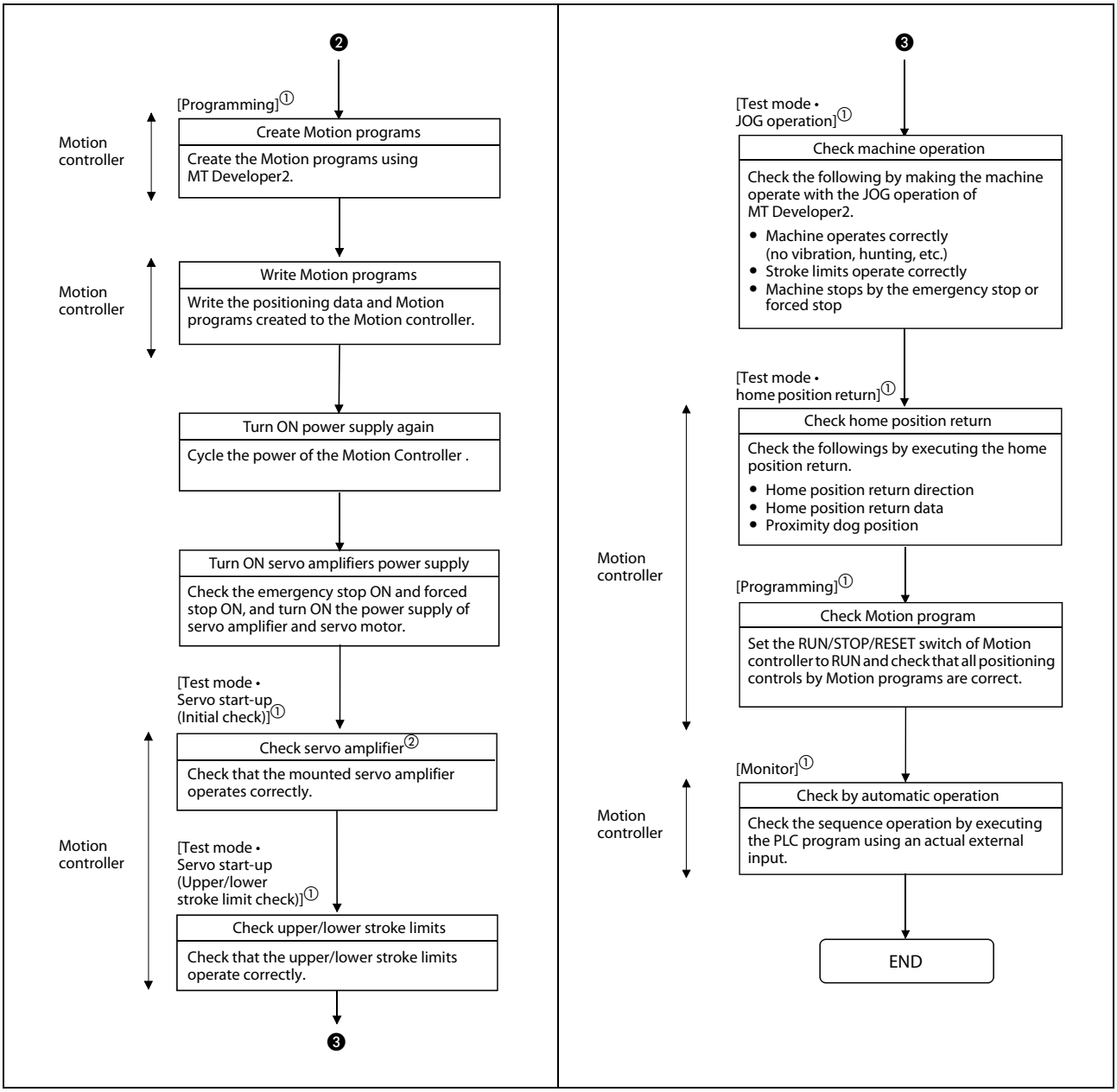


Fig. 4-1: *Start-up procedure (2)*

① The mode indicated in the brackets [ ] at top left of each step is the mode for checking or setting using MT Developer2.

② Axis No. and error description of servo amplifier which detected errors are displayed on initial check screen.

NOTES

Make a note of the series name of the motor before mounting to a machine. The servo motor name plate may not be visible after the servo motor is mounted.

When the servo amplifier, servomotor is first turned on, check the operation before mounting them to a machine in order to avoid unexpected accidents such as machine damage.

4.2 Software installation

4.2.1 Programming software

Install all of the software listed in the table below.

Product	Detail
MELSOFT MT Works2 (MT Developer2①)	Ver. 1.04E or later
MR Configurator (optional)	Ver. C1 or later

Tab. 4-1: *Software*

① This software is included in Motion controller engineering environment "MELSOFT MT Works2"

4.2.2 Combination of software version and function

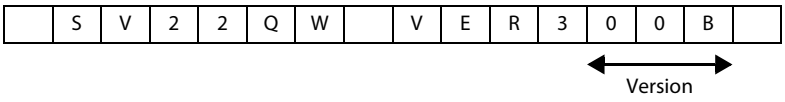
There are combinations in the function that can be used by the version of the operating system software and programming software. The combination of each version and a function is shown below.

Function	Operating system software version	Programming software version (MELSOFT MT Works2)
MC protocol communication	00B	1.06G
Incremental synchronous encoder current value in real mode	00B	—
Connection of the servo amplifier for direct drive motor	00B	1.06G

Tab. 4-2: *Combination of software version and a function*

Confirmation method of the operating system software's version

The operating system software's version of the connected Motion controller is displayed on the OS type item of the ***Read from CPU*** screen in MT Developer2.



4.2.3 Operating system (OS)

The operating system software is installed at the time of motion controller purchase, so there is no need to install any operating system into the motion controller before first start up.

It is only necessary to install a new operating system software after any upgrades.

The installation procedure of an updated operation system is described in the MR-MQ100 Motion controller Users Manual (see preamble for manual number).

5 Communication

5.1 Connection to peripheral devices

There are two ways to communicate between the Motion controller and a computer.

- Direct connection
- Hub connection

Ethernet cables and parameters are different for "Direct connection" and "Hub Connection". Please note there are two types of Ethernet cables.

- Crossover cable
- Straight cable

5.1.1 Direct connection

Direct connection uses an Ethernet cable between the Motion controller and a computer. Select ***Direct connection*** on the "Transfer Setup" screen of MT Developer2
(Menu: "Online" – "Transfer Setup").
There is no need to set ***IP address***, ***IP Input Format*** or ***Protocol***.

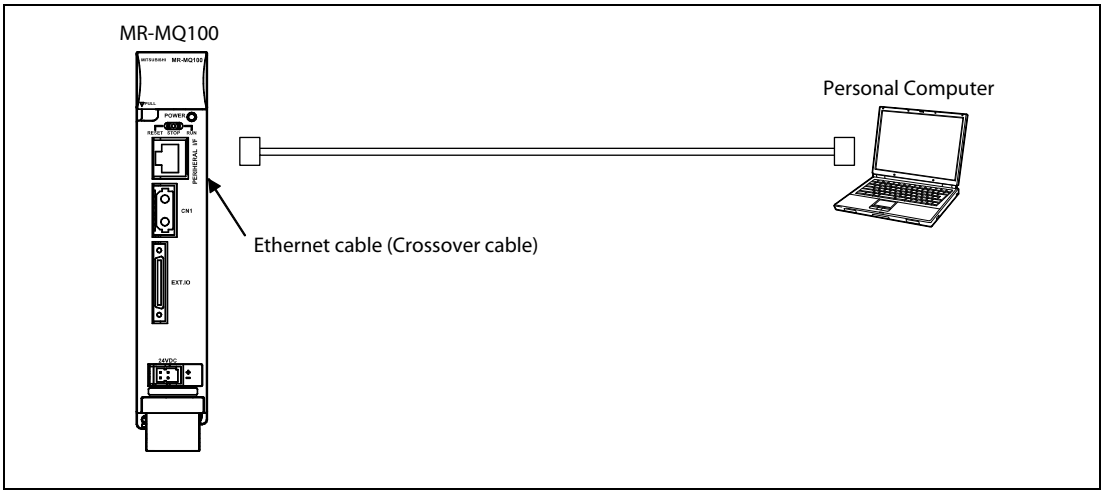
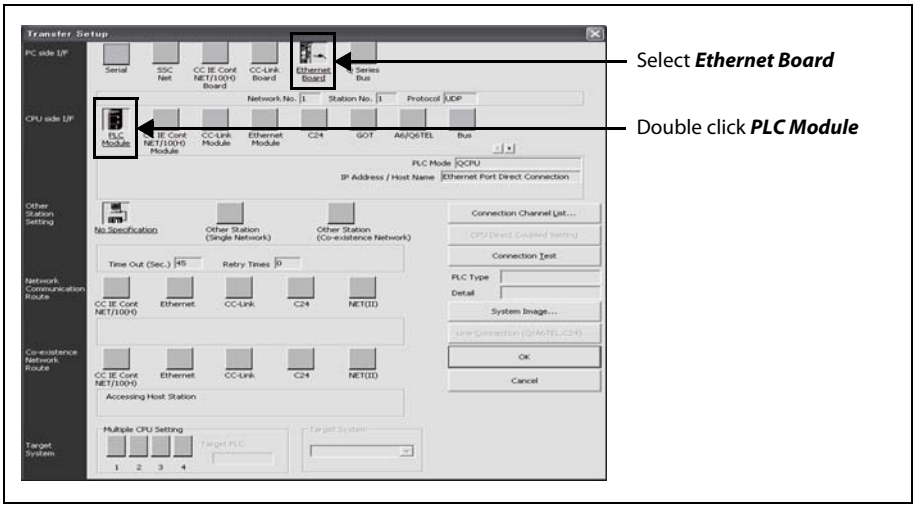


Fig. 5-1: *Direct connection between Motion controller and PC*

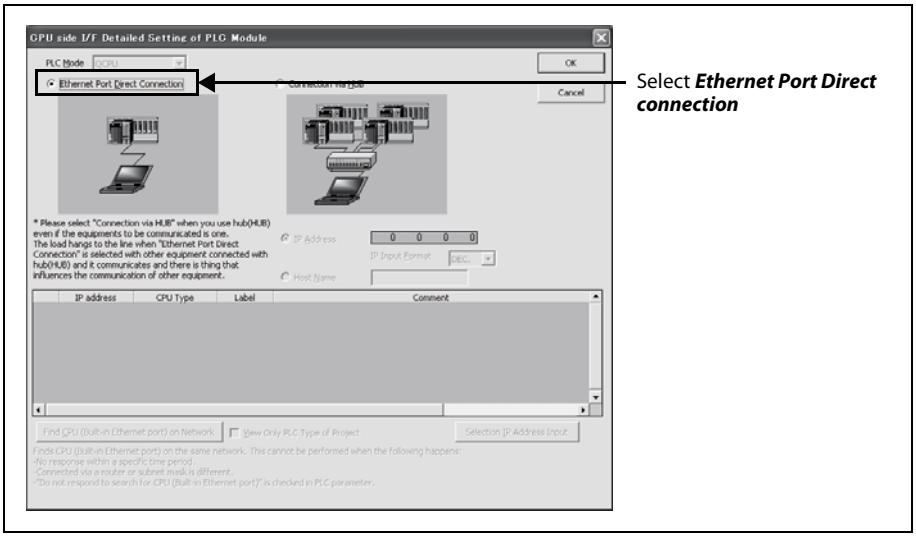
Direct connection settings

Select Ethernet Port Direct connection on the "Transfer Setup" screen.



CPU side I/F Detailed Setting of PLC Module

(Menu: "Online" – "Transfer Setup" – "CPU side I/F Detailed Setting of PLC Module")



NOTES

Do not connect to a LAN with ***Direct connection*** setting. The LAN line will become busy and may effect communication of other equipment on the LAN.

IP address setting does not matter when using a direct connection. However, communication may fail with the below conditions.

– In the Motion controller IP address, bits corresponding to "0" in the computer subnet mask are all ON (255) or all OFF (0).

Example:	Motion controller IP address:	64.	64.**255.255**
	Personal computer IP address:	64.	64.1.1
	Personal computer subnet mask:	255.	255.**0.0**

– In the Motion controller IP address, bits corresponding to the computer IP address for each class in the personal computer IP address are all ON (255) or all OFF (0).

Example:	Motion controller IP address:	64.	64.255.255
	Personal computer IP address:	192.	168.0.0
	Personal computer subnet mask:	255.	0.0. 0

5.1.2 Hub Connection

The Motion controller can be connected to multiple computers through a hub.

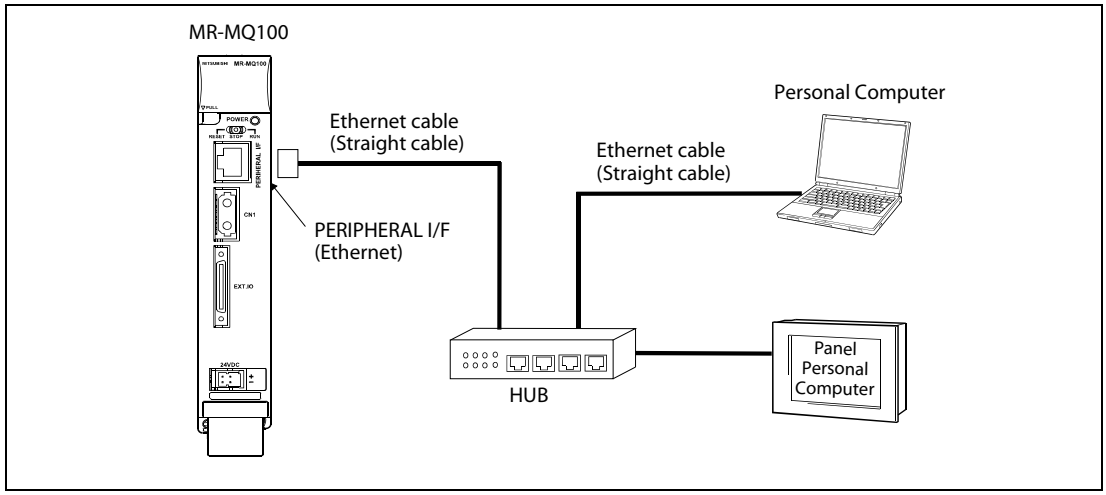


Fig. 5-2: *Connection between Motion controller and PC via Hub*

Hub connection settings

Before connection with a hub can be made, the Motion controller's settings must be changed using a direct connection method.

① Connecting an Ethernet cable (Crossover cable)

Connect an Ethernet cable (Crossover cable) between the Motion controller and a computer.

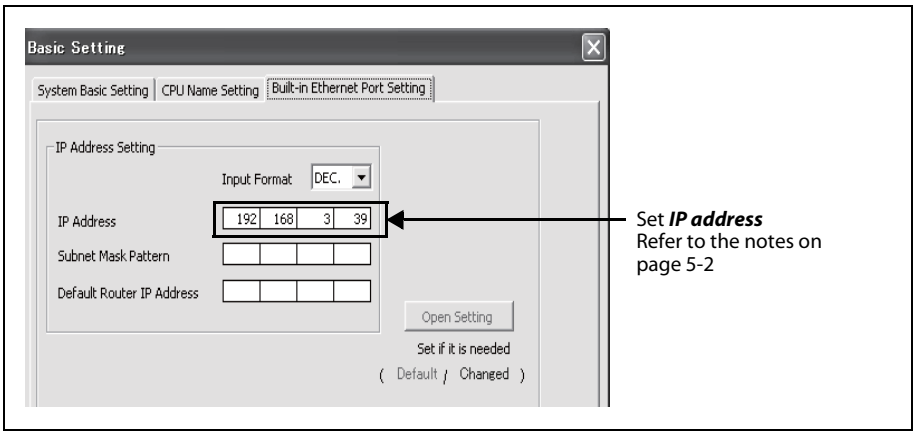
② Setting IP address of the Motion controller

Set the IP address located in the tab "Built-in Ethernet Port Setting".

The default IP address value is [192.168.3.39].
Refer to the notes on page 5-2 about IP address value setting.

No need to set ***Subnet Mask Pattern*** or ***Default Router IP Address***.

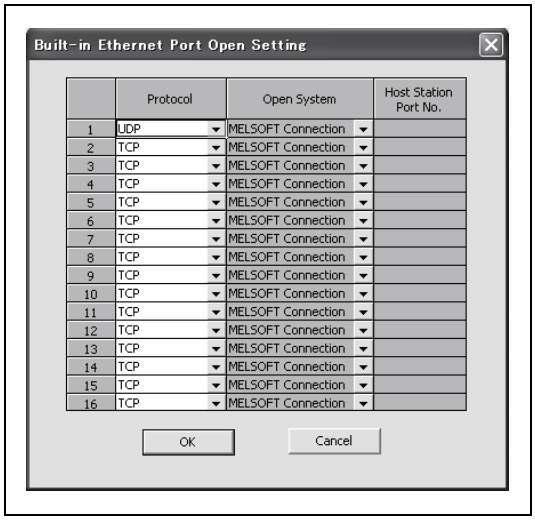
The setting is done in the menu "Built-in Ethernet Port Setting":
(Menu: "System Setting" – "Basic Setting"– "Built-in Ethernet Port Setting")



③ Open setting of the Motion controller

Select ***TCP*** or ***UDP*** to correspond to current setting of the computer. TCP is recommended, because of the quality of the communication.

The setting is done in the menu "Open Setting"
(Menu: "System Setting" – "Basic Setting" – "Built-in Ethernet Port Setting" – "Open Setting")



④ Writing parameters

Write parameters to the Motion controller.
(Crossover cable must be used for this step.)

⑤ Changing cables

Power off the Motion controller, then change the Ethernet cable from a crossover cable to a straight cable.

Equipment	**Ethernet cable**
The Motion controller – Hub	Straight cable
All Computers – Hub	Straight cable

Tab. 5-1: *Ethernet cables for use with Hub*

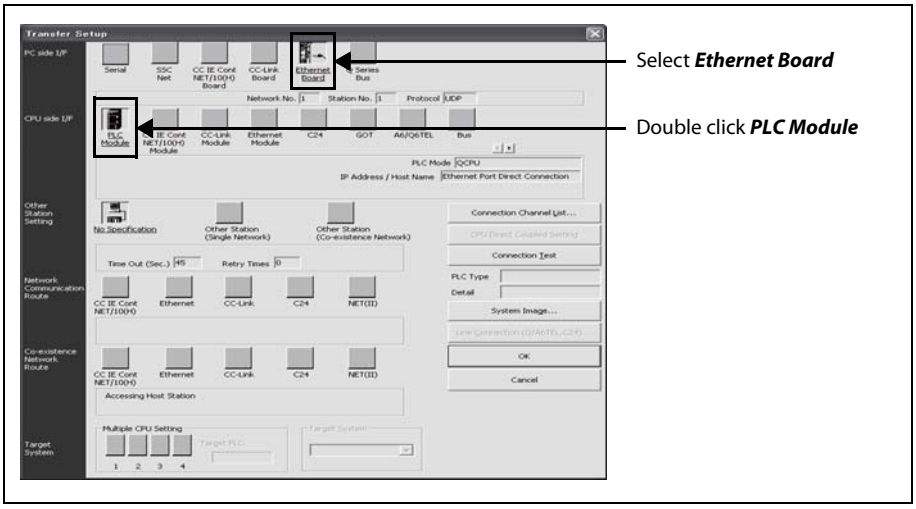
⑥ Enabling the parameters of the Motion controller

Once power returns to the Motion controller, the IP address and parameters of the menu "Open Setting" will become enabled.

⑦ Transfer Setup of the computer (MT Developer2)

Select ***Connection via Hub*** on the "Transfer Setup" screen.

The setting is done in the menu "Transfer Setup" (Menu: "Online" – "Transfer Setup")

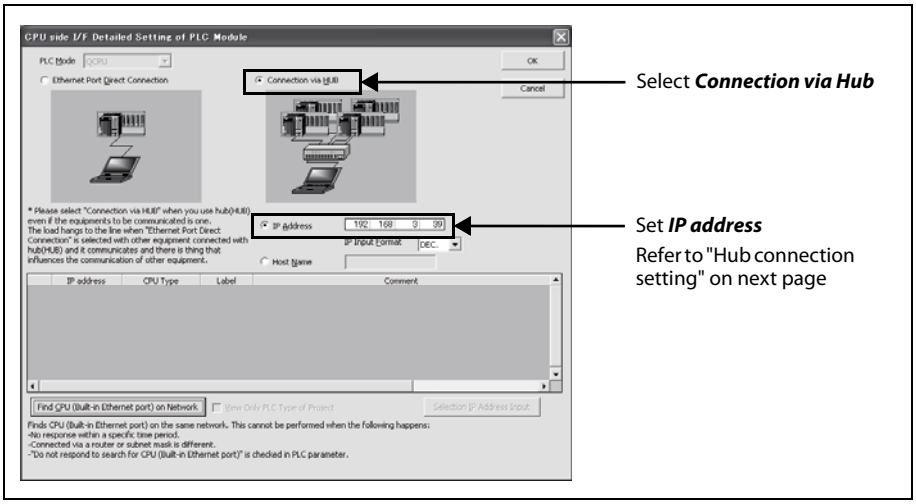


⑧ CPU side I/F Detailed Setting of PLC Module

Select ***Connection via Hub***

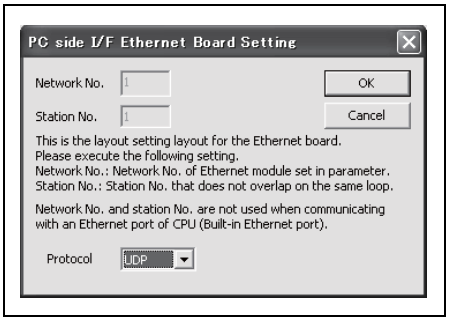
Set the IP address to the same value as the IP address of the Motion controller.

The default value of the IP address is [192.168.3.39].
Refer to the notes on page 5-2 about IP address value setting.



⑨ PC side I/F Ethernet Board Setting

Select ***TCP*** or ***UDP*** to be same as "Open Setting"



Hub connection setting

① IP Address

The IP address of the Motion controller has to be considered when the IP address of the computer is already set.

