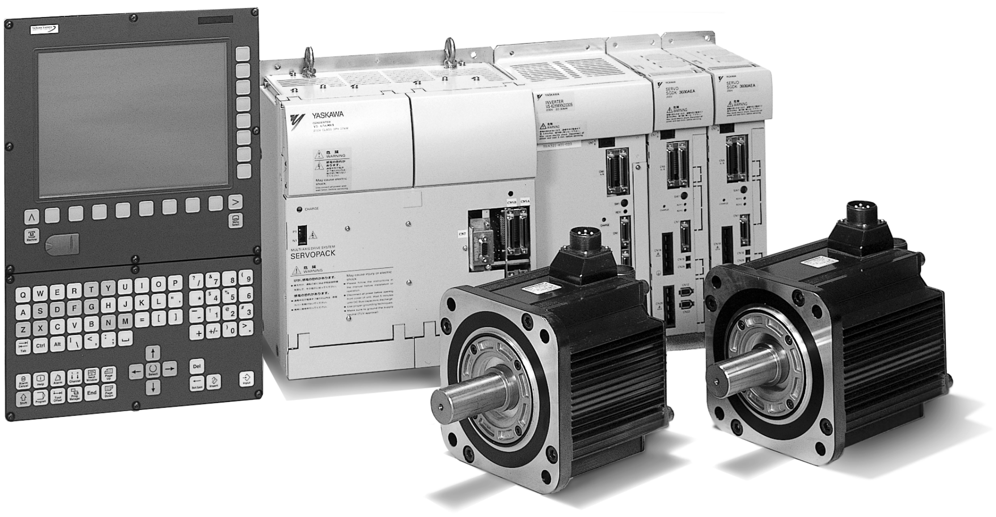
Yaskawa Siemens
numerical controls

Yaskawa Siemens CNC Series

Maintenance Manual
Serviceman Handbook



MANUAL No. NCSIE-SP02-19

Yaskawa Siemens Numerical Controls Corp. has been merged to Siemens K.K. and Siemens Japan K.K. as of August, 2010 respectively. "Yaskawa Siemens Numerical Controls Corp." in this manual should therefore be understood as "Siemens Japan K.K."

This manual is intended for both of Yaskawa Siemens 840DI and Yaskawa Siemens 830DI. In this manual, the functional differences of these two models are not taken into account in its description, thus please refer to the catalog (MANUAL No.: NCKAE-PS41-01) for available basic functions and possible optional functions of each model.

Safety-related symbol marks

The following symbol marks are used in this manual to draw special attention to safety information.
The information next to these symbol marks is important for safety and thus must always be followed.

⚠ WARNING

Indicates activities that could result in a dangerous condition, including death and serious injury, if done wrongly.

⚠ CAUTION

Indicates activities that could result in a dangerous condition, including major and minor injury, or in damage to objects, if done wrongly.

It is noted that those activities as indicated by the ⚠ CAUTION symbol mark could even result in death or serious injury if done wrongly in a worst-case situation.

PROHIBITED

Indicates what you must not do. For example, the mark means that you must not make or use a fire here.

MANDATORY

Indicates what you must do unconditionally. For example, the ground mark means that you must always ground the object you are working with.

Icons

The following icons are used as necessary throughout this manual to categorize description next to them:

IMPORTANT

Indicates what you must always keep in mind. If the instruction were not fully followed, an error could occur that might not damage a machine or other objects but would result in an alarm.

◀ EXAMPLE ▶

Indicates program examples or operation examples.

INFO

Indicates additional information or what you should keep in mind for better efficiency.

TERMS

Indicates unfamiliar technical terms or those not defined in the text. Description of such terms will follow.

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Table of Contents

Outline of this manual

- This manual is a handy book for use by those who are familiar with the NC machine tool Yaskawa Siemens YS 840DI (hereafter called YS 840DI) and are responsible for its operation, maintenance or setup.
- As a handy book, this manual may not contain basic information or technical details. For such basic or detailed information, refer to the related manuals as listed below.

Related manuals

- Related manuals are listed below, which you should read as necessary along with this manual.
- Read all related manuals to grasp the specifications and any usage constraints of the control/operation panels before attempting to operate them.

Manuals	Manual No.
Yaskawa Siemens YS 840DI Operating Manual	NCSIE-SP02-04
Yaskawa Siemens YS 840DI Maintenance Manual	NCSIE-SP02-10
Yaskawa Siemens YS 840DI Maintenance Manual Serviceman Handbook (this manual)	NCSIE-SP02-19
Yaskawa Siemens YS 840DI Programming Manual for Machining Center	NCSIE-SP02-20
Yaskawa Siemens YS 840DI Programming Manual for Programming Lathe	NCSIE-SP02-21

How to use this manual

■ Target group

This manual is intended for those who are responsible for:

- manufacturing, inspection, trial run and tuning, or servicing of YS 840DI control panels, operation panels, and other related units and devices.

■ Low-active signals

In this manual, low-active signals are indicated by the slash symbol (/) followed by their name. For example:

- /S-ON for a low-active signal of S-ON
- /P-ON for a low-active signal of P-ON

Trademarks

- Windows and Windows NT are trademarks of Microsoft Corporation of the U.S.A.
- Ethernet is a trademark of Xerox Corporation of the U.S.A.

Safety precautions

Listed below are important safety precautions that you must always follow when using the product. Read and fully understand this manual and other related manuals before attempting to install, operate, maintain, or service the product. The safety precautions and the knowledge of the product are indispensable for the safety of yourself and the product.

■ Handling

⚠ CAUTION
• When handling the product, do not hold it by the cables. Otherwise injury or damage could result. • After installing the product on the machine, remove the eyebolts from the product, and attach ordinary bolts of the same size in place of them to close the eyebolt openings. Otherwise damage could result.

⃠ PROHIBITED
• Do not handle the product in such places where it could get wet from rain or water drops, or where harmful gas or liquid is present. Otherwise injury or damage could result.

■ Storing

⃠ PROHIBITED
• Do not store the product in such places where they could get wet from rain or water drops, or where harmful gas or liquid is present. Otherwise damage could result. • Do not let the packaged product fall from heights more than 60 cm. Otherwise damage could result.

MANDATORY

- Store the product in an indoor clean place satisfying the environmental requirements.
  Otherwise damage could result.
  The environmental requirements:
  - Ambient temperature: -20 to +60 ℃
  - Relative humidity: 10 to 90%
  - Altitude: 1000 m or lower

■ Installing

⚠ CAUTION

- Install the product such that its air intake or discharge opening is not blocked by a wall or other objects and that foreign matter would not get into the opening.
  Otherwise a fire or damage could result.
- When installing, take care not to subject the product to a strong shock.
  Otherwise damage could result.
- The electric power supplied to the product must be sufficient satisfying its power requirements.
  Otherwise malfunction could result.
- The power requirements of the 24 VDC external power supply unit supplying input/output contacts depend on the number of the contacts they supply.
  If necessary to provide enough power, install an additional external power supply unit.
- The motors have their flanges and shaft ends coated with rustproof agent. Remove the agent with a cloth before installing the motors.
- When coupling a motor with a machine, well align the motor with the machine.
  Failing to do so could cause vibration, resulting in injury or damage.

⚠ CAUTION

- Observe the following when designing or installing enclosures (a poorly designed or installed enclosure for a high-voltage unit could result in damage or malfunction):
  - The enclosures must be of hermetic seal type.
  - The average temperature rise of the product must be not more than 10 ℃ .
  - Air stirring fans must be installed within the enclosures to improve cooling efficiency and prevent local heat buildup (fans should be UL certified).
  - Sealing to close cable inlet holes and doors must be effective.
  - Displays tend to collect airborne dust and thus malfunction. Therefore their enclosures must be so designed as to prevent dust intrusion.
  - CNC and other units as well as PC boards could malfunction due to accumulated dust. Therefore their enclosures must be so designed as to prevent dust intrusion.
  - Packing must be provided so that cable inlet holes, doors, and back plates are fully closed.
- Observe the following when installing the units (poorly installed units could result in damage or malfunction):
  - The servo units must be fixed upright using screws or bolts.
  - The servo units must be provided with enough space over and under them to allow them to effectively dissipate their heat.
  - Install a servo unit in an enclosure such that the heat sink fins of the unit come out of the enclosure to keep the unit's internal temperature lower. The exposed heat sink fins must be subjected to a 2.5 m/s air draft.
  - If an air stirring fan is installed inside an enclosure, the fan must be oriented such that the air does not directly hit a servo unit (to prevent the servo unit from collecting more dust).
  - Units must be installed such that inspection, replacement and other servicing activities are easy.
- Do not operate the system if any inverter or converter is physically broken or otherwise damaged.

  Otherwise injury could result.
- When handling the units, hold them by the mounting base, not by the front cover.

  If you hold them by the front cover, the main body could come off the front cover and might drop onto and injure your foot.

  Mount the units to a metal or other non-flammable structure. Otherwise, a fire could result.
- The maximum operating temperature of 55 ℃ must not be exceeded. The air draft hitting the heat sink must be at not more than 45 ℃ .

  Note that overheat could result in a burn or a fire.
- An external emergency stop circuit must be provided so that operation can be stopped and power shut off immediately.

  Be aware of a risk of injury.

■ Wiring

⚠ WARNING

- Shut off power to the product before attempting to work on it.
  Otherwise electric shock or a fire could result.
- Wiring work must be done only by qualified personnel.
  Otherwise electric shock or a fire could result.
- After wiring work for completing an emergency stop circuit, always check the circuit for functionality. The customer is responsible for the wiring work.
  Be aware of a risk of injury.
- The grounding terminals ⏚ must be grounded properly.
  Otherwise electric shock or a fire could result.

⚠ CAUTION

- Wiring work must be duly done by qualified personnel.
  Otherwise electric shock, a fire, or malfunction could result.
- Never apply an AC three-phase power to the U, V, and W output terminals on a SERVOPACK powering a servo motor.
  Otherwise the SERVOPACK would be damaged.
- The capacity and wiring size of customer's power supply must be so selected as to satisfy the specific operating conditions and required capacity. Note that the actual capacity of a cable decreases significantly if the ambient temperature exceeds 30 ℃. Determine a correct cable size according to applicable electrical installation regulations and the technical specifications issued by the cable manufacturer.
  Use of a cable of incorrect size could result in a fire.
- Signal cables must be of twist pair, twist-pair multi-strand, or shielded twist-pair multi-strand type. If a type is specified for signal cables in this manual, that type must always be used.
  Otherwise malfunction could result.
- Cables must be so routed as to be as short as possible.
  Otherwise malfunction could result.
- Input or output signal cables must not be bundled together with power cables or routed in the same wiring duct with power cables inside or outside the panels.
  Properly separating signal cables from power cables reduces the effect of electric noise from the power cables on the signal cables.
  If electric noise comes into the product along the power line, install a noise filter at the panel.

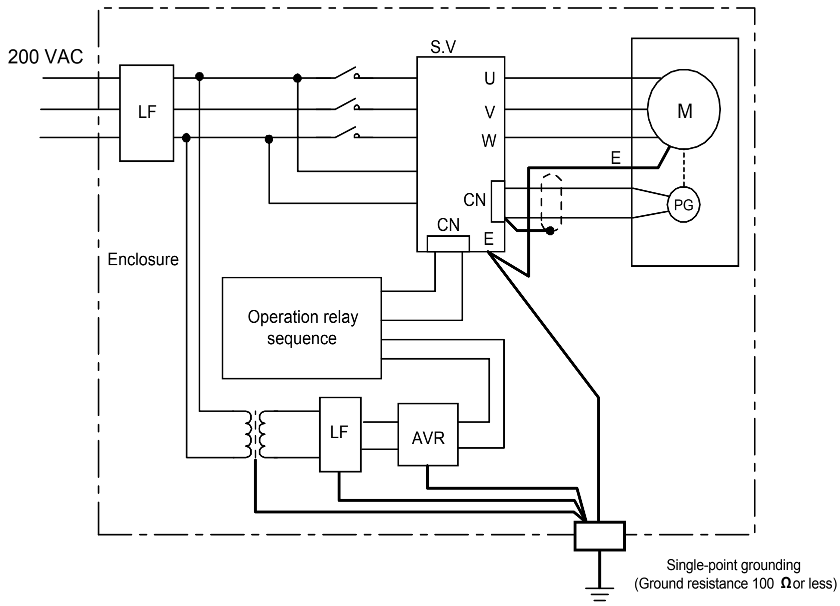
⚠ CAUTION

- For information on the required capacity and other specifications of a noise filter, see the General Documentation - Hardware.
  A properly selected noise filter can reduce conducted electric noise significantly.
- Provide the last SERVOPACK module with a terminating connector.
  Otherwise malfunction could result.
- Ensure that the voltage of the AC power supply to a converter is equal to the rated voltage of that converter.
  Otherwise injury or a fire could result.
- Do not subject the inverters or converters to a high-voltage withstanding test.
  Otherwise their semiconductor components would be damaged.
- Wiring to the inverters or converters must be done according to the relevant wiring drawing.
  Otherwise they could be damaged.
- The screws of a terminal block must be tightened to a specified torque.
  Otherwise a fire could result.
- Never connect an AC main power supply to the U/T1, V/T2, and W/T3 output terminals.
  Otherwise the inverter would be damaged.

❗ MANDATORY

- The grounding wire from each unit must be connected to the enclosure or the grounding plate directly.

Example grounding wiring



- Wires for grounding must be in accordance with applicable electrical installation regulations and the internal wiring rules.
- The grounding terminal of a servo motor must be wired to the grounding terminal of the corresponding SERVOPACK.
- All wires to be grounded must be directly connected to a single point that is class-D or better grounded.
  Otherwise electric shock, a fire, or malfunction could result.
- The single grounding point for the product must not be used to also ground a power device.
  Otherwise malfunction could result.

■ Operating

⚠ WARNING

- Do not touch live units or terminals.
  Otherwise electric shock or malfunction could result.
- Do not touch any current-carrying parts even if you have shut off power to them, until at least 5 minutes have passed (to let any residual charge go out).
  Otherwise electric shock or malfunction could result.
- Take care not to damage, pull on, or pinch the cables.
  Otherwise electric shock could result.
- Do not touch any rotating parts before you shut off power to them.
  Otherwise injury could result.
- Never attempt to modify the product.
  Otherwise electric shock, a fire, or damage could result.
- Close the upper and lower covers before switching on the input power.
  Otherwise electric shock could result.
- Provide an additional emergency stop button outside the product.
  This is a necessary safety precaution.

⚠ CAUTION

- Ensure that the environmental requirements are fully met.
  A fire, electric shock, or malfunction could result if the product were operated in excessively hot, humid, dusty, corrosive, vibration-, or shock-ridden conditions.
  The environmental requirements are these:
  - The atmosphere must be free of corrosive gas or vapor.
  - There must be no risk of being splashed with machining oil or organic solvent.
  - The relative humidity must be between 10 and 90%RH with no dew.
  - The ambient temperature around the control panels must be between 5 and 30°C. The control panels must be protected from freezing, direct sunlight, heat sources, or the elements.
  - Floor vibration must not be more than 4.9 m/s^2.
- Take care so that no wire chips or other foreign matter would enter the product.
  Otherwise a fire, damage, or malfunction could result.
- When using the programming functions, always follow the instructions given in the relevant manuals.
  Otherwise injury or malfunction could result.

⚠ CAUTION

- Do not touch the heat sinks, as they can get very hot.
  Otherwise a burn could result.
- Confirm that the speed limits of the motors are compatible with the inverter settings before operation.
  Otherwise injury could result.
- Do not measure the signal voltages during operation.
  Otherwise damage could result.
- The inverters are already set at the factory. Do not change the settings unless you know exactly what you are doing.
  Otherwise damage could result.

MANDATORY

- When switching on the main power, ensure that at least 2 seconds have elapsed after the last switching-off operation.
  Otherwise malfunction could result.

PROHIBITED

- Never attempt to disassemble or modify the units or devices in the panels.
  Otherwise a fire, damage, or malfunction could result.
- Do not tamper with the settings of the rheostats or other devices of the control panels.
  Otherwise a fire, damage, or malfunction could result.

■ Maintaining

⚠ WARNING

- Do not touch the terminals of the inverters or converters, as some of them are at high voltage and very dangerous.
  Otherwise electric shock could result.
- Do not leave the upper or lower cover open when the panel is energized. Always turn off the circuit breaker before opening the covers.
  Otherwise electric shock could result.
- Confirm that the main power and the control power are switched off and the CHARGE lamp is not lit before starting maintenance work.
  Be aware that capacitors can have a high voltage charge for a while even after the circuit breaker is switched off.
- Only qualified personnel may perform maintenance or service work.
  Otherwise electric shock could result.

⚠ CAUTION

- When handling the control PC boards, take necessary measure to prevent their CMOS ICs from being damaged from electrostatic discharge.
  Do not touch the CMOS ICs. Otherwise they could be damaged.
- Never attempt to change wiring connections, or engage or disengage connectors while they are energized.
  Otherwise injury could result.

■ Others

⚠ WARNING

- Never attempt to modify the product.
  Otherwise electric shock or injury could result.

■ General notes

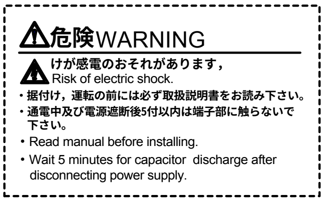
Notes on the usage of this manual

- Illustrations and drawings in this manual may show parts with their cover or safety shield removed so that inside details can be seen. Regardless of the drawings, the products must always be operated according to the manual with all the covers and shields installed in place.
- Illustrations and photos in this manual represent typical configurations, and may not exactly represent the products delivered.
- This manual is subject to change to reflect modification or specification change to the product or to make it easier to read. An updated document No. means a new version of this manual.
- If you need additional copies of this manual to replace damaged or lost ones or otherwise, please order from the nearest sales office indicated on the back cover referring to the document No. printed on the front cover of this manual.
- If the nameplate on the products is defaced or damaged, order a new one from your dealer or the nearest sales office indicated on the back cover of this manual.
- Yaskawa Siemens would not guarantee the quality of the product modified by the customer. Yaskawa Siemens is not responsible for any injury or damage due to the product modified by the customer.

Warning labels

Warning labels are attached to the product to draw special attention. Always follow the instructions. The locations and meanings of the warning labels are as follows:

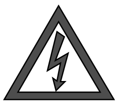
■ Warning label 1



Risk of electric shock

- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.

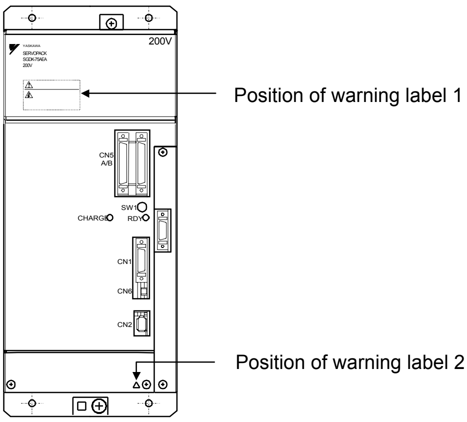
■ Warning label 2



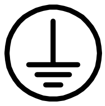
Risk of electric shock

- Do not touch the terminals while the product is switched on or for 5 minutes after the product is switched off.

SERVOPACK

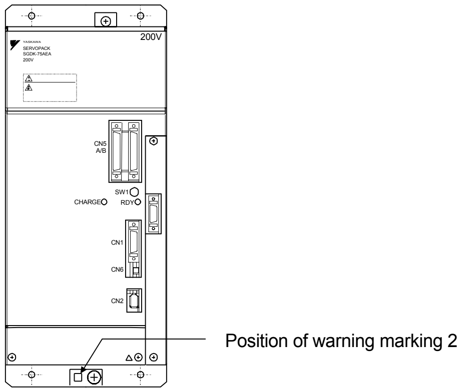


■ Warning marking



Ground the unit by connecting a grounding wire to this grounding terminal.

SERVOPACK



Part 1

Hardware

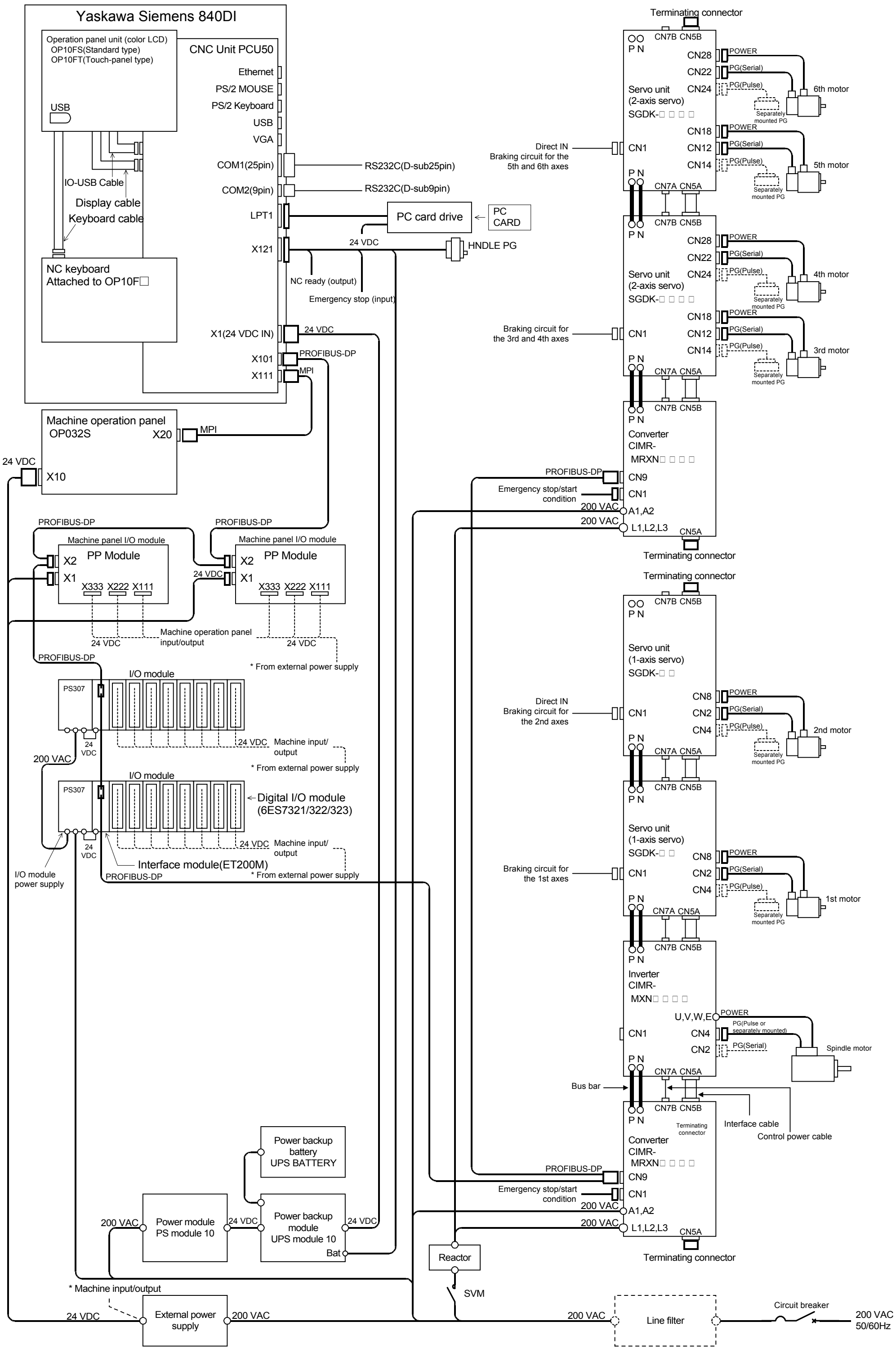
Chapter 1

System Configuration

1.1 System configuration

1.1.1 General wiring drawing

The following drawing shows how wiring is made between the components of the YS 840DI system:



INFO

■ Notes on the general wiring drawing

- Number of axes of the YS 840DI system:

  The maximum number of axes of the system is seven (including the spindle) per converter.
- External power supply:

  An external power supply of appropriate capacity must be provided by the customer.
- Separately mounted encoder:

  Separately mounted encoders are optional for any servo unit or inverter.
- Emergency stop/start circuit:

  An emergency stop/start circuit must be provided for each converter. Thus a system with two converters requires two separate emergency stop/start circuits.
- Braking circuit:

  A braking circuit may be provided only for an axis that needs it.
- Direct IN circuit:

  A direct IN circuit must be provided for each converter system. The direct IN circuit may be connected to any servo unit of the converter system.

1.1.2 List of system components

The following table lists the components of the YS 840DI system:

Category	Function	Name	Designation/Catalog number	Specifications/Remarks
YS 840DI	CNC unit	PCU50	6FC5220-0AB00-1AA0	
	Operation panel	OP010FS	6FC5203-0AF10-0AA0	Standard type
		OP010FT	6FC5203-0AF11-0AA0	Touch panel type
	NC keyboard	OP010F □	—	Attached to operation panel
Machine control panel	Machine control panel	OP032S	6FC5203-0AD10-1AA	Optional
PC card drive	PC card drive	PCMCIA extension card slot from PCU50 parallel port	6FC5235-0AA06-0AA0	Optional
I/O module	Machine control panel I/O	PP module	6FC5611-0CA01-0AA0	72 inputs/48 outputs
	Interface module	ET200M	6ES7153-1AA03-0XB0	
	I/O power supply module	PS307(2A)	6ES7307-1BA00-0AA0	2 A output at 24 VDC
		PS307(5A)	6ES7307-1EA00-0AA0	5 A output at 24 VDC
		PS307(10A)	6ES7307-1KA00-0AA0	10 A output at 24 VDC
	Digital input module	SM321(DI32 × 24 VDC)	6ES7321-1BL00-0AA0	32 inputs at 24 VDC
		SM321(DI16 × 24 VDC)	6ES7321-1BH00-0AA0	16 inputs at 24 VDC
		SM321 (DI16 × 24 VDC source)	6ES7321-1BH50-0AA0	16 inputs at 24 VDC source
		SM321(DI16 × 120 VAC)	6ES7321-1EH01-0AA0	16 inputs at 120 VAC
		SM321(DI8 × 120/230 VAC)	6ES7321-1FF01-0AA0	8 inputs at 120/230 VAC
	Digital output module	SM322(DO32 × 24 VDC/0.5A)	6ES7322-1BL00-0AA0	32 outputs at 24 VDC/0.5 A
		SM322(DO16 × 24 VDC/0.5A)	6ES7322-1BH00-0AA0	16 outputs at 24 VDC/0.5 A
		SM322(DO8 × 24 VDC/2A)	6ES7322-1BF01-0AA0	8 outputs at 24 VDC/2 A
		SM322(DO16 × 120VAC/1A)	6ES7322-1EH01-0AA0	16 outputs at 120 VAC/1 A
		SM322(DO8 × 120/230VAC/2A)	6ES7322-1FF01-0AA0	8 outputs at 120/230 VAC/2 A
	Digital I/O module	SM323 (DI16/DO16 × 24VDC/0.5A)	6ES7323-1BL00-0AA0	16 inputs at 24 VDC, 16 outputs at 24 VDC/0.5 A
		SM323(DI8/DO8 × 24 VDC/0.5A)	6ES7323-1BH00-0AA0	8 inputs at 24 VDC, 8 outputs at 24 VDC/0.5 A
	Relay output module	SM323 (DO16 × 120 VAC relay)	6ES7322-1HH00-0AA0	16 relay outputs at 120 VAC
		SM323 (DO8 × 230 VAC relay)	6ES7322-1HF00-0AA0	16 relay outputs at 230 VAC
	Dummy module	DM307	6ES7370-0AA01-0AA0	Dummy module
Power supply module	Power supply module	PS module 10	6ES1334-2BA00	24 VDC/10 A output
	Power supply backup module	UPS module 10	6EP1931-2EC01	24 VDC/10 A output
	Power supply backup battery	UPS BATTERY	6EP1935-6MD11	3.2A/h
SERVOPACK	Converter	45 kW converter	CIMR-MRXN20455A	
		37 kW converter	CIMR-MRXN20375A	
		30 kW converter	CIMR-MRXN20305A	
		22 kW converter	CIMR-MRXN20225A	

Category	Function	Name	Designation/Catalog number	Specifications/Remarks
SERVOPACK (continued)	Converter	18.5 kW converter	CIMR-MRXN20185A	
		15 kW converter	CIMR-MRXN20155A	
		11 kW converter	CIMR-MRXN20115A	
		7.5 kW converter	CIMR-MRXN27P55A	
		5.5 kW converter	CIMR-MRXN25P55A	
		3.7 kW converter	CIMR-MRXN23P75A	
	Inverter	37 kW inverter	CIMR-MXN20375A	
		30 kW inverter	CIMR-MXN20305A	
		22 kW inverter	CIMR-MXN20225A	
		18.5 kW inverter	CIMR-MXN20185A	
		15 kW inverter	CIMR-MXN20155A	
		11 kW inverter	CIMR-MXN20115A	
		7.5 kW inverter	CIMR-MXN27P55A	
		5.5 kW inverter	CIMR-MXN25P55A	
		3.7 kW inverter	CIMR-MXN23P75A	
	1-axis servo unit	0.5 kW servo unit	SGDK-05AEA	
		1 kW servo unit	SGDK-10AEA	
		1.5 kW servo unit	SGDK-15AEA	
		2 kW servo unit	SGDK-20AEA	
		3 kW servo unit	SGDK-30AEA	
		5 kW servo unit	SGDK-50AEA	
		6 kW servo unit	SGDK-60AEA	
		7.5 kW servo unit	SGDK-75AEA	
	2-axis servo unit	0.5 kW × 2 servo units	SGDK-0505AEA	
		1 kW × 2 servo units	SGDK-1010AEA	
		1.5 kW × 2 servo units	SGDK-1515AEA	
		2 kW × 2 servo units	SGDK-2020AEA	
		3 kW × 2 servo units	SGDK-3030AEA	
	Optional unit	PC board for separately mounted PG	SGDK-CF01A	Per axis
Motor	Spindle motor	5.5kW	MX □□□ -06AS □□□	
		7.5kW	MX □□□ -08AS □□□	
		11kW	MX □□□ -11AS □□□	
		15kW	MX □□□ -15AS □□□	
		18.5kW	MX □□□ -19AS □□□	
		22kW	MX □□□ -22AS □□□	
		30kW	MX □□□ -30AS □□□	
	Servo motor	0.45 kW servo motor	SGMKS-05A □□□□	
		0.85 kW servo motor	SGMKS-09A □□□□	
		1.3 kW servo motor	SGMKS-13A □□□□	
		1.8 kW servo motor	SGMKS-20A □□□□	
		2.9 kW servo motor	SGMKS-30A □□□□	
		4.4 kW servo motor	SGMKS-44A □□□□	
		5.5 kW servo motor	SGMKS-55A □□□□	
		7.5 kW servo motor	SGMKS-75A □□□□	

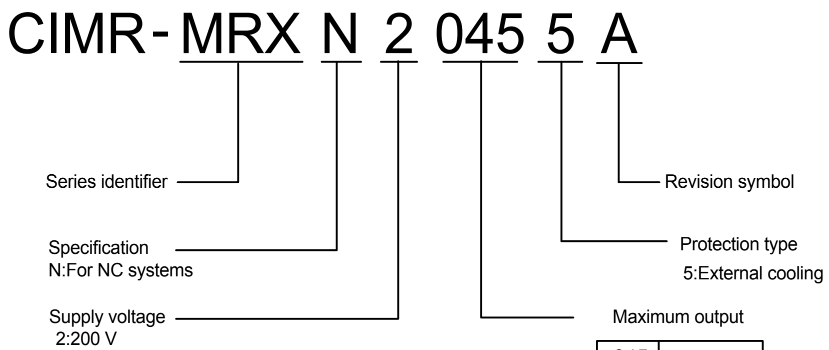
Category	Function	Name	Designation/Catalog number	Specifications/Remarks
Bus bar	Bus bar		JZSP-CGB02-1	For connection inside a 250-mm wide unit
			JZSP-CGB02-2	Between 250- and 150-mm wide units
			JZSP-CGB02-4	Between 250- and 75-mm wide units
			JZSP-CGB02-3	Between 150- and 150-mm wide units
			JZSP-CGB02-5	Between 150- and 75-mm wide units
			JZSP-CGB02-6	Between 75- and 75-mm wide units
			JZSP-CGB02-7	Between 150- and 250-mm wide units
			JZSP-CGB02-8	Between 75- and 250-mm wide units
			JZSP-CGB02-9	Between 75- and 150-mm wide units
	Local bus cable		JZSP-CNS90-1	Between 250- and 150-mm wide units, between 150- and 150-mm wide units, and between 75- and 150-mm wide units
			JZSP-CNS90-2	Between 250- and 75-mm wide units, between 150- and 75-mm wide units, and between 75- and 75-mm wide units
			JZSP-CNS90-4	1 m long between upper and lower units
			JZSP-CNS90-5	Between 150- and 250-mm wide units, and between 75- and 250-mm wide units
	Control power cable		JZSP-CNB00-1	Between 250- and 150-mm wide units, between 150- and 150-mm wide units, and between 75- and 150-mm wide units
			JZSP-CNB00-2	Between 250- and 75-mm wide units, between 150- and 75-mm wide units, and between 75- and 75-mm wide units
			JZSP-CNB00-3	1 m long between upper and lower units
			JZSP-CNB00-4	Between 150- and 250-mm wide units, and between 75- and 250-mm wide units
	Terminating connector		JZSP-CNS90-9	
AC reactor	Reactor		UZBA-B150A 0.07mH	For a 45 kW converter
				For a 37 kW converter
				For a 30 kW converter
				For a 22 kW converter
				For a 18 kW converter

Category	Function	Name	Designation/Catalog number	Specifications/Remarks
AC reactor (continued)	Reactor			For a 15 kW converter
				For a 11 kW converter
				For a 7.5 kW converter
				For a 5.5 kW converter
				For a 3.7 kW converter
PROFIBUS-DP related	PROFIBUS-DP connector	Vertical-connection type connector	6ES7972-0B □ 11-0XA0	□ indicates whether a PG port is available. (A) means not available, and (B) means available.
	PROFIBUS-DP connector	35-degree-connection type connector	6ES7972-0B □ 40-0XA0	□ indicates whether a PG port is available. (A) means not available, and (B) means available.
	PROFIBUS-DP connector	Horizontal-connection type connector	6GK1500-0EA0	For a converter
	PROFIBUS-DP cable	Stranded-wire cable	6XV1830-3EH10	
Others	Manual pulse generator	Handle PG	OSM-01-2GA-15	
	Braking power supply unit	BK unit	OPR-109A	For 200 VAC
			OPR-109F	For 100 VAC

1.2 Meanings of component designations

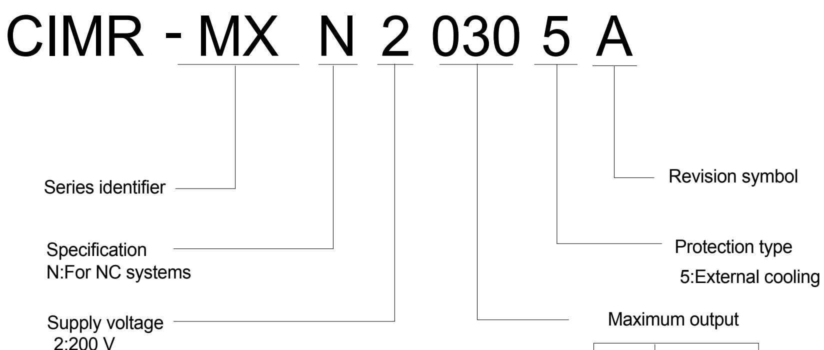
1.2.1 SERVOPACK designations

■ Converter



045	45kW
037	37kW
030	30kW
022	22kW
018	18kW
015	15kW
011	11kW
7P5	7.5kW
5P5	5.5kW
3P7	3.7kW

■ Inverter



037	37kW
030	30kW
022	22kW
018	18kW
015	15kW
011	11kW
7P5	7.5kW
5P5	5.5kW
3P7	3.7kW

■ Servo unit

SGDK - 75 - A E A

or

3030

Series identifier — SGDK

Rated output (see the table below) — 75 or 3030

Supply voltage A:2000 V — A

Communication command (E only) — E

Basic specification(A only) — A

1-axis unit		2-axis unit	
Number	Capacity	Number	Capacity
0.5	0.5kW	0505	0.5kW
10	1kW	1010	1kW
15	1.5kW	1515	1.5kW
20	2kW	2020	2kW
30	3kW	3030	3kW
50	5kW	—	—
60	6kW	—	—
75	7.5kW	—	—

1.2.2 Servo motor designations

SGMKS - 05 A 2 A 2 S

Servo motor capacity (kW)

Symbol	SGMKS 1500min $^{-1}$
05	0.45
09	0.85
13	1.3
20	1.8
30	2.9
44	4.4
55	5.5
75	7.5

Brake and oil seal specifications
- 1: No brake nor oil seal
- S: With oil seal
- B: With 90 VDC brake
- C: With 24 VDC brake
- D: With oil seal, with 90 VDC brake
- E: With oil seal, with 24 VDC brake

Shaft-end specification

Symbol	Specification	SGMKS
2	Straight, with no key	◎
3	1/10 tapered, with a parallel key	○
6	Straight, with a key and a tap	○

Design category
- A: SGMKS (400% peak torque)
- B: SGMKS (standard peak torque)

Serial encoder specification

Symbol	Specification	SGMKS
2	17-bit, absolute	◎
3	20-bit, absolute	○
C	17-bit incremental	○

Voltage
- A : 200 V

1.2.3 Spindle motor designations

UA K A - 30 A Z 1 _

AC spindle motor

Cooling method
K: Fully closed, forced air cooling

Winding type
A: Single winding (standard)

50% ED output
30: 30 kW

Shaft-end specification
N: No key
Blank: With a key (standard)

Mounting method
1: By flange
3: With feet

Encoder specification
Z: With an origin
N: No encoder

Design category
A: Standard

1.2.3 Spindle motor designations

Chapter 2

Installing the control panels

This chapter describes how to install the components of the YS 840DI system.

2.1 Designing the panels

2.1.1 Environmental conditions for installing the control panels and other system components

The operating temperature requirements for the YS 840DI system components are as follows:

Function	Name	Allowable operating temperature range
CNC unit	PCU50	5 - 45 ℃
CNC operation panel (face)	OP010F □	
CNC operation panel (back)		
Machine control panel	OP032S	0 - 45 ℃ (face), 0 - 55 ℃ (back)
Power supply module	PS module	0 - 60 ℃
Power supply backup module	UPS module	
Power supply backup battery	UPS battery	5 - 40 ℃
Machine control panel I/O	PP module	0 - 55 ℃
I/O power supply module	PS307	0 - 60 ℃ (horizontal mounting), 0 - 40 ℃ (vertical mounting)
Interface module	ET200M	
I/O module	I/O module	
SERVOPACK	SERVOPACK	0 - 55 ℃ , 0 - 45 ℃ (heat sink)
Reactor/winding changeover switch	Reactor	0 - 60 ℃
Braking power supply unit	BK unit	0 - 60 ℃

IMPORTANT

If the operating temperature requirements were not observed, the performance could not be guaranteed.

The environmental requirements for the control panels are as follows:

Table 2.1 Environmental requirements for the control panels and other system components

<table>
<tr><th colspan="2">Items</th><th colspan="3">Requirements</th></tr>
<tr><td rowspan="9">Environmental conditions</td><td rowspan="2">Ambient temperature *1</td><td colspan="2">During storage or transportation</td><td>-20 to +60 ℃</td></tr>
<tr><td colspan="2">During operation</td><td>5-30 ℃ *2</td></tr>
<tr><td>Humidity</td><td colspan="3">10-90% RH (with no dew)</td></tr>
<tr><td>Vibration and shock</td><td colspan="3">4.9 and 73.5 m/s^2 respectively</td></tr>
<tr><td>Atmosphere</td><td colspan="3">Without excessive airborne dust, machining oil mist, or organic solvent vapor</td></tr>
<tr><td>Power supply module, I/O power supply module</td><td colspan="3">100 - 230 VAC 50/60Hz</td></tr>
<tr><td>Power supply</td><td colspan="3">Input supply voltage: 100/200 VAC; Frequency: 50/60 Hz</td></tr>
<tr><td rowspan="2">Converter</td><td>Main power supply</td><td colspan="2">200-230 VAC +10/-15%, 50/60 Hz ± 5%, three-phase</td></tr>
<tr><td>Control power supply</td><td colspan="2">200-230 VAC +10/-15%, 50/60 Hz ± 5%, single-phase</td></tr>
</table>

IMPORTANT

- Even if the ambient temperature requirement is met, the system must not be installed in such places where it is exposed to direct sunlight, nearby heat sources, or the elements.
- The ambient temperature must be between 5 and 30℃ taking into account UPS battery's operating temperature requirement of 5-40 ℃ and the expected temperature rise of 10 ℃ .

2.1.2 Thermal design of the enclosures

The enclosure of a panel must hermetically enclose a CNC or other unit and be so designed as to keep the internal average temperature rise 10 ℃ or less.

■ Internal average temperature rise

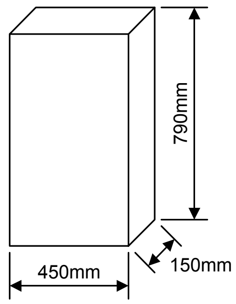
The internal average temperature rise for a sheet metal enclosure can be calculated as follows:

• ΔT	: Internal temperature rise	(℃)
• P	: Internal heat produced	(W)
• qe	: Enclosure's thermal transfer ratio	(W/ ℃)
• k	: Sheet metal's thermal transfer constant	(W/m^2 ℃)
	With an internal fan	6W m^2 ℃
	Without internal fan	4W/ m^2 ℃
• A	: Enclosure's effective surface area (m^2)	

Note: Effective surface area means the area of an enclosure's surface that can dissipate heat
(excluding such a surface as is in contact with another object).

Internal temperature rise of a panel with an internal fan

◀ EXAMPLE ▶ The size of the enclosure is assumed 450 (W) × 790 (H) × 150 (D) mm.



- Effective surface area $A = 1.0155\ (m^2)$
  (the bottom surface is excluded as the panel is of stand-alone type)
- Internal heat produced $P = 60\ (W)$
- Internal temperature rise

$$\triangle T = \frac{P}{qe} = \frac{P}{k \cdot A} = \frac{60}{6 \times 1.0155} = 9.8\ (℃)$$

The calculated internal temperature rise $\Delta T = 9.8$ (℃), thus the temperature rise requirement of 10 ℃ is satisfied.
If the temperature rise requirement is not satisfied, additional measure must be taken to lower the temperature rise.

■ Capacity of heat exchangers

If an internal fan alone is not sufficient for satisfying the temperature rise requirement, a heat exchanger must be installed (see the table below).

Table 2.2 Heat exchanger

Type	Designation	Capacity	Outside dimensions (mm)
DE9404550-1	REX1600ESYE	110W/10 ℃	194 : (W) 800 : (H) 65 : (D)

Note: Capacity means the amount of heat that a heat exchanger can remove, on the ground that the temperature rise must be kept 10 ℃ or less.

Maximum internal heat that can be safely produced in a panel equipped with a heat exchanger

◀ EXAMPLE ▶ Up to 359 W of internal heat can be safely produced in a panel if it is equipped with a heat exchanger of table 2.2, as shown below.

- $P = k \cdot A \cdot \triangle T + 110W/10\ ℃ = 6 \times 4.16 \times 10 + 110 = 359W/10\ ℃$

■ Installing a heat exchanger

It is the responsibility of the customer to prepare and install together an enclosure and a heat exchanger. The internal fan must be mounted at an uppermost location so as to force the internal air down. The external fan must be mounted at a lowermost location so as to force the external air up.

❗ MANDATORY
• Always install a heat exchanger. Otherwise damage could result.

Fig. 2.1 shows an example installation of a heat exchanger.

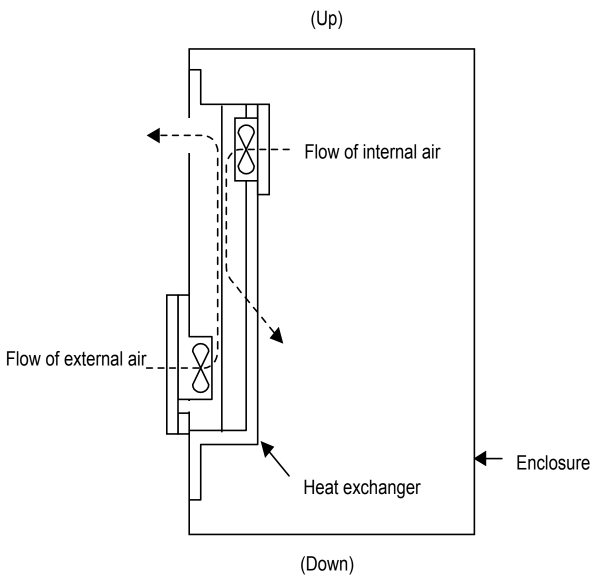


Fig. 2.1 Example installation of a heat exchanger

2.1.3 Heat dissipation

The table below lists the heat each YS 840DI system unit dissipates.

Function	Name	Heat dissipation			
		Total heat dissipation (W)	Heat dissipation inside panel (W)	Heat dissipation outside panel (by heat sink) (W)	Minimum air flow rate (m/s)
CNC unit	PCU50	130	—	—	—
Operation panel	OP010F □	24			
NC keyboard					
Machine control panel	OP032S				
Power supply module	PS module 10	10.5			
Power supply backup module	UPS module	10			
Power supply backup battery	UPS BATTERY	1			
Machine control panel I/O	PP module	11			
I/O power supply module	PS307 (24 VDC/2A output)	10			
	PS307 (24 VDC/5A output)	18			
	PS307 (24 VDC/10A output)	30			
Interface module	ET200M	4.5			
Digital input module	SM321 (DI32 × 24 VDC)	6.5			
	SM321 (DI16 × 24 VDC)	3.5			
	SM321 (DI16 × 24 VDC source)	3.5			
	SM321 (DI16 × 120 VAC)	4.1			
	SM321 (DI8 × 120/230 VAC)	4.9			
Digital output module	SM322 (DO32 × 24 VDC/0.5A)	0.26			
	SM322 (DO16 × 24 VDC/0.5A)	0.19			
	SM322 (DO8 × 24 VDC/2A)	6.8			
	SM322 (DO16 × 120 VAC/1A)	9			
	SM322 (DO8 × 120/230 VAC/2A)	8.6			
Digital I/O module	SM323 (DI16/DO16 × 24 VDC/0.5A)	6.5			
	SM323 (DI8/DO8 × 24 VDC/0.5A)	4.5			
Relay output module	SM322 (DO16 × 120 VAC REL)	4.5			
	SM322 (DO8 × 120/23O VAC REL)	2.2			
Converter*	CIMR-MRXN20455A	470	190	280	2.5
	CIMR-MRXN20375A				
	CIMR-MRXN20305A				
	CIMR-MRXN20225A				
	CIMR-MRXN20185A				
	CIMR-MRXN20155A				
	CIMR-MRXN20115A				
	CIMR-MRXN27P55A				
	CIMR-MRXN25P55A				

Function	Name	Heat dissipation			
		Total heat dissipation (W)	Heat dissipation inside panel (W)	Heat dissipation outside panel (by heat sink) (W)	Minimum air flow rate (m/s)
Converter *	CIMR-MRXN23P75A				2.5
Inverter *	CIMR-MXN20375A				2.5
	CIMR-MXN20305A	687	213	474	
	CIMR-MXN20225A				
	CIMR-MXN20185A				
	CIMR-MXN20155A				
	CIMR-MXN20115A				
	CIMR-MXN27P55A				
	CIMR-MXN25P55A				
	CIMR-MXN23P75A				
1-axis servo unit *	SGDK-75AEA	270	90	180	2.5
	SGDK-60AEA				
	SGDK-50AEA	180	70	110	
	SGDK-30AEA				
	SGDK-20AEA				
	SGDK-15AEA				
	SGDK-10AEA				
	SGDK-05AEA				
2-axis servo unit *	SGDK-3030AEA	290	120	170	2.5
	SGDK-2020AEA	230	100	130	
	SGDK-1515AEA				
	SGDK-1010AEA				
	SGDK-0505AEA				
Reactor	UZBA-B150A 0.07mH		—	—	—

* Heat dissipation of a converter, inverter or servo unit is at a 70% load.

2.1.4 Power consumption

The table below lists the power each YS 840DI system unit consumes. When designing a control panel, use this data.

Function	Name	Power consumption (supply voltage)	Other units powered by this unit
Power supply module	PS module 10	2.6A 270W (200 VAC)	• Power supply backup module (UPS module 10) • Power supply backup battery (UPS BATTERY) • CNC unit (PCU50) • Operation panel/NC keyboard (OP010F ☐)
Machine control panel	OP032S	6W (24 VDC)	None
Machine control panel I/O	PP module	11W (24 VDC)	None
I/O power supply module	PS307(2A)	10W (200 VAC)	• Interface module (ET200M) • I/O module (SM321/322/323) • Power supply for I/O loads
	PS307(5A)	18W (200 VAC)	
	PS307(10A)	30W (200 VAC)	
Converter	CIMR-MRXN20455A	(200 VAC)	• Inverter • Servo unit
	CIMR-MRXN20375A	(200 VAC)	
	CIMR-MRXN20305A	(200 VAC)	
	CIMR-MRXN20225A	(200 VAC)	
	CIMR-MRXN20185A	(200 VAC)	
	CIMR-MRXN20155A	(200 VAC)	
	CIMR-MRXN20115A	(200 VAC)	
	CIMR-MRXN27P55A	(200 VAC)	
	CIMR-MRXN25P55A	(200 VAC)	
	CIMR-MRXN23P75A	(200 VAC)	

2.2 Protecting against electric noise

2.2.1 Separation of cables

There are three types of cables used in the YS 840DI system: AC Power, DC power, and signal. These types of cables must be separated from each other as follows:

Type	Cable	Separation requirements
AC power (1)	AC power supply lines (primary/secondary)	These cables must not be bundled with DC power cables (2) or signal cables (3), or must be provided with an electromagnetic shield. Solenoids and relays must be provided with a surge absorber or a diode.
	Power cables to spindle and servo motors	
	AC lines to solenoids, contactors, and relays	
DC power (2)	24 VDC power supply lines to CNC, I/O, and power supply modules	These cables must not be bundled with AC power cables (1), or must be provided with an electromagnetic shield. These cables must be separated far enough from signal cables (3). DC solenoids and DC relays must be provided with a diode.
	24 VDC I/O lines between I/O and machine	
	24 VDC lines to solenoids and relays	
Signal (3)	PROFIBUS-DP cables between CNC and I/O module and between I/O module and converter	These cables must not be bundled with AC power cables (1), or must be provided with an electromagnetic shield. These cables must be separated far enough from DC power cables (2). Cables that need to be shielded must always be shielded.
	RS232C cables	
	Cables to manual pulse generator	
	Encoder cables between spindle inverter and spindle motor	
	Encoder cables between servo unit and servo motor	
	Cables to separately mounted PG	
	Battery cables	
	Other cables that need to be shielded	

INFO

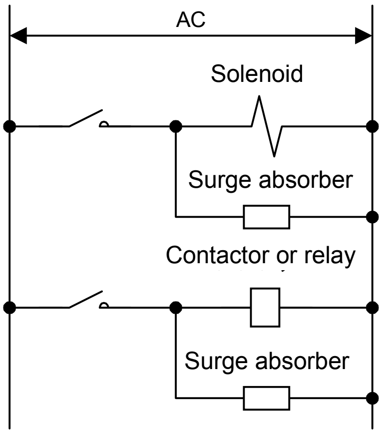
- Two cables are considered to be bundled with each other if they are less than 100 mm apart.
- An electromagnetic shield is a grounded iron plate separating a type of cables from another.

2.2.2 Noise-proof devices

■ Installing CR-type surge absorbers

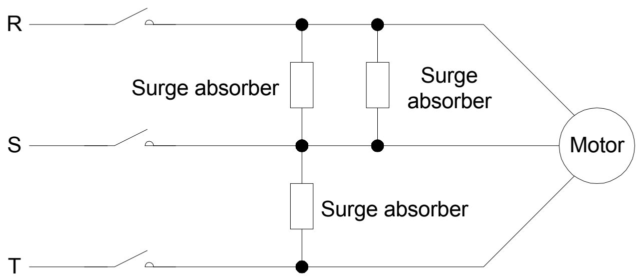
Provide AC-powered solenoids, contactors, relays, and induction motors with a CR-type surge absorber.

For solenoids, contactors, and relays:



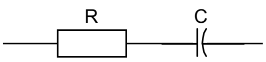
Note: A surge absorber must be installed as close to a coil as possible.

For induction motors:



Note: A surge absorber must be installed as close to a motor as possible.

INFO ■ Construction of a surge absorber



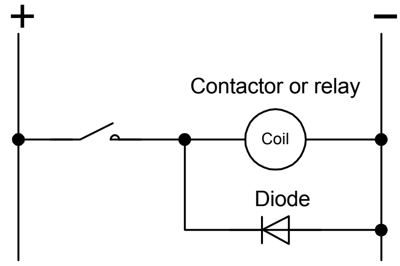
The recommended values of C and R are as follows:

- R = DC resistance of a coil (Ω)
- $C = \frac{I^2}{10}$ to $\frac{I^2}{20}$ (μF)

Note: I = Steady-state current of a coil

■ Installing diodes

Provide DC-powered contactors and relays with a diode.



Note: A diode must be installed as close to a coil as possible.

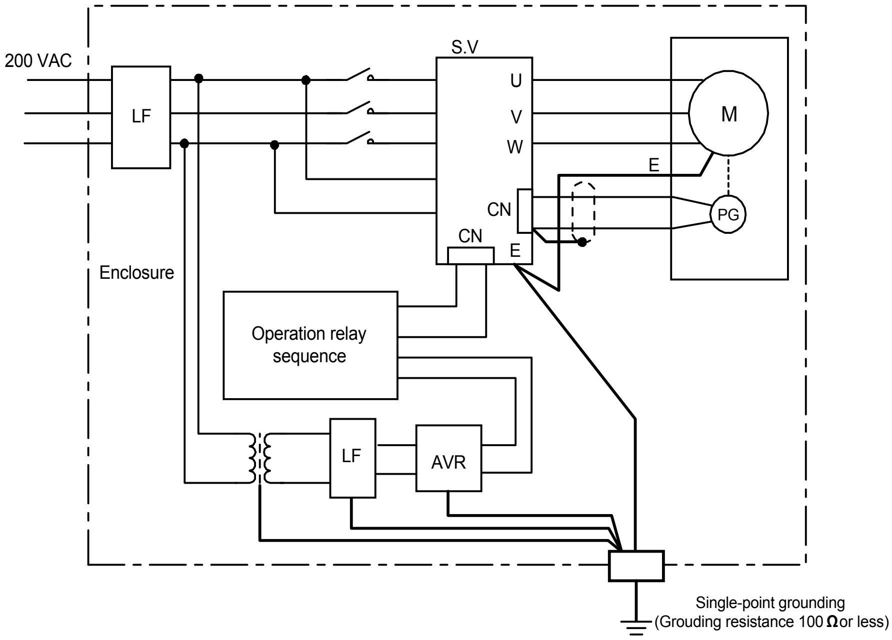
INFO

The recommended voltage and current ratings of a diode are twice the voltage and current ratings of a coil respectively.

2.2.3 Grounding

The grounding wire from each unit must be connected to the enclosure or the grounding plate directly.

Example grounding wiring



- Wires for grounding must be in accordance with applicable electrical installation regulations and the internal wiring rules.
- The grounding terminal of a servo motor must be wired to the grounding terminal of the corresponding SERVOPACK.
- All wires to be grounded must be directly connected to a single point whose grounding resistance 100 Ω or less. Otherwise electric shock, a fire, or malfunction could result.
- The single grounding point for this product must not be used to also ground a power device. Otherwise malfunction could result.

2.2.4 Cable shield clamp

A cable between a servo unit and a motor encoder must be shielded and grounded. To securely connect the shield of the cable to a grounding plate, use a cable clamp as illustrated below.

Cable clamping is not only for mechanically supporting a cable but also for securely grounding its shield, and thus essential to the safe operation of the system. The recommended cable clamping method is that stripping off a length of the insulation of a cable to expose its shielding braid, placing a cable clamp over the shielding braid, and fixing the cable clamp to a grounding plate, as illustrated below.

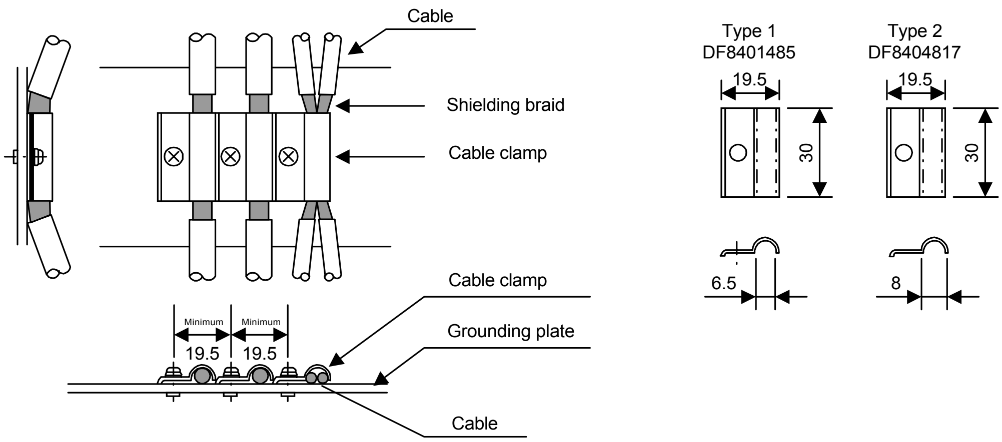


Fig. 2.2 Cable clamp

A grounding plate must be installed near a SERVOPACK as illustrated below.

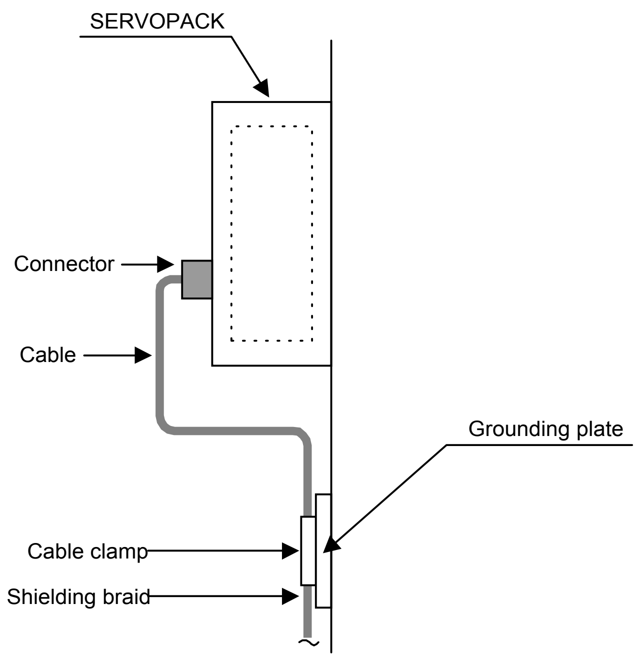


Fig. 2.3 Grounding plate position

2.3 Installation precautions

When designing an enclosure to contain a CNC or other unit, observe the precautions below.

2.3.1 Installing the CNC units

When installing the CNC unit in an enclosure, observe the following precautions:

- Install the CNC unit such that it is oriented as shown below.

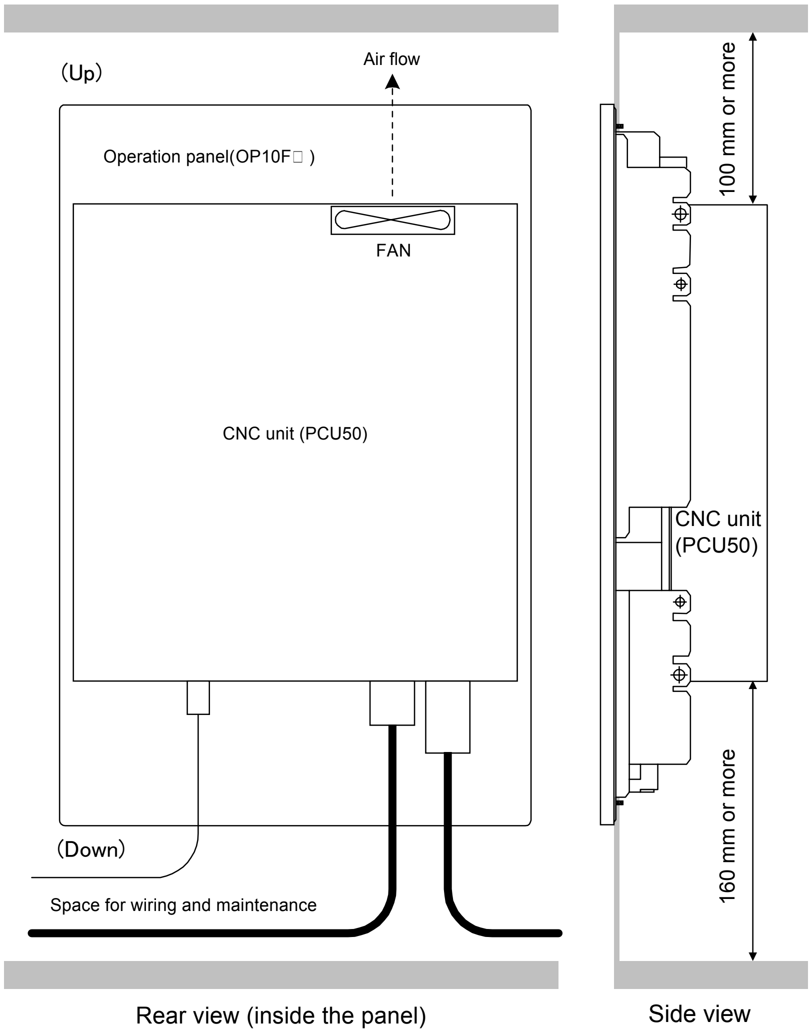


Fig. 2.4 CNC unit installation

- The CNC unit has a cooling fan at the top on the rear side. Do not place any obstacle that could block the air flow. Otherwise damage could result.
- Provide a 100 mm or more space over and a 160 mm or more space under the CNC unit for air circulation as well as for wiring and maintenance work.

INFO

The CNC unit is normally provided with an NC keyboard under it. Thus a 160 mm or more space will be naturally provided under the CNC unit.

2.3.2 Installing the feed/spindle SERVOPACK

When installing the feed or spindle SERVOPACK in an enclosure, observe the following precautions:

- Since the SERVOPACK is a wall-mounted type, it must be secured vertically to a wall of an enclosure with screws or bolts.
- The SERVOPACK must be installed such that checking, replacement or other maintenance work is easy.
- The SERVOPACK must be installed such that its heat sink fins are exposed to the outside cooling air to reduce the internal temperature rise. This way the panel can be airtight and the size of the heat sink can be designed smaller (see the figure below).
- The flow rate of the cooling air flowing through the heat sink fins must be at least 2.5 m/s as measured near the fins.
- The outside cooling air must be applied to each heat sink at the specified flow rate.
- The fan producing the cooling air should preferably be made of metal. A plastic fan could be deteriorated by machining oil, causing the drive to be damaged.

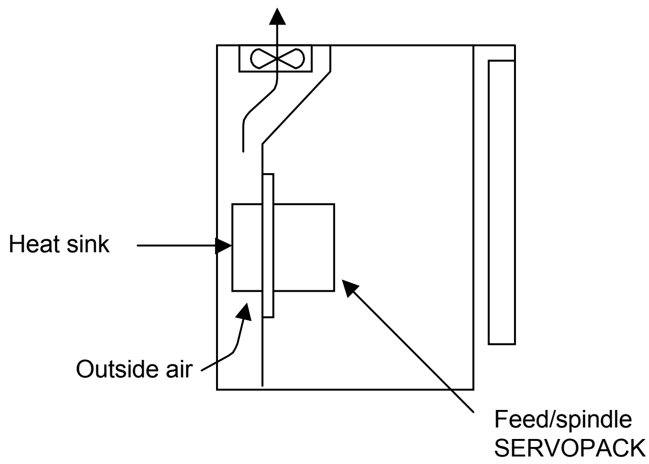


Fig. 2.5 Heat sink as exposed to the outside

2.3.3 Orientation of and installation space for the SERVOPACK

The SERVOPACK must be installed vertically and sufficient space must be provided around them for better cooling efficiency, as shown below.

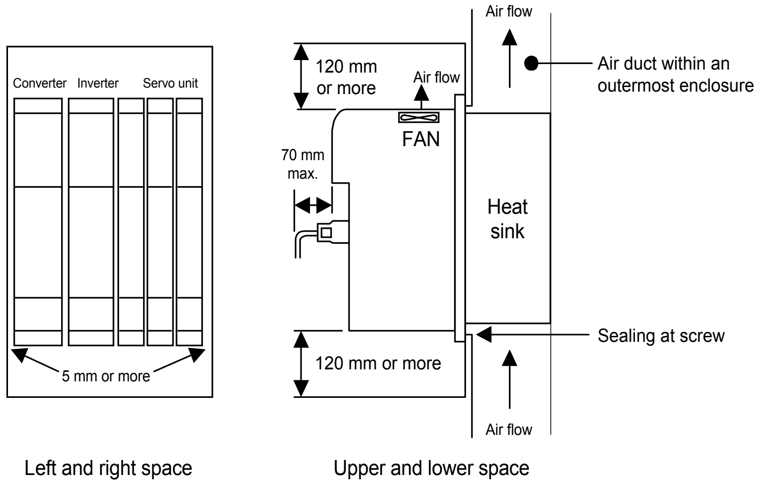


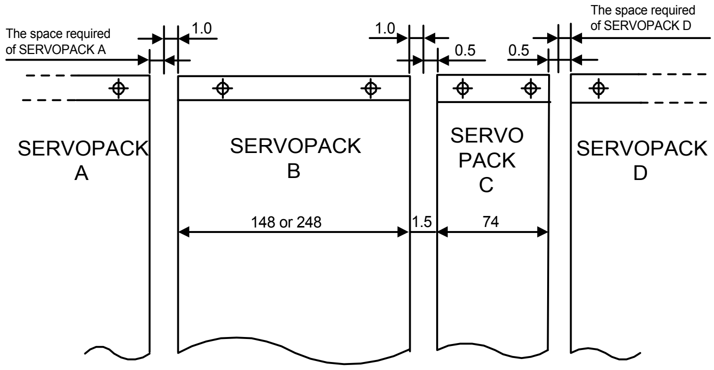
Fig. 2.6 SERVOPACK's orientation and space

- All SERVOPACKs are designed so as to have their heat sink exposed to the outside.
- For the outside dimensions of and installation space for the SERVOPACKs, see the relevant outline drawings given in the General Documentation - Hardware.
- The allowable temperature range of the air draft against the SERVOPACK is 0-45 ℃ at the heat sink (outside) and 0-55 ℃ inside.
- Apply sealing agent to the mounting screw areas of the SERVOPACK to prevent oil from entering inside.
- The SERVOPACK has a built-in fan as shown in Fig. 2.6.
- To prevent the SERVOPACK from overheating, arrange other units and devices such that the required space is provided over and under the SERVOPACK.
- If an air stirring fan is installed in a panel, the fan must be oriented such that the air does not directly hit the SERVOPACK (to prevent the SERVOPACK from collecting more dust).

A space must be provided to the right and left of each SERVOPACK as follows:

SERVOPACK width	Space width
74 mm	0.5 mm (right and left)
148 or 248 mm	1.0 mm (right and left)

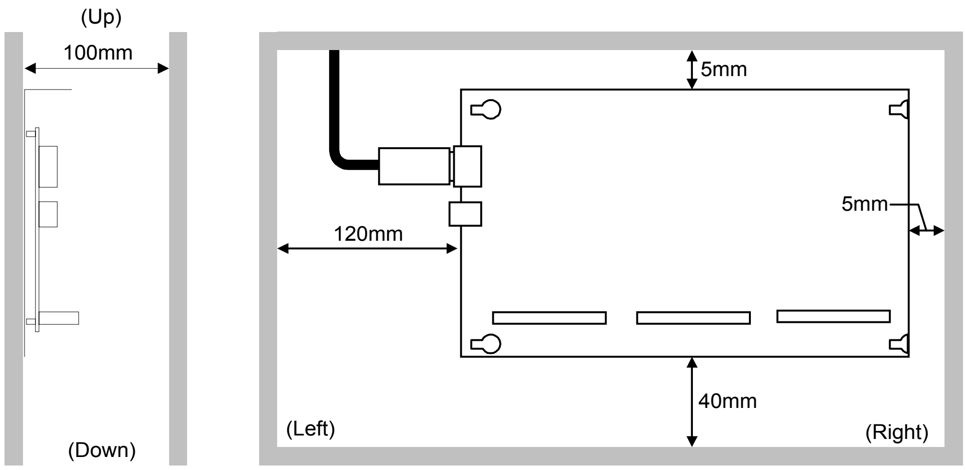
If two SERVOPACKs are installed side by side, the minimum space between them is a total of the right-side space required of the left SERVOPACK and the left-side space required of the right SERVOPACK, as illustrated below.



2.3.4 Installation space for the I/O modules

The I/O modules must be installed as illustrated below.

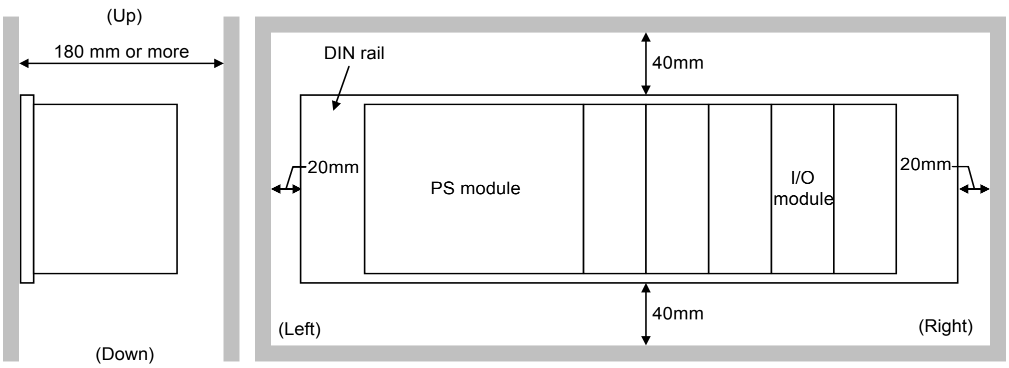
■ Machine control panel I/O (PP72/48)



INFO

There must be a 120 mm or more space to the left of the machine control panel I/O to provide for PROFIBUS-DP and power supply connections.

■ I/O modules



INFO

The enclosure that houses the I/O module must be at least 180 mm deep so that the front cover can be opened safely.

2.3.5 Installing lightning-surge absorbers

Lightning-surge absorbers must be installed to prevent electric and electronic devices from malfunctioning even if the power, communication, or signal line is subjected to a high-energy disturbance such as switching or lightning surge. Normally the power line should be provided with surge absorbers as shown below.

- Normal-type surge absorber between phases
- Common-type surge absorber between phases and ground

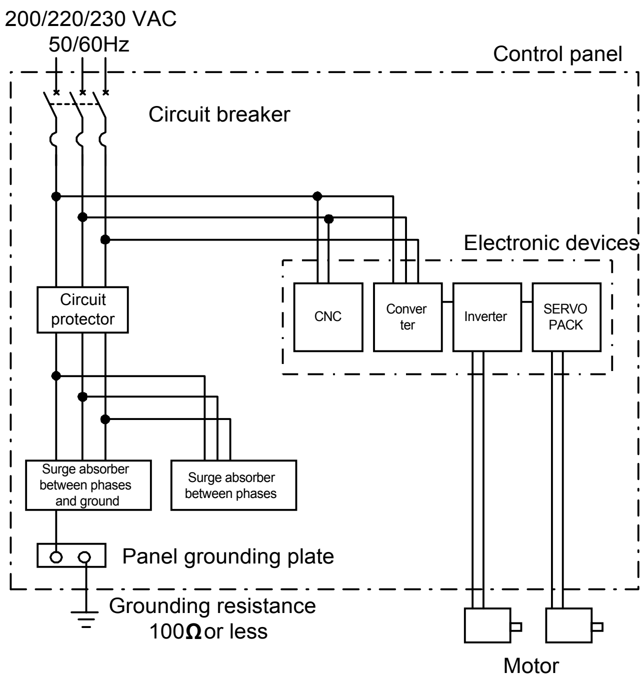


Fig. 2.7 Installing lightning-surge absorbers

■ Recommended surge absorbers

Application	Designation	Make
Normal-type surge absorber between phases	RAV-781BYZ-2	Okatani Electric
Common-type surge absorber between phases and ground	RAV-781BXZ-4	Okatani Electric

IMPORTANT

If the surge absorber failed and got shorted due to repeated lightning or switching surge, the wiring and devices could burn. To prevent this, 5-A fuses or other circuit protectors must be provided in the protected line.

Chapter 3

Installing the motors

This chapter presents the precautions to be observed when installing the YS 840DI motors.

3.1 Servo motors

The SGMKS-type servo motors must be used indoor. The environmental requirements for the motors are these:

- Indoor and free of corrosive or flammable gas
- Well ventilated and free of excessive dust, dirt, or moisture
- Ambient temperature: 0-40 ℃
- Relative humidity: 20-80%RH with no dew
- Can be easily cleaned and checked

3.2 Spindle motors

- The spindle motor must be provided with enough space so that it is cooled effectively by its cooling fan. Especially, there must be a 100 mm or more space between the no-load side of the spindle motor and a nearest machine part. If the spindle motor were not cooled enough, a motor overheat protector could operate even if the spindle motor runs at the rated load.
- The bed, foundation or mount on which the spindle motor is installed must be rigid enough. Otherwise the bed could vibrate due to the weight of the motor and the dynamic load from the machine.
- The installation site must be free of excessive dust or iron particles. As the air forced by the built-in cooling fan passes along the motor core, it could be blocked by any accumulated dust in the way. If the spindle motor were not cooled enough, a motor overheat protector could operate even if the spindle motor runs at the rated load.

Chapter 4

Connection method

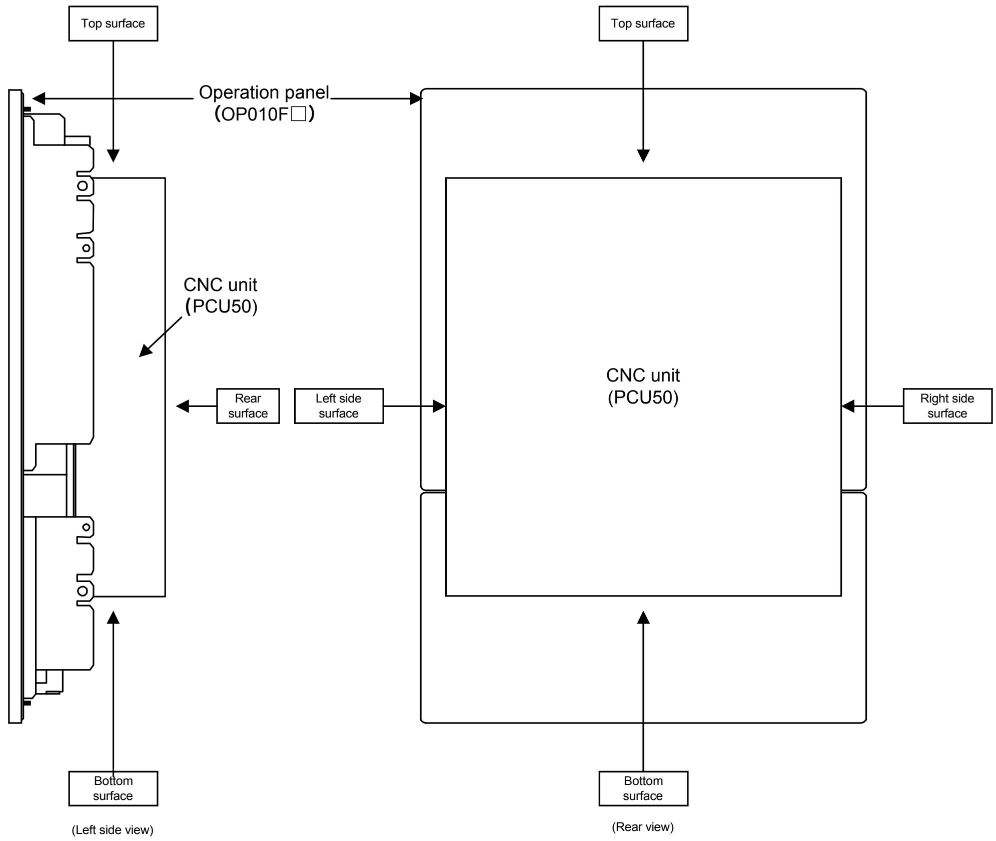
This chapter describes how to wire units and devices together.

4.1 Arrangement of connectors and switches

4.1.1 CNC unit

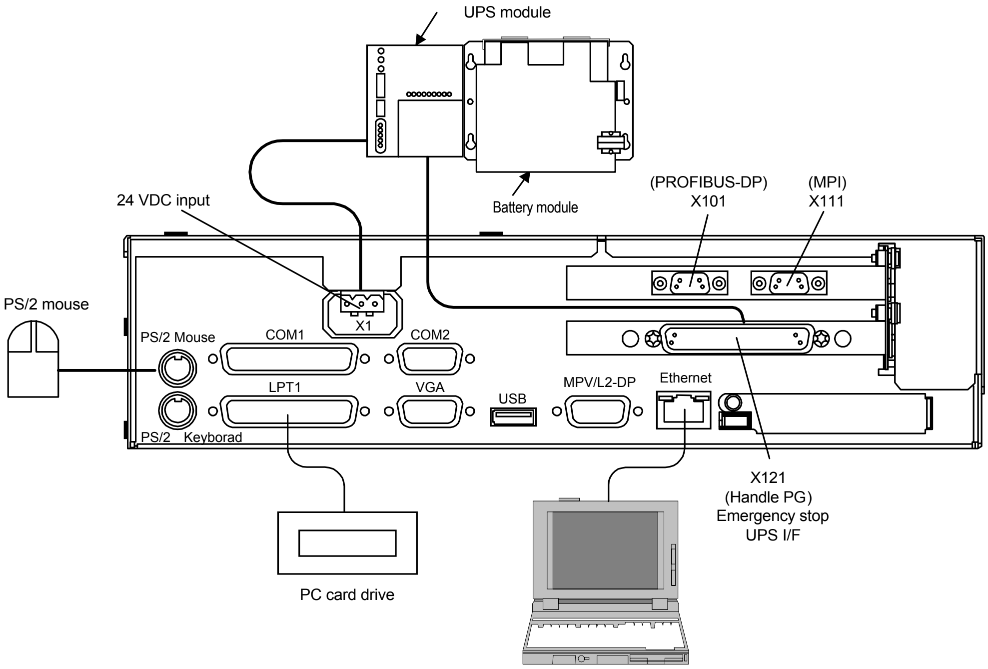
■ Definitions of the surfaces of combined CNC unit (PCU50) and operation panel (OP010F □)

The YS 840DI system uses a combination of the CNC unit (PCU50) and the operation panel (OP010F □). The surfaces of the combined units are defined as follows:

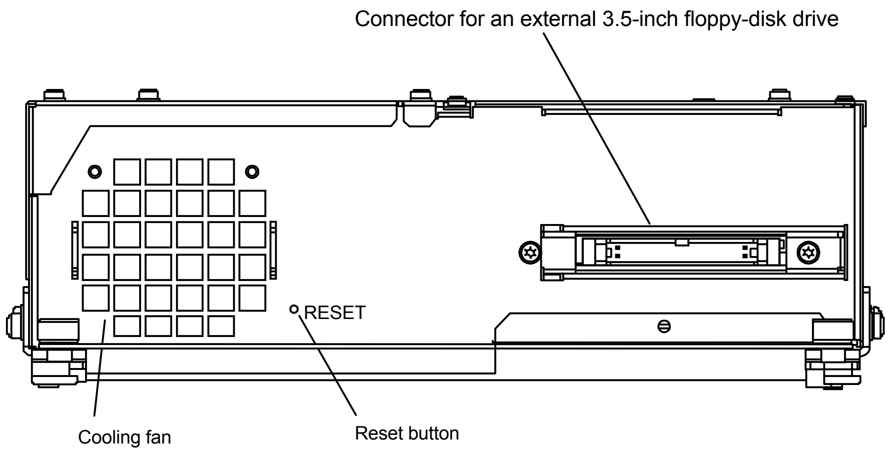


■ Arrangement of connectors

The arrangement of connectors on each surface is as shown below.