Example ▽ The below setting is one example, if the IP address of the computer is [192.168.1.1]

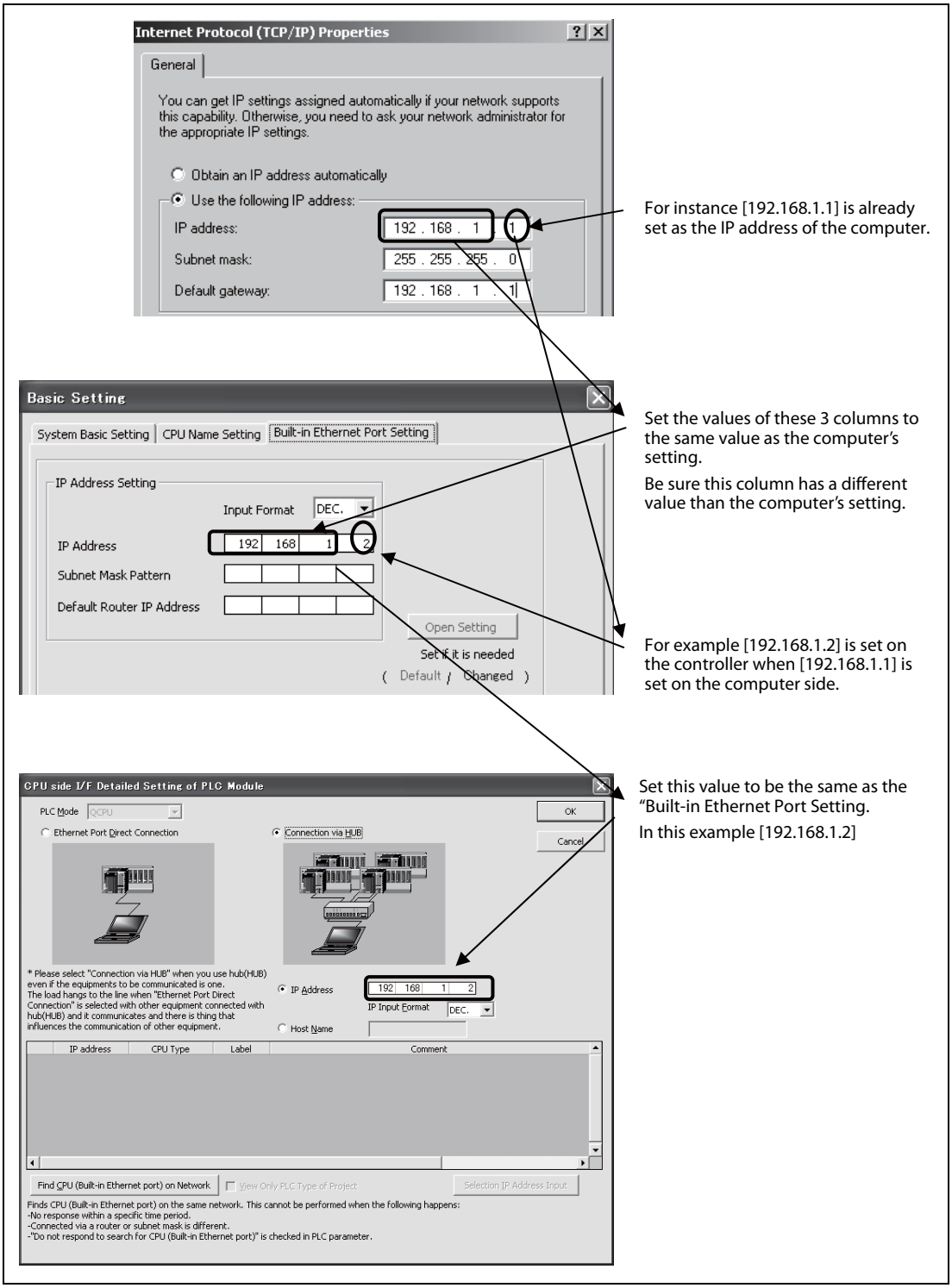


Fig. 5-3: *Setting example of the IP address*

△

② Up to 16 different equipment can access the Motion controller.

③ Hub

The hub can be either a 10BASE-T or 100BASE-TX port.
(It has to meet IEEE802.3 100BASE-TX or IEEE802.3 10BASE-T)

④ The Ethernet cables must to be installed away from power cabling lines.

⑤ The connections cannot be guaranteed under below conditions:

- Any connection made over the internet.
- Any connection made through a fire wall.
- Any connection made through a broadband router.
- Any connection made through a wireless LAN.

⑥ When multiple Motion controllers are connected to MT Developer2, beware of the below cautions:

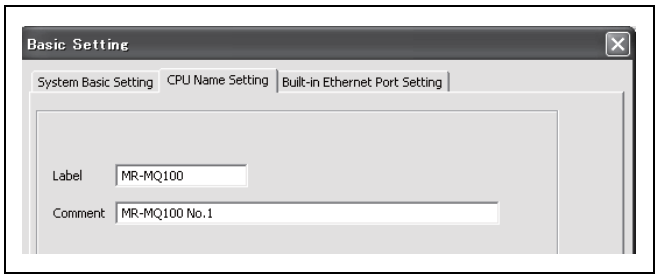
- IP addresses must be different for each Motion controller.
- Different projects must be used for each Motion controllers on MT Developer2.
- Only one instance each of the "Digital oscilloscope function" and "Test mode function" can be used on a single computer at a time.

5.2 Setting CPU name

5.2.1 HUB connection setting

When setting up a connection to a hub, a label and comments can be added to each controller in the CPU Name Setting tab of the Basic Settings window.
(Communication is still available even without defining a Label and/or Comment.)

The setting is done in the menu "CPU Name Setting"
(Menu: "System Setting" – "Basic Setting" – "CPU Name Setting")



Item	Contents	Length
Label	Enter a label (name and/or purpose) of the Motion controller.	Up to 10 characters
Comment	Enter comments regarding the Motion controller.	Up to 64 characters

Tab. 5-2: *Setting of the menu items*

The "Find CPU (Built-in Ethernet port) on Network" function in the "CPU side I/F Detailed Setting of PLC Module" conveniently shows the below information when MT Developer2 and the Motion controller are connected via the PERIPHERAL I/F (Ethernet).

- IP address
- CPU type
- Label
- Comment

5.3 MC Protocol Communication

PERIPHERAL I/F of the Motion controller enables communication using the MC protocol.

NOTE

The MC protocol is an abbreviation for the MELSEC communication protocol.

The MELSEC communication protocol is a name of the communication method used to access CPU modules from external devices in accordance with the communication procedure of Q-series programmable controllers (such as serial communication modules, Ethernet modules).

For details on the MC protocol, refer to the "Q Corresponding MELSECCommunication Protocol Reference Manual".

External devices such as personal computers and display devices read/write device data from/to the Motion controller using the MC protocol.

External devices monitor the operation of the Motion controller, analyze data, and manage production by reading/writing device data.

5.3.1 Topics of the MC Protokoll

- The MC Protocol was implemented in MR-MQ100 for communication to Q-PLC, FX-PLC and 3rd party products.
- The QnA compatible 3E frame was implemented and the communication is compatible to QnUDE-Communication.
- Two types of communication systems are available; one using ASCII code data and the other using binary code data.
- Protocol must be programmed in the external device side and the MR-MQ100 reply of the protocol without any program in the Motion Controller.
- The Read/Writing/Monitoring of M, SD, X, Y, M, F, B, D, W, # devices is supported.
- Data communication is performed using half-duplex communication.

5.3.2 Transmission of command messages

Data communication through the MC protocol is performed using half-duplex communication.①

When accessing the programmable controller CPU, send the next command message after receiving a response message from the programable controller CPU side for the previous command message transmission.

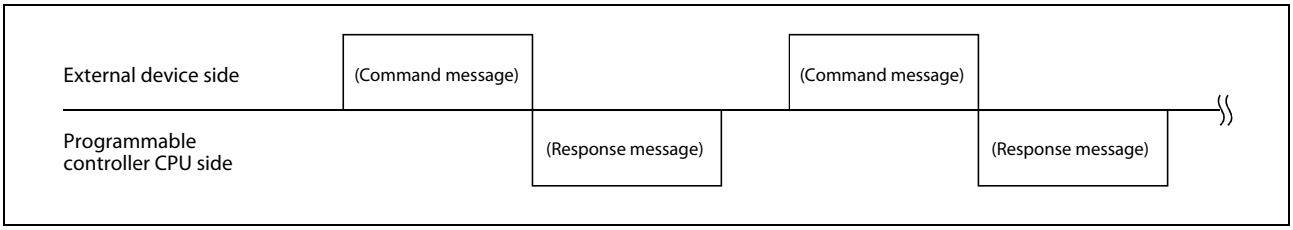


Fig. 5-4: *Half-duplex communication*

① When accessing via the Q series C24, full-duplex communication is performed by user setting when the on-demand function is being used. When the system between external devices and programmable controller CPUs is configured with a m : n connection, the next command message transmission cannot be performed until data communication between either of the external devices and programmable controller CPUs is completed.

When using ASCII code in QnA compatible 3E frame

When reading data from the local station programmable controller CPU at the external device.

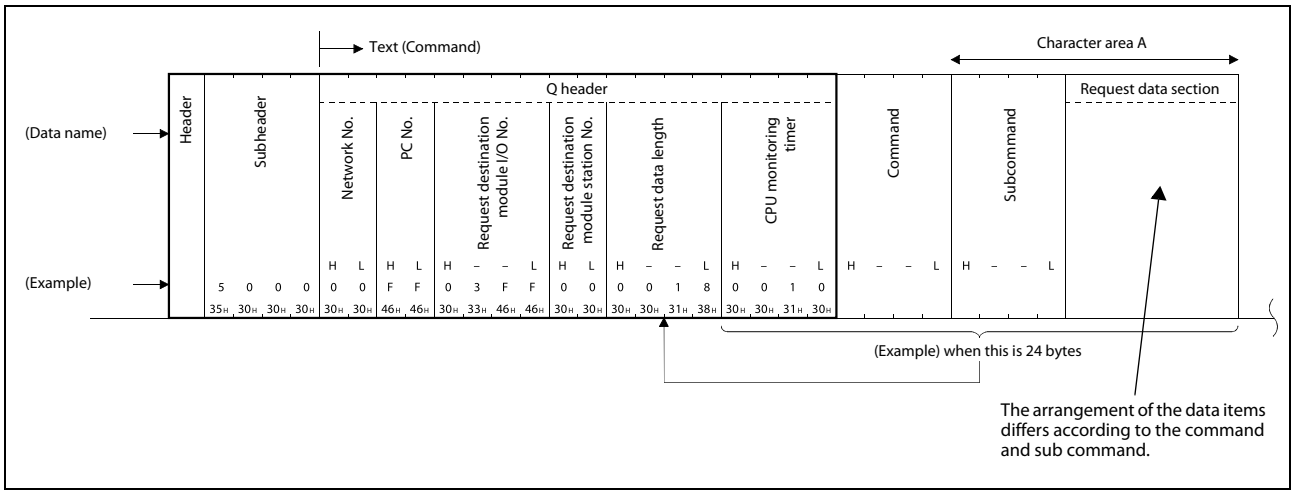


Fig. 5-5: *External device side → Programmable controller CPU side (Command message)*

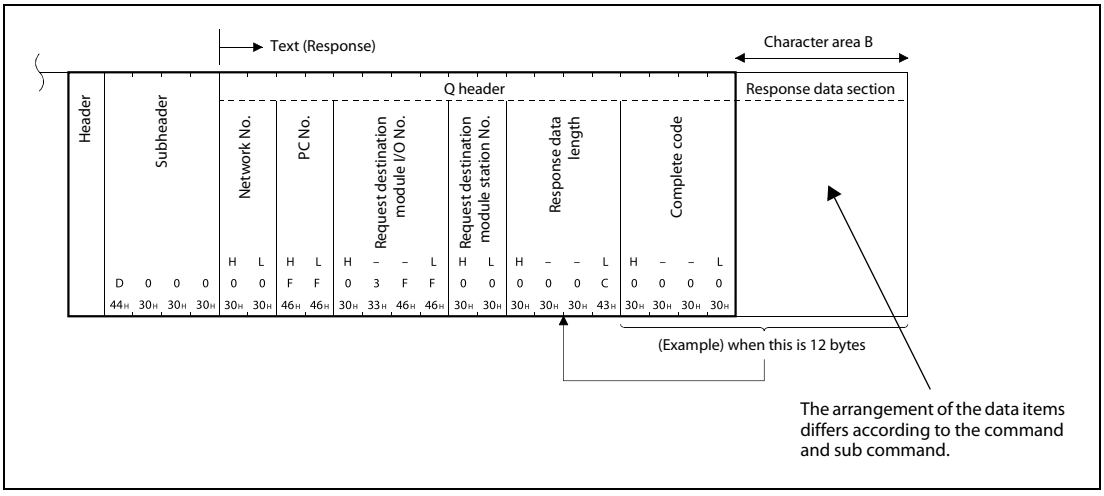


Fig. 5-6: *Programmable controller CPU side → External device side (Response message)*

When using binary code in QnA compatible 3E frame

When reading data from the local station programmable controller CPU at the external device.

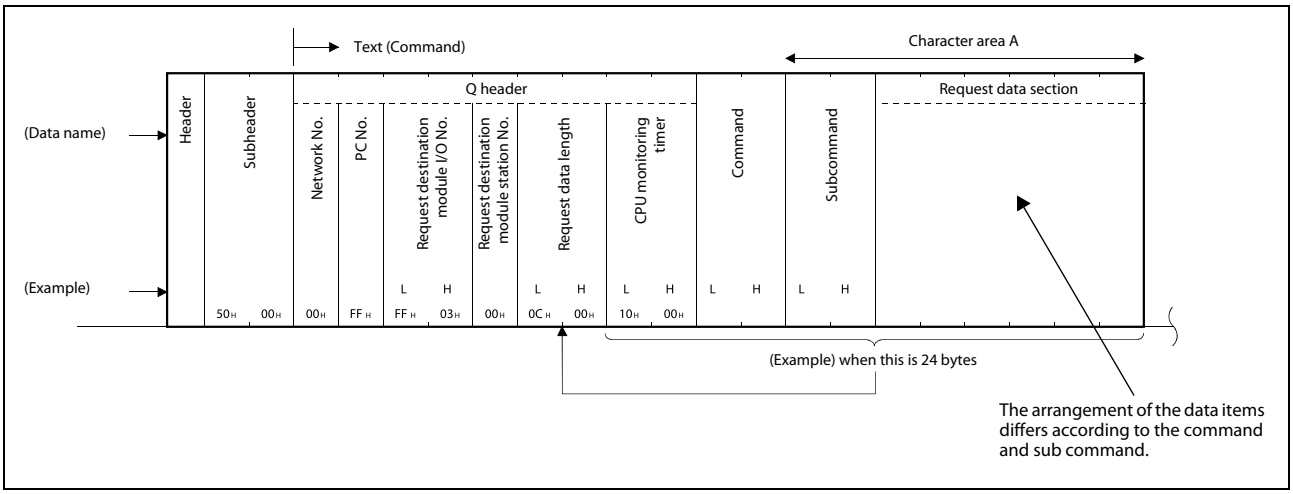


Fig. 5-7: *External device side → Programmable controller CPU side (Command message)*

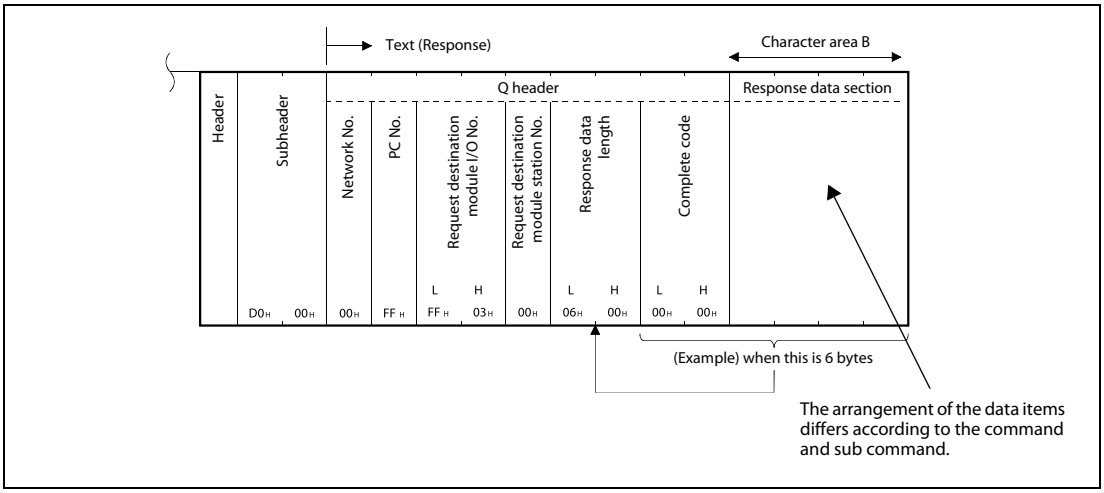


Fig. 5-8: *Programmable controller CPU side → External device side (Response message)*

Reading values in QnA-compatible 3E frame

Reading the current values of the three points from data registers D100 to D102 while communicating in binary code.

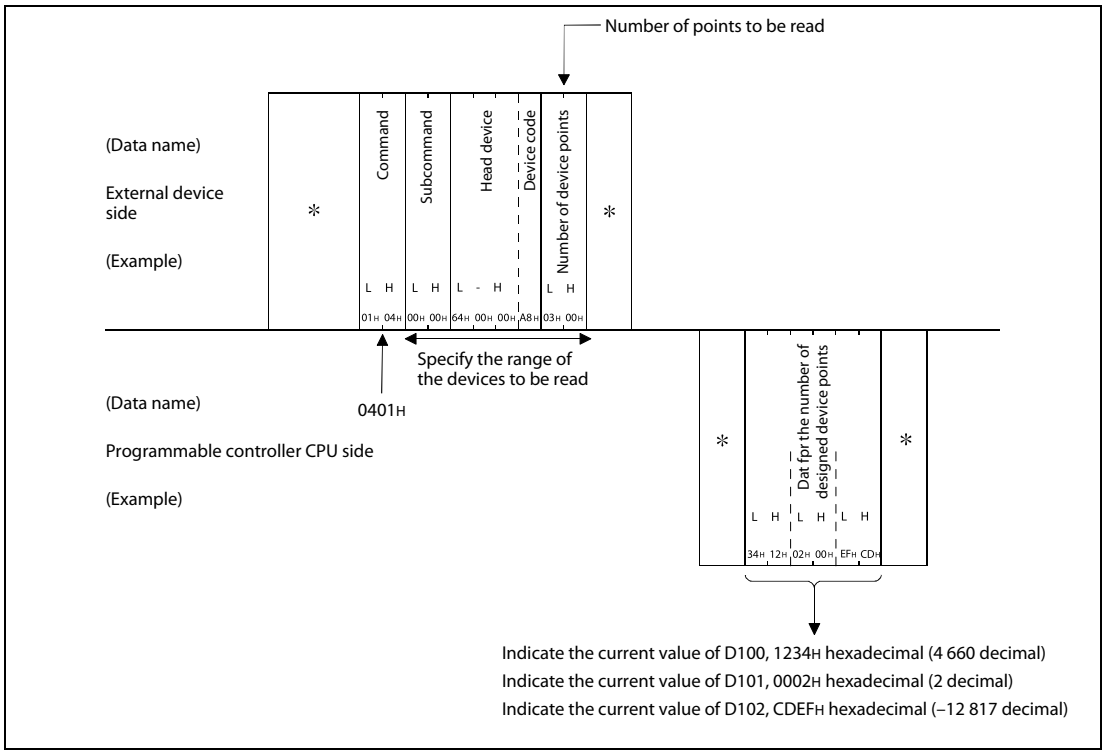


Fig. 5-9: *Reading from the registers D100 to D102*

Writing values in QnA-compatible 3E frame

Writing three points to D100 to D102 while communicating in binary code.

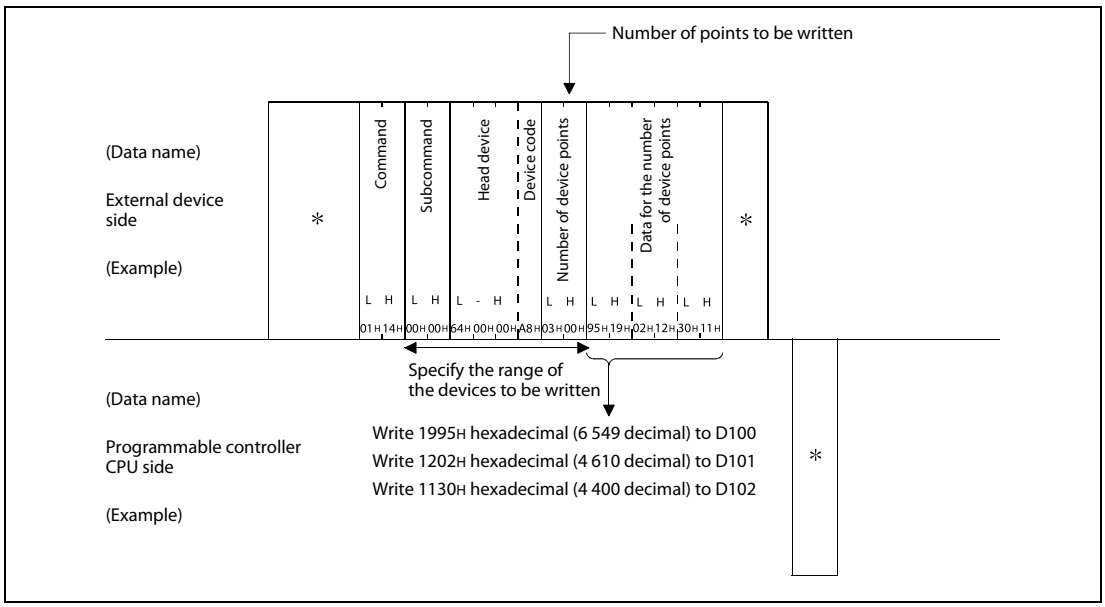


Fig. 5-10: *Writing to the registers D100 to D102*

5.3.3 Command list

When the PERIPHERAL I/F of the Motion controller communicates using the MC protocol, commands listed in table below can be executed.

Function			Command (Sub-command)①	Description	Number of processed points	Status of Motion controller		
						STOP	RUN	
							Write enabled	Write disabled
Device memory	Batch read	In units of bits	0401 (0001)	Reads bit devices in units of one point.	ASCII: 3 584 points BIN: 7 168 points	●	●	●
		In units of words	0401 (0000)	Reads bit devices in units of 16 points.	960 words (15 360 points)			
				Reads word devices in units of one point.	960 points			
	Batch write	In units of bits	1401 (0001)	Writes bit devices in units of one point.	ASCII: 3 584 points BIN: 7 168 points	●	●	○
		In units of words	1401 (0000)	Writes bit devices in units of 16 points.	960 words (15 360 points)			
				Writes word devices in units of one point.	960 points			
	Random read②	In units of words	0403 (0000)	Reads bit devices in units of 16 or 32 points by randomly specifying a device or device Random read number.	192 points	●	●	●
				Reads word devices in units of one or two points by randomly specifying a device or device number.				
	Test (Random write)	In units of bits	1402 (0001)	Sets/resets bit devices in units of one point by randomly specifying a device or device number.	188 points	●	●	○
		In units of words	1402 (0000)	Sets/resets bit devices in units of 16 or 32 points by randomly specifying a device or device number.	⑤			
				Writes word devices in units of one or two points by randomly specifying a device or device number.				
	Monitor registration ②, ③, ④	In units of words	0801 (0000)	Registers bit devices to be monitored in units of 16 or 32 points.	192 points	●	●	●
				Registers word devices to be monitored in units of one or two points.				
	Monitor	In units of words	0802 (0000)	Monitors devices registered.	Number of registered points	●	●	●

Tab. 5-3: *Executable commands using the MC protocol*

●: Available ○: Not available

① Subcommand is for the QnA-compatible 3E frame.

② Devices such as TS, TC, SS, SC, CS and CC cannot be specified in units of words.
For the monitor registration, an error (4032H) occurs during the monitor operation.

③ During monitor registration, monitor condition cannot be set.

④ Do not execute monitor registration from multiple external devices. If executed, the last monitor registration becomes valid.

⑤ Set the number of processed points so that the following condition is satisfied.
(Number of word access points) x 12 + (Number of double-word access points) x 14 ≤ 1 920

- Bit devices are regarded as 16 bits during word access and 32 bits during double-word access.
- Word devices are regarded as one word during word access and two words during double-word access.

5.3.4 Available devices

The devices available in commands used in the MC protocol communication function is shown below.