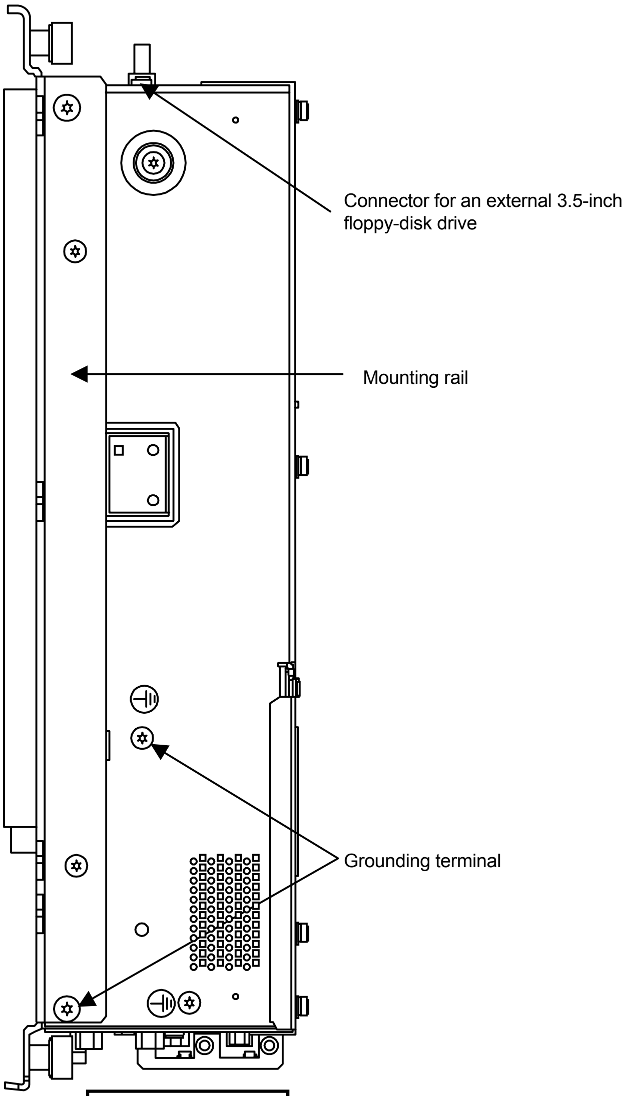
Bottom surface



Top surface

IMPORTANT

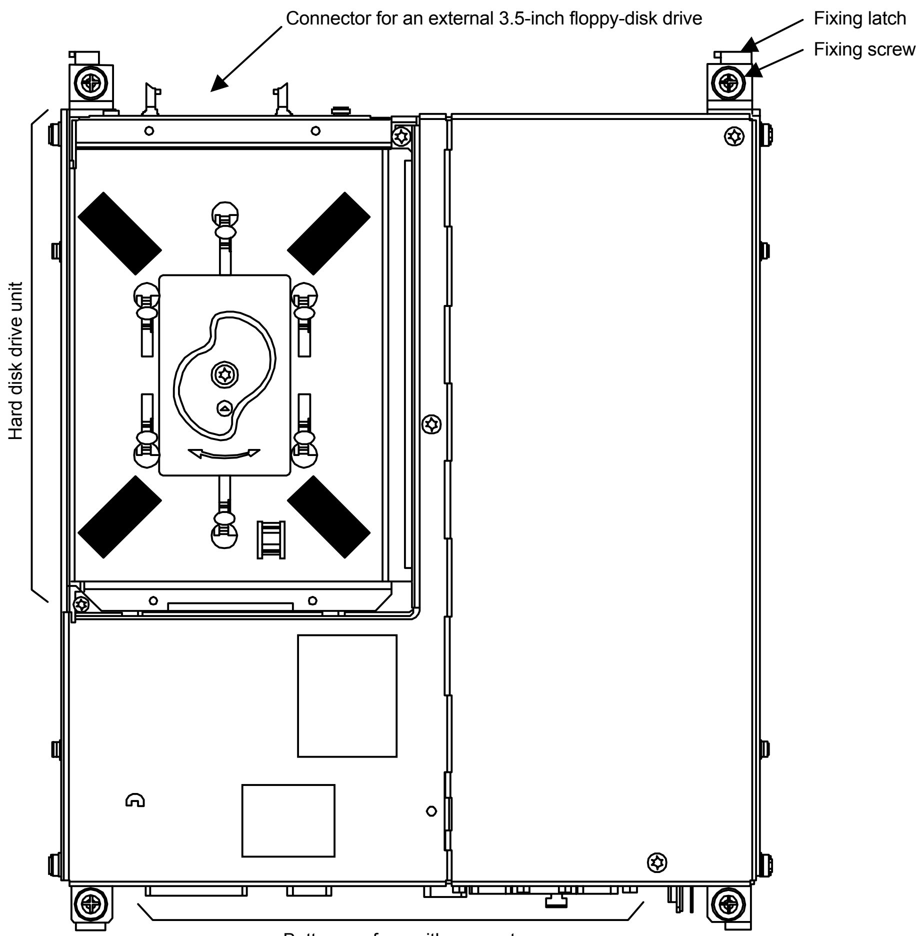
Pressing the reset button causes the system to reboot. Do not touch the reset button unless this is what you exactly want.



Right side surface

INFO

Remove the mounting rail if you want to combine the CNC unit with the OP010F □ operation panel.



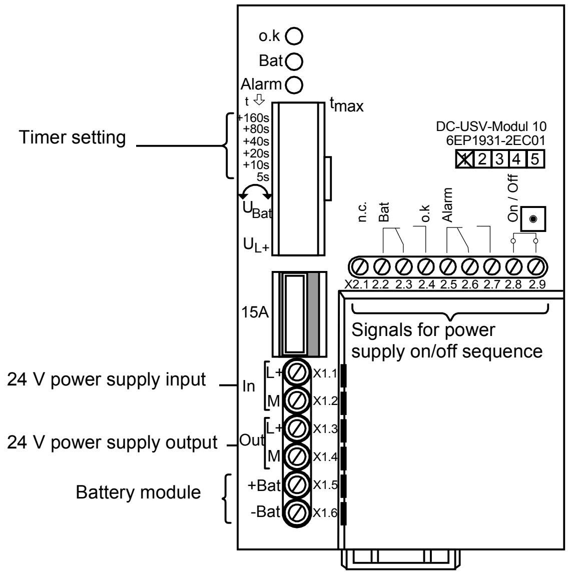
Rear surface

INFO

The left side surface is not shown because there is no connector on it.

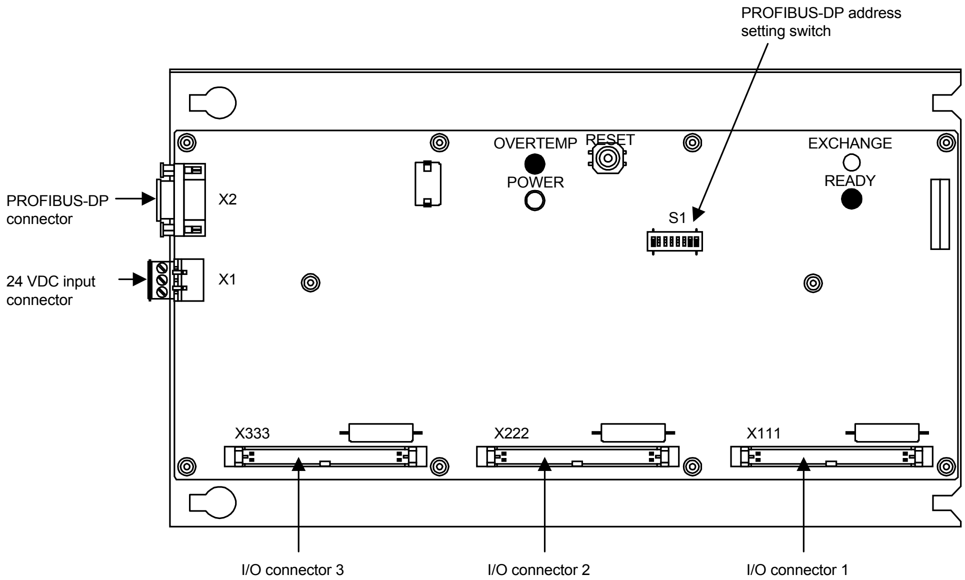
4.1.2 Power supply module

■ Power supply backup module (UPS module 10)

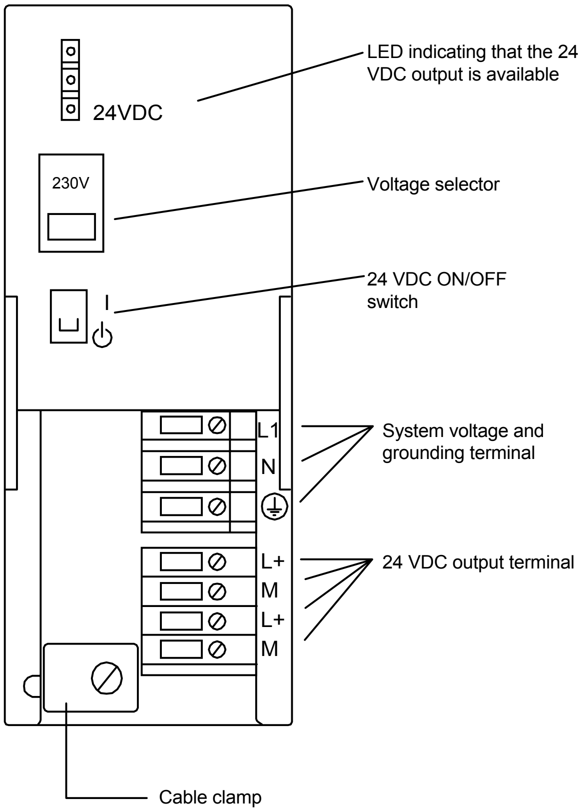


4.1.3 I/O module

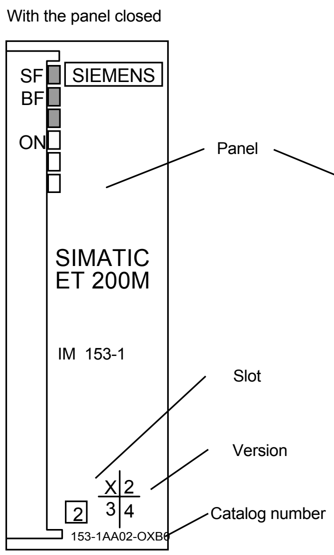
■ Machine control panel I/O (PP72/48)

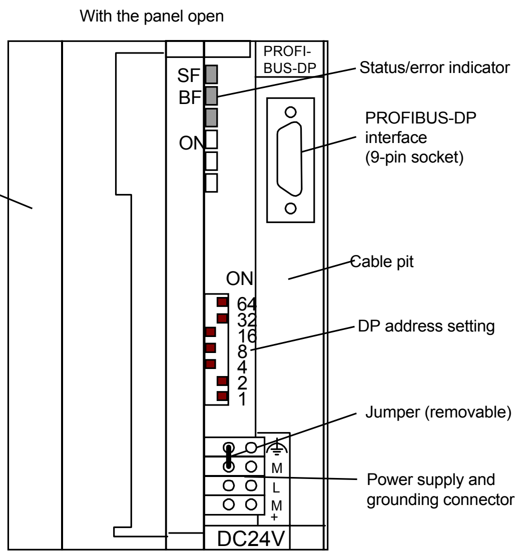


■ PS module for I/O (PS307(2A))

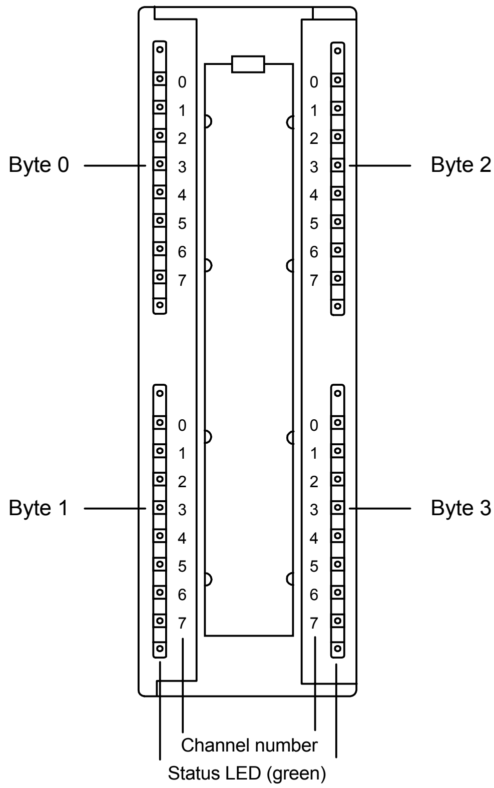


■ Remote I/O interface module (ET200M)

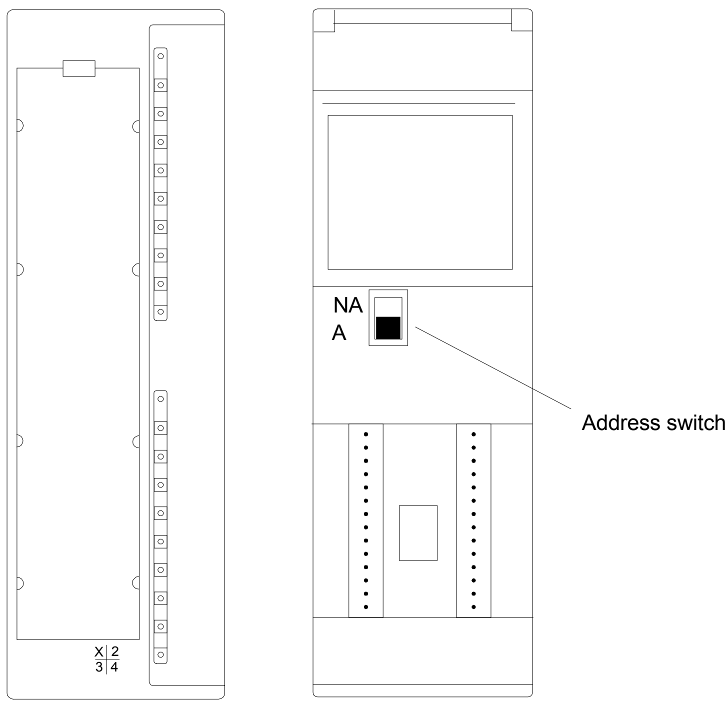




■ Digital I/O module (SM321 (D132 × 24 VDC))



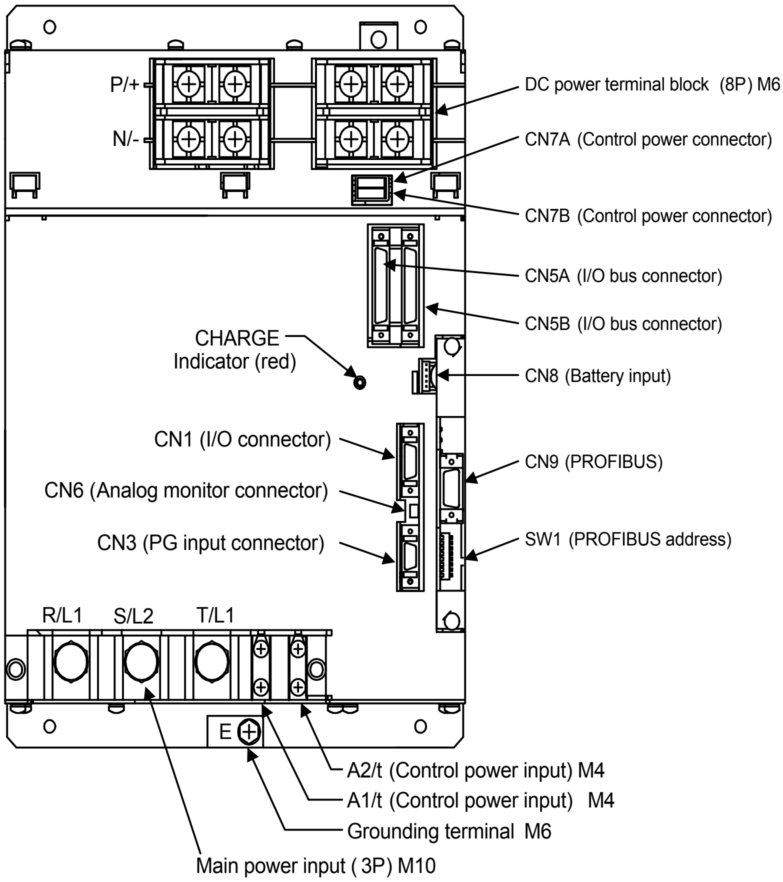
■ Dummy module (DM370)



Front view Rear view

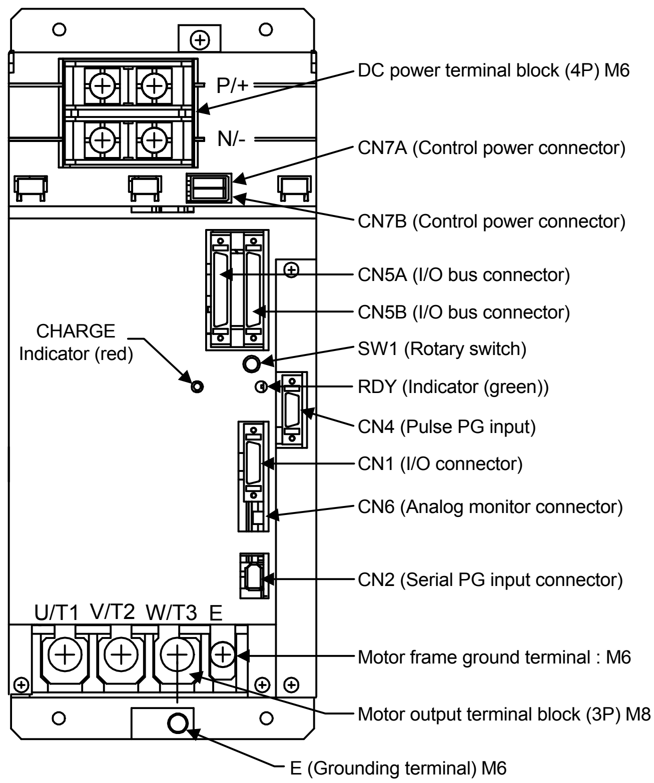
4.1.4 Converter

■ Converter (CIMR-MRXN20455A(45kW))



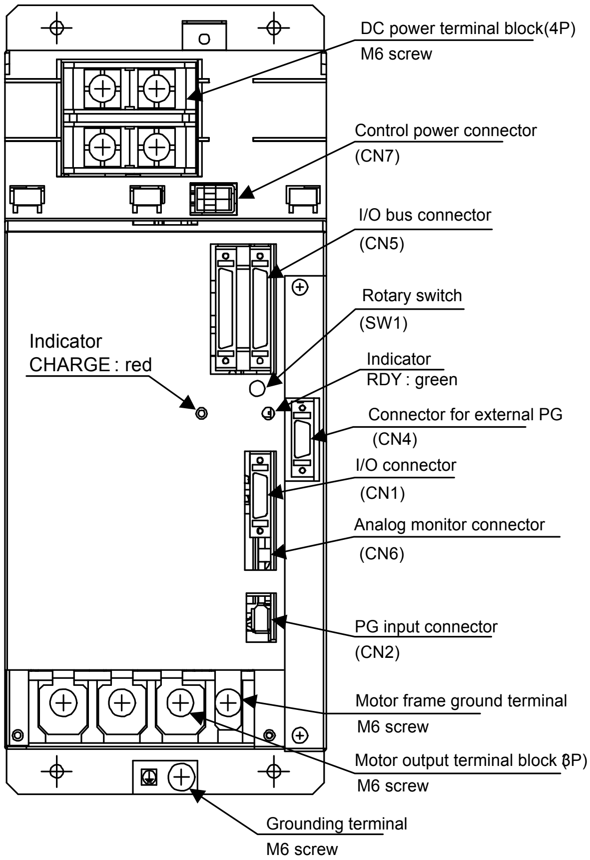
4.1.5 Inverter

■ Inverter (CIMR-MXN20305A(30kW))

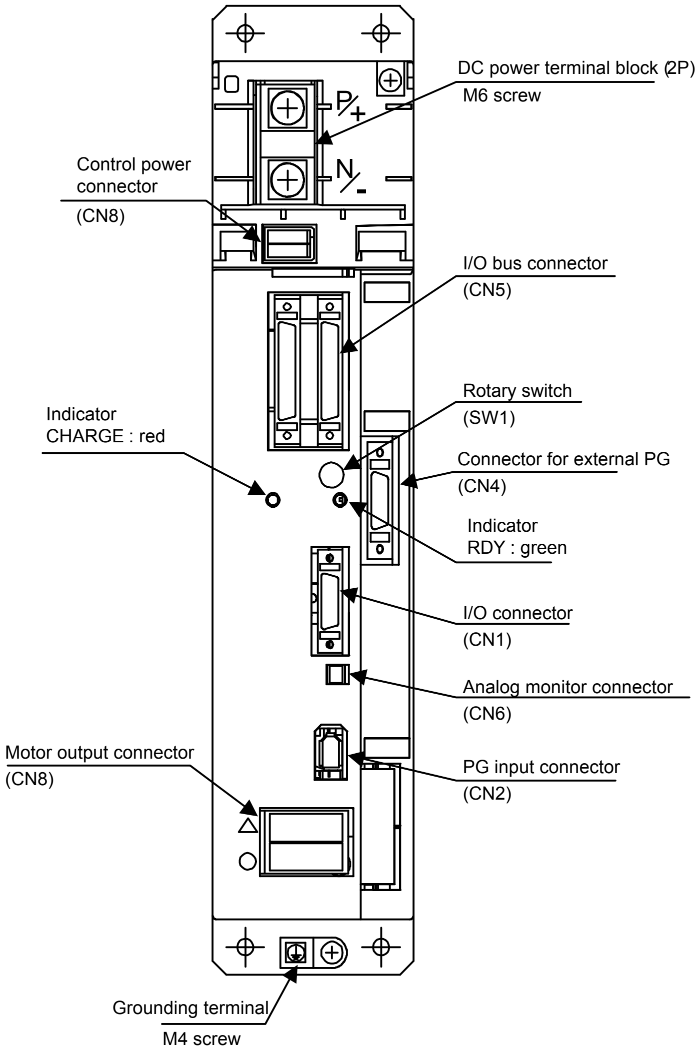


4.1.6 Servo unit

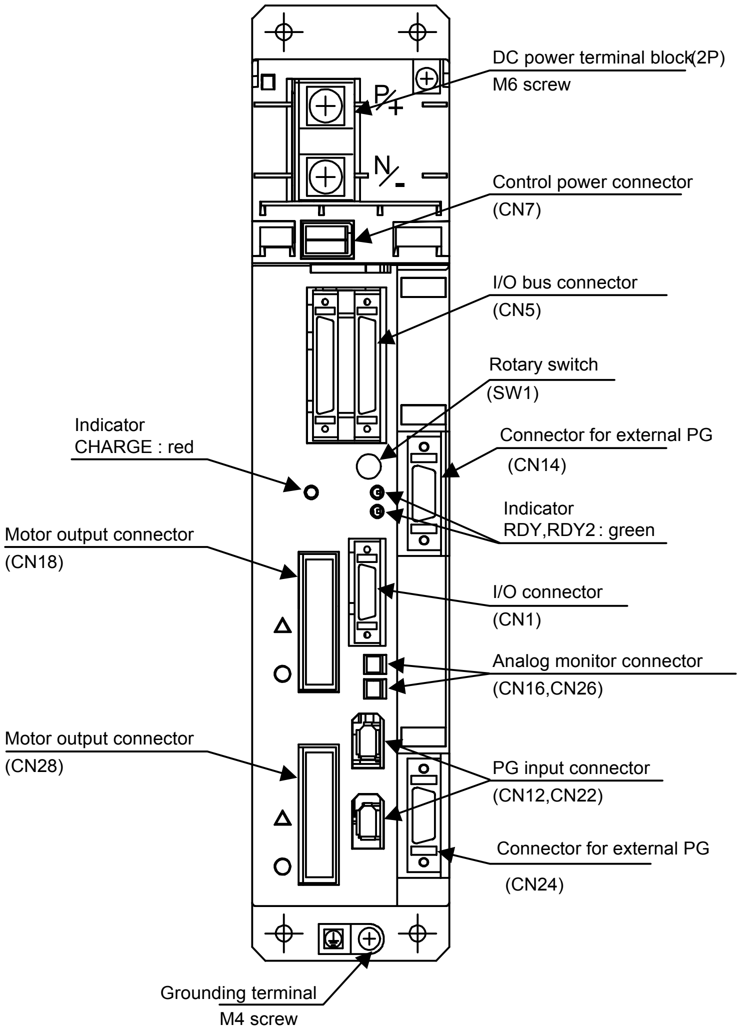
■ 1-axis servo unit (SGDK-60AEA (6 kW), SGDK-75AEA (7.5 kW))



■ 1-axis servo unit (SGDK-50AEA (5 kW))



■ 2-axis servo unit (SGDK-0505AEA (0.5 kW), SGDK-1010AEA (1 kW), SGDK-1515AEA (1.5 kW), SGDK-2020AEA (2 kW), SGDK-3030AEA (3 kW))



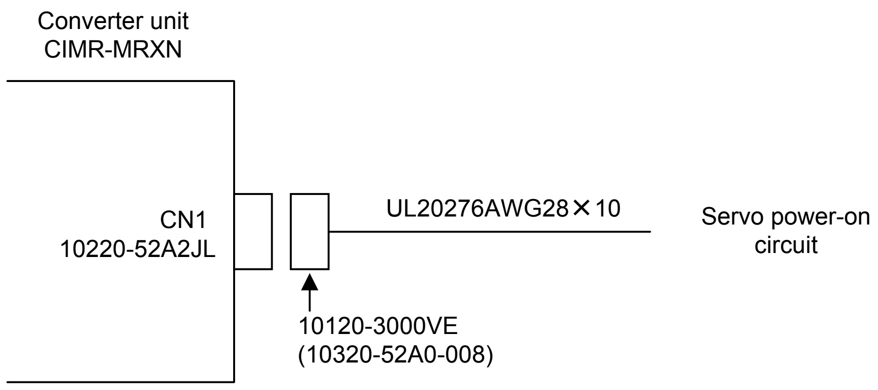
4.2 Power on/off signals

4.2.1 Wiring for servo power-on and other signals

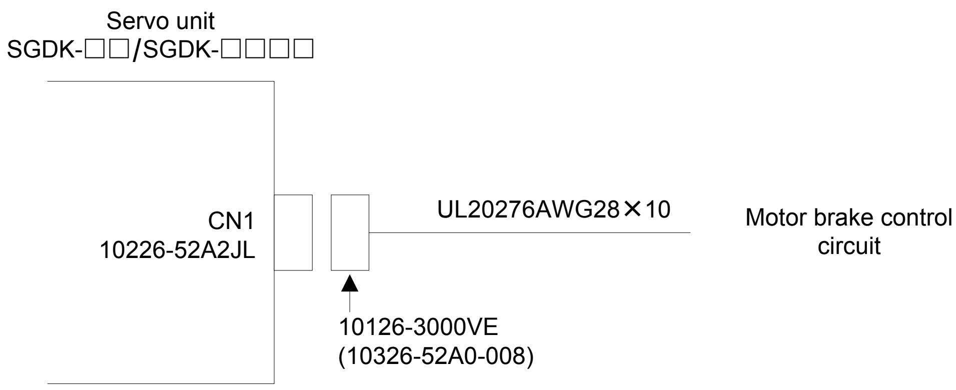
The wiring for the servo power-on and brake release output signals must be done as follows:

■ Wiring between units

Servo power-on output signal (SVMX)



Brake release output signal (BKX)



■ Detailed wiring drawing

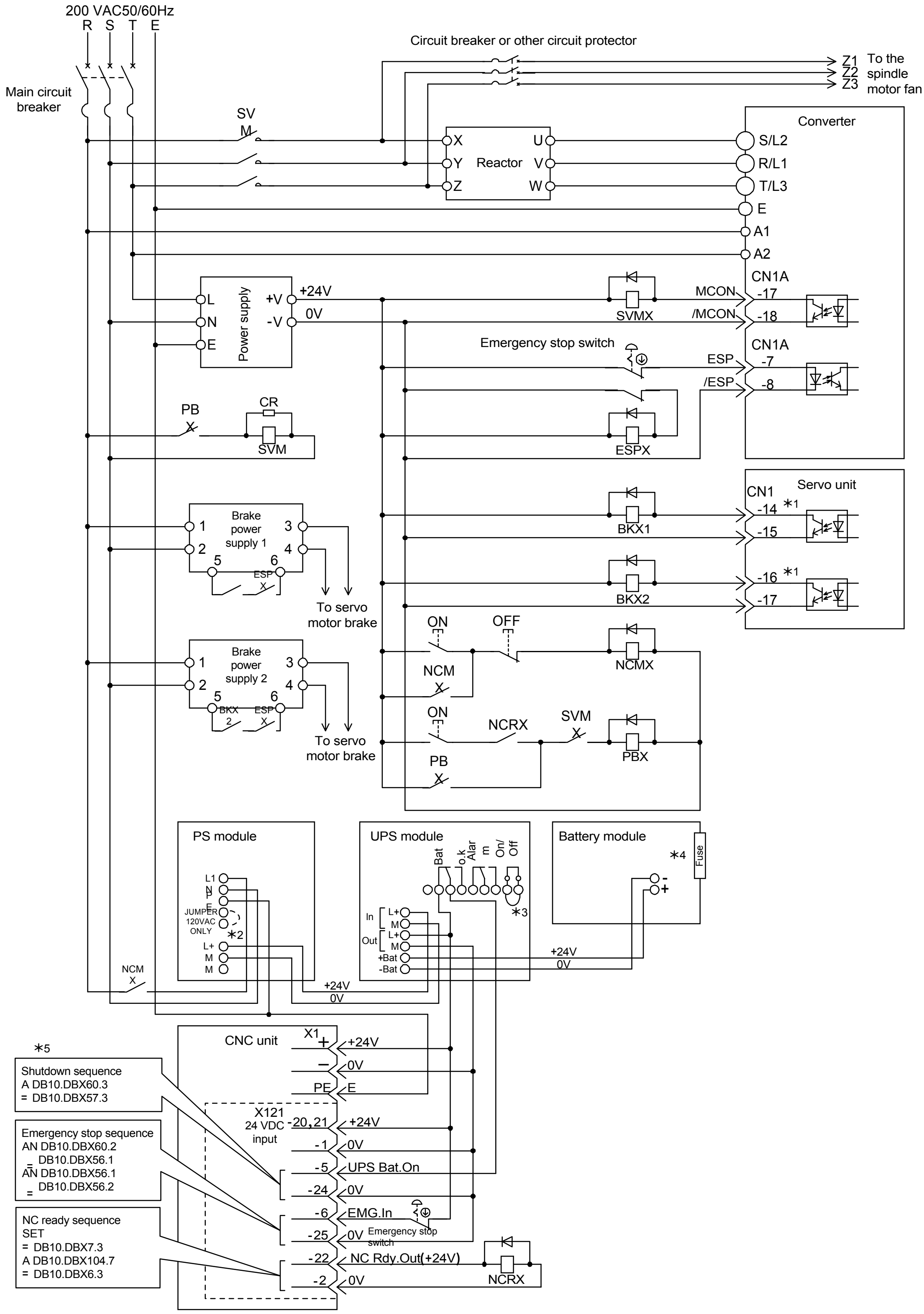


Fig. 4.1 Wiring for the SVMX and BKX output signals

IMPORTANT

*1. The brake release output signal as shown in Fig. 4.1 is for 2-axis servo units. For 1-axis servo units, use only pins 14 and 15. For 2-axis servo units, use pins 14 and 15 for the first axis, and pins 16 and 17 for the second axis.

Servo unit	Axis	Connector pins
1-axis servo unit	−	CN1 − 14 (+ 24V)
		CN1 − 15 (0V)
2-axis servo unit	First axis	CN1 − 14 (+ 24V)
		CN1 − 15 (0V)
	Second axis	CN1 − 16 (+ 24V)
		CN1 − 17 (+ 0V)

*2. If the voltage of power input to the PS module is 100-120 VAC, short the JUMPER120 VAC ONLY terminals together.

*3. To use the UPS module, short the On/Off terminals together. Otherwise an alarm would result.

*4. To use the battery module, insert a 15-A fuse in its fuse holder. Otherwise an alarm would result. When inserting a fuse, a spark may occur (if the battery is in the charged state). Don't worry about the spark since it's quite safe to you and the module.

*5. To make the UPS, emergency, and NC-ready functions available, program the necessary sequences in the PLC. Once the shutdown sequence has been programmed, disconnecting or otherwise disabling the UPS module would cause a switched-on NC to shutdown soon. To make the NC powered up normally, always keep the UPS module functional.

INFO

- The brake release output signal to control the brake of a motor must come from the servo unit driving that motor.
- The UPS module must not be used to power other than those units shown in Fig. 4.1.
- Wire between the Alarm terminals and an I/O module as necessary.
- Interlock the BKX relay as necessary by externally adding an interlock signal to the brake release output signal.
- It is the responsibility for the customer to provide the emergency stop switch and its wiring.
- It is the responsibility for the customer to provide the X121 connector (37-pin D-Sub female connector) and related wiring.
- The SVMX, ESPX, and BKX relays must be 24 VDC miniature relays (preferably LY-2 from OMRON).

4.2.2 UPS module timer setting

The UPS module must have its timer set so that the 24 VDC power supply will be available for a certain period even after a blackout occurs (to earn time necessary for memory data to be transferred to a hard disk). The relationship between timer setting and covered period is shown below. The covered period should be at least 85 seconds.

X 400	Covered period															
	5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155
On	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
6	0	1	0	0	1	0	1	0	1	0	1	0	1	0	1	0

X 400	Covered period																
	165	175	185	195	205	215	225	235	245	255	265	275	285	295	305	315	max
On	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	x
3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	x
4	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	x
5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	x
6	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	x

Fig. 4.2 UPS module timer setting

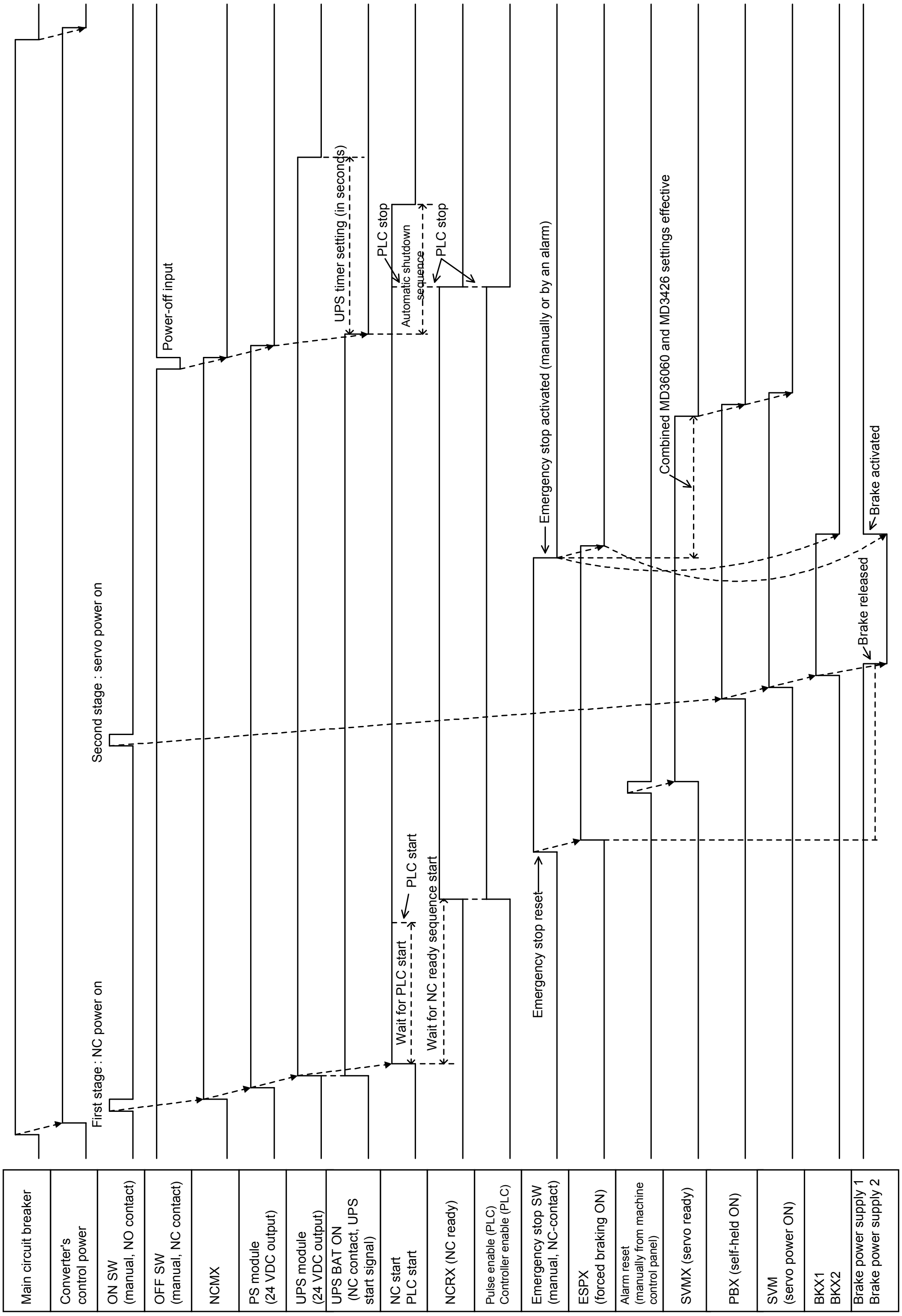
■ Position of the timer switch elements

1 means ON, 0 means OFF, and x means any position (irrelevant).

If switch element 1 is set to the OFF position, the UPS module supplies power as long as the supplied voltage is above the low battery level.

4.2.3 Time chart

The time chart below illustrates the typical timings of power-related signals.

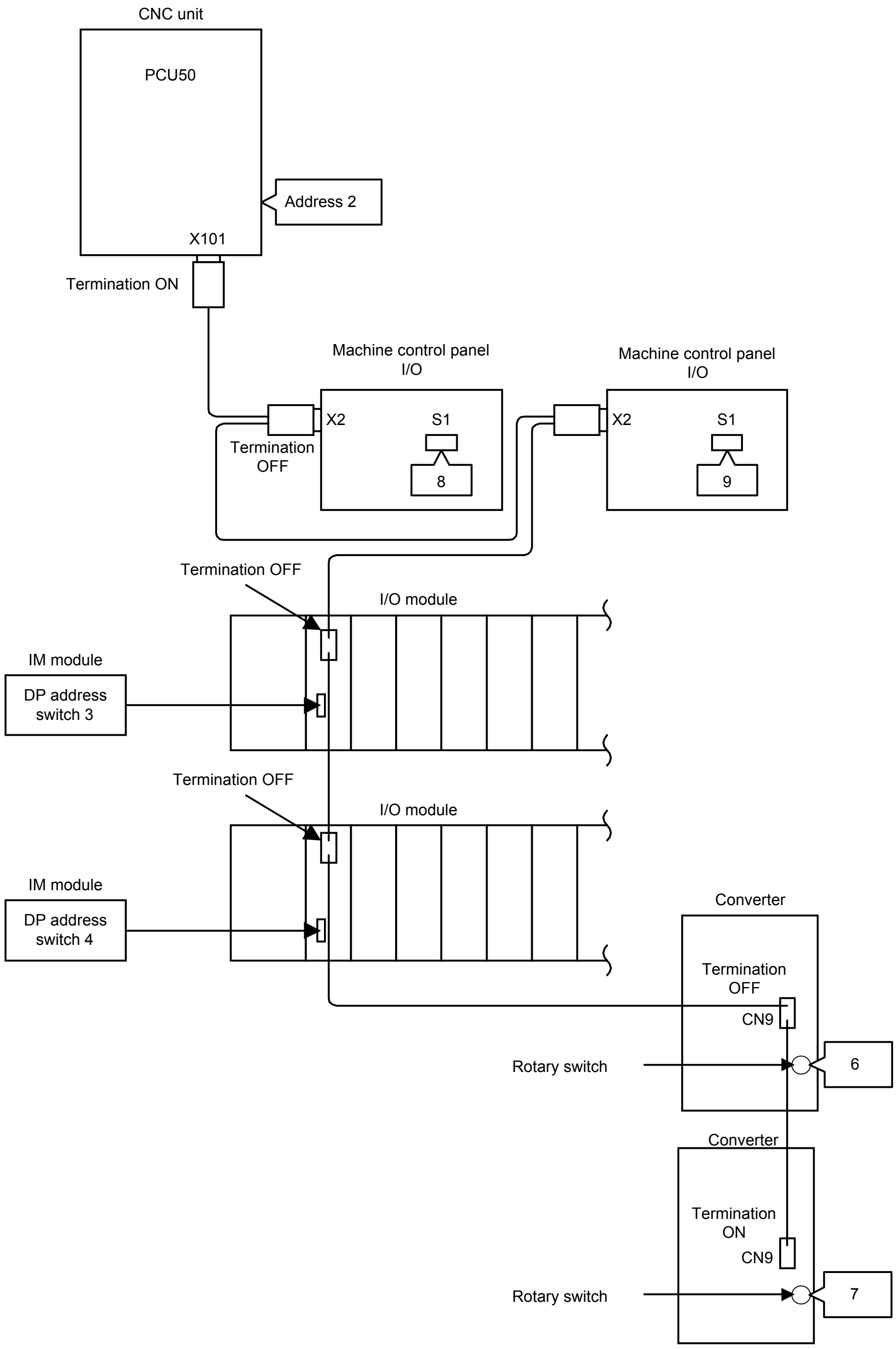


4.3 Wiring units and devices

4.3.1 PROFIBUS-DP address and termination setting

Shown below are examples of PROFIBUS-DP address setting and termination setting.

■ Example wiring



■ CNC unit address setting

The address of the CNC unit is fixed to 2 (no hardware setting).

■ Machine control panel I/O

Set the DIP switch S1 on the PC board to a value between 3 and 32 such that each unit has a unique value.

■ I/O module

Set the DP address switch (DIP switch) on the ET200M interface module to a value between 3 and 32 such that each unit has a unique value.

■ Converter

Set the DIP switch to a value between 3 and 32 such that each unit has a unique value.

■ Termination setting

Set the termination switch on each PROFIBUS-DP connector as given below.

Unit	Setting
CNC unit	ON
Units in between	OFF
End units	ON

INFO

- Any unit other than CNC must not have its address set to 0, 1, or 2.
- Up to 32 PROFIBUS-DP addresses are available with the YS 840DI system.
- For information on how to specify addresses in software, see Chapter 9, Hardware Configuration.

4.3.2 Setting the rotary switches on the inverters and servo units

Each of the inverters and servo units has a rotary switch to specify a PROFIBUS-DP slot allocated to it. Set the rotary switch as follows:

- Each axis must have its rotary switch set to a unique number in sequence starting with 0.
- 2-axis servo units have only one rotary switch but use two values because each axis needs a unique value. Thus, if a 2-axis servo unit has its rotary switch set to 2, the values 2 and 3 are actually used by those two axes, and the next unit must have its rotary switch set to 4. A 2-axis servo unit should have its rotary switch set to an even number (0, 2, 4, ...).
- The units connected to one converter may have their rotary switch set to a unique number between 0 and 6. The sequence in position of the units need not correspond to the sequence of the set values of their rotary switches.

INFO

If a unit has its rotary switch wrongly set, the corresponding LED above the PROFIBUS connector on the converter would go red (normally green).

Chapter 5

Assembling and replacing

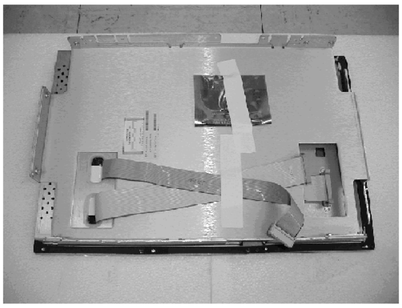
5.1 Installing the CNC unit

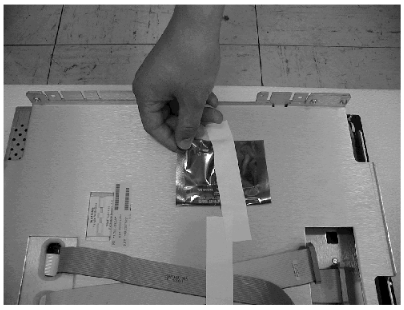
This subsection describes how to install the CNC unit (PCU50).

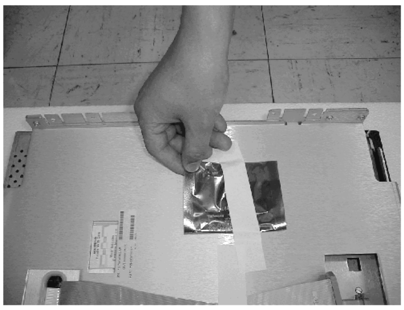
■ Installation procedure

The CNC unit of the YS 840DI system is normally delivered with the operation panel attached to it. Make any necessary adjustment to the CNC unit or the operation panel separately, and then assemble them together using the following procedures:

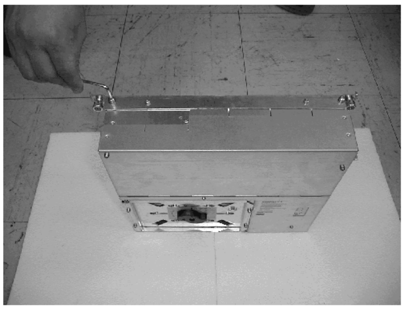
1. Remove the screws in a vinyl bag and a cable fixing seal from the back of the operation panel.

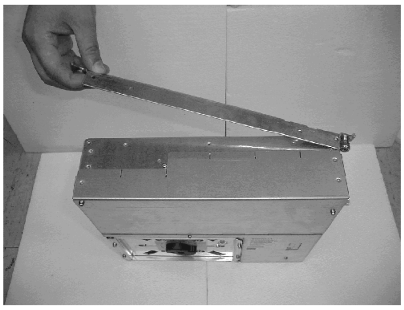




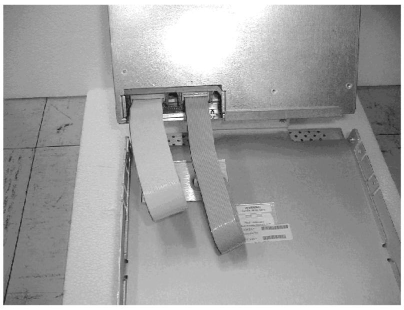


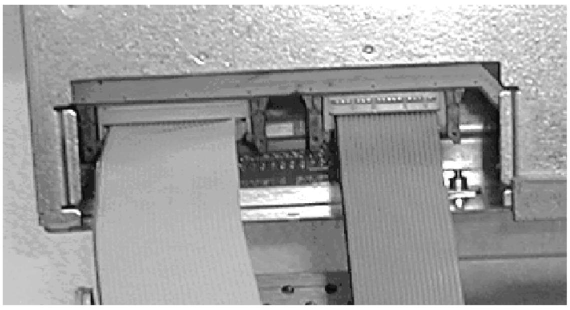
2. Remove the mounting rail from the CNC unit by unscrewing 4 M4 screws and 4 M3 screws. A Torx wrench or Torx screwdriver is required for this work.





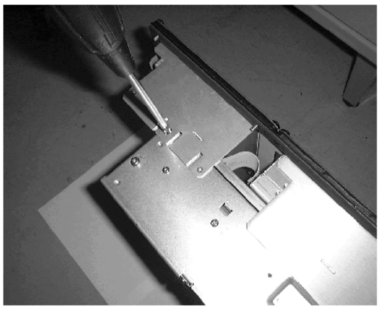
3. Connect 2 flat cables from the operation panel to the CNC unit.



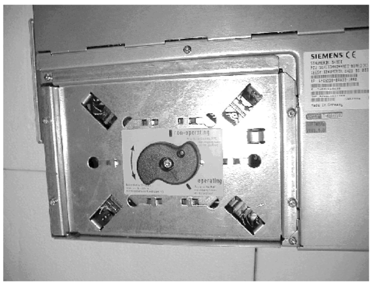


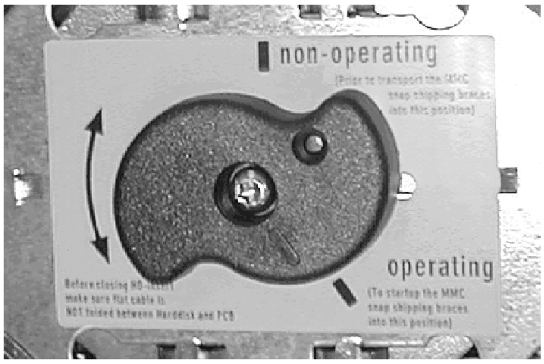
Ensure that the connectors are firmly inserted with their latches fully closed.

4. Connect the CNC unit and the operation panel together using the supplied screws. There are four M4 screws and four M3 screws. Use a Phillips screwdriver.

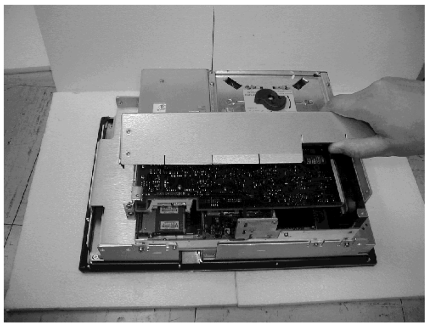


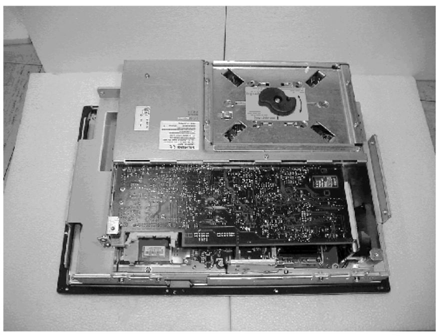
5. Turn the hard disk operation switch on the back of the CNC unit to the operating position until it clicks.



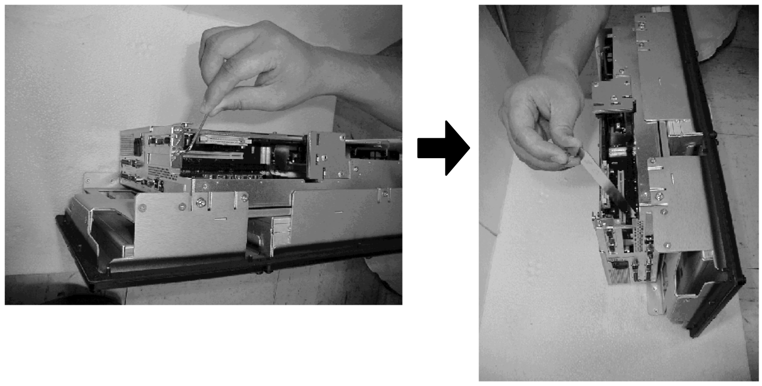


6. Unscrew two M3 screws from the top cover of the CNC unit, and then remove the top cover. A Torx wrench or Torx screwdriver is required for this work.

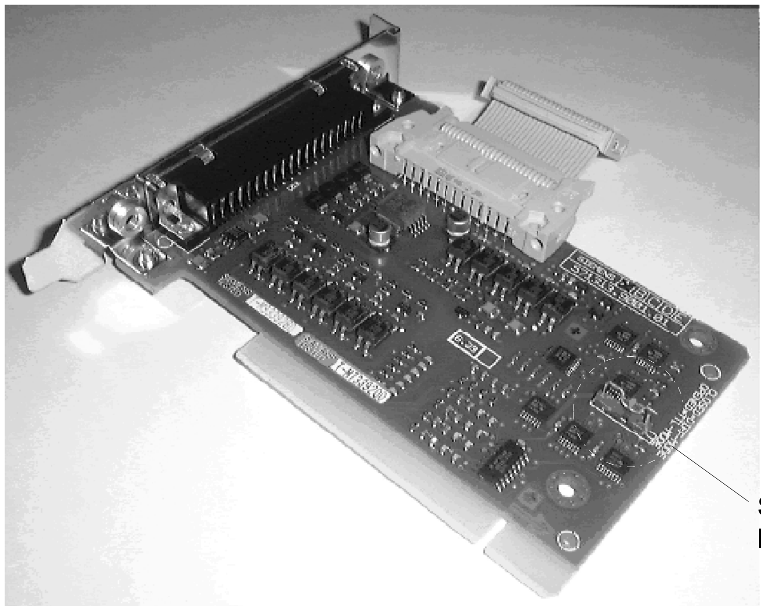


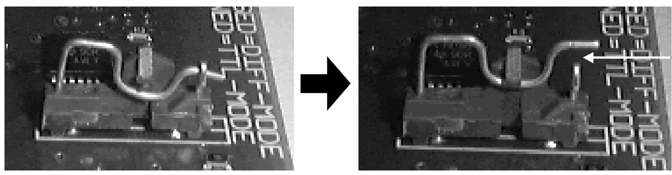


7. Unscrew one M3 screw from the slot cover, and then remove the slot cover.



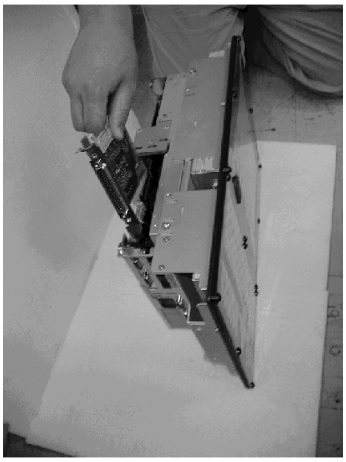
8. Open the MCI Extension Board selector lever (S1).

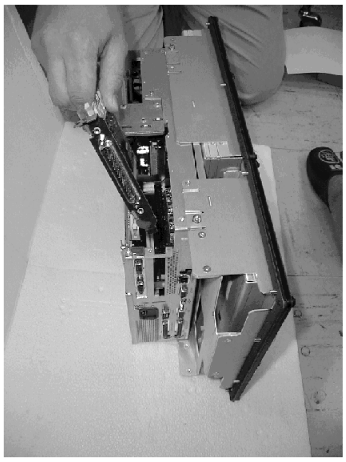


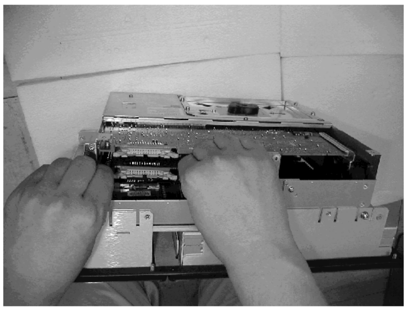


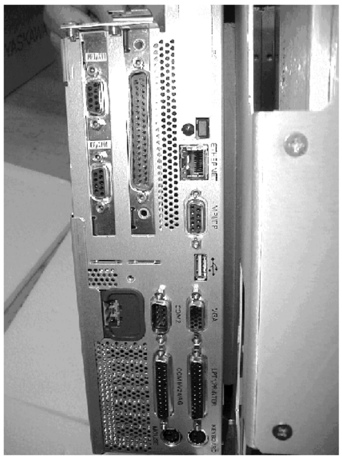
Closed Open

9. Insert the MCI Extension Board into the optional board slot as far as it will go.

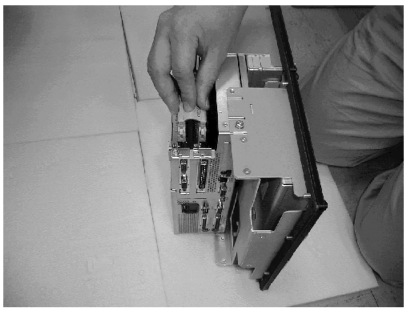


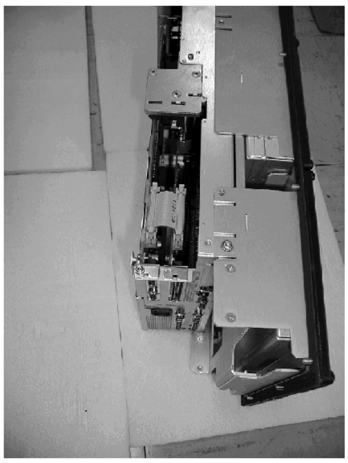






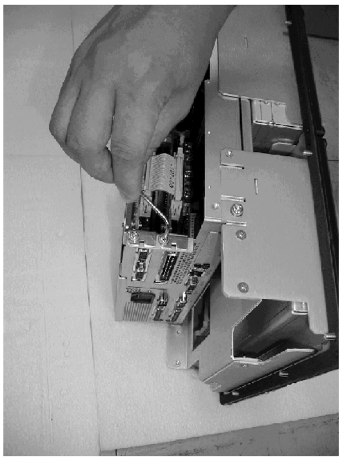
10. Connect the MCI Extension Board connector to the corresponding connector on the board above it using the supplied cable.



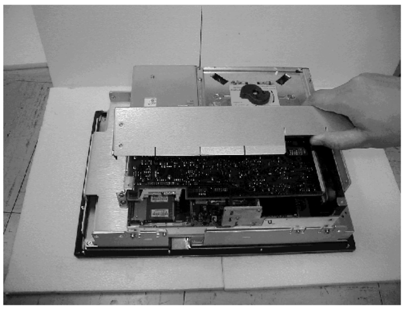


Ensure that the connectors are firmly inserted with their latches fully closed.

11.Fix the MCI Extension Board in position with the slot cover screw.



12.Reinstall the top cover and secure it with the screws.
A Torx wrench or a Torx screwdriver is required for this operation.



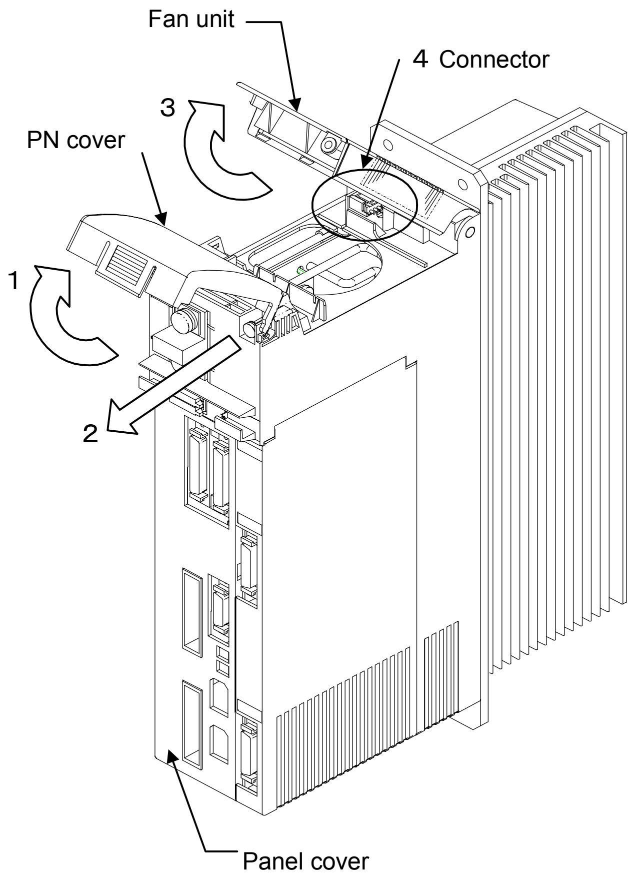
This step concludes the installation procedure.

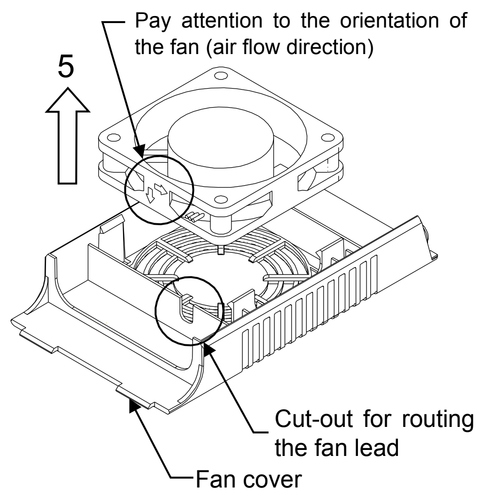
5.2 Replacing the servo unit fan

5.2.1 Procedure for replacing the 0.5-3.0 and 5.0 kW servo unit fans

Replace the servo unit fans as follows:

1. Open the PN cover.
2. Unscrew the screw that holds the fan unit. The screw will remain loosely attached to the panel cover.
3. Remove the fan unit.
4. Disengage the connector.
5. Remove the fan from its fan cover, and install a new one.

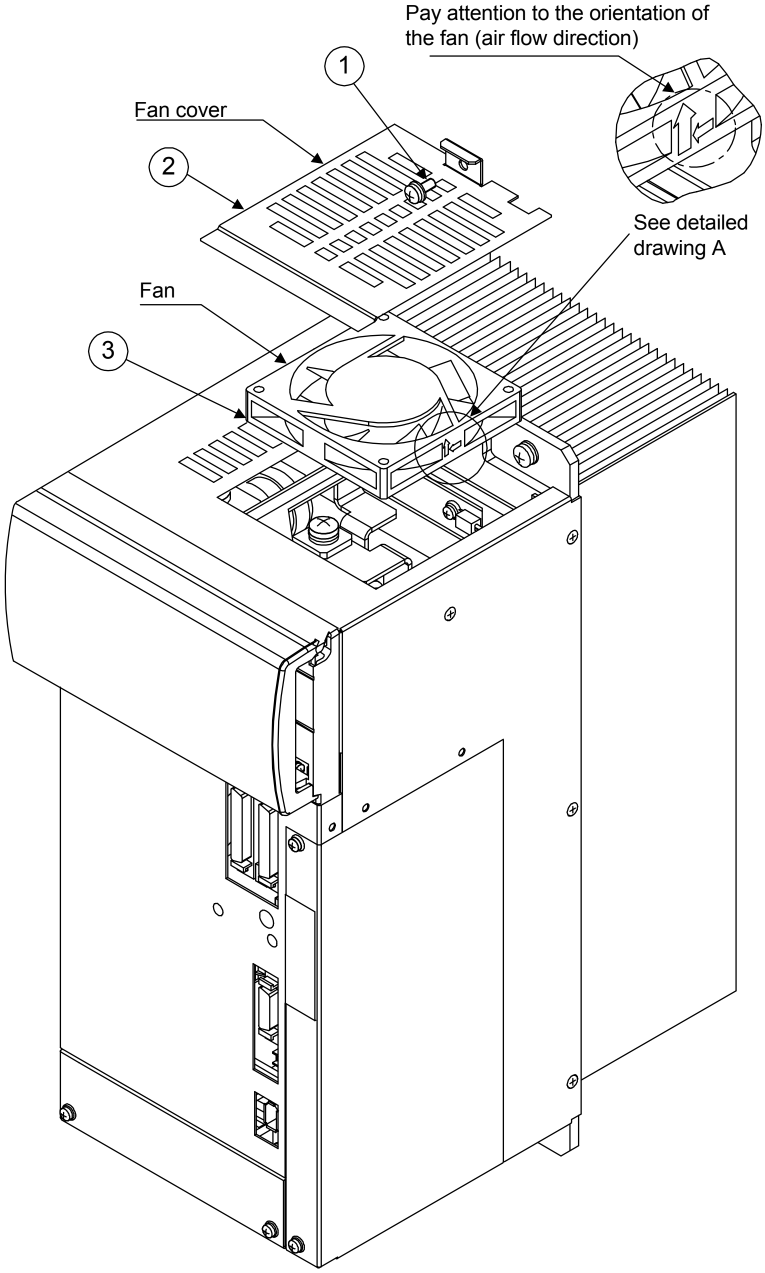




5.2.2 Procedure for replacing the 6.0 and 7.5 kW servo unit fans

Replace the servo unit fans as follows:

1. Unscrew the screw that holds the fan cover. The screw will remain loosely attached to the fan cover.
2. Remove the fan.
3. Disengage the fan connector.
4. Replace the fan with a new one.

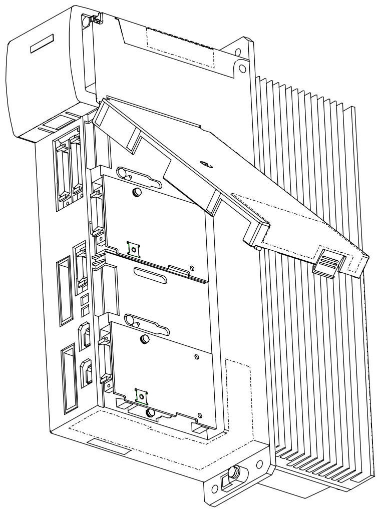


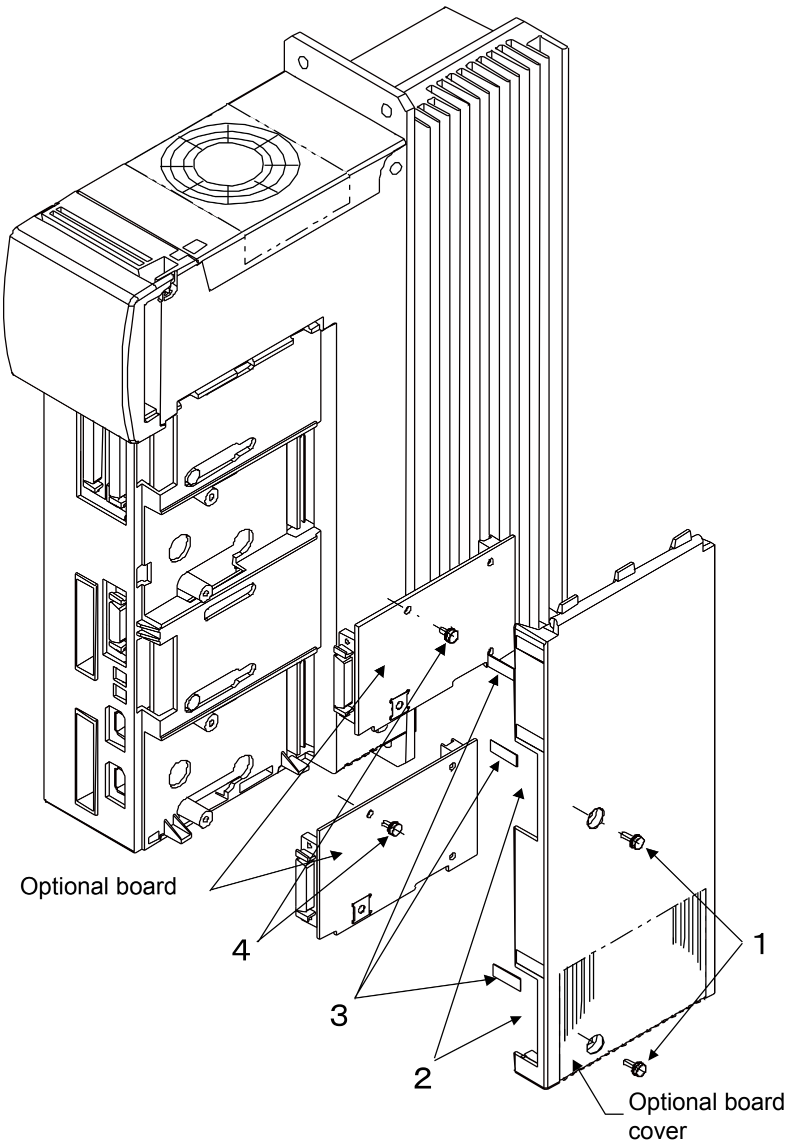
5.3 Installing the servo unit optional board

5.3.1 Procedure for installing the board for the 0.5-3.0 and 5.0 kW servo units

Install the optional board as follows:

1. Unscrew the screws that hold the optional board cover, and remove the cover.
2. Cut the blind plates off.
3. Install the NPs.
4. Install the optional board and secure it with the screws.
5. Reinstall the optional board cover, and secure it with the screws.

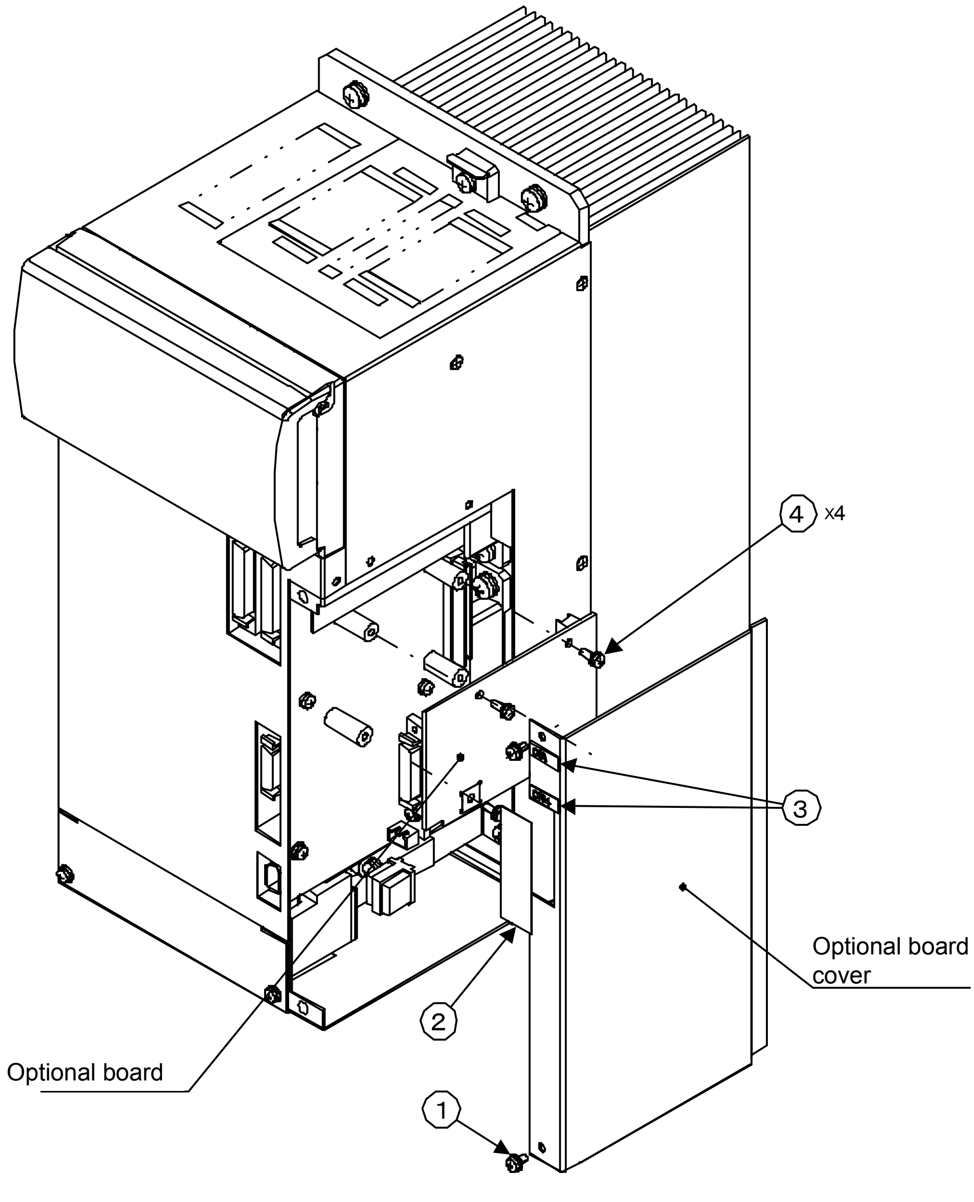




5.3.2 Procedure for installing the board for the 6.0 and 7.5 kW servo units

Install the optional board as follows:

1. Unscrew the screws that hold the optional board cover, and remove the cover.
2. Remove the blind plate NP.
3. Install the NPs on the optional board cover.
4. Install the optional board and secure it with the four screws.
5. Reinstall the optional board cover, and secure it with the screws.



Part 2

Software

Chapter 6

Software configuration

6.1 System software components

The system software components are listed below.

Table 6.1 System software components

Hardware	Software component	Version	System number
HMI	Windows NT	4.0 SP6 (Service Pack)	Example: 00.02.00*
	YS 840DI Start up	V01.00.08	
	MMC 103	06.00.28	
	ShopMill	Version 05.03.07	
		PLC Version 05.02.03	
	STEP 7	Version 5.0 SP2 (Service Pack)	
NC	NC	YORK 9.0	
PLC	PLC	4.20.21	
Servo unit	F151		Example: 00*
Inverter	F026		
Converter	00		

* Example: A system number, as shown in the table above as an example, changes as the software is revised.

6.2 Data types

The YS 840DI system handles the following data types:

Table 6.2 Data types and locations

Archive type	Data type	Location	Remarks
MMC data (Part of the HMI)	Display-Machine-data	Stored in the resident directory.	Machine Data (display parameters) for operation panel
	MBDDE-alarm-text	Stored in the resident directory.	Alarm message tables for different languages
	Tool Managements	User's custom settings (for configuration)	Default settings and other data for tool management
	Definitions	yet to be loaded to NC.	System definition program
	Standard Cycle		Mostly standard G-code definition cycles
	USER Cycle		Special cycles for user customization
	Part-Program		System program
	Sub-Program		Mostly machining subprograms with the SPF extension
	Work pieces		User data for machining main programs
NC data	Option data	Stored in the resident directory.	Machine data (optional parameters)
	Machine data		Machine data (general, series, axis, and collective)
	Setting data		Setting data
	Tool offset	User's custom settings	Machine-specific setting data (defaults = 0)
	Zero offset	User's custom settings	Machine-specific setting data (defaults = 0)
	Global user data		GUD5, 6, 7 (controlling the cycle files)
	Local user data		
	Definitions	Loaded to NC already	SMAC and CST definition programs
	Standard Cycle		Mostly standard G-code definition cycles
	USER Cycle		Special cycles for user customization
	Part-Program		System programs
	Sub-Program		Machining subprograms
	Work pieces		Machining main program
PLC data	PLC data		Archive created in STEP7
	Sequence data		

6.3 Service screen directories

This subsection describes the service screen directories.

Use the data selection function to select folder contents to be displayed. Normally, folders not used are not displayed.

The following directories are in the folder dh of the F drive, YS 840DI, as displayed by the NT's Explorer:

Table 6.3 Directories

Data name	Data type	Description	Backup selection by the MMC extension	Directory names in the folder dh of the F drive, YS 840DI, as displayed by the NT's Explorer
FDD data	DIR	Not used (free space).		
MBDDE alarm list	DIR	Storing alarm text and various language files.	MB	.mb,Cus.dir,
MSD data	DIR	Not used (free space).		
NC active data	DIR	Storing the data which cannot be stored in a file format in the NC memory, such as machine data, origin offsets, corrections, and tool data.		_nc _act.dir
Saved NC data	DIR	This folder is not displayed.		
OEM data	DIR	Storing various files.	OEM	.oem.dir
TMP.DIR	DIR	Temporary directory		
WORK (WORK PIECES)	DIR	Storing various machining programs (machine-specific data files).	WKS	.wks.dir
Tool management	DIR	Storing configuration and tool list data.	WZV	.wzv.dir
Diagnosis	DIR	Subdirectories are used. Data can be stored in diagnosis screens.		.dg.dir
Interactive programming	DIR	Subdirectories are used. Interactive system data can be stored.		
Definition	DIR	Storing global user data and SMAC system definition files.		.def.dir
Standard cycles	DIR	Storing G-code cycles and program control cycles.		
Continuous machining	DIR	Not used (free space).		
Clip board	CLP	Not used (free space).		clip.clp
Archive	DIR	Storing NC and PLC archives.		arc.dir
Comment	DIR	Storing comments and messages.		.pda.dir
Subprogram	DIR	Storing machining subprograms.	SPF	.spf.dir
System	DIR	Not used (free space).		.syf.dir
Start-up	DIR	Not used (free space).		
Template	DIR	Storing circularity and other test waveforms and image files.		.templ.dir
Data management	DIR	Storing data that is to be managed by the user.		
Part programs	DIR	Storing data that is to be managed by the user.	MPF	.mpf.dir
Machine data display	DIR	Storing display-related machine data.	BD	Bd..dir

Table 6.3 Directories

Data name	Data type	Description	Backup selection by the MMC extension	Directory names in the folder dh of the F drive, YS 840DI, as displayed by the NT's Explorer
Manufacturer cycle	DIR	Storing custom cycles created by the user.	CMA	Cma.dir
User cycle	DIR	Storing custom cycles created by the user.		

Chapter 7

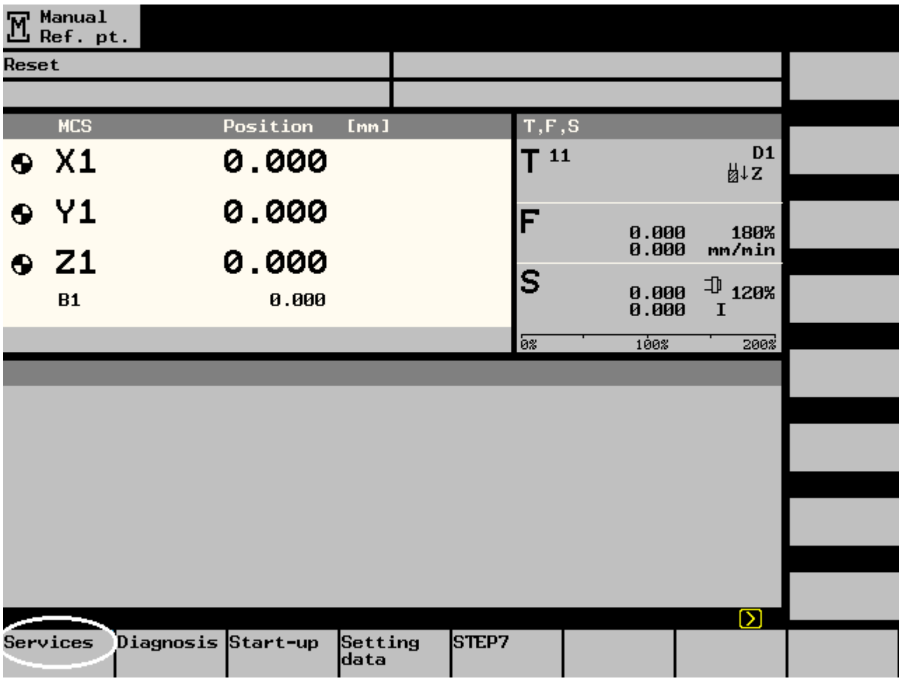
Backup

7.1 How to archive

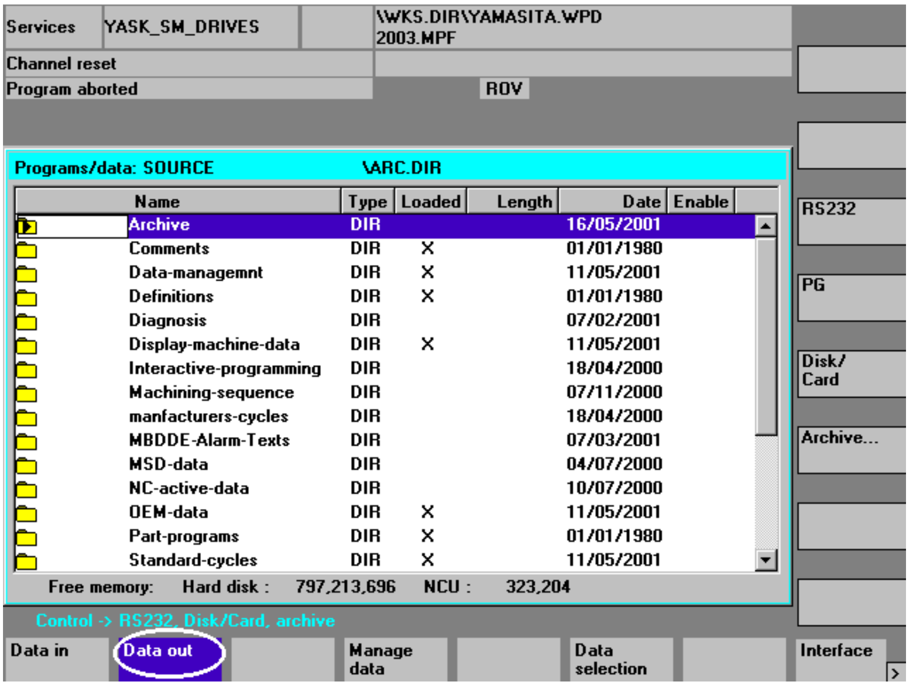
To back up, or archive, programs or data individually, follow the procedure described below.

Assuming to archive a machining program:

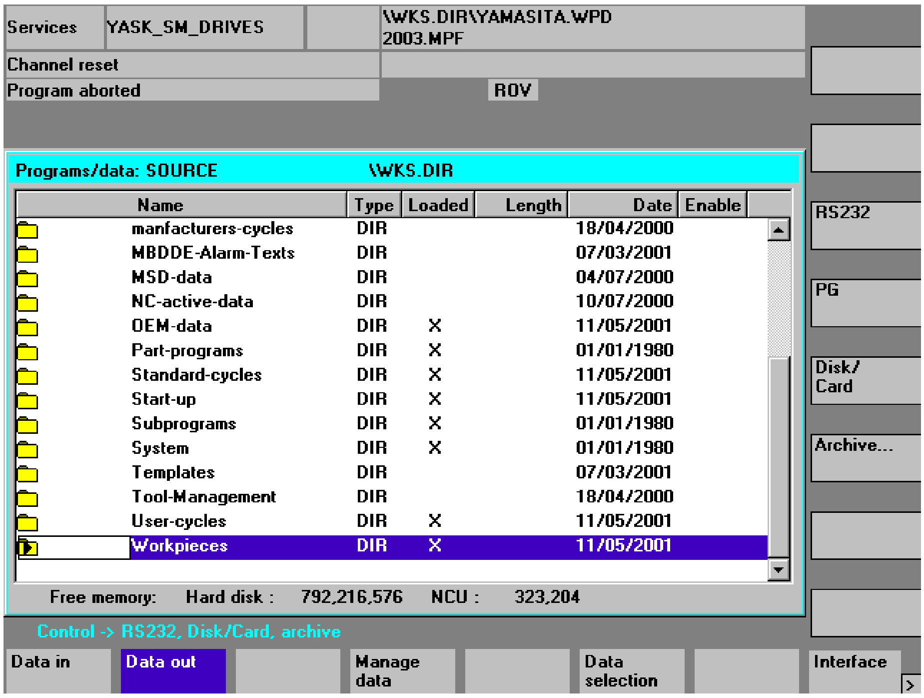
1. Click on Service, which is at the lower left corner of the screen.