Classification	Device	Device code		Device number range		Remarks
		ASCII code①	Binary code			
Internal system device	Special relay	SM	91H	000000–002255	Decimal	—
	Special register	SD	A9H	000000–002255	Decimal	
Internal user device	Input	X□	9CH	000000–001FFF	Hexadecimal	Including actual input device PX.
	Output	Y□	9DH	000000–001FFF	Hexadecimal	Including actual output device PY.
	Internal relay	M□	90H	000000–012287	Decimal	—
	Annunciator	F□	93H	000000–002047	Decimal	
	Link relay	B□	A0H	000000–001FFF	Hexadecimal	
	Data register	D□	A8H	000000–008191	Decimal	
	Link register	W□	B4H	000000–001FFF	Hexadecimal	
	Motion register	#□	E0H	000000–012287	Decimal	

Tab. 5-4: *Availible devices in the MC protocol communication function*

① When data is communicated in ASCII code, the second character "□" can be designated a blank space (code: 20H).

5.3.5 Precautions

Number of connected modules

In the connection with external devices using the MC protocol, the number of Motion controllers set as "MELSOFT connection" in the "Open Settings" on "Built-in Ethernet Port setting" of "Basic Setting" can be connected simultaneously.

Data communication frame

The table below shows the frames available in the communication function using the MC protocol with PERIPHERAL I/F.

Communication frame	Communication function using the MC protocol with PERIPHERAL I/F
4E frame	Not available
QnA-compatible 3E frame	Available
A-compatible 1E frame	Not available

Access range

Only Motion controller connected by Ethernet can be accessed. Accessing a Motion controller not connected by Ethernet results in an error.

Precautions when UDP protocol is selected

– If a new request message is sent to the same UDP port while the port waits for a response message, the new request message is discarded.

– Setting same host station port number to multiple UDP ports is regarded as one setting. When communicating with multiple external devices using the same host station port number, select TCP protocol.

Response message receive processing

Figure below shows an example of the response message receive processing on the external device side.

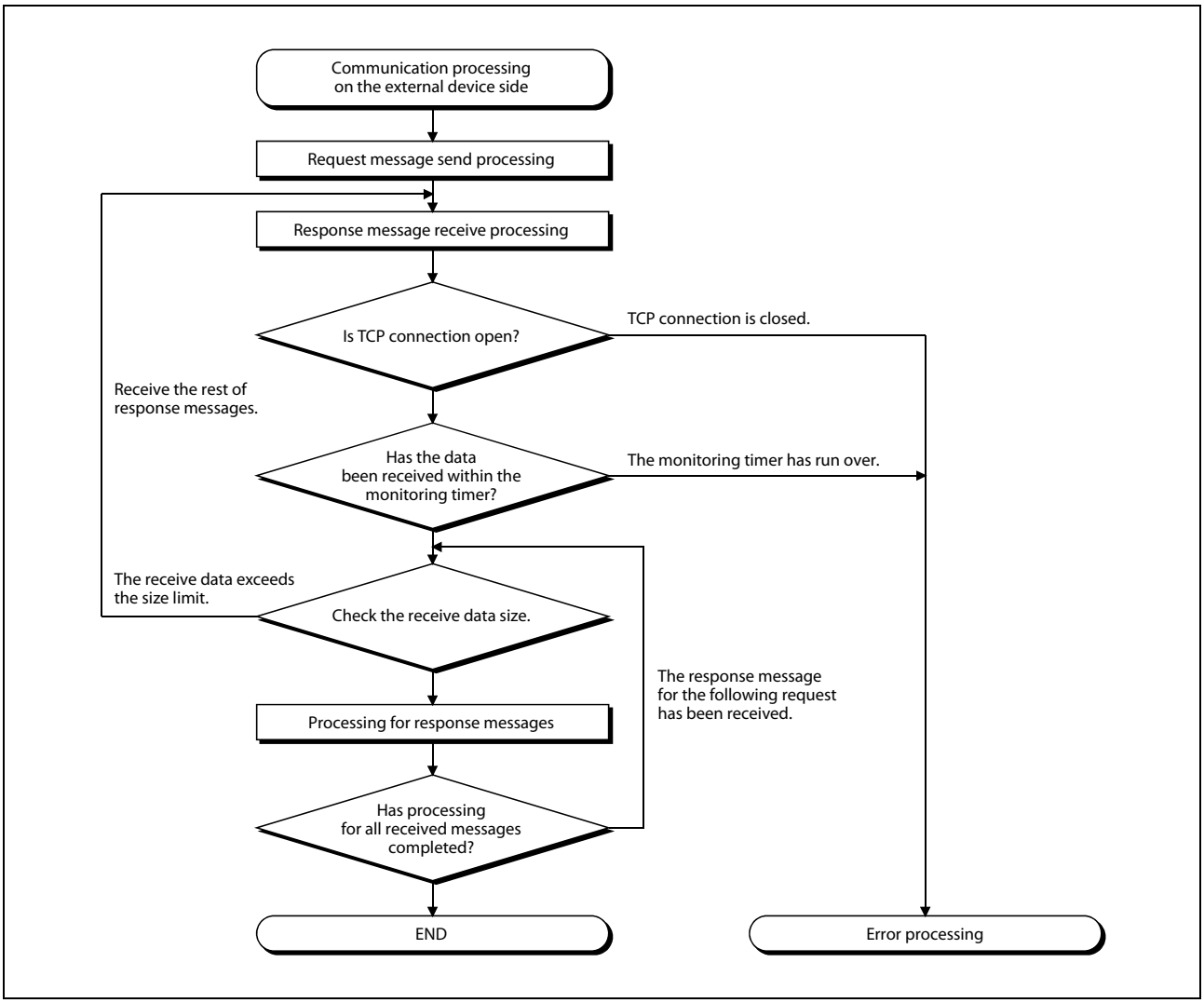


Fig. 5-11: *Flow chart of response message receive processing*

NOTES

Personal computers use the TCP socket functions internally for Ethernet communication.
These functions do not have boundary concept. Therefore, when data is sent by executing the "send" function once, the "recv" function needs to be executed once or more to receive the same data.
(One execution of the "send" function does not correspond to one execution of the "recv" function.)
For this reason, receive processing described above is required on the external device side.
If the "recv" function is used in blocking mode, data may be read by executing the function once.

For the error codes of communication using MC protocol please refer to the MR-MQ100 Motion controller Users Manual.

Example ▽ Reading of D2000–D2063

Command

Byte order	Value (hex)	Description	Word order	Value (hex)
1	50	Sub header	1	0050
2	00			
3	00	Network No.	2	FF00
4	FF	PC No.		
5	FF	Destination I/O No.	3	03FF
6	03			
7	00	Destination Station No.	4	0C00
8	0C	Request data length (h0C = 12 bytes)		
9	00		5	1000
10	10	CPU monitoring timer		
11	00		6	0100
12	01	Command (h0401 ⟶ batch read)		
13	04		7	0004
14	00	Subcommand		
15	00		8	00D0
16	D0	Starting Address (h07D0 ⟶ D2000)		
17	07		9	0007
18	00	Data type (hA8 ⟶ D-register)		
19	A8		10	40A8
20	40	Reading data length (h40 ⟶ 64 points)		
21	00		11	0000

Tab. 5-5: *MC Protocol for Batch Read*

Response

Byte order	Value (hex)	Description	Word order	Value (hex)
1	D0	Sub header	1	00D0
2	00			
3	00	Network No.	2	FF00
4	FF	PC No.		
5	FF	Destination I/O No.	3	03FF
6	03			
7	00	Destination Station No.	4	8200
8	82	Response data length (No. of receive bytes + 2)		
9	0		5	0000
10	0	Complete code		
11	0		6	..00
12	Data1	Low byte		
13	Data1	High byte	7	....
14	Data2	Low byte		
15	Data2	High byte	8	....
16	Data3	Low byte		
17	Data3	High byte	....	....
...	...	...		
139	Data64	High byte	70	....

Tab. 5-6: *MC Protocol for Batch Read*

△

Example ▽ Writing of D3000–D3063

Command

Byte order	Value (hex)	Description	Word order	Value (hex)
1	50	Sub header	1	0050
2	00			
3	00	Network No.	2	FF00
4	FF	PC No.		
5	FF	Destination I/O No.	3	03FF
6	03			
7	00	Destination Station No.	4	8C00
8	0C	Request data length (No. of send byte + 12)		
9	00		5	1000
10	10	CPU monitoring timer		
11	00		6	0100
12	01	Command (h1401 ⟶ batch write)		
13	14		7	0014
14	00	Subcommand		
15	00		8	B800
16	B8	Starting Address (h0BB8 ⟶ D3000)		
17	0B		9	000B
18	00	Data type (hA8 ⟶ D-register)		
19	A8		10	40A8
20	40	Reading data length (h40 ⟶ 64 points)		
21	00		11	..00
22	Data1	Low byte		
23	Data1	High byte	12	....
24	Data2	Low byte		
25	Data2	High byte	13	....
26	Data3	Low byte		
27	Data3	High byte	...	....
...	...	...		
149	Data64	High byte	75	....

Tab. 5-7: *MC Protocol for Batch Write*

NOTE

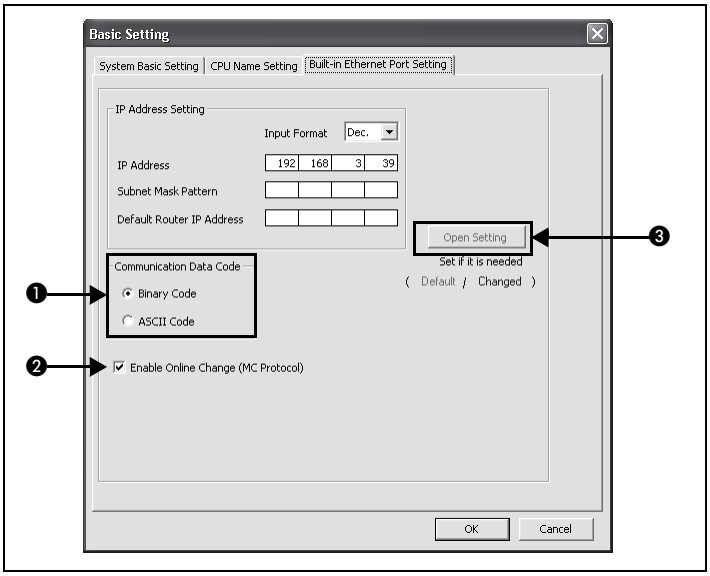
It is important to understanding how the data are handled, because the order of the bytes is correct however they have been shifted by one byte within the PLC (see the data table).
The Mitsubishi PLC is always using words, so it is necessary to create form the shifted byte data, values using a word format. This could be done by a for-next loop that rearranges the high byte and low byte and puts them in a readable word format.

△

5.3.6 Setting for MC protocol communication

Setting for communication using the MC protocol is described below.

Set the items of following ❶ to ❸ in the "Built-in Ethernet Port Setting" of the "Basic Setting" of MT Developer2.



① Communication data code

Select a communication data code used for the MC protocol, ***Binary code*** or ***ASCII code***.

② Enable online change (MC protocol)

Check the checkbox to enable online change when writing data to the Motion controller from the external device that communicates using the MC protocol.
For details on the available functions with this setting, refer to section 5.3.3.

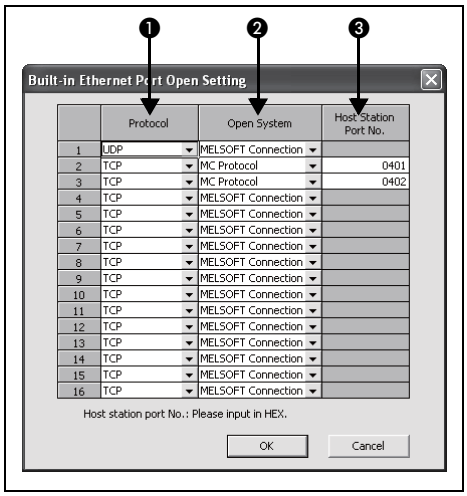
③ Open Setting

Set the following items.

– Protocol (❶)
Select a connection used as MC protocol. (Up to 16 CPU modules can be connected.)

– Open System (❷)
Select ***MC protocol***.

– Host Station Port No. (Required) (❸)
Set the host station port number (in hexadecimal).
Setting range: 0401H–1387H, 1392H–FFFEH



NOTE

When the "Enable online change (MC protocol)" box is unchecked, if a data write request is sent from an external device to the Motion controller which is in the RUN status, data will not be written to the Motion controller and the module returns the NAK message.

5.4 FX3U/FX3G Communication

5.4.1 Hardware Configuration

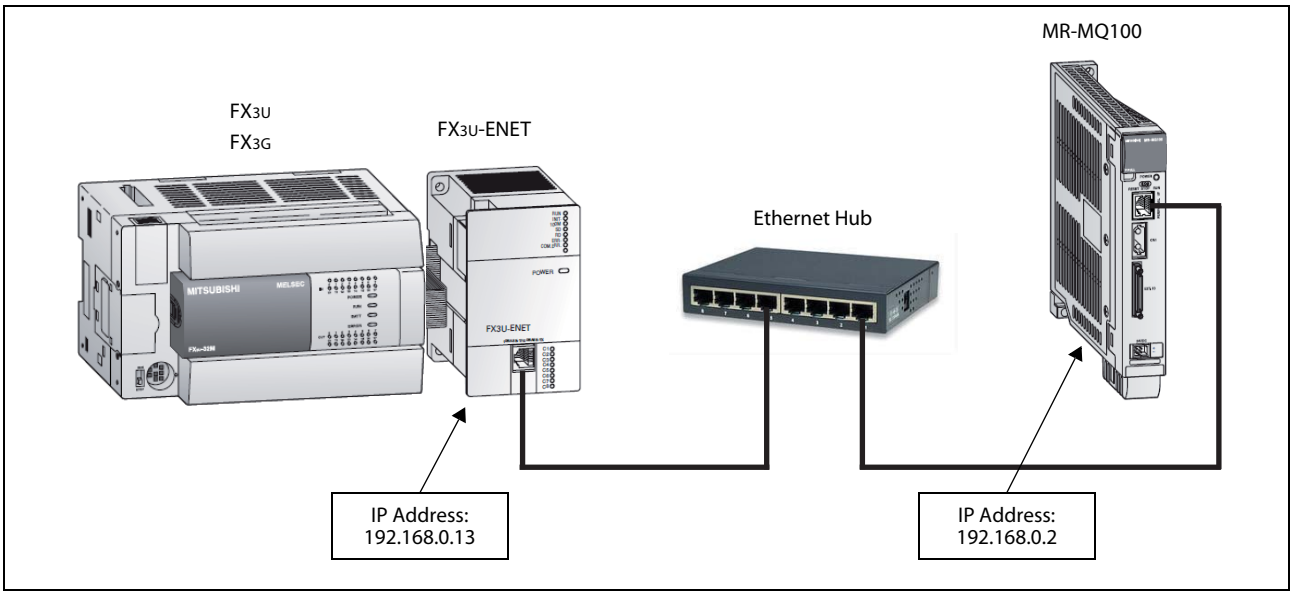
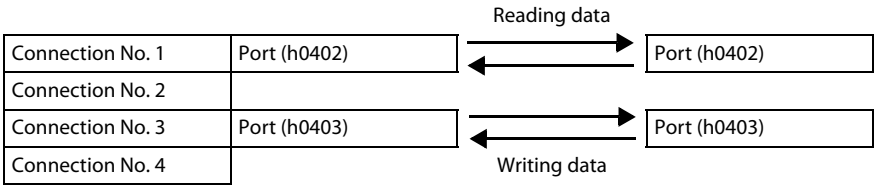
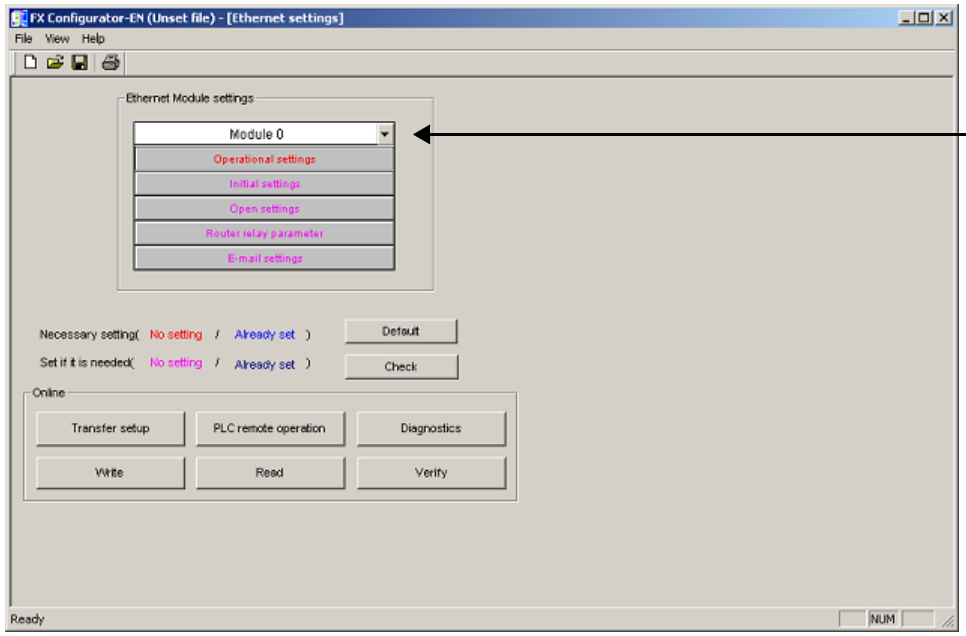


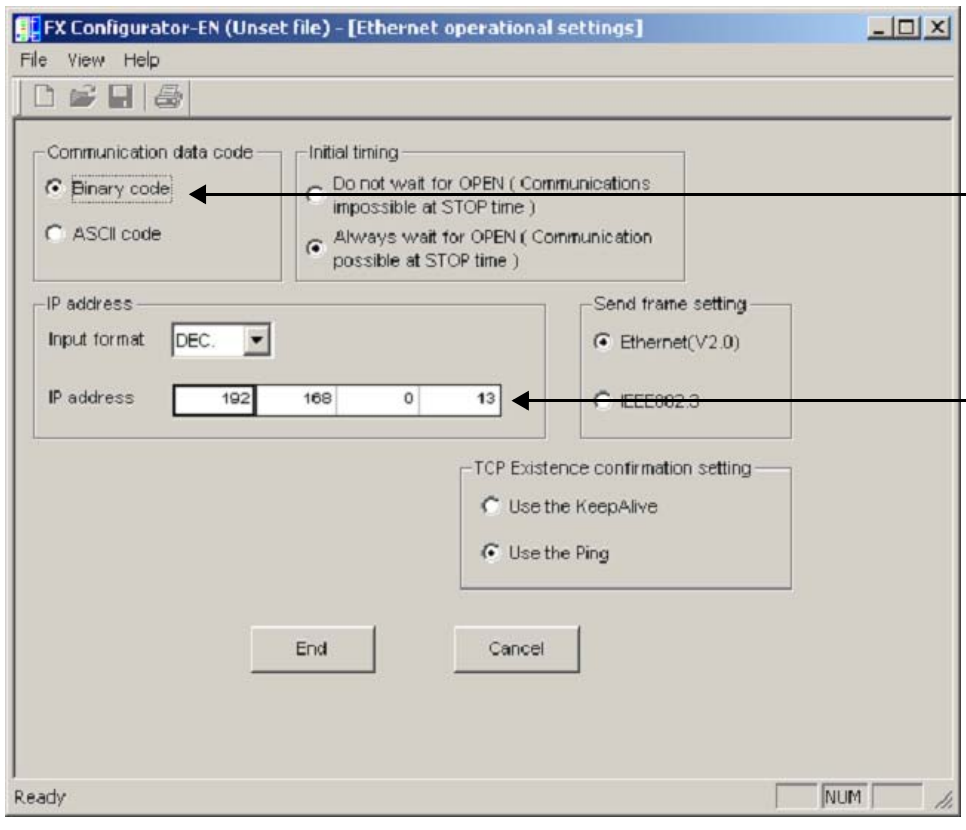
Fig. 5-12: *Ethernet communication via Hub*



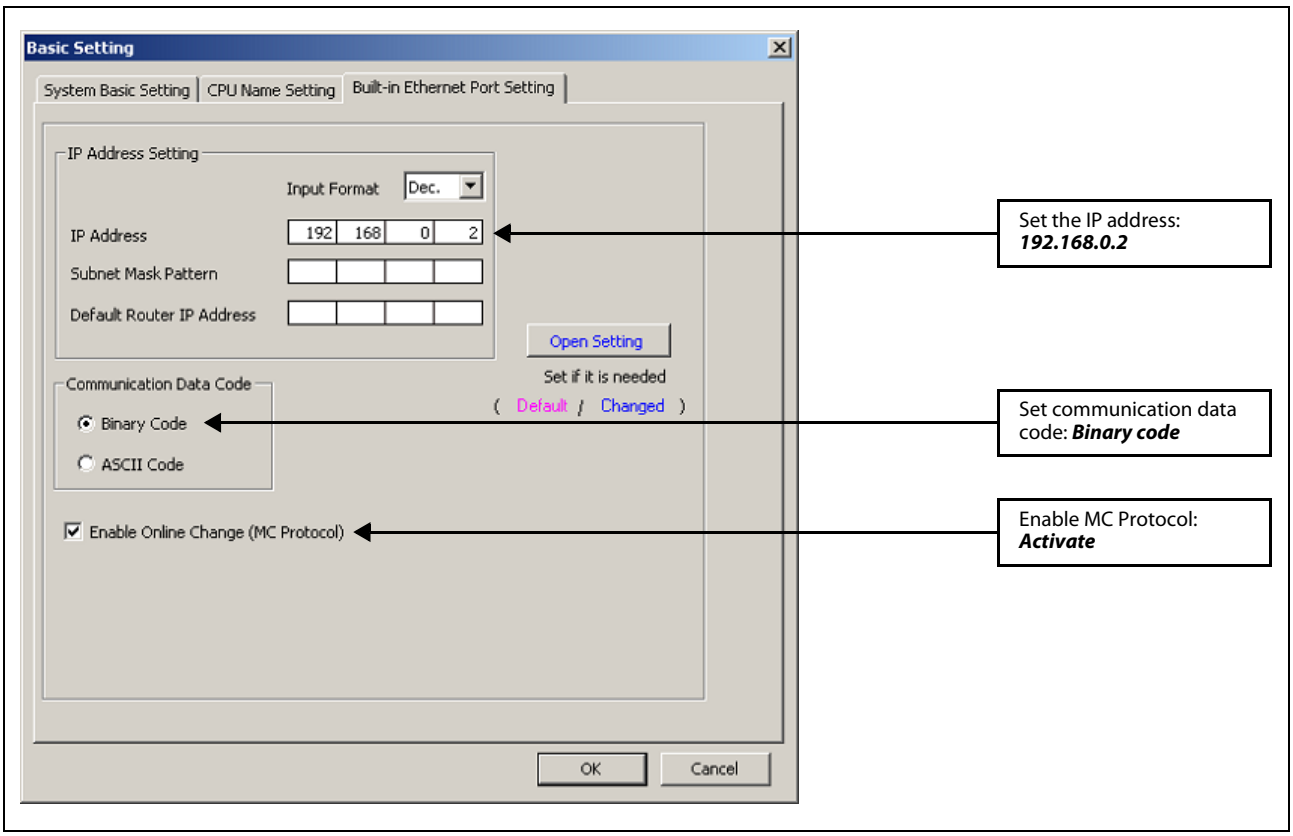
5.4.2 Software Configuration

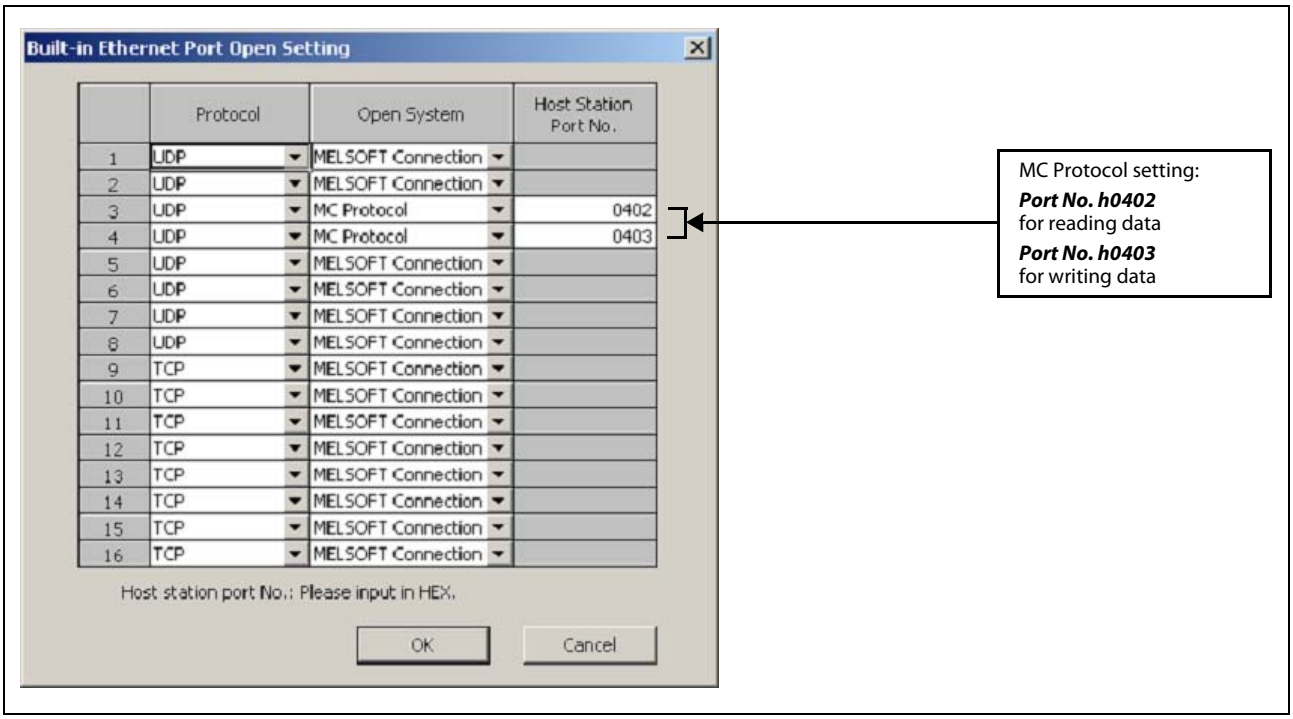
The FX3U-ENET module requires the following configuration by FX Configurator-EN.