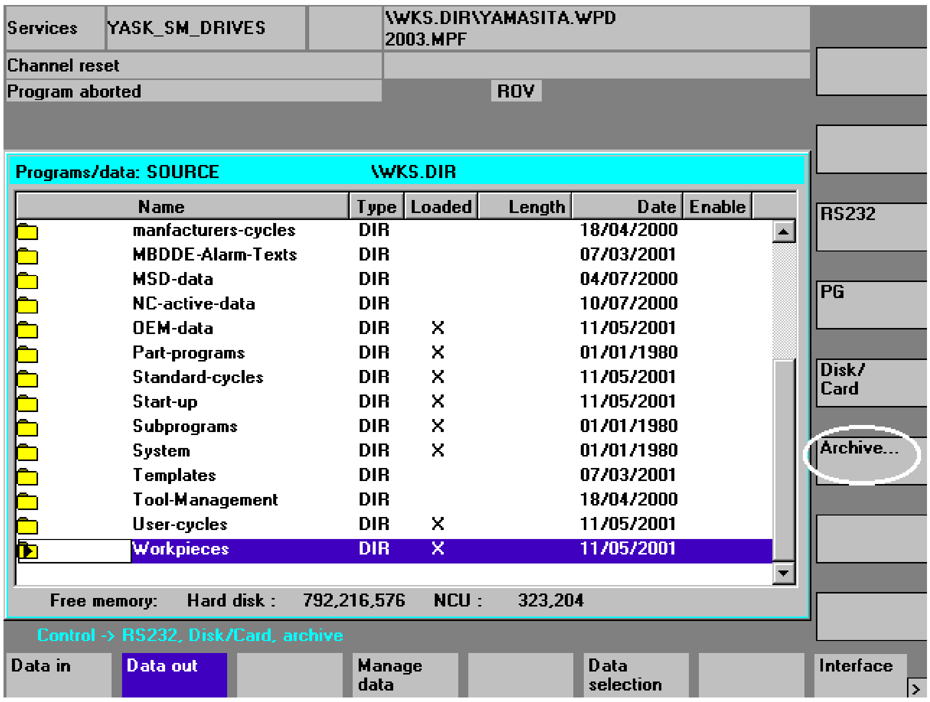
2. Click on Data out, which is at the bottom of the screen.



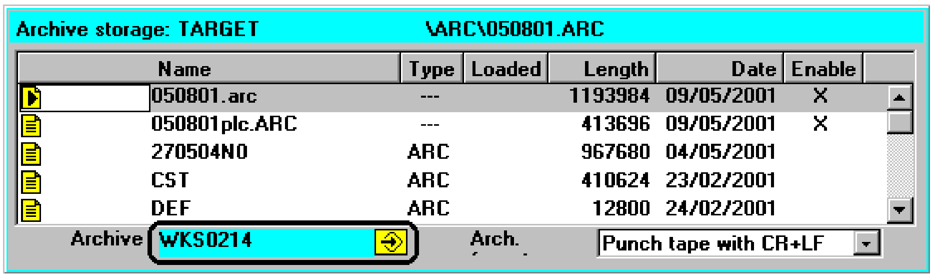
3. Select the Workpieces folder.



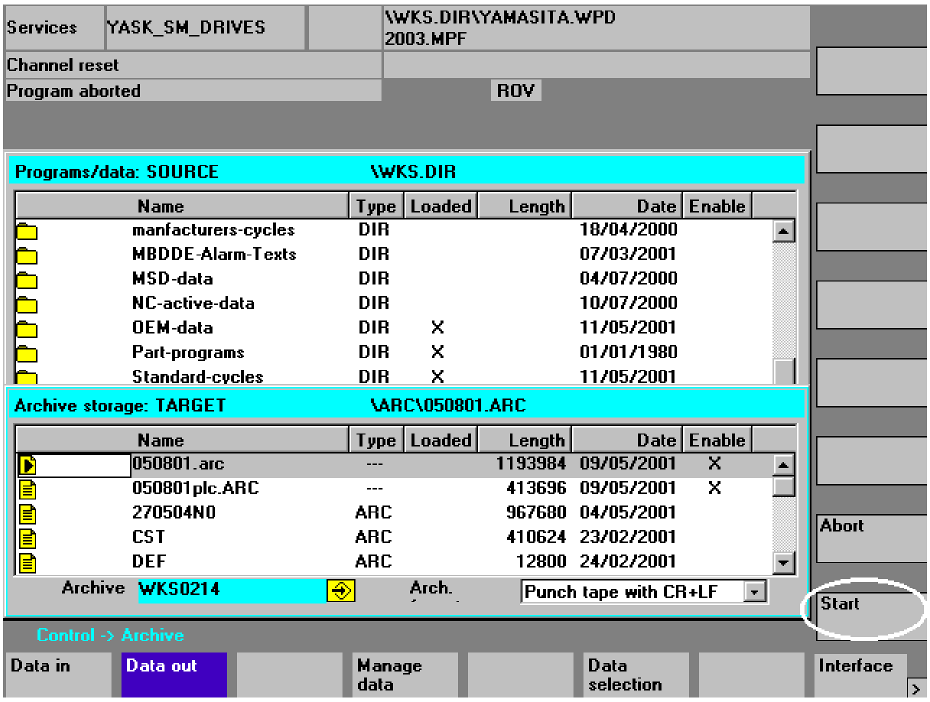
4. Click on Archive File, which is one of the right-side keys.



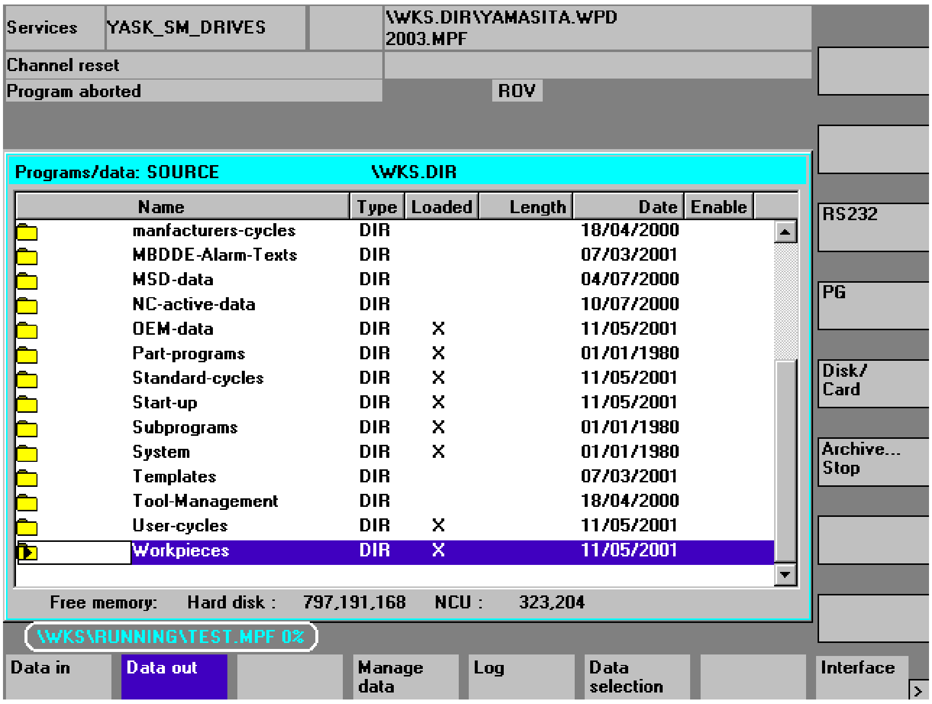
5. The target screen will appear. Enter an archive name (WKS0214 in this example) in the archive name field.



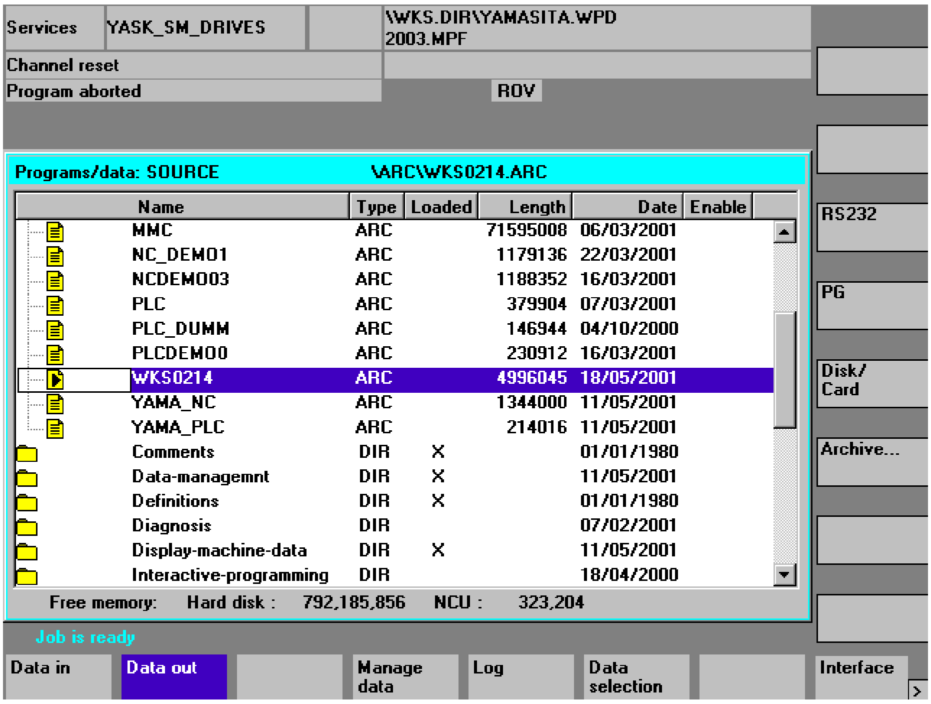
6. Click on Start, which is one of the right-side keys.



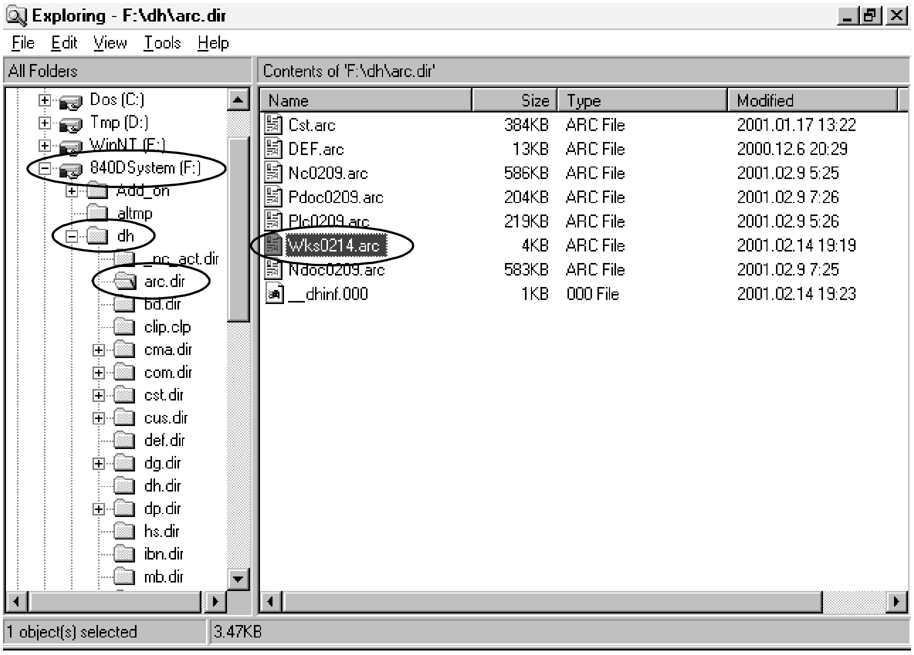
7. The part program archive data will be written in the hard disk, as shown below.



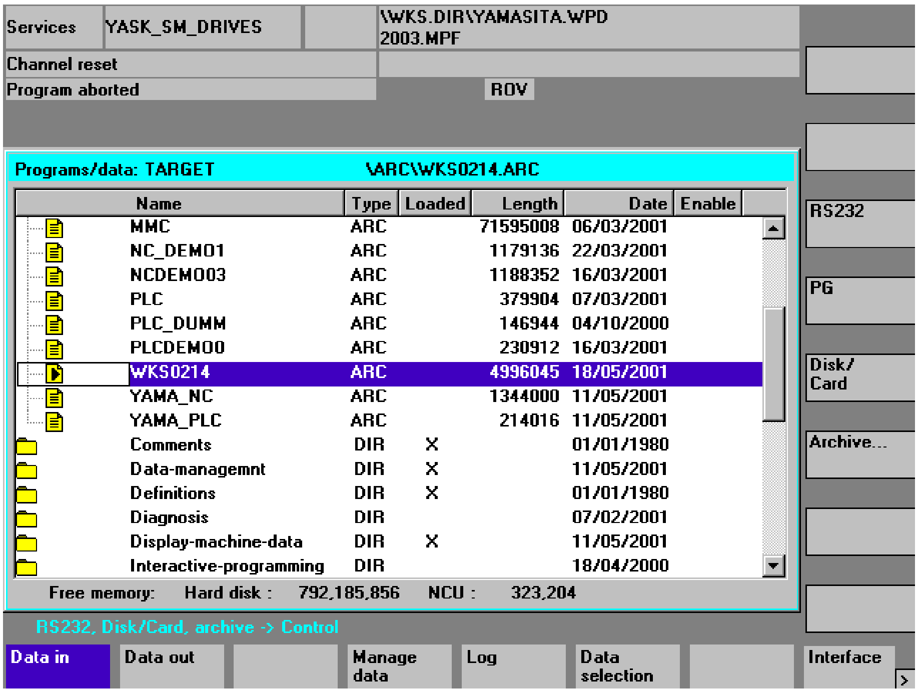
8. After a while, an archive file named WKS0214 will be created in the archive folder.



9. All archive data is stored in F:\dh\ARC.dir. Use the Explorer to copy the created archive data to a PC as necessary.



10. To restore the archive data, click on Data Input, and then Archive File.



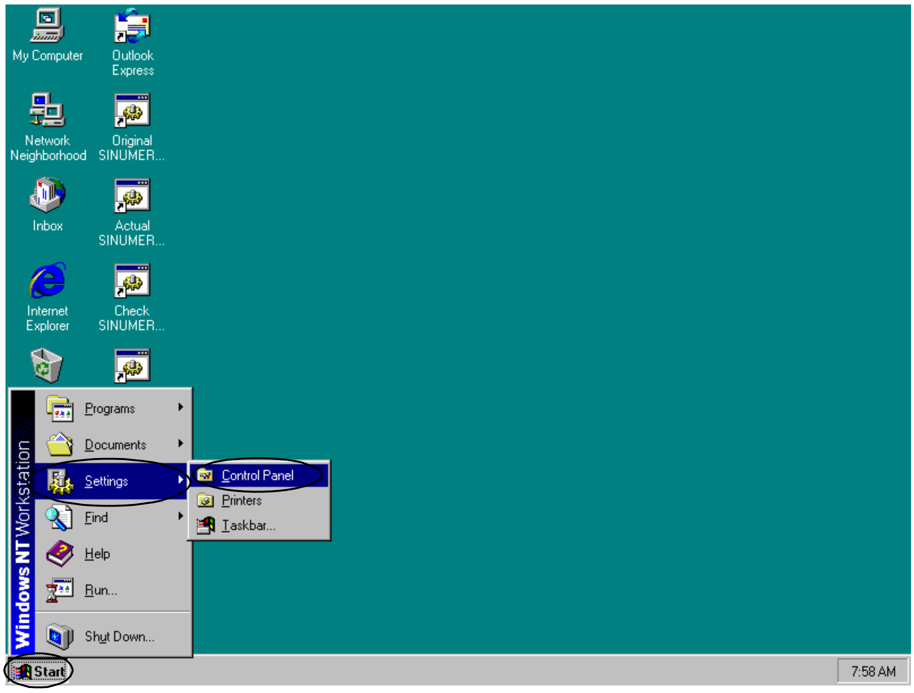
7.2 Network settings

Perform necessary network settings so that data, as may be stored in the hard disk, can be transferred from the YS 840DI system to a PC, as described below.

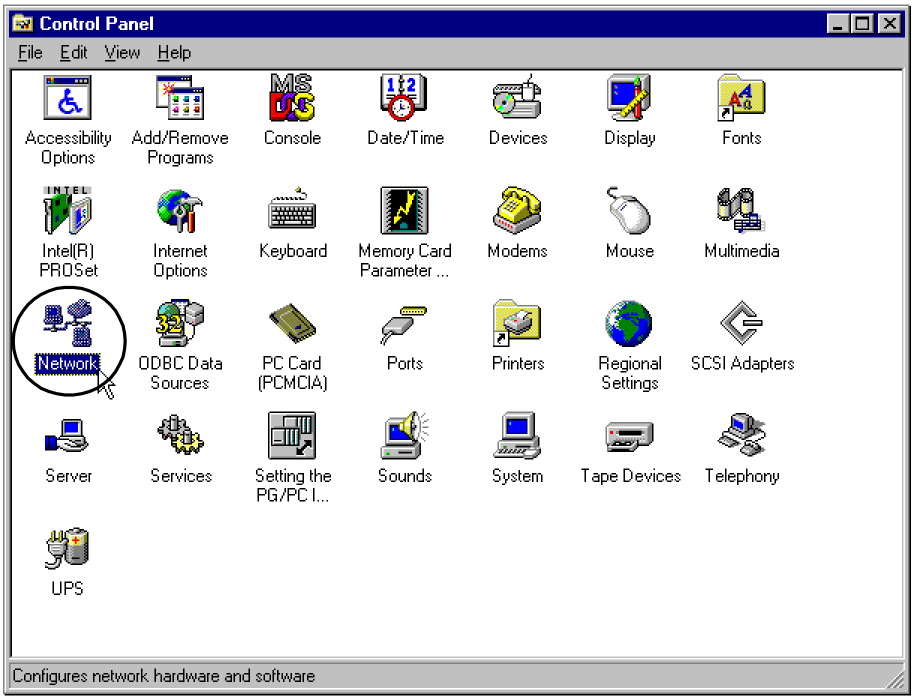
7.2.1 YS 840DI settings

The procedure for the network settings on the YS 840DI is as follows:

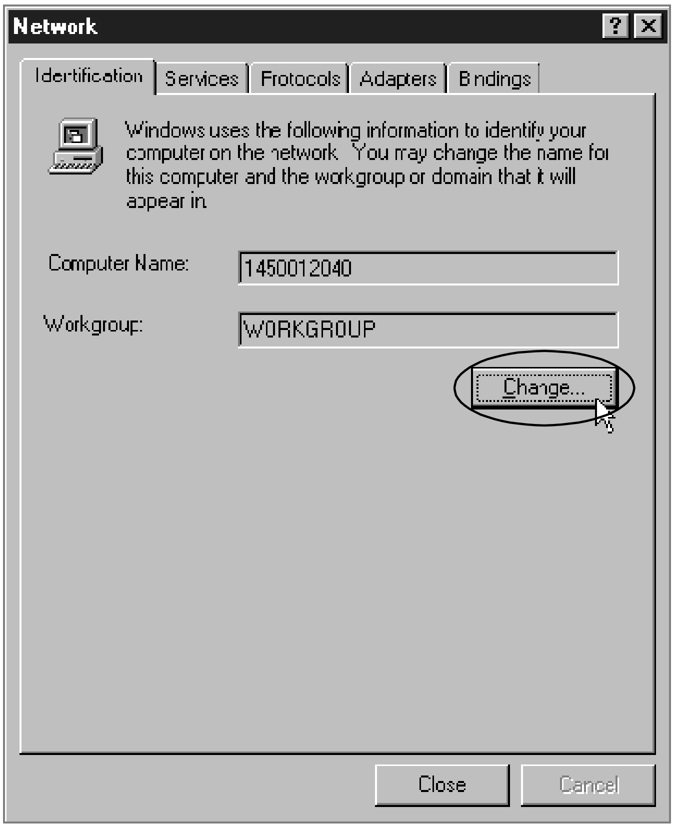
1. Select Start > Settings > Control Panel. The control panel window will appear.



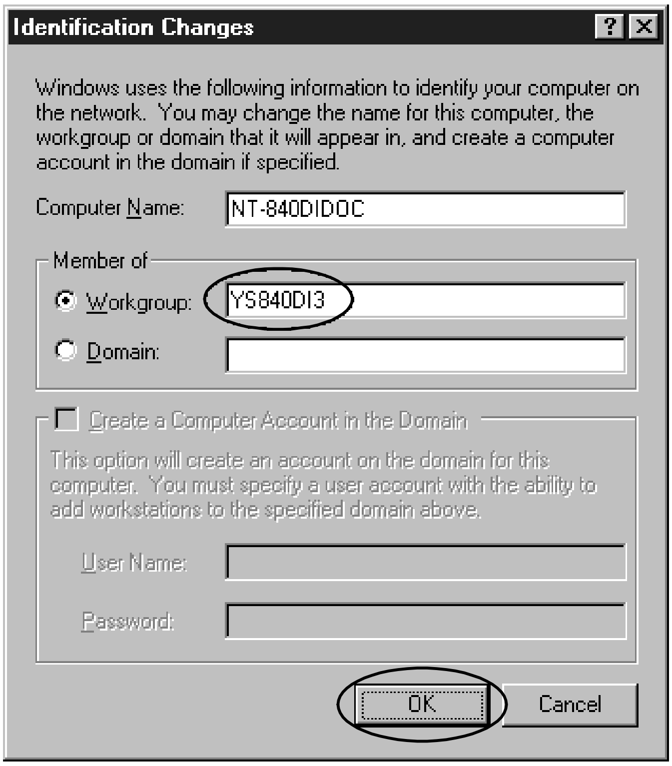
2. Double-click on Network in the control panel window.



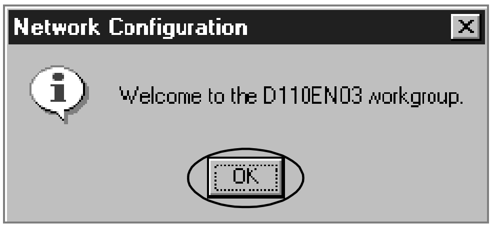
3. With the following window displayed, click on Change.



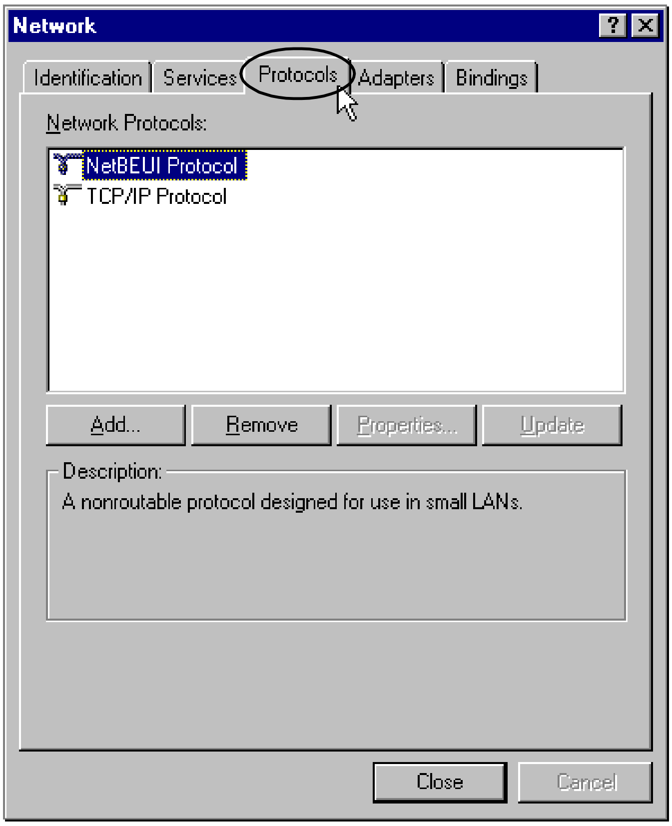
4. Enter in the Workgroup field the name (YS 840DI3 in this example) of the workgroup of the destination PC. Click on OK.



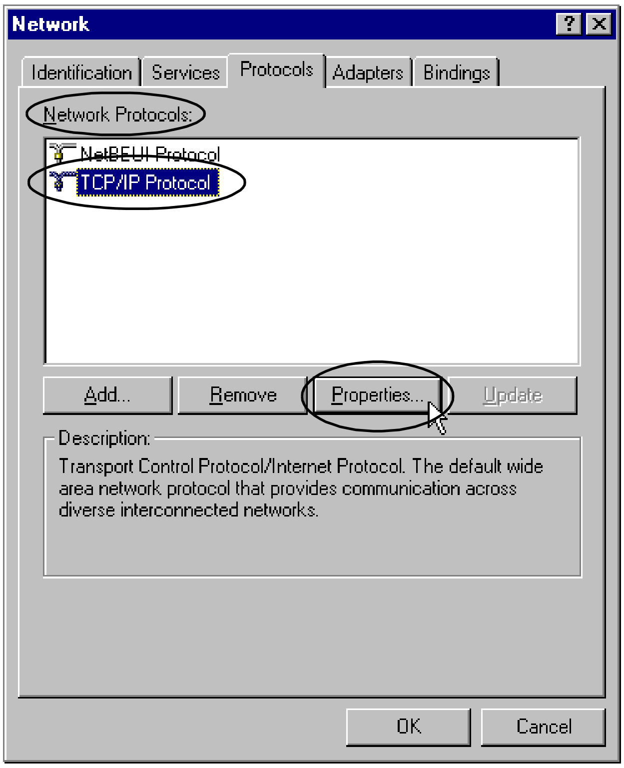
5. With the following message displayed, click on OK.



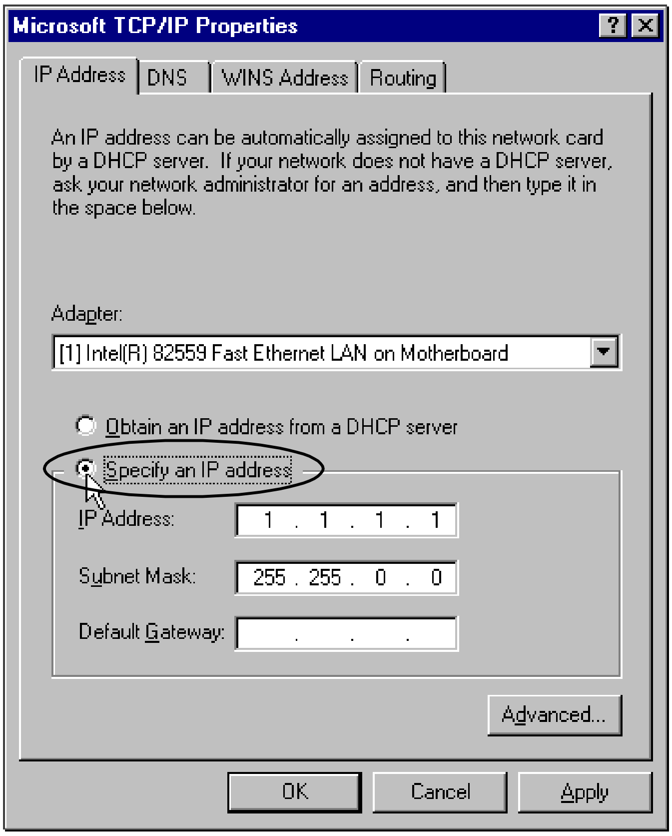
6. Click on the Protocols tag.



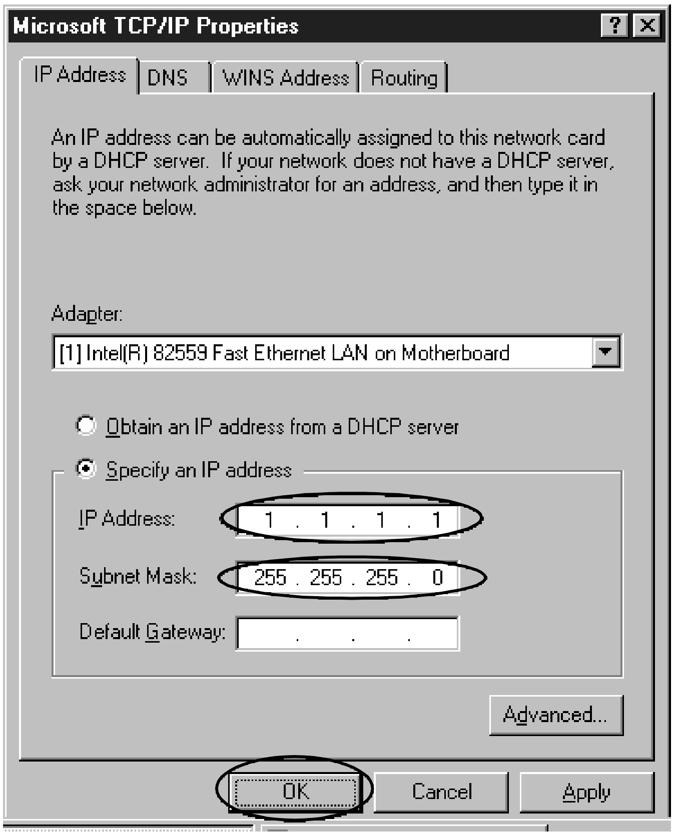
7. Select TCP/IP Protocol from Network Protocols, and click on Properties.



8. Click on the radio button to the left of "Specify an IP address."



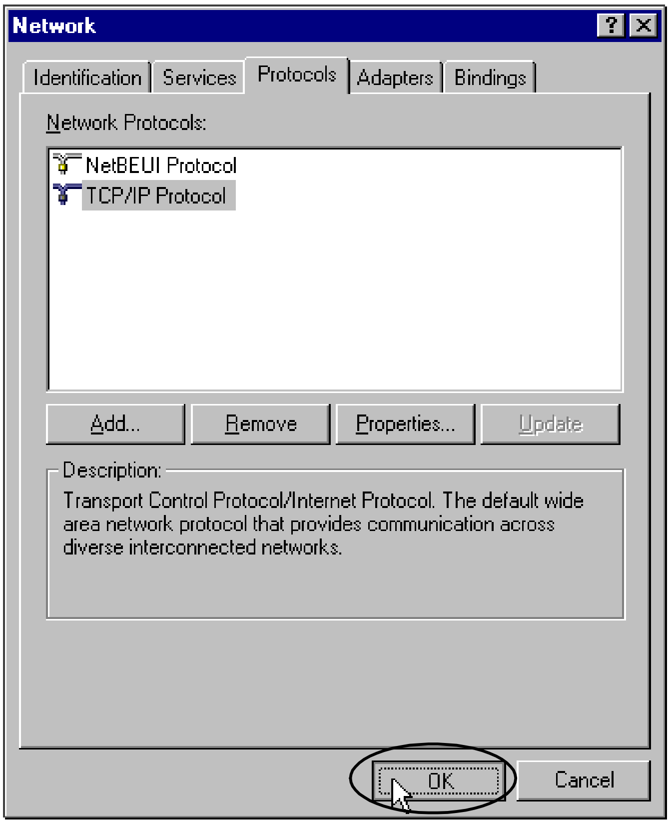
9. Enter 1.1.1.1 in the IP Address field, and 255.255.255.0 in the Subnet Mask field. Click on OK.



INFO

The IP address 1.1.1.1 and the subnet mask 255.255.255.0 as used in this example are just examples. In practice, these values must be changed to correct ones, such that they are compatible with those for the target PC. The last part of the IP address of the YS 840DI system must be different from that of the target PC.

10. When returned to the Network window, click on OK.



11. With the following message displayed, click on YES.

12. After a while, the YS 840DI system restarts and the Windows-NT gets ready for communication with the target PC.

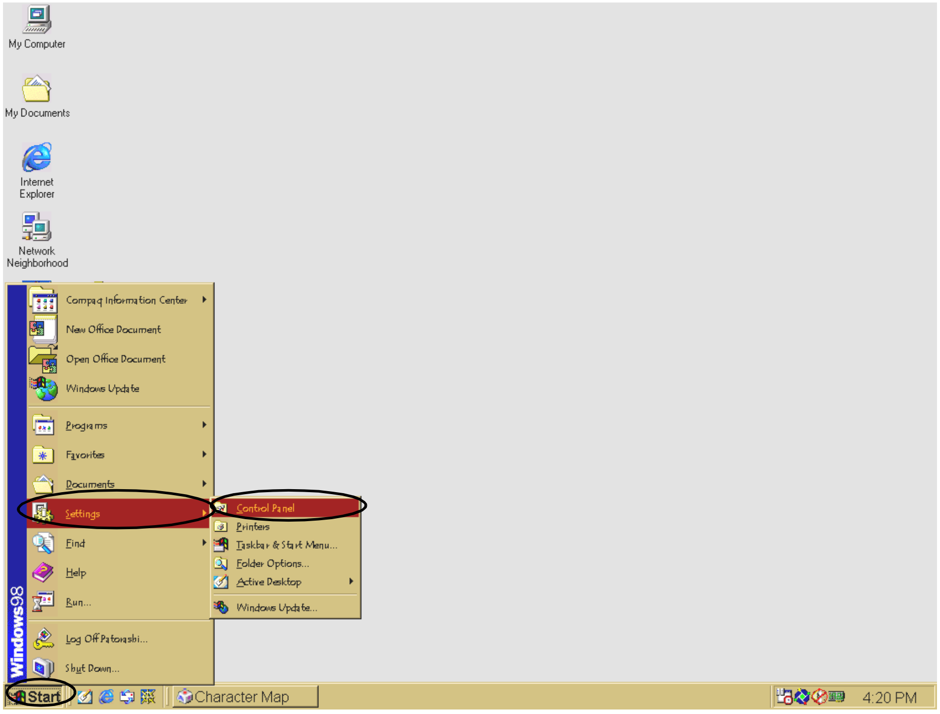
INFO

If communication fails, restart the target PC.

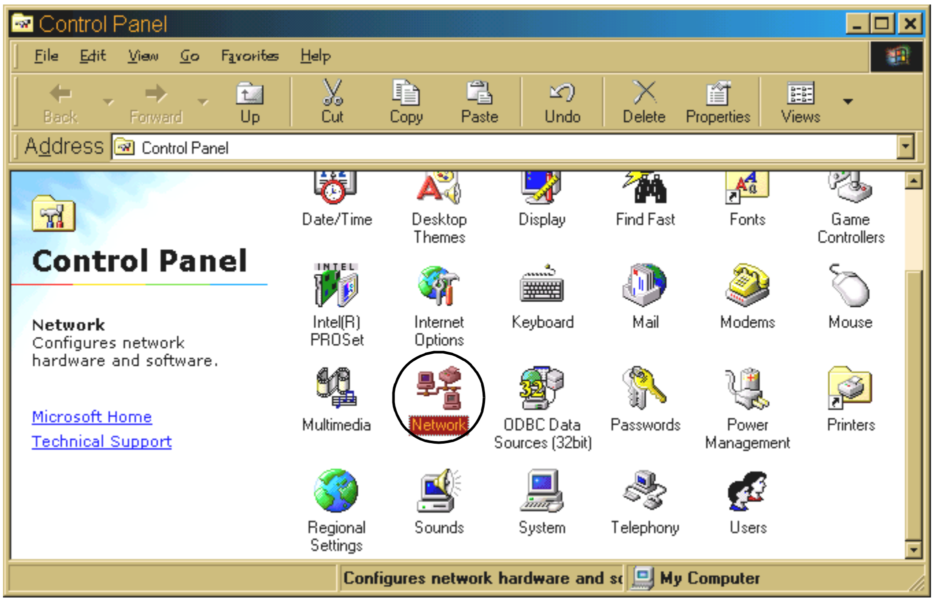
7.2.2 PC settings

The procedure for the network settings on a target PC (running Windows 98) is as follows:

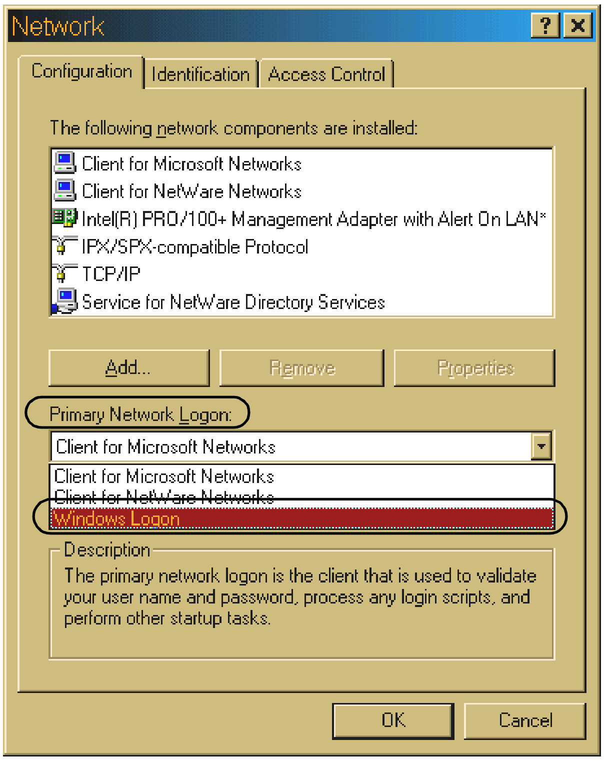
1. Switch on the target PC and let it run Window 98. Select Start > Settings > Control Panel to display Control Panel.



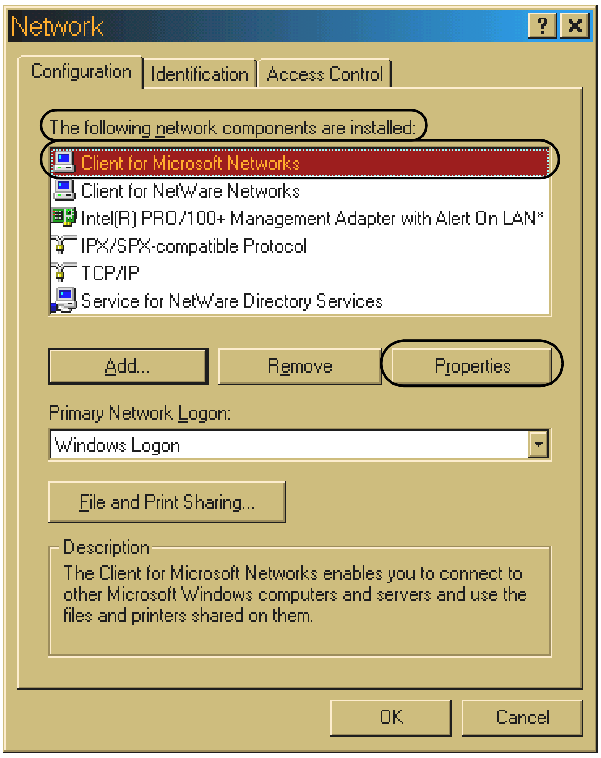
2. In the Control Panel window, double-click on Network.



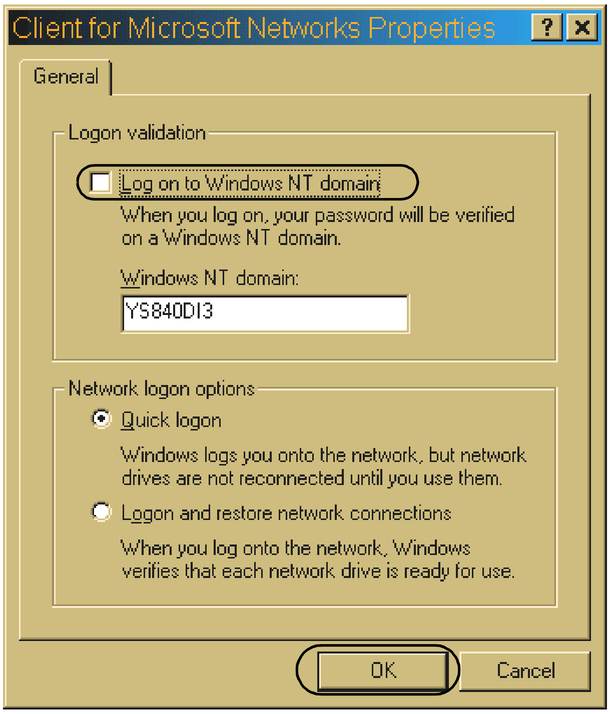
3. In the Network window, select Windows Logon as a preferred network to log on.



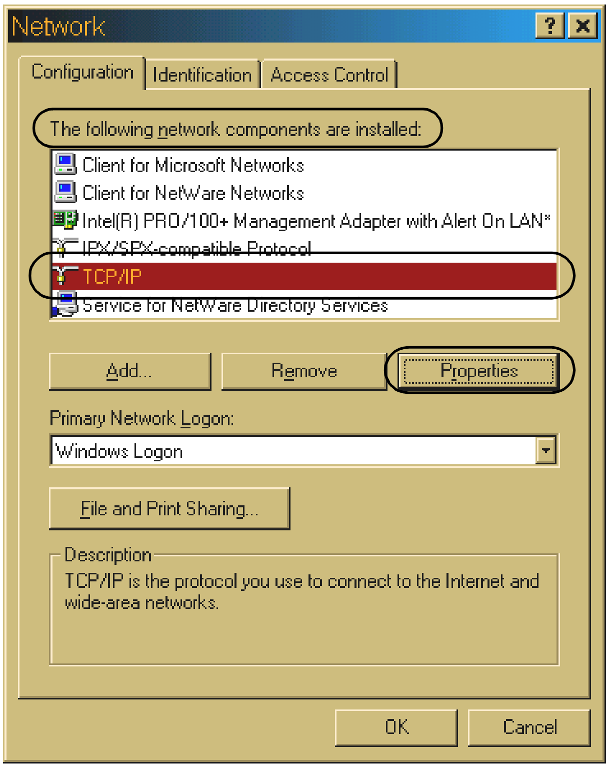
4. Select Client for Microsoft Networks from the following network components are installed, and click on Properties.



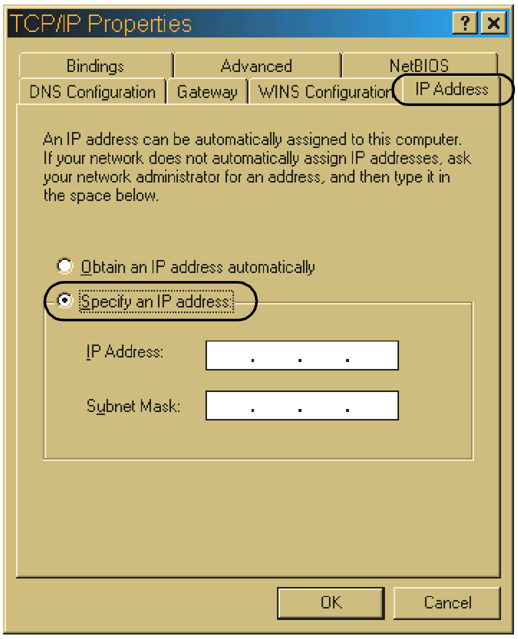
5. Uncheck the square to the left of the line "log on to Windows NT domain." Click on OK.



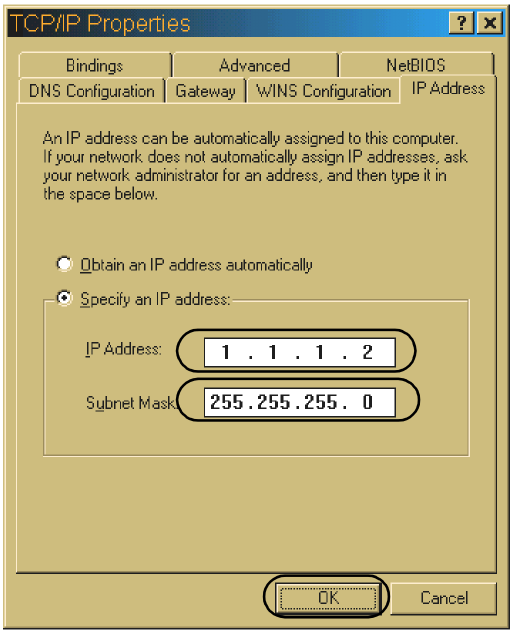
6. Select TCP/IP (the actual display depends the LAN card used) from the following network components are installed, and click on Properties.



7. In the IP Address tag, click on the radio button to the left of "Specify an IP address."



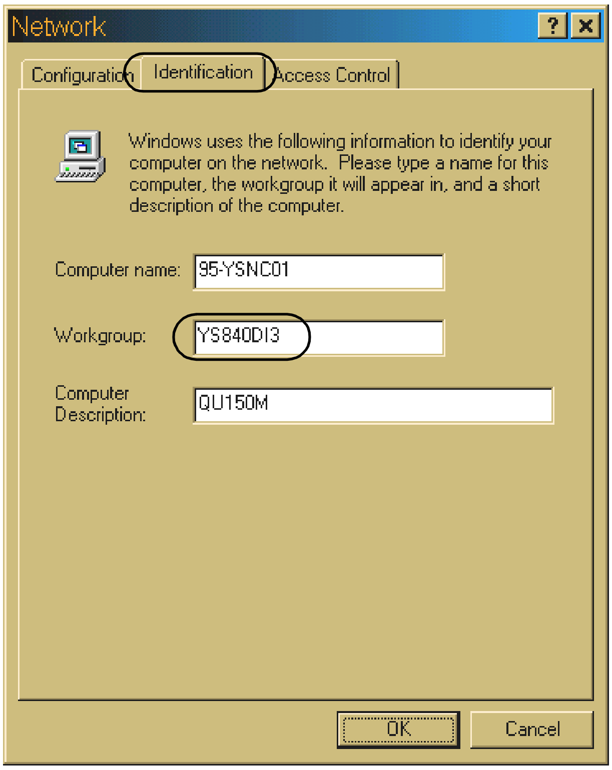
8. Enter 1.1.1.2 in the IP Address field, and 255.255.255.0 in the Subnet Mask field. Click on OK.



INFO

The IP address 1.1.1.2 and the subnet mask 255.255.255.0 as used in this example are just examples. In practice, these values must be changed to correct ones, such that they are compatible with those for the YS 840DI system. The last part of the IP address of the PC must be different from that of the YS 840DI system.

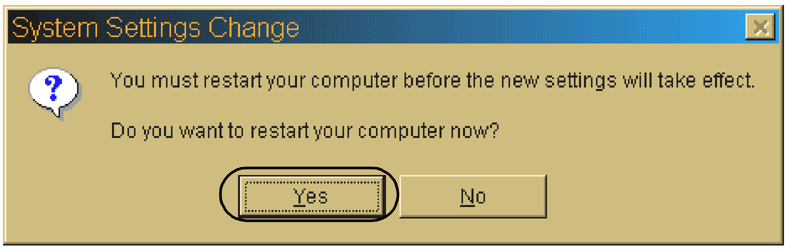
9. Click on the identification tag, enter YS 840DI3 in the Workgroup field, and click on OK.



INFO

- The workgroup name YS 840DI3 as used in this example is just an example. The workgroup name entered here can be any name provided that the same name is also specified on the YS 840DI side.
- The computer name can be any name provided that it is in alphanumerics such that it can be displayed correctly on the YS 840DI side.

10. In the following message window, click on Yes.



After a while, the Windows restarts with the new settings in effect.

Part 3

PLC

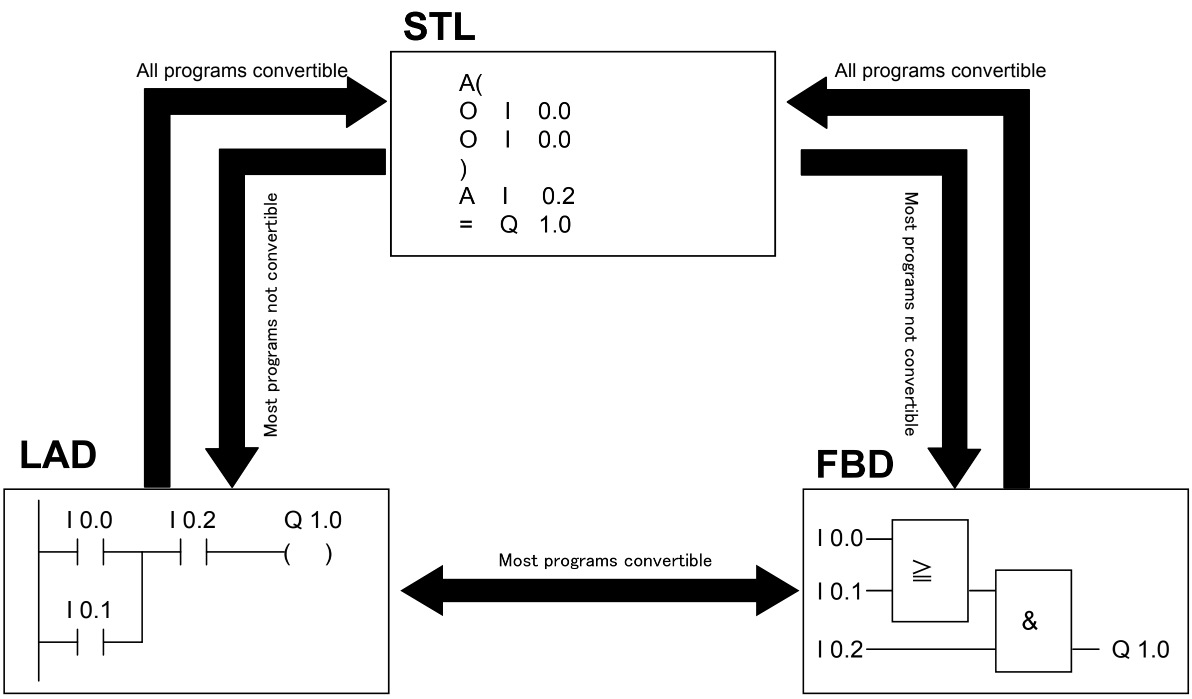
Chapter 8

General programming notes

This chapter provides information on the program (PLC ladder language), address, and interface structures of the STEP7. The STEP7 uses a program structure compatible with the IEC 1131-3 international standard. The program structure allows ladder diagram programming that supports various languages such as LAD, FBD, STL, and GRAPH. Thanks to the structured nature and advanced features, programs are not only easy to understand, but far more powerful than the conventional ladder logic. The PLC for the YS 840DI system is the S7-300, allowing the use of LAD, FBD, and STL in ladder logic design.

8.1 LAD/FBD/STL compatibility

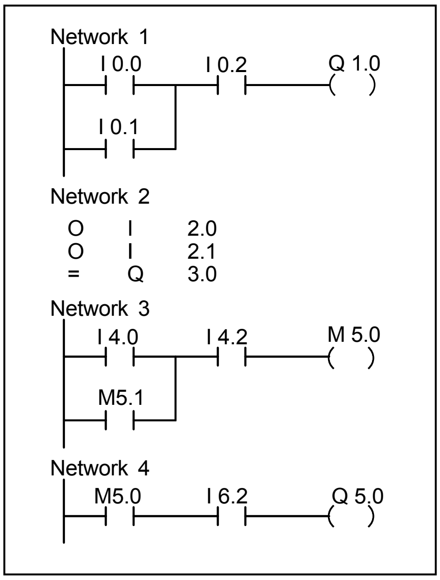
Not all programs written in a certain language (e.g., STL) can be converted into those of another (e.g., LAD or FBD). Normally, all programs in LAD or FBD can be rewritten in STL, but not all programs in STL can be rewritten in LAD or FBD.



8.2 Program structure

A STEP7 structured program consists of blocks, each of which in turn consists of networks (see the figure below). Each network can be expressed either in LAD, FBD, or STL. Thus a block can consist of mixed LAD and STL networks, or mixed FBD and STL networks. LAD and FBD networks, however, cannot be mixed in a block.

While most instructions can be written in any of LAD, FBD, and STL, the LOOP, variable-address, and some other STEP7 instructions can be written only in STL. In such a case, LAD and STL networks need to be mixed.



8.3 Address structure

8.3.1 Address symbols

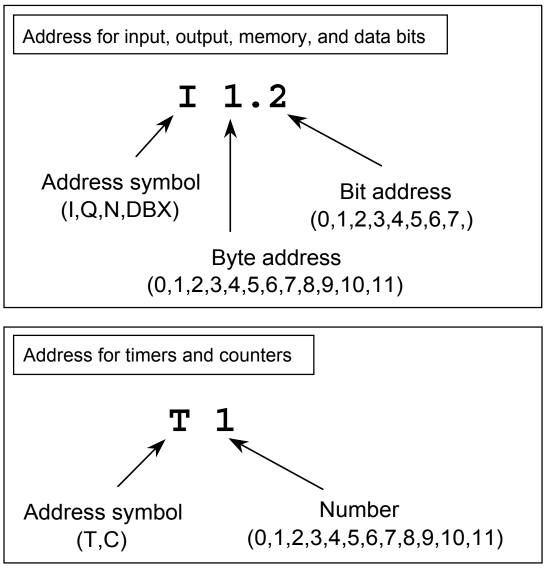
Each STEP7 bit is represented by an address starting with a symbol that identifies the function of the bit (e.g., input or output). The symbol of the address of an output bit is letter Q, not letter O (to distinguish from number 0).

Symbol	Function	Examples
I	Input	I5.2
Q	Output	Q54.3
M	Memory (internal relay)	M12.7
D	Data	DBX1.1
T	Timer	T24
C	Counter	C15
P	Peripheral (e.g., analog, direct I/O access)	PIW128 PQW128
	Local stack	L1.2, LW2

In this manual, all bit addresses are expressed in accordance with the IEC international standard representation. Thus the function of each bit can be easily identified by looking at its symbol (for example, "I" means an input bit, and "Q" means an output bit).

8.3.2 Bit address

A bit address is expressed in the following format:



I 0.0	Q 0.0	M 0.0	DBX 0.0	T 0	C 0
I 0.1	Q 0.1	M 0.1	DBX 0.1	T 1	C 1
I 0.2	Q 0.2	M 0.2	DBX 0.2	T 2	C 2
I 0.3	Q 0.3	M 0.3	DBX 0.3	T 3	C 3
I 0.4	Q 0.4	M 0.4	DBX 0.4	T 4	C 4
I 0.5	Q 0.5	M 0.5	DBX 0.5	T 5	C 5
I 0.6	Q 0.6	M 0.6	DBX 0.6	T 6	C 6
I 0.7	Q 0.7	M 0.7	DBX 0.7	T 7	C 7
I 1.0	Q 1.0	M 1.0	DBX 1.0	T 8	C 8
I 1.1	Q 1.1	M 1.1	DBX 1.1	T 9	C 9
I 1.2	Q 1.2	M 1.2	DBX 1.2	T 10	C 10
I 1.3	Q 1.3	M 1.3	DBX 1.3	T 11	C 11
I 1.4	Q 1.4	M 1.4	DBX 1.4	T 12	C 12
I 1.5	Q 1.5	M 1.5	DBX 1.5	T 13	C 13
I 1.6	Q 1.6	M 1.6	DBX 1.6	T 14	C 14
I 1.7	Q 1.7	M 1.7	DBX 1.7	T 15	C 15
I 2.0	Q 2.0	M 2.0	DBX 2.0	T 16	C 16
:	:	:	:	:	:

8.3.3 Addressing of input, output, bit memory, and data bits

Each bit is identified by the address of a byte to which it belongs and its own address relative to that byte (each byte consists of 8 bits). Thus a bit is expressed in the following format:

[address symbol][byte address]. [bit address] (e.g., I1.2)

■ Address symbol

A bit address starts with a symbol such as I, Q, M, or DBX.
The symbol for a data bit is DBX (e.g., DBX1.2).

■ Bit address

The bit address part of a bit address is the numerical part after the period (.). It is represented by a digit between 0 and 7 (the 8 bits make up a byte).

■ Byte address

The byte address part of a bit address is the numerical part after the address symbol and before the period (.). It is represented by an integer in the decimal notation (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, ...). As a byte is expressed as a combination of an address symbol and a byte address, I1.2 and Q1.2 are two different bits.

8.3.4 Addressing of timers and counters

A timer or counter is expressed as a combination of an address symbol and a byte address (with no bit address). Thus a timer or counter is expressed in the following format:

[address symbol][number] (e.g., T10)

The number is any integer in the decimal notation (starting with 0). The maximum allowable value of the number depends on the CPU used.

8.4 Interface structure

8.4.1 General

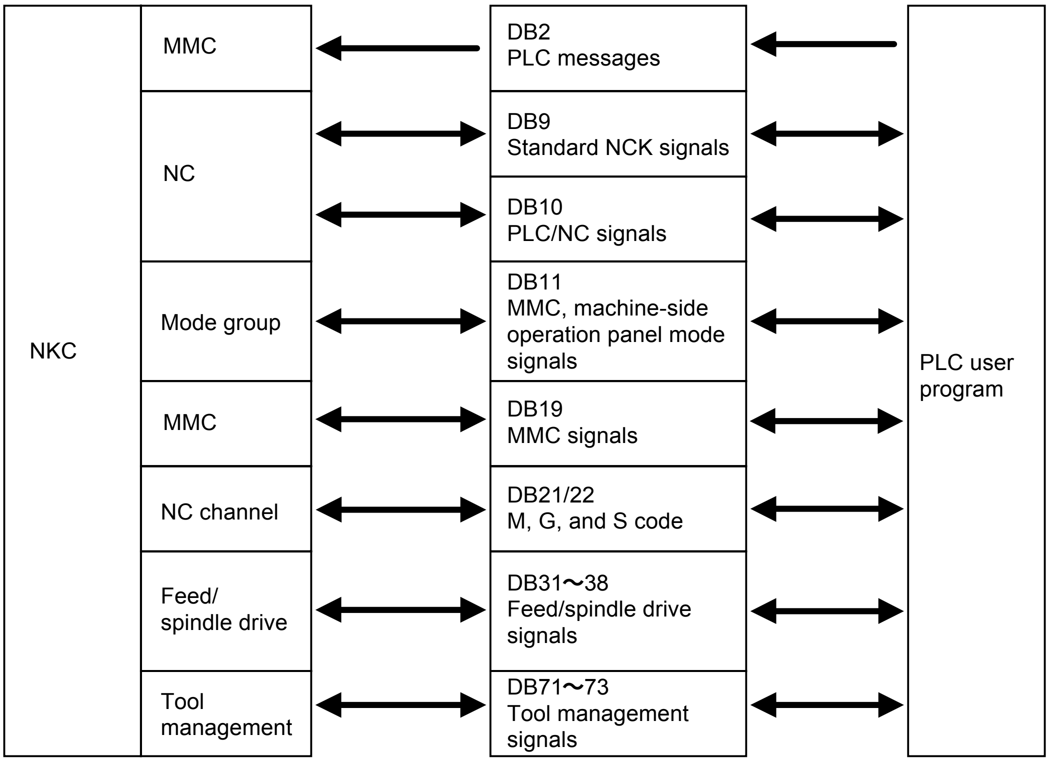
The interface between PLC and NC is implemented by the exchange of data blocks (DB) and functions (FC) between them. The PLC sends external information to and receives status information from the NC.

The following four groups of information are transferred through the interface:

- NC kernel (NCK) information
- Mode group information
- Channel information
- Feed/spindle information

8.4.2 Signals through the PLC/NC interface

The flow of signals through the interface is illustrated below.



8.4.3 Data blocks

The functions of the data blocks are described below. For the function of each bit of a data block, refer to the separate input/out signal documentation.

- DB2: PLC messages (self-diagnosis information)
- DB9: Signals sent in synchronization with the PLC scanning between PLC and NC
- DB10: Signals sent between PLC and NC as shown below. The man-machine communication (MMC) selector signals and MMC status signals are included.

PLC/NC	• NC high-speed digital I/O signals
	• Keyswitch and emergency stop signals
NC/PLC	• NC digital and analog signals (representing current values)
	• NC ready and other status signals.

- DB11: MMC or machine control panel mode signals sent from PLC to NC. NC return the signals indicating the current mode.
- DB19: Signals sent through the PLC/MMC interface as shown below
  - Control signals: MCS or WCS current position display and key disable
  - Machine operation: Input from the machine control panel
  - PLC messages
  - PLC status signals
- DB21/22: Signals as shown below
  - Control/status signals: Signals periodically sent from OB1
  - Auxiliary/G functions: M code, G code, and S commands
  - Tool management functions
  - NCK functions: PLC function calls
- DB31-38: Servo feed/spindle signals as shown below
  - Signals between feed and spindle
  - Feed signals
  - Spindle signals
  - Drive signals
- DB71-73: Tool management signals

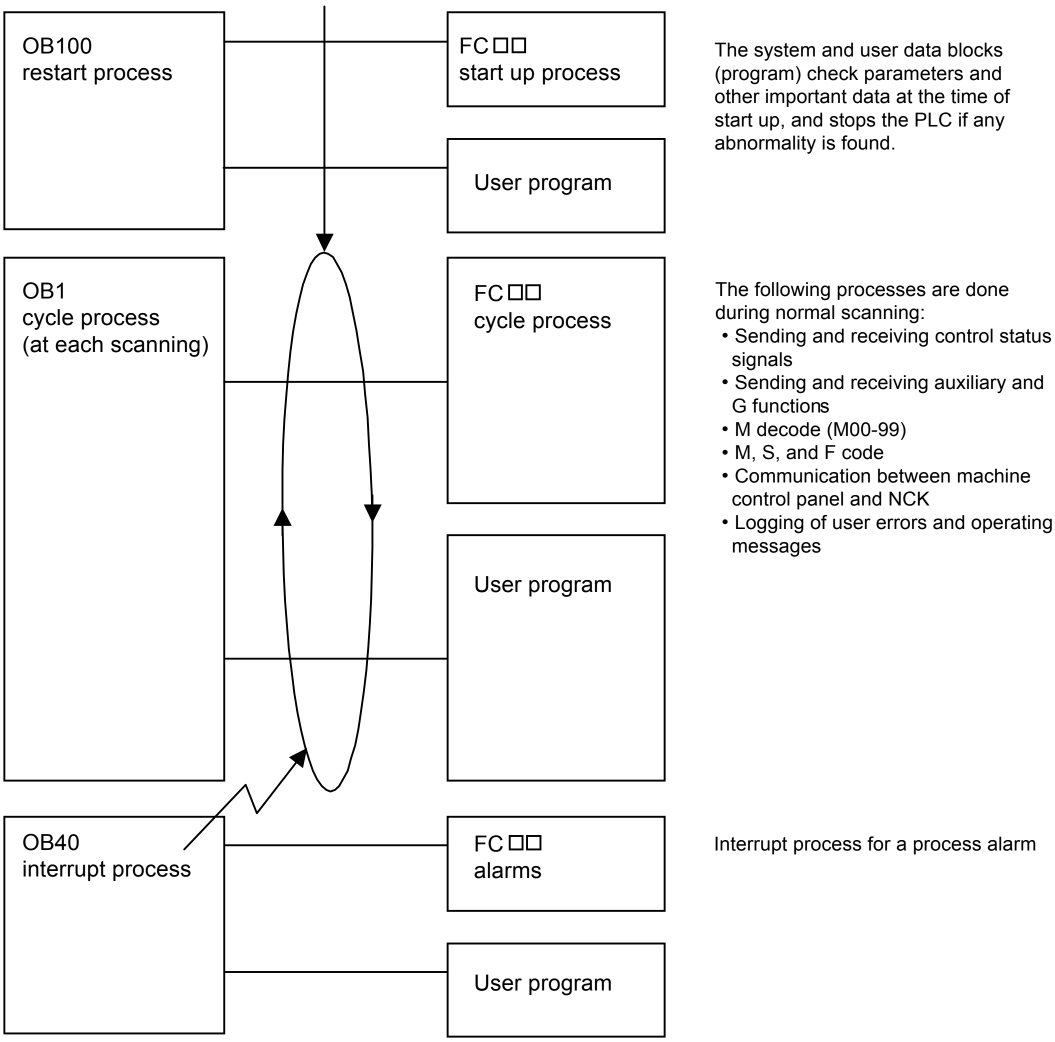
8.4.4 Program components

■ Modules

A program consists of the following levels of modules:

- Modules that are executed at start up (OB100)
- Modules that are called from OB1 and executed in synchronization with scanning
- Modules that are executed in interrupt processes

The basic parts of a program are started by OB1, OB40, and OB100 as shown below.



The illustration above shows only basic the parts of a program. An actual program may be more complicated including some other interrupt processes. For details on OB, FC and FB, see the System Software for S7-300/S7-400 (System and Standard Functions).

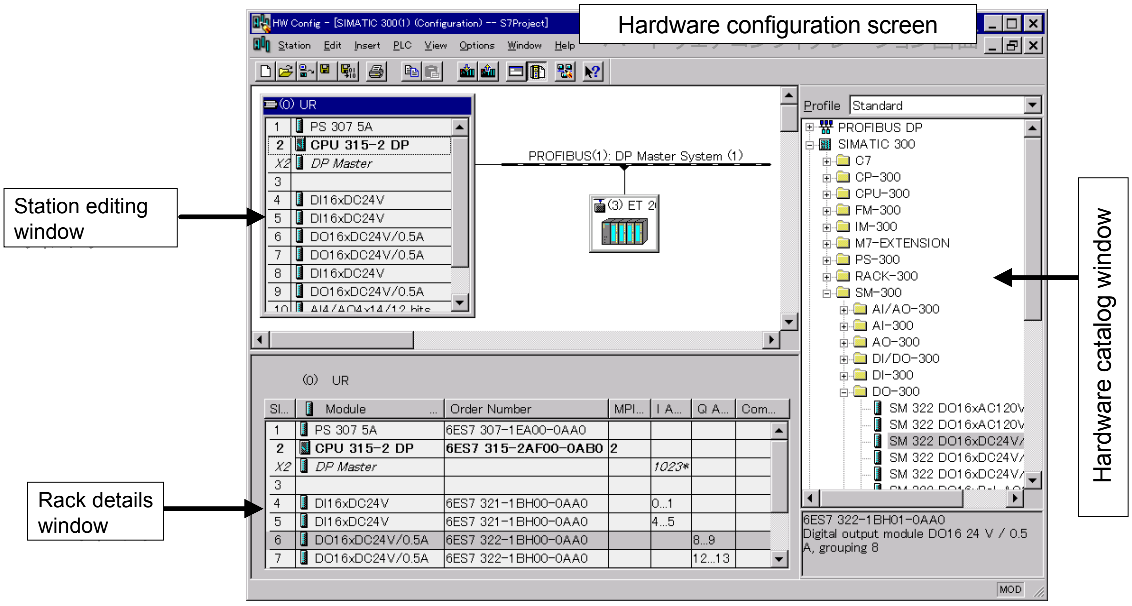
Chapter 9

SIMATIC manager and hardware configuration

This chapter describes how the modules are configured with the SIMATIC manager, a PLC ladder program development tool.
The SIMATIC manager runs in the Windows NT environment, and is used to configure the PLC hardware, develop PLC ladder programs online/offline, debug through online monitoring, and do other important functions. The manager is capable of real time processing on the Windows NT, and can be used to edit a PLC ladder program during machining (some restrictions apply to saving).

9.1 Hardware configuration

The hardware configuration function allows you to configure the PLC modules and set their parameters on screen. You can set or modify the CPU operating environments, not by setting various DIP switches but by simply downloading the configuration information to the CPU.



The following settings can be done with the hardware configuration function:

- Configuration of the PLC modules
- Configuration and addressing of the PROFIBUS-DP
- Setting of the retention memory area, node address and other CPU properties
- Addressing of the I/O modules
- Setting of the range and addresses of the analog inputs

The hardware configuration screen consists of the following three windows:

- Station editing window

  Shows how the PLC modules are configured.

- Hardware catalog window

  Lists the components of the PLC modules available. The listed components include racks, modules, and DP slave nodes, and are grouped into the PROFIBUS-DP and S7-300 components (the S7-400 components are not available with the YS 840DI system).

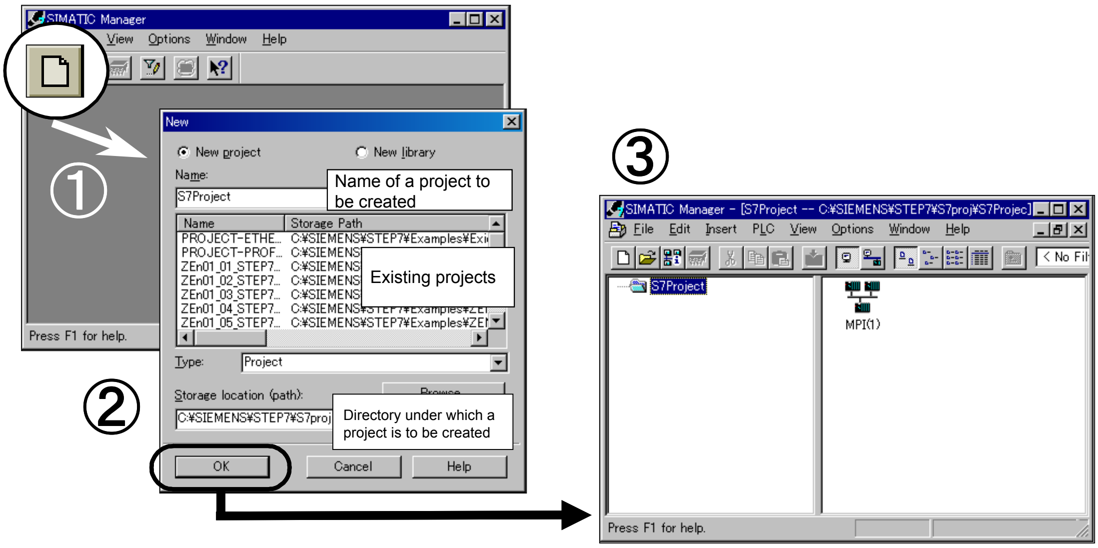
- Rack details window

  Shows the configuration, designation, address and other details of each module for a rack or DP slave.

9.2 Defining the hardware

9.2.1 Creating a new project

Create a new project as follows (using a wizard):



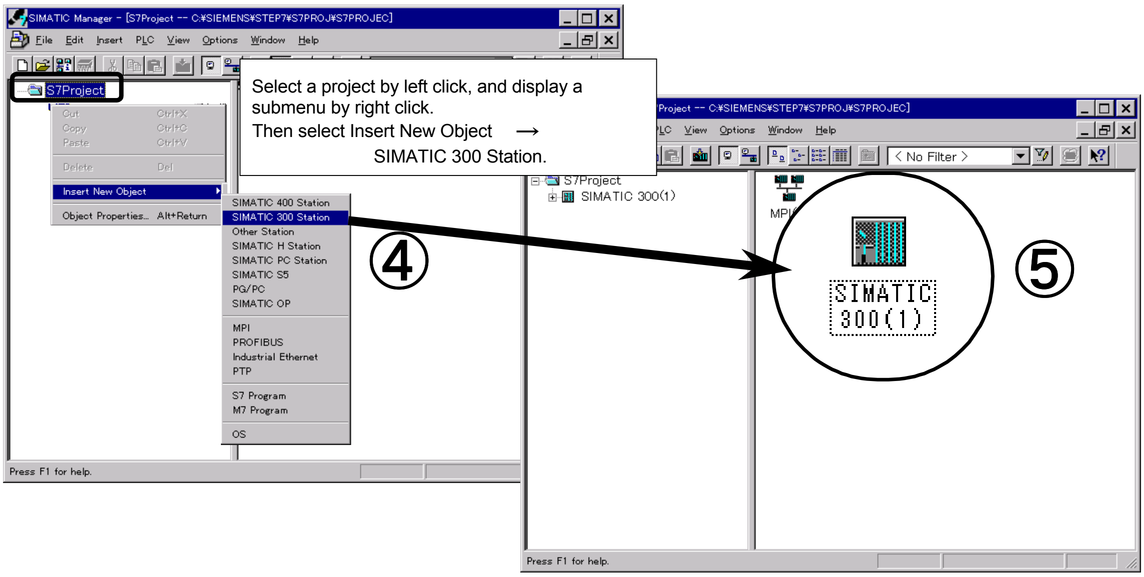
1. Click on the New icon of the SIMATIC manager's tool bar
2. Enter the name of a project you want to create while checking existing projects as listed below.

   You can select any directory under which the project will be by using the browse button. The default directory is SIEMENS\STEP7\S7_Proj. This is the recommended directory.
3. A project newly created on the SIMATIC manager is shown here. The project has no content yet.
4. An MPI network icon named MPI (1) is created in the right half of the window.

Now you are ready to add stations.

9.2.2 Adding a station

Add a station as follows (assuming a S7-300 station is to be added):



1. Select a project by left click, and display a submenu by right click.
   In this submenu, select Insert New Object > SIMATIC 300 Station.
2. S7-300 station named SIMATIC 300 Station (1) is created under the project. The name can be changed freely.

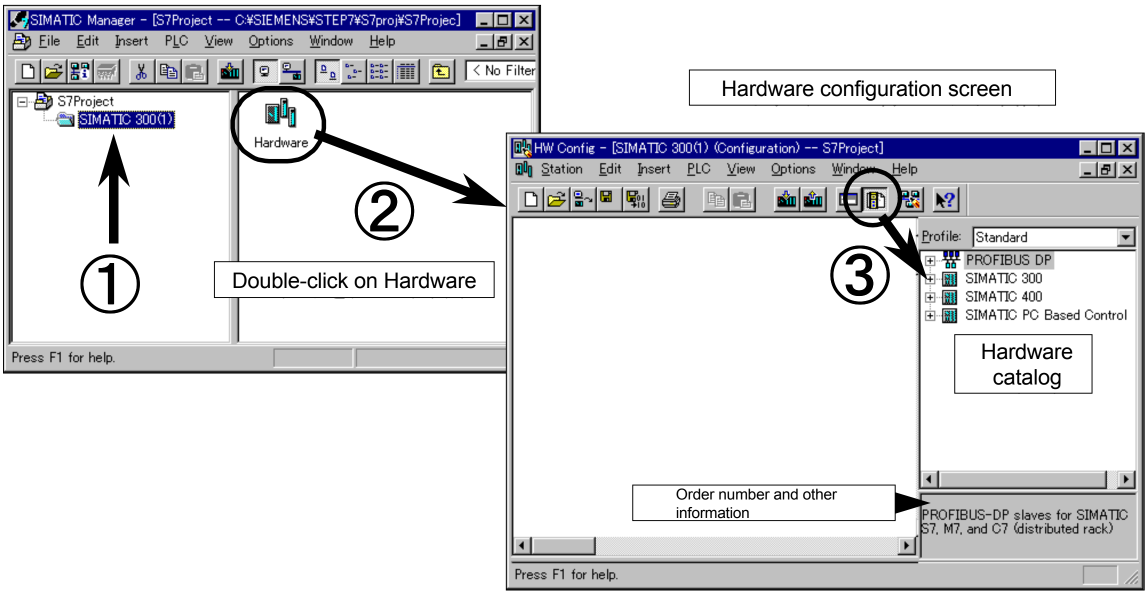
Now you are ready for hardware configuration.

INFO

When adding a station, if you select Insert New Object > S7 program, a program container is created under the project. The container contains programs but no hardware configuration. If blocks created here are downloaded to the CPU, they are automatically transferred to the CPU whose MPI node address is 2.

9.2.3 Opening the hardware configuration

For hardware environment settings, such as PLC module configuration, CPU environment setting, and module address setting, you will use the hardware configuration screen to open the hardware configuration.



1. Click on a station (SIMATIC 300 Station (1) in this example) in the SIMATIC manager screen.
2. Double-click on the Hardware icon in the right frame.
   The hardware configuration function will start up.

   If the selected station has its hardware already configured, that hardware configuration is displayed. If not, a blank window results (see the figure above).
3. Click on the catalog icon of the hardware configuration screen's tool bar.

A hardware catalog is displayed listing the modules and other products for the SIMATIC300, SIMATIC400, and PROFIBUS-DP categories.

You can create a new hardware configuration in the hardware configuration window using these products. For example, click on the plus sign (+) before the SIMATIC300 category in the hardware catalog, and the following product groups will be displayed:

• CP-300	Communication processor
• CPU-300	CPU
• FM-300	Function module
• IM-300	Interface module
• PS-300	Power supply module
• Rack-300	Rack
• SM-300	Signal module (I/O)

Clicking on the plus sign (+) before a product group causes the products of that group to be displayed.

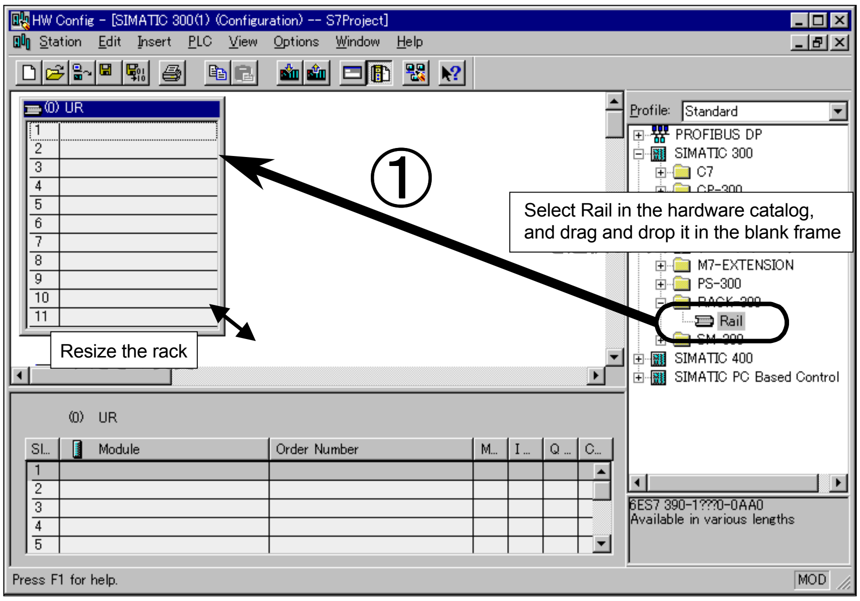
INFO

Clicking on a particular product causes its product designation and explanation to be displayed. Note that a product may have two or more versions, and selecting the right version by designation is essential to correct functioning of the CPU. If no correct version is listed, contact your Yaskawa Siemens representative.

9.2.4 Adding a rack

When you open the hardware configuration of a newly created station, a blank frame will show up in the hardware configuration window.

You must first add a rack on which you are going to put modules.



1. Expand the SIMATIC300 category in the hardware catalog to display the S7-300 product groups. Then expand the rack-300 product group to display a rail. Select the rail, and drag and drop it in the blank frame on the left, or simply double-click on the rail. The S7-300 rack will be displayed.
2. Reposition or resize the rack as necessary.

Now you are ready for adding a module.

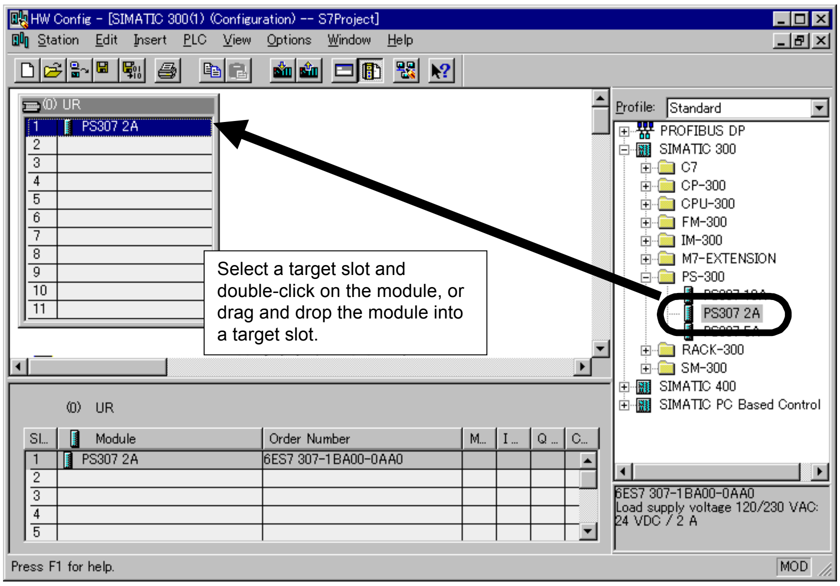
9.2.5 S7-300 rack

The S7-300 rack can have up to 11 slots numbered 1-11. Slots 1-3 can contain only a specific module: slot 1 can contain a power supply module (PS), slot 2 a CPU module (CPU), and slot 3 an interface module (IM). Thus, if no PS or IM module is used, the corresponding slot must be left empty.

Slot 4 and later slots, however, may contain any of the SM module (digital or analog I/O), communication module (CP), and function module (FM). Slot 4 and later slots must not be left empty. A supplementary rack must have slots 1 and 2 left empty. It is recommended that the FM or CP module be inserted in the main rack, as it cannot always be inserted in a supplementary rack.

9.2.6 Adding the power supply module

Insert the power supply module first in slot 1.



When adding the power supply module, CPU module, or I/O module to the rack, you can use one of the two methods: slot specification and drag-and-drop.

■ Slot specification method

Select a target slot and double-click on the module as follows:

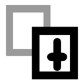
1. Click on a slot of the rack to which you want to add a module of your choice. The selected slot is indicated by blue background.
2. Click on the module in the hardware catalog. The selected module is indicated by blue background.
3. Double-click on the same module. The module is automatically inserted in the selected slot.

■ Drag-and-drop method

1. Select a module of your choice by clicking on it in the hardware catalog.

   If any preselected slot (as indicated by blue background) has no meaning.

2. Drag and drop the module into a target slot. The module is inserted in that slot. With this method, when you drag a module over a slot, the pointer changes its appearance as shown below to indicate whether the module can be inserted in that slot.

	
Can be inserted	Cannot be inserted

Depending on the hardware configuration, when a module is inserted in a slot, a property screen may automatically appear for that module. The content of a property screen depends on the type of a module. The properties of each module are described later in this chapter. If no property screen automatically appears when a module is added, you can still display the property screen for that module by double-clicking on Module in the station editing window.

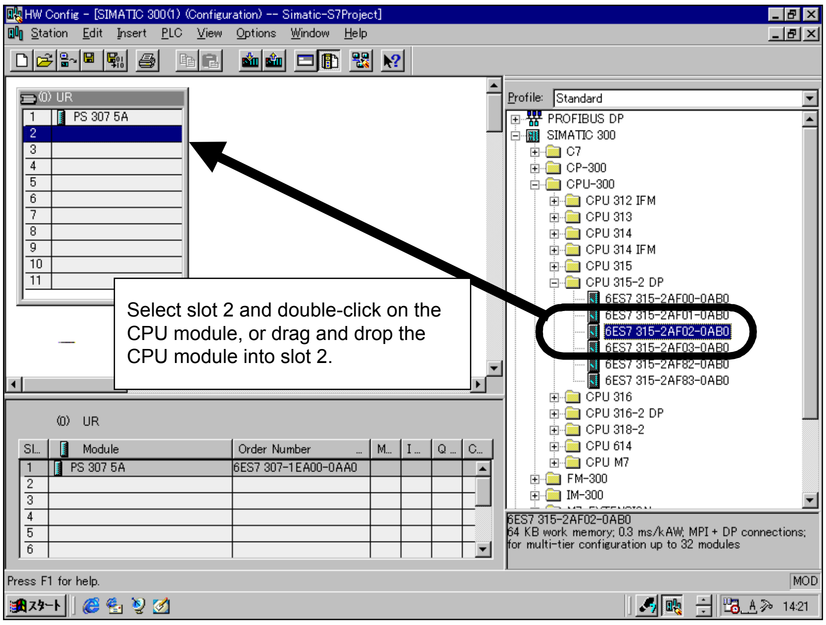
The CP, FM or some other module requires special software for its setting. As such software does not come with the STEP7, it must be purchased and installed by the customer.