The MR-MQ100 requires the following configuration by MT Developer2.





5.4.3 PLC Programming

The FX3U PLC CPU requires a program where the MC Protocol is generated and send out via Ethernet module to MR-MQ100 for reading and writing devices.

There are 2 program examples shown for GX Developer and GX IEC Developer.

① GX Developer ladder program for reading D2000–D2063 from MR-MQ100

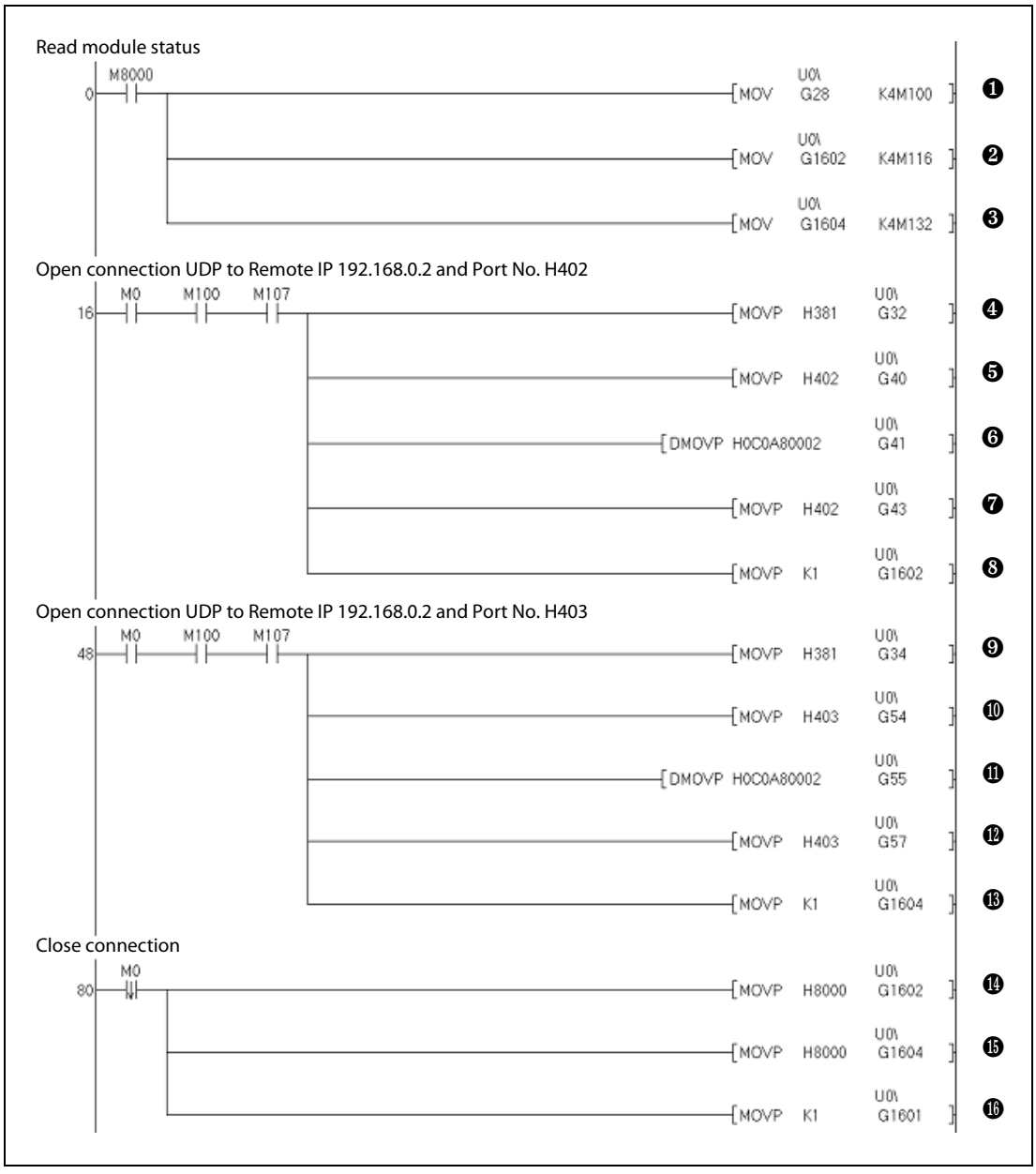


Fig. 5-13: *Ladder program (1)*

Number	Description
❶	Read FX3U-ENET status
❷	Read Connection no. 1 status
❸	Read Connection no. 3 status
❹	Connection no. 1 setup
❺	Local Port No. h0402
❻	Destination IP Address
❼	Destination Port No. h0402
❽	Open command
❾	Connection no. 3 setup
❿	Local Port No. h0403
⓫	Destination IP Address
⓬	Destination Port No. h0403
⓭	Open command
⓮	Close command Con. no. 1
⓯	Close command Con. no. 3
⓰	[COM.ERR.] LED Off request

Tab. 5-8: *Description of the ladder program (1) in fig. 5-13*

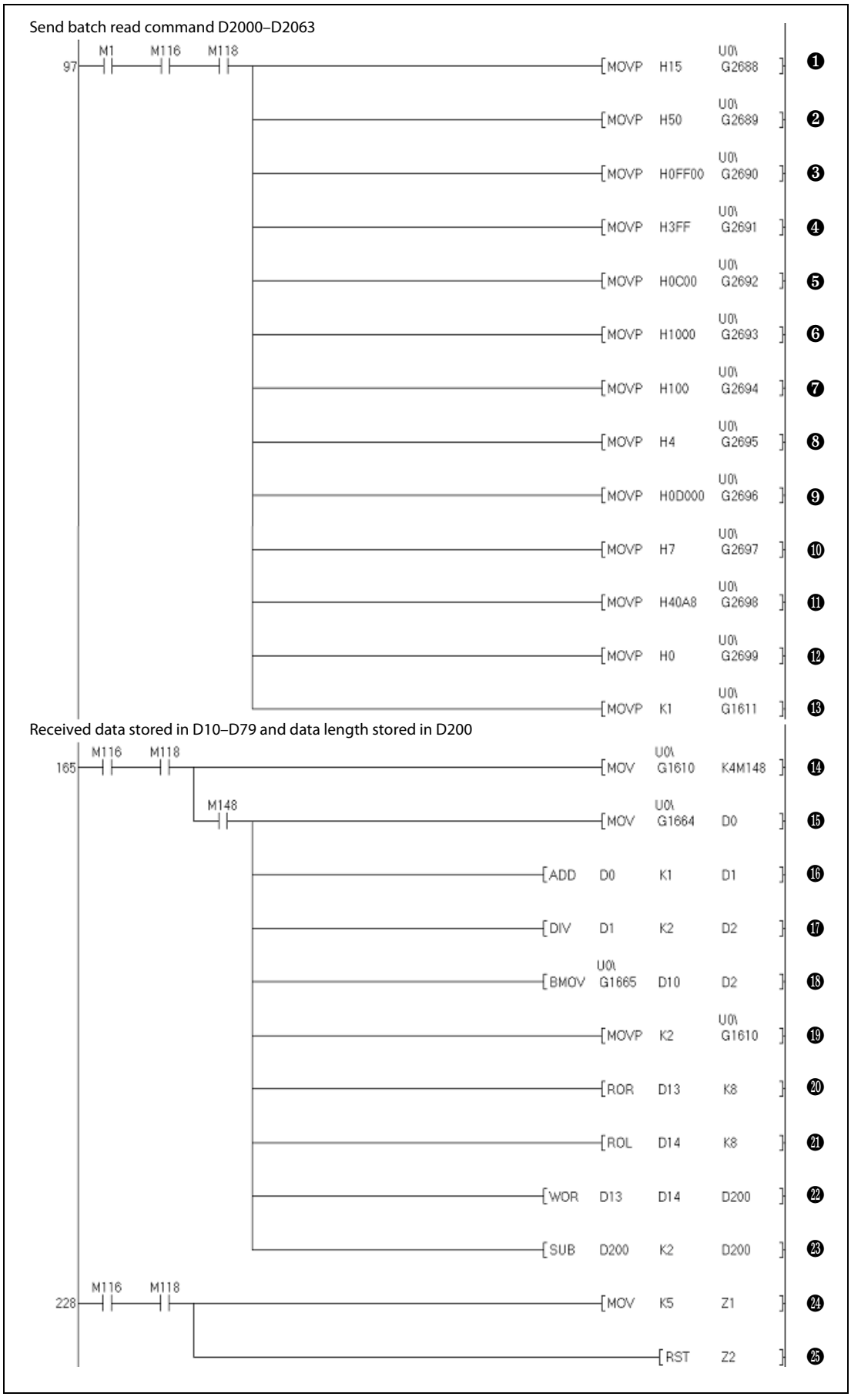


Fig. 5-14: *Ladder program (2)*

Number	Description
❶	Data length for Fix Buffer 2
❷	MC frame (Subheader)
❸	MC frame (Net. & PC No.)
❹	MC frame (Module I/O No.)
❺	MC frame (Data length)
❻	MC frame (Mon. timer)
❼	MC frame (Command)
❽	MC frame (Sub-Command)
❾	MC frame (Starting address)
❿	MC frame (Starting address)
⓫	MC frame (Data type & length)
⓬	MC frame (Data length)
⓭	Send command
⓮	Receive status
⓯	Receive data length in byte
⓰	Add 1 to byte for even value
⓱	Divide by 2 to get word length
⓲	Read data to D10
⓳	Read complete
⓴	Receive data length low byte
㉑	Receive data length high byte
㉒	Receive data length in bytes
㉓	Receive data length in words
㉔	Initial Index Register
㉕	Initial Index Register

Tab. 5-9: *Description of the ladder program (2) in fig. 5-14*

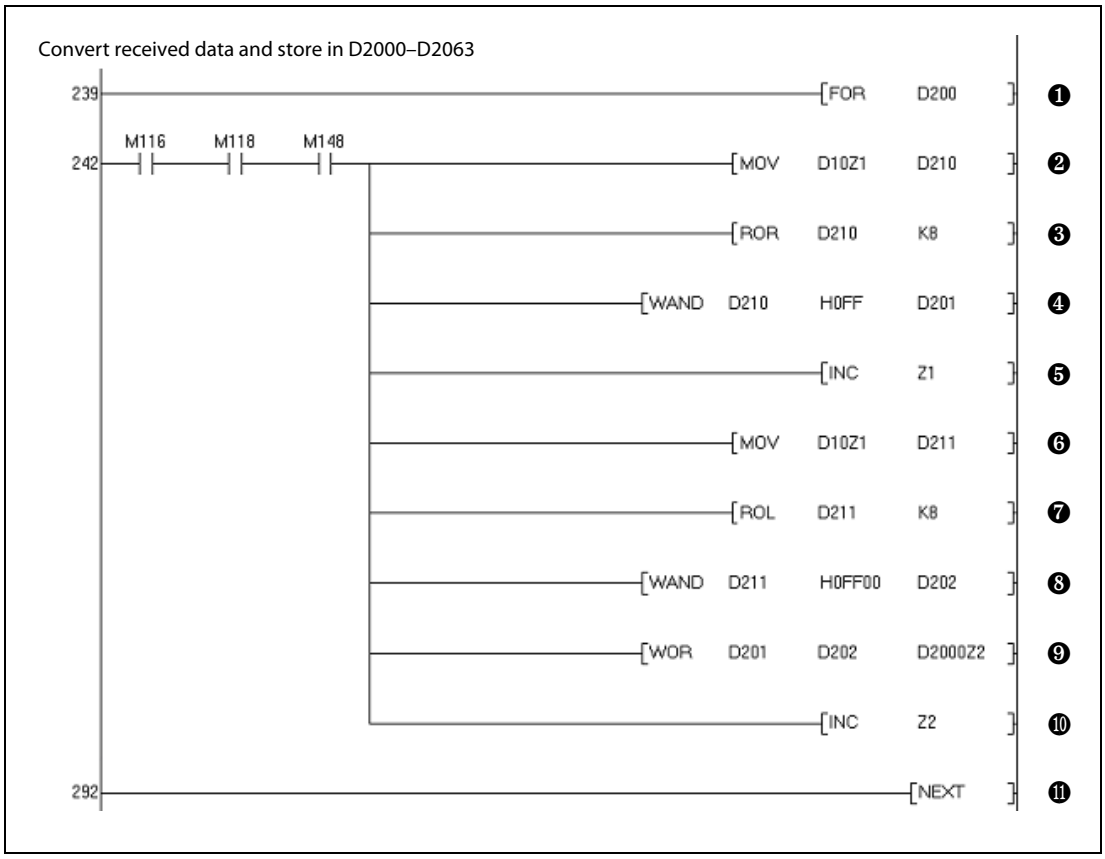


Fig. 5-15: *Ladder program (3)*

Number	Description
❶	For loop
❷	Split value
❸	Rotate data right
❹	WORD AND with hex FF
❺	Increment Z1
❻	Split value
❼	Rotate data left
❽	WORD AND with hex FF
❾	Store converted value
❿	Increment Z2
⓫	Next command

Tab. 5-10: *Description of the ladder program (3) in fig. 5-15*

NOTE

The received data which are stored in the buffer memory of the FX3U-ENET module, the low and high bytes are swapped. The program above converts the received data and store them in the data register D2000–D2063.

GX IEC Developer program with function block for reading D2000–D2063 from MR-MQ100

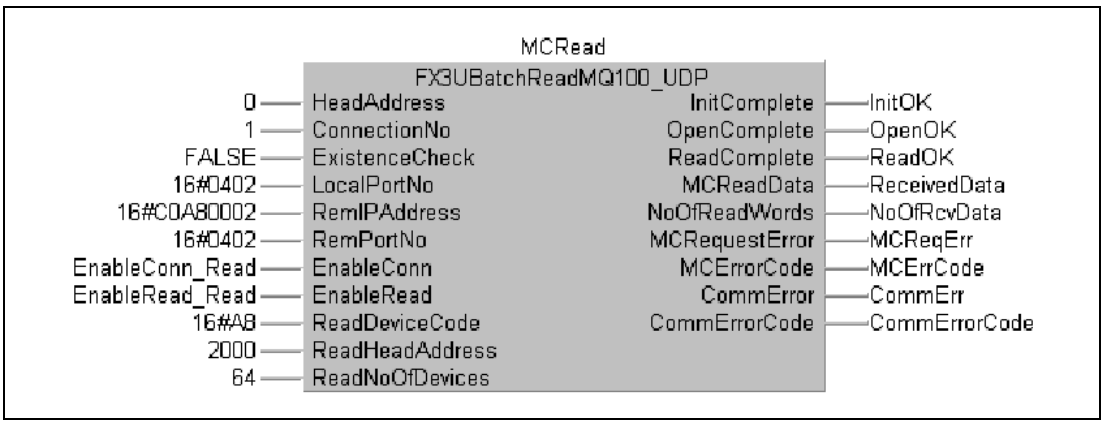


Fig. 5-16: *Ladder diagram Batch Read*

Input variables	Explanation
HeadAddress	Head address of the FX3U-ENET module
Connection No	Connection number
ExistenceCheck	Set the usage of the destination existence check
LocalPortNo	Set the local station port number (h0402)
RemIPAddress	IP Address of the remote device station (192.168.0.2)
RemPortNo	Port number of the remote device station (h0402)
EnableConn	Open the communication connection
EnableRead	Start the MC Protocol batch read command
ReadDeviceCode	Set the device type (A8 → D-register)
ReadHeadAddress	Set the start device address (2000 → D2000)
ReadNoOfDevices	Set the number of devices (64 → D2000–D2063)

Ouput variables	Explanation
InitComplete	Initialization procedure completed
OpenComplete	Connection status
ReadComplete	MC Protocol Batch Read command completed
MCReadData	Device Array with read data
NoOfReadWords	Number of data words read in MCReadData array
MCRequestError	MC Protocol error occurred
MCErrorCode	MC Protocol error code
CommError	Communication error occurred
CommErrorCode	Communication error code

GX IEC Developer program with function block for writing D3000–D3063 to MR-MQ100

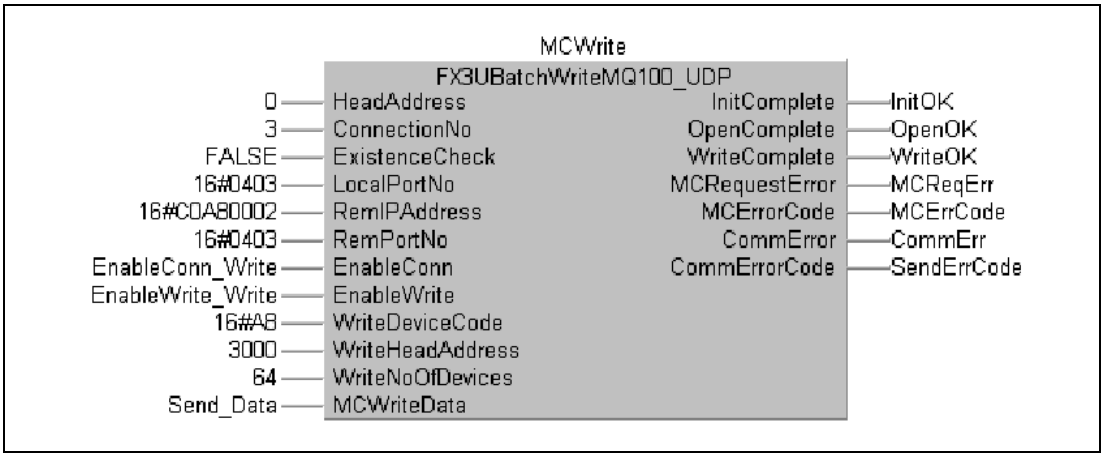


Fig. 5-17: *Ladder diagram Batch Write*

Input variables	Explanation
HeadAddress	Head address of the FX3U-ENET module
Connection No	Connection number
ExistenceCheck	Set the usage of the destination existence check
LocalPortNo	Set the local station port number (h0403)
RemIPAddress	IP Address of the remote device station (192.168.0.2)
RemPortNo	Port number of the remote device station (h0403)
EnableConn	Open the communication connection
EnableWrite	Start the MC Protocol batch write command
WriteDeviceCode	Set the device type (A8 → D-register)
WriteHeadAddress	Set the start device address (3000 → D3000)
WriteNoOfDevices	Set the number of devices (64 → D3000–D3063)
MCWriteData	Device Array with write data

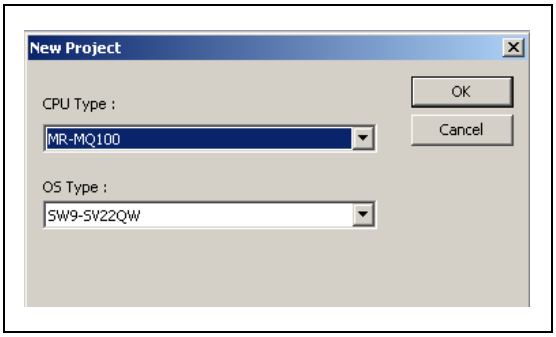
Ouput variables	Explanation
InitComplete	Initialization procedure completed
OpenComplete	Connection status
WriteComplete	MC Protocol Batch Write command completed
MCRequestError	MC Protocol error occurred
MCErrorCode	MC Protocol error code
CommError	Communication error occurred
CommErrorCode	Communication error code

6 Project creation

NOTE

The sample programs, described in this manual can be downloaded free of charge through the website www.mitsubishi-automation.com/mymitsubishi/mymitsubishi_content.html.

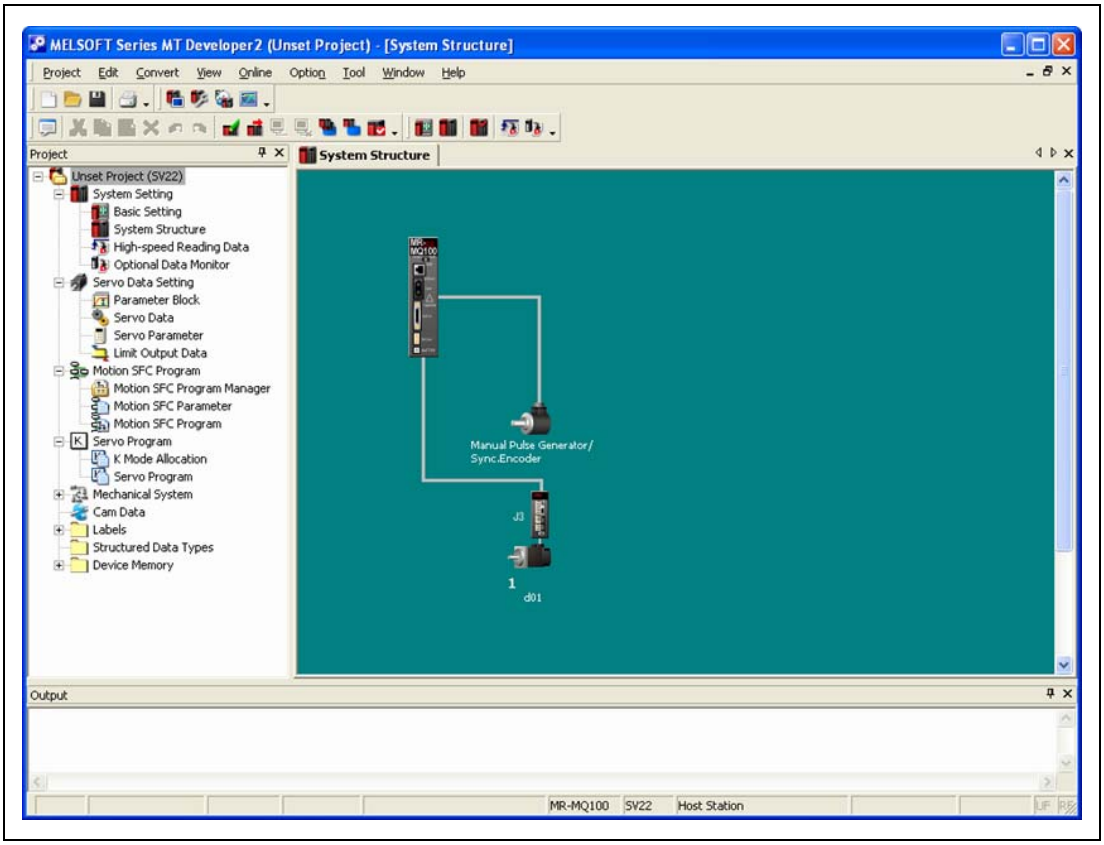
6.1 Sample project creation with MT Developer2

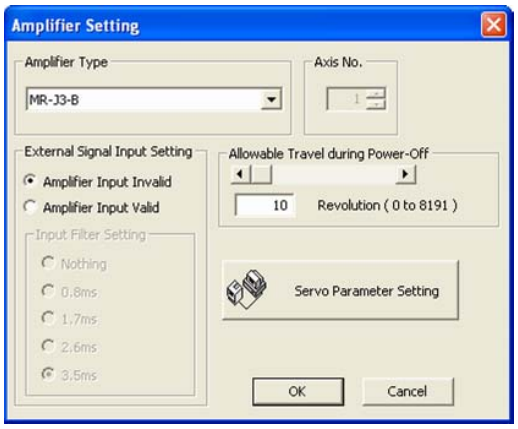


① New project creation

Start MT Developer2 and create a new project with CPU and OS Type selected as shown left.

After clicking ***OK*** in the New Project Window, the MT Developer2 project window will appear, as shown below.

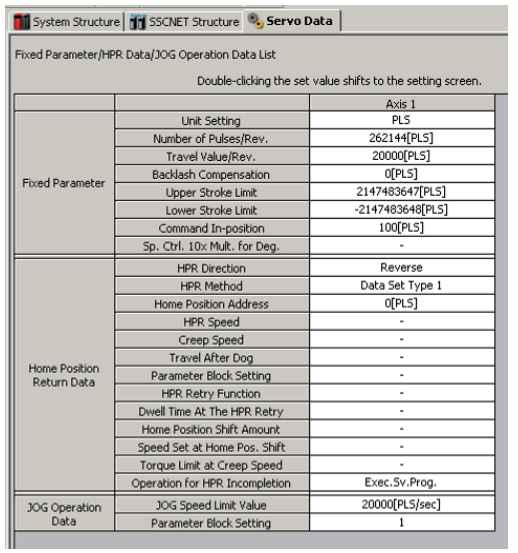




② System Structure Settings

Double-click the amplifier icon (SSCNET Structure) to confirm the set amplifier type is correct.

If any I/O are wired to the amp, such as home or limit sensors, select the ***Detail Setting*** tab and set the ***External Signal Input Setting*** to ***Amplifier Input Valid.***



		Axis 1
Fixed Parameter	Unit Setting	PLS
	Number of Pulses/Rev.	262144[PLS]
	Travel Value/Rev.	20000[PLS]
	Backlash Compensation	0[PLS]
	Upper Stroke Limit	2147483647[PLS]
	Lower Stroke Limit	-2147483648[PLS]
	Command In-position	100[PLS]
	Sp. Ctrl. 10x Mult. for Deg.	-
Home Position Return Data	HPR Direction	Reverse
	HPR Method	Data Set Type 1
	Home Position Address	0[PLS]
	HPR Speed	-
	Creep Speed	-
	Travel After Dog	-
	Parameter Block Setting	-
	HPR Retry Function	-
	Dwell Time At The HPR Retry	-
	Home Position Shift Amount	-
	Speed Set at Home Pos. Shift	-
	Torque Limit at Creep Speed	-
	Operation for HPR Incompletion	Exec.Sv.Prog.
JOG Operation Data	JOG Speed Limit Value	20000[PLS/sec]
	Parameter Block Setting	1

③ Servo Data Settings and Parameter Block

In the "MT Developer2 Project Window Menu", double-click ***Servo Data*** to bring up the "Servo Data" tab.

Edit the settings so that they match the screenshot shown in the left figure.

– "Travel Value/Rev." should represent how far the load moves for every rotation of the motor.

Example ▽ The ball screw lead is 5 mm and the mechanical gear ratio is 1/5.

Servomotor:	HF-KP43
Unit setting:	mm
Number of Pulses/Rev.:	262 144 [PULSES]
Travel Value/Rev.:	1/5 x 5 000.0 = 1 000.0 [µm]

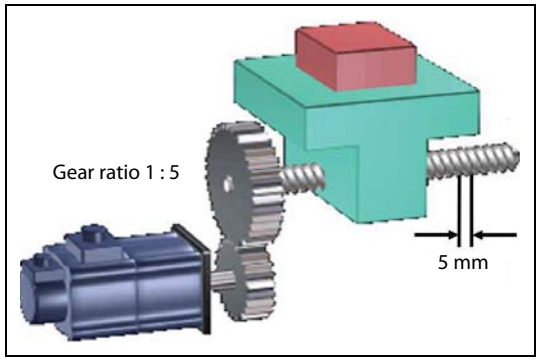


Fig. 6-1: *Mechanical configuration of the example*

△

– "Upper stroke limit" and "Lower stroke limit" enable software stroke limits.

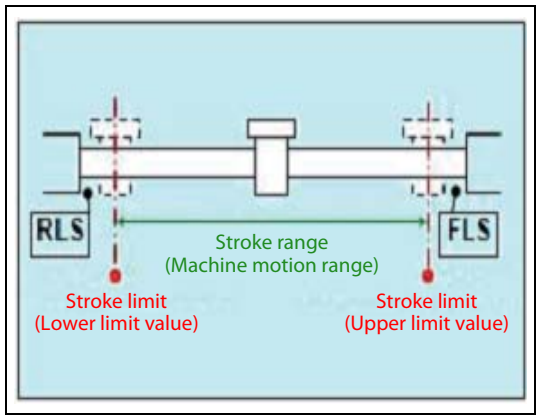
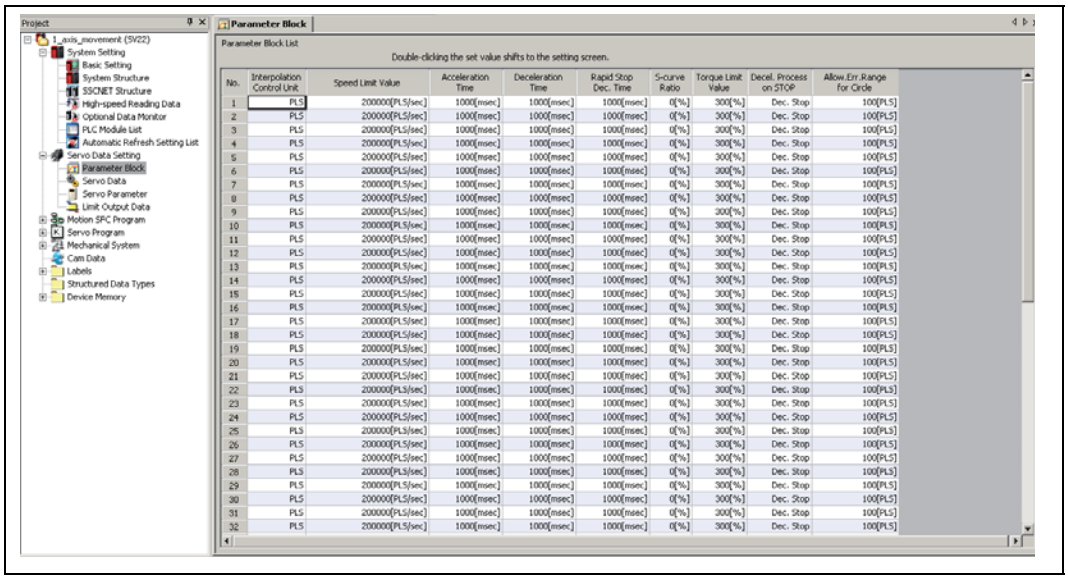


Fig. 6-2: *Stroke limits*

– "Exec.Sv.Prog." will allow the servo programs to be executed even if the servo motor has not yet been homed. If "Not Exec.Sv.Prog." is selected and the servo has not been homed, the servo programs will stop and an error will occur.

– The Parameter Blocks, accessible by the "Servo Data" menu, serve to make setting changes easy by allowing data such as the acceleration/deceleration control to be set for each positioning processing.
A maximum of 64 blocks can be set as parameter blocks.



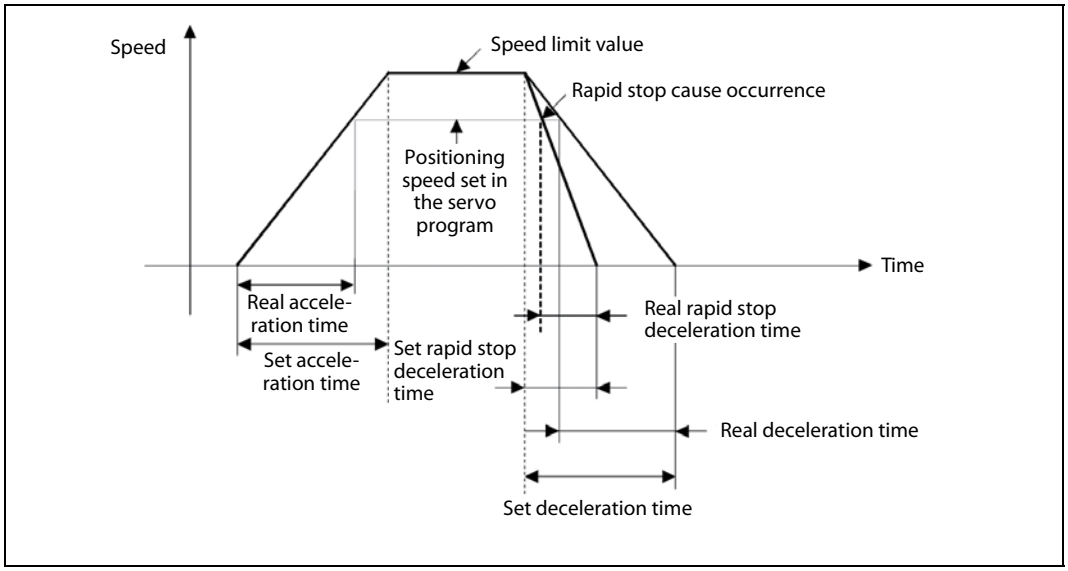
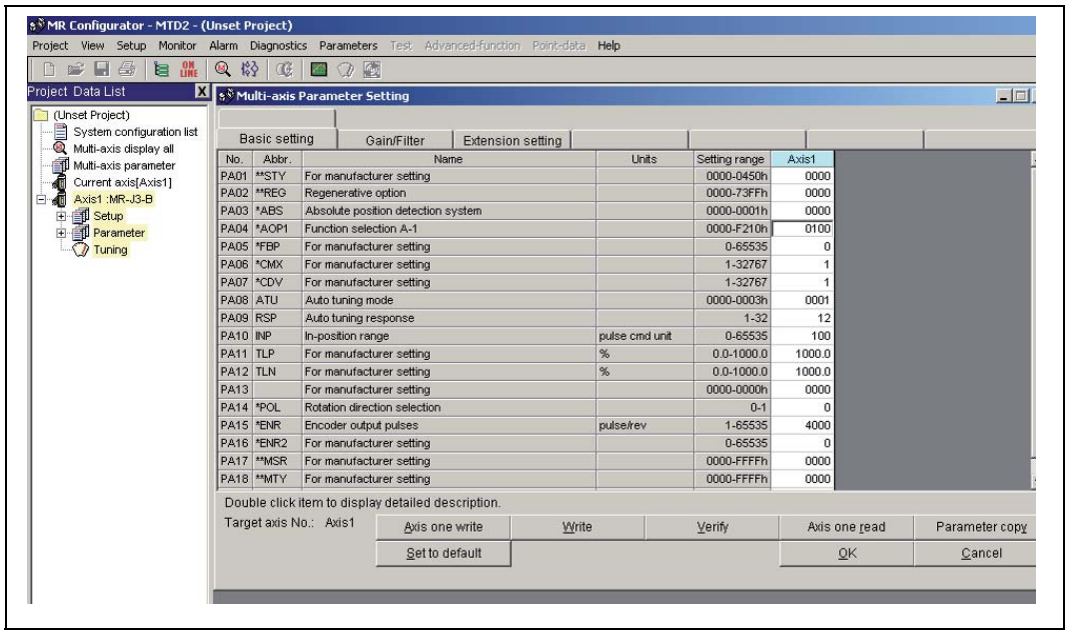


Fig. 6-3: *Time diagram for setting of parameter blocks*

④ Servo Parameter Settings

In the "Project Window Menu", double-click ***Servo Parameter***. This will launch the servo setup software called MR Configurator.



Please change the following parameter in the "Basic setting":

- PA04: 0100
  (Disabling the EMG input on servo amplifier. This will allow the amplifier to operate regardless of forced stop input status.)
- PA14: 0 or 1 according to the motor rotation direction (CW or CCW)

and click ***OK***.

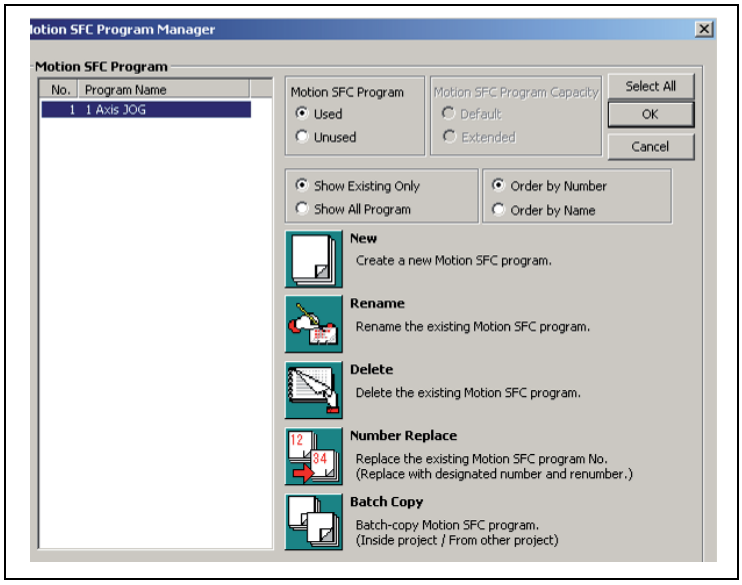
NOTE

Launching MR Configurator from within MT Developer2 is not the same as launching MR Configurator from the Windows Start Menu. Opening from within MTD2 allows changes to servo parameters to be saved within the MTD2 project files.

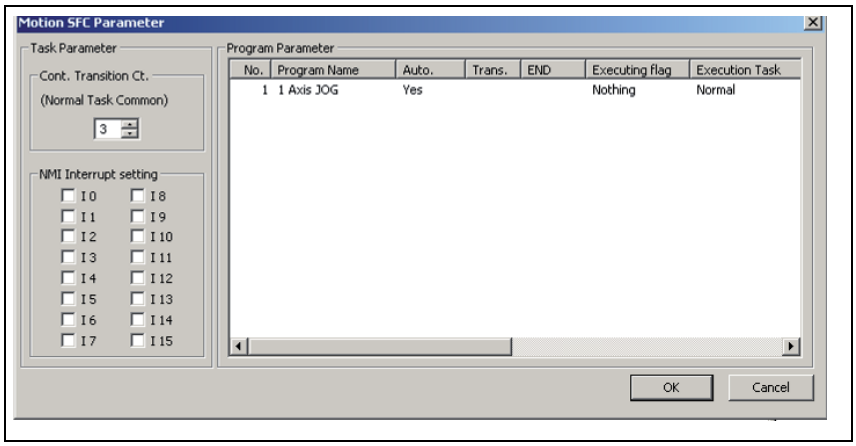
⑤ Motion SFC Program Creation

In the "Project Window Menu" under "Motion SFC Program", double-click ***Motion SFC Program Manager***. This open the "Motion SFC Program Manager" pop-up window.

Click the icon ***New*** which opens up the "New Motion SFC Program" window. Set the Motion SFC Program No. to "1", enter "1 Axis JOG" as the program name and then click ***OK***.

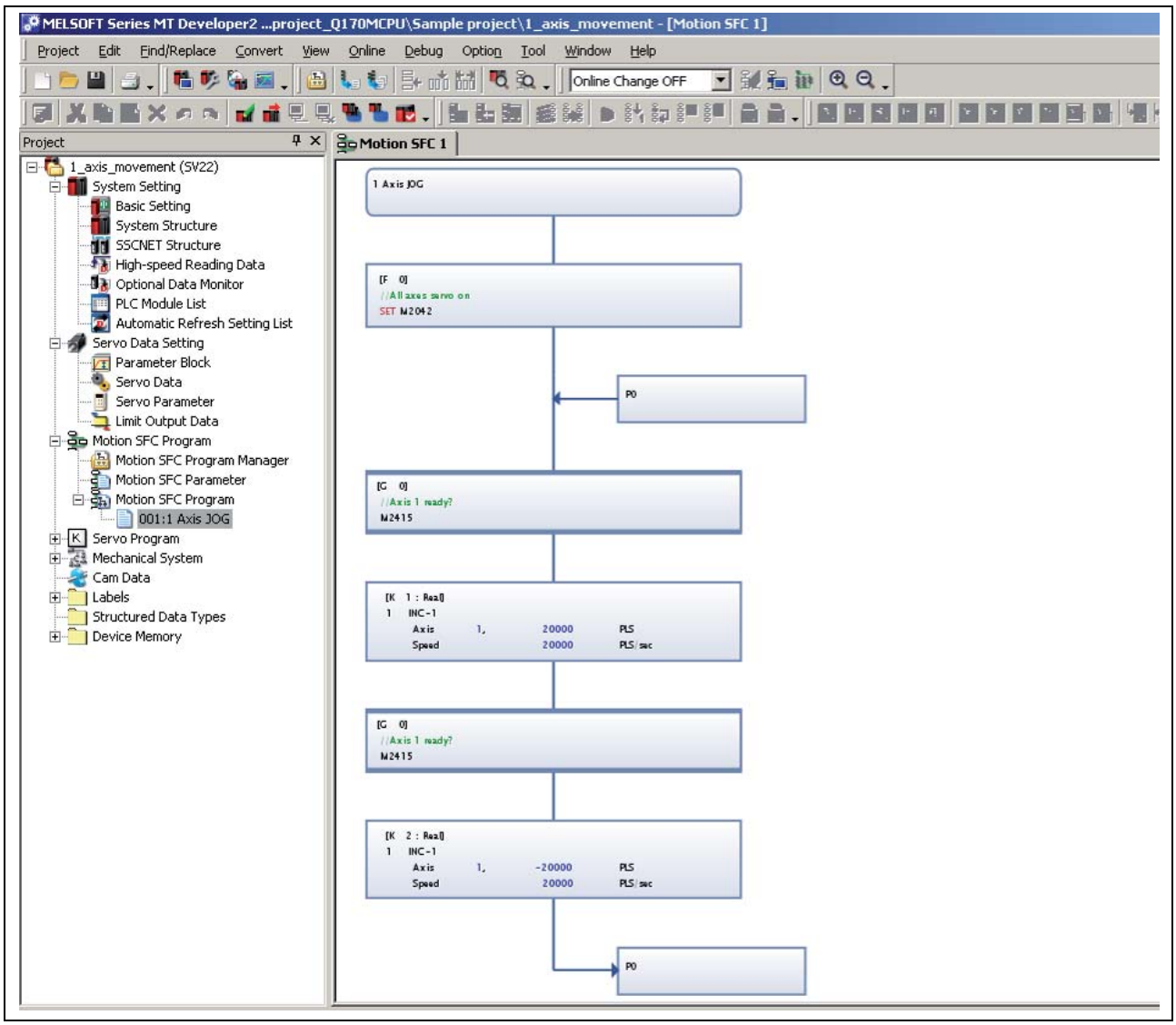


In the "Project Window Menu" under “Motion SFC Program”, double-click ***Motion SFC Parameter***. This open the “Motion SFC Parameter” pop-up window.



Double-click ***program 1*** and then change the Start Setting to "Automatic Start". Then close this window.

Prepare an SFC program. The sample program below allows a simple forward and backward movement of Axis 1.