INFO

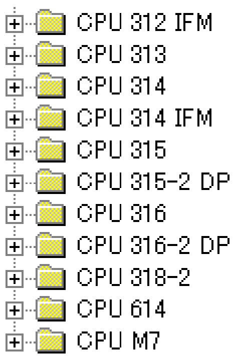
If wrong hardware configuration information were transferred to the CPU, the CPU could fail to start up.

9.2.7 Adding the CPU module

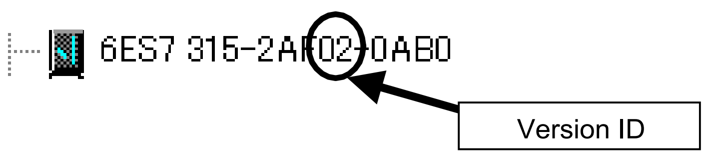
Select and insert the CPU module as follows:



With the S7-300, the CPU module must be inserted in slot 2 of the CPU rack.
The STEP7 V5.x supports the following CPU module families:



A product designation is in the following format:

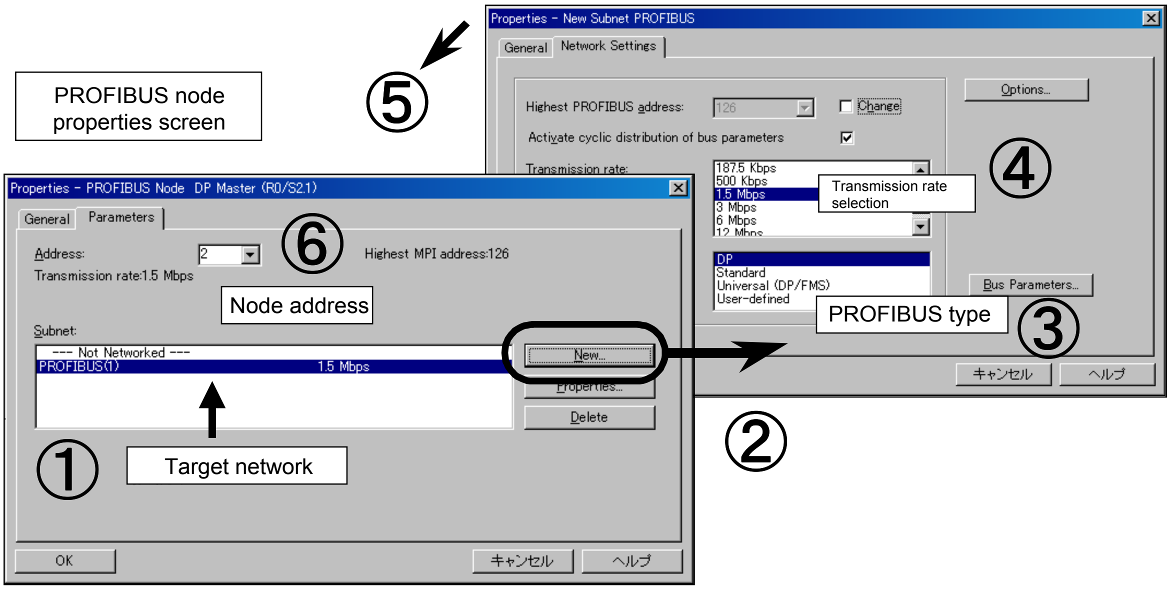


INFO

Each CPU module has its designation displayed in the CPU module list in the hardware catalog. Note that a CPU module may have two or more versions, and selecting the right version by designation is essential to correct functioning of the CPU.

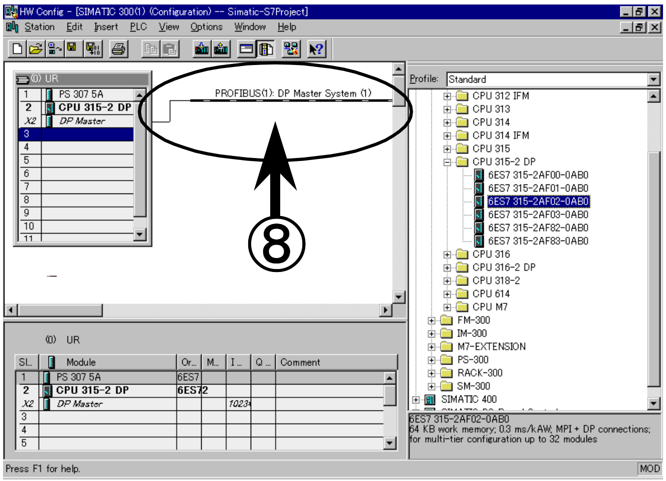
9.2.8 CPU's DP port setting

When a CPU provided with a DP port is inserted in a slot, the DP port properties screen automatically appears.
To manually display the screen, double-click on the DP-Master line under a CPU with a DP port.



1. Select a PROFIBUS network through which the selected CPU is connected.
2. To create a new network, click on the New button to display the network properties screen. To check or modify the properties of an existing network, click on the Properties button.
3. Select a PROFIBUS type.
4. Select a transmission rate according to the total cable length for the network:
   - 3-12M bps : 100 m max.
   - 1.5M bps : 200 m max.
   - 500K bps : 400 m max.
5. Click on OK, and you will return to the DP port properties screen.
6. Specify a unique number between 1 and 126 as the CPU's PROFIBUS network address.
7. Click on OK.

8. The DP Master System line appears as extending from the CPU slot in the hardware configuration window. If the rack is hiding the line, move the rack aside. DP slaves can be added so as to connect to the line.

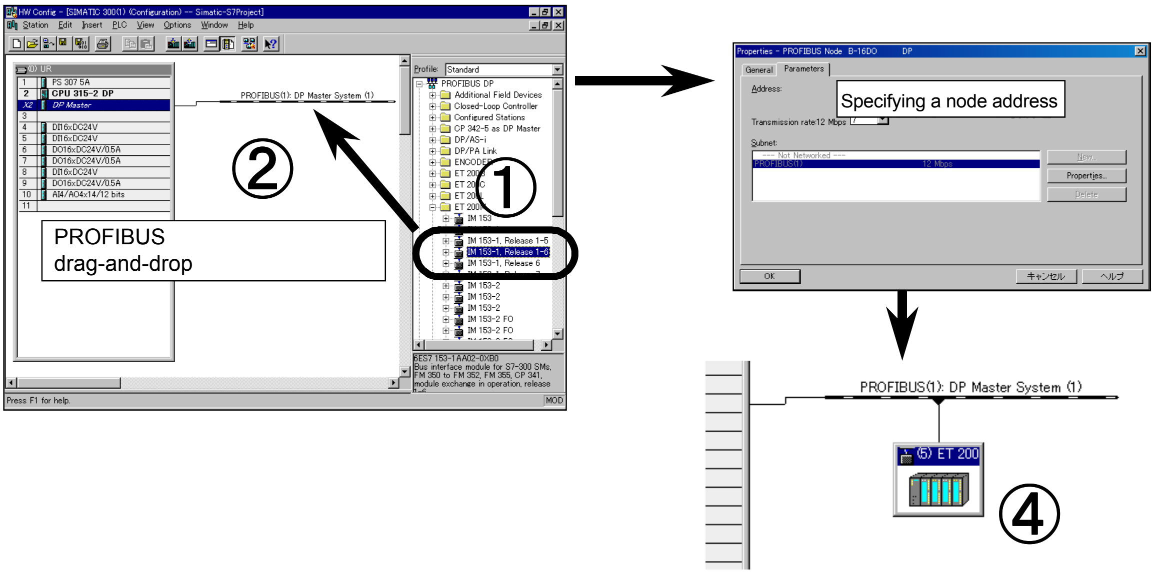


INFO

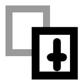
If a CPU with a DP port is used but that DP port is not used, the DP port should be set nonetheless. Otherwise the BUSF LED for the CPU would light up.

9.2.9 Adding a PROFIBUS-DP node

In the hardware configuration screen, you can also add DP slaves to the CPU module with a DP port.



1. Expand PROFIBUS-DP in the hardware catalog, and select a DP slave to add.
2. Drag and drop the DP slave onto the DP Master System line. Note that when the pointer gets over the line, the pointer changes its appearance to that shown below.

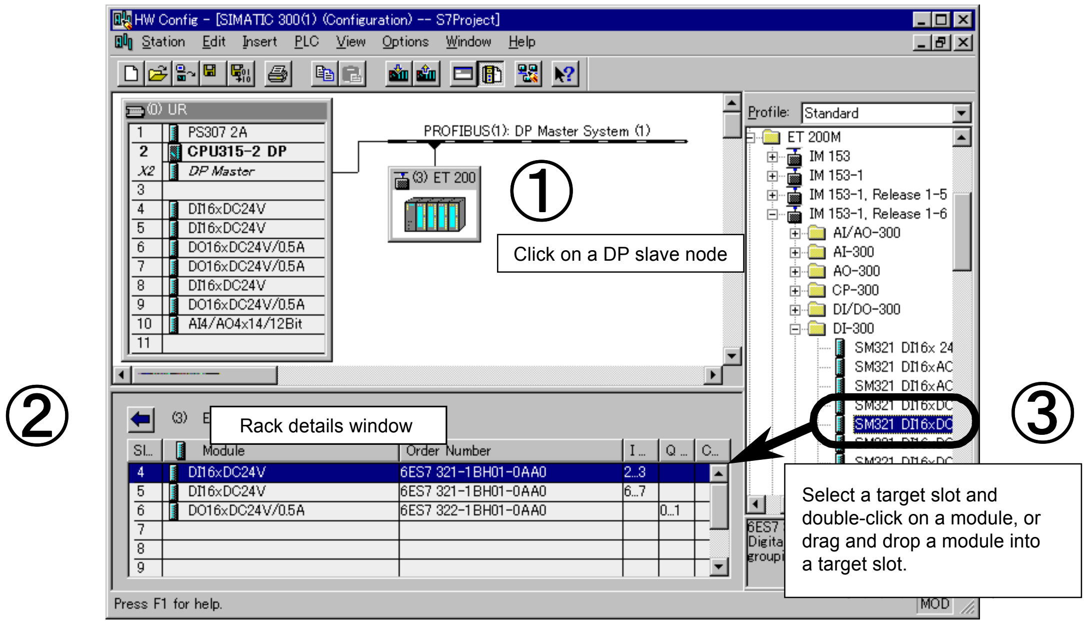
   

   The DP slave properties screen appears.
3. Specify a unique number between 1 and 125 as the node address.
4. Click on OK. A node is displayed for the selected DP slave in the hardware configuration screen.

Double-clicking on the icon of the registered DP slave causes its properties screen to be displayed. To change the node address of the DP slave, click on the PROFIBUS button in this screen.
The hardware catalog shows a list of DP slaves from Yaskawa Siemens. If you want to use PROFIBUS-compatible DP slaves from other than Yaskawa Siemens, you must first install them in the catalog file.

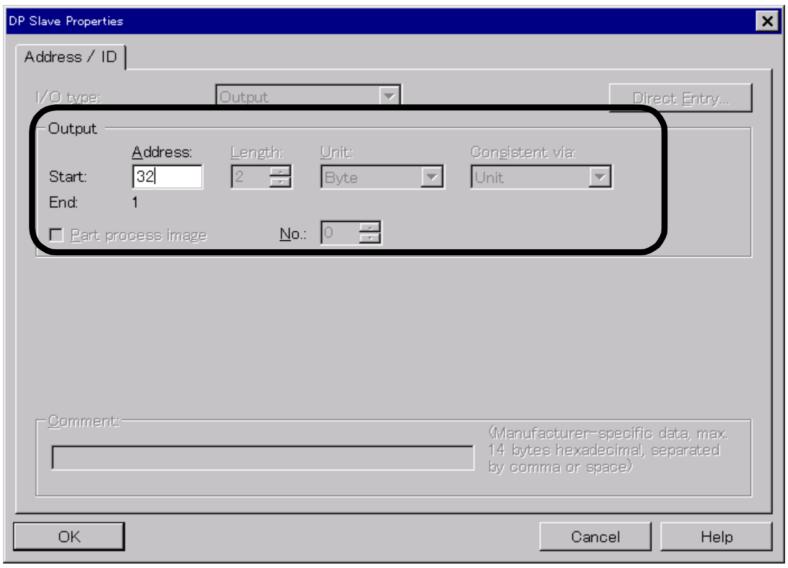
9.2.10 DP slave (ET200) construction and addressing

The I/O details of a DP slave are shown in the rack details window at the bottom of the hardware configuration screen. Edit the I/O details as follows:



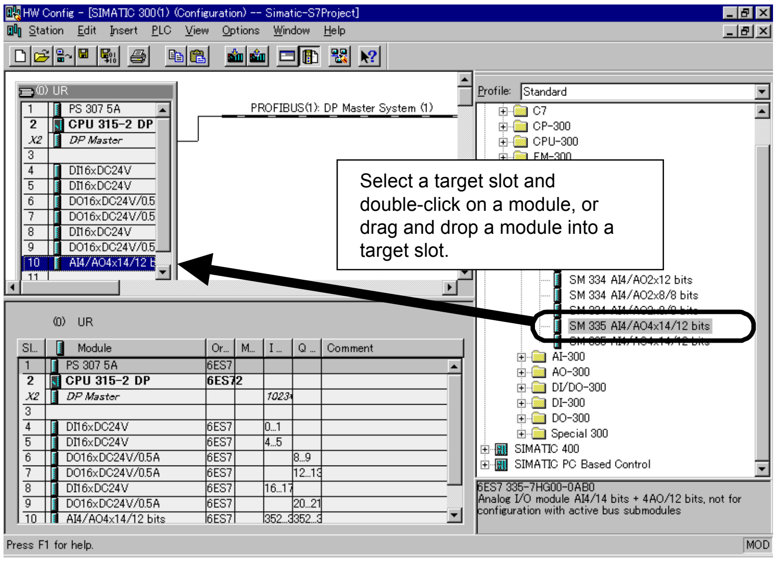
1. Click on the icon of a DP slave node you want to edit.
2. The rack details window appears showing the rack configuration of the selected node.
3. For the ET200M and other nodes that require module configuration, select an I/O module from the hardware catalog and move it into the rack details window, as is the case for the CPU rack. With the ET200M rack, insert modules in slot 4 or later slots.

   For ET200B and other slaves whose I/O configuration is automatically determined when they are selected, this step may be skipped.
4. Double-click on a slot in the rack details window to display the properties screen. Then specify a start address.

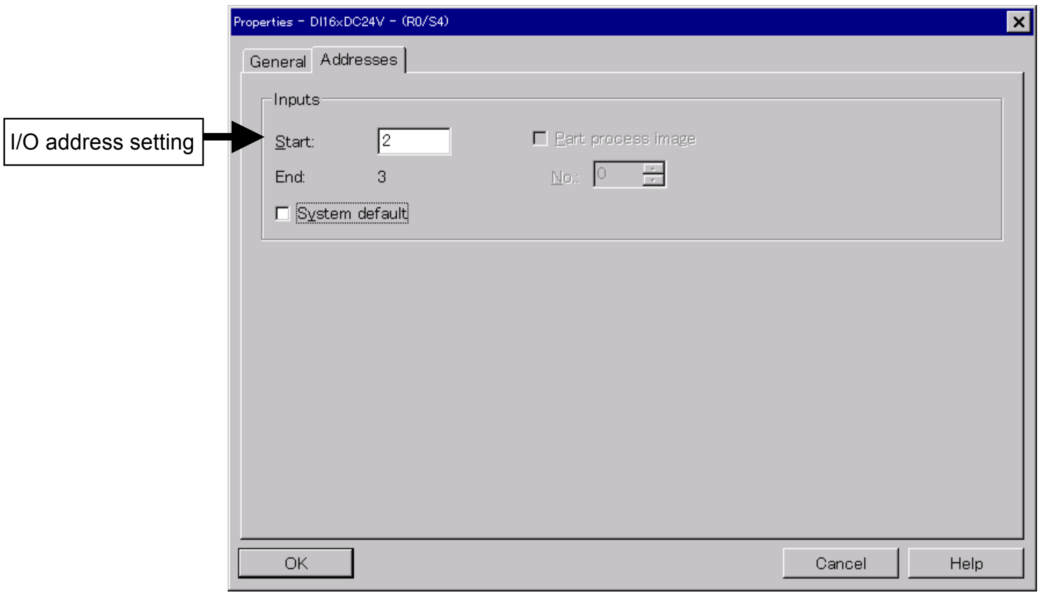


9.2.11 Adding the SM module

Insert the digital and analog modules as necessary.



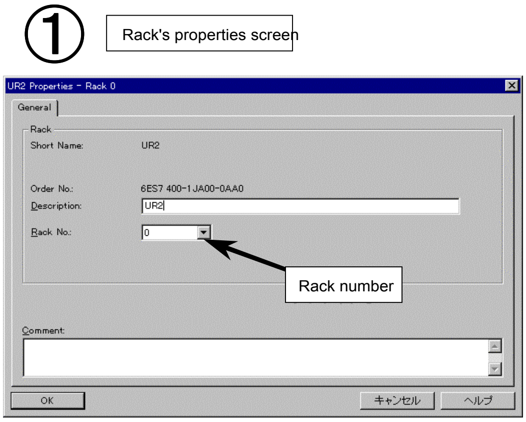
Double-click on a slot containing a module to display the properties screen for that module. Specify or confirm the start address of the module on the address sheet (no start address can be specified for some CPUs).

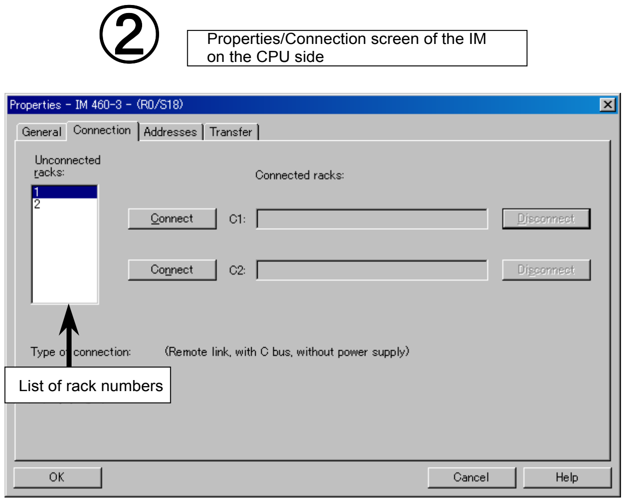


9.2.12 Connecting the racks (interface)

Connect the racks as shown below.

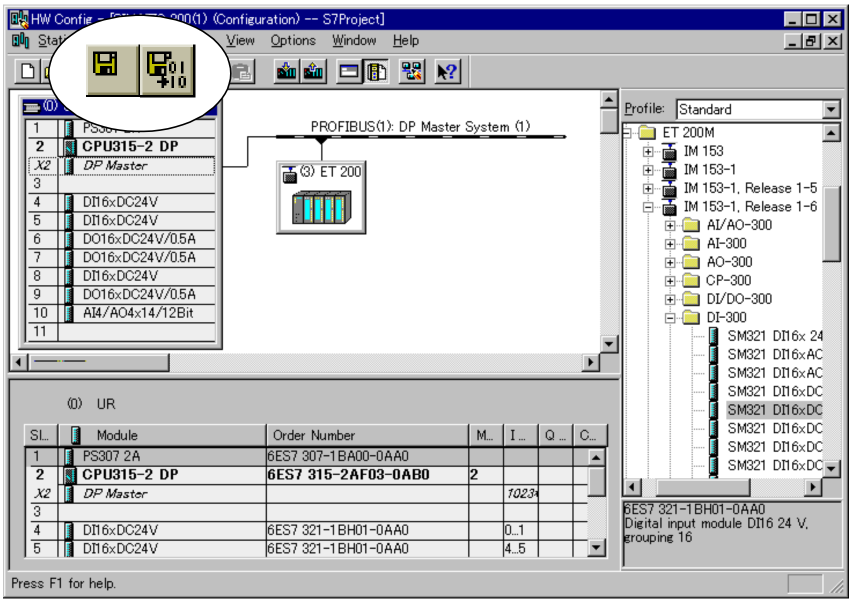
For the S7-300 racks, this operation is not necessary because, when the interface module (IM) is installed in each of the racks, the interfaces are automatically connected together.

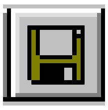
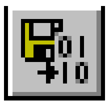


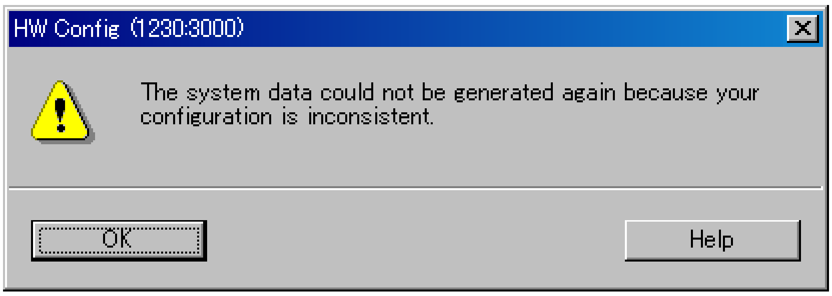


9.2.13 Saving the hardware configuration

When the hardware configuration is done, save it in a project file by using tool bar icons as shown below.



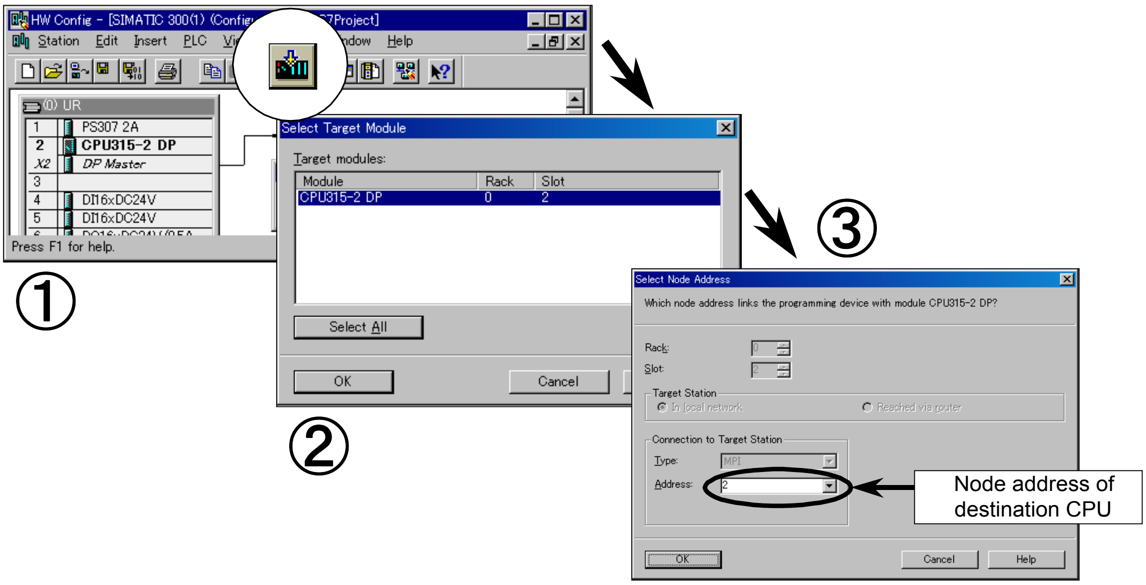
	Save	The hardware configuration is saved, but not compiled. It is saved even if it contains errors. Normally this icon is used to temporarily save a hardware configuration in progress.
	Save and compile	The hardware configuration is compiled and saved. If an error is found during compilation, an error message as shown below is displayed and the configuration is not saved.



Normally the hardware configuration should be compiled and free of errors before downloaded. Otherwise the download process automatically initiates the compilation process. A compiled hardware configuration is saved in the system data block in the block container of the SIMATIC manager.

9.2.14 Downloading the hardware configuration

Transfer from file to CPU, or download, the finished hardware configuration as follows:

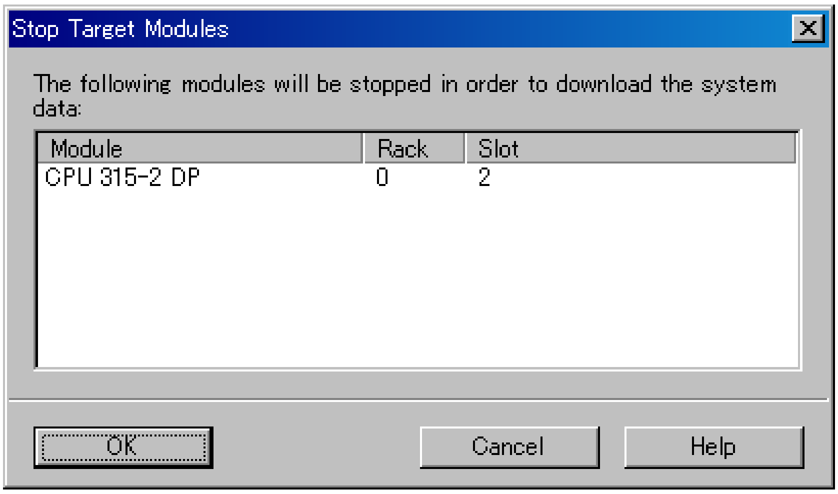


1. Set the CPU's mode switch to STOP or RUN-P.
2. Click on the Download icon of the tool bar to start the download process.
3. Select a module in the project, and click on OK.
4. Define a destination CPU by specifying its MPI address on the MPI network to which the PLC is connected and then clicking on OK. The MPI address to be specified must be that to which a PLC is actually connected and the hardware configuration can be downloaded. If only one PLC is connected, simply click on OK.
5. The program is transferred to the CPU. Then you are returned to the hardware configuration screen.

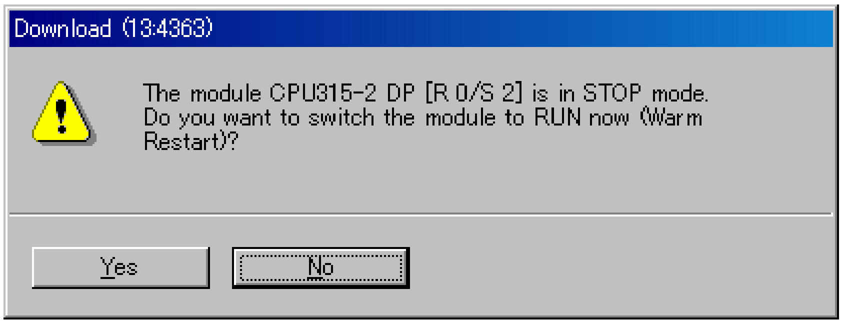
At the time of hardware configuration download, that is, at the restart following a memory reset, do not transfer the program to the CPU. If the SF LED on the CPU is lit after you have attempted to download the hardware configuration, it is meant that the downloading of the hardware configuration has failed. In this case, correct the hardware configuration and try to download it again.

INFO

The CPU must be stopped before the hardware configuration can be downloaded. If the downloading is started with the mode switch set to the RUN-P position, the following confirmation message will be displayed:



↑ The CPU run state is to be switched from RUN to STOP. OK?

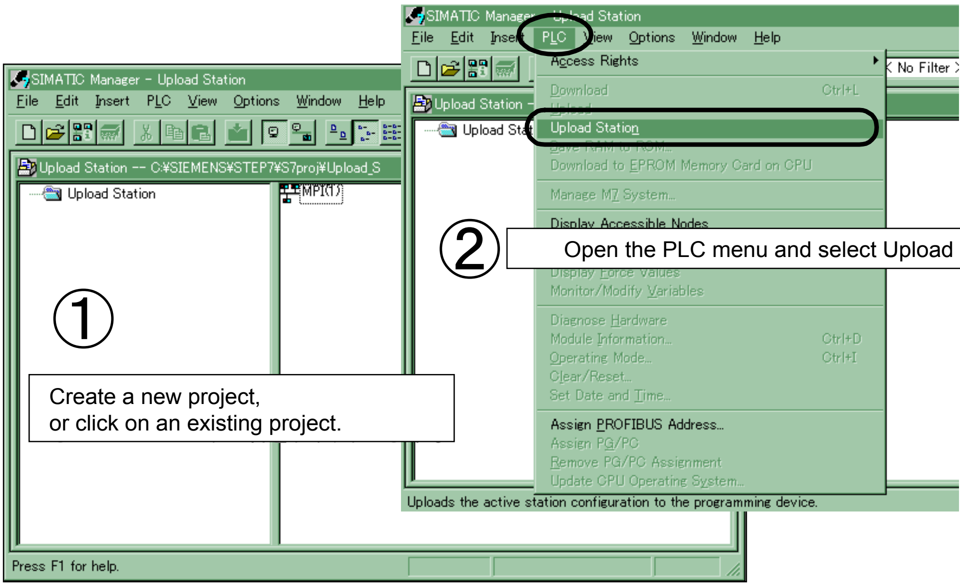


↑ The CPU run state is to be switched from STOP to RUN. OK?

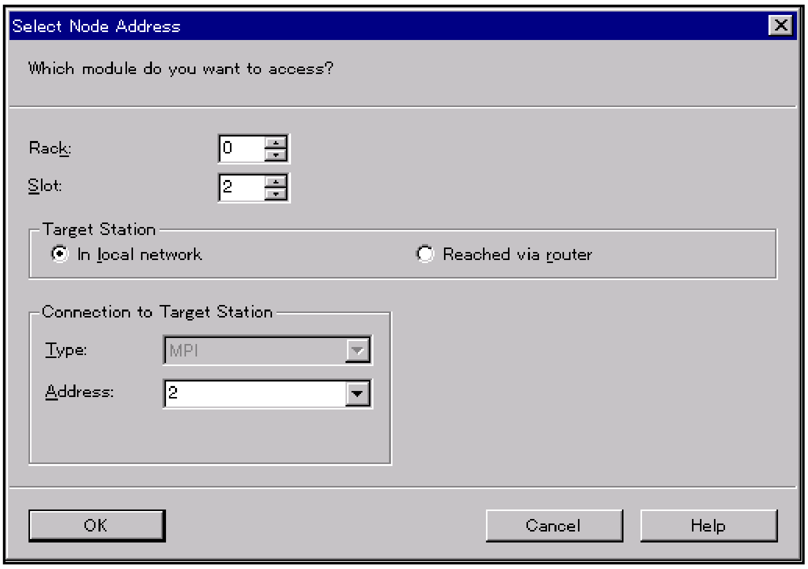
9.3 Uploading hardware configuration

9.3.1 Uploading hardware configuration (1)

There are two methods by which you can upload the hardware configuration information to a project.



1. Open the SIMATIC manager screen, and create a new project or open an existing project and click on a project name.
2. Open the PLC menu and select Upload Station (Upload Station can be selected only when step 1 above is correctly done).
3. The following screen appears so that you can specify a source CPU:



- Rack

  Specify the number (normally 0) of the rack in which a source CPU is contained.
- Slot

  Specify the number (2 for the S7-300) of the slot in which the source CPU is inserted.
- Address

  Specify the node address (normally 2) of the source CPU.

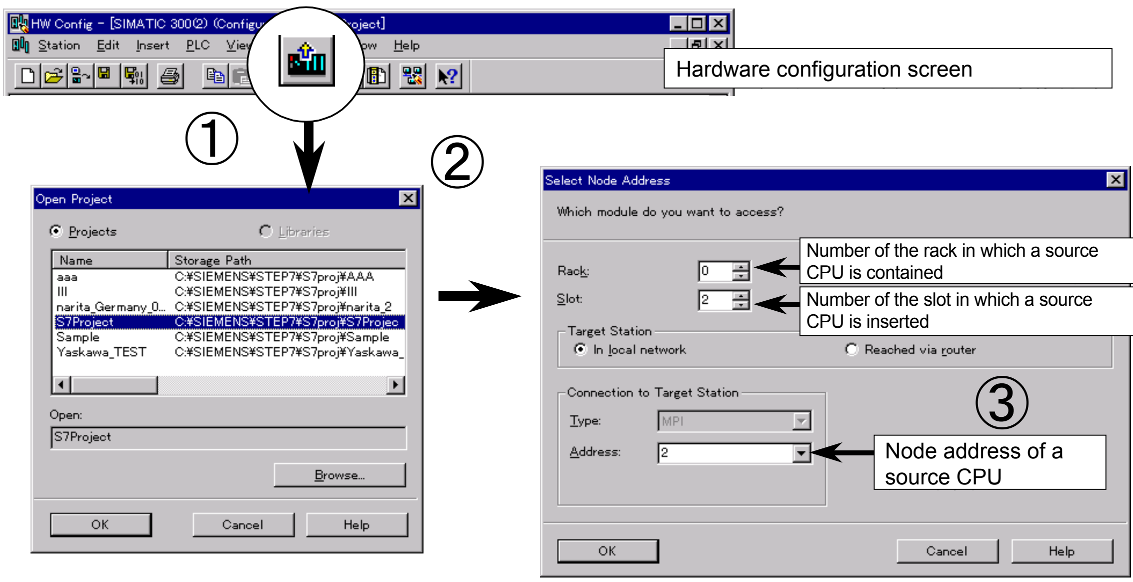
4. Click on the OK button, and the hardware configuration information of the source CPU will be uploaded.

INFO

For the network communication module and some FM modules, the information they have themselves is not uploaded.

9.3.2 Uploading hardware configuration (2)

The other method by which you can upload the hardware configuration information of a CPU to a project is this:



1. Click on the Upload icon of the hardware configuration screen.
2. As the open project screen appears, select a destination project to which the hardware configuration information is to be uploaded, and click on the OK button.

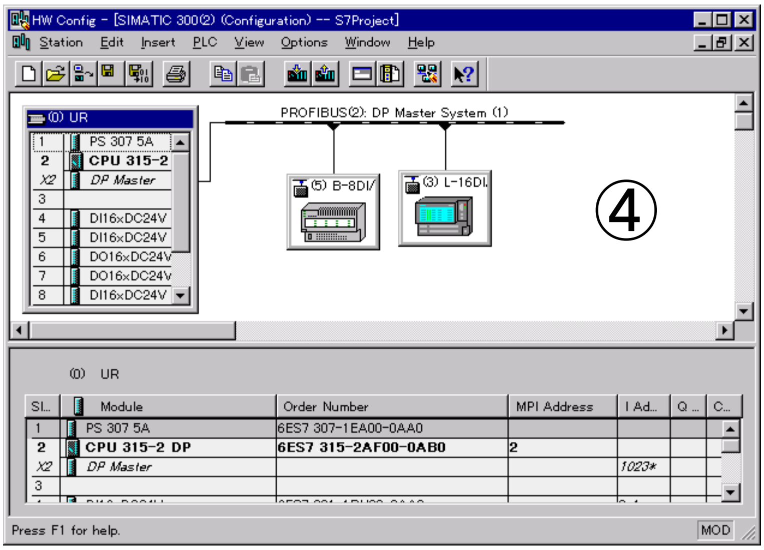
   Note that this method is applicable only when a destination project already exists (a new project cannot be created by this method).

3. The node address selection screen appears.
   - Rack

     Specify the number (normally 0) of the rack in which a source CPU is contained.
   - Slot

     Specify the number (2 for the S7-300) of the slot in which the source CPU is inserted.
   - Address

     Specify the node address (normally 2) of the source CPU.
4. Click on the OK button, and the hardware configuration information of the source CPU will be uploaded. Then the following screen appears:

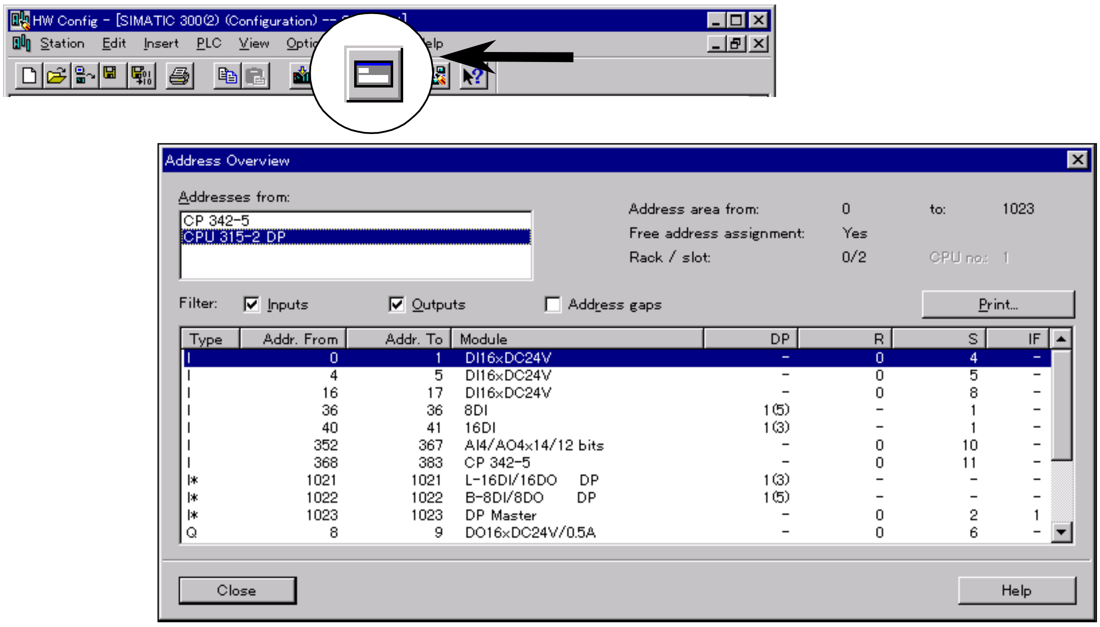


INFO

For the network communication module and some FM modules, the information they have themselves is not uploaded.

9.3.3 List of addresses

You can display a list of addresses that are used in hardware configuration.



To bring up this screen, click on the address list icon of the hardware configuration screen.

The content of the address list screen is as follows:

Address from	Select a module whose address list you want to display. Normally the names of available CPUs are shown. The name of CP is also shown if the CP is configured as a DP master.	
Filter	Input	Input addresses are to be listed.
	Output	Output addresses are to be listed.
	Address gap	Address gaps are to be listed * (address gaps are the addresses currently not used).
Type	I: Input address	
	I*: Input address of diagnosis byte	
	Q: Output address	
Addr: From	Module's start byte address	
Addr: To	Module's end byte address	
Module	Module type	
DP	For DP slaves, a DP address is shown in the parentheses ( ).	
R	Number of a rack in which the module is contained	
S	Number of a slot in which the module is inserted	
IF	Interface port number	

Part 4

Setting up and maintenance

Chapter 10

Overview of System

10.1 Screen operation

This document explains the specification and operational procedure of YS 840DI screen operation.

For the detailed information about each screen, see

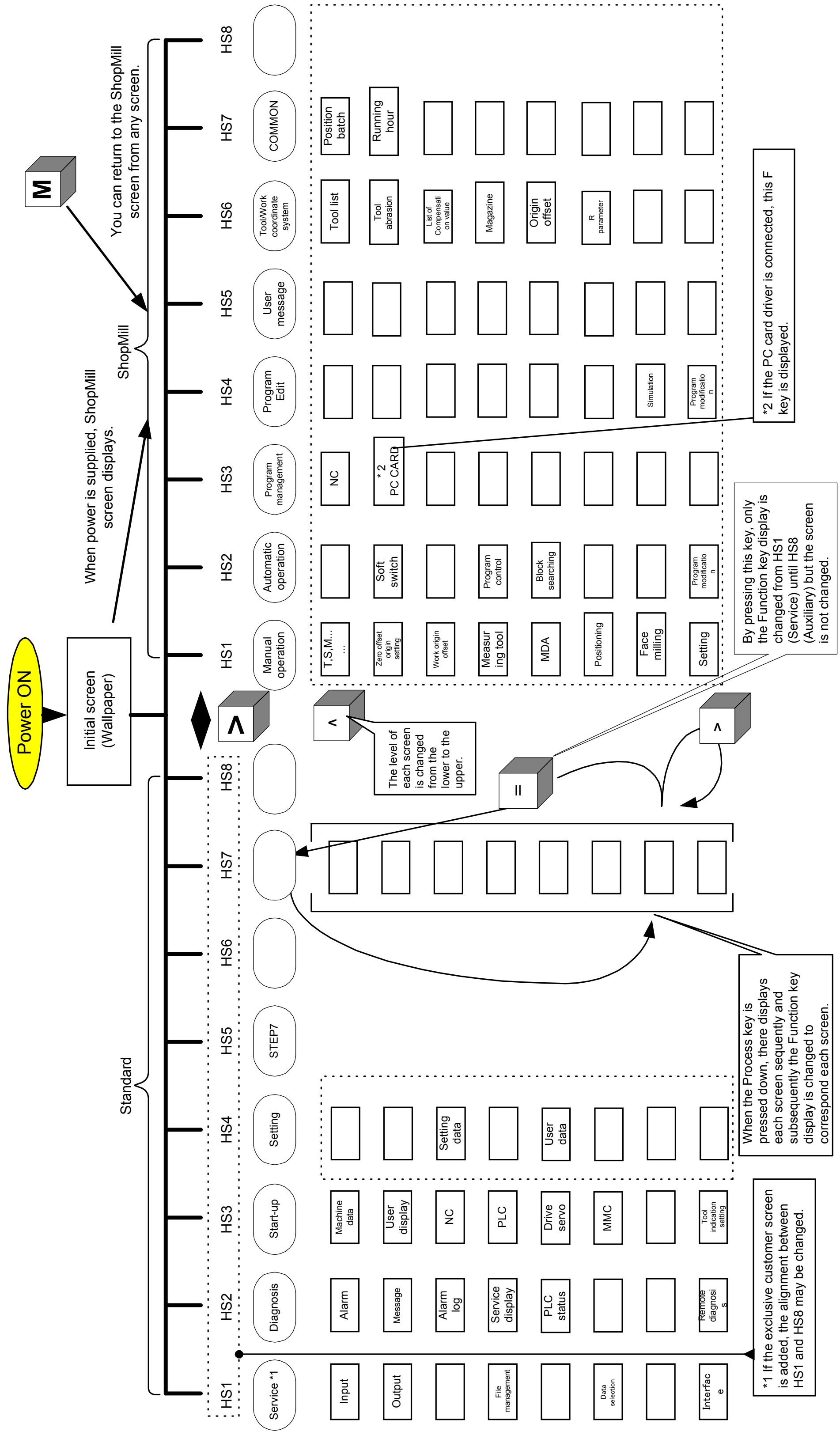
- Yaskawa Siemens 840DI Operating Manual (NCSIE-SP02-04)
  or
- Yaskawa Siemens 840DI Maintenance Manual (NCSIE-SP02-10)

10.1.1 Basic concept

YS 840DI employs the screen system called ShopMill as the operation control basic screen, from which you can call the screens required for maintenance. Therefore, on this ShopMill-based screen, end users can easily maneuver the operation control and also switch over to the maintenance screen.
Additionally, for the function key operation on each screen, the vertical and perpendicular function keys are used.

10.1.2 Basic operation

The following screen tree shows the transition of screen states.



Here is the description about screen switching by using the following four keys;

- MENU [=] key

  This can switch the front/back top function key display to which the current screen belongs.

  However, the content of the screen remains unchanged

- MACHINE[M] key

  This allows you to change the screen level from the lower to the top layer of each function.

  For example, on the lower layer screen, press the [M] key to jump up to the ShopMill manual operation screen.

- [>] key

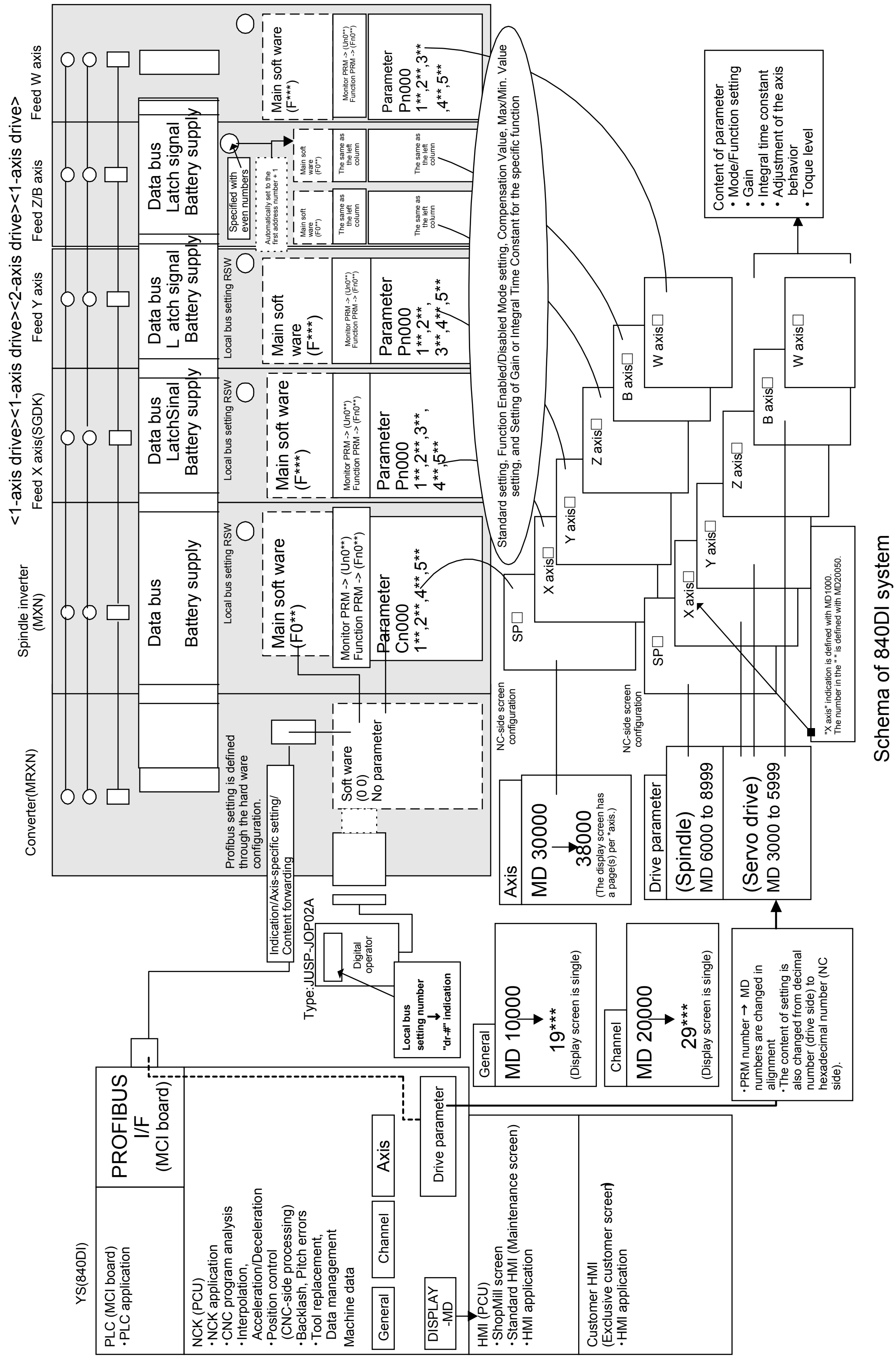
  This allows you to switch over the function front/back displays.

- [Λ] key

  This allows you to go to the one-upper layer screen.

10.2 MD components

The following diagram shows the drive-related MD and the screen display types.



Chapter 11

Drive Parameter Screen

This chapter describes the indication of drive parameter and the overview and operation of editor function.

11.1 Drive Parameter Screen Operation

This function allows you to indicate and edit the parameters of the drive which is connected to YS 840DI via the drive parameter screen which is housed in YS 840DI standard HMI application.

11.1.1 Startup

■ Startup

To display the drive parameter screen, use the following procedure;

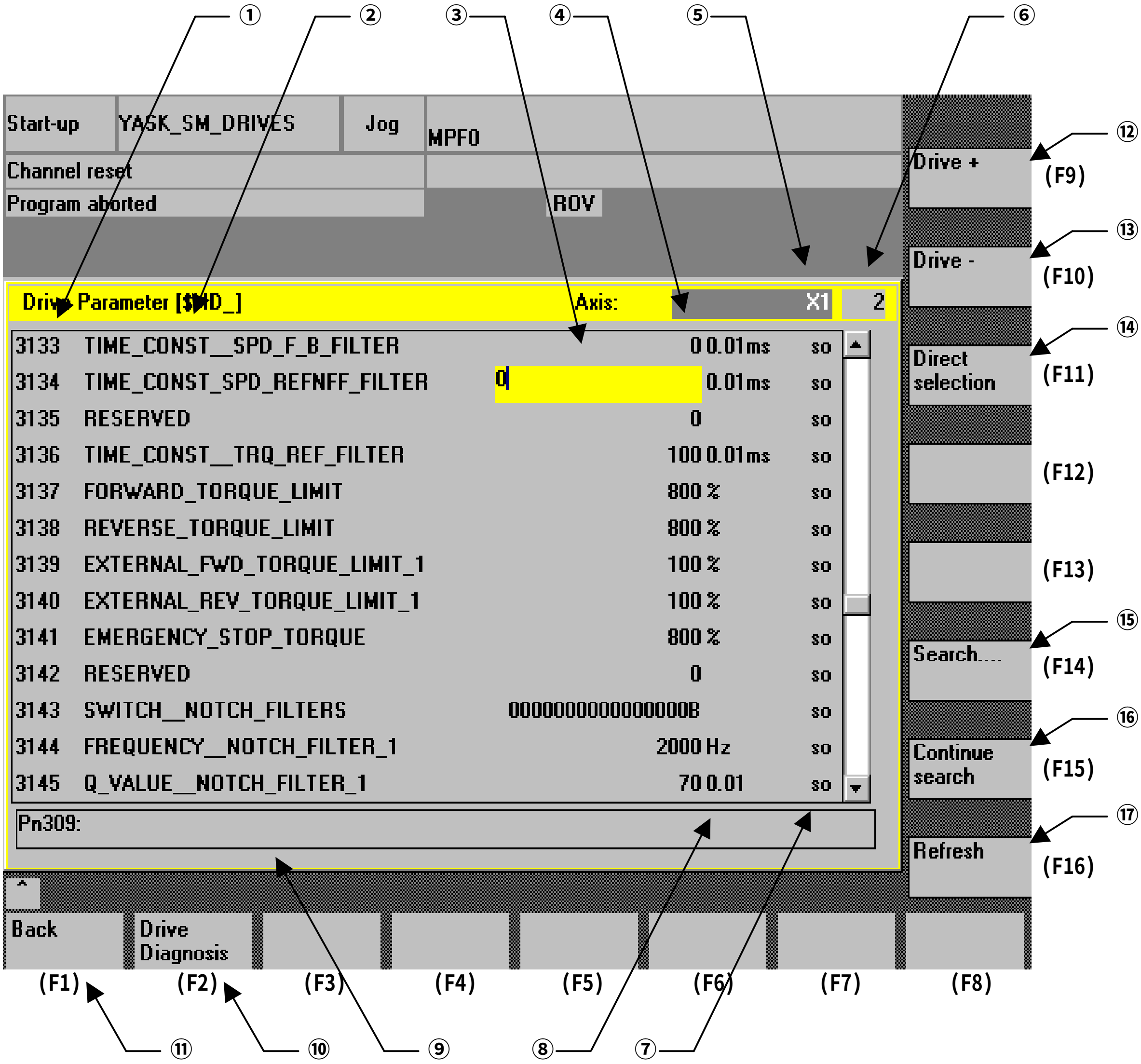
1. Select the [MENU SELECT] key to go to the Top tree.
2. Press the [>] key and the [Start up] key displays.
3. Click the [Start up] key.
4. Select the [Machine data] key from the bar as shown below.

5. Click the [Drive Parameter] key to display the drive parameter screen.

11.1.2 Screen Configuration

■ Screen Configuration

The configuration of drive parameters are displayed as follows.



① : Parameter number
② : Name of parameter
③ : Selection display
④ : Parameter setting value
⑤ : Name of axis
⑥ : Drive number
⑦ : Conditions of validity
⑧ : Unit
⑨ : Description of selected parameter
⑩ : Drive diagnosis screen switching key
⑪ : Screen switching key
⑫ : Target axis switching key
⑬ : Target axis switching key
⑭ : Target axis directly-switching key
⑮ : Search key
⑯ : Continuing search key
⑰ : Update key

11.1.3 Operation method

On the drive parameter screen, the following operations are available.

■ Basic operation

The basic operations are listed below;

- Use the upward/downward arrow key for one-line scroll.
- Use the right/left arrow key to transit the selected row by one.
- Use the PAGE UP/PAGE DOWN key for one-page scroll.
- Use [Drive + (F9)] key or [Drive - (F10)] key for switching the displayed target axes.
- Use [Direct selection (F11)] key for the direct switching for the target axis displayed.
- Use [Search . . . (F14)] key for searching.
- Use [Continue search (F15)] key for continuing the search.
- Use [Refresh (F16)] key to update the displayed data.
- Use [Back (F1)] key to goes back to the last page.
- Without connection to the drive, [Drive +] key, [Drive －] key, [Direct selection] key, [Search . . .]key, and [Continuous search] key are not available.

■ Input of setting value

The input method of setting values are categorized into 3 types; decimal number, hexadecimal number and binary number.

Decimal number

Decimal number data can be input using only the numeric keys. However, if the parameter can accept minus data, [-] key input is permitted.

Hexadecimal number

Hexadecimal number data is displayed with "H" at the end of the value. The numeric keys from 0 to 9 and alphabetical letter keys from A to F input is available.

Binary number

Binary number data is displayed with "B" at the end of the value. Only [0] and [1] key input is accepted. Press the [INSERT] key to switch over to the inset mode. On this mode, you can goes to the bit position you want to modify by using [->] and [<-] keys. The input is limited to up to 16 digits. If there are already input up to 16 digits on the insert mode, you must delete any number using the [DEL] key.

IMPORTANT

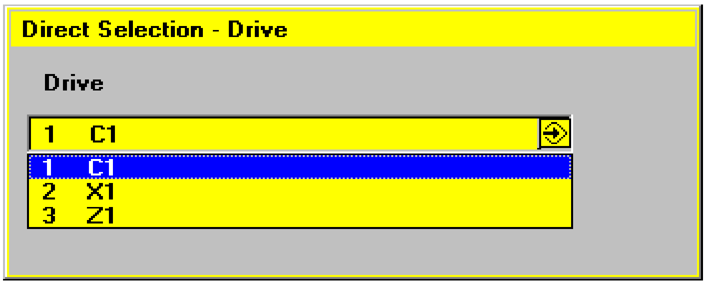
On the drive parameter screen, press the [INPUT] key after having input the data in order to write the data into the drive.
Take notice that the method of data input on the drive parameter screen is different from that on the other machine data setting screens.

■ Switching over the target axes

The axis-specific drive parameter can be displayed by switching over the target axes.

Use the following procedure;

- Press the [Drive + (F9)] key to display the drive parameter of the axis number that is the current axis number plus one. If you click the "final page", there displays the axis number on the top page.
- Press the [Drive － (F10)] key to display the drive parameter with the axis number that is the current axis number minus one. If you click the "top page", there displays the axis number on the final page.
- Press the [Direct selection (F11)] key to display the dialog box for direct switching (see the figure below). Press the [INSERT] key to display the list of drives you can switch over. When selecting one from the list, there displays the screen of the selected drive number.



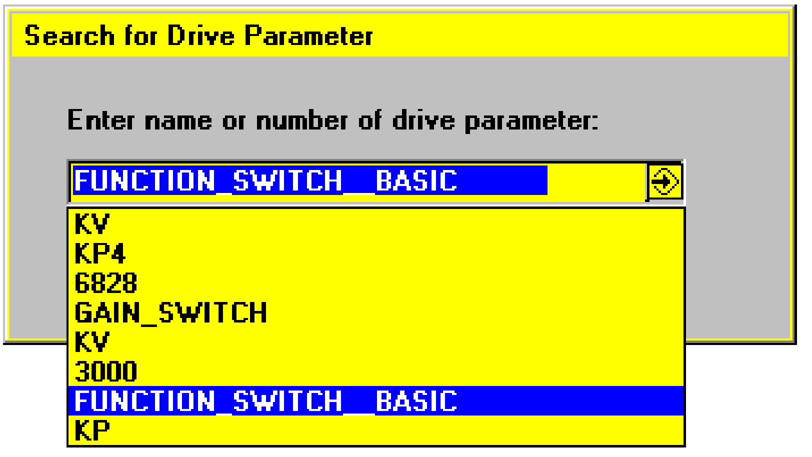
■ Searching

There are two types of searching methods; the parameter number method and the parameter name method.

The searching procedure is as followings.

1. Press [Search . . . (F14)] key.
2. There displays the search dialog box .(See the figure below)
3. Input the parameter number or the parameter name. Alternatively, by pressing the [INSERT] key a list of the latest key input history (up to eight) is displayed. You can select the search key from the list.
4. Press the [INPUT] key or [OK (F16)] key to execute the search. To cancel the search, press the [Abort (F15)] key.
5. When the search key is sought out, the screen jumps to display the result. When the search key is not found, the cursor remains standstill and the error message "7. Search term not found." is output.

6. In addition, if you want to continue searching with the same search key, you can use the [Continue search (F15)] key for the continuous searching. With every press on the [Continue search (F15)] key, searching is taken place from the current cursor position down to the bottom. When having reached the bottom line, searching is continued from the top line.



■ Updating the data display

The data display of drive parameter does not update automatically.

To update the data display into the up-to-the-date value, press the [Refresh (F16)] key.

11.1.4 Conditions for the modified parameters to be effective

For the details about the conditions on which the modified parameters are enabled, see the ⑦ Conditions to be Effective described on the section 11.1.2 Screen configuration. Below is shown the meanings of each symbol.

Symbol	Meanings
po	Modification can not make the parameter effective. To enable the modified parameter, you must execute the NCK-Reset. Alternatively, cut off and then turn on the drive power supply.
im	The modified parameter becomes effective just after modification. You need not cut off and then turn on the drive power supply.

11.1.5 Protection level

Operational protection level on drive parameter screen

Protection level is divided into the eight-layer hierarchy as shown below.

Only the user groups belonging to the protection levels between 0 to 4 can operate the drive parameter screen.

Drive parameter screen operation permitted/ unpermitted	Protection level	Requirements	User group
Operation permitted	0	System password	YSNC
	1	MTB password	Tool machine manufacturer
	2	Maintenance password	Setup/Service person
	3	User password	Privilege user
	4	Key switch position 3	Programmer
Operation unpermitted	5	Key switch position 2	Authorized operator
	6	Key switch position 1	Trained and experienced operator
	7	Key switch position 0	Operator with medium technique (NC Start/Stop, Panel operation)

Protection level and Parameter access level

The access level of drive parameter is divided into three levels; Read-Only, system parameter and user parameter. These levels are correspondent to the protection levels as shown below.

		Parameter indication		Parameter rewrite		
Parameter access level		System parameter	User parameter	Read-Only	System parameter	User parameter
Protection level	0	Indication	Indication	Unrewritable	Rewritable	Rewritable
	1 to 3	No indication	Indication	Unrewritable	Unrewritable	Rewritable
	4	No indication	Indication	Unrewritable	Unrewritable	Unrewritable

11.2 Drive Diagnosis Function

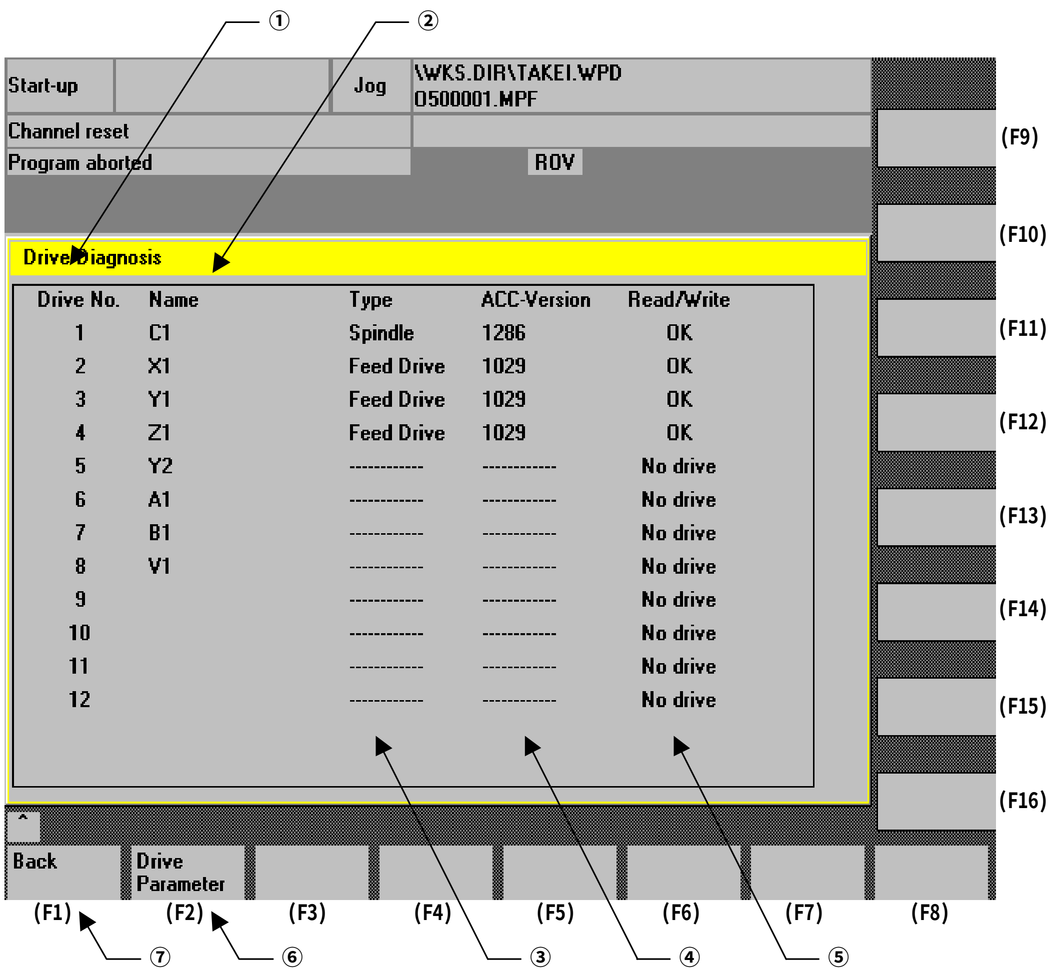
Drive diagnosis function takes part in diagnosing whether the parameter of the drive which is connected with YS 840DI is available for Read/Write.

11.2.1 Drive diagnosis screen initiation

To start up the drive diagnosis screen, activate the drive parameter screen and then press the [Drive Diagnosis (F2)] key (see the section 11.1.2 Screen configuration).

11.2.2 Drive diagnosis screen configuration

Here is the configuration of drive diagnosis screen.



① : Drive number
② : Name of axis
③ : Drive type (Spindle/Feed axis)
④ : ACC file version
⑤ : Drive state (Writable/Unwritable)
⑥ : Drive parameter screen switching key
⑦ : Screen switching key

■ Drive diagnosis

With the function ⑤ Read/Write, you can diagnose the state of drive.

The indication is shown "OK", "NG", or "No drive". Each sign is explained below.

Read/Write	Drive state
OK	The state of drive can Read/Write the parameter.
NG	The state of drive is not available to Read/Write.
No drive	No drive has the specified number.

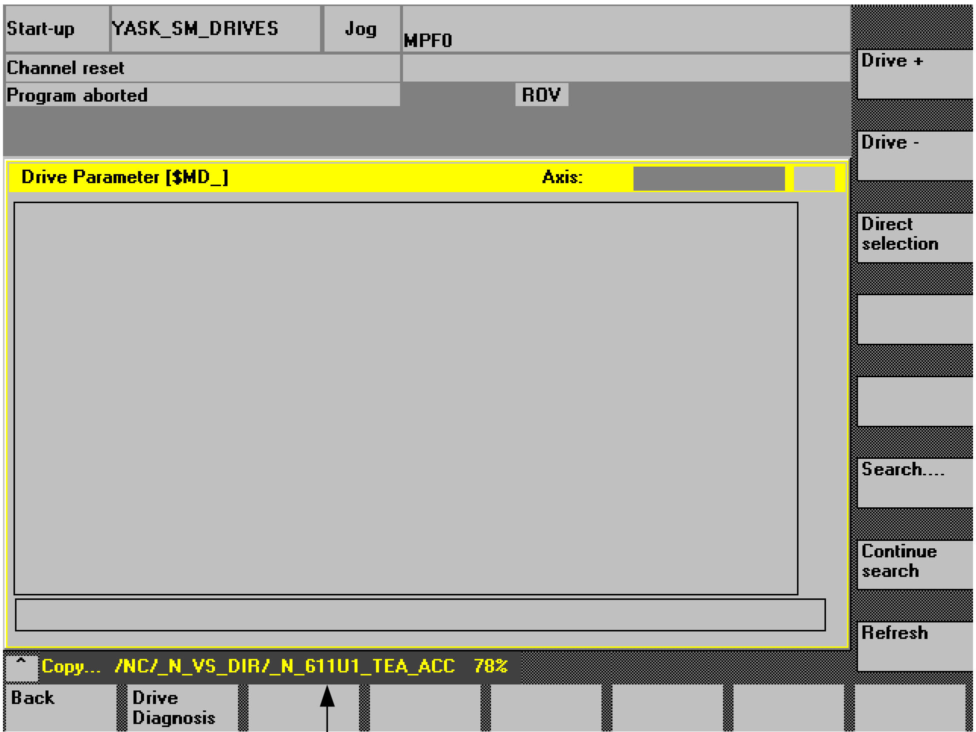
11.3 Mapping ACC file

11.3.1 ACC file

ACC file is a file which is composed of the information which is required for indication/ rewrite, such as attribute, unit, maximum/minimum value, name, etc. for each drive parameter. The data displayed on the drive parameter screen is created on the basis of the information of ACC file.

11.3.2 Mapping ACC file

To read/write the drive parameter, you must beforehand register the parameter by mapping. Just after initiating the drive parameter screen, mapping function is executed and the ongoing process is shown as followings.



Display of the on-going process of mapping

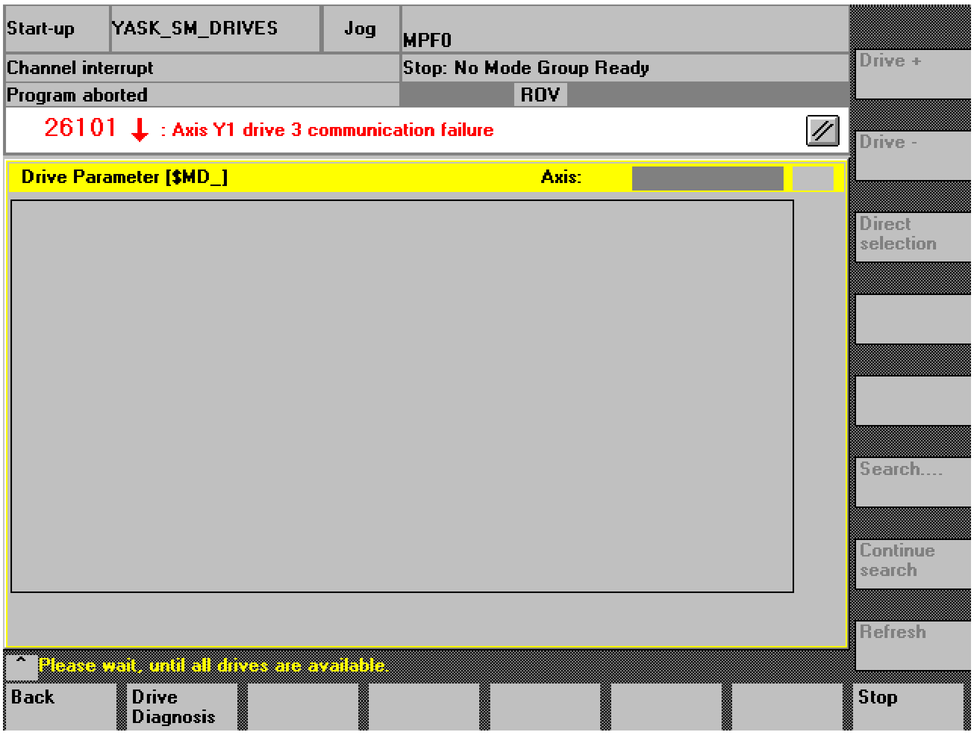
11.3.3 Timing of mapping processing

Mapping of ACC file can only take place just after the drive parameter screen is initiated for the first time.

11.4 Error screen display and troubleshooting

11.4.1 Error screen display

There occurs an error, for example the drive is not powered on, or the communication with the drive has failed, the screen will be shown as followings.
On this screen conditions, "Drive +", "Drive -", "Direct selection", "Search . . .", "Continue search", and "Refresh" can not be enabled.
When the normal communication with all the drives is recovered, the screen automatically comes back to the normal display.



IMPORTANT

The screen display remains unchanged until the communication with all the drives comes back to the normal state.
However, by pressing the [Stop (F8)] key, you can forcedly terminate the communication waiting state. Then you can Read/Write the parameter only for the drive(s) which has normal communication.

11.4.2 Troubleshooting

When the screen of abnormal state is displayed, use the following procedure.

1. Check if the drive power supply is powered on.
2. Press the [Back (F1)] key to go back to the last screen.
3. Activate NCK-Reset.
4. After NCK-Reset has completed, wait for the drive diagnosis screen to display OK showing the Read/Write function is available.
5. The drive parameter screen displays.

11.4.3 Indication of parameter whose value can not be read

The parameter whose value can not be read or which is failed to read is displayed with "#" for the parameter setting value (see ④ of the section 11.1.2 Screen configuration).

11.4.4 Error message display

This is a list of error messages in relation to this function.

Error message	Content
ACC-file Mapping failed !	Mapping of ACC file has failed.
No drive is available !	The drive is not connected. Or the drive is not powered on.
Please wait, until all drives are available.	This indication is displayed until all drives recover the normal communication. There exists one or more drives which is abnormal in communication. This message remains on the screen until all the drives recover the normal communication.
Write Error ! Read-only: Parameter No.	Rewrite operation is executed for an unrewitable parameter.
Write Error ! Can not be changed in current access level: Parameter No.	Rewrite operation is executed for a parameter which is unrewritable in the current protection level.
Write Error ! Range over Minimum =< value =< Maximum: Parameter No.	Setting value is below or above the range permitted for the parameter setting.
Write Error: Parameter No Parameter Name	There occurs a Write Error other than those above.
Search term not found.	The Search was executed but the target item has not been found.

Chapter 12

How to use Digital Operation

This chapter describes the basic and advanced operation of the digital operator. The digital operator allows you to set various constants and also to operate the motor in different ways. Control the digital operator according to the description of this chapter.

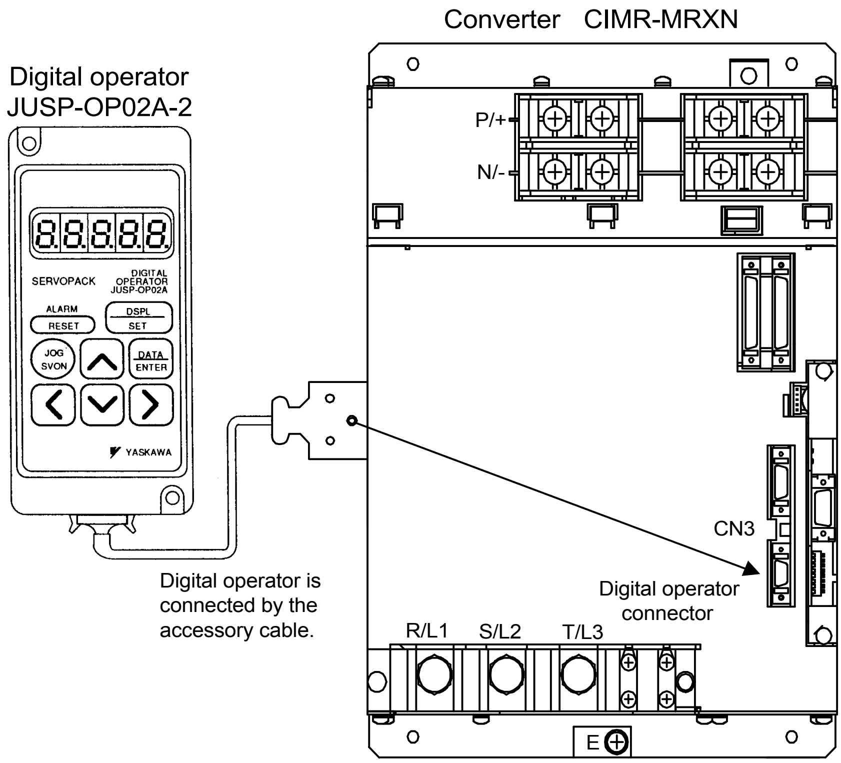
12.1 Basic operation

Here explains the basic operation of digital operator to set the operational conditions.

12.1.1 Connecting the digital operator

The Digital Operator is a hand-held operator (JUSP-OP02A-2) which can be attached to the connector CN3 of converter.

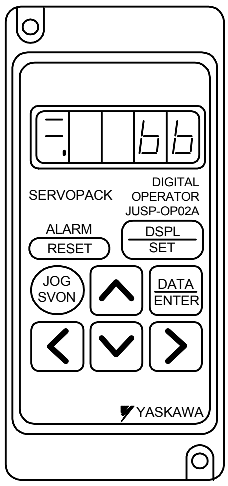
The following figure shows where to attach the digital operator to the converter. The digital operator connector can be attached/detached even if the converter is powered on.



12.1.2 Function of digital operator

The digital operator allows you to set each user constant, to execute the operational command, and to view the state indication.
The following table describes the names and functions of the keys of digital operator which displays the initial screen.

digital operator



Key	Name		Function
ALARM RESET	RESET key		To reset the servo drive alarm, press this key.
DSPL SET	DSPL/SET key		• To switch over the status display mode, the auxiliary function execute mode, the constant setting mode, and the monitor mode, press this key. • This key can function as the data selection key on the constant setting mode.
DATA ENTER	DATA/ENTER key		• To display the setting and setting value of each user constant, press this key. • To switch over the axis selection mode and the status display mode, press this key.
∧	Value modification/JOG key	UP key	• To increase the setting value, press this key. This key can be used as the reverse start key on the JOG operation. • On the axis selection mode, press this key in order to increase the axis number.
∨		DOWN key	• To decrease the setting value, press this key. This key can be used as the reverse start key on the JOG operation. • On the axis selection mode, press this key in order to decrease the axis number.
>	Digit selection key	RIGHT key	• To select the setting digit you want to modify, press this key. The flashing digit means to be available. • By pressing the RIGHT key, the digit decreases by one (shifts toward right). • By pressing the LEFT key, the digit increases by one (shifts toward left).
<		LEFT key	
JOG SVON	SVON key		To enable the JOG operation with digital operator, press this key.

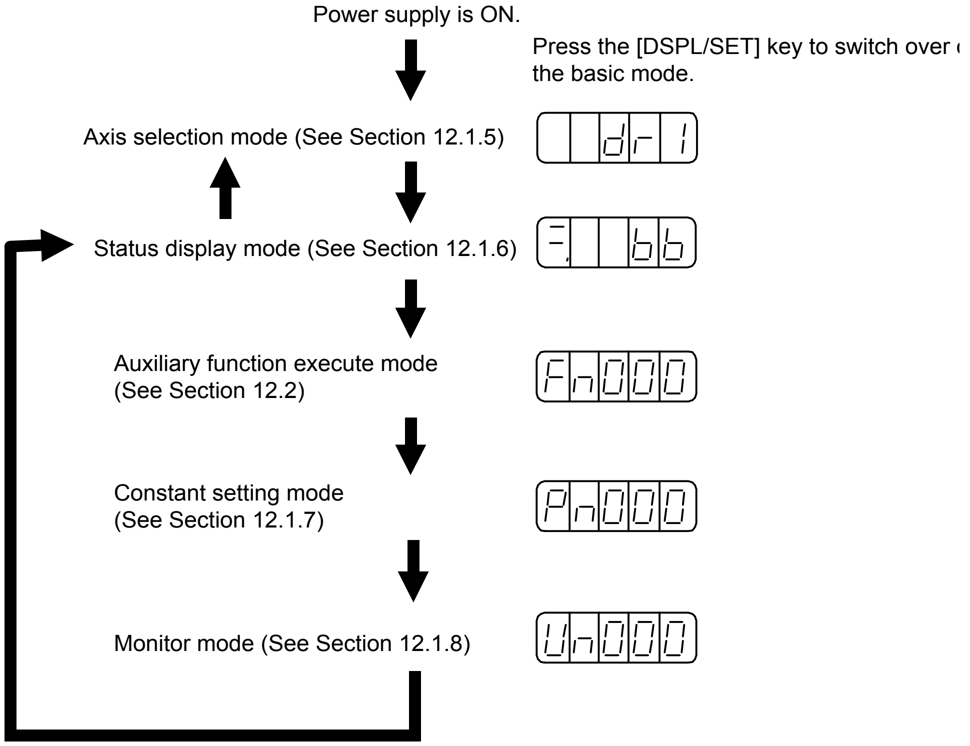
12.1.3 Reset of servo alarm

You can reset the servo drive alarm via the digital operator; press the [RESET] key on the status display mode.

IMPORTANT When there occurs an alarm, first eliminate the cause of alarm and then reset the alarm.

12.1.4 Switching the basic mode

The operation state display, user constant setting, operation instruction , and other operations can be available by switching over on the basic mode of digital operator.
This basic mode includes the status display mode, auxiliary function execute mode, constant setting mode, and monitor mode. These modes can be switched over in the following order by pressing the key.



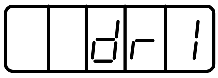
12.1.5 Axis selection mode

On the axis selection mode, select an axis you want to operate.

■ How to use the axis selection mode

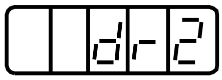
Here is the procedure to select the second axis.

1. Turn on the power supply, the axis selection mode displays.

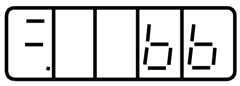


2. Select the axis number you want to operate.

   Press the [UP] or [DOWN] key, and the axis number is changed.
   (In this case you select "dr2".)



3. Press the [DATA/ENTER] key. The status display mode for the axis you selected on Step 2 is displayed.



   Now the second axis has selected.
   To return to the axis selection mode, press the [DATA/ENTER] key on the status display mode.

INFO

The first axis of the 1-axis drive and 2-axis drive is the rotary switch number of each drive plus one.
The second axis number of the 2-axis drive is the rotary switch number plus two.
On the mode other than the axis selection mode, the LED of the drive which is selected flashes.

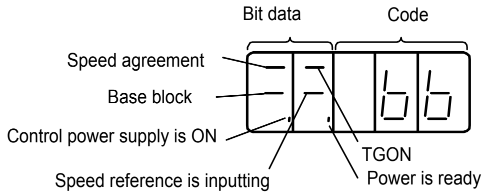
12.1.6 Status display mode

In the status display mode, bit data and codes are used to indicate the status of the SERVOPACK.

■ Indication on the status display mode

The indication of status display mode is different between the speed control mode and the position control mode.

Speed control mode

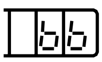
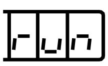


The indication of bit data and codes is shown in the following tables.

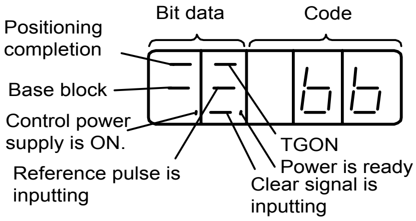
Table 12.1 The bit data indication on the speed control mode

Bit data	Indication
Control power supply ON	Lights when the SERVOPACK control power supply is turned on.
Base block	Lights when the base block is enabled. Goes out when the servo drive is turned on.
Speed Agreement	Lights when the deviation between the reference speed and the actual speed of motor is equal or below the specified value. Specified value: Set with Pn503 (Standard value is 10 min^{-1}.)
/TGON	Lights when the motor speed is higher than the specified value. Goes out when the speed is lower than the specified value. Specified value: Set with Pn502 (Standard value is 20 min^{-1}.)
Speed reference is inputting	Lights when the value which you are inputting is higher than the specified value. Goes out when the reference is lower than the specified value. Specified value: Set with Pn502 (Standard value is 20 min^{-1}.)
Power is ready	Lights when the main circuit power supply is normal. Goes out when the main circuit power supply is off.

Table 12.2 Indication of code on speed control mode

Code	Indication
	Base block is enabled. Servo drive is turned off. (Motor is not supplied with power.)
	In operation Servo drive is turned on. (Motor is supplied with power.)
  :	Alarm states Displays the alarm number. .

Position Control Mode

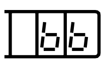
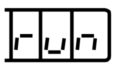
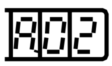


The indication of bit data and codes is shown in the following tables.

Table 12.3 The bit data indication on the position control mode

Bit data	Indication
Control power supply ON	Lights when the SERVOPACK control power supply is turned on.
Base block	Lights when the base block is enabled. Goes out when the servo drive is turned on.
Positioning completion	Lights when the deviation between the reference position and the actual motor position is equal or below the specified value. Goes out when the value is lower than the specified value. Specified value: Set with Pn500 (Standard value is 7 pulses.)
/TGON	Lights when the motor speed is higher than the specified value. Goes out when the speed is lower than the specified value. Specified value: Set with Pn502 (Standard value is 20 min^{-1}.)
Reference pulse is inputting	Lights when the reference pulse is being inputting. Goes out when the reference pulse is not being inputting.
Clear signal	Lights when the clear signal is being inputting. Goes out when the clear signal is not being inputting.
Power ready	Lights when the main circuit power supply is normal. Goes out when the main circuit power supply is off.

Table 12.4 Indication of code on position control mode

Code	Indication
	Base block is enabled. Servo drive is turned off. (Motor is not supplied with power.)
	In operation Servo drive is turned on. (Motor is supplied with power.)
  :	Alarm state Displays the alarm number.

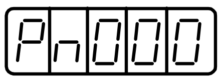
12.1.7 User Constant Setting Mode

Setting the user constants allows you to select and adjust the functions. For setting the user constant, you can select either from two types: constant setting and function selection. Each has different setting methods.
The constant setting function can shift the data of constant you want to change within a certain range. The function selection can select the function which is assigned to each digit of the panel indicator (5-digit 7-segment LED). The user constants are listed in Appendix A.