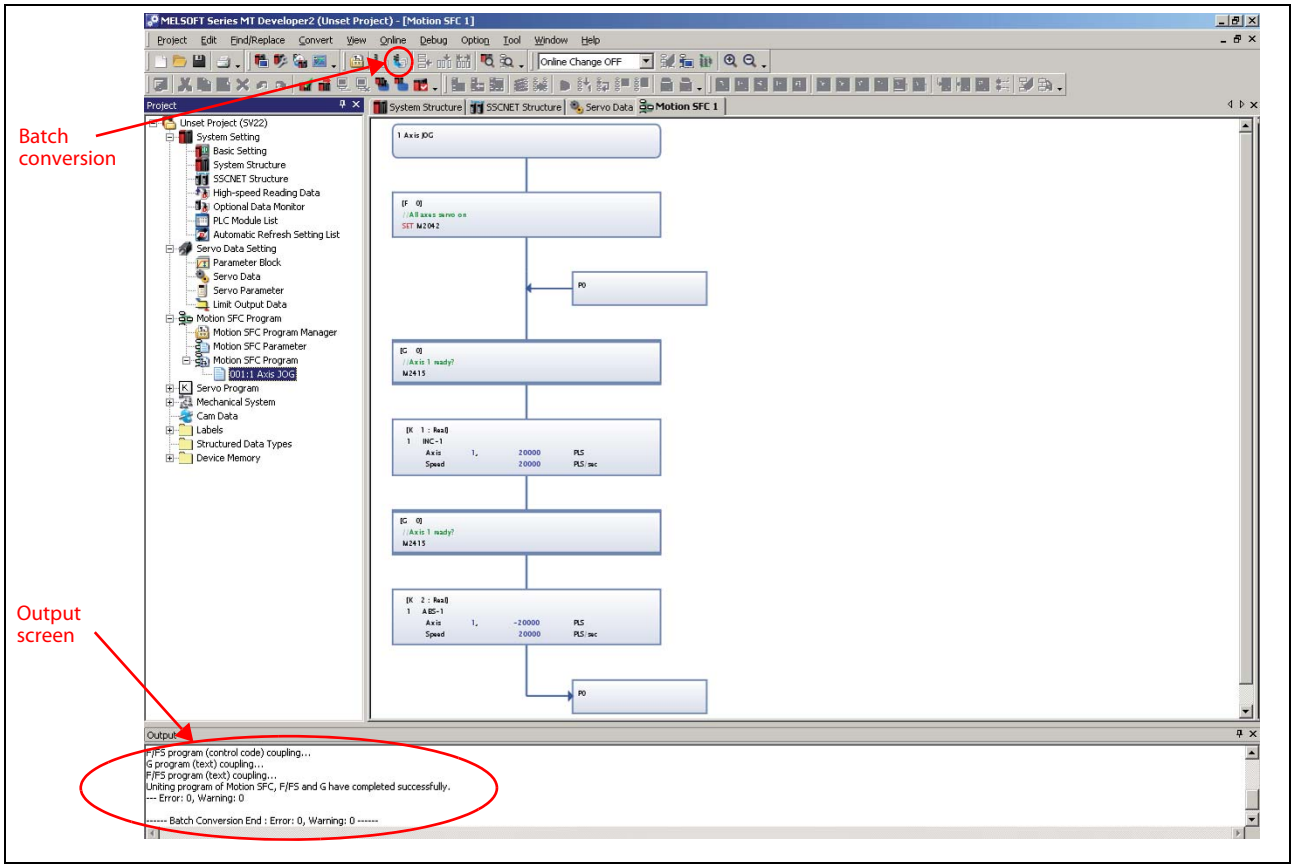


Step	Description
5a	Add an F-block, 2 x G-block, 2 x K-block, a Jump, and a Pointer to the program by left-clicking the respective button on the menu bar and left-clicking in the program workspace. Press the ***Esc*** key (or right click) after adding each block to the workspace.
5b	Double-click the ***F-block***, enter "0" for the program number. Next, press ***Enter*** or click the ***Edit*** button. In the Program Editor window, type "SET M2402". The common system device M2402 enables "Servo On" for all axes when set.
5c	Double-click the ***G-block***, enter "0" for the program number. Next, press ***Enter*** and then input the text "M2415". The axis status device M2415 shows if axis 1 is ready. We are telling the controller to wait until the axis is fully initialized before moving on to the next step. Without such a delay in front of a motion command (K-block), an error is likely to occur.
5d	Double-click the ***K-block***, enter "1" for the program number. Next, press ***Enter*** and select "Linear Interpol." as the Command Class and "INC-1" as the Servo Command. Click ***OK***. The Servo Program Editor window will now open. In the Servo Program Editor window, set the Axis to 1 and the travel amount to 20000 PLS. Then set the Speed to 20000 PLS/s.
5e	Repeat step 5c.
5f	Repeat step 5d changing the travel amount to -20000 PLS.
5g	Connect each function block to the one after it by clicking the ***Connect*** button from the menu bar and then left-clicking on one block and dragging to the next box.

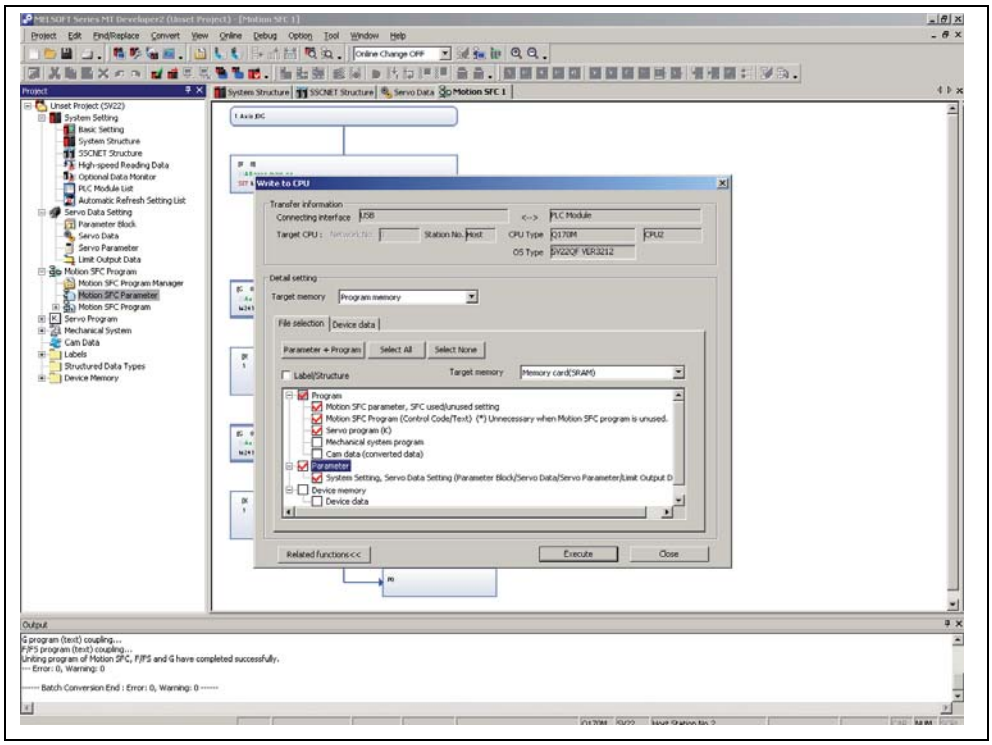
Tab. 6-1: *Detailed procedure for preparing the SFC program*

⑥ File Conversion, Download and Program Run

Click the ***Batch Conversion*** button from the menu bar. If all steps were followed correctly, you should receive a "Complete successfully" message in the output bar at the bottom of the screen.



Transfer programs and parameters to the Motion controller using the setting in the screenshot below.



Please refer to the "Writing project to the Motion controller" section of this quick-start guide for further details on writing/reading programs (section 6.2.2).

⑦ Enjoy your program!

Cycle the power supply of MR-MQ100 and MR-J3 servo both.

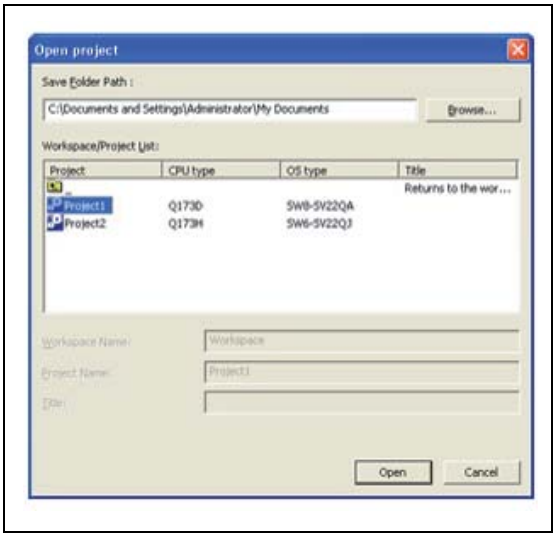
According to the program, you created, the motor will automatically rotate 1 revolution in both directions. The movement will be stopped by using RUN/STOP switch at the MR-MQ100 front panel.

6.2 Additional procedures

6.2.1 Project opening

This section explains the method for reading a project saved in the hard disk or other memory media of the personal computer.

Operating Procedure (MT Developer2 project)



① Select "Project" - "Open Project". The "Open Project" window appears.

② Enter the folder (drive/path), where the workspace is saved, in the Folder field.

③ Double click ***Workspace*** in the "Workspace/ Project List".

④ Select the project data. Details of the specified project data are displayed in the "Project Name" and "Title" columns.

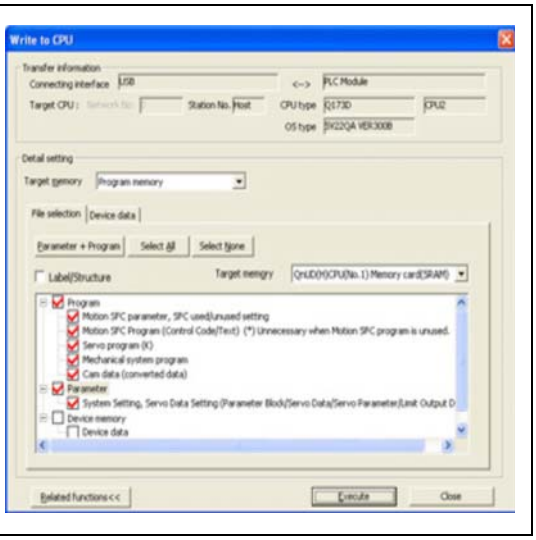
⑤ Click the ***Open*** button.

6.2.2 Writing project to the Motion controller

This section explains the method for writing a project saved in the hard disk or other memory media of the personal computer to the Motion controller internal memory.

Operating Procedure (MT Developer2)

① Select "Online" - "Write to CPU". The "Write to CPU" screen appears.



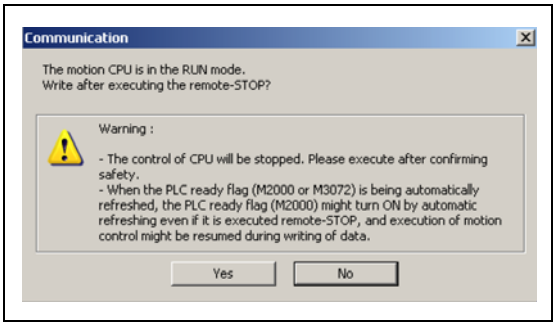
② Select ***Program memory*** as target memory to write to.

③ Click on ***Parameter+ Program*** to select the data to be written.

④ Click the ***Execute*** button.

When a password is registered, the Password Check dialog box appears.

When program write is to be executed, a message appears if there are programs that have not been converted.



⑤ The screen on the left appears if the motion controller is in RUN mode.
Click the ***OK*** button.

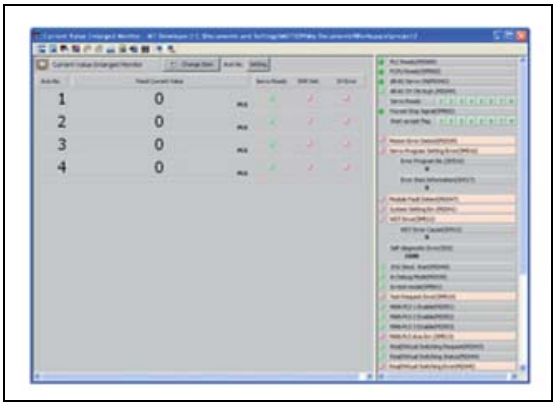
⑥ Once download is complete, another message will appear asking if you would like to place the controller back in Run mode. Again, select ***Yes*** and then ***Close***.

⑦ The specified data is written to the target memory. When writing is completed, the dialog box appears notifying the process completion.

6.2.3 Monitoring function

Operating Procedure

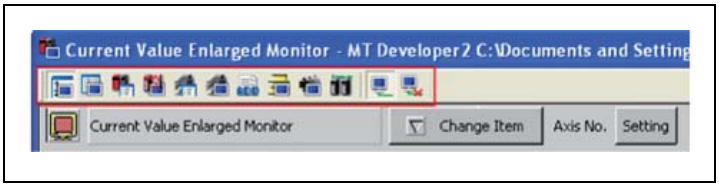
① Click the monitor icon of the application jump toolbar on the main frame.



② Monitor is started.

③ Clicking on the buttons in the shown toolbar is possible to select the devices to be monitored:

- Current value monitor
- Motion error
- Axis monitor
- Servo Monitor
- Positioning monitor
- …



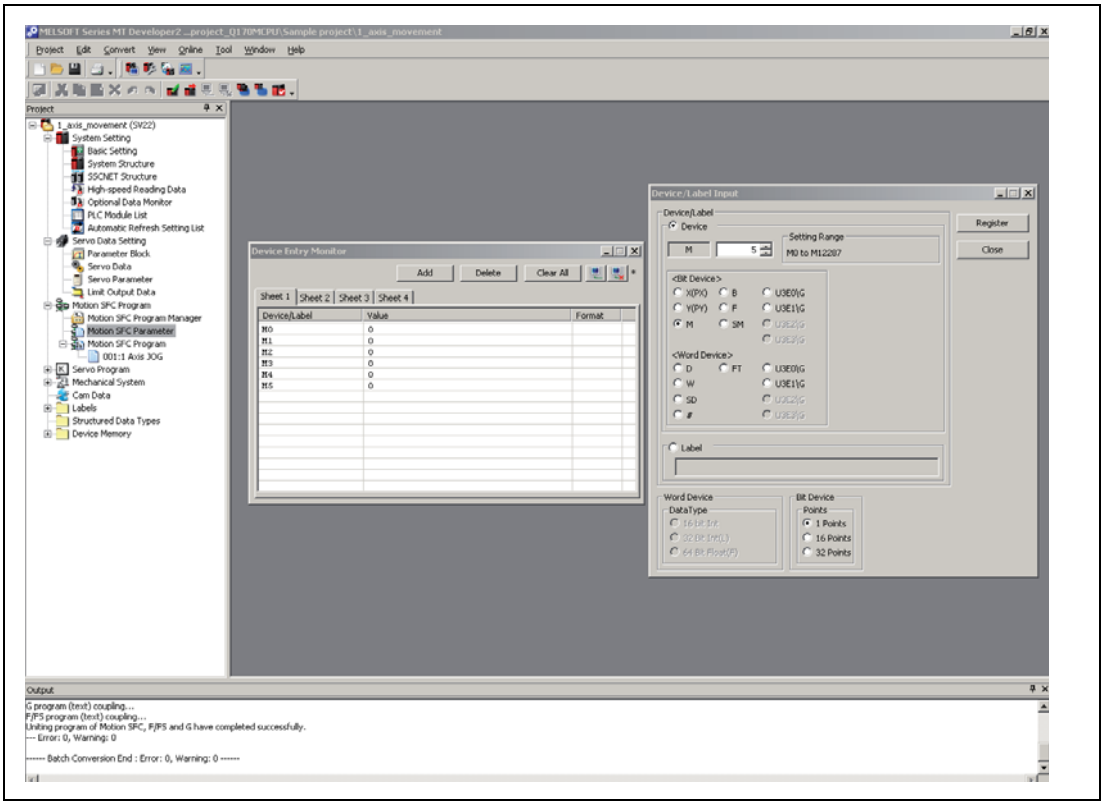
NOTE

Refer to MT Developer2 Help for further information.
Tip: Press function key "F1" for immediate help on displayed function.

6.2.4 Device monitoring and testing

Operating Procedure (MT Developer2)

① Select "Online" - "Monitor" - "Commons" - "Entry Device Monitor".
The "Device Entry Monitor" screen appears.

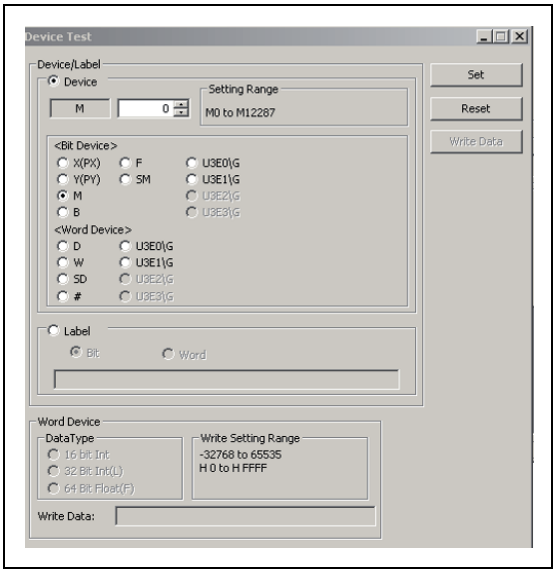


② Click ***Add***. The "Device"/"Label" windows appears.

③ Select the device to be monitored and then push ***Register*** button.
The chosen devices will be displayed in the "Device Entry Monitor".

④ Click ***Close***.

⑤ Click ***Start Monitoring*** button. The actual values of the registered devices will be displayed in the column "Value".



⑥ Double-click the value of the Device to be tested. The "Device Test" window appears.

⑦ Click ***Set*** or ***Reset*** to test the selected bit device or ***Write Data*** to write a value into the selected register.

7 Application Example for MR-MQ100

7.1 Flying Saw application

7.1.1 What is a Flying Saw?

In a flying saw web-cut application, the material to be cut is fed on a continuous conveyor that is driven by an open-loop motor. The saw is mounted on a carriage under servo control that runs parallel to the conveyor. The saw accelerates to meet the velocity of the material to perform the cut at the correct location. When the cut is complete, the saw rapidly decelerates and moves back to the starting position to begin the next cutting cycle. This results in equal length pieces of material being fed to the next machine process.

Flying saw applications don't always involve a saw and can be utilized in a variety of industries for:

- Steel/paper cutting
- Wood machining
- Drilling/embossing
- Filling/sorting
- …

There are 2 typical types for starting of the synchronisation:

- Cutting length control

  An encoder on the material registers the material speed and position of the production process. A length calculator calculates equidistant lengths in the controller and generates a start signal for the synchronising process. The advantage of cutting length control is that no cutting marks are required on the material.

- Cutting mark control

  A sensor registers the cutting marks present on the material. This sensor signal is processed as an interrupt in the drive and starts the sawing process. This method is used if there are cutting marks on the material which have to be referred to, e. g. when using printed materials.

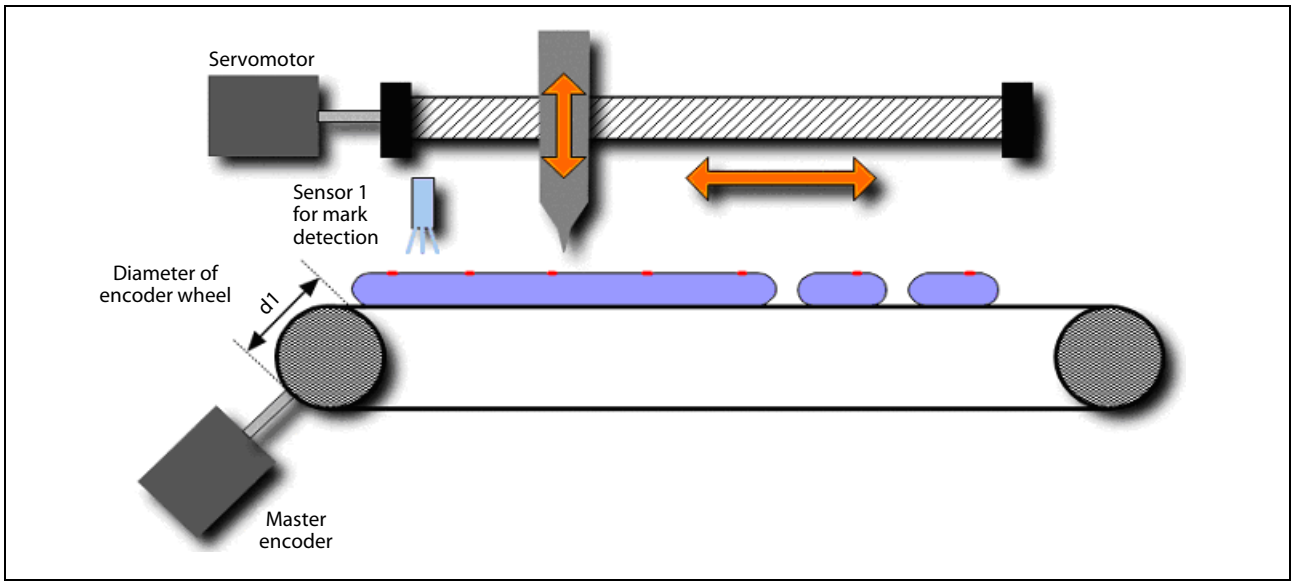


Fig. 7-1: *Typical construction of a flying saw*

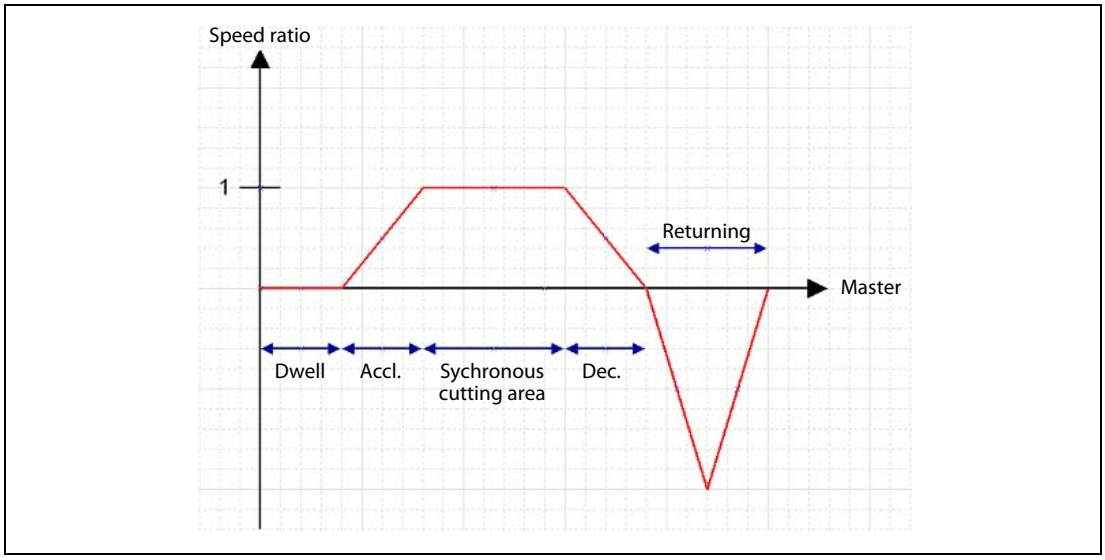


Fig. 7-2: *Relationship between speed ratio of the Master axis and the slave axis*

7.1.2 Machine parameters

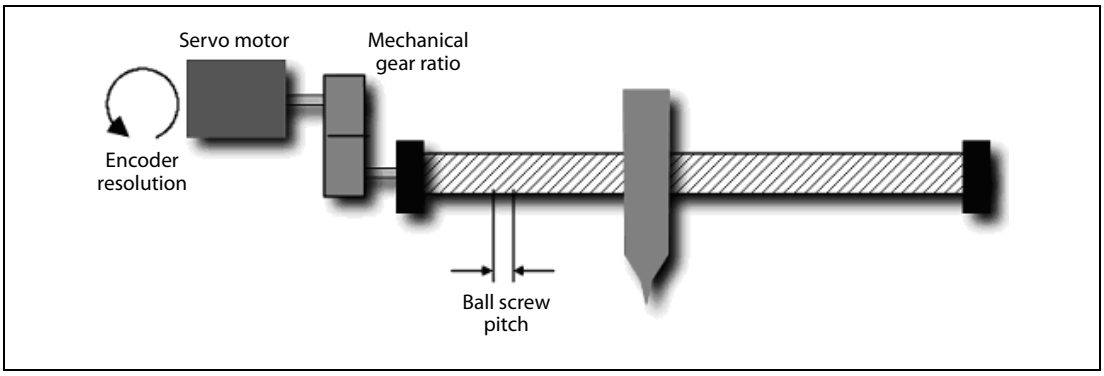


Fig. 7-3: *Mechanical construction of slave axis controlled by servo drive*

Data of the mechanical construction with the slave axis:

- Encoder resolution: 262 144 p/rev
- Mechanical gear ratio: 1:1
- Ball screw pitch: 10 mm

Fixed parameter settings:

- Number of Pulses/Rev. : 262 144 x 1 = 262 144 [PLS]
- Travel Value/Rev. : 10 mm = 10 000.0 [µm]

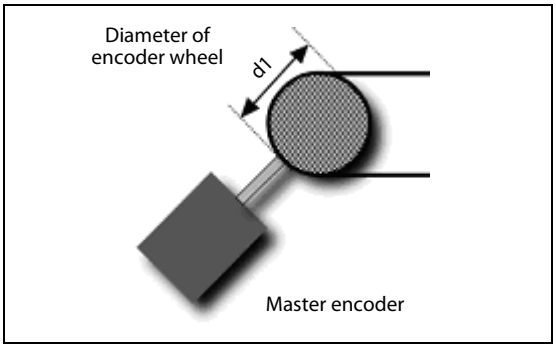


Fig. 7-4: *Mechanical construction master axis with external encoder*

Data of the mechanical construction with the master axis

- Diameter of wheel: 50.93 mm
  → Circumference: 50.93 mm x π = 160 mm
- Encoder resolution: 2 048 pulses/Rev.
  → 2 048 x 4 = 8 192 edges/Rev.