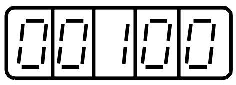
■ Procedure for modifying the data of constant setting

On the constant setting mode, you can set the constant data that you want to adjust. Check the available range in Appendix A.1 "Servo unit parameter list".
Here is the procedure for changing the content of the user constant Pn507 from 100 to 85.

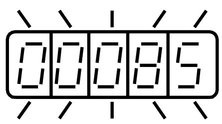
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the constant setting mode.



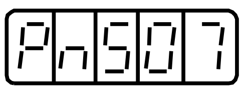
3. Select the user constant number you want to set. (In this example, Pn507 is selected.)
   By pressing the [LEFT] or [RIGHT] key, the setting digit will flash and be selected.
   Press the [UP] or [DOWN] key until the value you want to set is displayed.
4. Press [DATA/ENTER] key.
   There displays the current data of the user constant you have selected on the step 2.



5. Modify the data to what you want to set. (In this case, 85 is set.)
   By pressing the [LEFT] or [RIGHT] key, the setting digit will flash and be selected.
   By pressing the [UP] or [DOWN] key, the value is changed.
   Keep on pressing the key until there displays 00085.
6. Press the [DATA/ENTER] key. The data flashes and be stored.



7. Press again the [DATA/ENTER] key. The screen returns to the user constant number display.



This completes the change of the user constant Pn507 from 100 to 85.
To make another change, repeat Step 3 to Step 7.

INFO

The user constant numbers which is not defined will be skipped during the operation.

■ User constant for function selection

Type of function selection user constant

The following table lists the user constants used for selecting each function of SERVO-PACK.

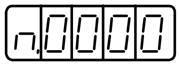
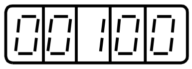
Type	User constant number	Name	Preset value	Remarks
Constant for function selection	Pn000	Function selection basic switch	0070	○
	Pn001	Function selection application switch 1	0000	○
	Pn002	Function selection application switch 2	0000	○
	Pn003	Function selection application switch 3	0002	
	Pn004	Function selection application switch 4	0000	○
	Pn005	Function selection application switch 5	0000	○
	Pn006	Function selection application switch 6	0000	○
Constant for servo gain	Pn10B	Gain application switch	0004	*
	Pn110	On-line automatic tuning switch	0012	*
	Pn126	Function switch 1	0000	○
	Pn127	Function switch 2	0000	*
	Pn128	Loop gain bank switch	0000	○
	Pn131	Predictive control parameter switch	0000	○
Constant for Position control	Pn200	Position control instruction type selection switch	0100	○
	Pn207	Position control function switch	0000	○
Constant for toque	Pn408	Torque function switch	0000	*
Communication	Pn800	Communication control	0000	
Constant for sequence	Pn801	Soft limit selection switch	0000	
	Pn802	Command mask	0000	○
Monitor	Pn813	Option monitor	0010	
Command supplement	Pn816	Return to reference point direction	0000	
Control function selection	Pn81B	Model following control mask	0000	

IMPORTANT

If you change the user constant that has a " ○ " in the remark column, you must cut off and then turn on (or reclose) the power supply of both the main circuit and the control source in order to enable the function of which setting you have just changed.

Also, some of the user constants that have an asterisk (*), such as Pn10B.1, Pn10B.3, Pn110.0, Pn110.3, Pn127.0, and Pn408.2 requires the "reclosing the power supply" as shown above. On the contrary, Pn127.1 (Speed FF smoothing selection), Pn408.0 (1st stage notch filter selection) and Pn408.1 (2nd notch filter selection) can function on-line. Therefore they do not require the "recloseing the power supply".

Here is the description about indication of setting value. There are two types of user constant display.

An example of the function selection user constant		· · · ·Displayed with hexadecimal number per digit.
An example of the constant setting user constant		· · · ·Displayed with 5-digit decimal number.

For the function selection user constant, since the value of each digit have individual meanings, you can only change the value on each digit respectively. In addition, each digit displays only the value available in the setting range.

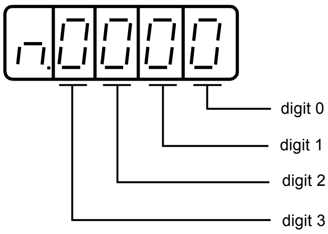
Definition of display of function selection user constant

The function selection user constant has individual meanings for each digit.
For example, the number on the right end of the user constant "Pn000" is indicated "Pn000.0".

IMPORTANT

The individual "digit" of function selection user constant setting value is defined as followings. The "example of display" shows the user constant display according to this "digit" definition of the setting value.

- Setting value



- Indication of user constant

Pn000.0 ••••• Shows the value which is indicated on the "0" digit of the setting value of the user constant "Pn000".

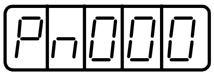
Pn000.1 ••••• Shows the value which is indicated on the "1" digit of the setting value of the user constant "Pn000".

Pn000.2 ••••• Shows the value which is indicated on the "2" digit of the setting value of the user constant "Pn000".

Pn000.3 ••••• Shows the value which is indicated on the "3" digit of the setting value of the user constant "Pn000".

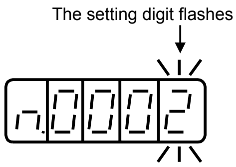
■ Procedure for changing the function selection user constant

1. Select the axis you want to change on the axis selection mode.
2. Press the [DSPL/SET] key and select the constant setting mode.

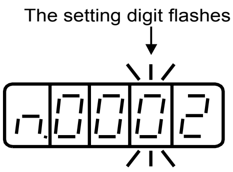


3. Select the user constant number you want to specify.

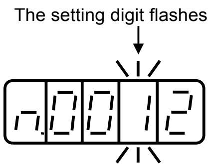
   Press the [LEFT] or [RIGHT] key until the setting digit flashes. Select the value using the [UP] or [DOWN] key. (In this case, Pn003 is selected.)
4. Press the [DATA/ENTER] key to display the current data of the user constant that you just selected Step 3.



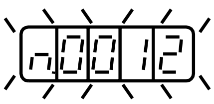
5. Press the [LEFT] or [RIGHT] key to select the digit number you want to set.



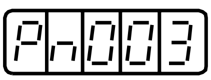
6. Press the [UP] or [DOWN] key to select the "value" of function setting which is defined by the setting digit number.



   To change the data, repeat the Step 5 and Step 6.
7. Press the [DATA/ENTER] key. The data is stored and flashes.



8. Press again the [DATA/ENTER] key to return to the user constant number display.



   The one-digit setting of user constant Pn003 is already changed into 1.

12.1.8 Operation on the monitor mode

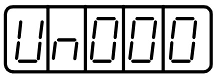
On the monitor mode, you can observe the reference value input into the SERVOPACK, the state of input/output signals, and the interior state of SERVOPACK.

The monitor mode can be changed even while the motor is running.

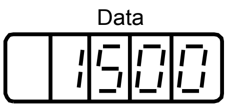
■ How to use the monitor mode

This is the procedure to view the monitor number Un000 data 1500 when the servo motor is running at the speed of 1500 min^{-1}.

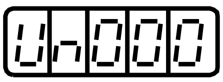
1. On the monitor mode, select the axis you want to operate.
2. Press the [DSPL/ENTER] key to select the monitor mode.



3. Press the [UP] or [DOWN] key to view the monitor number you want.
4. Press the [DATA/ENTER] key to display the data of the monitor number you just selected Step 3.



5. Press again the [DATA/ENTER] key to return to the monitor display.



This completes the view of the monitor number Un000 data 1500.

■ Indication of Monitor Mode

Indication of the monitor mode is listed below.

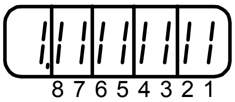
Monitor number	Indication	Unit	Remarks
Un000	Actual motor speed	min^{-1}	
Un001	Speed reference input	min^{-1}	
Un002	Interior torque reference	%	Value for the rated torque
Un003	Rotation angle 1	Pulse	Number of pulses from the origin
Un004	Rotation angle 2	deg	Angle from the origin (Electrical degree)
Un005	Input signal monitor	-	*1
Un006	Output signal monitor	-	*1
Un007	Position command speed	min^{-1}	*3
Un008	Value of deviation counter	Command unit	Position deviation*3
Un009	Percentage of cumulative load	%	Value taking the rated torque as 100 %. Indication of 10-sec. cycle actual torque
Un00A	Preserved constant (No accessing)	-	
Un00B	DB resistance power consumption	%	Value taking the controllable electric power as 100 %. Indication of 10-sec. cycle DB power consumption.
Un00C	Position command counter	Command unit	Indication with hexadecimal number*2, *3
Un00D	Feedback pulse counter	Pulse	Indication with hexadecimal number*2
Un00E	Full-closed pulse counter	Pulse	Indication with hexadecimal number*2

* 1. See "Monitoring the input/output signal for sequence" on the next page.
* 2. See "Monitor display of the command pulse and feedback pulse counter"
* 3. Available only on the position control mode.

■ Monitor display of input and output signal for sequence

The monitor display of the input/output signal for sequence is shown as following.

Input signal monitor display

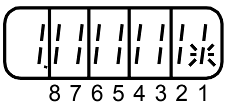


Display LED number	Name of terminal	Presetting
1	CN1-4	/EXT1
2	CN1-5	/EXT2
3	CN1-6	/EXT3
4	CN1-7	DEC
5	CN1-8	N-OT1
6	CN1-9	P-OT1
7	CN5-71	ESP0
8	CN5-73	SEQ0

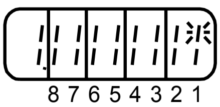
The indication of input signal is arranged like above on the indicator of the SERVOPACK or digital operator. The upper or lower side of the corresponding segment LED of the seven segments flashes. When the input signal is ON ("L" level) the lower half of the segment flashes and when the input signal is OFF ("H" level) the upper half of the segment flashes.

◀ EXAMPLE ▶

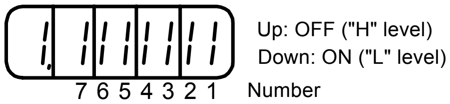
- When /EXIT1 signal is ON,



- When /EXT1 signal is OFF,



Output signal monitor display

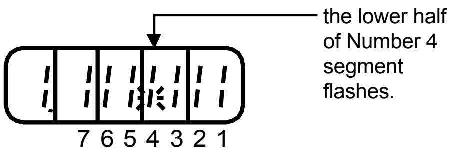


Display LED number	Name of output terminal	Presetting
1	CN153-38	/SKPOP1
2	CN5-17	/SKIP1
3	CN5-19	/SKIP2
4	CN5-97	ALM1
5	CN2-1	PGON
6	CN1-14,15	BK
7	CN1-17	RDY

The indication of output signal is, like the monitor display of input signal, arranged like above on the indicator of the panel or digital operator. When the output signal is ON ("L" level) the lower half of the segment flashes and when the output signal is OFF ("H" level) the upper half of the segment flashes.

◀ EXAMPLE ▶

- When the ALM1 signal is enabled (in case of "L", an alarm is output);

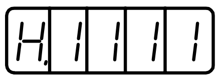


■ Monitor display of reference pulse, feedback pulse counter, full-closed pulse counter

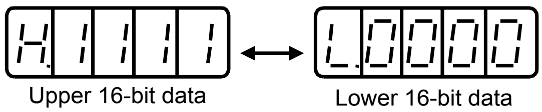
For the monitor display of the reference pulse, feedback pulse, and full-closed pulse counters, the 32-bit data is displayed with hexadecimal numbers.

Here is the procedure to view.

1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key to select the monitor mode.
3. Press the [UP] or [DOWN] key to select one from "Un00C", "Un00D", and "Un00E".
4. Press the [DATA/ENTER] key to display the data of the monitor number you just selected Step 3.



5. Press the [UP] or [DOWN] key to view the upper and lower 16-bit data alternately.



6. By pressing the [UP] and [DOWN] keys all together, you can clear the data on the 32-bit counter.
7. Press again the [DATA/ENTER] key to return to the monitor number display.

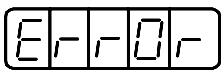
12.2 Application

This section describes the application operation of digital operator in order to operate and adjust the motor.
Read the section 12.1 "Basic operation" first.

You can set the user constant for application operation on the "Auxiliary function execution mode". The following table lists the user constants for auxiliary function execution mode.

User constant number	Function	Remarks
Fn000	Display of alarm trace back data	
Fn001	Rigid setting at the time of on-line auto-tuning	○
Fn002	Reserved constant (no accessing)	
Fn003	Origin searching mode	
Fn004	(reserved constant)	
Fn005	Initiation of user constant setting value	○
Fn006	Clear of alarm trace back data	○
Fn007	Inertia ratio from the result of on-line auto-tuning action Write into EEPROM	○
Fn008	Multi return reset of absolute value encoder (setup operation) and Alarm reset of encoder	○
Fn009	Reserved constant (no accessing)	○
Fn00A	Reserved constant (no accessing)	○
Fn00B	Reserved constant (no accessing)	○
Fn00C	Adjustment of analogue monitor output manual zero	○
Fn00D	Adjustment of analogue monitor output manual gain	○
Fn00E	Automatic adjustment of motor current detection signal offset	○
Fn00F	Manual adjustment of motor current detection signal offset	○
Fn010	Password setting (User constant rewrite prohibit)	
Fn011	Check of motor type	
Fn012	Indication of SERVOPACK soft ware version	
Fn013	Setting changing of multi-return limit value at the time of the alarm "Multi-return limit value mismatch (A.CC)" output	○

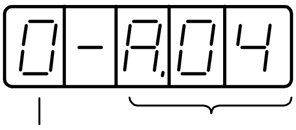
Note: The user constants with a " ○" mark and the user constants beginning with "Pn" which have been set a password by Fn 010 are displayed as followings. These user constants can not be changed.



Flashes a second.

12.2.1 Alarm Trace Back Mode

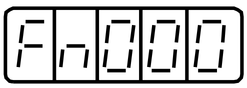
On the alarm trace back mode, you can view the latest alarms up to ten so that you may check what kind of alarms have occurred.
The alarm trace back data can not be cleared when the alarm reset is initiated or even when the SERVOPACK power supply is cut off. This has no effect on the operation.
You can delete these data using the clear on the alarm trace back mode of the special mode. See the section 12.2.2.



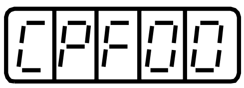
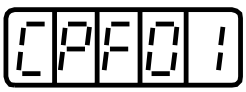
■ Check of alarm

To check the previous alarm, use the following procedure.

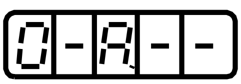
1. Select the axis you want to operate on the axis selection mode.
2. Press the [DSPL/SET] key and select "Indication of alarm trace back data (Fn000)" of the auxiliary mode.



3. Press the [DATA/ENTER] key to view the alarm trace back data.
4. Press the [UP] or [DOWN] key to scroll the alarm occurence number. The alarm history information is displayed.
   The larger the number on the left-side digit is, the older the alarm is.
   For the details about the alarm number, see 15 "Error diagnosis and Troubleshooting".
   These are the digital operator relevant alarms. They are not stored in the trace back data.

	Digital operator communication error 1
	Digital operator communication error 2

If there occurs no alarm, the indication is displayed like following.



INFO

If there successively occurs the same alarm, that alarm trace back data is not updated. However, when a single alarm code has two or more causes, that alarm code may be written in the alarm trace back data in succession when the power supply is turned on or when an alarm is reset.

12.2.2 Clearing the alarm trace back data

This function allows to clear the alarm history stored in the SERVOPACK. When the function is enabled, all the alarm generation history is set "A. - -" which does not mean an alarm. For the details, see the section 12.2.1 "Operation on the alarm trace back mode".

To clear the alarm trace back data, use the following procedure.

1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the auxiliary function execution mode.

   Fn000

3. Select the user constant Fn006.

   Press the [LEFT] or [RIGHT] key to select the setting digit.
   Press the [UP] or [DOWN] key until the value you want to set is displayed.

   Fn006

4. Press the [DATA/ENTER] key. The screen is displayed as below.

   trCLr

5. Press the [DSPL/SET] key. The following display flashes a second, the alarm trace back data is cleared and then the screen displays the indication as Step 4.

   donE flashes a seconds → crCLr

6. Press the [DATA/ENTER] key to return to the user constant number display.

   Fn006

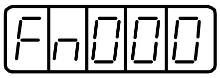
   This completes clearing the alarm trace back data.

12.2.3 Checking the motor type

This display mode is used for maintenance of the motor. When the user constant Fn011 is set, this mode becomes the motor type checking mode. In addition, when the SERVOPACK is a special specification item, you can check its specification number.

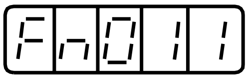
To check the motor type, use the following procedure.

1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the auxiliary function execution mode.

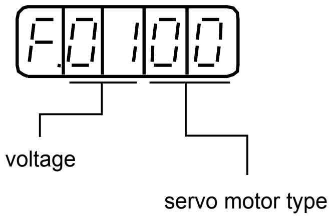


3. Select the user constant Fn011. Press the [LEFT] or [RIGHT] key to select the setting digit.

   Press the [UP] or [DOWN] key until the value you want to set is displayed.



4. Press the [DATA/ENTER] key to view the servo motor type and voltage identification data.



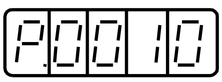
Voltage

Data	Voltage
00	100 VAC or 140 VDC
01	200 VAC or 280 VDC
02	Reserved

Servo motor type

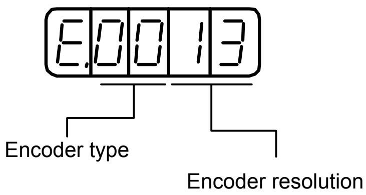
Data	Servo motor type
00	SGMAH
01	SGMPH
02	SGMSH
03	SGMGH- □ A (1500 min^{-1})
04	SGMGH- □ B (1000 min^{-1})
05	SGMDH
06	SGMUH
07	SGMKS

5. Press the [DSPL/SET] key to view the capacity of servo motor.



The capacity is the indication multiplied by 10 [W].
The example on the left shows 100 W.

6. Press the [DSPL/SET] key to view the encoder type and resolution identification data.



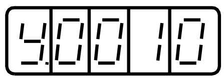
Encoder type

Data	Type
00	Incremental encoder
01	Absolute value encoder

Encoder resolution

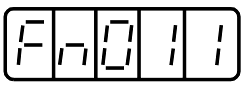
Data	Resolution
13	13 bits
16	16 bits
17	17 bits
20	20 bits

7. DSPL/SET key to view the special specification number of SERVOPACK (Y specification number).



The example on the left shows the special specification "Y10".
(Displayed with decimal number)

8. Press the [DATA/ENTER] key to return to the auxiliary function mode. You can also return to the auxiliary function mode by pressing the [DATA/ENTER] key after viewing the indication of Step 4 to Step 6.



This completes checking the motor type.

12.2.4 Checking the software version

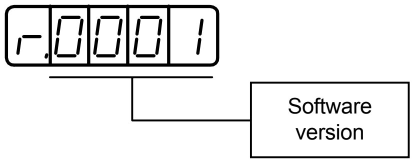
This mode is used for maintenance of the motor.

When Fn012 is set, this mode becomes the software version checking mode.

To check the software version, use the following procedure.

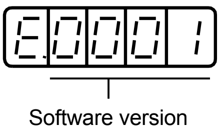
1. On the axis selection mode, select the axis you want to operate.
2. Set Fn012.
3. Press the [DATA/ENTER] key to view the SERVOPACK software version.

Display of software version

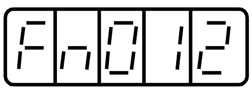


4. Press the [DSPL/SET] key to view the software version of encoder which is mounted on the motor.

Display of software version



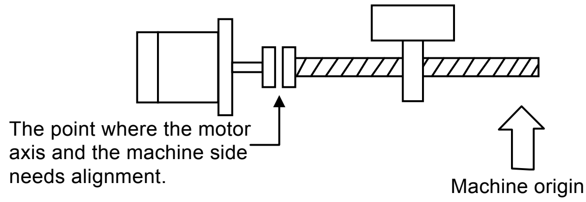
5. Press the [DATA/ENTER] key to return to the user constant number display.



This completes checking the software version.

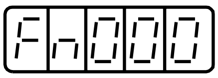
12.2.5 Origin searching mode

The origin searching mode function enables to position and stop (cramp) at the origin pulse position of encoder. This function can be used when the alignment of motor axis and machine is required. Initiate the origin search without coupling.
The motor speed for the origin search is 60 min^{-1}.

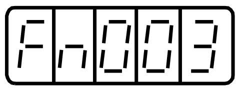


To search the origin, use the following procedure.

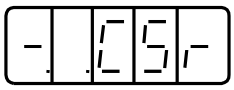
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key to select the auxiliary mode.



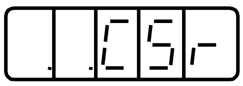
3. Select the user constant Fn003. Press the [LEFT] or [RIGHT] key to select the setting digit. Press [UP] or [DOWN] key until the value you want is displayed.



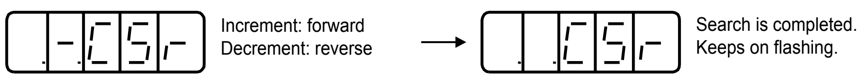
4. Press the [DATA/ENTER] key and the screen displays as below.



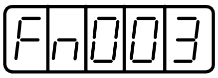
5. Press the [SVON] key. The indication will display as below to show that the origin search mode is ready.



6. Keep on pressing the [UP] or [DOWN] key to execute the origin search.
   If the user constant is Pn000.0 = 0 (standard setting), pressing the [UP] key enables the motor to rotate forward, while pressing the [DOWN] key to rotate reverse. If the user constant is Pn000.0 = 1, press the [DOWN] key to enable the motor to rotate forward and press the [UP] key to rotate reverse.



7. Press the [DATA/ENTER] key to return to the auxiliary function execution mode display.



This completes the origin searching.

12.2.6 Initializing the user constant setting value

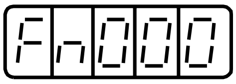
This function allows you to recover the standard setting (initial setting) even after changing the user constants many times.

IMPORTANT

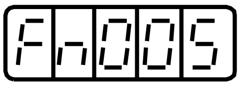
You must turn off the servo drive when activating this user constant initialization function .

To initialize the user constant, use the following procedure.

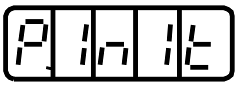
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the auxiliary function execution mode.



3. Select the user constant Fn005. Press the [LEFT] or [RIGHT] key to select the setting digit. Press the [UP] or [DOWN] key until the value you want to set is displayed.

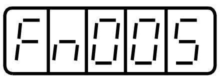


4. Press the [DATA/ENTER] key and the indication will display as below.



5. Press the [DSPL/SET] key. The new display like following initiates the user constant.

6. Press the [DATA/ENTER] key to return to the auxiliary function execution mode display.



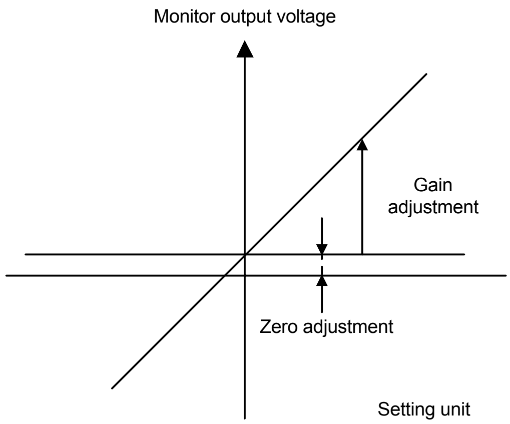
This completes the initialization of user constant.

INFO

When the servo drive is powered on, pressing the [DSPL/SET] or [MODE/SET] key can not initialize the user constant.
After initializing the user constant, you must turn off and then turn on the power supply.

12.2.7 Manual zero adjustment and gain adjustment for analogue monitor output

This analog monitor output can allows you to observe the motor speed, torque reference or position deviation. For the detailed information, see the section 16.4 "Analog Monitor".
The analog monitor output manual zero adjustment function is used for compensating the output voltage deviation which is caused by drift, or the zero point deviation which is caused by noise interference with observation system. Also, the gain adjustment function can be modified to meet the sensitivity of observation system.



Zero adjustment range : ±2V → 24mV/LSB
Gain adjustment range : 50 to 150% → 0.4%/LSB

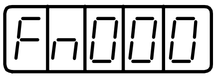
INFO

The output voltage range of analog monitor is ± 8V (MAX). Even if the voltage exceeds this range, the indication shows only ± 8V.

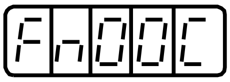
■ Analog monitor output manual zero adjustment

Use the following procedure for the manual zero adjustment of analog monitor output.

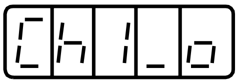
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the auxiliary function execution mode.



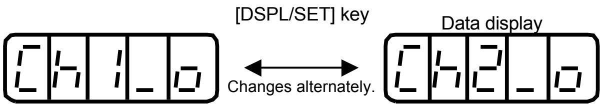
3. Select the user constant Fn00C. Press the [LEFT] or [RIGHT] key to select the setting digit. Press the [UP] or [DOWN] key until the value you want to set is displayed.



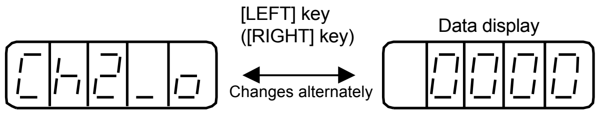
4. Press the [DATA/ENTER] key. The indication will display like below.



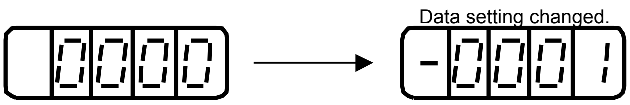
5. Press the [DSPL/SET] key to switch over the 2-channel monitor output.



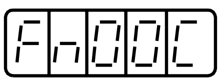
6. Press the [LEFT] or [RIGHT] key to view the analog monitor output data. Press the [LEFT] or [RIGHT] key again to return to the display of Step 4 or Step 5.



7. Press the [UP] or [DOWN] key to enable the analog monitor output zero adjustment.



8. After the zero adjustment for the two output channels, press the [DATA/ENTER] key. The indication will return to the auxiliary function execution mode display.

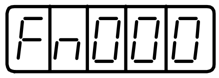


This completes the analog monitor output manual zero adjustment.

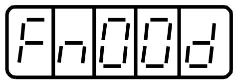
■ Analog monitor output manual gain adjustment

Use the following procedure for manual gain adjustment for analog monitor output.

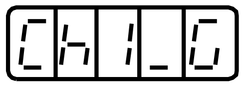
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the auxiliary function execution mode.



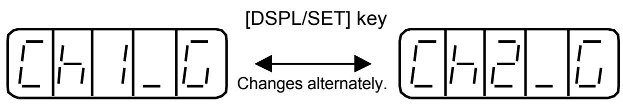
3. Select the user constant Fn00D. Press the [LEFT] or [RIGHT] key to select the setting digit. Press the [UP] or [DOWN] key until the value you want to set is displayed.



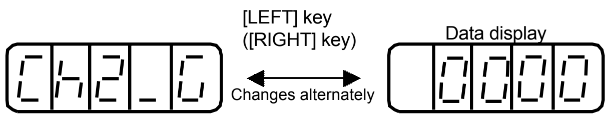
4. Press the [DATA/ENTER] key. The indication will display like below.



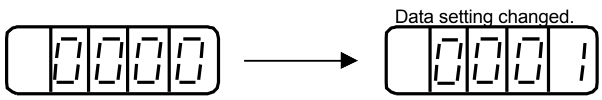
5. Press the [DSPL/SET] key to switch over the 2-channel monitor output.



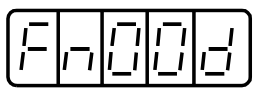
6. Press the [LEFT] or [RIGHT] key to view the analog monitor gain factor. Press the [LEFT] or [RIGHT] key again to return to the display of Step 4 or Step 5.



7. Press the [UP] or [DOWN] key to enable the analog monitor output gain adjustment.



8. After the gain adjustment for the two output channels, press the [DATA/ENTER] key. The indication will return to the auxiliary function execution mode display.



This completes the analog monitor output manual gain adjustment.

12.2.8 Motor current detection signal offset adjustment

The offset adjustment for motor current detection signal does generally require no customer adjustment because the YSNC completed the adjustment before shipping. However, if you need more precise accuracy, for example, in case that you recognize the torque ripple based on the current offset is excessively large, or in case that you want to reduce the torque ripple furthermore, this function is available.
This is the procedure for the automatic and manual adjustment for offset.

IMPORTANT

If you carelessly initiate this function, especially manual adjustment, that may deteriorate the feature. When you determine the torque ripple is obviously large in comparison to other SERVOPACK, you may execute the automatic adjustment for offset.

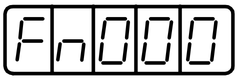
■ Motor current detection signal offset automatic adjustment

Use the following steps for the motor current detection signal offset automatic adjustment.

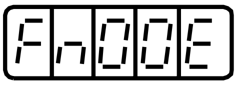
The automatic adjustment is available only when the main circuit power supply is turned on and simultaneously the servo drive is cut off.

---

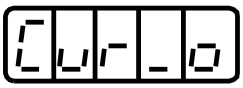
1. On the axis selection mode, select the axis you want to operate.
2. Press the DSPL/SET key to select the auxiliary function execution mode.



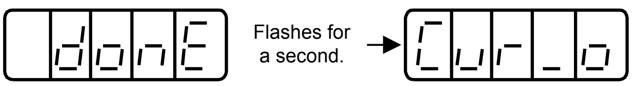
3. Select the user constant Fn00E. Press the [LEFT] or [RIGHT] key to select the setting digit. Press the [UP] or [DOWN] key until the value you want to set is displayed.



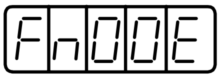
4. Press the [DATA/ENTER] key. The indication displays as below.



5. Press the [DSPL/SET] key. The following indication displays and the offset automatic adjustment is executed.



6. Press the [DATA/ENTER] key to return to the auxiliary function execution mode display.



This completes the motor current detection signal offset automatic adjustment.

■ Motor current detection signal offset manual adjustment

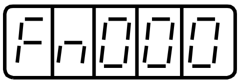
Use the following procedure for the offset manual adjustment of motor current detection signal.

IMPORTANT

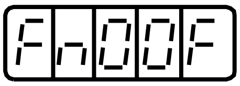
Before initiating the manual adjustment, run the motor at about 100 min^{-1} and adjust the ripple for the torque reference monitor (See the Section 16.4 "Analog monitor") becomes minimum. You must balance the U-phase and V-phase current offset when adjusting. For this purpose, you have to adjust alternately these phase current offsets several times.

---

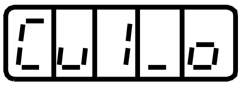
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key to select the auxiliary function execution mode.



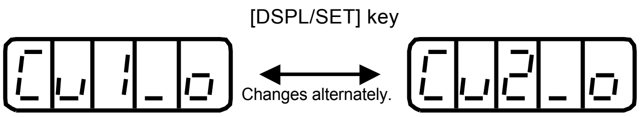
3. Select the user constant Fn00F. Press the [LEFT] or [RIGHT] key to select the setting digit. Press the [UP] or [DOWN] key until the value you want to set is displayed.



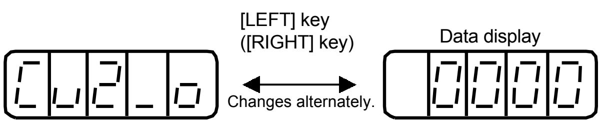
4. Press the [DATA/ENTER] key. The indication will be displayed as below.



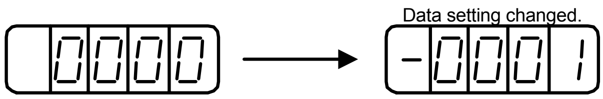
5. Press the [DSPL/SET] key to switch over the U-phase (Cu1_0) to and from V-phase (Cu2_0) current detection signal offset adjustment mode.



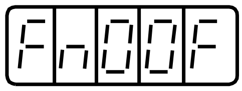
6. Press the [LEFT] or [RIGHT] key to view the current detection data. Press the [LEFT] or [RIGHT] key again to return to the display of Step 4 or Step 5.



7. Press the [UP] or [DOWN] key to adjust the offset. You must observe the torque reference monitor signal carefully during the adjustment.



8. After completing the adjustment of U-phase (Cu1_0) and V-phase (Cu1_0) current offset, press the [DATA/ENTER] key to return to the auxiliary function execution mode display.



This completes the motor current detection signal offset manual adjustment.

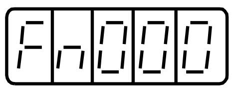
12.2.9 Setting the password (setting for write prohibit)

This password setting is the function to prevent the user constant form being rewritten carelessly.
When setting the password, the user constant which is prohibited to write is a part of the constants beginning with Pn □□□ or Fn □□□ .
The setting value for passwords are followings.

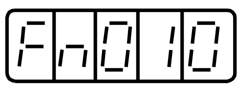
- "0000" ••••• Writable (cancel of write prohibit)
- "0001" ••••• Write prohibit
  (The user constant can not be written when and after the power source is turned on next time.)

To set the password, use the following procedure.

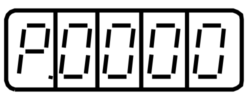
1. On the axis selection mode, select the axis you want to operate.
2. Press the [DSPL/SET] key and select the auxiliary function execution mode.



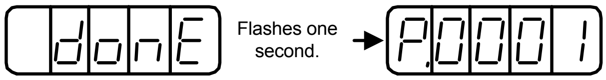
3. Select the user constant Fn010. Press the [LEFT] or [RIGHT] key to select the setting digit. Press the [UP] or [DOWN] key until the value you want to set is displayed.



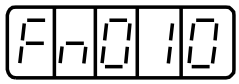
4. Press the [DATA/SET] key and the indication will display as below.



5. Write the password value "0001" and then press the [DSPL/SET] key. The display like following appears and the password is written.



6. Press the [DATA/ENTER] key to return to the auxiliary function execution mode display.



This completes the password setting. This password setting will be enabled when the power supply is turned on the next time.

Chapter 13

Drive system overview 1

This chapter and next chapter deal with procedures to set up axis control-related functions, which are necessary to use the functions and capabilities of CNC and each drive in order to control feed axes and spindle of YS 840DI system. Since most of the axis-related functions consist of both CNC and drive functions, this document explains how to set up machine data and parameters for both CNC and drives for your smooth set-up operation. If you want to know how to use CNC, refer to manuals for the YS 840DI system (see Related manual in the preface). If you want to know how to use each drive, refer to the other chapters in this manual for each drive.

---

[1]Feed axis and Spindle

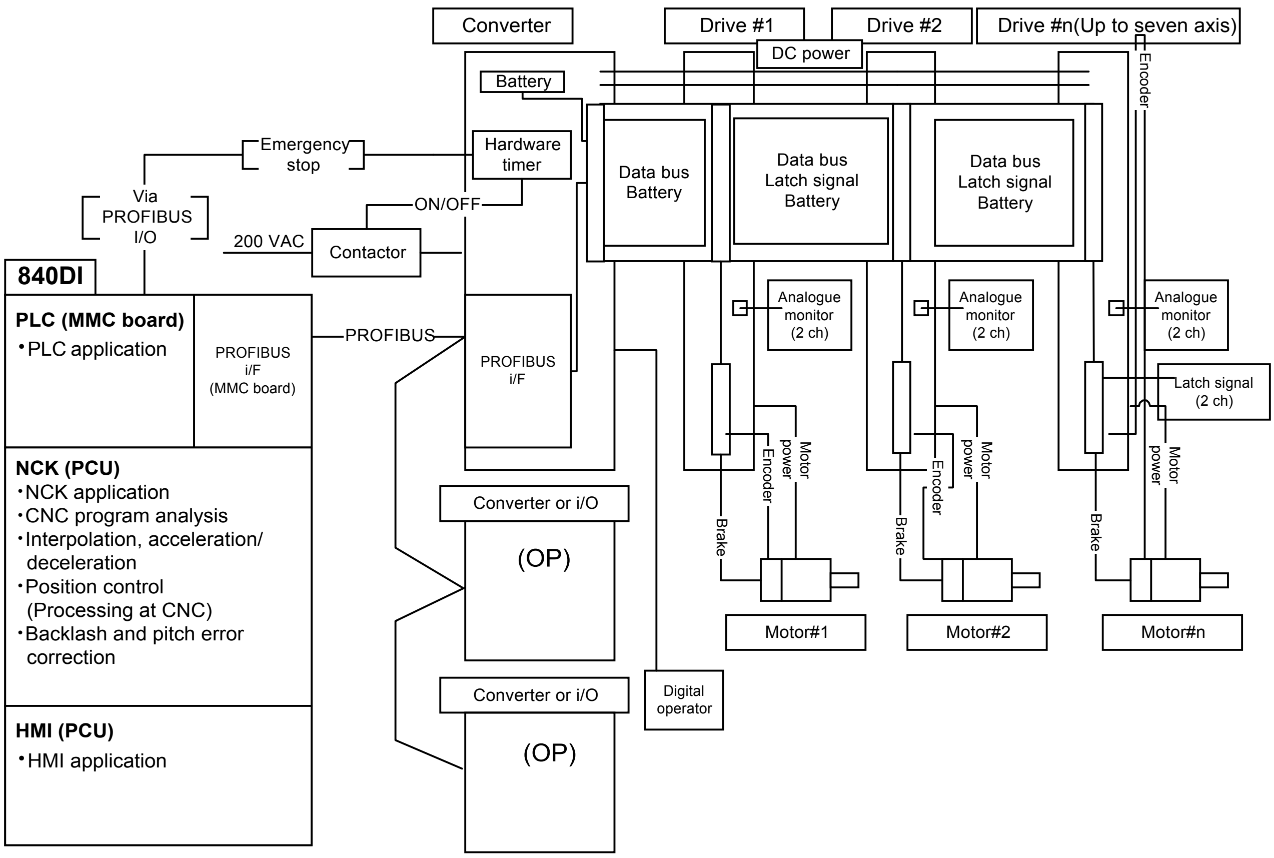
Regardless of applications, feed axis or Spindle refers to a control axis driven by a drive directly connected to PROFIBUS, excluding those auxiliary machine axes connected to I/O units and driven by contact signals.

This document deals with the following systems:

- CNC system: 00.02.02 or later versions
- Converter system: 0002 or later versions
- Servo drive system: 0003 or later versions
- Spindle drive system: 018 or later versions

13.1 System configuration

The following figure shows 840DI drive system configuration overview.



Main features of the system are:

- Multi-axis drive system consisting of MRX-type converter unit (Converter), SGDK-type drive unit (Servo drive), and MX-type spindle drive unit (Spindle drive).
- Each Converter can accommodate up to 7 units of Servo drives and Spindle drives. For multi-axis configuration, more than 1 Converter can be connected.
- "PROFIBUS" network (PROFIBUS) is used as an interface with CNC. The Converter performs network processing for all axes.
- In order to reduce wiring to CNC, absolute encoder battery is embedded; and emergency stop signal input/output, brake signal output, and latch signal input are input/output to Drive system.
- Digital operator, connected to a Converter, can be used for both a Servo drive and a Spindle drive in common.

13.2 Specification of machine data and parameters

13.2.1 Structures of machine data and parameters

In 840DI system, machine data (CNC data) and parameters (Drive data) have the following structures:

MD numbers	Display screen	Application	Remark
MD0 - 2999	Drive parameters	Parameters common to Servo drives and spindle drives. (Data, such as Load and Alarm, are included.)	Read-only (No data can be set.)CNC reads as necessary.
MD3000 - 5999		Parameters to control Servo drives	Correspond to Pn numbers.To be set for each axis.
MD6000 - 8999		Parameters to control spindle drives	Correspond to Cn numbers.To be set for each axis.
MD9000 - 9999	MD display	HMI-related machine data	
MD10000 - 19 □□□	General MD	General machine data for CNC	
MD20000 - 28 □□□	Channel MD	Channel specific machine data	
MD30000 - 38 □□□	Axis MD	Axis-related machine data for CNC	To be set for each axis and spindle.
MD40000 - 4 □□□□	Setting data	Setting data for CNC	
MD60000 - 65536	To be added to each MD screen	OEM data for CNC	

INFO

- Parameters MD3000-MD8999 for Servo drives and spindle drives can also be set from the Operator panels for drives.
- For correspondence between Pn and Cn, refer to Appendix A "Parameters".
- For how to use Operator for drive and precautions in setting data from the Operator for drive, refer to Chapter 12. "How to use Digital Operation".

13.2.2 How to control machine data and parameters

In YS840DI system, each drive controls parameters that the drive uses. Since the parameters are stored in the nonvolatile memory in the drive, the drive parameters MD3000-MD8999 in previous table can be set either from the CNC screen or from the Digital operator for the drive. However, the values are stored inside the drive and CNC only displays the values. Parameters MD0-MD2999 can be displayed on the drive parameter screen, but can't be set from the screen. CNC machine data are controlled in the memory inside CNC.

13.2.3 Activation condition of machine data and parameters

For each machine data or parameter to be changed from the CNC display, some of the following conditions are also displayed to indicate how to activate the parameter.

- po: Parameter becomes active either when CNC power is turned on/off or [NCK Reset] is entered.
- cf: Parameter becomes active when [Set MD Active] is entered.
- re: Parameter becomes active when CNC panel reset key is pressed.
- im: Parameter becomes active imidiately when a value is entered.

Especially for drive-control parameters MD3000-MD8999, "po" or "im" is indicated.

13.2.4 How to set machine data and parameters

Previously, a number is assigned to each parameter; however, in this YS 840DI system, each of the numbers to be assigned is constructed differently according to applications. Especially, machine data and parameters for each axis are constructed as following ■ :

■ Drive parameters (MD0-MD8999) and axis MD (MD30000-MD38 □□□□)

Each axis has its own parameter screen. With the same number, the same parameters are assigned. You can change over parameter screens by using function keys.

◀ EXAMPLE ▶

- MD918 PROFIBUS_NODE_ADDRESS (for each axis)

■ Other machine data section

As to machine data associated with each axis, one number represents an array for 1st axis to n-th axis ([n] is displayed). The order of axis number (n-th axis) corresponding to [0] and [1] are defined in MD10000 and MD10002.

◀ EXAMPLE ▶

MD10000 AXCONF_MACHAX_NAME_TAB [0] (1st axis)
MD10000 AXCONF_MACHAX_NAME_TAB [1] (2nd axis)

INFO

The array structure is used not only for the axis setting but also for differentiating items that are of the same type but are used for different applications--for example, differentiating between motor encoder and external encoder, and representing gear numbers and parameter set numbers.

■ About “digit” setting

Especially, some Servo drive parameters (MD3000 or greater) are set in hexadecimal digits. As shown in the following example, a digit is either of the 4 hexadecimal digits of a parameter. Each parameter digit is to be set to a value from 0 to 15 (0-FH in hexadecimal notation). The digits are numbered from 0 to 3.

MD3000= 0 F 1 0 (Hex)

Digit0 (0-F)
Digit1 (0-F)
Digit2 (0-F)
Digit3 (0-F)

If it is specified to set parameters in digits, set the digit one by one as shown in the example, paying attention not to confuse the digits.

■ About unit data

If different machine data units are used for linear axis and rotary axis in 840DI, take care that setting values may be displayed in different units.
In 840DI system, generally, machine data having fractional portion can be displayed or entered without the frictional portion removed off.

INFO

MD10230 [9] SCALING_FACTOR_USER_DEF [9] (Common to all axes)
Meaning: Setting unit of position loop gain
Setting value: 1.0 [1/S]

For drive parameters MD3000-MD8999, data are to be displayed or entered with fractional portion removed off so that they can be set also from the Digital Operator in the same way. In this case, the unit displayed together indicates whether or not the data has frictional portion.

INFO

MD3008 (Pn101) KVI (For each axis)

Meaning: Speed loop integration time constant setting

Setting value: [0.01 ms]

Chapter 14

Drive set-up procedure

This chapter deals with procedures to set up machine data and parameters relating to axis control for YS 840DI. Since this manual includes only minimum amount of information required, refer to other manuals on functions and appendix pages for more information on machine data and parameters. Notice that machine data and parameters of specific importance are marked with "##". If they are not set, machines may fail to start up or malfunctions.

The following functions are introduced in this manual.

Table 14.1 List of related functions

Item	Function	Feed axis	Spindle	Related section
Fundamental function	Control cycle	○	○	14.1.1
	NCK processing capability	○	○	14.1.2
	Servo control method and fundamental operation	○	○	17.1.3
	Axis configuration	○	○	14.1.4
	Motor encoder	○	○	14.1.5
	External encoder	○	○	14.1.6
	Maximum number of motor revolutions	○	○	14.1.7
	Various mask settings	○	○	14.1.8
	Software version number check	○	○	14.1.9
	Initializing parameters		○	14.1.10
Servo control	Position control	○	○	14.2.1
	Speed control	○	○	14.2.2
	Spindle servo mode		○	14.2.3
	Backlash compensation	○		14.2.4
	Quadrant error compensation	○		14.2.5
	Torque reference notch filter	○		14.2.6
	Speed feedback compensation	○		14.2.7
	Predictive control	○		14.2.8
	Model following control	○		14.2.9
	Stop vibration suppression	○		14.2.10
	Vibration-damping control	○		14.2.11
	Gain switching	○		14.2.12
	Current offset adjustment	○		14.2.13
	Analog monitor	○	○	14.2.14
Motion control	Feed speed	○	○	14.3.1
	Acceleration/deceleration	○	○	14.3.2
	Positioning	○	○	14.3.3
	Emergency stop	○	○	14.3.4
	Return to reference point	○		14.3.5
	Brake control	○		14.3.6
	Speed feedforward	○	○	14.3.7
	Torque restriction and Fixed Stop function	○	○	14.3.8
	Absolute value detection	○		14.3.9
	Gantry control	○		14.3.10
	Collision detection	○		14.3.11
	Spindle sequence I/O signal		○	14.3.12
	Spindle orientation		○	14.3.13
	Spindle winding changeover		○	14.3.14
	Spindle changeover and Spindle-embedded C axis control		○	14.3.15

Item	Function	Feed axis	Spindle	Related section
Motion control	Rigid tapping	○	○	14.3.16
	Thread cutting	○	○	14.3.17
	Spindle synchronous control		○	14.3.18
	Skip	○		14.3.19
High-speed and high-precision cutting	Multi-block look-ahead	—	—	14.4.1
	Block compression	—	—	14.4.2
	Spline interpolation	—	—	14.4.3

Note: The mark " ○ " indicates that the function relates with each feed axis and Spindle.

14.1 Fundamental settings

At first, fundamental settings to operate each axis are shown as follows.

14.1.1 Control cycle

The following 2 settings specify the control cycle of YS 840DI system.

- DP cycle: Interpolation cycle of CNC and data transmission cycle between CNC and a drive.
- IPO cycle: Program block analysis cycle of CNC.
  IPO cycle must be an integral multiple (× 1, × 2, ...) of a DP cycle.

■ DP cycle setting

Currently, you can select 2 ms or 4 ms as a DP cycle.
In YS 840DI system, the following standard values are set.

- Machining center : 0.002 sec (2 ms)
- Turning : 0.004 sec (4 ms)

The DP cycle is set through a hardware configuration using a PLC set-up tool "STEP7".
Refer to STEP7 instruction for more information.

You can check the DP cycle, having been set by the hardware configuration, by using the following machine data (read-only data).

- MD10050 SYSCLOCK_CYCLE_TIME
  Meaning: DP cycle time
  Displayed value: [sec]

■ IPO cycle setting

IPO cycle is to be set to an integral multiple of the DP cycle.
You can set IPO cycle using the following machine data.

- MD10070 IPO_SYSCLOCK_TIME_RAITIO ##
  Meaning: IPO cycle time
  Setting value: Integral multiple of DP cycle
  Standard setting value: 2 to 4
- MD19296 ON_PERFORMANCE_INDEX ##
  Meaning: Limitation to IPO cycle
  Standard setting value: 4

14.1.2 NCK processing capability

With this setting, it is specified that how much CPU power should be distributed from PCU unit to NCK (NC kernel) in YS 840DI system.
50-75% should be specified with the following machine data.

- MD10185 NCK_PCOS_TIME_RATIO
  Meaning: CPU power ratio to be distributed to NCK.
  Setting value: [%]
  Standard setting value: 65 [%]

Set the following machine data to make an adjustment between high NCK processing speed and high screen refreshing speed.

- MD10131 SUPPRESS_SCREEN_REFRESH
  Meaning: Suppression setting of HMI screen refreshing
  0 --- Suppression for entire system
  1 --- Suppression only for a partial system in which the processing must be done in a short time.
  2 --- No suppression at all

  Standard setting value: 0

14.1.3 Servo control method and fundamental operation

■ CNC setting

The servo control method of YS 840DI system is called "DSC" (Direct Servo Control). In this method, CNC and drives perform position control to attain high-speed response. To enable this control method, set the following parameters.

- MC32640 STIFFNESS_CONTROL_ENABLE [0] (for each axis) ##
  Setting value: 1
- MD13060 DRIVE_TELEEGRAM_TYPE [0] (for the 1st axis) ##
  MD13060 DRIVE_TELEEGRAM_TYPE [1] (for the 1st axis) ##
  : (Repeat for all remaining axes)
  Setting value: 201

For operation specification at NCK reset and system shutdown, set the following machine data.

- MD11250 PROFIBUS_SHUTDOWN_TYPE (Spindle)
  Meaning: Operation specification at NCK reset and shutdown
  Setting value: 0 --- Drive stops on an alarm without PROFIBUS cleared.
  1 --- Drive stops after deceleration with PROFIBUS cleared.
  2 --- Drive stops after deceleration without PROFIBUS cleared.
  Standard setting value: 2

INFO

This machine data was added to 01.00.00 system. For systems earlier than this version, the data should be set to 0.

As an initial setting of command unit system (mm/inch), set the following machine data.

- MD20154 EXTERN_GCODE_RESET_VALUE [5]
  Meaning: Initial setting of command unit system (mm/inch)
  Setting value: 1 --- G20
  2 --- G21

As a default Spindle status, set the following machine data.

- MD35020 SPIND_DEFAULT_MODE (Spindle)
  Meaning: Spindle default mode
  Setting value: 0 --- Speed reference mode (Without position control)
  1 --- Speed reference mode (With position control)
  2 --- Positioning axis mode
  3 --- C axis mode
  Standard setting value: 0
- MD35030 SPIND_DEFAULT_ACT_MASK (Spindle)
  Meaning: Spindle default mode timing
  Timing when the default mode, set by MD35020, becomes active.
  Setting value: 0 --- When power is turned on.
  1 --- When power is turned on and NC starts.
  2 --- When power is turned on and reset (M2 and M30).
  Standard setting value: 0
- MD35040 SPIND_ACTIVE_AFTER_RESET (Spindle)
  Meaning: Spindle operation after reset and M2/M30.
  Setting value: 0 --- Spindle stops on reset and M2/M30.
  1 --- Spindle does not stop on reset and M2/M30.
  Standard setting value: 0

■ Drive setting

Fine interpolation

To apply fine interpolation to a speed reference (for interpolation so that the separation from DP cycle to drive control cycle may be carried out continuously), set the following data to "1".

- MD3069 digit 1 (Pn127 digit 1) SWITCH_FUNCTION_2 (For each Servo drive axis) ##
  Meaning: Fine interpolation of a speed reference.
  Setting value: 0 --- Fine interpolation disabled.
  1 --- Fine interpolation enabled.
  The data must be set to "1".

14.1.4 Axis configuration

Control axes (feed axis and Spindle) configuration set-up is carried out in the following 3 methods:

1. Switch settings at a drive
2. Hardware configuration using PLC set-up tool "STEP7"
3. Machine data settings

To set up axis configuration,

1. Set switches at a drive so that a PROFIBUS station No. of the Converter and axis numbers under the Converter can be set up.
2. Perform a hardware configuration using PLC set-up tool "STEP 7" so that all the hardware (such as drives and I/O modules) can be physically set up and the PROFIBUS can be connected.
3. Set up machine data assuming that "Switch setting at drives" and "Hardware configuration" have been carried out correctly.

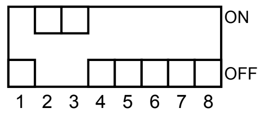
If you have made a change to drive configuration, for example, by adding or deleting a drive, you need to perform again "1. Switch setting at drives", "2. Hardware configuration", and "3. Setting up machine data".

■ Setting switches and others at drives

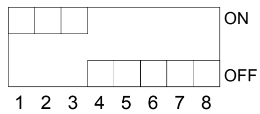
Setting Converter station numbers

The station number of the Converter PROFIBUS is set to 6 by factory default.
In case multiple Converters are to be connected, you need to assign a unique station number to each Converter.
If you want to change the station numbers of the Converters, set the Converter switch (SW1) as shown below.

Default value: 1st Converter --- 6



2nd Converter --- 7
:



You can check the Converter station numbers using the following parameters on the bottom of the drive parameter screen.

- MD918 PROFIBUS_NODE_ADDRESS (For each axis)
  Meaning: PROFIBUS station number
  A station number is displayed for a Converter to which the drive is connected.

Setting a rotary SW for each Servo/Spindle drive

A rotary switch, for setting slot information of the PROFIBUS, is associated with each Servo/Spindle drive. Set the switches in the following procedures:

- Assign an integer number, starting with 0, in succession to each of the rotary switches. (The numbers assigned must be sequential; otherwise, you need to take care in performing a hardware configuration.)
- In the case of a 2-axis-combined Servo drive, numbers for 2 axes must be assigned although only 1 rotary switch exists. In this case, if you assign "2" to the switch for example, both numbers "2" and "3" will actually be assigned. For this reason, you need to assign "4" to the next rotary switch.

  Note: You need to configure axes so that even numbers (0, 2, 4) may be assigned to rotary switches for 2-axis-combined drives. If an odd number is assigned to a rotary switch, the switch is treated as assigned with a predetermined number "-1".
- You can assign numbers 0-6 under 1 Converter. (If the end edge is a 2-axis-combined type, numbers 0-5 are to be assigned.)
  As far as no duplicated number is assigned, the drives need not be placed sequentially.

  Note: In case any incorrect setting is made, Converter communication module LED lights up in Red; otherwise, it lights up in green in normal case.

Parking setting (GAP axis setting)

When a drive is not used, the parking axis setting (GAPaxis setting) is required. For example, in the case of that only one motor is connected to a 2-axis-combined drive.

- MD3004 digit 2 (Pn004 digit 2) FUNCTION_SWITCH_APPLIC4 (For each axis) ##
  Meaning: An axis is set as being a parking axis (GAP axis)
  Setting value: 0 --- Active axis
  2 --- Parking axis

  Note: In case any setting error exists, the communication module LED of the Converter lights up in Red; otherwise, it lights up in Green. You cannot specify a Spindle as being a parking axis.

■ Hardware configuration using STEP7

This section summarizes precautions to be taken in performing a hardware configuration, especially when you are using an SGDK drive. For how to use STEP 7 in detail, refer to STEP7 manual.
CNC, Converters, and drives connected to the Converters are to be set up. Up to 7 axes can be connected to one Converter.
The following settings are to be made to the STEP7 for the GSD file of drive. As mentioned above, you can connect up to 7 axes to one Converter and you can select either 2 ms or 4 ms as a DP cycle.

- A portion that you need to set up: "Assigning Hexadecimal Parameters" of "DP Slave Properties".
- A GSD file to be used is "YASK04E7".
- Setting descriptions: For a DP cycle of 2 ms or 4 ms, make the following settings:

00,00,00,1C,E1,00,00,E1,<u>00,00,17,70</u>,<u>00,04</u>,01,<u>00,00,0B,B8</u>,<u>00,03</u>,<u>00,07</u>,00,00,17,70,00,0A,00,00

To --- For 2 ms setting: 00,07(1750us)
For 4 ms setting: 00,09(2250us)
Ti --- Always 00,03 (750us)
Tbase_io --- Always0B,B8 (250us)
Tdp --- For 2 ms setting: 00,04 (2ms)
For 4 ms setting: 00,08 (4ms)
Tbase_dp --- Always 17,70 (500us)

In the case of 2 ms setting, the following setting (initial setting) can also be used.

00,00,00,1C,E1,00,00,E1,00,00,5D,C0,00,01,01,00,00,0B,B8,00,03,00,07,00,00,17,70,00,0A,00,00

For a logical address to be set using STEP7, set a value that matches with the following machine data.

- MD1350 DRIVE_LOGIC_ADDRESS [n] (For each axis)
  Meaning: Logical address of PROFIBUS for each drive

Note: 1. When you set a value using STEP7, adjust it to this machine data setting.
2. This address is effective also for the following GAP axis. When you make a setting using STEP7, define an address of 1 axis length also for an axis that is to be set as an GAP axis.

INFO

■ Precautions in setting GAP axis

- The parking setting (GAP axis setting), which is made to a drive not to be used, is possible only when the drive is a Servo drive.
- Spindle drive cannot be set up as a parking drive. (In the case of a spindle drive, you need to mask alarms relating to a motor and encoder as active axis. Refer to 14.1.8.)
- With hardware configuration, you can set up a drive as being a parking drive (inactive drive although connected to a system) by selecting a GAP axis (G). However, if you want to specify an axis connected to a Converter end edge as being a GAP axis, do not set as such during the hardware configuration, but configure the whole system counting out the axis. (You can also use 7 axes, setting the 8th axis as a parking axis.)
- You need to assign a logical address of MD13050 even to a GAP axis. For this reason, in STEP7, assign an axis address even to an axis to be set as a GAP axis like an active axis.

■ Machine data setting

The following are machine data for setting up axis configuration.

- MD10000 AXCONF_MACHAX_NAME_TAB [0] (1st axis)
  MD10000 AXCONF_MACHAX_NAME_TAB [1] (2nd axis)
  : (Repeat for 20 axes)
  Meaning: Machine axis name
  Names of active axes, simulation axes, and inactive axes are defined irrespective of their group. The sequence in which each axis is defined here becomes an axis number displayed in the axis MD screen.
  Setting value: X1, X2, C1, and etc.
- MD10002 AXCONF_LOGIC_MACHAX_TAB [0] (1st axis)
  MD10002 AXCONF_LOGIC_MACHAX_TAB [1] (2nd axis)
  : (Repeat for 20 axes)
  Meaning: Machine axis number
  Defines an axis number defined by MD10000
  Setting value: AX1, AX2, and AX3...
- MD20050 AXCONF_GEOAX_ASSIGN_TAB [0] (1st axis)
  MD20050 AXCONF_GEOAX_ASSIGN_TAB [1] (2nd axis)
  : (Repeat for all remaining axes)
  Meaning: Geometry axis number for each channel
  Setting value: 1, 2, and 3...

Note: You cannot set up for the Spindle axis.

- MD20060 AXCONF_GEOAX_NAME_TAB [0] (1st axis)
  MD20060 AXCONF_GEOAX_NAME_TAB [1] (2nd axis)
  : (Repeat for all remaining axes.)
  Meaning: Names of geometry for each channel
  Setting value: X, Y, C and etc.
  Note: You cannot set up for the Spindle axis.

- MD20070 AXCONF_MACHAX_USED [0] (1st axis)
  MD20070 AXCONF_MACHAX_USED [1] (2nd axis)
  : (Repeat for all remaining axes)
  Meaning: Axis number of active axis for each channel
  Axis numbers, defined with MD10000, used for channel.
  (Defines array number of [n] -1)
  Setting value: 1, 2, and 3...
  Note: Simulation axes are also to be defined. Inactive axis is not to be defined.
- MD20080 AXCONF_CHANAX_NAME_TAB [0] (1st axis)
  MD20080 AXCONF_CHANAX_NAME_TAB [1] (2nd axis)
  : (Repeat for all remaining axes)
  Meaning: Names of axes used in CNC program.
  Defines names of axes, in a channel, corresponding to MD20070.
  Setting value: X, Y, C and etc.
  Note: Also define a simulation axis, but you do not need to define inactive axis.
- MD30110 CTRLOUT_MODULE_NR (For each axis)
  Meaning: Drive number defined during hardware configuration
  Setting value: A number starting from 1
  Note: 1. Assign a number also to each simulation axis sequentially.
  2. Assign the same value as the machine data also to MD30220 [0] (or MD30220 [1] if a External encoder is used).
- MD30130 CTRLOUT_TYPE [0] (For each axis)
  Meaning: Active axis (with a drive) setting
  Setting value: 0 --- Simulation axis and inactive axis settings
  1 --- Active axis setting

The next page summarizes relations among the machine data, drive settings, and hardware configuration discussed above.

Definitions of logical axis numbers and names in the whole system.

		MD10000	MD10002
1st axis	[0]	: SP1	AX1
2nd axis	[1]	: SP2	AX2
3rd axis	[2]	: X1	AX3
4th axis	[3]	: Y1	AX4
5th axis	[4]	: Z1	AX5
6th axis	[5]	: X2	AX6
7th axis	[6]	: Y2	AX7
8th axis	[7]	: Z2	AX8
9th axis	[8]	: A1	AX9
10th axis	[9]	: B1	AX10
11th axis	[10]	: A2	AX11
12th axis	[11]	: B2	AX12

Definitions of logical axis numbers and names of the 1st group.

MD20070	MD20080
[0] : 3	[0] : X
[1] : 4	[1] : Y
[2] : 5	[2] : Z
[3] : 9	[3] : A
[4] : 1	[4] : SP

Definitions of logical axis numbers and names of the 2nd group.

MD20070	MD20080
[0] : 6	[0] : X
[1] : 7	[1] : Y
[2] : 8	[2] : Z
[3] : 11	[3] : A
[4] : 2	[4] : SP

A2 axis is to be defined although it is a simulation axis (without a drive).

Relations between logical and physical axis numbers, and settings of active and inactive axes in the whole system

Logical axis name	Drive Logical address	Motor encoder Logical address	External encoder Logical address	Axis enable/disable
MD10000	MD30110	MD30220 [0]	MD30220 [1]	MD30130
SP1	1	1	1	1
SP2	6	6	6	1
X1	2	2	2	1
Y1	3	3	3	1
Z1	4	4	4	1
X2	7	7	7	1
Y2	8	8	8	1
Z2	9	9	9	1
A1	5	5	5	1
B1	Invalid setting	Invalid setting	Invalid setting	0
A2	Invalid setting	Invalid setting	Invalid setting	0
B2	Invalid setting	Invalid setting	Invalid setting	0

In the order of addresses during hardware configuration

To be set to 0 because A2 is a simulation axis (without a drive).

Definitions of geometry axis numbers and names of the 1st channel

MD20050	MD20060
[0] : 1	[0] : X
[1] : 2	[1] : Y
[2] : 3	[2] : Z

Definition of the sequence of X, Y, and Z-axis defined with MD20070.

Definitions of geometry axis numbers and names of the 2nd channel

MD20050	MD20060
[0] : 1	[0] : X
[1] : 2	[1] : Y
[2] : 3	[2] : Z

Physical axis configuration (Drive configuration)

Converter 1 PROFIBUS ID=6	Drive 1 (SP1) SW No=0	Drive 2 (X1) SW No=1	Drive 3 (Y1) SW No=2	Drive 4 (Z1) SW No=3	Drive 5 (A1) SW No=4
Hardware configuration first address (MD19050)	272	292	312	332	352

Converter 2 PROFIBUS ID=7	Drive 1 (SP2) SW No=0	Drive 2 (X2) SW No=1	Drive 3 (Y2) SW No=2	Drive 4 (Z2) SW No=3
Hardware configuration first address (MD19050)	372	392	412	432

14.1.5 Motor encoder

The following shows machine data and parameter settings of motor encoders.
Since a feed axis uses a serial encoder as a motor encoder, some parameter settings for a Servo drive encoder are omitted here because the encoder directly reads those setting values.

■ CNC setting

- MD30200 NUM_ENC (For each axis)

  Meaning: The number of encoders

  Setting value: 0 --- No encoder
  1 --- Only motor encoders
  2 --- Motor encoder + External encoders

- MD31000 ENC_LINEAR [0] (For each axis)

  Meaning: Motor encoder type (Rotary encoder/Linear scale) setting
  Setting value: 0 --- Rotary encoder

- MD30220 ENC_MODULE_NR (For each axis)

  Meaning: Encoder number determined during hardware configuration.
  Setting value: MD30110 The same value as CTRLOUT_MODULE_NR is to be set.

- MD30230 ENC_INPUT_NR [0] (For each axis)

  Meaning: Encoder input port number
  Standard setting value: 1

- MD30240 [0] ENC_TYPE [0] (For each axis)

  Meaning: Motor encoder type
  Setting value: 0 --- Simulation axis setting
  1 --- Incremental encoder
  4 --- Absolute encoder

  Note: If you use an absolute encoder as an incremental encoder, assign "1".
  If you use absolute value detection function of a External encoder,
  assign "4" irrespective of motor encoder types.

- MD30240 [1] ENC_TYPE [1] (For each axis)

  Meaning: External encoder type
  Setting value: 0 --- External encoder is not used.
  1 --- Incremental encoder
  4 --- Absolute encoder

  Note: If you use an absolute encoder as an incremental encoder, assign "1".

- MD30260 ABS_INC_RATIO [0] (For each axis)

  Meaning: Ratio of motor encoder absolute position data, from drive to CNC, to Motor encoder position data.

  Standard setting value: 1

- MD30300 IS_ROT_AX (For each axis) ##

  Meaning: Linear/Rotary axis setting

  Setting value: 0 --- Linear axis
  1 --- Rotary axis

- MD31020 ENC_RESOL [0] (For each axis) ##

  Meaning: The number of motor encoder pulses
  The setting value is compared with a value read from a drive. If the values are different each other, an alarm is issued.

  Setting value: The number of encoder pulses (4-multiplication value) /MD31025. Refer to Table 14.2.

- MD31025 ENC_PULCE_MULT [0] (For each axis) ##

  Meaning: Motor encoder pulse scaling factor

  Setting value: See the following table.

Table 14.2 Motor encoder list

The number of pulses (4-multiplication value)	Serial/ pulse	Servo axis/ Spindle	MD31020 [0]	MD31025 [0]	Remark
2048	Pulses	Spindle	1	2048	
3600	Pulses	Spindle	900	4	This has been used with J300L.
4096	Pulses	Spindle	2	2048	
8192	Pulses	Spindle	4	2048	
8192 (13bit)	Serial	Servo	4	2048	
65536 (16 bit)	Serial	Servo	32	2048	
131072 (17 bit)	Serial	Servo/Spindle	64	2048	
524288 (19 bit)	Serial	Spindle (C axis)	256	2048	
1048576 (20 bit)	Serial	Servo	512	2048	

- MD31030 LEADSCREW_PITCH (For each axis)

  Meaning: Ball screw pitch

  Setting value: [mm/rev]

- MD31050 DRIVE_AX_RATIO_DENOM [0] (For each axis)

  Meaning: Load gear denominator (Amount of rotation at machine (The number of gear teeth at motor))

- MD31060 DRIVE_AX_RATIO_NUMBER [0] (For each axis)

  Meaning: Load gear numerator (Amount of rotation at motor (The number of gear teeth at machine))

  Setting value: MD31050 : MD30160 = Amount of rotation at machine : To be set to motor rotation amount.

  = The number of gear teeth at motor : The number of gear teeth at machine

- MD31070 DRIVE_ENC_RATIO_DENOM [0] (For each axis)

  Meaning: Encoder/Motor gear ratio denominator (Amount of encoder rotation)

- MD31080 DRIVE_ENC_RATIO_NUMERA [0] (For each axis)

  Meaning: Encoder/Motor gear ratio numerator (Amount of motor rotation)

  Setting value: MD31070:MD31080 = Amount of encoder rotation : To be set to motor rotation amount.

  Standard setting value: 1 : 1

- MD32100 AX_MOTOR_DIR (For each axis)

  Meaning: Motor encoder rotation direction

  Setting value: 0 or 1 --- Forward rotation
  -1 --- Reverse rotation

- MD34200 ENC_REFP_MODE [0] (For each axis)

  Meaning: Return to reference point mode setting (Motor encoder)

  Setting value: For returning to encoder C-phase origin, be sure to assign "1".
  When absolute value detection function is enabled, be sure to assign "0".

- MD34220 ENC_ABS_TURNS_MODULO [0] (For each axis)

  Meaning: Multi-turn limit setting (1-100000)

  Setting value: To be set to Drive setting value MD3205 (Pn205) + 1

  Standard setting value: 65536 (Because the standard setting value of MD3205 is 65535.)

  Note: If you want to set multi-turn limit value in accordance with a value such as a gear ratio, set MD34220 to the gear ratio and set MD3205 to a value 1 less than MD34220.

■ Drive setting

Servo drive

- MD3000 digit 0 (Pn000 digit 0) FUNCTION_SWITCH_BASIC (For each axis)

  Meaning: Selection of rotation direction

  Setting value: 0 --- CCW rotation to be treated as forward rotation.
  (1 --- CW rotation to be treated as forward rotation.)

  Note: To set up reverse connection, use CNC machine data.

- MD3002 digit 2 (Pn002 digit 2) FUNCTION_SWITCH_APPLIC2 (For each axis)

  Meaning: Method for operating absolute encoder

  Setting value: 0 --- Uses an absolute encoder as an absolute encoder.
  1 --- Uses an absolute encoder as an incremental encoder.

- MD3205 (Pn205) Multi_TURN_LIMIT

  Meaning: Multi-turn limit setting

  Setting value: Multi-turn limit setting of absolute encoder
  You need not change this parameter setting even if you want to detect rotation axis absolute value in YS 840DI system. (Excluding absolute value detection with a External encoder using MP scale. Refer to next section 14.1.6 for a setting when MP scale is used.)

  Standard setting value: 65535

INFO

■ When multi-turn limit value inconsistency happens

If alarm 204 (A. CC) "Multi-turn limit value inconsistency" happens as a result of this parameter setting, release the alarm by using Digital operator as follows.

1. Connect the Digital operator to the Converter. Select a drive (dr1, dr2 ...: the drive number is a value, 1 more than the rotary switch setting value of each drive) to check by using [Up] and [Down] keys, and press [DATA ENTER] key.
2. Press [DSPL/SET] key to display "Fn ***", and then press [Up] key to display "Fn013". Press [DATA ENTER] key to display "PGSEt".
3. Press [DSPL/SET] key to display "done". The encoder is set to a value of Pn205.
4. Alarm is released when the power is turned on again.

Since the 20-bit absolute encoder cannot be released with Fn013, set MD34220 to a multi-turn limit value + 1.

- MD3214 (Pn20E) ELECTRIC_GEAR_NUMERATOR_LW (For each axis)

  Meaning: Electronic gear ratio numerator (Lower word)

  Setting value: [Pulse]

- MD3215 (Pn20F) ELECTRIC_GEAR_NUMERATOR_HW (For each axis)

  Meaning: Electronic gear ratio numerator (Upper word)

  Setting value: [Pulse]

  Note: Electric gear functions at CNC side are to be used. Assign the factory setting value (1, 0) to MD3214 and MD3215.

- MD3216 (Pn210) ELECTRIC_GEAR_DENOMIN_LW (For each axis)

  Meaning: Electronic gear ratio denominator (Lower word)

  Setting value: [Pulse]

- MD3217 (Pn211) ELECTRIC_GEAR_DENOMIN_HW (For each axis)

  Meaning: Electronic gear ratio denominator (Upper word)

  Setting value: [Pulse]

  Note: Electric gear functions at CNC side are to be used. Assign factory setting value (1, 0) to MD3216 and MD3217.

INFO

You do not need to set the number of motor encoder pulses because it is read from an encoder directly. You can check the number of encoder pulses with the following drive parameters.

- MD1005 ENC_RESOL_MOTOR (For each axis)

  Meaning: Motor encoder resolution

- MD1042 RESOLUTION_G1_XIST1 (For each axis)

  Meaning: Motor encoder resolution magnification 1

  The number of motor encoder pulses = MD1005 $\times$ 2^{MD1042}

Spindle drive

- MD6529 (Cn529) ENCODER_SPECIFICATION_0 (For each axis)

  Meaning: Encoder specification

  Setting value: Bit 1, 0 0, 0 --- No encoder used.
  0, 1 --- External encoder is used.
  1, 0 --- Motor encoder is used.
  Bit 2 0 --- CCW rotation to be treated as forward rotation.
  (1 --- CW rotation to be treated as forward rotation.)
  Bit 6 0 --- Incremental encoder
  1 --- Absolute encoder
  Bit 7 0 --- Pulse encoder
  1 --- Serial encoder

  Note: To set up reverse rotation connection, use CNC machine data.

- MD6533 (Cn533) NUMBER_OF_ENCODER_PULSE_0 (For each axis)

  Meaning: The number of motor encoder pulses (4-multiplication value)

  Setting value: 11 --- 2048 Pulse encoder
  12 --- 4096 Pulse encoder
  13 --- 8192 Pulse encoder
  17 --- 17-bit Serial encoder
  19 --- 19-bit Serial encoder

  Note: If this parameter is set to a number ranging from 8 to 32, the parameter represents a value of n in "2 to the n-th power" pulse type encoder. If the parameter is set to "32" or larger number, the parameter represents the number of 4-multiplication pulses of a pulse encoder.

- MD6915 (Cn87F) FULL_CLOSED_PG_PULSE_L_1 (For each axis)

  Meaning: The number of PG pulses used for position control/Single revolution of motor (Lower word)

  Setting value: [Pulse]

- MD6916 (Cn880) FULL_CLOSED_PG_PULSE_H_1 (For each axis)

  Meaning: The number of PG pulses used for position control/Single revolution of motor (Upper word)

  Setting value: [Pulse]

  Note: Set MD6915 and MD6916 to a 4-multiplication value.

■ Resetting Absolute encoder

If an absolute encoder (motor encoder), used for a Servo drive, exhibits an alarm such as encoder alarm 129 (81H), reset the encoder in the following operation.

1. Connect the Digital operator to the Converter. Select a drive (dr1, dr2 ...: the drive number is a value, 1 more than the rotary switch setting value of each drive) to check by using [UP] and [DOWN] keys, and press [DATA ENTER] key.
2. Press [DSPL/SET] key to display "Fn □□□ ", and then press [UP] key to display "Fn008". Press [DATA ENTER] key.
3. "PGCL1" is displayed. Press [UP] key to display "PGCL5".
4. Press [DSPL/SET] key to display "done".
5. The alarm is released when the power is turned on again.

14.1.6 External encoder

The following explains how to set a External encoder.
To use a External encoder, you need to set the following machine data and parameters in addition to above-mentioned motor encoder set-up.

INFO

To use a External encoder, you need to change the setting value from "1" to "2" of the "Position measuring system" for PLC->NCK signals DB3nDBX1.5-1.6.

- DBX1.5 = 1 & DBX1.6 = 0: External encoder inactive.
- DBX1.5 = 1 & DBX1.6 = 1: External encoder active.

■ CNC setting

- MD30200 NUM_ENC (For each axis)

  Meaning: The number of encoders
  Setting value: 0 --- No encoder used.
  1 --- Only motor encoders
  2 --- Motor encoders + External encoders

- MD30230 ENC_INPUT_NR [1] (For each axis)

  Meaning: Encoder input port number
  Standard setting value: 1

- MD30240 [1] ENC_TYPE [1] (For each axis)

  Meaning: External encoder type
  Setting value: 0 --- No External encoder used.
  1 --- Incremental encoder
  4 --- Absolute encoder

  Note: If you want to use an absolute encoder as an incremental encoder, assign "1".

- MD30260 ABS_INC_RATIO [1] (For each axis)

  Meaning: Ratio to External encoder absolute position data from drive to CNC

  Standard setting value: 1

- MD31000 ENC_LINEAR [1] (For each axis)

  Meaning: External encoder type (rotary encoder/linear scale) setting

  Setting value: 0 --- Rotary encoder
  1 --- Linear scale

- MD31010 ENC_GRID_POINT_DIST [1] (For each axis)

  Meaning: Linear scale resolution

  Setting value: [mm]

- MD31020 ENC_RESOL [1] (For each axis)

  Meaning: The number of separate rotary encoder pulses
  The setting value is compared with a value read from a drive. If the values are different each other, an alarm is issued.

  Setting value: The number of separate rotary encoder pulses (4-multiplication values)/ MD31025 [1]
  Refer to Table 14.3.

- MD31025 ENC_PULSE_MULT [1] (For each axis)

  Meaning: External encoder pulse magnification

  Setting value: Linear scale --- 1
  Rotary encoder --- 4 (Refer to the table below)

- MD31040 ENC_IS_DIRECT [1] (For each axis)

  Meaning: External encoder active/inactive

  Setting value: 0 --- Inactive
  1 --- Active

Table 14.3 List of separate rotary encoders

Number of pulses (4-multiplication value)	Serial/ Pulse	Servo axis/ Spindle	MD31020 [1]	MD31025 [1]	Remarks
4096	Pulses	Spindle	1024	4	
32768	Pulses	Servo	8192	4	
360000	Pulses	Servo	90000	4	Spindle-embedded C axis is excluded from targets because 19-bit encoders are used for the time being.

- MD32110 ENC_FEEDBACK_POL [1] (For each axis)

  Meaning: Separate rotary encoder rotation direction

  Setting value: 0 or 1 --- forward rotation
  (-1 --- Reverse rotation)

  Note: (Note) Set up External encoder reverse rotation connection at the drive side. Be sure to set this parameter to "0" or "1".

- MD32642 STIFFNESS_CONTROL_CONFIG [0] (For each axis)

  Meaning: External encoder function selection

  Setting value: 0 --- Type 1 (Internal drive position feed-back is to be used as motor encoder pulse.)

  Setting value: 1 --- Type 2 (Internal drive position feed-back is to be used as External encoder pulse.)

  Standard setting value when a External encoder is used: 1

  Note: Be sure to assign "0" if a External encoder is not used.

- MD34200 ENC_REFP_MODE [1] (For each axis)

  Meaning: Return to reference point mode setting (External encoder)

  Setting value: For returning to encoder C-phase origin, be sure to assign "1".
  When absolute value detection function is active, be sure to assign "0".

- MD34220 ENC_ABS_TURNS_MODULO [1] (For each axis)

  Meaning: Multi-turn limit setting (1-100000)

  Setting value: Linear scale --- No value needs to be set.
  Mitsubishi Heavy Industries MP scale --- 1
  Futaba Corporation (Sony) or Yaskawa I/F rotary scale --- 1

- MD36300 ENC_FRQ_LIMIT [1] (For each axis)

  Meaning: External encoder frequency clamp

  Setting value: Maximum pulse rate [Hz] (Rotary encoder: pps/4; Linear scale: pps)

  Standard setting value: 1200000 [Hz] (120% of the hardware capability, 4 Mpps)

■ Drive setting

Servo drive

- MD3002 digit 3 (Pn002 digit 3) FUNCTION_SWITCH_APPLIC2 (For each axis)

  Meaning: Method for using full-closed PG pulse

  Setting value: 0 --- Not to be used.
  (1 --- To be used without C-phase. (Incremental encoder))
  2 --- To be used with C-phase. (Incremental encoder)
  (3 --- To be used in reverse rotation mode without C-phase. (Incremental encoder))
  4 --- To be used in reverse rotation mode with C-phase (Incremental encoder)
  (5 --- To be used without C-phase (Absolute encoder))
  6 --- To be used with C-phase (Absolute encoder)
  (7 --- To be used in reverse rotation mode without C-phase. (Absolute encoder))
  8 --- To be used in reverse rotation mode with C-phase. (Absolute encoder))

  Note: "Without C-phase" setting is applied when such an encoder is used that has no C-phase signal. In this case, "C-phase wire break detection" is not performed.

INFO

■ When a External encoder is connected for reverse rotation

MD32100 (Motor encoder rotation direction), MD32110 (External encoder rotation direction), and MD3002 digit 3 (External encoder rotation direction) are to be set as follows.

External encoder specification	Motor encoder connection	Motor rotation direction MD32100	External encoder rotation direction MD32110	Motor rotation encoder MD3000 digit 0	External encoder rotation direction MD3002 digit 3
Type 2 reverse rotation connection	Forward rotation	1	1	0	4 or 8
	Reverse rotation	-1	1	0	2 or 6

- MD3006 digit 2 (Pn006 digit 2) FUNCTION_SWITCH_APPLIC6 (For each axis)

  Meaning: Full-closed specification

  Setting value: 0 --- Type 2 (Internal drive position feed-back is used as External encoder pulse.)

  1 --- Type 1 (Internal drive position feed-back is used as motor encoder pulse.)

  Standard setting value: 0

- MD3205 (Pn205) MULTI_TURN_LIMIT

  Meaning: Multi-turn limit setting

  Setting value: Multi-turn limit setting of absolute motor encoder
  When Mitsubishi Heavy Industries MP scale is used, assign a number, 1 less than the gear ratio between motor encoder and MP scale.

  Note: If Servo drive alarm "204 (A.CC)" is displayed as a result of this parameter setting, release it using Fn013 operation from the Digital operator. (See INFO " ■ When multi-turn limit value inconsistency happens" in 14.1.5.)
  Since the Fn013 operation cannot be made to a 20-bit absolute encoder, you cannot use a 20-bit absolute encoder in combination with the MP scale.

- MD3207 digit 3 (Pn207 digit 3) SWITCH_POSITION_REF (For each axis)

  Meaning: External PG type selection

  Setting value: 0 --- Pulse encoder (Linear scale)

  1 --- Pulse encoder (Rotary scale)

  3 --- Mitsubishi Heavy Industries MP scale

  Note: Be sure to assign "3" when an MP scale is used.

- MD3210 (Pn20A) PG_PLS_MTRRND_LW_FULLCLOSED (For each axis)

  Meaning: The number of full-closed PG pulses/Single revolution of motor (Lower word)

  Setting value: [Pulse]

- MD3211 (Pn20B) PG_PLS_MTRRND_HW_FULLCLOSED (For each axis)

  Meaning: The number of full-closed PG pulses/Single revolution of motor (Upper word)

  Setting value: [Pulse]

  Note: Set MD3210 and MD3211 to a 1-multiplication value.