7.1.3 Configuration

1 x MR-MQ100

1 x MR-J3-□B with MR-J3 Motor

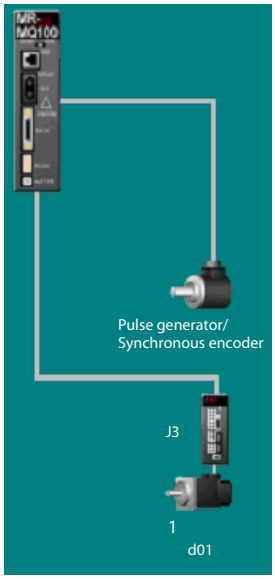
1 x External incremental Encoder (Open collector/Differential line driver)

1 x External sensor 24 V for mark detection

7.1.4 Software

The powerful programming tool MT Developer2-MQ and MR Configurator helps you to setup, program, tune and easily monitor your system.

System Structure



External encoder will be set active to follow the line speed.

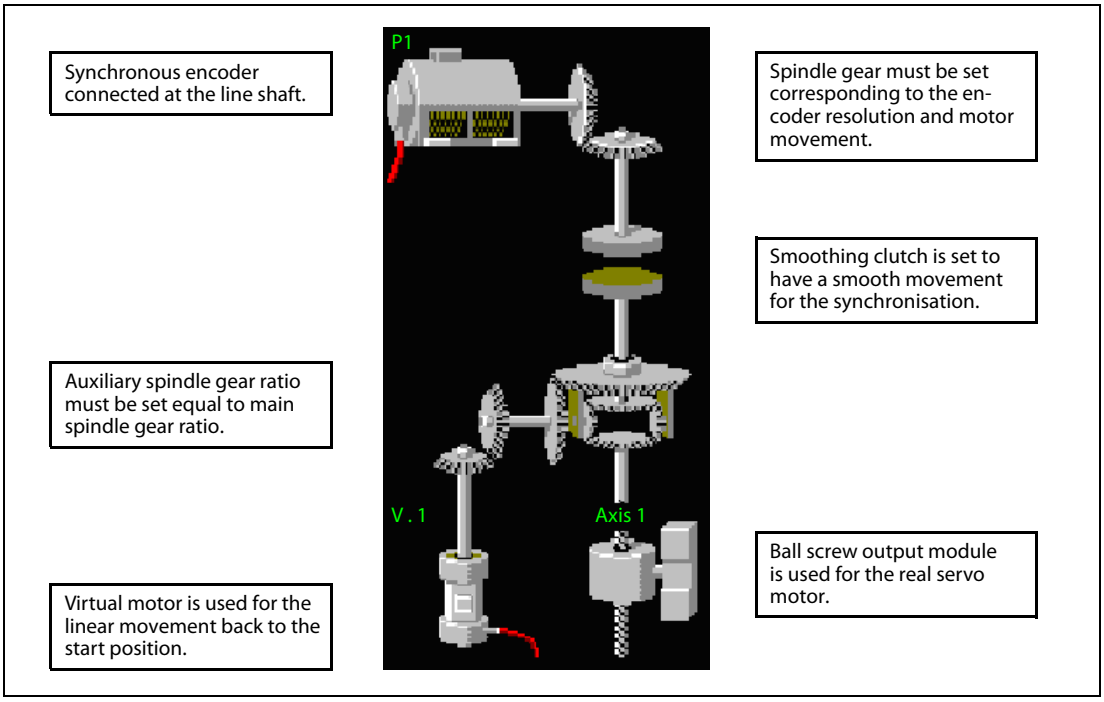
One MR-J3-_B can connected. The axis no. rotary switch must be set to 0.

		Axis 1
Fixed Parameter	Unit Setting	mm
	Number of Pulses/Rev.	262144[PLS]
	Travel Value/Rev.	10000,0[µm]
	Backlash Compensation	0,0[µm]
	Upper Stroke Limit	214748364,7[µm]
	Lower Stroke Limit	-214748364,8[µm]
	Command In-position	10,0[µm]
	Sp. Ctrl. 10x Mult. for Deg.	-
Home Position Return Data	HPR Direction	Reverse
	HPR Method	Dog Cradle Type
	Home Position Address	0,0[µm]
	HPR Speed	1000,00[mm/min]
	Creep Speed	100,00[mm/min]
	Travel After Dog	-
	Parameter Block Setting	1
	HPR Retry Function	Invalid
	Dwell Time At The HPR Retry	-
	Home Position Shift Amount	15000,0[µm]
	Speed Set at Home Pos. Shift	HPR Speed
	Torque Limit at Creep Speed	-
	Operation for HPR Incompletion	Exec.Sv.Prog.
JOG Operation Data	JOG Speed Limit Value	200,00[mm/min]
	Parameter Block Setting	1

Electronic gear to adapt the mechanical construction to the servo system.

Home Position Return method can be set according to the type needed.

Mechanical System:



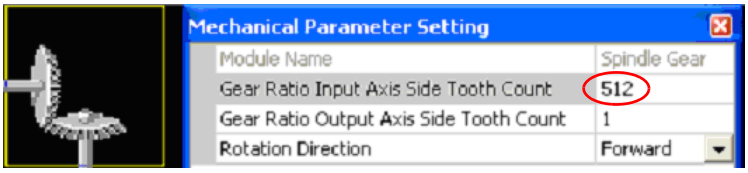
Calculation of spindle gear ratio based on pls/mm:

Motor: Fixed parameter: Number of Pulses/Rev. : 262 144 [PLS]
Travel Value/Rev. : 10 000.0 [µm]

Encoder: Wheel circumference: 160 mm
Encoder resolution: 2 048 pls/rev x 4 = 8 192 pls/rev

The gear ratio input G = Motor / Encoder is calculated according the following formula:

$$G = \frac{(262144\ [pls])/(10\ [mm])}{(8192\ [pls])/(160\ [mm])} = \frac{512}{1}$$



7.1.5 Variables

Variable	Function
PX0	Mark sensor
PX1	Cutting Cmd
PY0	Home position return complete
PY1	Cutting
M0	Clutch ON/OFF Cmd
M1	Clutch ON/OFF Status
M2	Clutch Smoothing Status
M3	Phase compensation Cmd
M10	True = Sensor Control
	False = Length Control
D6000	Clutch Mode
D6006	Phase compensation advance time
D6008	Phase compensation time constant
D6010	Phase compensation amount monitor
D6020	Clutch Slippage Dev.
D6022	Clutch Slippage Range
D6030	Speed of Virtual motor V1
D4000	Wheel circumference
D4002	Encoder resolution
D4004	Synchronous moving distance [mm]
D4006	Distance sensor to start [mm]
D4008	Cutting length [mm], PY01 ON
D4010	Cutting On distance [mm], PY01 OFF
D4100	Line speed [mm/s]
#0	Encoder pulses per mm [pls/mm]
#2	Moving distance [pls]
#4	Distance sensor to start [pls]
#6	Cutting length [pls]
#8	Cutting on distance [pls]
#10	Temp. value calculation of line speed
#12	Temp. value calculation of line speed
#14	CAM switch ON addr. PY01
#16	CAM switch OFF addr. PY01
#20	Mark detection counter
#22	Backup actual encoder value

Tab. 7-1: *Variable definition*

Phase compensation

The phase compensation advance time (D6006) is set according the formula below:

Advance time = System delay time + 1/PG1 (Model gain of Servo amplifier)

D6006 = 1 088 [µs] + 1/150 [s]
= 1 088 [µs] + 6 667 [µs]
= 7 755 [µs]