- MD3212 (Pn20C) PG_PLS_ENCRND_LW_FULLCLOSED (For each axis)

  Meaning: The number of full-closed PG pulses/Single revolution of encoder (Lower word)

  Setting value: [Pulse]

- MD3213 (Pn20D) PG_PLS_ENCRND_HW_FULLCLOSED (For each axis)

  Meaning: The number of full-closed PG pulses/Single revolution of encoder (Upper word)

  Setting value: [Pulse]

  Note: Set MD3212 and MD3213 to a 1-multiplication value.

- MD3231 (Pn21F) PG_PLS_ENCRND_Z_PHASE (For each axis)

  Meaning: The number of Z-phase pulses/Single revolution of encoder.
  When Mitsubishi Heavy Industries MP scale is used, this value must be set.

  Setting value: [Pulse]

- MD3508 (Pn808) ABS_PG_POINT_OFFS_LW (For each axis)

  Meaning: Absolute PG zero offset (Lower word)
  When Mitsubishi Heavy Industries MP scale is used, this value must be set to an offset amount from motor encoder.

  Setting value: [Pulse]

- MD3509 (Pn809) ABS_PG_POINT_OFFS_HW (For each axis)

  Meaning: Absolute PG zero offset (Upper word)
  When Mitsubishi Heavy Industries MP scale is used, this value must be set to an offset amount from motor encoder.

  Setting value: [Pulse]

INFO

When drive-related parameters are set to a value extending over upper and lower words, the following settings are required:

To set MD3210 (Pn20A) and MD3211 (MD20B) to 90000,

1. Convert 90000 to a hexadecimal number.

   Example: 90000 = 15F90H

2. Separate the hexadecimal number into upper and lower words.

   Example: Upper word = 1H; Lower word = 5F90H

3. Convert the upper word to a decimal number again and set MD3211 to the decimal number.

   Example: 1H = 1
   MD3211 = 1

4. Convert the lower word to a decimal number again and set MD3210 to the decimal number.

   Example: 5F90H = 24464
   MD3210 = 24464

Method for setting zero offset of Mitsubishi Heavy Industries MP scale

1. Initializing an offset

   Set MD3508 (Pn808) and MD3509 (Pn809) to "0" and carry out NCK reset.

2. Initializing motor encoder

   Select Fn008 and press [DATA ENTER] key. Display "PGCL5" by pressing [Up] and [Down] keys.
   Press [DSPL/SET] key to display "done". This completes the initialization. Carry out NCK reset.

3. Un00D: Checking motor encoder absolute position (2 words displayed in hexadecimal), rotate the motor until it comes to a position denoted by a lower word "00XX" (Upper byte is zero), near the motor encoder origin. Carry out NCK reset.

4. Enabling MP scale, check absolute positions of the motor encoder and MP scale immediately after drive control power is turned on. Installing a Digital operator, check the following data of an axis that is to be set up.

   Un00D: Motor encoder absolute position (2 words displayed in hexadecimal)

   Convert the hexadecimal number to a decimal number so that it can be used in the next step 5.

   Un00E: MP scale absolute position (2 words displayed in hexadecimal)

   Convert the hexadecimal number to a decimal number so that it can be used in the next step 5.

   Note: For Un00D and Un00E, you can display both upper word (H. XXXX) and lower word (L. XXXX) by switching between the words using [Up] and [Down] keys. Be sure to check both of the words.

5. Calculating offset AA.

   AA = Un00D × (The number of MP scale pulses per motor rotation / (The number of motor encoder pulses)) - Un00E

   Where,

   The number of MP scale pulses per motor rotation: A setting value of MD3210 (Pn20A) and MD3211 (Pn20B).

   The number of motor encoder pulses: The number of pulses in the motor encoder list (See Table 4.2) / 4

   Example: For 17-bit encoder, assign 32768.

6. Setting offset

   Set MD3508 (Pn808) and MD3509 (Pn809) to AA calculated in the step 5.

   AA may be a negative number. For how to set the values, refer to the following examples.

◀ EXAMPLE ▶

Example: How to set MD3508 (Pn808) and MD3509 (Pn809) to 1000

a) Set MD3509

   MD3509 = 0

b) Set MD3508

   MD3508 = 1000

◀ EXAMPLE ▶

Example: How to set MD3508 (Pn808) and MD3509 (Pn809) to -1000

a) Convert -1000 to an 8-digit hexadecimal number.

   Example: -1000 = FFFFFC18H

b) Separate the hexadecimal number into upper and lower words.

   Example: Upper word = FFFFH; Lower word = FC18H

c) Convert the upper word to a decimal number again and assign it to MD3509.

   Example: FFFFH = 65535
   MD3509 = 65535

d) Convert the lower word to a decimal number again and assign it to MD3508.

   Example: FC18H = 64536
   MD3508 = 64536

Note: After setting MD3508 and MD3509, carry out NCK reset.

Spindle drive

If a External encoder is to be used at a Spindle drive, the encoder at the Spindle motor must be a serial encoder. You cannot use pulse encoders both for motor encoder and for External encoder at the same time.

- MD6530 (Cn530) ENCODER_SPECIFICATION_1 (For each axis)

  Meaning: External encoder specification

  Setting value: Bit 1, 0 — 0, 0 --- No encoder used.
  0, 1 --- External encoder used.
  1, 0 --- Motor encoder used.

  Bit 2 — 0 --- CCW rotation to be treated as forward rotation.
  (1 --- CW rotation to be treated as forward rotation.)

  Note: To set up reverse rotation connection, use CNC parameter.

  Bit 6 — 0 --- Incremental encoder
  1 --- Absolute encoder

  Bit 7 — 0 --- Pulse encoder
  1 --- Serial encoder

- MD6534 (Cn534) NUMBER_OF_ENCODER_PULSE_1 (For each axis)

  Meaning: The number of motor encoder pulses (4-multiplication value)

  Setting value: 11 --- 2048 Pulse encoder
  12 --- 4096 Pulse encoder
  13 --- 8192 Pulse encoder
  19 --- 19-bit Serial encoder

  Note: If this parameter is set to a number ranging from 8 to 32, the parameter represents a value of n in "2 to the n-th power" pulse type encoder. If the parameter is set to "32" or larger number, the parameter represents the number of 4-multiplication pulses of a pulse encoder.

- MD6915 (Cn87F) FULL_CLOSED_PG_PULSE_L_1 (For each axis)

  Meaning: The number of PG pulses used for position control / Single revolution of motor (Lower word)

  Setting value: [Pulse]

- MD6916 (Cn880) FULL_CLOSED_PG_PULSE_H_1 (For each axis)

  Meaning: The number of PG pulses used for position control / Single revolution of motor (Upper word)

  Setting value: [Pulse]

  Note: If a External encoder is used, set MD6915 and MD6916 to the number of pulses of the External encoder.
  Assign a 4-multiplication number to MD6915 and MD6916.

The next 2 pages show lists of machine data and parameters to be set in accordance with specifications of feed axis-related motor encoder and External encoder.

Table 14.4 A list of feed axis encoder-related CNC parameters

A list of feed axis encoder-related Servo drive parameters

Machine data No.	Machine data name	Description	External encoder / Rotary encoder / Absolute / Linear axis	External encoder / Rotary encoder / Absolute / Rotary axis	External encoder / Rotary encoder / Incremental / Linear axis	External encoder / Rotary encoder / Incremental / Rotary axis	External encoder / Linear scale / Absolute / –	External encoder / Linear scale / Incremental / –	Motor encoder / Rotary encoder / Absolute / Linear axis	Motor encoder / Rotary encoder / Absolute / Rotary axis	Motor encoder / Rotary encoder / Incremental / Linear axis	Motor encoder / Rotary encoder / Incremental / Rotary axis
MD30200	NUM_ENCS	The number of encoders	2	2	2	2	2	2	1	1	1	1
MD30230	ENC_INPUT_NR[0]	Encoder input port No. [0]	1	1	1	1	1	1	1	1	1	1
MD30230	ENC_INPUT_NR[1]	Encoder input port No. [1]	1	1	1	1	1	1	–	–	–	–
MD30240	ENC_TYPE[0]	Encoder type (Incremental/absolute) setting [0]	4	4	1	1	4	1	4	4	1	1
MD30240	ENC_TYPE[1]	Encoder type (Incremental/absolute) setting [1]	4	4	1	1	4	1	–	–	–	–
MD30260	ABS_INC_RATIO[0]	G1_XIST/G1_XIST2 ratio [0]	1	1	1	1	1	1	1	1	1	1
MD30260	ABS_INC_RATIO[1]	G1_XIST/G1_XIST2 ratio [1]	1	1	1	1	1	1	1	1	1	1
MD30300	IS_ROT_AX	Rotary axis/Linear axis	0	1	0	1	0	0	0	1	0	1
MD30310	ROT_IS_MODULO	Rotary axis/Linear axis	0	1	0	1	0	0	0	1	0	1
MD30320	DISPLAY_IS_MODULO	Rotary axis/Linear axis	0	1	0	1	0	0	0	1	0	1
MD31000	ENC_IS_LINEAR[0]	Linear scale setting [0]	0	0	0	0	0	0	0	0	0	0
MD31000	ENC_IS_LINEAR[1]	Linear scale setting [1]	0	0	0	0	1	1	–	–	–	–
MD31010	ENC_GRID_POINT_DIST[0]	Linear scale resolution [0]	–	–	–	–	–	–	–	–	–	–
MD31010	ENC_GRID_POINT_DIST[1]	Linear scale resolution [1]	–	–	–	–	mm/pulse	mm/pulse	–	–	–	–
MD31020	ENC_RESOL[0]	The number of encoder pulses 1 [0]	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev	(pulse/2048)/rev
MD31020	ENC_RESOL[1]	The number of encoder pulses 1 [1]	(pulse/4)/rev	(pulse/4)/rev	(pulse/4)/rev	(pulse/4)/rev	–	–	–	–	–	–
MD31025	ENC_PULSE_MULT[0]	The number of encoder pulses 2 [0]	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
MD31025	ENC_PULSE_MULT[1]	The number of encoder pulses 2 [1]	4	4	4	4	1	1	–	–	–	–
MD31030	LEADSCREW_PITCH	Ball screw pitch	mm/rev	–	mm/rev	–	–	–	mm/rev	–	mm/rev	–
MD31040	ENC_IS_DIRECT[0]	Load axis encoder setting [0]	0	0	0	0	0	0	0	0	0	0
MD31040	ENC_IS_DIRECT[1]	Load axis encoder setting [1]	1	1	1	1	1	1	–	–	–	–
MD31050	DRIVE_AX_RATIO_DENOM[0]	Load gear denominator	Motor rotation amount	Motor rotation amount	Motor rotation amount	Motor rotation amount	1	1	Motor rotation amount	Motor rotation amount	Motor rotation amount	Motor rotation amount
MD31060	DRIVE_AX_RATIO_NUMERA[0]	Load gear numerator	Mechanical rotation amount	Mechanical rotation amount	Mechanical rotation amount	Mechanical rotation	1	1	Mechanical rotation	Mechanical rotation amount	Mechanical rotation amount	Mechanical rotation
MD31070	DRIVE_ENC_RATIO_DENOM[0]	Electronic gear denominator [0]	1	1	1	1	1	1	1	1	1	1
MD31070	DRIVE_ENC_RATIO_DENOM[1]	Electronic gear denominator [1]	1	1	1	1	1	1	–	–	–	–
MD31080	DRIVE_ENC_RATIO_NEMERA[0]	Electronic gear numerator [0]	1	1	1	1	1	1	1	1	1	1
MD31080	DRIVE_ENC_RATIO_NEMERA[1]	Electronic gear numerator [1]	1	1	1	1	1	1	–	–	–	–
MD32100	AX_MOTION_DIR	Forward/Reverse rotation connection	1/-1	1/-1	1/-1	1/-1	1/-1	1/-1	1/-1	1/-1	1/-1	1/-1
MD32642	STIFFNESS_CONTROL_CONFIG	Full-closed type	1	1	1	1	1	1	0	0	0	0
MD34200	ENC_REFP_MODE[0]	Return to reference point mode	0	0	1	1	0	1	0	0	1	1
MD34200	ENC_REFP_MODE[1]	Return to referencen point mode [1]	0	0	1	1	0	1	–	–	–	–
MD34220	ENC_ABS_TURNS_MODULO[0]	Rotary axis encoder multi-turn limit value [0]	–	1 more than Pn205 value	–	–	–	–	–	1 more than Pn205	–	–
MD34220	ENC_ABS_TURNS_MODULO[1]	Rotary axis encoder multi-turn limit value [0]	–	1	–	1	–	–	–	–	–	–
MD36300	ENC_FREQ_LIMIT[1]	Encoder frequency clump	1200000	1200000	1200000	1200000	1200000	1200000	–	–	–	–

Table 14.5 A list of feed axis encoder-related Servo drive parameters

A list of feed axis encoder-related Servo drive parameters

Parameter No.	Parameter name	Description	External encoder						Motor encoder			
			Rotary encoder				Linear scale		Rotary encoder			
			Absolute		Incremental		Absolute	Incremental	Absolute		Incremental	
			Linear axis	Rotary axis	Linear axis	Rotary axis	–	–	Linear axis	Rotary axis	Linear axis	Rotary axis
MD3000 Digit 3 (Pn000 digit 0)	FUNCTION_SWITCH_BASIC	Encoder forward/reverse rotation	0	0	0	0	0	0	0	0	0	0
MD3002 Digit 2 (Pn002 digit 2)	FUNCTION_SWITCH_APPLIC2	Absolute encoder (Motor encoder) designation	0	0	1	1	0	1	0	0	1	1
MD3002 Digit 3 (Pn002 digit 3)	FUNCTION_SWITCH_APPLIC2	External encoder setting	6	6	2	2	5	1	0	0	0	0
MD3006 Digit 2 (Pn006 digit 2)	FUNCTION_SWITCH_APPLIC6	Full-closed specification	0	0	0	0	0	0	0	0	0	0
MD3205(Pn205)	MULTI_TURN_LIMIT	Multi-turn limit	Encoder setting value Gear ratio setting when MP scale is used.	Encoder setting value Gear ratio setting when MP scale is used.	–	–	–	–	Encoder setting value	Encoder setting value	–	–
MD3207 Digit 3 (Pn207 digit 3)	SWITCH_POSITION_REF	External PG type selection	1 or 3	1 or 3	1	1	0 or 3	0	–	–	–	–
MD3210(Pn20A) MD3211(Pn20B)	PG_PRS_MTRRND_LW_FULLCLOSED PG_PRS_MTRRND_HW_FULLCLOSED	The number of full-closed PG pulses / Single revolution of motor	(pulse/4)/rev	(pulse/4)/rev	(pulse/4)/rev	(pulse/4)/rev	(pulse/4)/rev	(pulse/4)/rev	–	–	–	–
MD3212(Pn20C) MD3213(Pn20D)	PG_PRS_ENCRND_LW_FULLCLOSED PG_PRS_ENCRND_HW_FULLCLOSED	The number of full-closed PG pulses / Single revolution of encoder	(pulse/4)/rev	(pulse/4)/rev	–	(pulse/4)/rev	(pulse/4)/rev	–	–	–	–	–
MD3214(Pn20E) MD3215(Pn20F)	ELECTRIC_GEAR_NUMERATOR_LW ELECTRIC_GEAR_NUMERATOR_HW	Electronic gear ratio (Denominator)	1	1	1	1	1	1	1	1	1	1
MD3216(Pn210) MD3217(Pn211)	ELECTRIC_GEAR_DENOMIN_LW ELECTRIC_GEAR_DENOMIN_HW	Electronic gear ratio (Numerator)	1	1	1	1	1	1	1	1	1	1
MD3231(PN21F)	PG_PLS_ENCRND_Z_PHASE	The number of Z-phase pulses / Single revolution of External encoder.	Gear ratio setting when MP scale is used.	Gear ratio setting when MP scale is used.	–	–	–	–	–	–	–	–
MD3508(Pn808) MD3509(Pn809)	ABS_PG_ZERO_POINT_OFFS_LW ABS_PG_ZERO_POINT_OFFS_LW	Absolute PG zero position offset	Gear ratio setting when MP scale is used.	Gear ratio setting when MP scale is used.	–	–	–	–	–	–	–	–

14.1.7 Maximum number of motor revolutions

■ CNC setting

- MD32250 RATED_OUTVAL [0] (For each axis) ##

  Meaning: Ratio of speed reference to maximum number of motor revolutions

  Standard setting value: 100 [%]

- MD32260 RATED_VELO [0] (For each axis)

  Meaning: Maximum number of motor revolutions

  Setting value: To be set to maximum number of motor revolutions (the number of revolutions [min^{-1}] under maximum command value)
  Assign the value of MD880.

  Note: In the case of a Servo drive, the parameter is to be set to specified maximum number of motor revolutions × 1.2 (Over-speed alarm detection speed).

■ Drive setting

Settings of Servo axis and Spindle drives in common

- MD880 NORMALIZATION_OVER_PROFIBUS (For each axis)

  Meaning: The number of motor revolutions under maximum speed reference (ox40000000) at PROFIBUS.

  Setting value: Setting this parameter is prohibited because it is automatically set to internal drive data.

  CNC creates a value equivalent to MD32260 using this parameter if [min^{-1}] and MD32250 = 0.

Servo drive

No related parameter exists. Maximum number of motor revolutions is automatically read from a motor encoder and set. The setting value multiplied by 1.2 is displayed at MD880.

Spindle drive

- MD6500 (Cn500) RATED_SPEED_SETTING (For each axis)

  Meaning: Rated speed

  Setting value: [min^{-1}]
  The value of this parameter is also displayed at MD880.

14.1.8 Various mask settings

■ Settings at CNC

At CNC, you can mask some processing to be done with each drive. Always set the parameter to "0" to disable the masks unless you specifically need to use the masks for temporary examination purpose or so.

- MD13070 DRIVE_FUNCTION_MASK [0] (1st axis) ##
  MD13070 DRIVE_FUNCTION_MASK [1] (2nd axis) ##
  : (Repeat for all remaining axes)
  Meaning: d0 --- Reading alarm from a drive
  d1 --- Reading ACC file (parameter definition file) from a drive
  d2 --- Reading encoder-related parameters from a drive
  d3 --- Reading drive control-related parameters from a drive

  Setting value: 0 --- Not to be masked
  1 --- To be masked

  Standard setting value: 0

■ Settings at drive

Spindle drive

By setting this parameter, you can mask the following alarms.

- MD7018 (Cn8E6) ALARM_MASK (For each axis)
  Meaning: Alarm mask
  Initial value: 0000 (Hex)
  The following shows alarms to be masked with bit wise settings:
  d0: ALM_OHL Motor thermistor wire break (A:79)
  d1: ALM_OHM Motor overheat 2 (A:79)
  d2: ALM_CUV Control circuit low voltage (A:43)
  d3: ALM_IFANERR Internal cooling fan error (A:75)
  d4: ALM_OHF Heat sink overheat 2 (A:7A)
  d5: ALM_UV Under voltage (A:41)
  d6: ALM_ADE850E CPU-embedded A/D error (A:B2)
  d7: ALM_WDC_ERR WDC error (A:E2)
  ALM_DPRAM DPRAM error (A:06)
  ALM_COMSYNC Network synchronization error (A:E5)
  d8: ALM_FPGBREAK1 FPG wire break (PA and PB) (A:C6)
  d9: ALM_FPGBREAK2 FPG wire break (PC) (A:C7)
  d10: ALM_DEV Speed deviation too large (A:53)

  Setting example: When Spindle motor is removed off --- 0303H (Set d0, d1, d8, and d9 to "1".) With this setting, Spindle servo can be turned on.

14.1.9 Software version number check

■ CNC version number check

Check a CNC version number by pressing function keys "Diagnosis", "Service displays", and "Version" in this order.

■ Converter main version number

Connecting a Digital operator to a Converter, check the version number in the following procedures:

1. Select a Converter (con) by pressing [Up] or [Down] key and press [DATA ENTER] key.
2. A lower word address "L0000" is displayed. Enter "L0002".
3. Press [DSPL/SET] key to display an upper word address "h0000". Enter "hA0001".
4. Press [DATA ENTER] key to display a Converter software version number.

■ Converter communication module version number

You can check a Converter communication module version number using the following machine data for each drive. (Those drives under the same Converter show the same version number.)

- MD1795 OPTMOD_FIRMWARE_VIRSION (For each axis)
  Meaning: Communication software version number (Read-only)

■ Servo drive unit version number

Connect a Digital operator to a Converter and check the version number in the following procedures:

1. Select a drive (dr1, dr2...: the drive number is a value, 1 more than the rotary switch setting value of each drive) to check by pressing [Up] or [Down] keys. Press [DATA ENTER] key.
2. Press [DSPL/SET] key to display "Fn □□□ , and then select "Fn012".
3. Press [DATA ENTER] key to display a drive software version number.

■ Spindle drive unit version number

Connect a Digital operator to a Converter and check the version number in the following procedures:

1. Select a drive (dr1, dr2...: the drive number is a value, 1 more than the rotary switch setting value of each drive) to check by pressing [Up] or [Down] keys. Press [DATA ENTER] key.
2. Press [DSPL/SET] key to display "Un □□□ , and then select "Un021".
3. Press [DATA ENTER] key to display a drive software version number.

■ Servo/Spindle drive ACC file version number

You can check a version number of a parameter format file (ACC file) using the following machine data for each drive.

- MD1799 FIRMWARE_VIRSION (For each axis)
  Meaning: ACC file version number (Read-only)

b15 b10	b9 b8	b7 b0
Converter ACC version	Axis type	Drive ACC version
0-63	Refer to the following types	0-255

Axis type

00: Servo drive
01: Spindle drive
10 and 11: Reserved

14.1.10 Parameter initialization

Initialize parameters of each drive to restore the factory default settings.

Servo drive

Initialize parameters using a Digital operator in the following procedures:

1. Connect a Digital operator to a Converter and select a drive (dr1, dr2...: the drive number is a value, 1 more than the rotary switch setting value of each drive) to check by pressing [Up] or [Down] keys. Press [DATA ENTER] key.
2. Press [DSPL SET] key to display "Fn □□□ ". Select "Fn005" and press [DATA ENTER] key.
3. "P. INIT" is displayed.
4. Press [DSPL SET] key. "done" is displayed and initialization completes.

Spindle drive

Initialize parameters by setting the following drive parameters.

- MD6988 (Cn8C8) RESERVED_FOR_USER_OF (Spindle)

  Meaning: Parameter initialization
  Setting value: 0 --- Initial value
  1 --- Initialization start

Note: Notice that carrying out the initialization changes parameter values that you have set to factory default values. Take a note of all the parameters you have changed before starting the initialization.

14.1.11 Alarm display

■ Display at CNC

If an alarm is issued in a drive, the following alarm is displayed. Since this alarm is transmitted from the drive to a CNC through a high-speed cyclic communication line, the alarm indication at CNC precisely shows the time when the alarm was issued.

◀ EXAMPLE ▶ Example: When an alarm is issued at X1 axis.

25201: X1 drive failure

Detailed information on the alarm is displayed on CNC screen.

When alarm "41" is issued at X1 axis and then alarm "255" is issued at Y1 axis

```
380500:  PROFIBUS DP:    Drive X1,    Code 41,     Value 0,    Time 524112
380500:  PROFIBUS DP:    Drive Y1,    Code 255,    Value 0,    Time 524112
```

Alarm time counter (in ms)
Alarm group code
Alarm-issuing axis name
CNC alarm code (Drive-related alarm load in common)

Since this information is transmitted from the drive to the CNC through a low-speed message line, the alarm indication at CNC has a few-minute delay from the alarm-issued time. However, the alarm time counter shows a precise time.

■ Drive Digital operator display

Alarm for an axis selected by the Digital operator is displayed as follows:

Example: A.51 --- Alarm "51" (a "Drive code" in the Alarm list) is issued at a drive selected.

INFO

- Alarm code for a drive is displayed in decimal number on the CNC screen, while it is displayed in hexadecimal number on the Digital operator.
- For drive alarm codes, refer to Appendix B.1 "List of Servo unit alarms" and Appendix B.2 "List of Inverter alarms".

14.2 Servo control

14.2.1 Position control

In DSC, CNC and a drive share the position control, so that CNC also has the position control-related machine data. The following explains how to set fundamental machine data and parameters for position control.

■ CNC setting

- MD10230 SCALING FACTOR_USER_DEF [9] (For all axes in common) ##

  Meaning: Position loop gain setting unit

  Setting value: 1.0 [1/s]

  With this setting, the unit of position loop gain MD32200 becomes [1/s].

  Note: If 16.66666667 has been assigned, the setting unit of MD32200 (position loop gain) is [m/min/mm].

- MD32200 POSCTRL_GAIN [0] (For each units)

  Meaning: Position loop gain

  Setting value: [1/s] (The unit defined by MD10230 becomes the unit of the position loop gain.)

- MD36400 CONTOR_TOL (For each axis)

  Meaning: Maximum deviation [Command unit (mm, deg, and others)]

  Setting value: To be set to the following value.

$$\frac{\text{Maximum feed speed [Command unit (mm, deg, and others)]} \times 1.2}{\text{Position loop gain [1/s]} \times 60}$$

■ Drive setting

Servo drive

- MD3000 digit 1 (Pn000 digit 1) FUNCTION_SWITCH_BASIC (For each axis) ##

  Meaning: Position control is enabled/disabled.

  Setting value: 0 --- Position control is disabled.

  1 --- Position control is enabled.

  7 --- Position control and speed control are switched over.

  Must be set to "7".

- MD3032 (Pn102) KP (For each axis)

  Meaning: Position loop gain

  Setting value: [0.1/s]

  This value is not used for DSC control, but used internally for calculating gain and others of the quadrant error compensation function. Set this parameter to a value of MD32200 at CNC, paying attention to the setting unit.

- MD3069 digit 0 (Pn127 digit 0) SWITCH_FUNCTION_2 (For each axis) ##

  Meaning: Method for setting position loop gain

  Setting value: 0 --- Drive setting value is used.
  1 --- The value set from CNC cyclic data is used.

  Note: Be sure to set this parameter to "1".

- MD3425 (Pn505) OVERFLOW_LEVEL (For each axis) ##

  Meaning: Excessive deviation area (Over flow level)

  Setting value: Values obtained from the following equations are to be set.
  (The number of encoder pulses is a 4-multiplication value.)

  - For motor encoder

$$\frac{\text{The number of revolutions [min}^{-1}\text{] at maximum feed speed} \times \text{The number of motor encoder pulses} \times 1.2}{\text{Position loop gain [1/s]} \times 256 \times 60}$$

  - For External encoder

$$\frac{\text{The number of revolutions [min}^{-1}\text{] at maximum feed speed} \times \text{(PPN)} \times 1.2}{\text{Position loop gain [1/s]} \times 256 \times 60}$$

  Where, (PPN) = The number of External encoder pulses / Single revolution of motor.

Spindle drive

- MD6522 (Cn522) MULTI_FUNCTION_SEL_SSC ##

  Meaning: Multi-function selection SSC

  Setting value: 0 --- SSC is set to "Soft start cancelled."
  1 --- SSC is set to "Servo mode."

  Note: Be sure to set the parameter to "1". When position control is carried out (for example, for orientation, tapping, or others), the operation mode must be "Full-time Servo mode."

- MD6837 (Cn831) GAIN_SWITCH ##

  Meaning: Method for setting position loop gain (Variable KP selection)

  Setting value: 0000 --- Drive setting value is used.
  0100 --- A value obtained from CNC cyclic data is used.

  Note: Be sure to set the parameter to "0100".

- MD6965 (Cn8B1) OVERFLOW_LEVEL (For each axis) ##

  Meaning: Excessive deviation area (Over flow level)

  Setting value: Values obtained from the following equations are to be set. (The number of encoder pulses is a 4-multiplication value.)

  - For pulse encoder

$$\frac{\text{The number of revolutions [min}^{-1}\text{] at maximum feed speed} \times \text{The number of motor encoder pulses} \times 1.2}{\text{Position loop gain [1/s]} \times 60}$$

  - For serial encoder

$$\frac{\text{The number of revolutions [min}^{-1}\text{] at maximum feed speed} \times \text{The number of motor encoder pulses} \times 1.2}{\text{Position loop gain [1/s]} \times 256 \times 60}$$

14.2.2 Speed control

The following explains how to set fundamental drive parameters for speed control.

Servo drive

- MD3030 (Pn100) KV (For each axis)

  Meaning: Speed loop gain

  Setting value: [0.1 Hz]
  To express the setting value in previous unit [1/s], multiply the value by $2\pi/10$.

- MD3031 (Pn101) KVI (For each axis)

  Meaning: Speed loop integration time constant
  Setting value: [0.01 ms]

- MD3033 (Pn103) LOAD_INERTIA_RATIO

  Meaning: Load inertia ratio to motor inertia
  Setting value: [%]

- MD3041 digit 1 (Pn10B digit 1) GAIN_SWITCH (For each axis) ##

  Meaning: Switching between PI control and IP control
  Setting value: 0 --- PI control is applied to speed control.
  1 --- IP control is applied to speed control.

  Standard setting value: 1

- MD3351 (Pn401) TIME_CONST_TRQ_REF_FILTER (For each axis)

  Meaning: 1st-stage torque reference filter time constant
  Setting value: [0.01 ms]

- MD3363 (Pn40D) TORQUE_FILTER_CONSTANT_2 (For each axis)

  Meaning: 2nd-stage torque reference filter time constant
  Setting value: [0.01 ms]

- MD3364 (Pn40E) TORQUE_FILTER_CONSTANT_3 (For each axis)

  Meaning: 3rd stage torque reference filter time constant
  Setting value: [0.001 ms]

Spindle drive

- MD6060 (Cn060) ASR_P_GAIN_H_I (For each axis)

  Meaning: Speed control proportional gain (H gear)
  Setting value: [0.1%/Hz]

- MD6061 (Cn061) ASR_I_TIME_H_I (For each axis)

  Meaning: Speed control integration time (H gear)
  Setting value: [0.1 ms]

- MD6062 (Cn062) ASR_P_GAIN_M_L_I (For each axis)

  Meaning: Speed control proportional gain (M and L gears)
  Setting value: [0.1%/Hz]

- MD6063 (Cn063) ASR_I_TIME_M_L_I (For each axis)
  Meaning: Speed control integration time (M and L gears)
  Setting value: [0.1 ms]

14.2.3 Spindle servo mode

In YS 840DI system, the Spindle speed control is to be set to servo mode. The following explains how to set fundamental Spindle drive parameters relating to servo mode.

- MD6522 (Cn522) MULTI_FUNCTION_SEL_SSC ##
  Meaning: Multi-function selection SSC
  Setting value: 0 --- SSC is set to "Soft start cancelled."
  1 --- SSC is set to "Servo mode."

  Note: Be sure to set the parameter to "1".
- MD6064 (Cn064) ASR_P_GAIN_H_2 (For each axis)
  Meaning: Speed control proportional gain (H gear in servo mode)
  Setting value: [0.1%/Hz]
- MD6065 (Cn065) ASR_I_TIME_H_2 (For each axis)
  Meaning: Speed control integration time (H gear in servo mode)
  Setting value: [0.1 ms]
- MD6066 (Cn066) ASR_P_GAIN_M_L_2 (For each axis)
  Meaning: Speed control proportional gain (M and L gears in servo mode)
  Setting value: [0.1%/Hz]
- MD6067 (Cn067) ASR_I_TIME_M_L_2 (For each axis)
  Meaning: Speed control integration time (M and L gears in servo mode)
  Setting value: [0.1 ms]
- MD6201 (Cn201) SV_MODE_FLUX_LEVEL_H (For each axis)
  Meaning: Servo mode flux level (H gear)
  Setting value: [%]
- MD6202 (Cn202) SV_BASE_SPEED_RATIO_H (For each axis)
  Meaning: Servo mode base speed ratio (H gear)
  Setting value: [0.01 times]
- MD6203 (Cn203) SV_MODE_FLUX_LEVEL_M_L (For each axis)
  Meaning: Servo mode flux level (M and L gears)
  Setting value: [%]
- MD6204 (Cn204) SV_BASE_SPEED_RATIO_M_L (For each axis)
  Meaning: Servo mode base speed ratio (M and L gears)
  Setting value: [0.01 times]

14.2.4 Backlash compensation

In YS 840DI system, backlash compensation is carried out at CNC. The following explains how to set backlash-related machine data.

- MD32450 BACKLASH [0] (For each axis)

  Meaning: Backlash compensation amount

  Setting value: [mm]

  Note: For variable-speed backlash compensation function, refer to separate specifications.

14.2.5 Quadrant error compensation

In YS 840DI system, functional quadrant error compensation function is used as a quadrant error compensation function for Servo axis.
The quadrant error compensation is carried out at a drive. (The compensation function in the CNC cannot be used.)

The following shows parameters relating to this function.
For detailed procedures to adjust functional quadrant error compensation function, refer to a separate instruction manual.

- MD3068 digit 1 (Pn126 digit 1) SWITCH_FUNCTION_1 (For each axis)

  Meaning: Selection of functional quadrant error compensation function

  Setting value: 0 --- Disabled
  1 --- Enabled (Without pulse suppression processing)
  2 --- Enabled (With pulse suppression processing)

  Note: Be sure to set the parameter to "2".

- MD3101 (Pn147) 1ST_P_GAIN_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 1st-stage gain (Negative -> Positive)

  Setting value: [0.00001/s^3]
  Equivalent to the quadrant error compensation 1st-stage integration time constant for J300/J100 system.
  For relations with previous parameters, refer to the (INFO) mentioned later.

- MD3102 (Pn148) 1ST_P_LMT_OFS_QUAD_ERR_COM (For each axis)

  Meaning: Quadrant error compensation 1st-stage limit offset (Negative -> Positive)

  Setting value: [0.01%]

- MD3103 (Pn149) 2ND_P_GAIN_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 2nd-stage gain (Negative -> Positive)

  Setting value: [0.00001/s^3]
  Equivalent to the quadrant error compensation 2nd-stage integration time constant for J300/J100 system.
  For relations with previous parameters, refer to the (INFO) in the next page.

- MD3104 (Pn14A) 2ND_P_LMT_OFS_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 2nd-stage limit (Negative -> Positive)
  Setting value: [0.01%]

- MD3105 (Pn14B) P_LMT_ADJ_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation limit increment value (Negative -> Positive)
  Setting value: [0.01%/ms]

- MD3106 (Pn14C) P_LMT_CLAMP_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation upper limit value (Negative -> Positive)
  Setting value: [0.01%/ms]

- MD3107 (Pn14D) 1ST_N_GAIN_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 1st-stage gain (Positive -> Negative)

  Setting value: [0.00001/s^3]
  Equivalent to the quadrant error compensation 1st-stage integration time constant for J300/J100 system.
  For relations with previous parameters, refer to the (INFO) mentioned later.

- MD3108 (Pn14E) 1ST_N_LMT_OFS_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 1st-stage limit offset (Positive -> Negative)
  Setting value: [0.01%]

- MD3109 (Pn14F) 2ND_N_GAIN_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 2nd-stage gain (Positive -> Negative)

  Setting value: [0.00001/s^3]
  Equivalent to the quadrant error compensation 2nd-stage integration time constant for J300/J100 system.
  For relations with previous parameters, refer to the (INFO) mentioned later.

- MD3110 (Pn150) 2ND_N_LMT_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation 2nd-stage limit (Positive -> Negative)
  Setting value: [0.01%]

- MD3111 (Pn151) N_LMT_ADJ_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation limit increment value (Positive -> Negative)
  Setting value: [0.01%/ms]

- MD3112 (Pn152) N_LMT_CLAMP_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation upper limit value (Positive -> Negative)

  Setting value: [0.01%/ms]

- MD3113 (Pn153) TIMING_CONST_QUAD_ERR_COMP (For each axis)

  Meaning: Quadrant error compensation timing constant

  Setting value: [0.1/s]

- MD3083 (Pn135) EQUIV_KP_ADJ_PREDICTED_I

  Meaning: 1st predictive control equivalent Kp fine adjustment amount (Quadrant error compensation timing constant when predictive control is used.)

  Setting value: [0.1/s]

The following figure shows relations between above-mentioned parameters and compensation amount waveform.

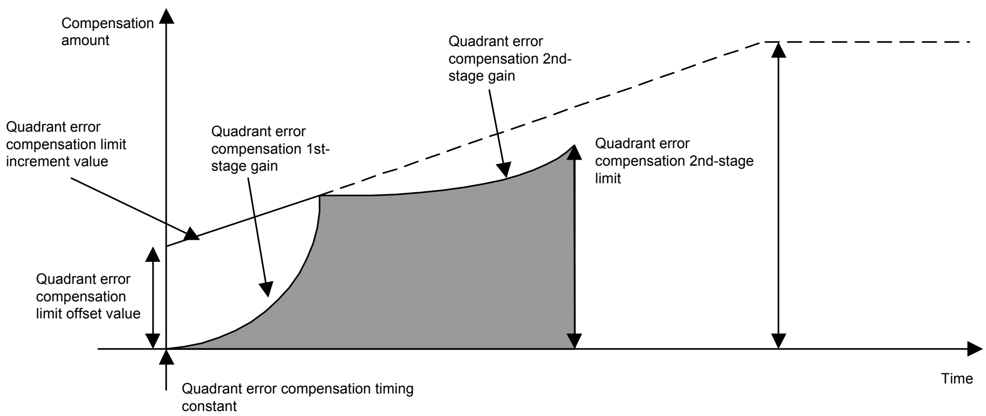


Fig. 14.1 Functional quadrant error compensation waveform

INFO

You can use quadrant error compensation 1st-stage gain and quadrant error compensation 2nd-stage gain as replacement parameters of quadrant error compensation 1st-stage integration time constant and quadrant error compensation 2nd-stage integration time constant of J300/J100 specification respectively. However, notice that their setting values are different.

By previous specification, the quadrant error compensation n-th stage gain "Kn" was expressed in (Tin [sec]), while by this specification, the "Kn" is expressed as follows:

Kn [0.00001/s^3] = Kp x Kv/Tin/10000

Where,

Kp: Position loop gain [1/s]

Kv: Speed loop gain [1/s] (Pay attention that this is not the drive setting unit [Hz].)

Tin: Quadrant error compensation n-th stage integration time constant [sec] (Pay attention that previous parameter setting value is [0.01 ms].)

Example) When Kp = 40 [1/s], Kv = 300 [1/s], and Tim = 0.5 [ms], Kn [0.00001/s^3] = 40 × 300/ 0.0005/100000 = 240 [0.00001/s^3]

14.2.6 Torque reference notch filter

To suppress stationary vibrations such as sympathetic axis vibration, created by Servo axis, of 400 Hz or higher, use a torque reference notch filter. The following shows parameters relating to the torque reference notch filter. For further information on the torque reference notch filter, refer to a separate instruction manual.

- MD3358 digit 0 (Pn408 digit 0) SWITCH_NOTCH_FILTERS (For each axis)

  Meaning: 1st-stage notch filter selection
  Setting value: 0 --- Disabled
  1 --- Enabled

- MD3358 digit 1 (Pn408 digit 1) SWITCH_NOTCH_FILTERS (For each axis)

  Meaning: 2nd-stage notch filter selection
  Setting value: 0 --- Disabled
  1 --- Enabled

- MD3359 (Pn409) FREQUENCY_NOTCH_FILTERS_1 (For each axis)

  Meaning: 1st-stage notch filter frequency
  Setting value: [Hz]

- MD3360 (Pn40A) Q_VALUE_NOTCH_FILTERS_1 (For each axis)

  Meaning: 1st-stage notch filter Q-value
  Setting value: [0.01 times]

- MD3361 (Pn40B) FREQUENCY_NOTCH_FILTERS_2 (For each axis)

  Meaning: 2nd-stage notch filter frequency
  Setting value: [Hz]

- MD3362 (Pn40C) Q_VALUE_NOTCH_FILTERS_2 (For each axis)

  Meaning: 2nd-stage notch filter Q-value
  Setting value: [0.01 times]

Torque filters (3-stage) and notch filters (2-stage) can be used in any combinations. You can select torque filters for up to 3 stages. (Notice that this specification differs from that of J300/J100.)

14.2.7 Speed feedback compensation

You can suppress vibration and increase speed loop gain by using speed feedback compensation.
The following explains about parameters for speed feedback compensation.

- MD3046 digit 1 (Pn110 digit 1) SWITCH_ONLINE_AUTO_TUNING (For each axis)

  Meaning: Selects speed feedback compensation function

  Setting value: 0 --- Enabled
  1 --- Disabled

  Note: Pay attention to the polarity of "Enabled" and "Disabled".
- MD3047 (Pn111) SPEED_FEEDBACK_COMP_GAIN (For each axis)

  Meaning: Speed feedback compensation gain

  Setting value: [%]
- MD3048 (Pn112) SPEED_FEEDBACK_DELAY_COMP (For each axis)

  Meaning: Speed feedback delay compensation
  (Speed feedback compensation inertia gain)

  Setting value: [%]

  Note: Previous parameter "Speed feedback compensation attenuation factor" is no longer used.

Adjustment procedures

1. Check an axis to which you want to make an adjustment to disable speed feedback function (MD3046 digit 1 (Pn110 digit 1) = 1) by watching its torque waveform or others on the analog monitor, and confirm that the axis vibrates.
2. Assign the following values to the parameters above for the axis you want to make an adjustment.
   - MD3047 = 100
   - MD3048 = Setting value of MD3033 (Load inertia ratio) + 100
3. Enable speed feedback function (MD3046 digit 1 (Pn110 digit 1) = 0)
4. Adjust only the 1st-stage torque filter time constant by assigning a large value to MD3351 (Pn401) as far as no vibration happens at any feed speed. If a vibration happens, decrease the value.
   The maximum value that can be assigned to the MD3351 (Pn401) is calculated from the speed loop gain MD3030 (Pn100) as follows. Notice that you should assign a smallest possible value to it.
   - MD3351 = 600000/(MD3030 $\times$ 2π)
5. If no vibration happens in the procedure 4, increase speed loop gain MD3030 (Pn100).
6. If vibration starts while you are increasing MD3030, increase MD3351 paying attention to the above-mentioned maximum value.

7. When the MD3030 value is determined, set the speed loop integration time constant MD3030 (Pn101) as follows:
   - MD3030 = 2000000/(MD3030 $\times$ 2π)

INFO

- Be sure to set speed loop integration time constants to the same value among the interpolation axes; otherwise, processing accuracy is affected.
- If a low frequency vibration is produced when you use this function, use torque filters or torque reference notch filters instead.

14.2.8 Predictive control

To use predictive control for cutting feed and positioning, set the following machine data and parameters.
Predictive control having been enabled with the following settings may become active/inactive in the following cases:

- Predictive control for cutting feed: Always active during programmed operation except during rigid tapping.
  (Predictive control becomes inactive during rigid tapping because the Spindle and servo gain are to be equal each other.)
- Predictive control for positioning: Always active for positioning during RAPID, JOG, and programmed operations excluding during handle or step feed operations.
  (During handle and step feed operations, predictive control becomes inactive.)

For procedures how to set predictive control, refer to a separate manual.

INFO

If model following control is used for positioning, disable predictive control.

■ CNC setting

For feed axis

- MD37610 PROFIBUS_CTRL_CONFIG (For each Servo axis)
  Meaning: CNC feed mode transmission to a drive
  Setting value: 0 --- Disabled
  1 --- Enabled
  Assign "1" (Enabled) to this parameter if the predictive control is used.

Note: Set this parameter to "Disabled" for Spindle; otherwise, you cannot change over Spindle drive parameters (DBX21.0-2) from PLC.

■ Servo drive settings

For cutting feed

- MD3079 digit 0 (Pn131 digit 0) SWITCH_PREDICTED_1

  Meaning: 1st predictive control switch
  Setting value: 0 --- Disabled
  1 --- Enabled (Tp = 0.001)
  2 --- Enabled (Tp = 0.002)

- MD3038 (Pn132) PARAM_C_PREDICTED_1

  Meaning: 1st predictive control parameter C
  Setting value: [0.01]

- MD3081 (Pn133) PARAM_CD_PREDICTED_1

  Meaning: 1st predictive control parameter Cd
  Setting value: [0.01]

- MD3082 (Pn132) PARAM_ALPHA_PREDICTED_1

  Meaning: 1st predictive control parameter α
  Setting value: [0.01]

- MD3083 (Pn135) EQUIV_KP_ADJ_PREDICTED_1

  Meaning: 1st predictive control equivalent Kp fine adjustment amount
  Setting value: [0.1/s]

- MD3084 (Pn136) SPD_FF_GAIN_PREDICTED_1

  Meaning: 1st predictive control speed FF gain
  (Added to predictive feed forward control.)
  Setting value: [%]

- MD3085 (Pn137) TRQ_FF_GAIN_PREDICTED_1

  Meaning: 1st predictive control torque FF gain
  (Added to predictive feed forward control.)
  Setting value: [%]

- MD3086 (Pn138) TRQ_FF_FIL_T_CONST_PREDIC_1

  Meaning: 1st predictive control torque FF filter time constant
  (Added to predictive feed forward control.)
  Setting value: [0.01 ms]

For positioning

- MD3079 digit 1 (Pn131 digit 1) SWITCH_PREDICTED_1

  Meaning: 2nd predictive control switch
  Setting value: 0 --- Disabled
  1 --- Enabled (Tp = 0.001)
  2 --- Enabled (Tp = 0.002)

- MD3087 (Pn139) PARAM_C_PREDICTED_2

  Meaning: 2nd predictive control parameter C

  Setting value: [0.01]
- MD3088 (Pn13A) PARAM_CD_PREDICTED_2

  Meaning: 2nd predictive control parameter Cd

  Setting value: [0.01]
- MD3089 (Pn13B) PARAM_ALPHA_PREDICTED_2

  Meaning: 2nd predictive control parameter α

  Setting value: [0.01]
- MD3090 (Pn13C) EQUIV_KP_ADJ_PREDICTED_2

  Meaning: 2nd predictive control equivalent Kp fine adjustment amount

  Setting value: [0.1/s]
- MD3091 (Pn13D) SPD_FF_GAIN_PREDICTED_2

  Meaning: 2nd predictive control speed FF gain
  (Added to predictive feed forward control.)

  Setting value: [%]
- MAD3092 (Pn13E) TRQ_FF_GAIN_PREDICTED_2

  Meaning: 2nd predictive control torque FF gain
  (Added to predictive feed forward control.)

  Setting value: [%]
- MD3093 (Pn13F) TRQ_FF_FIL_T_CONST_PREDIC_2

  Meaning: 2nd predictive control torque FF filter time constant
  (Added to predictive feed forward control.)

  Setting value: [0.01 ms]

14.2.9 Model following control

To use model following control for positioning, set the following machine data and parameters.
When model following control is enabled with the following machine data and parameters, each of the parameters becomes always active for positioning (during RAPID, JOG, and programmed operation excluding handle feed or step feed operation.) (For cutting feed, rigid tapping, and handle or step feed operation, the model following control becomes inactive.)
For procedures how to adjust model following control, refer to a separate manual.

IMPORTANT

If you want to use predictive control for positioning, disable model following control.

■ CNC settings

For feed axis

- MD37610 PROFIBUS_CTRL_CONFIG (For each Servo axis)

  Meaning: CNC feed mode transmission to a drive

  Setting value: 0 --- Disabled
  1 --- Enabled
  Assign "1" (Enabled) to this parameter when model following control is used.

  Note: Set this parameter to "Disabled" for Spindle; otherwise, you cannot change over Spindle drive parameters (DBX21.0-2) from PLC.

■ For Servo drive

- MD3046 digit 3 (Pn110 digit 3) SWITCH_ONLINE_AUTO_TUNING (For each axis)

  Meaning: Model following control (MFC) selection

  Setting value: 0 --- Model following control is disabled.
  1 --- Rigid model following control is carried out.
  (2 --- 2-inertia model following control is carried out. You need to study separately whether or not to use 2-inertia model following control.)

- MD3527 digit 0 (Pn81B digit 0) MASK_MFC_BANKSEL_0_3 (For each axis)

  Meaning: Model Following Control (MFC) bank 0 mask

  Setting value: (0 --- Model following control is enabled.)
  1 --- Model following control is disabled.

  Note: Since model following control is to be used only for positioning, disable the bank 0 by default.

- MD3527 digit 1 (Pn81B digit 1) MASK_MFC_BANKSEL_0_3 (For each axis)

  Meaning: Model Following Control (MFC) bank 1 mask

  Setting value: 0 --- Model following control is enabled.
  (1 --- Model following control is disabled.)

  Note: Since model following control is to be used only for positioning, enable the bank 1 (for positioning.)

- MD3527 digit 2 (Pn81B digit 2) MASK_MFC_BANKSEL_0_3 (For each axis)

  Meaning: Model Following Control (MFC) bank 2 mask

  Setting value: (0 --- Model following control is enabled.)
  1 --- Model following control is disabled.

  Note: Since model following control is to be used only for positioning, disable the bank 2 (for cutting feed.)

- MD3527 digit 3 (Pn81B digit 3) MASK_MFC_BANKSEL_0_3 (For each axis)

  Meaning: Model Following Control (MFC) bank 3 mask
  Setting value: (0 --- Model following control is enabled.)
  1 --- Model following control is disabled.

  Note: Since model following control is to be used only for positioning, disable the bank 3 (for handle feed.)

- MD3055 (Pn119) LOOP_GAIN_MFC (For each axis)

  Meaning: MFC gain (Model position loop gain)
  Setting value: [0.1/s]

- MD3056 (Pn11A) DUMP_FACTOR_MFC (For each axis)

  Meaning: MFC attenuation coefficient (Model loop gain correction)
  Setting value: [0-1000]

- MD3059 (Pn11D) SPD_FF_GAIN_MFC (For each axis)

  Meaning: MFC speed FF gain
  Setting value: [0-1000]

- MD3060 (Pn11E) TRQ_FF_GAIN_MFC (For each axis)

  Meaning: MFC torque FF gain
  Setting value: [0-1000]

14.2.10 Stop vibration suppression

The following shows parameters relating to stop vibration suppression used for Servo axis. If stop vibration is produced, decrease a setting value of the following parameter until the vibration stops. (Lowest limit value: 50%)
Notice that stop vibration becomes decreased as the number of stages and the time constant of torque filter settings are decreased.
If a vibration is still produced irrespective of this function, use the vibration-damping control shown in 14.2.11 "Vibration-damping control".

- MD3114 (Pn154) DAMP_RATIO_ANTIVIB_ON_STP (For each axis)

  Meaning: Stop vibration suppression attenuation ratio
  Setting value: [%]
  Initial value: 100% (Function disabled)

  Note: To eliminate stop axis Kv drop, set the parameter to 50% or higher.
  Be careful that parameter settings are different from that for J300.
  (Initial setting value is 0%.)

- MD3115 (Pn155) START_TIME_ANTIVIB_ON_STP (For each axis)

  Meaning: Stop vibration suppression start time
  Setting value: [ms]
  Standard setting value: 1024 ms

14.2.11 Vibration-damping control

Use this function in order to suppress stationary vibrations ranging from about 50 Hz to 400 Hz at a Servo axis.
The following explains about parameters relating to vibration-damping control.

- MD3041 digit 3 (Pn10B digit 3) GAIN_SWITCH (For each axis)

  Meaning: Vibration-damping control selection

  Setting value: 0 --- Vibration-damping control disabled.
  3 --- A-type vibration-damping control enabled.
  (1 and 2 --- M1-type and M2-type vibration-damping control enabled.
  You need to study separately whether or not to use those functions.)

- MD3050 (Pn114) SPD_DUMP_GAIN_ANTIVIBRATION (For each axis)

  Meaning: Vibration-damping speed damping gain
  Setting value: [%]

  Note: Set the parameter to "0" before adjustment.

- MD3051 (Pn115) LPF_CONST_ANTIVIBRATION (For each axis)

  Meaning: Vibration-damping low-pass filter time constant
  Setting value: [0.01 ms]

- MD3052 (Pn116) HPF_CONST_ANTIVIBRATION (For each axis)

  Meaning: Vibration-damping high-pass filter time constant
  Setting value: [0.01 ms]
  Standard setting value: The same value as MD3051 (Pn115)

- MD3071 (Pn129) OBSERVER_GAIN_ANTIVIBR (For each axis)

  Meaning: Vibration-damping observer gain
  Setting value: [Hz]
  Standard setting value: 1/2 of vibration frequency

- MD3072 (Pn12A) LOAD_INERTIA_ANTIVIBR (For each axis)

  Meaning: Vibration-damping observer inertia correction
  Setting value: [%]
  Standard setting value: 100

Adjustment procedures

1. Carry out analog monitor related setting.
   Such data that are monitored with measuring instruments, such as high coder, are to be treated as torque reference and vibration-damping signal.
   For this reason, set MD3003 (Pn003) digit 0 and digit 2 to "2" (or "E") and "E" (or "2") respectively.
2. Measure torque reference vibration waveform that was obtained with instruments such as a high coder.
3. Read out the frequency of the vibration waveform, and assign 1/2 of the frequency to MD3071 (Pn129).
4. Determine the values of MD3051 (Pn115) and MD3052 (Pn116) using the following equations so that the phase difference becomes 90 degrees between vibration-damping signal and torque reference.
   - MD3051 = $(2 \times 1000/(2\pi f)) \times 100$
   - MD3052 = Pn115
5. Set MD3051 (Pn115) and MD3052 (Pn116) to the values calculated in the procedure 4.
6. Turn off the Servo. (Enable vibration-damping function.)
7. After turning on the servo again, check if phase difference is 90 degrees between high coder torque reference and vibration-damping signal.
8. Increase the value of MD3050 (Pn114) gradually from 0. (The value starts to take effect when it becomes about 80.)
9. Amplitudes of both torque reference and vibration-damping signal become smaller if the vibration-damping function works.

INFO

If there is no change in the amplitudes even when the MD3050 (Pn114) is increased to about 200, the vibration-damping function may not work. If this is the case, set MD3050 (Pn114) to "0" to disable the vibration-damping function and use another vibration suppression function instead.

14.2.12 Gain switching

You can automatically switch speed loop gain between KV and KVI in Cutting feed, Positioning, and handle feed modes.
When gain switching is enabled with the following machine data and parameters, each of the parameters becomes active in the following cases.

- Cutting feed gain: Always active for cutting feed during programmed operation.
- Positioning gain: Always active for positioning during RAPID, JOG, and programmed operation excluding handle feed or step feed operation.
- Handle feed gain: Always active for handle feed and step feed operation.

■ CNC setting

For feed axis

- MD37610 PROFIBUS_CTRL_CONFIG (For each axis)

  Meaning: CNC feed mode transmission to a drive
  Setting value: 0 --- Disabled
  1 --- Enabled
  Assign "1" (Enabled) to this parameter when gain switching is used.

  Note: Set this parameter to "Disabled" for Spindle; otherwise, you cannot change over Spindle drive parameters (DBX21.0-2) from PLC.

■ Servo drive setting

For cutting feed

Standard setting value becomes the cutting feed gain.

- MD3030 (Pn100) KV (For each axis)

  Meaning: Speed loop gain
  Setting value: [0.1 Hz]
  To express the setting value in previous unit [1/s], multiply the value by $2\pi/10$.

- MD3031 (Pn101) KVI (For each axis)

  Meaning: Speed loop integration time constant
  Setting value: [0.01 ms]

For positioning

- MD3070 digit 0 (Pn128 digit 0) LOOP_GAIN_BANK_SWITCH (For each axis)

  Meaning: 2nd loop gain bank selection

  Setting value: 0 --- Disabled
  1 --- Enabled
  If you want to use gain switching function for positioning, set the parameter to "1".

- MD3034 (Pn104) KV2 (For each axis)

  Meaning: 2nd speed loop gain

  Setting value: [0.1 Hz]
  To express the setting value in previous unit [1/s], multiply the value by $2\pi/10$.

- MD3035 (Pn105) KVI2 (For each axis)

  Meaning: 2nd speed loop integration time constant
  Setting value: [0.01 ms]

For handle feed

- MD3070 digit 1 (Pn128 digit 1) LOOP_GAIN_BANK_SWITCH (For each axis)

  Meaning: 3rd loop gain bank selection

  Setting value: 0 --- Disabled
  1 --- Enabled
  If you want to use gain switching function for handle feed, set the parameter to "1".

- MD3073 (Pn12B) KV3 (For each axis)

  Meaning: 3rd speed loop gain

  Setting value: [0.1 Hz]
  To express the setting value in previous unit [1/s], multiply the value by $2\pi/10$.

- MD3074 (Pn12C) KVI3 (For each axis)

  Meaning: 3rd speed loop integration time constant
  Setting value: [0.01 ms]

14.2.13 Current offset adjustment

To adjust the current offset of a Servo drive, perform the following procedures using a Digital operator.

1. Stop to move a Servo drive that you want to make a current offset adjustment. Turn off the servo with the main power turned on.
   In general, to turn off the servo as such, you need to prepare a sequence ladder that can turn off the servo by axis (DB3nDBX21.7 = 0) and use forced contact input.

   Note: With the setting in section 14.3.6, the vertical axis will not fall down because the brake is applied at the same time when the servo is turned off; however, you need to pay attention to the vertical axis.
2. Select "Fn00E" using the Digital operator and press [DATA ENTER] key.
3. "Cur_o" is displayed. press [DSPL/DET] key.
4. "donE" blinks on the screen for about 1 second and the offset automatic adjustment completes.
5. Press [DATA ENTER] key to exit from the mode.

14.2.14 Analog monitor

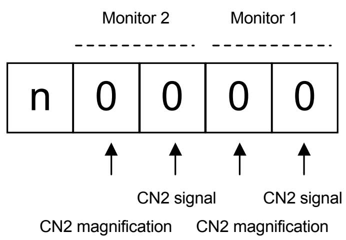
Each of the Servo drives and Spindle drives has an analog monitor function. You can observe various waveforms using a measuring instrument, such as an oscilloscope, connected to a monitor cable from the CN16 (CN26 in the case of 2nd axis of the 2-axis-combined drive) of each unit.

Servo drive

- MD3003 (Pn003) FUNCTION_SWITCH_APPLIC3 (For each axis)
  Meaning: Function selection application switch 3
  Initial value: 0002 (Monitor 1: Motor rotation speed; monitor 2: torque reference)

The following table shows a list of data that can be observed at a Servo drive and explains how to set the magnification and others.

User constant No.	Position	Name	Digit position	Setting	Description	Factory default setting
MD3003 (Pn003)	Lower byte	Analog monitor 1	Digit 0	0	Motor revolution speed: 1V/1000 min $^{-1}$	0002
Function selection application	Upper byte	Analog monitor 2	Digit 2	1	Speed reference: 1V/1000 min $^{-1}$	
			Signal descrip-tions	2	Torque reference: 1V/100%	
				3	Position deviation: 0.05 V/1 command unit	
				4	Position amplitude deviation: 0.05 V/1 command unit	
				5	Position command speed [min^{-1} conversion]: 1V/1000 min $^{-1}$	
				6	Observer speed: 1V/1000 min $^{-1}$	
				7	Collision detection amount: 1V/100%	
				8	Quadrant error compensation amount: 1V/100%	
				9	Speed feed forward: 1V/1000 min $^{-1}$	
				A	Torque feed forward: 1V/100%	
				B	Model torque reference: 1V/100%	
				C	Model position deviation: 0.05 V/1 position unit	
				D	Estimated disturbance torque: 1V/100%	
				E	Vibration-damping monitor: 1V/1000 min $^{-1}$	
				F	System constant data output	
			Digit 1 Digit 3 Magnifi-cation	0	Multiplied by 1	
				1	Multiplied by 10	
				2	Multiplied by 100	
				3	Multiplied by 1/10	
				4	Multiplied by 1/100	



Spindle drive

- MD6472 (Cn472) MONITOR_1_OUTPUT (For each axis)
  Meaning: Monitor 1 output
  Initial value: 0 --- Motor revolution speed
- MD6475 (Cn475) MONITOR_2_OUTPUT (For each axis)
  Meaning: Monitor 2 output
  Initial value: 1 --- Torque reference

Both MD6472 (Cn472) and MD6475 (Cn475) can output the following signals in analog form.

0: Motor revolution speed: 5 V/Max. number of revolutions

1: Torque reference (Short-duration rated torque): 5V/100%

2: Zero speed signal (sp_ZSPD)

3: Speed agreement signal (sp_AGR)

4: Speed detection signal (sp_SDET)

5: Torque detection signal (sp_TDET)

6: Under torque limitation (sp_TLE)

7: Load axis origin signal (sp_ORGSIG)

8: Orientation completion signal (sp_OREND)

9: Winding changeover completion signal (sp_CHWEND)

10: Failure signal (sp_FLTSIG)

11: Error warning signal (sp_TALM)

Monitor cable

Servo drive and Spindle drive in common

- DE9404559 (SGDC drive and Σ-II drive in common)
  Servo drive and Spindle drive in common
  White: Analog monitor 1 (CH1) output
  Red: Analog monitor 2 (CH2) output
  Black: 0 V

14.3 Motion Control

14.3.1 Feed Rate

■ Feed Axes/Spindles

- MD34990 ENC_ACTIVAL_SMOOTH_TIME [0] (For each axis)

  Meaning: Time constant of low pass filter inside CNC for encoder feedback
  Used as a smoothing filter for preventing cogging of CNC spindle speed or flickering data display when the resolution of spindle encoder is not high enough.
  (This machine data can also be set on feed axes.)
  This is valid for the speed and position display for G33, G34, G35, G95, G96, G97, FPRAON, and HMI.

  Setting value: [sec]
  A value between 0 and 0.5 sec. can be specified. Standard setting value is 0.05 sec. Adjust this value to have no flickering display.

  Note: Setting this filter does not decrease the position loop gain.

- MD34990 ENC_ACTIVAL_SMOOTH_TIME [1] (For each axis)

  Meaning: Time constant of low pass filter inside CNC for feedback from the separately mounted encoder.
  Used like MD34990 [0].

  Setting value: [sec]

■ Feed axes

- MD32000 MAX_AX_VERO (For each axis)

  Meaning: Maximum speed for memory operation (G00, G01, etc.)
  Setting value: [mm/min] or [deg/min]

- MD32010 JOG_VERO_RAPID (For each axis)

  Meaning: RAPID speed in JOB mode
  Setting value: [mm/min] or [deg/min]

- MD32020 JOG_VERO (For each axis)

  Meaning: JOG speed
  Setting value: [mm/min] or [deg/min]

- MD32060 POS_AX_VERO (For each axis)

  Meaning: Maximum speed for positioning command (POS command) maximum speed

  Setting value: [mm/min] or [deg/min]

- MD36200 AX_VERO_LIMIT (For each axis)

  Meaning: Speed limit (the speed which triggers alarm output)

  Setting value: [mm/min] or [min^{-1}]

  Note: If the speed exceeds this value, the alarm 25030 is output.
  For spindles, this is the speed limit in the positioning control mode.

- MD36210 CTRLOUT_LIMIT (For each axis)

  Meaning: Maximum speed reference percentage (the percentage of maximum speed reference taking the speed reference for maximum motor speed MD32260 (see, 14.1.7) as 100%).

  Setting value: 110 [%]

■ Spindle

- MD35010 GEAR_STEP_CHANGE_ENABLE (For each axis)

  Meaning: Gear changing

  Setting value: 0---No gear changing
  1---Gear changing

- MD35100 SPIND_VERO_LIMIT (For each axis)

  Meaning: Maximum speed of spindle

  Setting value: [min^{-1}]

- MD35110 GEAR_STEP_MAX_VERO [n] (For each axis)

  Meaning: Maximum speed of the nth gear

  Setting value: [min^{-1}]

- MD35120 GEAR_STEP_MIN_VERO [n] (For each axis)

  Meaning: Minimum speed of the nth gear

  Setting value: [min^{-1}]

- MD35130 GEAR_STEP_MAX_VERO_LIMIT [n] (For each axis)

  Meaning: Maximum speed limit of the nth gear

  Setting value: [min^{-1}]

- MD35140 GEAR_STEP_MIN_VERO_LIMIT [n] (For each axis)

  Meaning: Minimum speed limit of the nth gear

  Setting value: [min^{-1}]

- MD35300 SPIND_POSCNTL_VERO (For each axis)

  Meaning: Maximum speed for spindle positioning control mode

  Setting values: [min^{-1}]

14.3.2 Acceleration/Deceleration

■ Feed axes

For acc./dec. of feed axes, the pre-interpolation acc./dec. typically used for rapid machining is always enabled.
Acc./dec. control can achieve more effective acc./dec. by controlling both rate and jerk of acc./dec. (factor for S-shaped acc./dec.).
However, for G00 feed, different rate and jerk of acc./dec. from those for maching can be set.
For examples of machine data setting including those for rapid, precise machining, see section 14.4.4.
Also, the post-interpolation acc./dec. (acc./dec. For each axis) can be performed in previous ways.
For more information, see the setting method for post-interpolation acc./dec..

- MD20150 [20] GCODE_RESET_VALUES

  Meaning: Default setting of acc./dec. jerk

  Setting value: 1---BRISK (jerk is disabled) is set by default.
  2---SOFT (jerk is enabled) is set by default.

  Standard setting value: 2

- MD20600 MAX_PATH_JERK

  Meaning: Acc./dec. jerk (acceleration rate)

  Setting value: [mm/sec^3] or [deg/sec^3]

  Note: Applied for G00 and G01.
  To set acc./dec. jerk for each axis with MD32431 MAX_AX_JERK, use a larger value (ex. 1,000,000 for initial value) for this than the value with MD32431. If there occurs some kind of vibration, set the 20 to 50 % smaller value for this machine data than the maximum value with MD32431.
  Do not use MD32410 AX_JERK_TIME together with pre-interpolation acc./dec., because the machine data is post-interpolation acc./dec. jerk and affects machining profile errors.

- MD20602 CURV_EFFECT_ON_PATH_ACCEL

  Meaning: Acceleration factor of curve section
  By setting this machine data, the sum of tangential component and centrifugal component in curve section can be calculated to meet the value with MD32300.
  Where,

  - Tangential component: Decrease the acceleration speed in the curve section as shown with MD32300 × (1.0 - MD20602).
  - Centrifugal component: Decrease the speed at the corner of curve section as shown with MD32431 × MD20603.

  Setting value: 0 to 1.0

  Standard setting value: 0.75

- MD32300 MAX_AX_ACCEL (For each axis)

  Meaning: Acc./dec. rate

  Setting value: [mm/sec^2] or [deg/sec^2]

  Note: Applied for G00 and G01.

- MD32310 MAX_ACCEL_OVL_FACTOR (For each axis)

  Meaning: Corner speed change

  Setting value: [percentage]
  The speed differences of each axis according to changes of orientation of block boundary are controlled by the percentage for acc./dec. rate (MD32300). Generally set the value to "1.01". This value is equal to the conventional acceleration at the corner. For further reduction of shocks at the corner, output G642 command or decrease the value with MD32431.

  Note: Applied for G00 and G01.

  Standard setting value: 0.01

- MD32431 MAX_AX_JERK (For each axis)

  Meaning: Axis-specific acc./dec. jerk (acceleration rate)

  Setting value: [mm/sec^3] or [deg/sec^3]

  Note: Applied for G00 and G01.
  Do not use MD32410 AX_JERK_TIME together with pre-interpolation acc./dec., because it is post-interpolation acc./dec. jerk and affects machining profile errors.
  Specify a larger value (ex. 1,000,000 for the initial value) with MD20600 MAX_AX_JERK than the value with MD32431.

- MD32432 PATH_TRANS_JERK_LIM (For each axis)

  Meaning: Jerk limit between blocks
  Jerk setting for controlling the acceleration rate differences which occur according to the change of radius of curvature on the boundary of blocks such as continuous arc blocks.

  Setting value: [mm/sec^3] or [deg/sec^3]

  Standard setting value: Identical to MD32431

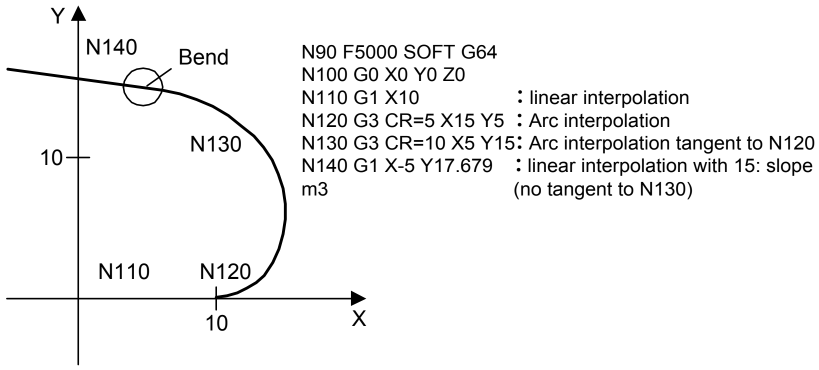
- MD32434 G00_ACCEL_FACTOR (For each axis)

  Meaning: Acceleration factor for G00. Percentage of acceleration for MD32300.
  Setting value: [percentage]

- MD32435 G00_JERK_FACTOR (For each axis)

  Meaning: Acc./dec. jerk for G00. Percentage of acc./dec. jerk for MD32431.
  Setting value: [percentage]

The following figure shows an example of actual machining program to demonstarete the meaning of each machine data.



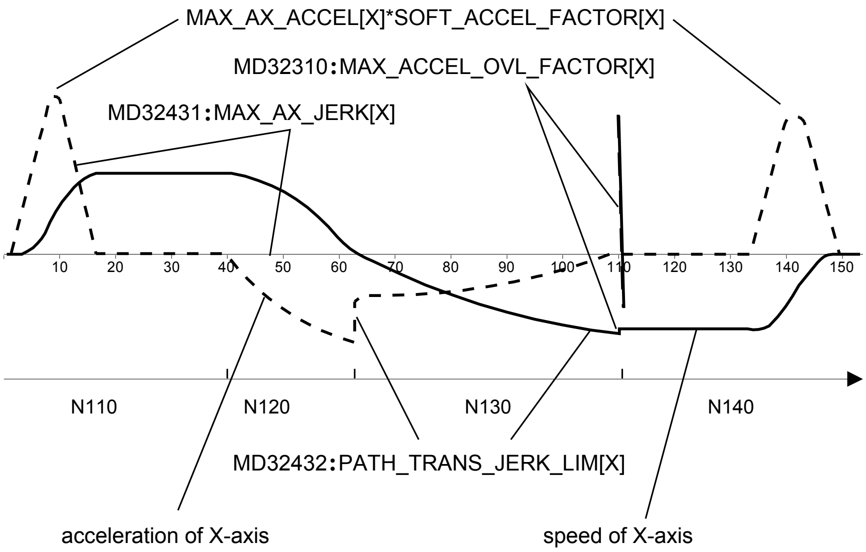


Fig. 14.2 Function of machine data related to acc./dec.

■ Spindle

- MD35200 GEAR_STEP_SPEEDCTRL_ACCEL [n] (For each axis)

  Meaning: Acceleration under the nth gear speed control

  Setting value: [r/sec^2]

  Note: Set this value large enough for spindle load to saturate when the spindle is on acc./dec motion. (If the value is not large enough, when acc./dec. function is enabled, the motor follows the command so that SAGR signal will be kept to standstill.

- MD35210 GEAR_STEP_POSCTRL_ACCEL [n] (For each axis)

  Meaning: Acceleration under the nth gear position control

  Setting value: [re/sec^2]

INFO

■ Usage of post-interpolation acc./dec.

For pre-interpolation acc./dec., the acc./dec. per program block is enabled so frequently that accuracy of machining is better than ever, while the machining time at the same feed rate is longer.

If you weight the machining time more than machining accuracy for the grinding feed, you can apply the post-interpolation acc./dec. employing post-interpolation jerk with the following setting.

In this case, set the machine data related to the following post-interpolation acc./dec. after setting the value to be almost disabled . For details about machine data setting, see the examples in the following table.

- MD32400 AX_JERK_ENABLE

  Meaning: post-interpolation jerk enabled

  Setting value: 0---disabled
  1---enabled
  Specify the value 1 (one) when post-interpolation jerk is employed.

- MD32402 AX_JERK_MODE

  Meaning: Post-interpolation jerk mode

  Setting value: 1---exponential acc./dec. filter
  2---linear acc./dec. (average) filter

  Standard setting value: 2 (1: exponential acc./dec. filter affects machining profile errors because of the large delay of this filter.)

- MD32410 AX_JERK_TIME

  Meaning: post-interpolation jerk time constant
  Setting value: [sec]

The following table shows examples of machine data setting when post-interpolation acc./dec. is employed, compared to the setting when pre-interpolation acc./dec. employed.

CNC machine data	Pre-interpolation acc./dec.	Pre-interpolation acc./dec. (Linear acc./dec.)	Remarks
Pre-interpolation acc./dec. rate MD32300 MAX_AX_ACCEL	3.3m/sec^2	100.0m/sec^2 (Almost infinite setting)	
Pre-interpolation acc./dec. jerk MD32431 MAX_AX_JERK	10000.0m/sec^3	10000.0m/sec^3	Almost disabled setting
Post-interpolation jerk enable MD32400 AX_JERK_ENABLE	0: disabled	1: enabled	
Post-interpolation jerk mode MD32402 AX_JERK_MODE	-	2: linear acc./dec.	
Post-interpolation jerk time constant MD32410 AX_JERK_TIME	0.001sec (Almost disabled setting)	0.05sec	

Note: Post-interpolation jerk MD32431 on the above example is shown as almost disabled, but it is possible to perform smoother acc./dec. by setting the values in the same way as pre-interpolation jerk.

14.3.3 Positioning

Positioning action and positioning completion is determined only in CNC. The positioning completion function and other relevant functions of the drive must not be used.
Primary machine data in relation to positioning is listed below.
For the details about the spindle orientation, see section 14.3.13.

- MD20154 EXTERN_GCODE_RESET_VALUE [14]

  Meaning: G61/G64 designation when reset

  Setting value: 0---G61 is selected
  3---G64 is selected

  Standard setting value: 3

- MD20732 EXTERN_G0_LINEAR_MODE

  Meaning: G0 feed specification

  Setting value: 0---Positioning axis feed is enabled
  1---Interpolation feed is enabled

  Standard setting value: 1

  Note: When specifying this machine data for "0", the PLC processing related to G0 and the machine data must be modified to satisfy the specification of positioning.

- MD20734 EXTERN_FUNCTION_MASK

  Meaning: G00 specification when G64 is specified

  Setting value: 0---When specifying G64, Exact Stop is not enabled for G00.
  1---When specifying G 64, Exact Stop is enabled for G00.

  Standard setting value: 1

  Note: This machine data is available for CNC system version 01.00.01 or higher.

- MD20522 EXACT_POS_MODE_G0_TO_G1

  Meaning: Motion of the axis when switching from G0 to G1 feed or from G1 to G0 feed, with MD20734.4 = 1.

  Setting value: 0---Exact Stop is not enabled
  1---Exact Stop is enabled according to G601 specification
  2---Exact Stop is enabled according to G602 specification
  3---Exact Stop is enabled according to G603 specification

  Standard setting value: 1

  Note: This machine data is available for CNC system version 01.00.01 or higher.

- MD36000 STOP_LIMIT_COARSE (For each axis)

  Meaning: Positioning completion range (coarse)

  Setting value: [mm] or [deg]

  Miscellanea: When coming into this positioning completion range, DB3nDBX60.6 = 1.
  When Exact Stop is initiated, coming into this positioning completion range is interpreted as the positioning completion according to G602 command and the processing begins at the next block.

- MD36010 STOP_LIMIT_FINE (For each axis)

  Meaning: Positioning completion range (fine)

  Setting value: [mm] or [deg]

  Miscellanea: When coming into this positioning completion range, DB3nDBX60.7 = 1.
  When Exact Stop is initiated, coming into this positioning completion range is interpreted as positioning completion according to G602 command and the processing begins at the next block.

- MD36020 POSITIONING_TIME (For each axis)

  Meaning: Positioning completion check starting time
  If the positioning completion has not been achieved within the positioning completion range with MD36000 when the this machine data setting time is over after the command delivery, alarm 25080 will be output.
  (This alarm check is permitted one time only.)

  Setting value:[sec]

  Note: Take notice that if this value of machine data is excessive large the alarm is late to be detected.

- MD36030 STANDSTILL_POS_TOL (For each axis)

  Meaning: In-position stop tolerance

  Setting value: [mm] or [deg]

- MD36040 STANDSTILL_DELAY_TIME (For each axis)

  Meaning: In-position stop tolerance check start time
  If the positioning completion has not been achieved within the positioning completion range with MD36000 when the this machine data setting time is over after the command delivery, alarm 25040 will be output.
  (This alarm check should be regularly permitted.)

  Setting value: [sec]

  Note: Take notice that if this value of machine data is excessive large the alarm is late to detected.

The following figure explains how to read major machine data.

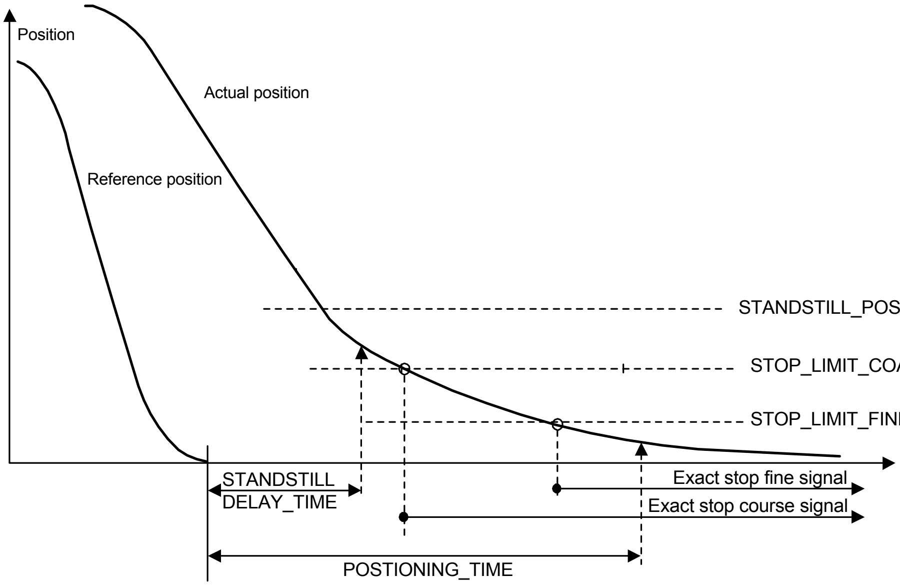


Fig. 14.3 Positioning timing

- MD30330 MODULO_RANGE (For each axis)

  Meaning: Rotation axis motion range
  Amount of motion until the position indicator has increased and be reset to zero (0).
  This command can be set to axis positioning control and also to rotation axis control.

  Setting value: [deg]
  Standard setting value: 360 deg

14.3.4 Emergency stop

On YS 840DI the emergency stop is activated by the deceleration stop according to CNC command, as described on the following page.
In this case, after emergency stop, CNC switches over to the speed reference mode for drive and outputs the deceleration command. When the speed has been fallen to or below MD36060, CNC outputs the emergency stop command to the drive to stop at the maximum torque and then to turn off the servo drive. The machine data and parameters related to the emergency stop are listed below.

■ CNC setting

- MD36060 STANDSTILL_VERO_TOL (For each axis)

  Meaning: Zero speed
  Stops at the maximum torque (error cut) on the drive when the speed falls down to or below this speed.

  Setting value: [mm/min] (linear axis) or [min^{-1}] (rotation axis)

- MD36610 AX_EMERGENCY_STOP_TIME (For each axis)

  Meaning: Emergency stop standstill
  This is the duration of time to be required until the emergency stop from the maximum speed specified with MD36210 CTRLOUT_STOP_ TIME

  Setting value: [sec]

- MD36620 SERVO_DISABLE_DELAY_TIME (For each axis)

  Meaning: Duration of time from the entry of emergency stop until the servo drive is turned off
  You must configure MD36620 > MD36610.

  Setting value: [sec]

■ Drive setting

Servo drive

- MD3356 (Pn406) EMERGENCY_STOP_TORQUE (For each axis)

  Meaning: Emergency stop torque
  Setting value: [%]
  Standard setting value: 800 [%] (stop at the maximum torque)

- MD3442 (Pn516) EMERGENCY_STOP_WAIT_TIME (For each axis)

  Meaning: Emergency stop waiting time
  This specifies the wait time between the input of emergency stop (switch -> PLC -> CNC) and the emergency stop of drive (CNC -> drive). If there is no input of the emergency stop to the drive even after this duration of time has past, the feed axes automatically decelerate to stop.
  If you want the emergency stop to be the deceleration stop via drive, not via CNC, specify "0" for this parameter.

  Setting value: [ms]
  Standard setting value: 500 [ms]

- MD3426 (Pn506) DELAY_FROM_BRK_SIG_TO_SVOFF (For each axis)

  Meaning: Brake command - Servo drive cutoff delay time

  Setting value: [10 ms]

- MD3528 (Pn81C) TACTOR_OFF_DELAY_TIME (For each axis)

  Meaning: Delay time of the main circuit cutoff after all axes servo drive have been turned off, including the event of emergency stop
  If there are two or more converters, configure this parameter to prevent this converter from cutting off the main circuit connector before the drive controlled by another converter has not been turned off.
  In setting values, consider the deceleration time of spindle (equivalent to MD6511).

  Setting value: [ms]

■ Spindle drive

- MD6511 (Cn511) EMERGENCY_STOP_WAIT_TIME (For each axis)

  Meaning: Emergency stop waiting time
  This specifies the wait time between the emergency stop input (switch -> PLC -> CNC) and the drive emergency stop (CNC -> drive). If there is no input of the emergency stop to the drive even after this duration of time has passed, the spindle automatically free-runs to stop.
  If you want the emergency stop to be the free-run stop instead of the deceleration stop, specify "0" to this parameter.

  Setting value: [ms]
  Standard setting value: 500 [ms]

- MD6819 (Cn819) TACTOR_OFF_DELAY_TIME (For each axis)

  Meaning: Delay time of the main circuit cutoff after all axes servo drives are turned off, including the event of emergency stop
  If there are two or more converters, configure this parameter to prevent this converter from cutting off the main circuit connector before the drive controlled by another converter has not been turned off.
  If the sum of the deceleration time of servo axis (equivalent to MD3426) and the delay time of brake (MD3426) is larger than the deceleration time (equivalent to MD6511), determine the setting value according to the difference.