7.1.6 SFC Program

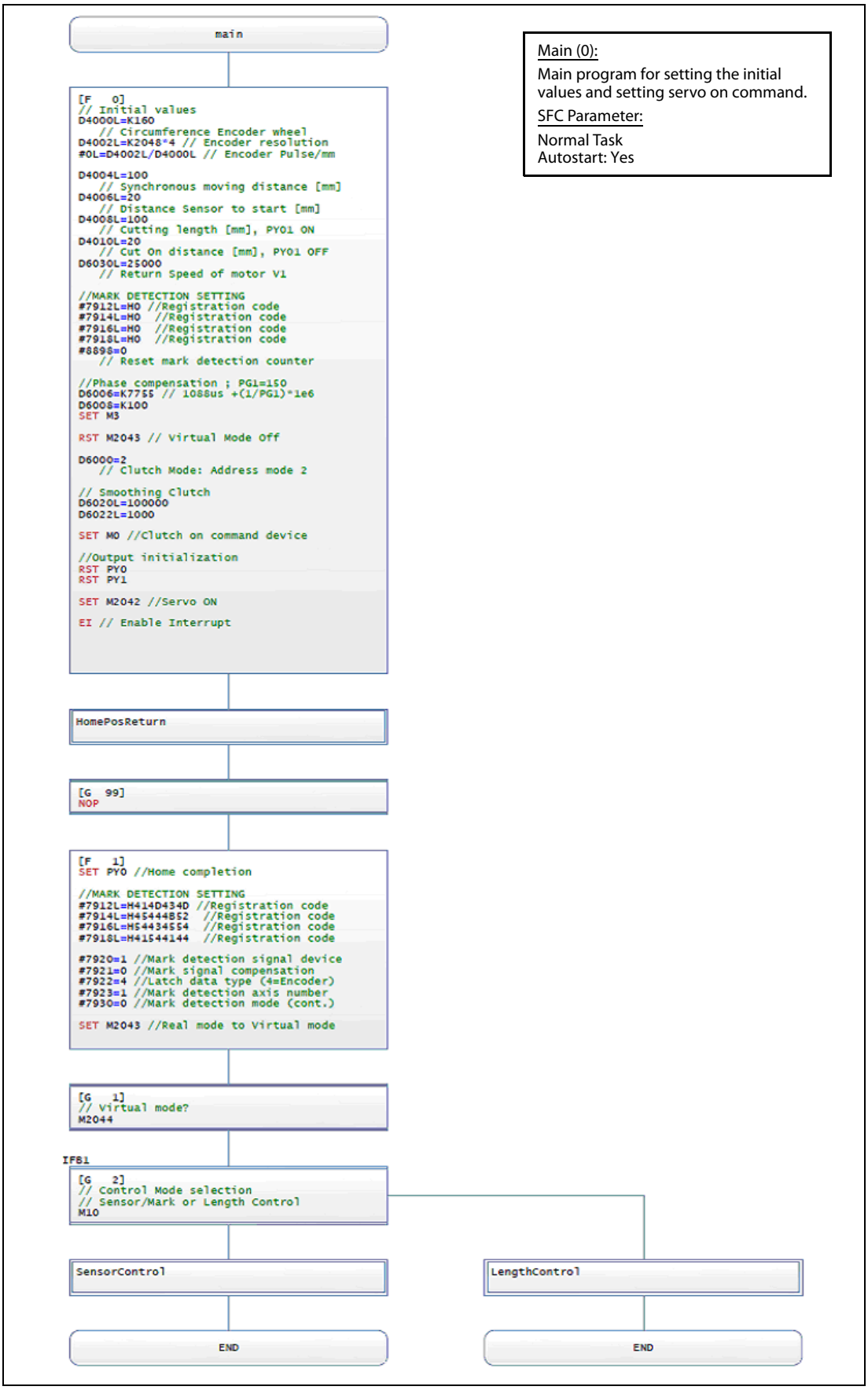


Fig. 7-5: *SFC program Main (0)*

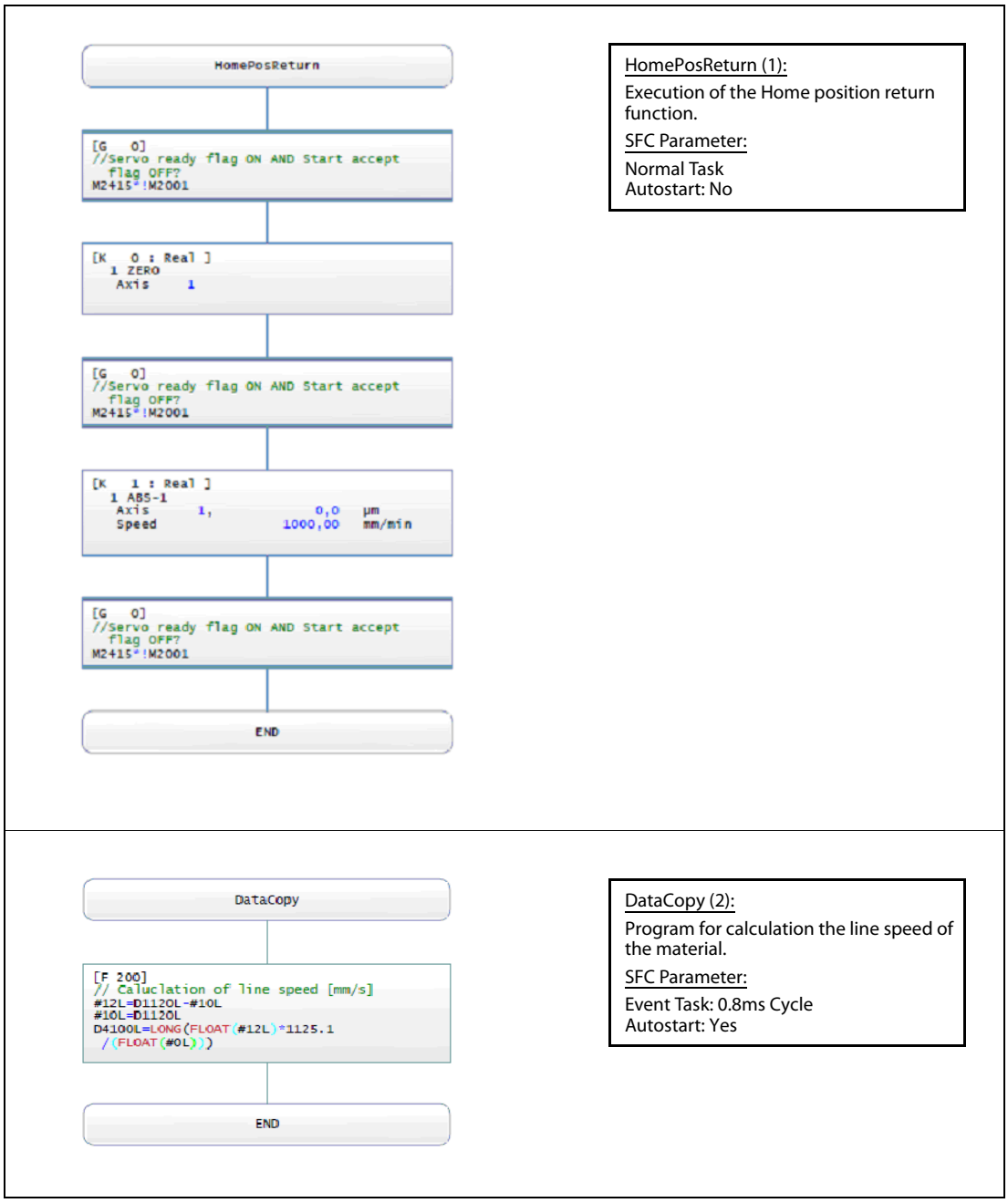


Fig. 7-6: *SFC programs HomePosReturn (1) and DataCopy (2)*

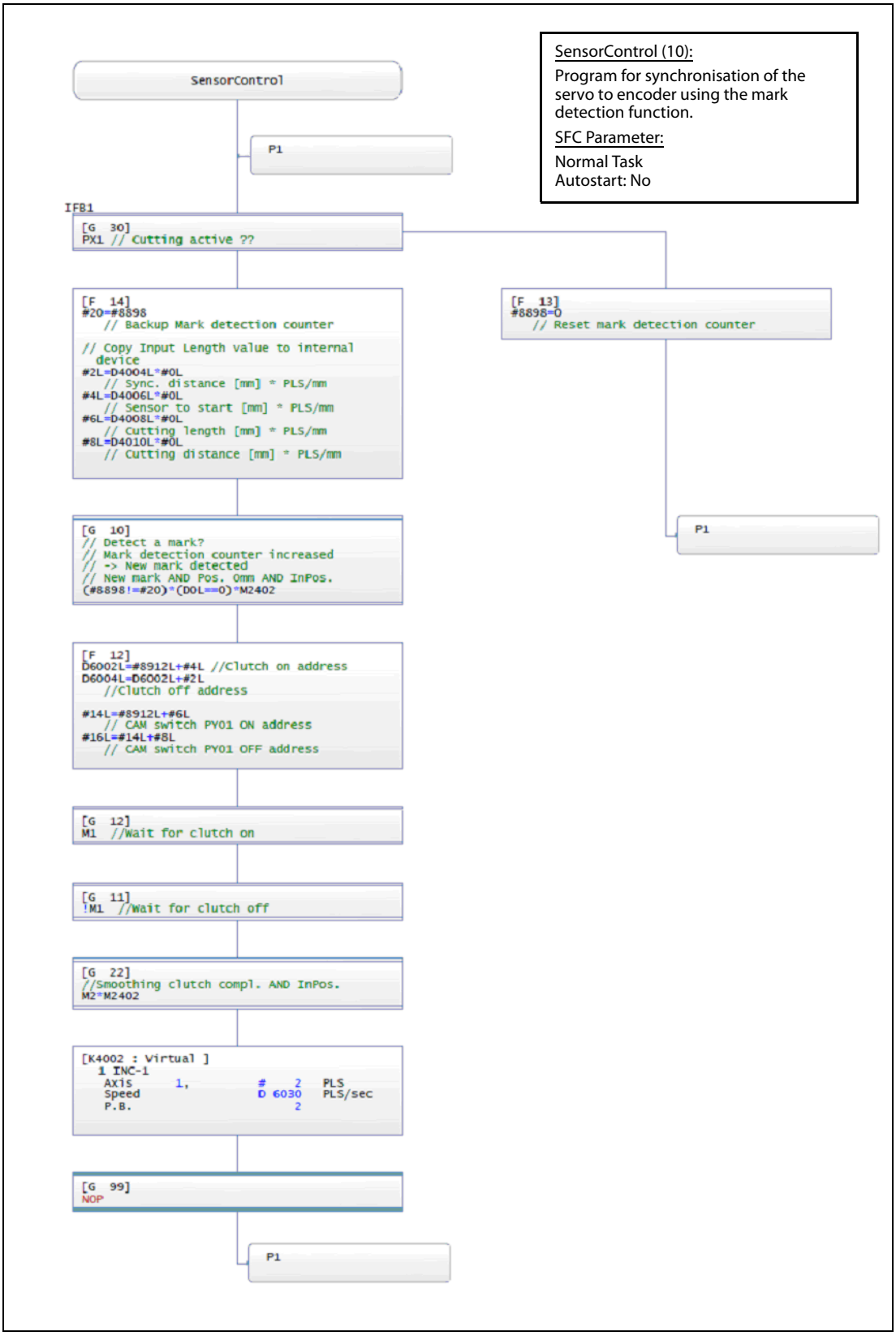


Fig. 7-7: *SFC program SensorControl (10)*

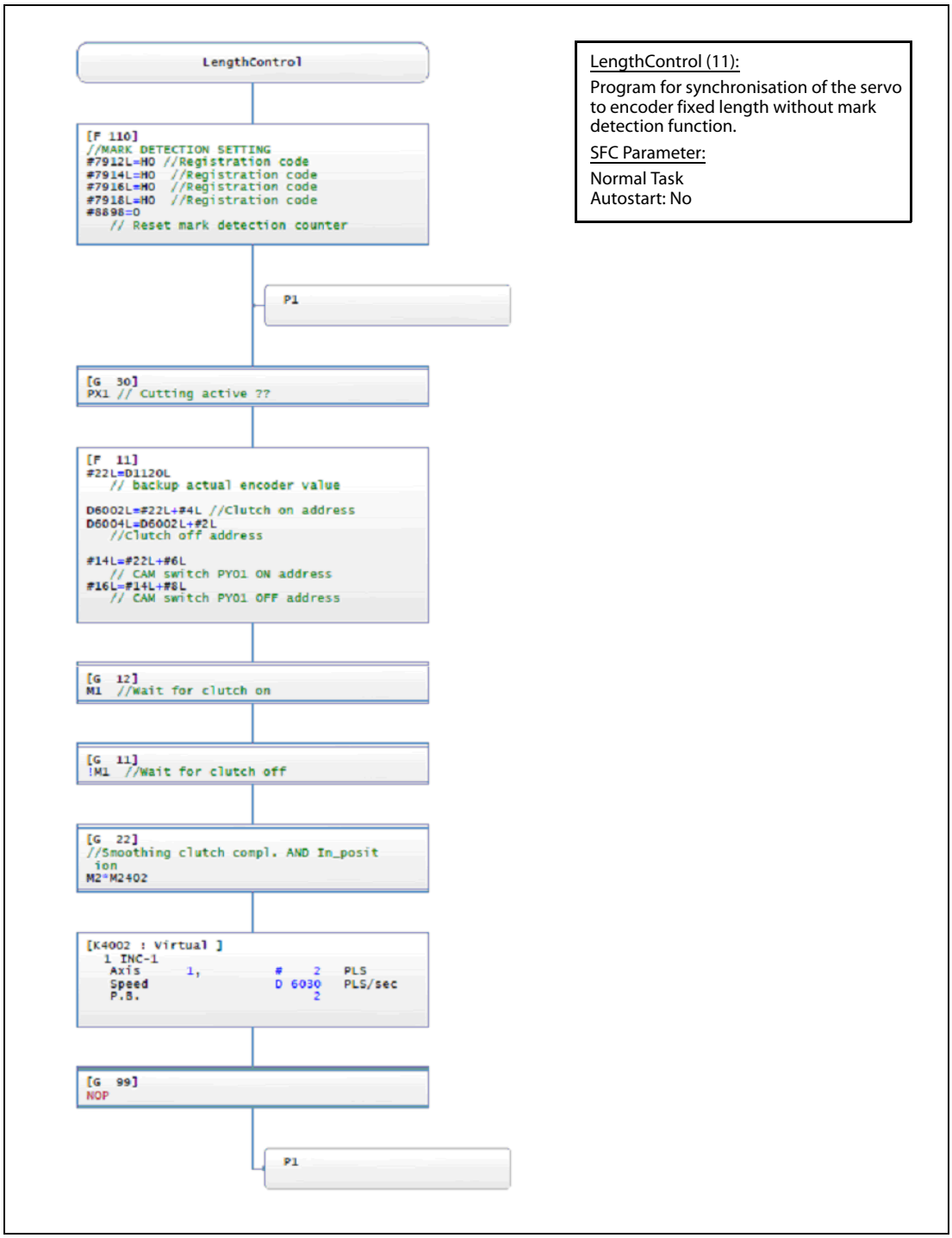


Fig. 7-8: *SFC program LengthControl (11)*

A Appendix

A.1 Exterior Dimensions

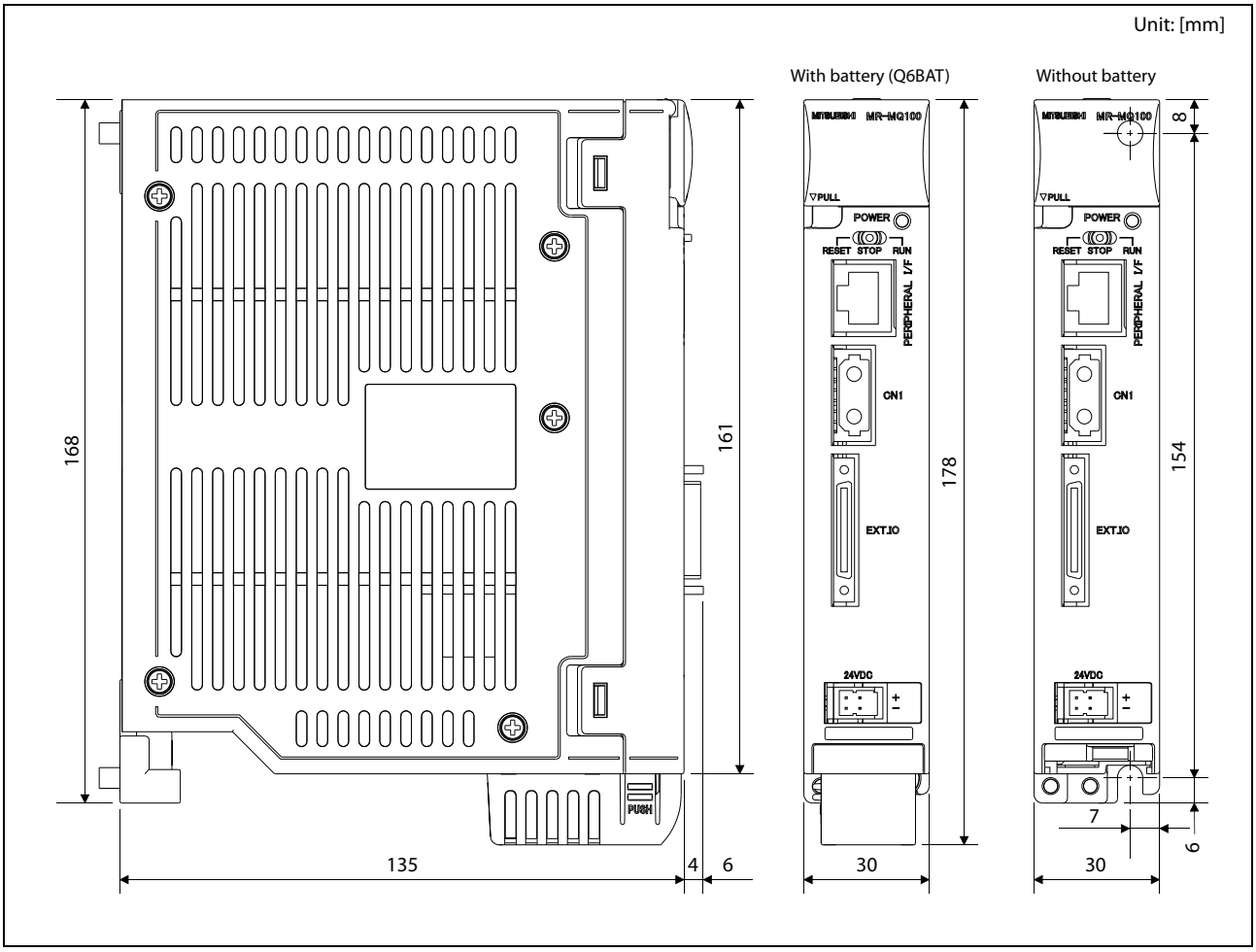


Fig. A-1: *Dimensions of MR-MQ100*

A.2 Troubleshooting

The following flowcharts show the contents of the troubles with the motion controllers classified into a variety of groups according to the types of events.

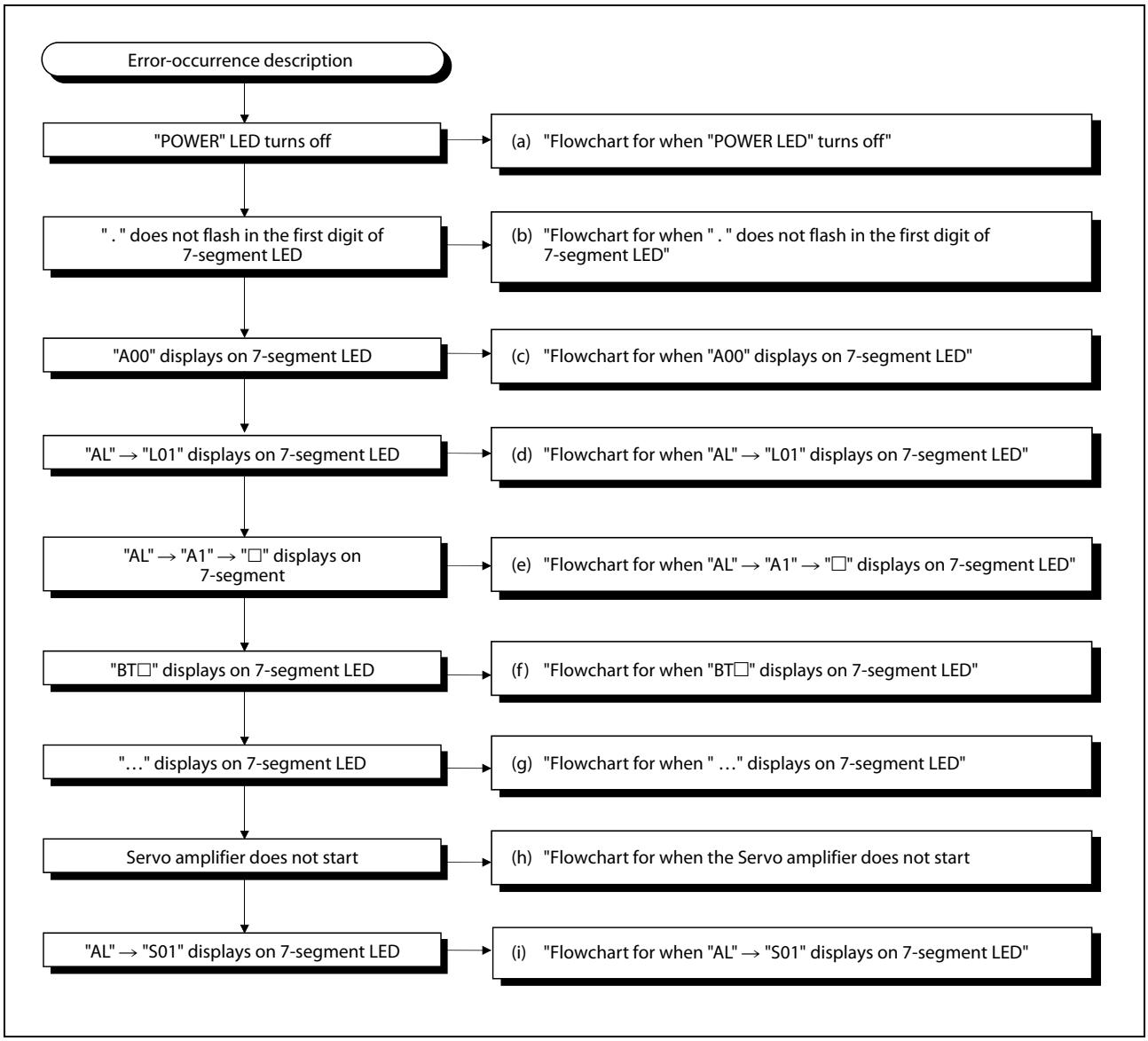


Fig. A-2: *Troubleshooting flowchart for MR-MQ100*

NOTE The procedure of fault finding for each event group (a) to (i), mentioned on the right side of the above flowchart, is described in chapter 6 of the user's manual of the motion controller MR-MQ100.

A.3 Internal devices

NOTE

In all following tables the unusable areas of the internal devices are marked with grey colour. ( )

Real mode	
Device No.	**Device Name**
M0 to	User device (2 000 points)
M2000 to	Common device (320 points)
M2320 to	Unusable (80 points)
M2400 to	Axis status (20 points × 1 axis)
M2420 to	Unusable (652 points)
M3072 to	Common device (Command signal) (64 points)
M3136 to	Unusable (64 points)
M3200 to	Axis command signal (20 points × 1 axis)
M3220 to M12287	User device (4 972 points)

Virtual mode	
Device No.	**Device Name**
M0 to	User device (2 000 points)
M2000 to	Common device (320 points)
M2320 to	Unusable (80 points)
M2400 to	Axis status (20 points × 1 axis)
M2420 to	Unusable (652 points)
M3072 to	Common device (Command signal) (64 points)
M3136 to	Unusable (64 points)
M3200 to	Axis command signal (20 points × 1 axis)
M3220 to	Unusable (780 points)
M4000 to	Virtual servomotor axis status (20 points × 8 axes)
M4160 to	Unusable (480 points)
M4640 to	Synchronous encoder axis status (4 points × 1 axis)
M4644 to	Unusable (156 points)
M4800 to	Virtual servomotor axis command signal (20 points × 1 axis)
M4820 to	Unusable (480 points)
M5440 to	Synchronous encoder axis command signal (4 points × 1 axis)
M5444 to	Unusable (44 points)
M5488 to M12287	User device (2 704 points)

Tab. A-1: *Internal relay list*

Real mode	
Device No.	**Device Name**
D0 to	Axis monitor device (20 points × 1 axis)
D20 to	Unusable (620 points)
D640 to	Control change register (2 points × 8 axes)
D656 to	Unusable (48 points)
D704 to	Common device (Command signal) (54 points)
D758 to	Unusable (42 points)
D800 to D8191	User device (7 392 points)

Virtual mode	
Device No.	**Device Name**
D0 to	Axis monitor device (20 points × 1 axis)
D20 to	Unusable (620 points)
D640 to	Control change register (2 points × 8 axes)
D656 to	Unusable (48 points)
D704 to	Common device (Command signal) (54 points)
D758 to	Unusable (42 points)
D800 to	Virtual servomotor axis monitor device (10 points × 8 axes)
D880 to	Unusable (240 points)
D1120 to	Synchronous encoder axis monitor device (10 points × 1 axis)
D1130 to	Unusable (110 points)
D1240 to	Cam axis monitor device (10 points × 1 axis)
D1250 to	Unusable (110 points)
D1560 to D8191	User device (6 632 points)

Tab. A-2: *Data register list*

Real/virtual mode common	
Device No.	**Device Name**
#0 to	User device (8 000 points)
#7912 to	Mark detection setting device (88 points)
#8000 to	Monitor device 2 (20 points × 1 axis)
#8020 to	Unusable (620 points)
#8640 to	Motion error history device (96 points)
#8736 to	Unusable (160 points)
#8896 to	Mark detection monitor device (320 points)
#8916 to #12287	Unusable (3 372 points)

Tab. A-3: *Motion register list*

Common devices (M)	
Device No.	**Device Name**
M2000	PLC ready flag
M2001 to	Start accept flag
M2009 to	Unusable
M2033	
M2034	
M2035	Motion error history clear request flag
M2036	Unusable
M2037	
M2038	Motion SFC debugging flag
M2039	Motion error detection flag
M2040	Speed switching point specified flag
M2041	System setting error flag
M2042	All axes servo ON command
M2043	Real mode/virtual mode switching request (SV22)
M2044	Real mode/virtual mode switching status (SV22)
M2045	Real mode/virtual mode switching error detection signal (SV22)
M2046	Out-of-sync warning (SV22)
M2047	Motion slot fault detection flag
M2048	JOG operation simultaneous start command
M2049	All axes servo ON accept flag
M2050	Unusable
M2051	Manual pulse generator 1 enable flag
M2052	Unusable
M2053	
M2054	Operation cycle over flag
M2055 to	Unusable
M2061 to	Speed changing accepting flag
M2069 to	Unusable
M2101 to	Synchronous encoder current value changing flag
M2109 to	Unusable
M2128 to	Automatic decelerating flag
M2136 to	Unusable
M2240 to	Speed change "0" accepting flag
M2248 to	Unusable
M2272	Control loop monitor status
M2273 to M2319	Unusable

Common devices (Command)	
Device No.	**Device Name**
M3072	PLC ready flag
M3073	Speed switching point specified flag
M3074	All axes servo ON command
M3075	Real mode/virtual mode change request (SV22)
M3076	JOG operation simultaneous start command
M3077	Manual pulse generator 1 enable flag
M3078	Unusable
M3079	
M3080	Motion error history clear request flag

Tab. A-4: *Common devices (M)*

Device No.	Device Name	
D704	PLC ready flag request	
D705	Speed switching point specified flag request	
D706	All axes servo ON command request	
D707	Real mode/virtual mode switching request	
D708	JOG operation simultaneous start command request	
D709	Unusable	
D710	JOG operation simultaneous start axis setting register	
D711		
D712		
D713		
D714	Manual pulse generator axis 1 No. setting register	
D715		
D716	Unusable	
D717		
D718		
D719		
D720	Axis 1	Manual pulse generators 1 pulse input magnification setting register
D721	Unusable	
D722		
D723		
D724		
D725		
D726		
D727		
D728		
D729		
D730		
D731		
D732		
D733		
D734		
D735		
D736		
D737		
D738		
D739		
D740		
D741		
D742		
D743		
D744		
D745		
D746		
D747		
D748		
D749		
D750		
D751		

Tab. A-5: *Common devices (D) (1)*

Device No.	Device Name
D752	Manual pulse generator 1 smoothing magnification setting register
D753	Unusable
D754	
D755	Manual pulse generator 1 enable flag request
D756	Unusable
D757	

Tab. A-5: *Common devices (D) (2)*

Axis status		Axis 1
Positioning start complete		M2400
Positioning complete		M2401
In-position		M2402
Command in-position		M2403
Speed controlling		M2404
Speed/position switching latch		M2405
Zero pass		M2406
Error detection		M2407
Servo error detection		M2408
Home position return request		M2409
Home position return complete		M2410
External signals	FLS	M2411
	RLS	M2412
	Unusable	M2413
	DOG/CHANGE	M2414
Servo ready		M2415
Torque limiting		M2416
Unusable		M2417
Virtual mode continuation operation disable warning①		M2418
M-code outputting		M2419

Axis command signal	Axis 1
Stop command	M3200
Rapid stop command	M3201
Forward rotation JOG start command	M3202
Reverse rotation JOG start command	M3203
Complete signal OFF command	M3204
Speed/position switching enable command	M3205
Unusable	M3206
Error reset command	M3207
Servo error reset command	M3208
External stop input disable at start command	M3209
Unusable	M3210
	M3211
Feed current value update request command	M3212
Address clutch reference setting command①	M3213
Cam reference position setting command①	M3214
Servo OFF command	M3215
Gain changing command	M3216
Unusable	M3217
Control loop changing command	M3218
FIN signal	M3219

Axis status (Common device)	Axis 1
Start accept flag	M2001
Speed change accepting flag	M2061
Automatic decelerating flag	M2128
Speed change "0" accepting flag	M2240

Axis status (Common device)	Axis 1
Control loop monitor status	M2272

Tab. A-6: *Internal relays (M) – Common*

① It is unusable in the real mode.

Virtual Servomotor axis status	Axis 1
Positioning start complete	M4000
Positioning complete	M4001
Unusable	M4002
Command in-position	M4003
Speed controlling	M4004
Unusable	M4005
	M4006
Error detection	M4007
Unusable	M4008
	M4009
	M4010
	M4011
	M4012
	M4013
	M4014
	M4015
	M4016
	M4017
	M4018
M-code outputting	M4019

Virtual Servomotor axis command signal	Axis 1
Stop command	M4800
Rapid stop command	M4801
Forward rotation JOG start command	M4802
Reverse rotation JOG start command	M4803
Complete signal OFF command	M4804
Unusable	M4805
	M4806
Error reset command	M4807
Unusable	M4808
External stop input disable at start command	M4809
Unusable	M4810
	M4811
	M4812
	M4813
	M4814
	M4815
	M4816
	M4817
	M4818
FIN signal	M4819

Synchronous encoder axis status	Axis 1
Error detection	M4640
Unusable	M4641
Virtual mode continuation operation disable warning	M4642
Unusable	M4643

Synchronous encoder axis command signal	Axis 1
Error reset	M5440
Unusable	M5441
	M5442
	M5443

Axis status (Common device)	Axis 1
Synchronous encoder current value changing flag①	M2101

Tab. A-7: *Internal relays (M) – Virtual mode*

① It is unusable in the real mode.

Axis monitor devices	Axis 1
Feed current value/ roller cycle speed (Virtual Mode)	D0
	D1
Real current value	D2
	D3
Deviation counter value	D4
	D5
Minor error code	D6
Major error code	D7
Servo error code	D8
Home position return re-travel value	D9
Travel value after proximity dog ON	D10
	D11
Execute program No.	D12
M-code	D13
Torque limit value	D14
Data set pointer for constant-speed control	D15
Unusable	D16
	D17
Real current value at stop input	D18
	D19

Axis monitor devices	Axis 1
JOG speed setting	D640
	D641

Tab. A-8: *Data register (D) – Common*

Virtual servomotor axis monitor devices	Axis 1
Feed current value	D800
	D801
Minor error code	D802
Major error code	D803
Execute program No.	D804
M-code	D805
Current value after virtual servomotor axis main shaft's differential gear	D806
	D807
Error search output axis No.	D808
Data set pointer for constant-speed control	D809

Cam axis monitor devices	Axis 1
Unusable	D1240
Execute cam No.	D1241
Execute stroke amount	D1242
	D1243
Current value within 1 cam shaft revolution	D1244
	D1245
Unusable	D1246
	D1247
	D1248
	D1249

Synchronous encoder axis monitor devices	Axis 1
Current value	D1120
	D1121
Minor error code	D1122
Major error code	D1123
Unusable	D1124
	D1125
Current value after synchronous encoder axis main shaft's differential gear	D1126
	D1127
Error search output axis No.	D1128
Unusable	D1129

Tab. A-9: *Data registers (D) – Virtual mode*

Axis monitor device 2	Axis
Servo amplifier type	#8000
Motor current	#8001
Motor speed	#8002
	#8003
Command speed	#8004
	#8005
Home position return re-travel value (Real mode only)	#8006
	#8007
Unusable	#8008
	#8009
	#8010
	#8011
	#8012
	#8013
	#8014
	#8015
	#8016
	#8017
	#8018
	#8019

Motion error history devices	7 times in past①
Error Motion SFC program No.	#8640
Error type	#8641
Error program No.	#8642
Error block No./Motion SFC list/Line No./ Axis No.	#8727
Error code	#8728
Error occurrence time (Year/month)	#8729
Error occurrence time (Day/hour)	#8730
Error occurrence time (Minute/second)	#8731
Error setting data information	#8732
Unusable	#8733
Error setting data	#8734
	#8735

①It is the last history on 0 times.

Mark detection setting devices	Signal 1
Registration code	#7912
	to
	#7914

Mark detection monitor devices	Signal 1
Mark detection data current monitor	#8896
Number of marks detected	#8897
Mark detection settings verification flag	#8898
Unusable	#8899
	to
	#8911
Latch data storage area 1	#8912
	#8913
Latch data storage area 2	#8914
	#8915
Latch data storage area 3	#8916
	#8917
Latch data storage area 4	#8918
	#8919
to	to
Latch data storage area 32	#8974
	#8975

Mark detection setting devices	Signal 1
Mark detection signal allocation devices	#7920
Mark detection signal compensation time	#7921
Latch data type	#7922
Mark detection axis number	#7923
Unusable	#7924
	#7925
Latch data upper limit	#7926
	#7927
Latch data lower limit	#7928
	#7929
Mark detection mode	#7930
Unusable	#7931
	#7932
	#7933
	#7934
	#7935
	#7936
	#7937
	#7938
	#7939

Tab. A-10: *Motion registers (#)*

Device No.	Device Name
SM0	Diagnostic error
SM1	Self-diagnosis error
SM51	Battery low latch
SM52	Battery low
SM53	AC/DC DOWN detection
SM58	Battery low warning latch
SM59	Battery low warning
SM211	Clock data error
SM400	Always ON
SM401	Always OFF
SM500	PCPU READY complete
SM501	Test mode ON
SM502	External forced stop input
SM503	Digital oscilloscope executing
SM510	TEST mode request error
SM512	Motion controller WDT error
SM513	Manual pulse generator axis setting error
SM516	Servo program setting error
SM526	Over heat warning latch
SM527	Over heat warning
SM800	Clock data set request
SM801	Clock data read request

Tab. A-11: *Special relays (SM)*

Device No.	Device Name
SD0	Diagnostic errors
SD1	Clock time for diagnostic error occurrence (Year/month)
SD2	Clock time for diagnostic error occurrence (Day/hour)
SD3	Clock time for diagnostic error occurrence (Minute/second)
SD4	Error information categories
SD5	Error common information
to	
SD15	
SD16	Error individual information
to	
SD26	
SD53	AC/DC DOWN counter No.
SD60	Fuse blown No.
SD200	State of switch
SD203	Operating state of CPU
SD210	Clock data (Year, month)
SD211	Clock data (Day, hour)
SD212	Clock data (Minute, second)
SD213	Clock data (Day of week)
SD290	Device assignment – Number of points assigned for X
SD291	Device assignment – Number of points assigned for Y
SD292	Device assignment – Number of points assigned for M
SD293	Device assignment – Number of points assigned for L
SD294	Device assignment – Number of points assigned for B
SD295	Device assignment – Number of points assigned for F
SD296	Device assignment – Number of points assigned for SB
SD297	Device assignment – Number of points assigned for V
SD298	Device assignment – Number of points assigned for S
SD299	Device assignment – Number of points assigned for T
SD300	Device assignment – Number of points assigned for ST
SD301	Device assignment – Number of points assigned for C
SD302	Device assignment – Number of points assigned for D
SD303	Device assignment – Number of points assigned for W
SD304	Device assignment – Number of points assigned for SW
SD502	Servo amplifier loading information
SD503	
SD504	Real mode/virtual mode switching error information
SD505	
SD506	
SD510	Test mode request error
SD511	
SD512	Motion CPU WDT error cause
SD513	Manual pulse generator axis setting error
SD514	
SD515	
SD516	Error program No.
SD517	Error item information

Tab. A-12: *Special register (SD) (1)*

Device No.	Device Name
SD520	Scan time
SD521	Maximum scan time
SD522	Motion operation cycle
SD523	Operation cycle of the Motion CPU setting
SD700	Device assignment – Number of points assigned for #
SD720	444 µs Coasting timer
SD721	

Tab. A-12: *Special register (SD) (2)*

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Symbols

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