  Setting value: [ms]

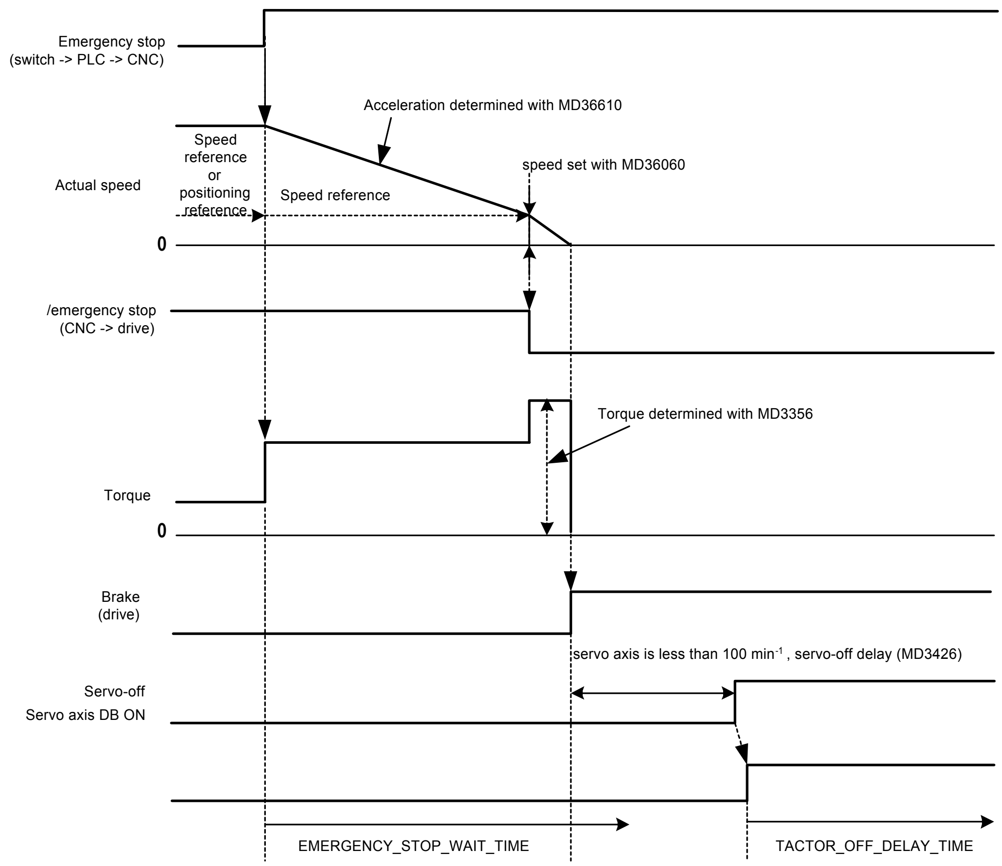


Fig. 14.4 Emergency stop processing

14.3.5 Return to reference point

For return to reference point, the typical motion is shown in the fig 14.5, being different from the conventional specification especially on the following points.

- After dog detection, motion pauses on the dog. (When the dog is not long enough, you must take some measures, for example retaining the signal of dog with a ladder.)
- Encoder C phase detection should be done by moving to the opposite direction to the dog.
  (However, if encoder C phase is preceding to the dog, it is possible to specify the direction with MD34050).

The primary machine data on return to reference point is as follows.

- MD34000 REFP_CAM_IS_ACTIVE (For each axis)

  Meaning: Return to reference point dog setting

  Setting value: 0---No dog

  1---Dog

Note: For spindles, specify "0" (no dog) for orientation.

- MD34010 REFP_CAM_DIR_IS_MINUS (For each axis)

  Meaning: Return to reference point direction setting

  Setting value: 0---positive direction

  1---negative direction

- MD34020 REFP_VERO_SEARCH_CAM (For each axis)

  Meaning: Approach speed. Speed from the beginning of return to reference point until or during the dog searching

  Setting value: [mm/min] or [min^{-1}]

- MD34030 REFP_MAX_CAM_DIST (For each axis)

  Meaning: Return to reference point dog searching maximum distance

  Setting value: [mm] or [deg]

- MD34040 REFP_VERO_SEARCH_MARKER [0] (For each axis)

  Meaning: Creep speed
  (Speed from the dog detection until or during the C phase searching)
  (Motor encoder)

  Setting value: [mm/min] or [min^{-1}]

- MD34040 REFP_VERO_SEARCH_MARKER [1] (For each axis)

  Meaning: Creep speed
  (Speed from the dog detection until or during the C phase searching)
  (Separately mounted encoder)

  Setting value: [mm/min] or [min^{-1}]

- MD34050 REFP_SEARCH_MARKER_REVERSE [0] (For each axis)

  Meaning: C-phase searching direction (motor encoder)

  Setting value: 0---positive direction (when C-phase is not preceding to the dog (see Fig. 14.5.)

  1---negative direction (when C-phase is preceding to the dog)
  If encoder C-phase is preceding the dog on the return to reference point way, specify "1".

- MD34050 REFP_SEARCH_MARKER_REVERSE [1] (For each axis)

  Meaning: C-phase searching direction (separately mounted encoder)

  Setting value: 0---positive direction (when C-phase is not preceding to the dog (see Fig.14.5.)
  1---negative direction (when C-phase is preceding to the dog)
  If the encoder C-phase is following the dog on the return to reference point way, specify "1".

- MD34060 REFP_MAX_MARKER_DIST [0] (For each axis)

  Meaning: C-phase searching maximum distance (motor encoder)
  Setting value: [mm] or [deg]

  Note: For spindles, specify 1080 deg. minimum for orientation.

- MD34060 REFP_MAX_MARKER_DIST [1] (For each axis)

  Meaning: C-phase searching maximum distance (separately mounted encoder)
  Setting value: [mm] or [deg]

- MD34070 REFP_VERO_POS (For each axis)

  Meaning: Return to reference point speed
  (return speed from the C-phase to the origin)
  Setting value: [mm/min] or [min^{-1}]

- MD34080 REFP_MOVE_DIST [0] (For each axis)

  Meaning: Return to reference point distance (distance from C phase to the origin) (motor encoder)
  Setting value: [mm] or [deg]

  Note: Setting a negative value enables the motion to orient to the direction opposite to the setting with MD34050.

- MD34080 REFP_MOVE_DIST [1] (For each axis)

  Meaning: Return to reference point distance (distance from C phase to the origin) (separately mounted encoder)
  Setting value: [mm] or [deg]

  Note: Setting a negative value enables the motion to orient to the direction opposite to the setting with MD34050.

- MD34090 REFP_MOVE_DIST_CORR [0] (For each axis)

  Meaning: Return to reference point distance offset (motor encoder)
  Setting value: [mm] or [deg]

  Note: When the absolute value detection function is used, the origin setting value is written into this parameter.

- MD34090 REFP_MOVE_DIST_CORR [1] (For each axis)

  Meaning: Return to reference point distance offset (separately mounted encoder)
  Setting value: [mm] or [deg]

  Note: When the absolute value detection function is used, the origin setting value is written into this parameter.

- MD34092 REFP_CAM_SHIFT [0] (For each axis)

  Meaning: Origin dog range shift (motor encoder)
  When the origin dog is so close to C phase, the dog range is virtually expanded with this machine data to prevent from detecting C phase following the dog.
  Setting value: [mm] or [deg]

- MD34092 REFP_CAM_SHIFT [1] (For each axis)

  Meaning: Origin dog range shift (separately mounted encoder)
  When the origin dog is so close to C phase, the dog range is virtually expanded with this machine data to prevent from detecting C phase following the dog.
  Setting value: [mm] or [deg]

- MD34100 REFP_SET_POS [n] (For each axis)

  Meaning: Origin position shift (n is a value set with DB3XDBX2. 4 to 7.)

  Setting value: [mm] or [deg]

- MD34200 ENC_REFP_MODE [0] (For each axis)

  Meaning: Return to reference point mode setting (motor encoder)

  Setting value: 0---No origin pulse

  1---C phase return to reference point

  Note: For the encoder C phase return to reference point, you must specify "1".
  When the absolute value detection function is enabled, you must specify "0".

- MD34200 ENC_REFP_MODE [1] (For each axis)

  Meaning: Return to reference point mode setting (separately mounted encoder)

  Setting value: 0---No origin pulse

  1---C-phase return to reference point

  Note: For the encoder C phase return to reference point, you must specify "1".
  When the absolute value detection function is enabled, you must specify "0".

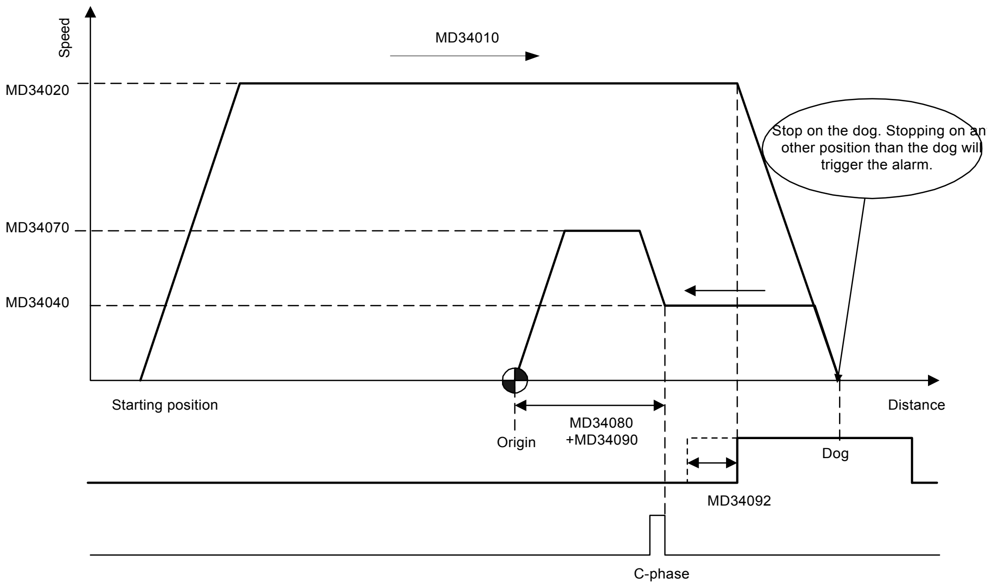


Fig. 14.5 Schema of return to reference point action

14.3.6 Brake control

Feed axes motor brakes are directly controlled with each servo drive, except for the special mechanical cramps.
We will describe the methods for brake control under the following conditions.

■ When servo drives are powered on

When servo drives are powered on, after turning on each servo drive and then checking the servo drive for being locked, release the brakes. There are no special parameters about the timing.

■ When servo drives are powered off

When servo drives are specified to be turned off, including the events of emergency stop, turn off the drive brakes and then turn off the servo drives after the period specified with the following parameter.

- MD3426 (Pn506) DELAY_FROM_BRK_SIG_TO_SVOFF (For each axis)

  Meaning: Brake command - servo drive cutoff delay time
  Setting value: [10ms]

14.3.7 Speed feedforward

On YS 840DI system, speed feedforward is one of CNC functions. CNC specifies the speed feed forward directly to the drive.
(The feed forward function housed in servo drives is not used.)
On YS 840DI, the speed feedforward is also used for switching the speed reference mode to the positioning reference mode as well as for instructing the spindle orientation (SPOS command), you must specify the valid setting (MD32620 = 3) for every axis.
For positioning control of feed axes, in order to activate the speed feedforward, specify Start/End code to CNC program as followings.

```
N1G91G01Y100.F2000
N2Y-100.
FFWON (Feedforward starts)
N3G01Y100.
N4Y-100.
FFWOF (Feedforward ends)
M30
```

On YS 840DI, however, for compensation of the machining profile errors occurred during the cutting feed, predictive control is generally used instead of the feedforward. For the usage of the predictive control, see 14.2.8.

CNC machine data for the feedforward is listed below.

- MD32620 FFW_MODE (For each axis)

  Meaning: Feedforward setting

  Setting value: 0---Feedforward is disabled
  3---Feedforward is defined as speed feedforward.
  You must specify "3".

  Note: Setting value "1" is for compatibility with conventional systems and causes no serious problem.

- MD32630 FFW_ACTIVATION_MODE (For each axis)

  Meaning: FFWON command with program

  Setting value: 0---enabled
  1---disabled

- MD32810 EQUIV_SPEEDCTRL_TIME (For each axis)

  Meaning: Speed feedforward time constant
  This adjusts the machine data and checks radius for shrinkage, or overshoot.

  Setting value: [sec]

- MD32610 VELO_FFW_WEIGHT (For each axis)
  Meaning: Speed feedforward weight
  Setting value: [0.01]
  Standard setting value: 1.0

14.3.8 Torque Control and Fixed Stop Function

■ Limiting with drive parameters

You can set the following parameters to control the torque for each axis continuously.

Servo drive

- MD3352 (Pn402) FORWARD_TORQUE_LIMIT (For each servo axis)
  Meaning: Forward torque limitingl value
  Setting value: [%] (percentage for rated torque)
- MD3353 (Pn403) REVERSE_TORQUE_LIMIT (For each servo axis)
  Meaning: Reverse torque limiting value
  Setting value: [%] (percentage for rated torque)

Spindle drive

- MD6421 (Cn421) TORQUE_LIMIT (For each servo axis)
  Meaning: Torque limiting level on motor side
  Setting value: [%]
- MD6422 (Cn422) REGENERATION_TORQUE_LIMIT (For each servo axis)
  Meaning: Torque limiting level on regenerator side
  Setting value: [%]

■ Control by CNC (Fixed Stop function)

On YS 840DI system, Fixed Stop function allows you to perform easy, continuous torque control with torque limiting for the servo axes or spindles via CNC program.
For example, to activate Fixed Stop function for X axis, input the following programming command.

```
FXS [X1] =1 G90G00X100.   : Positioning, after torque limiting is enabled for X1 axis
FXS [X1] =0 X0.           : Torque limit is released for X1 axis
```

Set the following machine data for Fixed Stop function.

■ CNC setting

- MD37000 FIXED_STOP_MODE (For each axis)

  Meaning: Fixed Stop function enabled/disabled

  Setting value: 0---disabled
  1---enabled

- MD37010 FIXED_STOP_TORQUE_DEF (For each axis)

  Meaning: Torque limiting value
  Percentage for maximum torque (adjustable during programming with FXST command)

  Setting value: [%]

  Note: The unit of this setting value is different from the setting value (percentage for rated torque) used for " ■ Limiting with drive parameters."

- MD37030 FIXED_STOP_THRESHOLD (For each axis)

  Meaning: Position deviation detection level when Fixed Stop function enabled (adjustable during programming with FXST command)
  When the amount of position deviation exceeds this setting value while the Fixed Stop function is enabled, DB3nDBX62.5 = 1.

  Setting value: [mm] or [deg]

■ Drive setting

Servo drive

- MD3358 digit 2 (Pn408 digit 2) SWITCH_NOTCH_FILTER (For each axis)

  Meaning: Variable torque limit selection
  Torque limit command from CNC is enabled.

  Setting value: 0---disabled
  1---enabled

  Note: You must specify "1".

■ Spindle drive

- MD6423 (Cn423) TORQUE_LIMIT_SELECT (For each axis)

  Meaning: Variable torque limit selection
  Torque limit command from CNC is enabled.

  Setting value: 0---disabled
  1---enabled

  Note: You must specify "1".

For Fixed Stop function, the tail stock press control, for example, is processed on the following steps.

1. With CNC program command, the feed axes moves toward the object and simultaneously the torque control is enabled.
   - CNC programming: G01X100. FXS [X] = 1
   - CNC sends the torque control value set with the machine data MD37010 or FXST command.
2. The feed axis contacts the object and then the torque and the amount of deviation increase.
3. Drive torque reference is cramped at the limiting value. The amount of deviation increases further.
4. When the increment of position deviation from steady state of Step 1 reaches the setting value with the machine data MD37030,
   - the drive is switched over to the speed control state and the torque is maintained with the torque control. (Speed reference is internally output. Position deviation = 0.
   - CNC program transfers to the nest block.

   In this way, the torque control state is enabled with the torque control.
5. When FXS[X] = 0 command is output,
   - the drive returns to the steady state.

   In this way, Fixed Stop function is disabled and the normal position control state is recovered. The pressing is released with the reverse procedure of Step 1.

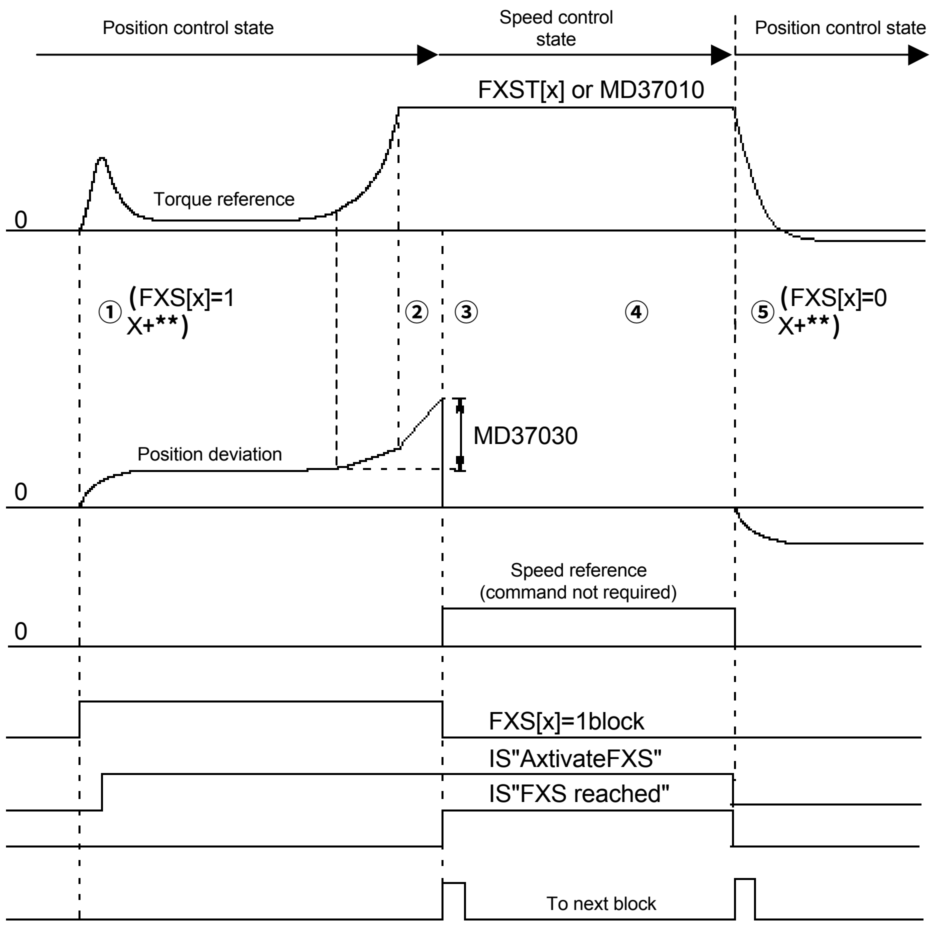


Fig. 14.6 Schema of Fixed Stop function

14.3.9 Absolute value detection

For machine data setting for the absolute value encoder, see Section 14.1.5 Motor Encoder and Section 14.1.6 Separately Mounted Encoder.
Other primary CNC data required for absolute value detection function are listed below.

- MD34090 ENC_MOVE_DIST_CORR [0] (For each axis)

  Meaning: Origin position offset (motor encoder)

  Setting value: [mm] or [deg]

  Note: When absolute value detection function is enabled, the origin setting value is written into this parameter.

- MD34090 ENC_MOVE_DIST_CORR [1] (For each axis)

  Meaning: Origin position offset (separately mounted encoder)

  Setting value: [mm] or [deg]

  Note: When absolute value detection function is enabled, the origin setting value is written into this parameter.

- MD34100 REFP_SET_POS [0] (For each axis)

  Meaning: After return to reference point, coordinate system offset (motor encoder)

  Setting value: [mm] or [deg]

- MD34100 REFP_SET_POS [1] (For each axis)

  Meaning: After return to reference point, coordinate system offset (separately mounted encoder)

  Setting value: [mm] or [deg]

- MD34200 ENC_REFP_MODE [0] (For each axis)

  Meaning: Return to reference point mode setting (motor encoder)

  Setting value: 0---No origin pulse
  1---C phase return to reference point

  Note: When the absolute value detection function is enabled, you must specify "0".

- MD34200 ENC_REFP_MODE [1] (For each axis)

  Meaning: Return to reference point mode setting (separately mounted encoder)

  Setting value: 0---No origin pulse
  1---C phase return to reference point

  Note: When the absolute value detection function is enabled, you must specify "0".

- MD34210 ENC_REFP_STATE [0] (For each axis)

  Meaning: Origin setting status (motor encoder)

  Setting value: 0---incremental encoder
  1---absolute value encoder origin setting mode
  2---absolute value encoder origin setting completion

- MD34210 ENC_REFP_STATE [1] (For each axis)

  Meaning: Origin setting status (separately mounted encoder)
  Same as the motor encoder.

- MD30240 [0] ENC_TYPE [0] (For each axis)

  Meaning: Motor encoder type

  Setting value: Always specify "4", independently of the type of motor encoder, when separately mounted encoder absolute value detection function is enabled.

Below is the method for setting origin when the absolute value detection function is enabled. (For the method of origin setting for the gantry axis absolute value detection function, see section 14.3.10.)

Setup process of origin setting for the absolute value detection function

1. In JOB mode, position the axis on a proper position.
2. Initiate REF (return to reference point) mode.

   Here, on NC screen, display START UP screen to show AXIS MD (machine data of axis) so that you can check the setting values with MD34210 : ENC_REEP_STATE (origin setting status).
   Specify "1" for the setting value with MD34210 : ENC_REEP_STATE (origin setting status) of the axis.
   When you want to position the axis origin at a certain coordinate position, follow the procedure for the setting of step 3 and then step 4. When you determine the current position as the origin, go on to step 4.
3. Input the coordinate value to specify with MD34100 : REEP_SET_POS (coordinate value after origin setting).
4. Set the axis feed (key) for the direction specified with MD34010 : REEP_CAM_DIR_IS_MINUS (return to reference point direction); "0" for positive direction and "1" for negative direction. (However, the axes does not move actually.)
5. When step 4 has completed, the status value of MD34210 : ENC_REEP_STATE automatically displays "2".

   When a certain coordinate value is specified on step 3, the origin setting process has completed when NC screen (coordinate value display: MCS) displays the value equal to the value of MD34090 : REEP_MOVE_DIST_CORR.

14.3.10 Gantry control

Apply gantry control for tandem axes. (YS 840DI master slave control is unavailable because this function is not enabled for the drive.)
You need not adjust the setting on the drive side because CNC enables all the specific controls which are different from the single-axis controls related to the gantry control.
With the absolute position detection function, after the origin setting is completed, the position deviation of the master axis and the slave axis is compensated at the same time when the servo drive is power on and then the synchronicity deviation during traveling is checked.
With the incremental encoder, the position deviation of the master axis and the slave axis is compensated at the same time when return to reference point is completed, and then synchronicity deviation during traveling is checked.
Primary machine data related to gantry control function is listed below.

- MD37100 GANTRY_AXIS_TYPE (For each axis)

  Meaning: Gantry axis setting
  1st digit: Gantry group setting (3 groups max.)
  2nd digit: Master axis/slave axis

  Setting value: 0---No gantry axis
  1---Group 1 master axis
  11---Group 1 slave axis
  2---Group 2 master axis
  12---Group 2 slave axis
  3---Group 3 master axis
  13---Group 3 slave axis

- MD37110 GANTRY_POS_TOL_WARNING (For each axis)

  Meaning: Synchronicity deviation warning output level position deviation

  Setting value: [mm] or [deg]
  The actual value of compensation for the position deviation of the master axis and the slave axis is below this setting value.

- MD37120 GANTRY_POS_TOL_ERROR (For each axis)

  Meaning: Synchronicity deviation alarm output level position deviation
  Setting value: [mm] or [deg]

- MD37130 GANTRY_POS_TOL_REF (For each axis)

  Meaning: When return to reference point synchronicity deviation alarm output level position deviation

  Setting value: [mm] or [deg]

- MD37140 GANTRY_BREAK_UP (For each axis)

  Meaning: Gantry axis synchronization release

  Setting value: 0---Synchronization
  1---Synchronization released

  Note: Never transfer the synchronization-released axes in the conditions that the gantry master axis and gantry slave axis are mechanically coupled. This may cause machinery damage.

Below is the setup process of origin setting for the gantry axis

Setup process for origin setting for the gantry axis absolute value detection function

1. The servo drive is not supplied with power. Specify "0" with MD34210 : ENC_REEP_STATE (origin setting status) for the both master and slave axes in order to disable the origin setting function mode.
2. Supply the servo drive with power. On JOG mode, position the axis at a proper position.
3. Enable REF (return to reference point) mode.

   Here, on NC screen, display START UP screen to show AXIS MD (machine data of axis) so that you can check the setting values with MD34210 : ENC_REEP_STATE (origin setting status) for the both of master and slave axes.
   Specify "1" for the setting value with MD34210 : ENC_REEP_STATE (origin setting status) of the both of master and slave axes in order to enable the origin setting function mode.
   When you want to position the axis at a certain coordinate position, follow the procedure for the setting of step 4 and then step 5. Otherwise, go on to step 5.
4. Input the coordinate value to specify with MD34100 [0] : REEP_SET_POS (coordinate value after origin setting) for the master and slave axes.
5. Set the axis feed (key) for the direction specified with MD34010 : REEP_CAM_DIR_IS_MINUS (return to reference point direction); "0" for the positive direction and "1" for the negative direction. (However, the axes does not move actually.)
6. When step 5 has completed, there automatically displays "2" for the status value of the master and slave axes with MD34210 : ENC_REEP_STATE.

   When a certain coordinate value is specified on step 3, the origin setting process has completed when NC screen (coordinate value display: MCS) displays the value equal to the value with MD34090 : REEP_MOVE_DIST_CORR.
7. Check the gantry axis for synchronized motion. The process is completed.

Setup process for the return to reference point for the gantry axis incremental encoder

1. Specify "0.001" with MD37110 : GANTRY POS TOL WARNING (synchronicity deviation warning output level position deviation). (This prevents the slave axis from being synchronized at the first return to reference point.)
2. After supplying power to the servo drives, initiate the return to reference point on REF mode.

   First the return to reference point for master axis is enabled and then that for slave axis is enabled.(Here you have an alarm output, but ignore the alarm and go on to the following process.)
3. On the diagnosis (service display) screen, check the master axis "measurement position for measurement system 1" (for motor encoder) or "measurement position for measurement system 2" (for separately mounted encoder) after the slave axis return to reference point is completed.
4. Reverse the sign of the value you just checked on Step 3 and enter the value with the reversed sign into the slave axis with MD34080 [0] or [1] : REEP_MOVE_DIST (return to reference point travel distance). ([0] for the motor encoder control, and [1] for the separately mounted encoder)
5. Check that the gantry axis moves synchronously.
6. Specify a proper value with MD37110.
7. Initiate NCK Reset. Check the return to reference point motion again and then complete the process.

INFO

Supposing the C phase searching direction as the reverse setting (MD34050 = 1), set the return to reference point direction (MD34010) for slave axis and C phase searching direction (MD34050) for the opposite direction to the master axis when the position of encoder C phase is ahead of the origin dog in the return to reference point direction (direction setting for MD34010) for the master axis.

14.3.11 Collision detection

Collision detection function detects the collision of feed axes with the disturbance observer and enables the pullback-stop of the torque reference. You can individually specify the torque disturbance detection level of collision detection for each of

- positioning feed
- feed other than positioning feed, and
- forced input signal.

Also, it is possible to disable the collision detection function by the external input . With this function, a series of events from the collision detection to the stop are processed with the servo drive. The machine data and parameters related to the collision detection function are listed below.

For the detailed information about adjustment procedure for the collision detection function, see the separate explanation.

IMPORTANT

Collision detection function is not available for spindles.

■ CNC setting

Feed axes

- MD37610 PROFIBUS_CTRL_CONFIG (For each axis)

  Meaning: CNC feed mode to the drive
  This machine data permits the switching over the disturbance detection level from the positioning feed to the other feed and vise versa.

  Setting value: 0---disabled
  1---enabled
  You must specify 1 (enabled) when the collision detection function is enabled.

■ Drive setting

- MD3063 (Pn121) GAIN_DISTURB_OBSERVER (For each servo axis)

  Meaning: Disturbance observer gain
  Setting value: [Hz]

- MD3064 (Pn122) HPF_CUT_FREQ_DISTURB_OBSRVR (For each servo axis)

  Meaning: Disturbance observer high pass filter cutoff frequency
  Setting value: [Hz]

- MD3066 (Pn124) LPF_CUT_FREQ_DISTURB_OBSRVR (For each servo axis)

  Meaning: Disturbance observer low pass filter cutoff frequency
  Setting value: [Hz]

- MD3067 (Pn125) INERTIA_ADJ_DISTURB_OBSRVR (For each servo axis)

  Meaning: Disturbance observer inertia compensation

  Setting value: [%]

- MD3368 (Pn412) DISTURB_TORQUE_LEVEL_1 (For each servo axis)

  Meaning: 1st torque disturbance level
  Disturbance level for feed except for positioning feed

  Setting value: [%]

- MD3369 (Pn413) DISTURB_TORQUE_LEVEL_2 (For each servo axis)

  Meaning: 2nd torque disturbance level
  Disturbance level for positioning feed

  Setting value: [%]

- MD3370 (Pn414) DISTURB_TORQUE_LEVEL_3 (For each servo axis)

  Meaning: 3rd torque disturbance level
  Disturbance level for forced entry

  Setting value: [%]

- MD3371 (Pn415) DISTURB_TORQUE_LEVEL_4 (For each servo axis)

  Meaning: 4th torque disturbance level
  When Collision Detection is disabled

  Setting value: [%]

  Note: Be sure to set the parameter to "0".

- MD3372 (Pn416) COMPLIANCE_TORQUE (For each servo axis)

  Meaning: Compliance torque

  Setting value: [%]

■ Relevant I/O

- DB3nDBX20. 2 (Torque limit 2) (For each servo axis)

  Meaning: Collision detection function enabled/disabled
  By setting this signal to "1", the collision detection signal is enabled.

  Setting value: 0---collision detection function disabled
  1---collision detection function enabled

- DB3nDBX21. 2 (Drive parameter set selection d2) (For each servo axis)

  Meaning: Collision detection function forced input selection

  Setting value: 0---forced input disturbance level disabled
  1---forced input disturbance level enabled

- DB3nDBX93. 2 (Active drive parameter set d2) (per servo axis)

  Meaning: Collision detection function forced input selection state

  Setting value: 0---forced input disturbance level not selected
  1---forced input disturbance level selected

14.3.12 Spindle sequence I/O signals

■ Comparison of spindle sequence signals

The following table shows comparison of the spindle sequence signals with the conventional spindle sequence signals.

Name of conventional signal	YS 840DI signal	Specification (relation to the conventional)	Remarks
Emergency Stop (EMG)	None	Main supply ON is common to the servo drive.	
Operation is Ready (RDY)	DBB2.1 (Controller enable)	Same as RDY	
Servo Drive ON and Forward (FOR)	DBX21.7 (Pulse enable)	Same as the servo drive	
Servo Drive ON and Reverse (REV)	None	Reverse command is for CNC function	
P/Pi Control Switching (PPi)	DBX21.6, DBX93.6 (controller integrator disable)	DBX21.6 is equal to PPi. DBX93.6 is added to the completion check.	Also used for prevention of spindle fluctuation. See section 14.3.13.
Orientation (ORT)	None	CNC function is enabled.	See 14.3.13.
Orientation Completion (ORE)			
Soft Start (SSC)	None	Automatically enabled with spindle control system.	
Torque Limit (TLH, TLL)	None	Limit value is specified from CNC.	
Torque Limit Enabled (TLE)	None		
Speed Agreement (SAGR)	DBX94.6 (nact=nset)	Equal to SAGR. ("1" for Speed agreement)	See the parameters below.
Zero Speed detection (ZSPD)	DBX94.4(|nact|<nmin)	Equal to ZSPD. ("1" for the speed equal or exceed setting value, "0" for the speed less or equal to setting value)	See the parameters below.
Speed Detection (SDET)	DBX94.5(|nact|<nx)	Equal to SDET. ("0" for the speed equal or exceed setting value, "1" for the speed less or equal to setting value)	See the parameters below. Also see 14.3.14.
Load axis origin (ORG)	None		
Torque Detection (TDET)	DBX94.3(Md<Mdx)	Equal to TDET. ("0" for the speed equal or exceed setting value, "1" for the speed less or equal to setting value)	See the parameters below.
Fault (FLT)	None	CNC	
Malfunction Warning	None		
Change Winding Request (CHW)	DBX21.3-5(Motor selection)	Different specification	See 14.3.14
Change Winding Completion (CHWE)	DBX93.3-4(Active motor)		
Gear Changing (MGR,LGR)	DBX21.0-2,DBX93.0-2 (Drive parametr set selection)	Different specification	See 14.3.15
C Axis Changing Request (CAX)	DBX21.0-2 (Drive parameter set selection)		
C Axis Changing Completion (CAXE)	DBX93.0-2 (Active drive parameter set)		
-	DBX94.0 (Motor temperature prewarning)	Abnormal motor temperature alarm (Normal; "1", Alarm; "0")	YS 840DI only
-	DBX94.1 (Heat sink temperature prewarning)	Abnormal heat sink temperature alarm (Normal; 1, Alarm; 0)	YS 840DI only (also servo axis)
-	DBX95.0 (UDC-link<alarm threshold)	Undervoltage alarm (Normal; "1" Alarm; "0")	YS 840DI only (also servo axis)

■ Relevant Parameter

Parameters for the spindle drive related to the spindle sequence are listed below.

- MD6030 (Cn030) ZERO - SPEED_DET_LEVEL (Spindle)
  Meaning: Zero speed (ZSPD) detection level
  Setting value: [0.1min^{-1}]
- MD6031 (Cn031) ZERO - SPEED_DET_WIDTH (Spindle)
  Meaning: Zero speed (ZSPD) detection range
  Setting value: [0.1min^{-1}]
- MD6400 (Cn400) SPEED_AGREE_WIDTH (Spindle)
  Meaning: Speed agreement signal (SAGR) range
  Setting value: [%]
  Percentage for rated speed MD6500 (Cn500)
- MD6401 (Cn401) SPEED_DETECTION_LEVEL (Spindle)
  Meaning: Speed detection signal (SDET) level
  Setting value: [0.01%]
  Percentage for rated speed MD6500 (Cn500)
- MD6402 (Cn402) SPEED_DETECTION_WIDTH (For each axis)
  Meaning: Speed detection signal (SDET) hysteresis
  Setting value: [0.01%]
  Percentage for rated speed MD6500 (Cn500)
- MD6410 (Cn410) TORQUE_DETECTION_LEVEL (Spindle)
  Meaning: Torque detection signal (TDET) level
  Setting value: [0.1%]
  Percentage for 30-minute rated speed
- MD6411 (Cn411) TORQUE_DETECTION_WIDTH (For each axis)
  Meaning: Torque detection signal (TDET) hysteresis
  Setting value: [0.1%]
  Percentage for 30-minute rated speed

14.3.13 Spindle orientation

Spindle orientation is conventionally permitted as the spindle drive function, but, on YS 840DI system, the speed and positioning references required for indexing are all created in CNC (equivalent to conventional NC indexing). Spindle drives permit positioning according to the speed and position references from CNC.
YS 840DI system spindle orientation (positioning) is permitted according to CNC SPOS command.
For the spindle orientation, even for the high-speed rotating spindle orientation, it is possible to permit orientation in a short time because of continuous switching over from the speed control mode to the position control mode.
Also, since the spindle orientation need the speed feedforward, the speed feedforward should be enabled.

■ Relevant CNC machine data

Primary relevant machine data is as follows. (For parameters such as MD34080, MD34090, and MD34100 related to the orientation stop position, see section 14.3.5 Return to reference point.)

- MD32620 FFW_MODE (For each axis)

  Meaning: Feedforward setting
  Setting value: 0---feedforward setting disabled
  3---Feedforward used for speed feedforward
  Specify "3" for the spindle.

  Note: The setting value "1" allows this system to be compatible with the conventional systems.
  There will occur no serious problems if this value is set.
- MD34060 REFP_MAX_MARKER_DIST [0] (For each axis)

  Meaning: C phase searching maximum distance (motor encoder)
  Setting value: [mm] or [deg]

  Note: For the spindle, specify the value equal or exceed 1080deg for orientation.
- MD35200 GEAR_STEP_SPEEDCTRL_ACCEL [n] (For each axis)

  Meaning: Acceleration under the nth gear speed control
  Setting value: [r/sec^2]
- MD35210 GEAR_STEP_POSCTRL_ACCEL [n] (spindle)

  Meaning: Acceleration under the nth gear position control
  Initial setting is n = 1. However the value is between 1 and 5 depending on the going gear setting.

  Setting value: [r/sec^2]

- MD35300 SPINDLE_POSCTRL_VELO (spindle)

  Meaning: Speed of switching over from speed control to position control
  When this speed is permitted for the spindle orientation, the position control mode is initiated for the spindle.

  Setting value: [min^{-1}]

The following diagram shows the relation between the speed during spindle orientation motion and each machine data.

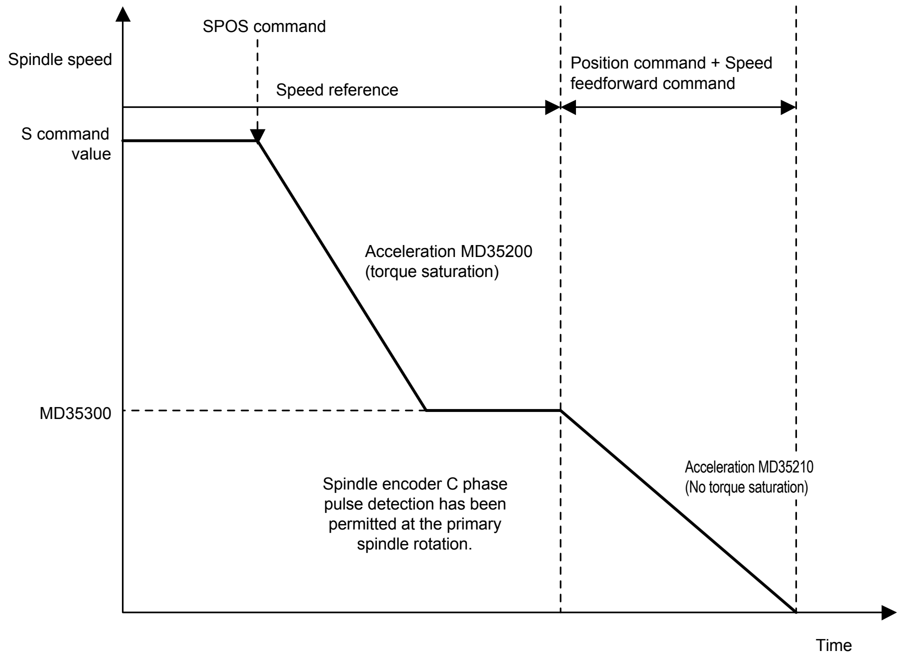


Fig. 14.7 Spindle orientation speed

INFO

■ Magnetic encoder

When magnetic encoders are used, if C phase range is not compensated, due to the range of about 20 pulse of C phase, the stop position is different, depending on the direction of orientation, positive or negative. In this case, the compensation for YS 840DI is enabled by the following procedure via PLC. When the traveling direction of spindle, positive or negative, is received with PLC, the value for CNC machine data Origin Position Shift (MD34100 REFP_SET_POS [n]) is changed to a different value depending on whether the direction is positive or negative.

For example;

Set the following machine data,

Positive direction origin position shift: REFP_SET_POS [0] = 0
Negative direction origin position shift: REFP_SET_POS [1] = * * * (C phase range angle).

For the spindle orientation, specify "0" and "1" with this machine data selection DB (DB3xDBX2. 4-7) when the CNC forward/reverse request is sent. This allows CNC to initiate the selection of REFP_SET_POS [0] or REFP_SET_POS [1]. Thus compensation of the orientation position is permitted.

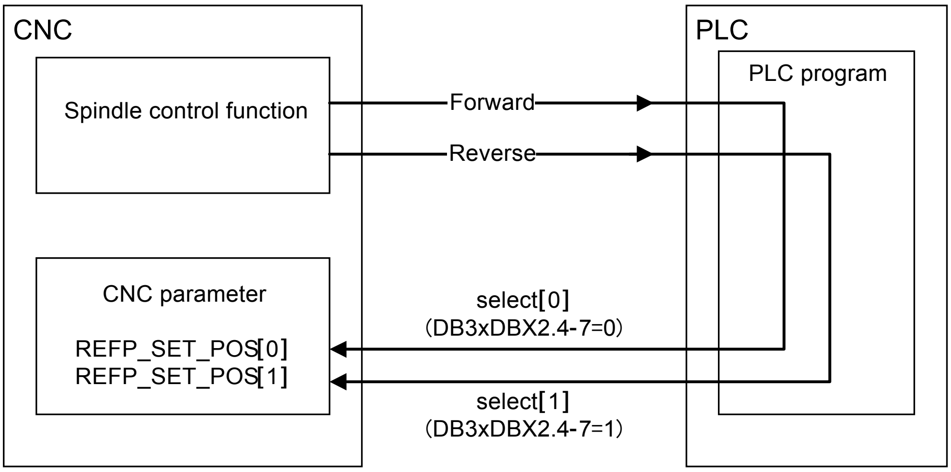


Fig. 14.8 Spindle orientation C phase range compensation

■ Fluctuation of spindle at the orientation stop

If the spindle fluctuates at the orientation stop, set one of the following spindle drive parameters and then follows the procedure for PLC program.

Setting the spindle drive parameter

- MD6525 (Cn525) MULTI_FUNCTION_SEL_PPI (For each axis)

  Meaning: Multi-function selection PPI

  Setting value: 0---Fluctuation control at position control stop function is disabled

  1---When PPI signal entered, fluctuation control at position control stop function is enabled

- MD6595 (Cn583) ORT_DB_GAIN_DEC_RATIO_H (For each axis)

  Meaning: Percentage of gain reduction at positioning completion (H gear)

  Setting value: [%]

- MD6596 (Cn584) ORT_DB_GAIN_DEC_RATIO_L (For each axis)

  Meaning: Percentage of gain reduction at positioning completion (L gear)

  Setting value: [%]

PLC program processing

- When orientation is enabled,

  Enable Orientation, and then wait for the spindle Exact Stop DB3nDBX60. 7 = 1.

  When DB3nDBX60. 7 = 1 is permitted, set DB3nDBX21.6 = 1 (PPI: n controller integrator disable). These parameters allows the servo drive gain to decrease.

- When activated (M3, Tapping, Re-indexing, etc.)

  Simultaneously with the wake-up signal, set DB3nDBX21.6 = 0 (PPI: n controller integrator disable).

14.3.14 Spindle winding changing

Spindle winding changing is allowed via the spindle drive by the command form PLC according to YS 840DI system specification.

■ Changing process

For example, the changing procedure with spindle speed detection signal (DBX94.5) is shown below.

1. Set the spindle speed detection speed (MD6401 (Cn401)) for the winding changing speed SCHW.
2. Set the spindle speed detection width (MD6402 (Cn402)) for the winding changing speed hysteresis range Δ S.

   MD6401, MD6402: Set the value in the units of 0.01 % of the rated revolution.
3. PLC detects ON/OFF for the spindle speed winding signal with DBX94.5.
4. PLC instructs the low-speed winding selection (DBX21.3 = 0, DBX21.4 = 0), and the high-speed winding selection (DBX21.3 = 1, DBX21.4=0). (Switching command is permitted with DBX21.5.)
5. PLC checks the winding selection status (DBX 93.3-4 agree with DBX 21.3.4) sent from CNC and completes the process.

An example of time chart in case that switching speed is 1250min^{-1} is shown below.

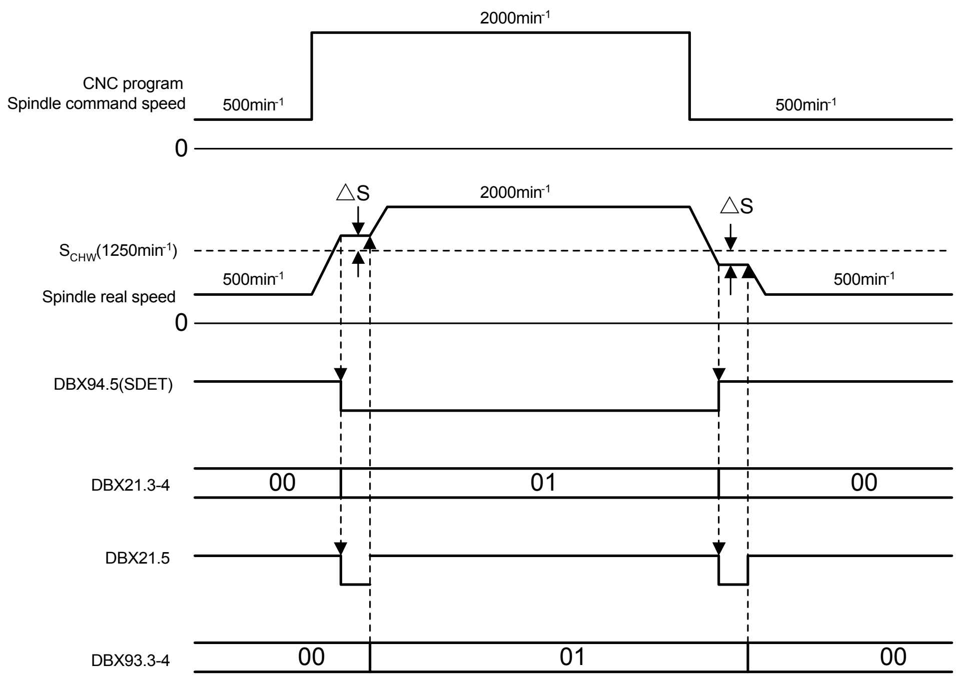


Fig. 14.9 Time chart for winding changing time chart

■ Relevant parameters

Below are the parameters in relation to the spindle drive winding change.

- MD6401 (Cn401) SPEED_DETECTION_LEVEL (spindle)

  Meaning: Speed detection signal level S_{CHW}

  Setting value: [0.01 %]

  Sets the percentage for the rated speed MD6500 (Cn500).

- MD6402 (Cn402) SPEED_DETECTION_WIDTH (spindle)

  Meaning: Speed detection signal hysteresis $\triangle$ S

  Setting value: [0.01 %]

  Set the percentage for the rated speed MD6500 (Cn500)

- MD6809 (Cn809) SELECTION_CODE1 (spindle)

  Meaning: Winding changing setting

  Setting value: 0001---No winding switching unit. High-speed winding fixed (initial value)

  0000---Winding switching unit is used

  0010---Winding switching unit and speed cramp function is used

At the time of acceleration with low-speed winding, if the rated speed operation is not activated with SDET signal detection speed S_{CHW} on CNC, the low-speed winding overspeed alarm for spindle drive may be output before switching over to the high-speed winding. In this case, by specifying the setting for the speed cramp function, when the speed reaches S_{CHW}, the spindle drive speed can be cramped to S_{CHW}.

14.3.15 Spindle gear changing and Spindle integrated with C axis control

The spindle changing for the spindle gear changing or the spindle/C axis changing under the spindle integrated C axis control is permitted via the spindle drive by the command from PLC according to the spindle parameter changing specification of YS 840DI system specification.

Parameter changing to H gear, M gear, L gear, or C axis is initiated by PLC when PLC verifys the request for the parameter selection status number (DBX21.0 - 2) sent from PLC to CNC and also the completion of changing the parameter selection status number (DBX93.0 - 2) from CNC to PLC. For the parameter changing, the parameter selection number in relation with each gear selection and C axis selection, and a skeleton time chart is shown below.

DBX21. 0 to 2 (PLC -> CNC) DBX93. 0 to 2 (CNC -> PLC)	Usage
0	C axis selection (CAX)
1	L gear selection (LGR)
2	M gear selection (MGR)
3	H gear selection
4 - 6	Reserved (currently H gear selection)
7	H gear selection (default)

Note: If you do not use the gear changing or C axis control, select H gear.

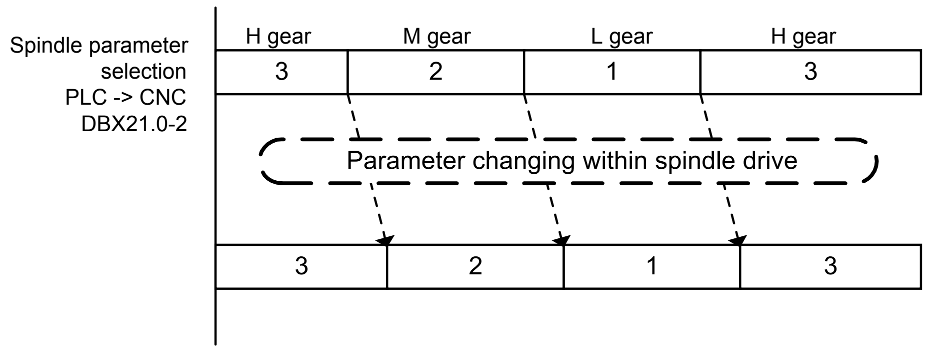


Fig. 14.10 Spindle parameter selection time chart

14.3.16 Rigid tap

YS 840DI system tapping function "Rigid Tap" is permitted with the interpolation control of the spindle and the feed axis, which is different from the conventional system.
In this case, to lessen the synchronicity errors, the position loop gain of feed axis (generally Z axis) and the position loop gain of spindle must be identical.
Therefore, when the rigid tap is enabled, the position loop gain POSCTRL_GAIN [1], dedicated to the rigid tap, is used.
Setting the same values for loop gain of the spindle and the feed axis (see below) can reduce the synchronicity errors during the rigid tapping.
For the detailed information of Rigid pap function, see the Programing Manual for Machining Center (NCSIE-SP02-20).

MD32200 POSCTRL_GAIN [1] (For each axis)

Meaning: Position loop gain
Setting value: [1/s] (Sets the position loop gain in the unit specified with MD10230)

Note: With each axis MD32900 DYN_MATCH_ENABLE = 1, it is possible to set each axis conventional position loop gain MD32200 [0] to be equal.
In this case. however, since the function is enabled for the axis for which interpolation is enabled independently with Rigid Tap, you must specify the individual spindle and feed axis separately when setting the time constant for adjustment MD32910 DYN_MATCH_TIME.

INFO

The acc./dec. rate during Tapping motion is set to the lower value of acceleration setting values of either the conventional cutting feed or the spindle orientation.

Also it is possible to improve accuracy by enabling the feedforward control when rigid tap is enabled. See section 14.3.7.

14.3.17 Threading

For YS 840DI threading feed, you can select; no spindle position control (mm/rev control. SPCOF) or the spindle position control (SPCON).
The following data shows the typical mm/rev control.

- MD20650 THREAD_START_IS_HARD

  Meaning: Acc./dec. motion when threading
  Setting value: 0---linear acc./dec. Jerk setting possible.
  1---step acc./dec.

- MD35150 SPIND_DES_VELO_TOL (For each spindle)

  Meaning: Spindle speed tolerance. Tolerance for reference speed
  Setting value: [percentage]

- MD35200 GEAR_STEP_SPEEDCTRL_ACCEL [n] (For each spindle)

  Meaning: Acceleration rate when spindle speed control enabled. Settable for each gear.
  Setting value: [r/sec^2]

- SD42010 THREAD_RAMP_DISP

  Meaning: Threading acc./dec. distance
  Setting value: [mm]
  -1---MD20650 = 0 motion
  0---MD20650 = 1 motion
  0 > ---accelerates to reach the specified speed before passing through the distance of this machine data setting value

14.3.18 Spindle synchronization control

All special processing in relation to the spindle synchronicity control is permitted by CNC. Following is shown the primary CNC machine data related to the spindle synchronicity control.

- MD21300 COUPLE_AXIS_1 [0]

  Meaning: Number of slave axis
  Setting value: Sets the axis number for the spindle to be a slave axis

- MD21300 COUPLE_AXIS_1 [1]

  Meaning: Number of master axis
  Setting value: Sets the axis number for the spindle to be a master axis

- MD21310 COUPLING_MODE_1

  Meaning: Spindle synchronicity mode

  Setting value: 0---actual value coupling: Slave axis synchronizes with the master axis position feedback value

  1---setpoint coupling: The salve axis synchronizes with the master axis position reference value.

  2---speed coupling: Speed synchronization control (normally not used since the position control is not executed in this mode)

- MD21320 COUPLING_BLOCK_CHANGE_CTRL_1

  Meaning: Block changing mode during synchronicity

  Setting value: 0---immediately change

  1---change when ’Fine synchronism’ tolerance MD37210 is initiated

  2---change when ’coarse synchronism’ tolerance MD37200 is initiated

- MD21330 COUPLING_RESET_MODE_1

  Meaning: Synchronicity setting when rest

- MD21340 COUPLING_IS_WRITE_PROT_1

  Meaning: Synchronicity conditions modifying setting

  Setting value: 0---adjustable with CNC program

  1---not adjustable with CNC program

- MD37200 COUPLE_POS_TOL_COARSE

  Meaning: ’Coarse synchronism’ tolerance range

  Setting value: [mm] or [deg]

- MD37210 COUPLE_POS_TOL_FINE

  Meaning: ’Fine synchronism’ tolerance range

  Setting value: [mm] or [deg]

- SD42300 COUPLE_RATIO [0]

  Meaning: Numerator for synchronicity speed ratio

- MD42300 COUPLE_RATIO [1]

  Meaning: Denominator for synchronicity speed ratio

  Setting value: Sets synchronicity speed ratio for spindle/following axis synchronizing with spindle

  Speed ratio = SD42300[0]/SD42300[1]

  Settable with CNC program.

14.3.19 Skip Function

To use the skip function for latching the sensor position by using external sensors, set the following machine data.
SGDK servo drive has two low-active probe inputs.

■ CNC side setting

- MD13200 MEAS_PROBE_LOW_ACTIVE [0]

  Meaning: Low/high-active of probe 1
  Setting value: 0---high-active (positive)
  1---low-active (negative)
  For SGDK servo drive, always set "1".

- MD13200 MEAS_PROBE_LOW_ACTIVE [1]

  Meaning: Probe 2 detection polarity
  Setting value: 0---positive
  1---negative
  For SGDK servo drives, always set "1".

- MD13210 MEAS_TYPE

  Meaning: Skip mode selection
  Setting value: When latching on SGDK servo drives, always specify "1".

■ Servo drive setting

For servo drives, there is no particular settings for the skip function.
As described above, for servo drives, since the polarity of skip input/output signal is low active, be careful to set the machine data correctly. If the setting is incorrect, the polarity of the I/O signal shown below is reversely set.

■ I/O signal

- DB10DBX107. 0

  Meaning: State of probe 1
  Setting value: 0 -> 1 - Probe 1 ON
  1 -> 0 - Probe 1 OFF

- DB10DBX107. 1

  Meaning: State of probe 2
  Setting value: 0 -> 1 - Probe 2 ON
  1 -> 0 - Probe 2 OFF

14.4 High-speed High-accuracy Cutting

YS 840DI system High-speed High-accuracy Cutting function does not have any special high-speed modes, such as conventional U-HSC function or G-HSC function, which are different from general cutting modes. This High-speed High-accuracy Cutting function enables the conventional cutting to provide machining as accurate as G-HSC function which employs the multi-block look-ahead.

In addition, by adding the following functions to the conventional cutting feed, higher-speed, higher-accuracy cutting is provided for micro-block program machining such as die machining.

- Block compression: Two or more blocks having accuracy less than setting tolerance are compressed into a single linear or spline block. This allows high-speed processing for micro-length block for die machining.
- Spline interpolation: Using some spline interpolation algorithms, linear blocks are converted into spline curves so that smooth machining face can be permitted.
  There is no particular conditions for maneuverability, especially for G code, since conventional cutting feed function is used.

INFO

- Predictive control is always enabled with usual cutting feed.
- For details about the acc./dec. control setting, see Section 14.3.2.

14.4.1 Multi-block look-ahead

To permit the feed speed control suitable for machining pattern, multi-block look-ahead is enabled.

Parameters for the multi-block look-ahead are shown as followings.

- MD18360 EXT_PRG_BUFFER_SIZE
  Meaning: Definition for memory required for external memory operation
  Setting value: 100Kbyte
- MD28060 IPO_BUFFER_SIZE
  Meaning: IPO buffer size
  (Definition for the number of blocks inside interpolation buffer)
  Setting value: 2 to 300 blocks
  Standard setting value: 100 blocks
- MD28070 NUM_BLOCKS_IN_PREP
  Meaning: Number of reserved blocks (Definition for the number of blocks reserved)
  Setting value: 2 minimum, maximum value depends on memory capacity
  Standard setting value: 60 blocks

- MD29000 LOOKAH_NUM_CHECKED_BLOCKS

  Meaning: Number of look-ahead blocks

  Setting value: 10 to 500 blocks

  Standard setting value: 100 blocks

  Note: Block compression is available for the blocks compressed by the block compression described in the next section.

14.4.2 Block compression

By compressing with the spline function the blocks having less tolerance than the specified value (compressing two or more linear blocks into a single spline interpolation block), fine profile machining program for die machining can be effectively operated.
The block compression is enabled by the following functions.

■ COMPCURV function

Compresses 10 blocks max. Does not compress the sections whose radius of curvature is not continuous even though they have tolerance below specified value.

- Compression start: Specify "COMPCURV" with CNC program.
- Compression end: Specify "COMPOF" with CNC program.

■ COMPCAD function

Compresses 50 blocks max. This function can compress blocks having less tolerance than the specified value and their radius of curvature are not continuous into a single spline running through the midpoints of the blocks. This function can compress blocks more effectively than COMRCURV function.

- Start compression: Specify "COMPCAD" with CNC program.
- End compression: Specify "COMPOF" with CNC program.

The conditions for compression are defined with the following machine data (common to COMPCURV and COMPCAD).

- MD33100 COMPRESS_POS_TOL

  Meaning: Block compression distance tolerance
  Compresses the blocks within the distance with specified tolerance

  Setting value: [mm]

- MD20170 COMPRESS_BLOCK_PATH_LIMIT

  Meaning: Block compression distance limit
  The limit of the length of block to compress

  Setting value: [mm]

- MD20172 COMPRESS_VEL_TOL

  Meaning: Block compression speed tolerance
  Block compression limitation based on feed rate. Block compression in the feed rate range within the specified tolerance.

  Setting value: [mm/min]

14.4.3 Spline interpolation

■ General spline interpolation

Set the following machine data as the conditions for general spline interpolation to be enabled within CNC.

- MD28530 PATH_VELO_SEGMENTS

  Meaning: Number of polynomial spline per block
  Setting this value allows the feed speed to be controlled to have better waveform.

  Standard setting value: 5

- MD28540 ARCLENGTH_SEGMENTS

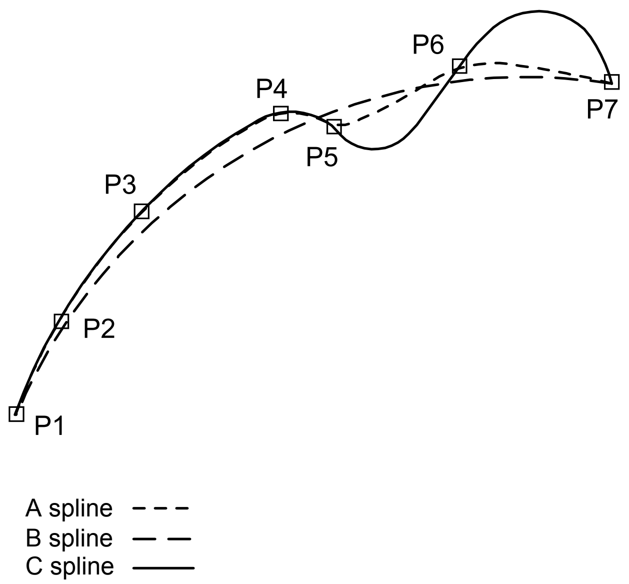
  Meaning: Number of polynomial spline within a single spline curve
  Setting this value allows the deviation of feed speed to decrease on the curve sections.

  Standard setting value: 10

■ Spline interpolation with NC program command

This allows the curve interpolation for linear blocks with the spline interpolation.
There are 3 types of spline curve for interpolation:

- A spline (Akima spline): Spline interpolation which always goes through the instructed points. The radius of curvature does not vary continuously.
- B spline (B-spline): Smooth spline interpolation which goes by the instructed points.
- C spline (Cubic spline): Spline interpolation which always goes through the instructed points and whose radius of curvature varies continuously on the instructed points.



■ Fine interpolation

DP cycle period interpolation is enabled for the position interpolated by IPO cycle period, when the interpolation position command is transferred from IPO cycle to DP cycle (Section 14.1.1).
There are two types of interpolation: difference interpolation (linear interpolation) and C spline interpolation (curvilinear interpolation).
Typically employ the C spline interpolation.

- MD33000 FIPO_TYPE

  Meaning: Fine interpolation type
  Setting value: 1---Differential interpolation
  2---C spline interpolation
  (setting value for compatibility with conventional versions)
  3---C spline interpolation

  Standard setting value: 3

14.4.4 Examples of machine data setting

The table below shows an example of evaluation conditions when evaluating the die machining with COMPCAD function at the machining center.
Program: Die machining for which Z axis reciprocates rapidly (In this case, the setting for the acceleration rate and the jerk of Z axis seriously affects the machining time.)

	COMPCAD results	
Z axis counter weight	None	Used
Machining time	15 min. 14 sec.	19 min. 04 sec.

CNC setting		Unit	Initial setting	COMPCAD setting value	
MD32300	MAX_AX_ACCEL [X,Y]	m/s^2	2	4	<-
MD32300	MAX_AX_ACCEL [Z]	m/s^2	2	4	2
MD32310	MAX_ACCEL_OVL_FACTOR		1.2	1.01	1.2
MD20600	MAX_PATH_JERK	m/s^3	10000	<-	<-
MD32431	MAX_AX_JERK [X,Y]	m/s^3	100	<-	<-
MD32432	PATH_TRANS_JERK_LIM [X,Y]	m/s^3	100	<-	<-
MD32431	MAX_AX_JERK [Z]	m/s^3	100	<-	<-
MD32432	PATH_TRANS_JERK_LIM [Z]	m/s^3	100	<-	<-
SD42470	CRIT_SPLINE_ANGLE		36	<-	<-
MD18360	MM_EXT_PROG_BUFFER_SIZE		30	100	<-
MD28530	PATH_VELO_SEGMENTS		0	5	<-
MD28540	ARCLENGTH_SEGMENTS		0	10	<-
MD28070	NUM_BLOCKS_IN_PREP		38	60	<-
MD28060	IPO_BUFFER_SIZE		10	100	<-
MD29000	LOOKAH_NUM_CHECKED_BLOCKS		500	100	<-
MD20170	COMPRESS_BLOCK_PATH_LIMIT		20	100	<-
MD33100	COMPRESS_POS_TOL		0.005	0.01	<-
MD32200	POSCTRL_GAIN [0]	1/s	40	<-	<-

14.5 Relevant Machine Data and Parameters

Relevant machine data and parameters described in Chapter 14 are listed below.

14.5.1 CNC relevant machine data

Main topic	Topic	Subtopic	Axis	Name of Machine Data	No. of Machine data	Typical Setting Value	UNIT	General setting and others
Standard setting	Cycle time	DP cycle time	-	SYSCLOCK_CYCLE_TIME	MD10050	-	sec	Read only. Results of hard ware configuration are displayed.
		IPO cycle time	-	IPO_SYSCLOCK_TIME_RATIO	MD10070	2 to 4	-	
		IPO cycle time limit	-	ON_PERFORMANCE_TIME_RATIO	MD19296	4	-	
		CPU performance NCK percentage	-	NCK_PCOS_TIME_RATIO	MD10185	65	%	Range between 50 and 75 %.
		HMI screen refresh suppress	-	SUPPRESS_SCREEN_REFRESH	MD10131	0	-	0: Whole group suppressed 1: Part of the group suppressed 2: No suppression
	Drive standard setting	DSC mode	Feed axis/Spindle	STIFFNESS_CONTROL_ENABLE[0]	MD32640	1	-	1: DSC mode. Always specify "1".
		Telegram type	Feed axis/Spindle	DRIVE_TELEGRAM_TYPE[0]	MD13060	201	-	Always specify "201". Specify the number of axes into the brackets ([ ]).
		NCK reset/shutdown motion specificationFeed axis/Spindle	Feed axis/Spindle	PROFIBUS_SHUTDOWN_TYPE	MD11250	2	-	0: Alarm stop 1: With bus clear, deceleration stop 2: Without bus clear, deceleration stop
		Command unit system (inch/mm)	Feed	EXTERN_GCODE_RESET_VALUE[5]	MD20154	2	-	1: G20/2: G21
	Spindle standard setting	Spindle default mode	Spindle	SPIND_DEFAULT_MODE	MD35020	0	-	0: Speed reference mode (speed control) 1: Speed reference mode (position control)
		Spindle default mode mask	Spindle	SPIND_DEFAULT_ACT_MASK	MD35030	0	-	Effective timing with MD35020. 0: When powered on
		Spindle motion after reset and M3/M30	Spindle	SPIND_ACTIVE_AFTER_RESET	MD35040	0	-	Motion (Reset, M2, and M30) 0: Stop 1: Not stop
	Axis component	Name of machine axis	Feed axis/Spindle	AXCONF_MACHAX_NAME_TAB[0]	MD10000	X1-	-	Enabled axes, disabled axes and simulation axes defined independently of group
		Number of geometry axis per group	Feed	AXCONF_GEOAX_ASSIGN_TAB[0]	MD20050	1-	-	Not permitted for Spindles.
		Name of geometry axis per group	Feed	AXCONF_GEOAX_NAME_TAB[0]	MD20060	X-	-	Not permitted for Spindles.
		Number of enabled axis per group	Feed axis/Spindle	AXCONF_MACHAX_USED[0]	MD20070	1-	-	Axes for MD10000 are defined within group. Disabled axes are not defined.
		Name of program axis	Feed axis/Spindle	AXCONF_CHANAX_NAME_TAB[0]	MD20080	X-	-	Axes manes are defined for MD270070. Disabled axes are not defined.
		Number of drive for hard ware configuration	Feed axis/Spindle	CTRLOUT_MODULE_NR	MD30110	1-	-	Same order as row of hard ware configuration
		Enabled axis/simulation axis	Feed axis/Spindle	CTRLOUT_TYPE[0]	MD30130	1	-	1: Enabled axes 0: Simulation and disabled axes
	Motor encoder	Number of encoder	Feed axis/Spindle	NUM_ENC	MD30200	-	-	1: Motor encoder only2: Including separately mounted encoder
		Rotary encoder/linear scale (motor encoder)	Feed axis/Spindle	ENC_LINEAR[0]	MD31000	-	-	0: Rotary encoder 1: Linear scale
		Number of encoder for hard ware configuration	Feed axis/Spindle	ENC_MODULE_NR	MD30220	1-	-	Same order as row of hard ware configuration
		Type of motor encoder	Feed axis/Spindle	ENC_TYPE[0]	MD30240	-	-	0: Simulation axes 1: Incremental encoder 4: Absolute encoder
		Absolute position data percentage	Feed axis/Spindle	ABS_INC_RATIO[0]	MD30260	1	-	
		Linear axis/rotation axis	Feed axis/Spindle	IS_ROT_AX	MD30300	-	-	0: Linear axes 1: Rotation axes
		Number of motor encoder pulse	Feed axis/Spindle	ENC_RESOL[0]	MD31020	-	pulse	
		Motor encoder pulse factor	Feed axis/Spindle	ENC_PULSE_MULT[0]	MD31025	-	-	
		Ball screw pitch	Feed axis/Spindle	LEADSCREW_PITCH	MD31030	-	mm/rev	
		Denominator of load-side gear ratio	Feed axis/Spindle	DRIVE_AX_RATIO_DEMON[0]	MD31050	-	-	
		Numerator of load-side gear ratio	Feed axis/Spindle	DRIVE_AX_RATIO_NUMERA[0]	MD31060	-	-	
		Denominator of encoder/motor gear ratio	Feed axis/Spindle	DRIVE_ENC_RATIO_DEMON[0]	MD31070	1	-	
		Numerator of encoder/motor gear ratio	Feed axis/Spindle	DRIVE_ENC_RATIO_NUMERA[0]	MD31080	1	-	
		Motor encoder rotation direction	Feed axis/Spindle	AX_MOTOR_DIR[0]	MD32100	-	-	
		Multi-turn limit setting value	Feed axis/Spindle	ENC_ABS_TURNS_MODULO[0]	MD34220	65536	rev	
	Separately mounted encoder	Type of separately mounted encoder	Feed axis/Spindle	ENC_TYPE[1]	MD30240	-	-	0: Excluding separately mounted encoder 1: Incremental encoder4: Absolute encoder
		Absolute position data percentage	Feed axis/Spindle	ABS_INC_RATIO[1]	MD30260	1	-	
		Rotary encoder/linear scale (separately mounted encoder)	Feed axis/Spindle	ENC_LINEAR[1]	MD31000	-	-	0: Rotary encoder 1: Linear scale
		Number of pulse of separately mounted encoder	Feed axis/Spindle	ENC_RESOL[1]	MD31020	-	pulse	

Main topic	Topic	Subtopic	Axis	Name of Machine Data	No. of Machine data	Typical Setting Value	UNIT	General setting and others
Standard setting (Cont'd)	Separately mounted encoder (Cont'd)	Separately mounted encoder enabled/disabled	Feed axis/Spindle	ENC_IS_DIRECT[1]	MD31040	-	-	0: Disabled 1: Enabled
		Separately mounted encoder pulse multiplication	Feed axis/Spindle	ENC_PULSE_MULT[1]	MD31025	-	-	
		Separately mounted encoder rotation direction	Feed axis/Spindle	ENC_FEEDBACK_POL[1]	MD32110	-	-	0 or 1: Forward -1: Reverse
		Separately mounted encoder function	Feed axis/Spindle	STIFFNESS_CONTROL_CONFIG	MD32642	1	-	0: Type 1 1: Type 2 Specify "0" when not using separately mounted encoders.
		Multi-turn limit setting value	Feed axis/Spindle	ENC_ABS_TURNS_MODULO[1]	MD34220	1	rev	When linear scale is enabled, this setting is not required.
	Motor maximum speed	Percentage of motor maximum speed for speed reference	Feed axis/Spindle	RATED_OUTVAL[0]	MD32250	100	%	
		Motor maximum speed	Feed axis/Spindle	RATED_VELO[0]	MD32260	-	min^{-1}	Specify value for MD880.
	Mask	Drive function mask	Feed axis/Spindle	DRIVE_FUNCTION_MASK[0]	MD13070	0	-	
Servo control	Position control	Setting unit for position loop gain	Feed axis/Spindle	SCALING_FACTOR_USER_DEF[9]	MD10230	1.0	1/s	Common to whole axes
		Position loop gain	Feed axis/Spindle	POSCTRL_GAIN[0]	MD32200	-	1/s	Unit depends on setting value with MD10230[9].
		Maximum tolerance	Feed axis/Spindle	CONTOR_TOL	MD36400	-	mm,deg	
	Backlash compensation	Backlash compensation	Feed axis/Spindle	BACKLASH[0]	MD32450	-	mm,deg	
	Each control	CNC feed mode to the drive	Feed	PROFIBUS_CTRL_CONFIG	MD37610	1	-	Used for prediction control, model following control, gain changing, and collision detection.
		CNC feed mode to the drive	Spindle	PROFIBUS_CTRL_CONFIG	MD37610	0	-	Unavailable for Spindles.
Motion control	Feed rate	Feedback low pass filter (motor encoder)	Feed axis/Spindle	ENC_ACTVAL_SMOOTHTIME[0]	MD34990	-	sec	Mainly used when Spindle encoder resolution is not high enough.
		Feedback low pass filter (separately mounted encoder)	Feed axis/Spindle	ENC_ACTVAL_SMOOTHTIME[1]	MD34990	-	sec	Mainly used when Spindle encoder resolution is not high enough.
		Memory operation maximum speed	Feed	MAX_AX_VERO	MD32000	-	mm/min,deg/min	Maximum speed for G0, G1, etc.
		RAPID speed in JOG mode	Feed	JOG_VELO_RAPID	MD32010	-	mm/min,deg/min	
		JOG speed	Feed	JOG_VELO	MD32020	-	mm/min,deg/min	
		Positioning command maximum speed	Feed	POS_AX_VELO	MD32060	-	mm/min,deg/min	POS command maximum speed
		Speed limiting value	Feed	AX_VELO_LIMIT	MD36200	-	min^{-1}	The peed which triggers alarm.
		Percentage of maximum speed reference	Feed	CTRLOUT_LIMIT	MD36210	110	%	
		Gear enabled/disabled	Spindle	GEAR_STEP_CHANGE_ENABLE	MD35010	1		
		Spindle maximum speed	Spindle	SPIND_VERO_LIMIT	MD35100	-	min^{-1}	
		The nth gear maximum speed	Spindle	GEAR_STEP_MAX_VERO[n]	MD35110	-	min^{-1}	
		The nth gear minimum speed	Spindle	GEAR_STEP_MIN_VERO[n]	MD35120	-	min^{-1}	
		The nth gear maximum speed limiting value	Spindle	GEAR_STEP_MAX_VERO_LIMIT[n]	MD35130	-	min^{-1}	
		The nth gear minimum speed limiting value	Spindle	GEAR_STEP_MIN_VERO_LIMIT[n]	MD35140	-	min^{-1}	
		Spindle position control mode maximum speed	Spindle	SPIND_POSCTRL_VERO	MD35300	-	min^{-1}	
	Acceleration/ deceleration	Acc./dec. jerk default setting	Feed	GCODE_RESET_VALUES[20]	MD20150[20]	2	-	1: BRISK 2: SOFT
		Acc./dec. jerk	Feed	MAX_PATH_JERK	MD20600	-	$mm/sec^3,deg/sec^3$	Generally set a larger value than MD32431.
		Acceleration factor in curve section	Feed	CURV_EFFECT_ON_PATH_ACCEL	MD20602	0.75	-	
		Acceleration rate	Feed	MAX_AX_ACCEL	MD32300	-	$mm/sec^2,deg/sec^2$	Common to G0 and G1.
		Corner speed difference factor	Feed	MAX_ACCEL_OVL_FACTOR	MD32310	-	-	
		Acc./dec. jerk	Feed	MAX_AX_JERK	MD32431	-	$mm/sec^3,deg/sec^3$	Common to G0 and G1.
		Jerk limit between blocks	Feed	PATH_TRANS_JERK_LIM	MD32432	-	$mm/sec^3,deg/sec^3$	
		Acceleration factor for G00	Feed	G00_ACCEL_FACTOR	MD32434	-	-	
		Acc./dec. jerk factor for G00	Feed	G00_JERK_FACTOR	MD32435	-	-	
		Acceleration under the nth gear speed contro	Spindle	GEAR_STEP_SPEEDCTRL_ACCEL[n]	MD35200	-	r/sec^2	
		Acceleration under the nth gear position control	Spindle	GEAR_STEP_POSCTRL_ACCEL[n]	MD35210	-	r/sec^2	

Main topic	Topic	Subtopic	Axis	Name of Machine Data	No. of Machine data	Typical Setting Value	UNIT	General setting and others
Moter control (Cont'd)	Positioning	G60/G64 designation when reset	Feed	EXTERN_GCODE_RESET_VALUES[14]	MD20154[14]	3	-	0: G61 3: G64
		G0 feed specification	Feed	EXTERN_G0_LINEAR_MODE	MD20732	1	-	0: Positioning axis feed is enabled 1: Interpolation feed is enabled.
		G00 specification when G64 command enabled	Feed	EXTERN_FUNCTION_MASK.4	MD20734.4	1	-	0: Exact stop disabled 1: Exact stop enabled
		Motion during travel from G0 to G1, or G1 to G0	Feed	EXACT_POS_MODE_G0_TO_G1	MD20522	1	-	0: Exact stop disabled 1: G601 motion 2: G602 motion 3: G603 motion
		Positioning completion range (coarse)	Feed axis/Spindle	STOP_LIMIT_COARSE	MD36000	-	mm,deg	
		Positioning completion range (fine)	Feed axis/Spindle	STOP_LIMIT_FINE	MD36010	-	mm,deg	
		Positioning completion check starting time	Feed axis/Spindle	POSITIONING_TIME	MD36020	-	sec	
		Positioning stop tolerance	Feed axis/Spindle	STANDSTILL_POS_TOL	MD36030	-	mm,deg	
		Positioning stop tolerance check starting time	Feed axis/Spindle	STANDSTILL_DELAY_TIME	MD36040	-	sec	
		Rotation axes moving range	Feed axis/Spindle	MODULO_RANGE	MD30330	-	deg	
	Emergency stop	Zero speed	Feed axis/Spindle	STANDSTILL_VELO_TOL	MD36060	-	mm/min,min^{-1}	
		Emergency stop standstill period	Feed axis/Spindle	AX_EMERGENCY_STOP_TIME	MD36610	-	sec	
		Period from emergency stop until servo drive cutoff	Feed axis/Spindle	SERVO_DISABLE_DELAY_TIME	MD36620	-	sec	MD36620 > MD36610
	Return to reference point	Return to reference point dog setting	Feed	REFP_CAM_IS_ACTIVE	MD34000	-	-	0: No dog 1: Dog
		Return to reference point dog setting	Spindle	REFP_CAM_IS_ACTIVE	MD34000	0	-	Spindle orientation is set to "0" (No dog).
		Return to reference point direction	Feed	REFP_CAM_DIR_IS_MINUS	MD34010	-	-	0: Positive 1: Negative
		Approach speed	Feed	REFP_VERO_SEARCH_CAM	MD34020	-	mm/min,min^{-1}	
		Return to reference point dog search maximum distance	Feed	REFP_MAX_CAM_DIST	MD34030	-	mm	
		Creep speed (motor encoder)	Feed	REFP_VERO_SEARCH_MAKER[0]	MD34040	-	mm/min,min^{-1}	
		Creep speed (separately mounted encoder)	Feed	REFP_VERO_SEARCH_MAKER[1]	MD34040	-	mm/min,min^{-1}	
		C-phase search direction (motor encoder)	Feed	REFP_SEARCH_MARKER_REVERSE[0]	MD34050	-	-	0: Positive (Not ahead of dog) 1: Negative (ahead of dog)
		C-phase search direction (separately mounted encoder)	Feed	REFP_SEARCH_MARKER_REVERSE[1]	MD34050	-	-	0: Positive (Not ahead of dog) 1: Negative (ahead of dog)
		C-phase search maximum distance (motor encoder)	Feed	REFP_MAX_MARKER_DIST[0]	MD34060	-	mm,deg	
		C-phase search maximum distance (motor encoder)	Spindle	REFP_MAX_MARKER_DIST[0]	MD34060	1080	mm,deg	Specify "1080deg" for spindle orientation.
		C-phase search maximum distance (separately mounted encoder)	Feed	REFP_MAX_MARKER_DIST[1]	MD34060	-	mm,deg	
		Return to reference point speed	Feed	REFP_VERO_POS	MD34070	-	mm/min,min^{-1}	
		Return to reference point travelling distance (motor encoder)	Feed	REFP_MOVE_DIST[0]	MD34080	-	mm,deg	
		Return to reference point travelling distance (separately mounted encoder)	Feed	REFP_MOVE_DIST[1]	MD34080	-	mm,deg	
		Return to reference point travelling distance offset (motor encoder)	Feed	REFP_MOVE_DIST_CORR[0]	MD34090	-	mm,deg	
		Return to reference point travelling distance offset (separately mounted encoder)	Feed	REFP_MOVE_DIST_CORR[1]	MD34090	-	mm,deg	
		Return to reference point dog shift range (motor encoder)	Feed	REFP_CAM_SHIFT[0]	MD34092	-	mm,deg	
		Return to reference point dog shift range (separately mounted encoder)	Feed	REFP_CAM_SHIFT[1]	MD34092	-	mm,deg	
		Reference position shift	Feed	REFP_SET_POS[n]	MD34100	-	mm,deg	Specify n with DB3xDBX2.4-7
		Return to reference point mode (motor encoder)	Feed	ENC_REFP_MODE[0]	MD34200	-	-	0: No origin pulse 1: C-phase Return to reference point
		Return to reference point mode (separately mounted encoder)	Feed	ENC_REFP_MODE[1]	MD34200	-	-	0: No origin pulse 1: C-phase Return to reference point
	Speed feedforward	Feedforward mode	Feed axis/Spindle	FFW_MODE	MD32620	3	-	0: Disabled 3: Speed feedforward enabled
		FFWON command for program	Feed axis/Spindle	FFW_ACTIVATION_MODE	MD32630	-	-	0: Disabled 1: Enabled
		Speed feedforward time constant	Feed axis/Spindle	EQUIV_SPEEDCTRL_TIME	MD32810	-	-	
		Speed feedforward weight	Feed axis/Spindle	VELO_FFW_WEIGHT	MD32610	1.0	-	
	Fixed Stop	Fixed Stop mode	Feed axis/Spindle	FIXED_STOP_MODE	MD37000	-	-	0: Disabled 1: Enabled
		Torque limiting value	Feed axis/Spindle	FIXED_STOP_TORQUE_DEF	MD37010	-	%	Ratio for maximum torque
		Position deviation detection level	Feed axis/Spindle	FIXED_STOP_THRESHOLD	MD37030	-	mm,deg	
	Absolute value detection	Reference position offset (motor encoder)	Feed	REFP_MOCE_DIST_CORR[0]	MD34090	-	mm,deg	
		Reference position offset (separately mounted encoder)	Feed	REFP_MOCE_DIST_CORR[1]	MD34090	-	mm,deg	
		Return to reference point mode (motor encoder)	Feed	ENC_REFP_MODE[0]	MD34200	-	-	"0" (to the position specified with MD34100) for the time when absolute value is detected
		Return to reference point mode (separately mounted encoder)	Feed	ENC_REFP_MODE[1]	MD34200	-	-	"0" (to the position specified with MD34100) for the time when absolute value is detected

Main topic	Topic	Subtopic	Axis	Name of Machine Data	No. of Machine data	Typical Setting Value	UNIT	General setting and others
Moter control (Cont'd)	Absolute value detection (Cont'd)	Return to reference point status (motor encoder)	Feed	ENC_REFP_STATE[0]	MD34210	-	-	"2" at the reference setting completion
		Return to reference point status (separately mounted encoder)	Feed	ENC_REFP_STATE[1]	MD34210	-	-	"2" at the reference setting completion
		Motor encoder type	Feed	ENC_TYPE[0]	MD30240	-	-	"4" at the separately mounted encoder absolute value detection
	Gantry control	Gantry axis setting	Feed	GANTRY_AXIS_TYPE	MD37100	-	-	
		Synchronicity warning output level position deviation	Feed	GANTRY_POS_TOL_WARNING	MD37110	-	mm,deg	
		Synchronicity alarm output level position deviation	Feed	GANTRY_POS_TOL_ERROR	MD37120	-	mm,deg	
		Return to reference point synchronicity deviation alarm output level position deviation	Feed	GANTRY_POS_TOL_REF	MD37130	-	mm,deg	
		Gantry axis synchronization release	Feed	GANTRY_BREAK_UP	MD37140	-	-	0: Disabled 1:Synchlonization release Take notice when using this function.
	Spindle orientation	Feedforward mode	Spindle	FFW_MODE	MD32620	1	-	0: Disabled 1: Speed feedforward enabled Specify "1" for spindles.
		Acceleration when the nth gear speed controlled	Spindle	GEAR_STEP_SPEEDCTRL_ACCEL[n]	MD35200	-	r/sec^2	
		Acceleration when the nth gear position controlled	Spindle	GEAR_STEP_POSCTRL_ACCEL[n]	MD35200	-	r/sec^2	
		Positioning control switching speed	Spindle	SPINDLE_POSCTRL_VELO	MD35300	-	min^{-1}	
	Rigid tap	Position loop gain when tap enabled	Feed	POSCTRL_GAIN[1]	MD32200	-	1/s	
		The nth gear spindle position loop gain	Spindle	POSCTRL_GAIN[n]	MD32200	-	1/s	n = 1 to 5
	Threading	Acc./dec. motion when threading enabled	-	THREAD_START_IS_HARD	MD20650	-	-	0: linear acc./dec. 1: Step acc./dec.
		Spindle speed tolerance	Spindle	SPIND_DES_VELO_TOL	MD35150	-	-	Tolerance for speed reference
		Acceleration when spindle speed controlled	Spindle	GEAR_STEP_SPEEDCTRL_ACCEL[n]	MD35200	-	r/sec^2	
		Threading acc./dec. distance	-	THREAD_RAMP_DISP	SD42010	-	mm	Specify acc./dec. distance when the value is less than zero (0)
	Spindle synchronicity control	Number of slave axis	Spindle	COUPLE_AXIS_1[0]	MD21300	-	-	
		Number of master axis	Spindle	COUPLE_AXIS_1[1]	MD21300	-	-	
		Spindle synchronicity mode	-	COUPLING_MODE_1	MD21310	-	-	0: Feedback synchronicity 1: Position command synchronicity 2: Speed synchronicity
		Block changing mode during synchronicity	-	COUPLING_BLOCK_CHANGE_CTRL_1	MD21320	-	-	0: Immediate changing 1: Changing is enabled (Fine) 2:Changing is enabled (Coarse)
		Synchronicity setting when reset	-	COUPLING_RESET_MODE_1	MD21330	-	-	
		Synchronicity conditions adjustment setting	-	COUPLING_IS_WRITE_PROT_1	MD21340	-	-	0: Program change available 1: Program change not available
		Tolerance range for "Coarse synchronism"	-	COUPLE_POS_TOL_COARSE	MD37200	-	mm,deg	
		Tolerance range for "Fine synchronism"	-	COUPLE_POS_TOL_FINE	MD37200	-	mm,deg	
		Numerator for synchronous speed ratio	-	COUPLE_RATIO[0]	SD42300	-	-	
		Denominator for synchronous speed ratio	-	COUPLE_RATIO[1]	SD42300	-	-	
	Skip	Detection polarity for probe 1	Feed	MEAS_PROBE_LOW_ACTIVE[0]	MD13200	1	-	0: Positive 1: Negative
		Detection polarity for prove 2	Feed	MEAS_PROBE_LOW_ACTIVE[1]	MD13200	1	-	0: Positive 1: Negative
		Skip mode selection	Feed	MEAS_TYPE	MD13210	1	-	Specify "1" for drive latching
High-speed high-accuracy machining	Multi-block look-ahead	Number of look-ahead blocks	-	LOOKAH_NUM_CHECKED_BLOCKS	MD29000	100	-	Number of blocks used for look-ahead acc./dec. Use on G64 mode.
	Block compression	Compression position tolerance	-	COMPRESS_POS_TOL	MD33100	-	mm	
		Block compression distance limiting value	-	COMPRESS_BLOCK_PATH_LIMIT	MD20170	-	mm	
		Compression speed tolerance	-	COMPRESS_VERO_TOL	MD20172	-	mm/min	
	Spline compensation	Number of polynomial spline per block	-	PATH_VELO_SEGMENTS	MD28530	5	-	
		Number of polynomial within a single spline curve	-	ARCLENGTH_SEGMENTS	MD28540	10	-	
		Type of fine interpolation	-	FIPO_TYPE	MD33000	2	-	1: Differential interpolation2: C spline interpolation

14.5.2 Servo drive relevant parameter

Main topic	Topic	Subtopic	Name of Parameter	No. of Parameter	Typical Setting Value	UNIT	General setting and others
Standard setting	Axes configuration	Parking axis setting	FUNCTION_SWITCH_APPLIC4	MD3004 digit 2(Pn004 digit 2)	-	-	0: Enabled axis 2: Parking axis
	Motor encoder	Rotation direction selection	FUNCTION_SWITCH_BASIC	MD3000 digit 0(Pn000 digit 0)	0	-	0: Forward 1: ReverseReverse connection is set with CNC.
		Usage for absolute value encoder	FUNCTION_SWITCH_APPLIC2	MD3002 digit 2(Pn002 digit 2)	-	-	0: Used as absolute value encoder 1: Used as incremental encoder
		Multi return limit	MULT_TURN_LIMIT	MD3205(Pn205)	65535	rev	
		Electronic gear ratio (numerator) (lower word)	ELECTRIC_GEAR_NUMERATOR_LW	MD3214(Pn20E)	1	-	Use CNC-side setting for electronic gear.
		Electronic gear ratio (numerator) (upper word)	ELECTRIC_GEAR_NUMERATOR_HW	MD3215(Pn20F)	0		
		Electronic gear ratio (denominator) (lower word)	ELECTRIC_GEAR_DENOMIN_LW	MD3216(Pn210)	1	-	Use CNC-side setting for electronic gear.
		Electronic gear ratio (denominator) (upper word)	ELECTRIC_GEAR_DENOMIN_HW	MD3217(Pn211)	0		
	Separately mounted encoder	Usage for full-closed PC pulse	FUNCTION_SWITCH_APPLIC2	MD3002 digit 3(Pn002 digit 3)	-	-	
		Full-closed specification	FUNCTION_SWITCH_APPLIC6	MD3006 digit 2(Pn002 digit 2)	-		2: Forward rotation with C phase 4: Reverse rotation with C phase
		Number of full-closed PC pulse/rotation of motor (lower word)	PG_PLS_MTRRND_LW_FULLCLOSED	MD3210(Pn20A)	-	pulse/rev	Set multiplication-by-one value.
		Number of full-closed PC pulse/rotation of motor (upper word)	PG_PLS_MTRRND_HW_FULLCLOSED	MD3211(Pn20B)	-		
		Number of full-closed PC pulse/rotation of encoder (lower word)	PG_PLS_ENCRND_LW_FULLCLOSED	MD3212(Pn20C)	-	pulse/rev	Set multiplication-by-one value.
		Number of full-closed PC pulse/rotation of encoder (upper word)	PG_PLS_ENCRND_HW_FULLCLOSED	MD3213(Pn20D)	-		
		Number of Z-phase pulse per rotation of encoder	PG_PLS_ENCRND_Z_PHASE	MD3231(Pn21F)	-	pulse	Setting is not required when MP scale is used.
		Absolute PG reference position offset (lower word)	ABS_PG_POINT_OFFS_LW	MD3508(Pn808)	-	pulse	Setting is not required when MP scale is used.
		Absolute PG reference position offset (upper word)	ABS_PG_POINT_OFFS_HW	MD3509(Pn809)	-	pulse	Setting is not required when MP scale is used.
Servo drive control	Position control	Position control enabled/disabled	FUNCTION_SWITCH_BASIC	MD3000 digit 1(Pn000 digit 1)	7	-	0: Position control is disabled 1: Position control is enabled 7:Position/speed changing is enabled
		Position loop gain	KP	MD3032(Pn102)	-	0.1/s	Specify the same value as MD32200. Take notice of unit.
		Position loop gain setting method	SWITCH_FUNCTION_2	MD3069 digit 0(Pn127 digit 0)	1	-	0: Setting value for drive is used 1: Cyclic data for CNC is used.
		Excessive deviation range	OVERFLOW_LEVEL	MD3425(Pn505)	-	pulse	
	Speed control	Speed loop gain	KV	MD3030(Pn100)	-	0.1Hz	
		Speed loop gain integral time constant	KVI	MD3031(Pn101)	-	0.01ms	
		Load inertia ratio for motor inertia	LOAD_INERTIA_RATIO	MD3033(Pn103)	-	%	
		PI control/ IP control switching	GAIN/SWITCH	MD3041 digit 1(Pn10B digit 1)	1	-	0: PI control1: IP control
		1st stage torque reference filter time constant	TORQUE_FILTER_CONSTANT_1	MD3351(Pn401)	-	0.01ms	
		2nd stage torque reference filter time constant	TORQUE_FILTER_CONSTANT_2	MD3363(Pn40D)	-	0.01ms	
		3rd stage torque reference filter time constant	TORQUE_FILTER_CONSTANT_3	MD3364(Pn40E)	-	0.01ms	
	Quadrant jerk compensation	Functional quadrant jerk compensation function selection	SWITCH_FUNCTION_1	MD3068 digit 1(Pn126 digit 1)	-	-	0: Disabled2: Enabled
		Jerk compensation 11th stage gain (negative to positive)	1ST_P_GAIN_QUAD_ERR_COMP	MD3101(Pn147)	-	$0.00001/s^3$	
		Jerk compensation 11th stage limit offset (negative to positive)	1ST_P_LMT_OFS_QUAD_ERR_COMP	MD3102(Pn148)	-	0.01%	
		Jerk compensation 12th stage gain (negative to positive)	2ND_P_GAIN_QUAD_ERR_COMP	MD3103(Pn149)	-	$0.00001/s^3$	
		Jerk compensation 12th stage limit (negative to positive)	2ND_P_LMT_QUAD_ERR_COMP	MD3104(Pn14A)	-	0.01%	
		Jerk compensation limit increment value (negative to positive)	P_LMT_ADJ_QUAD_ERR_COMP	MD3105(Pn14B)	-	0.01%/ms	
		Jerk compensation limit max. value (negative to positive)	P_LMT_CLAMP_QUAD_ERR_COMP	MD3106(Pn14C)	-	0.01%/ms	
		Jerk compensation 11th stage gain (positive to negative)	1ST_N_GAIN_QUAD_ERR_COMP	MD3107(Pn14D)	-	$0.00001/s^3$	
		Jerk compensation 11th stage limit offset (positive to negative)	1ST_N_LMT_OFS_QUAD_ERR_COMP	MD3108(Pn14E)	-	0.01%	
		Jerk compensation 12th stage gain (positive to negative)	2ND_N_GAIN_QUAD_ERR_COMP	MD3109(Pn14F)	-	$0.00001/s^3$	
		Jerk compensation 12th stage limit (positive to negative)	2ND_N_LMT_QUAD_ERR_COMP	MD3110(Pn150)	-	0.01%	
		Jerk compensation limit increment value (positive to negative)	N_LMT_ADJ_QUAD_ERR_COMP	MD3111(Pn151)	-	0.01%/ms	
		Jerk compensation limit max. value (positive to negative)	N_LMT_CLAMP_QUAD_ERR_COMP	MD3112(Pn152)	-	0.01%/ms	
		Quadrant compensation timing constant	TIMING_CONST_QUAD_ERR_COMP	MD3113(Pn153)	-	0.01/s	

Main topic	Topic	Subtopic	Name of Parameter	No. of Parameter	Typical Setting Value	UNIT	General setting and others
Servo drive control (Cont'd)	Torque reference notch filter	1st stage notch filter selection	SWITCH_NOTCH_FILTERS	MD3358 digit0(Pn408 digit0)	-	-	0: Disabled 1: Enabled
		2nd stage notch filter selection	SWITCH_NOTCH_FILTERS	MD3358 digit1(Pn408 digit1)	-	-	0: Disabled 1: Enabled
		1st stage notch filter frequency	FREQUENCY_NOTCH_FILTER_1	MD3359(Pn409)	-	Hz	
		1st stage notch filter Q value	Q_VALUE_NOTCH_FILTER_1	MD3360(Pn40A)	-	0.01	
		2nd stage notch filter frequency	FREQUENCY_NOTCH_FILTER_2	MD3361(Pn40B)	-	Hz	
		2nd stage notch filter Q value	Q_VALUE_NOTCH_FILTER_2	MD3362(Pn40C)	-	0.01	
	Speed feedback compensation	Speed feedback compensation function selection	SWITCH_ONLINE_AUTO_TUNING	MD3046 digit 1(Pn110 digit1)	-	-	0: Disabled 1: Enabled
		Speed feedback compensation gain	SPEED_FEEDBACK_COMP_GAIN	MD3047(Pn111)	-	%	
		Speed feedback delay compensation	SPEED_FEEDBACK_DELAY_COMP	MD3048(Pn112)	-	%	Speed feedback compensation inertia gain
	Predictive control	1st predictive control switch	SWITCH_PREDICTED_1	MD3079 digit 0(Pn131 digit 0)	-	-	For machining feed 0: Disabled 1: Enabled (Tp = 0.001) 2: Enabled (Tp = 0.002)
		1st predictive control parameter C	PARAM_C_PREDICTED_1	MD3080(Pn132)	-	0.01	For machining feed
		1st predictive control parameter Cd	PARAM_CD_PREDICTED_1	MD3081(Pn133)	-	0.01	For machining feed
		1st predictive control parameter α	PARAM_ALPHA_PREDICTED_1	MD3082(Pn134)	-	0.01	For machining feed
		1st predictive control equivalent Kp fine adjustment	EQUIV_KP_ADJ_PREDICTED_1	MD3083(Pn135)	-	0.1/s	For machining feed
		1st predictive control speed FF gain	SPD_FF_GAIN_PREDICTED_1	MD3084(Pn136)	-	%	For machining feed
		1st predictive control torque FF gain	TRQ_FF_GAIN_PREDICTED_1	MD3085(Pn137)	-	%	For machining feed
		1st predictive control torque FF filter time constant	TRQ_FF_FLT_T_CONST_PREDIC_1	MD3086(Pn138)	-	0.01Hz	For machining feed
		2nd predictive control switch	SWITCH_PREDICTED_1	MD3079 digit 1(Pn131 digit 1)	-	-	For positioning 0: Disabled 1: Enabled (Tp = 0.001) 2: Enabled (Tp = 0.002)
		1st predictive control parameter C	PARAM_C_PREDICTED_1	MD3087(Pn139)	-	0.01	For positioning
		2nd predictive control parameter Cd	PARAM_CD_PREDICTED_1	MD3088(Pn13A)	-	0.01	For positioning
		2nd predictive control parameter α	PARAM_ALPHA_PREDICTED_1	MD3089(Pn13B)	-	0.01	For positioning
		2nd predictive control equivalent Kp fine adjustment	EQUIV_KP_ADJ_PREDICTED_1	MD3090(Pn13C)	-	0.1/s	For positioning
		2nd predictive control speed FF gain	SPD_FF_GAIN_PREDICTED_1	MD3091(Pn13D)	-	%	For positioning
		2nd predictive control torque FF gain	TRQ_FF_GAIN_PREDICTED_1	MD3092(Pn13E)	-	%	For positioning
		2nd predictive control torque FF filter time constant	TRQ_FF_FLT_T_CONST_PREDIC_1	MD3093(Pn13F)	-	0.01Hz	For positioning
	Model following control	Model following control (MFC) selection	SWITCH_ONLINE_AUTO_TUNING	MD3046 digit 3(Pn110 digit 3)	-	-	0: Disabled 1: Rigid model following control selection
		Model following control (MFC) bank 0 mask	MASK_MFC_BNAKSEL_0_3	MD3527 digit 0 (MD81B digit 0)	1	-	0: Bank 0 enabled 1: Bank 0 disabled
		Model following control (MFC) bank 1 mask	MASK_MFC_BNAKSEL_0_3	MD3527 digit 1 (MD81B digit 1)	0	-	0: Bank 0 enabled 1: Bank 0 disabled
		Model following control (MFC) bank 2 mask	MASK_MFC_BNAKSEL_0_3	MD3527 digit 2 (MD81B digit 2)	1	-	0: Bank 0 enabled 1: Bank 0 disabled
		Model following control (MFC) bank 3 mask	MASK_MFC_BNAKSEL_0_3	MD3527 digit 3 (MD81B digit 3)	1	-	0: Bank 0 enabled 1: Bank 0 disabled
		MFC gain	LOOP_GAIN_MFC	MD3055(Pn119)	-	0.1/s	
		MAC attenuation factor	DUMP_FACTOR_MFC	MD3056(Pn11A)	-	0-1000	
		MFC speed FF gain	SPD_FF_GAIN_MFC	MD3059(Pn11D)	-	0-1000	
		MFC torque FF gain	TRQ_FF_GAIN_MFC	MD3060(Pn11E)	-	0-1000	
	Vibration control at a stop	Attenuation ratio for vibration control at a stop	DAMP_RATIO_ANTIVIB_ON_STP	MD3114(Pn154)	-	%	Function is disabled when the initial value is set to 100% (initial value = 100%).
		Starting time for vibration control at a stop	START_TIME_ANTIVIB_ON_STP	MD3115(Pn155)	1024	ms	
	Vibration control	Vibration control selection	GAIN_SWITCH	MD3041 digit 3(Pn10B digit 3)	-	-	0: Disabled 3: A-type vibration control function enabled
		Vibration control damping gain	SPD_DUMP_GAIN_ANTIVIBRATION	MD3050(Pn114)	-	%	
		Vibration control low pass filter time constant	LPF_CONST_ ANTIVIBRATION	MD3051(Pn115)	-	0.01ms	
		Vibration control high pass filter time constant	HPF_CONST_ ANTIVIBRATION	MD3052(Pn116)	-	0.01ms	
		Vibration control observer gain	OBSERVER_GAIN_ANTIVIBR	MD3071(Pn129)	-	Hz	
		Vibration control observer gain inertia compensation	LOAD_INERTIA_ANTIVIBR	MD3072(Pn12A)	-	%	
	Gain switching	2nd speed loop gain	KV2	MD3034(Pn104)	-	0.1Hz	
		2nd speed loop integral time constant	KVI2	MD3035(Pn105)	-	0.01ms	
		3rd speed loop gain	KV3	MD3073(Pn12B)	-	0.1Hz	
		3rd speed loop gain integral time constant	KVI3	MD3074(Pn12C)	-	0.01ms	
	Analog monitor	Data selection	FUNCTION_SWITCH_APPLIC3	MD3003(Pn003)	0002	-	

Main topic	Topic	Subtopic	Name of Parameter	No. of Parameter	Typical Setting Value	UNIT	General setting and others
Motion control	Emergency stop	Emergency stop torque	EMERGENCY_STOP_TORQUE	MD3356(Pn406)	800	%	When "800" is specified, machine stops at the maximum torque.
		Emergency stop wait time	EMERGENCY_STOP_WAIT_TIME	MD3442(Pn516)	500	ms	
		Brake command - servo drive cutoff delay	DELAY_FROM_BRK_SIG_TO_SVOFF	MD3426(Pn506)	-	ms	
		Delay between servo drive cutoff and connector cutoff	TACTOR_OFF_DELAY_TIME	MD3528(Pn81C)	-	ms	
	Torque control	Positive torque control	FORWARD_TORQUE_LIMIT	MD3352(Pn402)	-	%	
		Negative torque control	REVERSE_TORQUE_LIMIT	MD3352(Pn402)	-	%	
		Variable torque control selection	SWITCH_NOTCH_FILTER	MD3358 digit 2(Pn408 digit 2)	1	-	0: Disabled 1: Enabled
	Collision detection	Disturbance observer gain	GAIN_DISTURB_OBSERVER	MD3063(Pn121)	-	Hz	
		Disturbance observer high pass filter cutoff frequency	HPF_CUT_FREQ_DISTURB_OBSRVR	MD3064(Pn122)	-	Hz	
		Disturbance observer low pass filter cutoff frequency	LPF_CUT_FREQ_DISTURB_OBSRVR	MD3066(Pn124)	-	Hz	
		Disturbance observer inertia compensation	INERTIA_ADJ_DISTURB_OBSRVR	MD3067(Pn125)	-	%	
		1st torque disturbance level	DISTURB_TORQUE_LEVEL_1	MD3368(Pn412)	-	%	
		2nd torque disturbance level	DISTURB_TORQUE_LEVEL_2	MD3369(Pn413)	-	%	
		3rd torque disturbance level	DISTURB_TORQUE_LEVEL_3	MD3370(Pn414)	-	%	
		4th torque disturbance level	DISTURB_TORQUE_LEVEL_4	MD3371(Pn415)	-	%	
		Compliance torque	COMPLIANCE_TORQUE	MD3372(Pn416)	-	%	

14.5.3 Spindle relevant parameter and Servo drive relevant parameter

Main topic	Topic	Subtopic	Name of Parameter	No. of Parameter	Typical Setting Value	UNIT	General setting and others
Standard setting	Motor encoder	Encoder specification	ENCODER_SPECIFICATION_0	MD6529(Cn529)	-	-	
		Number of motor encoder pulse	NUMBER_OF_ENCODER_PULSE_0	MD6533(Cn533)	-	bit	11:2048/12:4096/13:8192/19:19bit serial
		Number of PG pulse for position control/rotation of motor (lower word)	FULL_CLOSED_PG_PULSE_L_1	MD6915(Cn87F)	-	pulse	The number of pulse for motor encoder (multiplication-by-four value) is set.
		Number of PG pulse for position control/rotation of motor (upper word)	FULL_CLOSED_PG_PULSE_L_1	MD6916(Cn880)	-	pulse	
	Separately mounted encoder	Separately mounted encoder specification	ENCODER_SPECIFICATION_1	MD6530(Cn530)	-	-	
		Number of separately mounted encoder pulse	NUMBER_OF_ENCODER_PULSE_1	MD6534(Cn534)	-	-	The number of pulse (multiplication-by-four value) for 11:2048/12:4096/13:8192/19:19bit serial/32 or higher
		Number of PG pulse for position control/rotation of motor (lower word)	FULL_CLOSED_PG_PULSE_L_1	MD6915(Cn87F)	-	pulse	The number of pulse for separately mounted encoder (multiplication-by-four value) is set.
		Number of PG pulse for position control/rotation of motor (upper word)	FULL_CLOSED_PG_PULSE_L_1	MD6916(Cn880)	-	pulse	
	Motor maximum speed	Rated speed	RATED_SPEED_SETTING	MD6500(Cn500)	-	min^{-1}	
	Mask setting	Alarm mask	ALARM_MASK	MD7081(Cn8E6)	-	-	
	Parameter initialization	Parameter initialization	RESERVED_FOR_USER_OF	MD6988(Cn8C8)	-	-	0: Initial value 1: Initialization
Servo drive control	Position control	Multi-function selection SSC	MULTI_FUNCTION_SEL_SSC	MD6522(Cn522)	1	-	0: Soft start with SSC disabled 1: Servo mode with SSC enabled
		Setting method for position loop gain	GAIN_SWITCH	MD6837(Cn831)	-	-	
		Excessive deviation range (over flow level)	OVERFLOW_LEVEL	MD6965(Cn8B1)	-	pulse	
	Speed control	Speed control proportion gain (H gear)	ASR_P_GAIN_H_1	MD6060(Cn060)	-	0.1%/Hz	
		Speed control integral time (H gear)	ASR_I_TIME_H_1	MD6061(Cn061)	-	0.1ms	
		Speed control proportion gain (M, L gear)	ASR_P_GAIN_M_L_1	MD6062(Cn062)	-	0.1%/Hz	
		Speed control integral time (M, L gear)	ASR_I_TIME_M_L_1	MD6063(Cn063)	-	0.1ms	
	Servo drive mode	Speed control proportion gain (servo mode H gear)	ASR_P_GAIN_H_2	MD6064(Cn064)	-	0.1%/Hz	
		Speed control integral time (servo mode H gear)	ASR_I_TIME_H_2	MD6065(Cn065)	-	0.1ms	
		Speed control proportion gain (servo mode M, L gear)	ASR_P_GAIN_M_L_2	MD6066(Cn066)	-	0.1%/Hz	
		Speed control integral time (servo mode M, L gear)	ASR_I_TIME_M_L_2	MD6067(Cn067)	-	0.1ms	
		Servo mode magnetic flux level (H gear)	SV_MODE_FLUX_LEVEL_H	MD6201(Cn201)	-	%	
		Servo mode base speed ratio (H gear)	SV_BASE_SPEED_RATIO_H	MD6202(Cn202)	-	0.01	
		Servo mode magnetic flux level (M, L gear)	SV_MODE_FLUX_LEVEL_M_L	MD6203(Cn203)	-	%	
		Servo mode base speed ratio (M, L gear)	SV_BASE_SPEED_RATIO_M_L	MD6204(Cn204)	-	0.01	
	Analog monitor	Monitor 1 output content	MONITOR_1_OUTPUT	MD6472(Cn472)	0	-	0: Motor speed
		Monitor 1 output content	MONITOR_1_OUTPUT	MD6472(Cn472)	1	-	1: Torque reference
Motion control	Spindle sequence relevant	Zero speed detection level	ZERO-SPEED_DET_LEVEL	MD6030(CN030)	-	$0.1min^{-1}$	
		Zero speed detection range	ZERO-SPEED_DET_WIDTH	MD6031(Cn031)	-	$0.1min^{-1}$	
		Speed coincidence signal range	SPEED_AGREE_WIDTH	MD6400(Cn400)	-	%	Ratio for MD6500 (Cn500) is set.
		Speed coincidence signal level	SPEED_DETECTION_LEVEL	MD6401(Cn401)	-	0.01%	Ratio for MD6500 (Cn500) is set.
		Speed coincidence signal hysteresis	SPEED_DETECTION_WIDTH	MD6402(Cn402)	-	0.01%	Ratio for MD6500 (Cn500) is set.
		Torque detection signal level	TORQUE_DETECTION_LEVEL	MD6410(Cn410)	-	0.1%	Ratio for 30-minute rated torque is set.
		Torque detection signal hysteresis	TORQUE_DETECTION_WIDTH	MD6411(Cn411)	-	0.1%	Ratio for 30-minute rated torque is set.
	Emergency stop	Emergency stop wait time	EMERGENCY_STOP_WAIT_TIME	MD6511(Cn511)	-	ms	
		Delay between servo cutoff and connector cutoff	TACTOR_OFF_DELAY_TIME	MD6819(Cn819)	-	ms	
	Torque control	Torque control level on motor side	TORQUE_LIMIT	MD6421(Cn421)	-	%	
		Torque control level on regenerator side	REGENERATION_TORQUE_LIMIT	MD6422(Cn422)	-	%	
		Variable torque control selection	TORQU_LIMIT_SELECT	MD6423(Cn423)	-	-	0: Disabled 1: Enabled

Main topic	Topic	Subtopic	Name of Parameter	No. of Parameter	Typical Setting Value	UNIT	General setting and others
Motion control (Cont'd)	Orientation	Multi-function selection PPI	MULTI_FUNCTION_SEL_PPI	MD6525(Cn525)	0	-	0:No fluctuation control at position control stop 1:Fluctuation control in PPI
		Positioning completion gain reduction percentage (H gear)	ORT_DB_GAIN_DEC_RATIO_H	MD6595(Cn583)	50	%	
		Positioning completion gain reduction percentage (L gear)	ORT_DB_GAIN_DEC_RATIO_L	MD6595(Cn583)	50	%	
	Winding changing	Winding changing selection	SELECTION_CODE_1	MD6809(Cn809)	-	-	0001: Winding changing unit is not used 0000: Winding changing unit is used 0010 : Speed cramp function as well as winding changing unit is used

14.6 Trouble shooting

14.6.1 Table of causes/countermeasures for troubles

Following list is the summary of causes and countermeasures for potential troubles occurring from the setting errors of machine data or parameters.。

Category	Symptom	Conditions	Candidate causes	Measures	Remarks (relevant sections)
Controlled source	There is one or more axis which can not be read by the digital operator of converter. Or There occurs the drive alarm 183 (A. B7: Link setting error) or 225 (A. E1: Timeout error).	When the control source is powered on.	There may exist any mismatchings on the axis number rotary switch of the drive.	Check if there are multiple switches specified for the same number under a single converter. Check if the switch setting is within the range between 0 and 6. Check if the switch indicates the target number properly.	14.1.4
	When powered on, the position becomes approximately fourfold the setting value.	When the control source is powered on.	The multiplication factor for the absolute value data is incorrectly set.	Set the value, MD 30260 = 1.	14.1.5
	There occurs the drive alarm 4 (A.0.4: Parameter setting is abnormal).	When the control source is powered on.	The parameter setting value is out of the setting range.	Set the parameter value within the setting range.	A.1, A2
	There occurs the drive alarm 2 (A.02: Flash memory is abnormal).	When the control source is powered on.	The checksum for user parameter or system parameter is abnormal. Parameter ID check is abnormal.	Re-enter the parameter file for drive.	
	There occurs CNC alarm 8044.	When CNC power supply is powered on.	Limitation for IPO cycle is not released.	Set the value, MD19296 = 4.	14.1.1
	There occurs CNC alarm 1019 Floating point arithmetic error.	When the control source is powered on.	The value MD32250[0] = 0 is set.	Set the value MD32250[0] = 100.	14.1.7
Servo drive is powered on	The feed axis behaves inching when the servo drive is powered on.	When restarting after an emergency stop.	The variable Kp setting is not enabled on the drive side.	Set the value MD3069 digit 0 (Pn127 digit 0) = 0.	14.2.1
		Including an axis with enabled separately mounted encoder.	MD32642 is set to 1 for the axis with disabled separately mounted encoder.	Set 0 to MD32642 for the axis with disabled separately mounted encoder.	14.1.6
	The feed axis coasts after the servo drive is powered on.	Especially the gravity axis	There is some mismatching between MD30110 and MD30220[0] or [1].	Specify the same value for MD30110 and MD30220[0] or [1].	14.1.5
	There appears one or more runaway axes, when the servo drive is powered on.		In PLC, the measuring system (DB3nDBX1.5-6) is incorrectly selected.	Specify "1" for motor encoder only, and "2" for including separately mounted encoder.	14.1.5,14.1.6
		Including the separately mounted encoder	The direction of motor rotation is unmatched to that of encoder rotation.	Correct the rotation directions.	14.1.6
			The setting for separately mounted encoder is unmatched for CNC and the drive.	Specify the correct value.	14.1.6
	Move command does not match the actual travel amount .	Including the separately mounted encoder.	The setting value for the separately mounted encoder is incorrect.	Correctly set the values for both the motor encoder and the separately mounted encoder.	14.1.5,14.1.6
	There occurs CNC alarm 1019 Floating point arithmetic error.	In 00.02.02 system, when the servo drive is powered on.	MD32642 is set to 1 for the semi-closed controlled (motor encoder controlled) axis.	Set 0 to MD32642 for the semi-closed controlled axis.	14.1.6
	Vibration	When the servo drive is powered on.	The unit for setting value for Kp is incorrect.	Use the same unit for MD102390[9] and MD32200.	14.2.1
	There occurs the drive alarm 81 (A.51: Undervoltage).	Multiple converters are connected.	Before the servo drive under one converter is powered off, another converter has blocked the main circuit connector.	With MC3528(Pn81C) and MD6989(Cn8C9), specify the amount for the delay time for the axis for which the servo drive is last to be powered on (for example, longer than the deceleration time for the spindle).	14.3.4
	It is impossible to power on the servo drive.	Whole axes are disabled.	The bus cable connector linking with drives is almost disconnected.	Check the connection of bus cable connector linking with the drives.	
		A single axis is disabled.	In PLC, the measuring system (DB3nDBX1.5-6) is not selected.	Specify "1" for motor encoder only, and "2" for including separately mounted encoder.	14.1.6
		Separately mounted encoder absolute value detection function is enabled.	The motor encoder setting value is not set to the absolute value detection.	When the absolute value detection function is enabled on the separately mounted encoder, set the motor encoder type to the absolute value encoder (MD30340[0] = 4) independently with the motor encoder type.	14.1.5
	When servo drive is powered on, or when the first travel command is instructed, there occurs a servo drive alarm 113 (A.71: Overloading).	Including separately mounted encoder.	The direction setting for the separately mounted encoder is incorrect.	Check the orientation of separately mounted encoder and correct the relevant machine data and parameters.	14.1.6
	There occurs a servo drive alarm 113 (A.71: Overloading).	When the servo drive is powered on.	The motor cable is disconnected.	Connect the motor cable properly.	
Control	Torque fluctuates in wave forms during deactivation.	Including separately mounted encoder.	The separately mounted encoder is set to Type 1 (MD32642 = 0).	Set the encoder to Type 2 (MD32642 = 1).	Standard setting is Type 2. 14.1.6
	There occurs CNC alarm 21610 Channel ** axis** encoder frequency exceeded.	Including separately mounted encoder.	Since the setting value with MD30600[1] is not high enough, the command frequency is abnormal.	Set the setting value with MD30600[1] to equal or higher value than 4 or the separately mounted encoder pulse rate (pps) at the top speed.	14.1.6
	There occurs the drive alarm 208 (A. D0 Position deviation is excessive).	During the rapid travelling.	The setting value for excessive deviation range on the drive side is not high enough.	Specify the value appropriate for the encoder and Kp with MD3425 (Pn505).	14.2.1
	Emergency stop is not initiated but DB stop (spindle is free-running) is enabled.	-	The delay time between the emergency stop and the servo drive cut-off is too short.	With MD3442 (Pn516) and/or MD6511 (Cn511), specify the proper value (for example, the value which is equal or exceed the spindle deceleration time) for the time from the emergency stop until the servo drive is cutoff.	14.3.4
	The position deviation is not match Kp.	Including separately mounted encoder.	The separately mounted encoder reverse connection is installed on the CNC side in case of the separately mounted encoder reverse connection along with the motor forward connection.	In this case, the separately mounted encoder reverse connection should be done on the drive side.	14.1.6
	There occurs low frequency vibration (about 20 Hz) during deactivation.	Quadrant jerk compensation is enabled.	The setting value for the functional quadrant jerk compensation function selection is wrong (current setting may be MD3068 digit 1 (Pn126 digit 1) = 1).	Correct the setting with MD3068 digit 1 (Pn126 digit 1) = 2.	14.2.5

Category	Symptom	Conditions	Candidate causes	Measures	Remarks (relevant sections)
Hard ware configuration	There occurs CNC alarm 25202 Axis waiting for drive or the LED lamp of PROFIBUS flashes.	The spindle is set as a parking axis.	It is impossible for the spindle to be a parking axis.	Set the spindle as an enabled axis. If there is no spindle motor, mask the motor and encoder relevant alarm(s) with the spindle alarm mask.	14.1.4,14.1.8
		The digital operation mode was once used.	The stand alone mode (digital operation mode) is enabled.	Release the stand alone mode.	14.1.3
		There are connected multiple converters.	The station number of converter is wrong.	Check the station number of the converter. Specify the station number which is not identical to any other converter station number but suitable for the setting of hard ware configuration.	14.1.4
		The parking axis was once enabled.	The parking axis setting (servo axis) is enabled.	Release the parking setting for the servo drive.	14.1.4
Encoder	There occurs CNC alarm 26002 Axis encoder N configuration error.	When power turned on.	The setting for the pulse number and type of CNC motor or separately mounted encoder does not match that for the drive. (N = 1: Motor N = 2: Separately mounted encoder)	Set the pulse number and type of CNC motor or separately mounted encoder to the setting value matching the actual encoder pulse.	14.1.5 14.1.6
	There occurs a servo drive alarm 129 (A:81:PG backup errors).	When power is turned on after the drive wiring is modified.	The backup value for the absolute value encoder is collapsed.	Reset the encoder.Reset the encoder.	14.1.5
		When power is turned on.	The battery of converter is empty. The voltage is not high enough.	Attach a new normal battery.	
		There is no battery used since the absolute value encoder is used as the incremental encoder.	Setting is not for the absolute value encoder to be used as the incremental encoder.	Set MD3002 digit 2 (Pn002 digit 2) = 1 in order to use the absolute value encoder as the incremental encoder.	14.1.5
	There occurs a servo drive alarm 204 (A.CC: multi-return limit value unmatched).	MD3205 (Pn205) has been modified.	The setting on the encoder side (Fn013) was not changed.	Modify the setting on the encoder side.	14.1.5
	The multi-return limit value can not be changed.	A 20-bit encoder is used.	For the 20-bit encoder, the multi-turn limit value is unchangeable.	Set the setting value on the CNC-side multi-turn limit to the encoder value plus 1 (one) (= 65536).	14.1.5
	With separately mounted encoder, there occurs position deviation in positioning after the servo drive power is turned on/off.	MK scale is used.	The servo drive multi-return limit value setting error.	With 3205 (Pn205), set the value "-1" for the gear ratio of MP scale and motor encoder.	14.1.6
	There occurs a servo drive alarm 203 (A.CB:PG echo back abnormal).	When control source is powered on.	The encoder cable is disconnected.	Properly connect the cable. When the absolute value detection function is enabled, re-establish the origin.	
Spindle	The rpm does not match the reference value.	When the speed reference operation is enabled.	The MD32260 setting value is wrong.	With MD32260, set the value of MD880.	14.1.7
	The orientation speed fluctuates.	When the position control is started after the orientation deceleration.	The speed feedforward for the spindle is not enabled.	Enable the spindle speed forward.	14.3.7,14.3.13
	The spindle feedback signal display (rpm, speed waveform, etc.) flickers.	After the servo drive is powered on.	Since the resolution of spindle encoder is not high enough, the display flickers in the range of encoder 1 pulse.	Set the low pass filter MD34990 for the spindle feedback.	14.2.2
	There occurs CNC alarm 22051 at the orientation.	The first orientation after powered-on.	MD34060 REEP_MAX_MAPKER_DIST setting value is not large enough.	Set the value which is equal or exceed 360 deg.	14.3.5
Hard ware	The LED lump of PROFIBUS lights, and there occurs the drive alarm 183 (B7: link setting errors) and/or 230 (E6: network communication abnormal).	The control source is powered on.	The termination at the PROFIBUS terminal connector is not enabled.	Properly enabled the termination.	
	The LED lump of the servo/spindle drive RDY fails to light.	The control source is powered	The fuse of the control source is blown. This event often occurs when the connector of control source is disconnected with the control source which is still powered on. on.Inaccessible under the digital operation.	Replace the servo/spindle drive unit.	

Chapter 15

Error and Troubleshooting

This chapter describes the troubleshooting for the errors without alarm display.

15.1 Errors without Alarm Display and Troubleshooting

The table below shows the causes and their countermeasures for the malfunctions accompanied with no alarm generation.

Before you check or take a countermeasure for what is described in the half-tone meshing column, you must turn off the power supply of servo system.

If you cannot remedy the malfunction even with these measures, please contact our service group without delay.

Table 15.1

Malfunction	Cause	Check point	Countermeasure
Motor does not start.	The power supply is not turned on.	Check the voltage between the power source terminals.	Correct the power turn-on circuit.
	Connection is loose.	Check the connector (CN2, CN5) terminals.	Correct the loose connection.
	External wiring of connector (CN2, CN5) is wrong.	Check the external wiring for CN2 and/or CN5.	Wire correctly according to the connection diagram.
	The servo motor and the encoder are unconnected.		Connect the cable properly.
	There generates overloading.	Try the no-load running.	Reduce the load, or replace with a servo drive which has larger capacity.
	Speed/position reference is missed.	Check the input pin.	Input the speed/position reference properly.
	The type of encoder to use is not the one which is set with the user constant.	Check the setting for whether an incremental encoder or an absolute value encoder.	Set the user constant Pn 002.2 to match the encoder type to be used.
Servo motor almost activates but comes back to and remains a standstill.	The servo motor and the encoder is improperly wired.		Correct the wiring.
Servo motor suddenly stops during operation and then wouldn't run.	An emergency stop is activated.	Check the emergency stop signal.	Turn off the emergency stop signal.
	The servo motor is cut off from the power source.	Check the power source.	Properly turn on the power.
Servo motor rotates unstablly.	There is a malfunction on the connection to the motor.	Check the condition of connectors of the power cable (U-, V-, and W-phase) and encoder.	Correct the loose connecting parts of processing terminal or connector.
Servo motor vibrates at the frequency around 200 to 400 Hz.	The speed loop gain is excessively high.		Decrease the setting value for the user constant Pn100 (speed loop gain).
	The wiring for speed/position reference input is excessively long.		Arrange the command input wiring shortest. Reduce the impedance to be equal or less than 100 Ω.
	The wiring for speed/position reference input is bundled with the power cable.		Separate the wiring for reference input from the power cable at least 30 cm.
When the motor starts or stops, the speed overshoot is very large.	The speed loop gain is excessively high.		Decrease the setting value for user constant Pn100 (speed loop gain). Increase the setting value for user constant Pn101 (integral time constant).

Table 15.1

Malfunction	Cause	Check point	Countermeasure
Servo motor overheats.	The surrounding temperature is excessively high.	Measure the temperature around the servo motor.	Lower the surrounding temperature to 40 ℃ or below.
	The surface of servo motor is dirty.	Visually check the surface.	Remove the dust and oil from the motor surface.
	The servo motor is overloaded.	Operate the servo motor without load.	Reduce the load or use another motor with larger capacity.
Unusual noise generates.	Mechanical installment is not good.	Check if the fixing screws of servo motor are not loosen.	Fasten the fixing screw again.
		Check if the alignment of coupling is deviate.	Align the coupling.
		Check if the coupling is unbalanced.	Balance the coupling.
	There is something abnormal on the bearing.	Check the noise and vibration around the bearing.	When you find something wrong about the bearing, contact our service group.
	The coupled machine generates vibration.	Check if there is any foreign matters, failure and/or deformation on the movable parts of the machine.	When you find any, take advice from the maker of that machine.

Chapter 16

Maintenance and Check

This chapter deals with how to conduct a basic check on the Servo motors and the SERVOPACKs, how to replace the Absolute encoder battery, and explanation about the Analogue monitor.

16.1 Checking Servo motor and SERVOPACK

16.1.1 Checking Servo motor

The following table shows how to conduct a daily check and maintenance of the Servo motor. Since AC servo motors are brushless, you need not conduct any other checks than a brief, daily check. The check timing in the table shows a guide line only; you need to define appropriate check timing according to the motor operating conditions.

IMPORTANT

Do not disassemble the servo motor for the purpose of maintenance and check. Be sure to contact our distributor or sales office nearest to you for dissassembly of motor.

Table 16.1 Servo motor check

Check item	Check timing	Check/maintenance method	Remark
Vibration and sound check	Once per day	Touching and hearing	Shall not be larger than normal
Appearance check	According to the degree of contamination	Cleaning with a cloth or air	-
Insulation resistance measurement	Once per year at least	Isolating the motor from SERVOPACK, measure insulation resistance using a 500 V megger tester. Normal resistance is more than 10 MΩ*	If the resistance is 10 MΩ or less, contact our service group.
Oil seal replacement	Once per 5,000 hours at least	Replace the seal by removing from a machine.	Only for a motor with an oil seal
Overall check	Once per 20,000 hours or 5 years at least	Contact our service group.	Do not disassemble or clean the servo motors.

* To be measured between FG and either of the motor power line U, V, and W phases.

16.1.2 Checking SERVOPACK

The following table summarizes how to check the SERVOPACK. You need not conduct a daily check; however, conduct a check once a year at least.

Table 16.2 SERVOPACK check

Check item	Check timing	Check method	Corrective action
Cleaning of main unit and board	Once per year at least	Shall be free from adherents such as dirt, dust, and oil.	Clean with a cloth or air.
Loose screw	Once per year at least	Fixing screws shall not be loose on terminal blocks and connectors etc.	Retighten the screws.
Failed parts on main unit or boards	Once per year at least	Shall be free from discoloration, breakage, wire-break resulting from heat generation.	Contact us.

■ A guide line of parts replacement timing

The following parts become worn or degraded over years. Conduct a periodical check.

As to the SERVOPACKs that we made an overall repair, we are returning them to users with resetting their user-defined constants to standard values. Be sure to check user-defined constants before starting operation.

Table 16.3 Periodical parts check

Part name	Standard replacement timing	Replacement method etc.
Cooling fan	4-5 years	Replace with new one
Smoothing capacitor	7-8 years	Replace with new one (after a check.)
Relays	-	Determine after a check.
Fuse	10 years	Replace with new one
Aluminum electrolytic capacitor on printed board	5 years	Replace entire board with new one (after a check.)

Operating conditions

- Ambient temperature: 30 ℃ on average
- Load factor: 80% or less
- Availability: 20 hours or less per day

16.2 Checking Spindle motors and Invertors

Carry out scheduled maintenance management so that the system may keep operating correctly in good conditions.

⚠ WARNING
• To check the MRX, you must turn off the power and wait for 5 minutes before accessing inside the unit. Be sure to wait until the "CHARGE" indicator turns off, showing the smoothing capacitor has been discharged completely; otherwise, you may receive an electric shock or may be injured.

16.2.1 Items to be checked daily

Conduct a daily check on the following items:

Table 16.4

Check object	Check procedure		Criteria	Corrective action
	Item	Method		
Environment	Ambient temperature	Thermometer	Inverter: 0-55 ℃ (Non-congelation) Motor: 0-40 ℃	Improve installation environment so that the values may become within normal ranges.
	Humidity	hygrometer	95%RH or less (Non-condensation)	
	Ventilation	Viewing	Intake/exhaust air shall flow smoothly	Remove any obstacles blocking smooth air flow.
Power supply status	Voltage	Voltmeter	Shall be within a range from -15% to +10% from rated voltage	Adjust the voltage to correct value (by using different transformer tap or so)
	Current	Ammeter	Shall be within a rated current.	Adjust a load
Appearance	Contamination on Inverter, Motor, and frame axis hole due to dust and others	Viewing	Contamination shall not be excessive than normal.	If contamination is excessive, clean them.
Operation status	Vibration	Touching or vibration meter	Shall be free from abnormal vibration or increase in the amplitude.	If allowable limit is exceeded, stop the system and remove any cause.
	Bad smell	Smelling	Smell of burning is not allowed.	Stop the system and remove any cause.
	Abnormal sound	Hearing	Shall be free from abnormal sound or increase in noise level.	If normal operation becomes difficult, stop the system and remove any cause.
	Inverter motor temperature rise	Viewing or thermometer.	Shall be free from abnormal temperature rise.	Stop and cool the system to check if the cooling devices such as fan operates correctly, and make a repair if any cause is found.

Table 16.4

Check object	Check procedure		Criteria	Corrective action
	Item	Method		
Around the bearing	Sound from the bearing	Hearing or ausculta-tion stick	Shall be free from abnormal sound or increase in noise level.	Replace the bearing.
	Vibration	Touching or vibration meter	Shall be free from abnormal vibration	
	Bearing temperature	Touching or thermom-eter	Shall be free from abnormal tem-perature rise	
	Grease	Viewing	Grease leakage shall not exist	Remove any cause.
Motor cooling fan	Operation status	Viewing or hearing	Shall be operated normally	Remove any cause or replace the fan if defective.

16.2.2 Scheduled maintenance

Clean the Inverters and motors in the following way periodically.

1. If air filters are used in the Control panel or other devices, clean the filters once a month at least.
2. If contaminated with dirt or dust, electronic parts may exhibit overheat or decrease in insulation characteristics; remove the dirt or dust periodically. Likewise, if the heat sink is contaminated with dust or oil at the rear surface of the inverter, it becomes unable to dissipate heat effectively, resulting in a failure. Clean the heat sink with an air blow or a cloth once per 6 months at least. (If it is contaminated considerably, cleaning shall be made more frequently.)
3. Checking vibration and sound levels by touching and hearing every day to verify that the levels do not become greater than normal.
4. Checking their appearance, clean them if necessary with an air blow or cloth according to the degree of contamination.

16.2.3 Megger test on Spindle motor

Test the insulation of Spindle motor using a Megger tester (500 VDC) as follows:

1. Isolate the Spindle motor from the Inverter by disconnecting connections.
2. Measure the resistance between either of the motor power lines U, V, and W phases and the FG (Frame Ground). [If Spindle motor uses 6 wires: U (U1), V (V1), W (W1), X (U2), Y (V2), and Z (W2); measure the resistance between each of the U (U1), V (V1), and W (W1) and the FG.]
3. The resistance is correct if the Megger tester reading is 10 MΩ or higher.

16.2.4 Periodical check

Referring to the following table, establish a maintenance schedule and conduct a periodical check. Check timing is mentioned for some items in the table; however, it is for your reference as standard timing. Determin appropriate timing that best fits your machine considering use status and environment by increasing or decreasing the standard value.

Table 16.5 Periodical check

Check object	Check procedure		Criteria	Corrective action
	Item	Method		
Daily check status	Review records	Viewing		Use as reference for periodical check.
Mounting status	Bolts for mounting Inverter and Motor	Viewing	Shall not become loose.	Retightening
Grounding	Inverter and Motor grounding terminals	Viewing	Grounding shall be made securely.	Restoration and retightening
Coating	Paint removal or rust	Viewing	Paint damage, discoloration, removal, or rust shall not exist.	Rustproofing and repainting
Connection and electric wire	Looseness, break on wire insulation, terminal box	Viewing	Looseness, break, deterioration, or deformation shall not exist.	Restoration and retightening
Cooling fan	Vibration	Touching	Shall be free from abnormal vibration or increase in the amplitude.	Replacing a cooling fan
	Strange sound	Hearing	Shall be free from abnormal sound or increase in noise level.	
Electrolytic capacitor	Electrolyte leakage and expansion	Viewing	Electrolyte leakage or expansion shall not exist.	Parts replacement
	(Measure capacitance)	(Capacitance meter)	(Reading shall be within a standard value.)	
Relay and contactor	Strange sound during operation	Hearing	Shall be free from strange sound such as rattle sound.	Parts replacement
Resistor	Crack in insulator	Viewing	Shall be free from abnormality	Parts replacement
	Break in wire	Circuit analyzer and others	Reading shall be within a standard value.	
Printed board	Discoloration	Viewing	Abnormal or partial discoloration shall not exist.	Printed board replacement
Control circuit	Functional check	Operating inverter alone	Output voltage from each phase shall no be out of balance.	Readjust printed board or repair inverter.
Insulation resistance	Motor (Between stator and Ground)	See section 16.2.3	Shall be 500 VDC 10MΩ or higher.	Contact our service group if the value is less than 10MΩ

Table 16.5 Periodical check

Check object	Check procedure		Criteria	Corrective action
	Item	Method		
Motor coupling status	Repetitive runout	-	-	Readjustment by direct-coupled centering
1. Shaft coupling 2. V-belt	Sunk key	Viewing	Scratch or deformation shall not exist.	Replacement
	Shaft coupling without key		Dowel marker shall not be fit loose.	Restoration
	Fastening reamer bolt		Shall not become loose.	Retightening
	Wear		Wear shall be a little.	Replacement
Motor	Bearing	Hearing, vibration meter and others (Check timing: Once per 12000 hours or 2 years.)	Shall be free from abnormal sound, increase in noise level, or temperature rise.	Consumable parts replacement by disassembling and necessary care
	Cooling fan	Hearing, vibration meter and others (Check timing: Once per 15000 hours or 2 years.)		Cooling fan replacement
	Oil seal	Viewing (Check timing: Once per 5000 hours)	Wear shall be a little.	Seal is to be replaced by being removed from a machine. Contact our service group.
	Overall check	Contact our service group. (Check timing: Once per 20,000 hours or 5 years)	-	Do not disassemble and clean the machine.

Note that if you are leaving a machine unused for a long time,
take care the following points:

- If you have installed an auxiliary Inverter that is not used normally, check if it operates correctly by energizing it every 6 month.

  Specifically, if you have not used the electrolytic capacitor for more than 1 year, re-transform it in the following method.

  - Open the emergency stop signal and turn on the power. ("CHARGE" indicator turns off.)
  - Close the emergency stop signal. ("CHARGE" indicator turns on.)
  - In this state, keep energizing it for 30 minutes.
- Slightly rotate the motor axis once a week so that it may be lubricated well.

16.3 Absolute encoder

16.3.1 Replacing a battery in the Absolute encoder

If the voltage of the Absolute encoder battery decreases to 2.7V or less, the SERVOPACK issues a "Battery warning (A.93)".

Replace the battery in the following procedure. For the recommended Absolute encoder batteries, refer to 16.3.2 "Handling a battery".

■ Procedure to replace a battery

1. Replace the battery with SERVOPACK control power turned on.
2. The "Battery warning (A.93)" will be released automatically after the battery has been replaced.
3. Verify that the encoder works correctly. This completes the battery replacement.

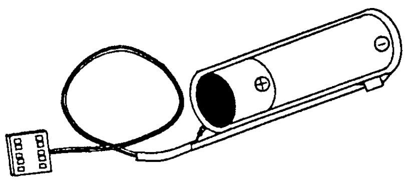
IMPORTANT

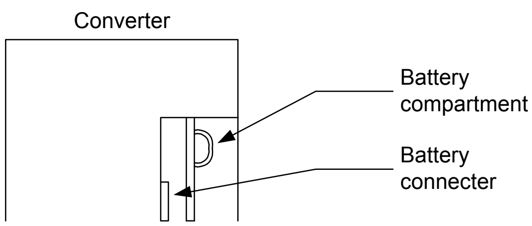
If the battery is disconnected (the encoder cable is disconnected) with the SERVOPACK control power turned off, the Absolute encoder data is cleared and you will have to set up the Absolute encoder again. Refer to 16.3.3 "Setting up (Initializing) Absolute encoder".

16.3.2 Handling a battery

In order for the Absolute encoder to hold the position information even while the power is turned off, a back-up battery is required. We recommend the following battery for this purpose.

Type: ER6VC3 (Lithium battery)
3.6 V 2000 mAH
Toshiba Battery





16.3.3 Setting up (Initializing) Absolute encoder

Set up Absolute encoder in the following cases:

- When a machine is initialized for the first installation.
- When "Encoder back-up" alarm is issued.
- When the encoder cable is disconnected with the SERVOPACK power turned off.

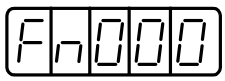
You can set up Absolute encoder using a Digital operator.

INFO

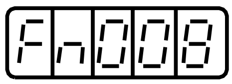
You can set up Absolute encoder only when the Servo is turned off. After completing the set-up process, be sure to turn on the power again.

■ Set-up operation using a Digital operator

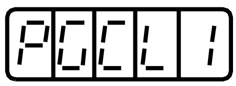
1. In the "Axis selection" mode, select an axis that you want to set up.
2. Press [DSPL/SET] key and select "Auxiliary function execution" mode.



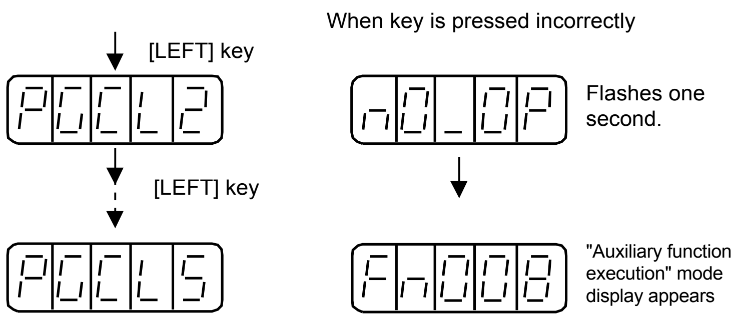
3. Select a user constant "Fn008". Select a digit to set by pressing [LEFT] or [RIGHT] keys. Change a value by pressing [UP] and [DOWN] keys.



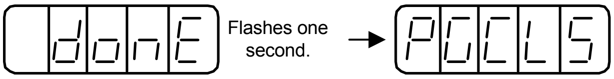
4. Press [DATA/ENTER] key. The following characters appear.



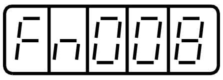
5. Press [UP] key to change the display as follows. Press [LEFT] key for several times until PGCL5 appears. If you press the key incorrectly, "nO_OP" flashes for one second and characters appear indicating that you have entered into "Auxiliary function execution" mode. Now, repeat the procedure from step 3.



6. If PGCL5 appears, press [DSPL/SET] key. The display changes as follows and the Absolute encoder
7. Multi-turn data is cleared.



8. Press the [DATA/ENTER] key to return to "Auxiliary function execution" mode.



This completes Absolute encoder set-up procedure.

IMPORTANT

If the following Absolute encoder alarms are issued, you must release them by following the same procedure as the "Set-up" procedure; you cannot release the alarms using the SERVOPACK alarm reset (/ARM-RST) input signal.

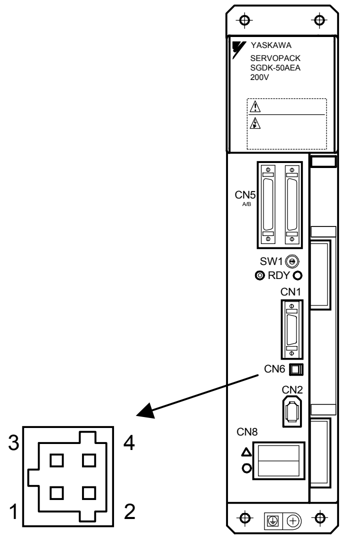
- Encoder back-up alarm (A.81)
- Encoder sum check alarm (A.82)

If an alarm that monitors inside the encoder is issued, you need to release it by turning off the power.

16.4 Analogue monitor

You can monitor various signals by using analogue voltage.

To monitor analogue monitor signals, use a dedicated monitor cable (DE9404559) connected to the connector shown below.



Pin No.	Cable color	Signal name
2	White	Analogue monitor 1
1	Red	Analogue monitor 2
3, 4	Black (2 pcs)	GND (0 V)

You can change analogue monitor signals by setting a user constant Pn003.

Pn003.0	Analogue monitor 1	Factory default setting: 2
Pn003.1	Analogue monitor 1 magnification	Factory default setting: 0
Pn003.2	Analogue monitor 2	Factory default setting: 0
Pn003.3	Analogue monitor 2 magnification	Factory default setting: 0

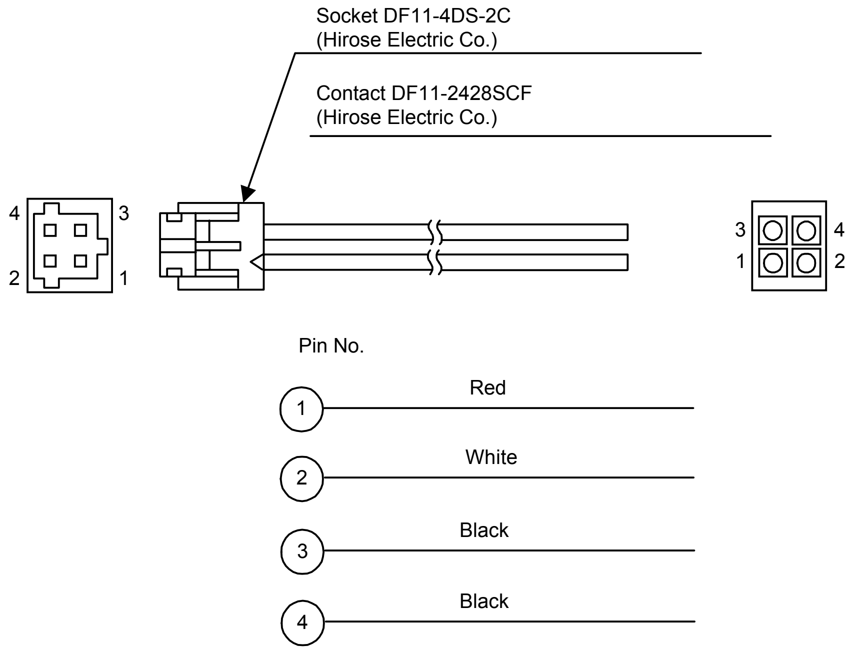


Fig. 16.1 Dedicated analogue monitor cable

The following monitor signals can be monitored.

Pn003.0 and Pn003.2 settings	Descriptions	
	Monitor signal	Observation gain
0	Motor rotation speed	1V/1000 min^{-1}
1	Speed reference	1V/1000 min^{-1}
2	Torque reference[*1]	1V/100% Rated torque
3	Position deviation[*2]	0.05V/a Command unit
4	Position amplitude deviation[*2] (Position control compensator deviation)	0.05V/a Command unit
5	Position command speed [min^{-1} conversion]	1V/1000 min^{-1}
6	Observer speed	1V/1000 min^{-1}
7	Collision detection amount	1V/100 %
8	Quadrant error compensation	1V/100 %
9	Speed feed forward	1V/1000 min^{-1}
A	Torque feed forward	1V/100 %
B	Model torque reference	1V/100 %
C	Model position deviation	0.05V/a command unit
D	Estimated disturbance torque	1V/100 %
E	Vibration-damping monitor	1V/1000 min^{-1}
F	System constant data-setting output	-

＊1. Torque reference after gravity compensation (Pn411)
＊2. In the case of speed control, the monitor signal for position deviation is indefinite.

Monitor magnification can be set as follows:

Pn003.1 and Pn003.3 settings	Descriptions
0	Monitor magnification: 1
1	Monitor magnification: 10
2	Monitor magnification: 100
3	Monitor magnification: 1/10
4	Monitor magnification: 1/100

INFO

Analogue monitor output voltage is ± 8 V max. Even if the voltage exceeds this range, it is displayed as ± 8 V.

Appendix

Drive data list

Appendix A Parameters

A.1 Servo unit parameter list

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
3000	Pn000	0x0070	0x0000	0x0FA1	None	Function switch Basic	Fundamental function switch
3001	Pn001	0x0000	0x0000	0x0022	None	Function switch Applic 1	Applied function switch 1
3002	Pn002	0x0000	0x0000	0x8100	None	Function switch Applic 2	Applied function switch 2
3003	Pn003	0x0002	0x0000	0x4F4F	None	Function switch Applic 3	Applied function switch 3
3004	Pn004	0x0000	0x0000	0x0312	None	Function switch Applic 4	Applied function switch 4
3005	Pn005	0x0000	0x0000	0x0001	None	Function switch Applic 5	Applied function switch 5
3006	Pn006	0x0000	0x0000	0x0172	None	Function switch Applic 6	Applied function switch 6
3030	Pn100	400	10	20000	0.1Hz	Kv	Speed loop gain
3031	Pn101	2000	15	51200	0.01ms	Kvi	Speed loop integration time constant
3032	Pn102	400	10	20000	0.1/s	Kp	Position loop gain
3033	Pn103	0	0	10000	%	Load Inertia Ratio	Load inertia
3034	Pn104	400	10	20000	0.1Hz	Kv2	2nd speed loop gain
3035	Pn105	2000	15	51200	0.01ms	Kvi2	2nd speed loop integration time constant
3036	Pn106	400	10	20000	0.1/s	Kp2	2nd position loop gain
3037	Pn107	0	0	450	min^{-1}	Bias	Bias
3038	Pn108	7	0	250	None	Bias Addition Width	Bias addition width
3039	Pn109	0	0	100	%	Feedforward	Feed forward
3040	Pn10A	0	0	6400	0.01ms	FF Filter Time Const	Feed forward filter time constant
3041	Pn10B	0x0004	0x0000	0x3014	None	Gain Switch	Gain-related applied switch
3042	Pn10C	200	0	800	%	Mode Switch Torque	Mode switch (Torque reference)
3043	Pn10D	0	0	10000	min^{-1}	Mode Switch Speed	Mode switch (Speed reference)
3044	Pn10E	0	0	3000	$10min^{-1}/s$	Mode Switch Accel	Mode switch (Acceleration)
3045	Pn10F	0	0	10000	None	Mode Switch Error Pulse	Mode switch (Deviation pulse)
3046	Pn110	0x0012	0x0000	0x2212	None	Switch Online Auto Tuning	On-line auto tuning-related switch
3047	Pn111	100	1	500	%	Speed Feedback Comp Gain	Speed feedback compensation gain
3048	Pn112	100	1	1000	%	Speed Feedback Delay Comp	Speed feedback delay compensation (Speed feedback compensation inertia gain)
3049	Pn113	0	0	1000	%	Trq Dump Gain AntiVibration	Anti-vibration torque damping gain
3050	Pn114	0	0	1000	%	Spd Dump Gain AntiVibration	Anti-vibration speed damping gain
3051	Pn115	0	0	65535	0.01ms	LPF const AntiVibration	Anti-vibration low-pass filter time constant
3052	Pn116	65535	0	65535	0.01ms	HPF const AntiVibration	Anti-vibration high-pass filter time constant
3053	Pn117	100	20	100	%	Curr Gain delayed	Current loop gain derating
3054	Pn118	100	50	100	None	Reserved	Reserved const (Do not use)

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
3055	Pn119	400	10	20000	0.1/s	Loop Gain MFC	MFC gain[0.ls^{-1}]
3056	Pn11A	1000	500	2000	0-1000	Dump Factor MFC	MFC damping coefficient
3057	Pn11B	500	10	1500	0.1Hz	Mecha Resonance Freq MFC	MFC mechanical resonance frequency
3058	Pn11C	700	10	1500	0.1Hz	Resonance Freq MFC	MFC resonance frequency
3059	Pn11D	1000	0	1500	0-1000	Spd FF Gain MFC	MFC speed FF gain
3060	Pn11E	1000	0	1500	0-1000	Trq FF Gain MFC	MFC torque FF gain
3061	Pn11F	0	0	2000	ms	Ki	Position integration time constant
3062	Pn120	0	0	51200	0.01ms	Kd	Position differentiation time constant
3063	Pn121	50	1	1000	Hz	Gain Disturb Observer	Disturbance observer gain
3064	Pn122	0	0	2000	Hz	HPF cut Freq Disturb Obsrvr	Cut-off frequency disturbance observer high-pass filter
3065	Pn123	0	0	100	%	Est Disturb Trq Factor	Estimated disturbance torque coefficient
3066	Pn124	0	0	2000	Hz	LPF cut Freq Disturb Obsrvr	Cut-off frequency disturbance observer low-pass filter
3067	Pn125	100	1	1000	%	Inertia Adj Disturb Obsrvr	Disturbance observer inertia correction
3068	Pn126	0x0000	0x0000	0x0110	None	Switch Function 1	Function switch 1
3069	Pn127	0x0000	0x0000	0x0011	None	Switch Function 2	Function switch 2
3070	Pn128	0x0000	0x0000	0x0111	None	Loop Gain Bank Switch	Loop gain bank switch
3071	Pn129	100	1	1000	Hz	Observer Gain AntiVibr	Anti-vibration observer gain
3072	Pn12A	100	1	1000	%	Load Inertia Adj AntiVibr	Anti-vibration observer inertia correction
3073	Pn12B	400	10	20000	0.1Hz	Kv3	3rd speed loop gain
3074	Pn12C	2000	15	51200	0.01ms	KVi3	3rd speed loop integration time constant
3075	Pn12D	400	10	20000	0.1/s	Kp3	3rd position loop gain
3076	Pn12E	400	10	20000	0.1Hz	Kv4	4th speed loop gain
3077	Pn12F	2000	15	51200	0.01ms	Kvi4	4th speed loop integration time constant
3078	Pn130	400	10	20000	0.1/s	Kp4	4th position loop gain
3079	Pn131	0x0000	0x0000	0x0222	None	Switch Predicted 1	Predictive control switch 1
3080	Pn132	800	0	1000	0.01	Param C Predicted 1	1st predictive control parameter C
3081	Pn133	0	0	1000	0.01	Param Cd Predicted 1	1st predictive control parameter Cd
3082	Pn134	0	-90	1000	0.01	Param Alpha Predicted 1	1st predictive control parameter α
3083	Pn135	0	-10000	10000	0.1/s	Equiv Kp Adj Predicted 1	1st predictive control equivalent Kp fine adjustment amount
3084	Pn136	0	0	100	%	Spd FF Gain Predicted 1	1st predictive control speed FF gain [%]
3085	Pn137	0	0	100	%	Trq FF Gain Predicted 1	1st predictive control torque FF gain [%]
3086	Pn138	0	0	65535	0.01ms	Trq FF Fil T Const Predic 1	1st predictive control torque FF filter time constant
3087	Pn139	800	0	1000	0.01	Param C Predicted 2	2nd predictive control parameter C
3088	Pn13A	0	0	1000	0.01	Param Cd Predicted 2	2nd predictive control parameter Cd
3089	Pn13B	0	-90	1000	0.01	Param Alpha Predicted 2	2nd predictive control parameter α

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
3090	Pn13C	0	-10000	10000	0.1/s	Equiv Kp Adj Predicted 2	2nd predictive control equivalent Kp fine adjustment amount
3091	Pn13D	0	0	100	%	Spd FF Gain Predicted 2	2nd predictive control speed FF gain
3092	Pn13E	0	0	100	%	Trq FF Gain Predicted 2	2nd predictive control torque FF gain
3093	Pn13F	0	0	65535	0.01ms	Trq FF Fil T Const Predic 2	2nd predictive control torque FF filter time constant
3094	Pn140	800	0	1000	0.01	Param C Predicted 3	3rd predictive control parameter C
3095	Pn141	0	0	1000	0.01	Param Cd Predicted 3	3rd predictive control parameter Cd
3096	Pn142	0	-90	1000	0.01	Param Alpha Predicted 3	3rd predictive control parameter α
3097	Pn143	0	-10000	10000	0.1/s	Equiv Kp Adj Predicted 3	3rd predictive control equivalent Kp fine adjustment amount
3098	Pn144	0	0	100	%	Spd FF Gain Predicted 3	3rd predictive control speed FF gain
3099	Pn145	0	0	100	%	Trq FF Gain Predicted 3	3rd predictive control torque FF gain
3100	Pn146	0	0	65535	0.01ms	Trq FF Fil T Const Predic 3	3rd predictive control torque FF filter time constant
3101	Pn147	10000	0	65535	None	1st P Gain Quad Err Comp	1st-stage positive quadrant error compensation gain
3102	Pn148	0	0	30000	0.01%	1st P Lmt Ofs Quad Err Comp	1st-stage positive quadrant error compensation limit offset
3103	Pn149	1000	0	65535	None	2nd P Gain Quad Err Comp	2nd-stage positive quadrant error compensation gain
3104	Pn14A	0	0	30000	0.01%	2nd P Lmt Ofs Quad Err Comp	2nd-stage positive quadrant error compensation limit
3105	Pn14B	0	-30000	30000	0.01%	P Lmt Adj Quad Err Comp	Positive quadrant error compensation limit fluctuation
3106	Pn14C	0	0	30000	0.01%	P Lmt Clamp Quad Err Comp	Positive quadrant error compensation limit clamp value
3107	Pn14D	10000	0	65535	None	1st N Gain Quad Err Comp	1st-stage negative quadrant error compensation gain
3108	Pn14E	0	0	30000	0.01%	1st N Lmt Ofs Quad Err Comp	1st-stage negative quadrant error compensation limit offset
3109	Pn14F	1000	0	65535	None	2nd N Gain Quad Err Comp	2nd-stage negative quadrant error compensation gain
3110	Pn150	0	0	30000	0.01%	2nd N Lmt Ofs Quad Err Comp	2nd-stage negative quadrant error compensation limit
3111	Pn151	0	-30000	30000	0.01%/ms	N Lmt Adj Quad Err Comp	Negative quadrant error compensation limit fluctuation
3112	Pn152	0	0	30000	0.01%	N Lmt Clamp Quad Err Comp	Negative quadrant error compensation limit clamp value
3113	Pn153	0	-350	1600	0.1/s	Timing Const Quad Err Comp	Quadrant error compensation timing constant
3114	Pn154	100	10	100	%	Damp Ratio AntiVib on STP	Stop vibration suppression attenuation ratio
3115	Pn155	1024	0	32767	ms	Start Time AntiVib on STP	Stop vibration suppression start time
3116	Pn156	0	0	65535	0.01ms	Scale Ovrsht Ctrl Tim Const	Scale overshoot suppression time constant
3200	Pn200	0x0100	0x0000	0x0300	None	Switch Position Control	Position control command type selection switch
3201	Pn201	16384	16	16384	pulse/rev	PG Divider	PG dividing ratio

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
3202	Pn202	4	1	65535	None	Reserved	Reserved constant(Do not use)
3203	Pn203	1	1	65535	None	Reserved	Reserved constant(Do not use)
3204	Pn204	0	0	6400	0.01ms	Tim Const Exp Accel Decel 1	1st exponential acceleration/ deceleration time constant (Position command acceleration/deceleration time constant)
3205	Pn205	65535	0	65535	rev	Multi Turn Limit	Multi-turn limit setting
3206	Pn206	16384	513	16384	None	Reserved	Reserved constant (Do not use)
3207	Pn207	0x0000	0x0000	0x3211	None	Switch Position Ref	Position command function switch
3208	Pn208	0	0	6400	0.01ms	Averaging Time Pos Ref 1	1st position command moving average time
3209	Pn209	0	0	6400	0.01ms	Averaging Time Pos Ref 2	2nd position command moving average time
3210	Pn20A	0x8000	0x0000	0xFFFF	None	PG Pls MtrRnd LW FullClosed	Full-closed PG pulse count/motor revolution (Lower word)
3211	Pn20B	0x0000	0x0000	0xFFFF	None	PG Pls MtrRnd HW FullClosed	Full-closed PG pulse count/motor revolution (Upper word)
3212	Pn20C	0x4000	0x0000	0xFFFF	None	PG Pls EcdRnd LW FullClosed	Full-closed PG pulse count/encoder revolution (Lower word)
3213	Pn20D	0x0000	0x0000	0xFFFF	None	PG Pls EcdRnd HW FullClosed	Full-closed PG pulse count/encoder revolution (Upper word)
3214	Pn20E	0x0001	0x0000	0xFFFF	None	Electric Gear Numerator LW	lectronic gear ratio numerator (Lower word)
3215	Pn20F	0x0000	0x0000	0xFFFF	None	Electric Gear Numerator HW	Electronic gear ratio numerator (Upper word)
3216	Pn210	0x0001	0x0000	0xFFFF	None	Electric Gear Denomin LW	Electronic gear ratio denominator (Lower word)
3217	Pn211	0x0000	0x0000	0xFFFF	None	Electric Gear Denomin HW	Electronic gear ratio denominator (Upper word)
3218	Pn212	0	0	65535	None	Bias Exp Accel Decel 1	1st exponential acceleration/ deceleration bias
3219	Pn213	0	0	6400	0.01ms	Tim Const Exp Accel Decel 2	2nd exponential acceleration/ deceleration time constant
3220	Pn214	0	0	65535	None	Bias Exp Accel Decel 2	2nd exponential acceleration/ deceleration bias
3221	Pn215	0	0	25000	0.01ms	Shape compensation	Shape compensation constant
3222	Pn216	0	0	25000	0.01ms	Shape Comp MFC	MFC shape compensation constant
3223	Pn217	0	0x8000	0x7FFF	None	Backlash Comp 1	1st backlash compensation amount
3224	Pn218	0	0	65535	0.01ms	Time Const Backlash Comp 1	1st backlash compensation time constant
3225	Pn219	0	0x8000	0x7FFF	None	Backlash Comp 2	2nd backlash compensation amount
3226	Pn21A	0	0	65535	0.01ms	Time Const Backlash Comp 2	2nd backlash compensation time constant
3227	Pn21B	0	0x8000	0x7FFF	None	Backlash Comp 3	3rd backlash compensation amount
3228	Pn21C	0	0	65535	0.01ms	Time Const Backlash Comp 3	3rd backlash compensation time constant
3229	Pn21D	0	0x8000	0x7FFF	None	Backlash Comp 4	4th backlash compensation amount
3230	Pn21E	0	0	65535	0.01ms	Time Const Backlash Comp 4	4th backlash compensation time constant

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
3231	Pn21F	1	1	65535	None	PG Pls EcdRnd Z Phase	Z-phase pulse count/encoder revolution
3300	Pn300	600	150	3000	None	Spd Ref Gain	Speed reference input gain
3301	Pn301	100	0	10000	min^{-1}	Internal Set Speed 1	Internal set speed 1
3302	Pn302	200	0	10000	min^{-1}	Internal Set Speed 2	Internal set speed 2
3303	Pn303	300	0	10000	min^{-1}	Internal Set Speed 3	Internal set speed 3
3304	Pn304	500	0	10000	min^{-1}	JOG Speed	JOG speed
3305	Pn305	0	0	10000	ms	Accel Time Soft Start	Soft start acceleration time
3306	Pn306	0	0	10000	ms	Decel Time Soft Start	Soft start deceleration time
3307	Pn307	40	0	65535	None	Reserved	Reserved constant (Do not use)
3308	Pn308	0	0	65535	0.01ms	Time Const Spd F B Filter	Speed F/B filter time constant
3309	Pn309	0x0000	0	65535	0.01ms	Tim Const Spd RefnFF Filter	(Speed reference & speed FF) filter time constant
3350	Pn400	30	10	100	None	Reserved	Reserved constant (Do not use)
3351	Pn401	100	0	65535	0.01ms	Time Const Trq Ref Filter	1st-stage low-pass filter time constant (Torque reference filter time constant)
3352	Pn402	800	0	800	%	Forward Torque Limit	Forward rotation torque limit
3353	Pn403	800	0	800	%	Reverse Torque Limit	Reverse rotation torque limit
3354	Pn404	100	0	800	%	External Fwd Torque Limit 1	1st forward rotation external torque limit
3355	Pn405	100	0	800	%	External Rev Torque Limit 1	1st reverse rotation external torque limit
3356	Pn406	800	0	800	%	Emergency Stop Torque	Emergency stop torque
3357	Pn407	10000	0	10000	None	Reserved	Reserved constant (Do not use)
3358	Pn408	0x0000	0x0000	0x0111	None	Switch Notch Filters	Notch filter function switch
3359	Pn409	2000	50	2000	Hz	Frequency Notch Filter 1	1st-stage notch filter frequency
3360	Pn40A	70	70	100	0.01	Q Value Notch Filter 1	1st-stage notch filter Q value
3361	Pn40B	2000	50	2000	Hz	Frequency Notch Filter 2	2nd-stage notch filter frequency
3362	Pn40C	70	70	100	0.01	Q Value Notch Filter 2	2nd-stage notch filter Q value
3363	Pn40D	0	0	65535	0.01ms	Torque Filter Constant 2	2nd-stage low-pass filter time constant
3364	Pn40E	50	0	65535	10us	Torque Filter Constant 3	3rd-stage low-pass filter time constant
3365	Pn40F	100	0	800	%	External Fwd Torque Limit 2	2nd forward rotation external torque limit
3366	Pn410	100	0	800	%	External Rev Torque Limit 2	2nd reverse rotation external torque limit
3367	Pn411	0	-20000	20000	0.01%	Gravity Comp Torque	Gravity compensation torque
3368	Pn412	0	0	800	%	Disturb Torque Level 1	1st-torque disturbance level
3369	Pn413	0	0	800	%	Disturb Torque Level 2	2nd-torque disturbance level
3370	Pn414	0	0	800	%	Disturb Torque Level 3	3rd torque disturbance level
3371	Pn415	0	0	800	%	Disturb Torque Level 4	4th torque disturbance level
3372	Pn416	0	0	800	%	Compliance Torque	Compliance torque
3420	Pn500	7	0	250	None	Pos Completion Range	Positioning completion width
3421	Pn501	10	0	10000	min^{-1}	Zero Clamp Level	Zero-clamp level
3422	Pn502	20	1	10000	min^{-1}	Zero Speed Level	Zero-speed level
3423	Pn503	10	0	100	min^{-1}	Speed Window	Speed matching signal output width

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
3424	Pn504	7	1	250	None	Near Window	NEAR signal width
3425	Pn505	1024	1	32767	None	Overflow Level	Overflow level
3426	Pn506	0	0	50	10ms	Delay from BrkSig to SvOff	Brake command-to-Servo off delay time
3427	Pn507	100	0	10000	min^{-1}	Spd on Brake Sig Out	Brake command output speed level
3428	Pn508	50	10	100	10ms	Sv Off Brk Sig Wait Time	Servo off-to-Brake command wait time
3429	Pn509	20	20	1000	None	Reserved	Reserved constant (Do not use)
3430	Pn50A	0x8880	0x7000	0x8FFF	None	Reserved	Reserved constant (Do not use)
3431	Pn50B	0x8888	0x7000	0x8FFF	None	Reserved	Reserved constant (Do not use)
3432	Pn50C	0x8888	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3433	Pn50D	0x8888	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3434	Pn50E	0x0000	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3435	Pn50F	0x0000	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3436	Pn510	0x0000	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3437	Pn511	0x8888	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3438	Pn512	0x0000	0x0000	0xFFFF	None	Reserved	Reserved constant (Do not use)
3439	Pn513	7	0	250	None	Position Window 1	1st positioning completion width
3440	Pn514	7	0	250	None	Position Window 2	2nd positioning completion width
3441	Pn515	7	0	250	None	Position Window 3	3rd positioning completion width
3442	Pn516	500	0	10000	ms	Emergency Stop Wait Time	Emergency stop wait time
3470	Pn600	0	0	65535	None	Reserved	Reserved constant (Do not use)
3471	Pn601	0	0	65535	None	Reserved	Reserved constant (Do not use)
3472	Pn602	0x0000	0x0000	0x0001	None	Ext PG Power Switch	External PG power high/low voltage switch
3508	Pn808	0x0000	0x0000	0xFFFF	None	Abs PG Zero Point Offs LW	Absolute PG zero point offset (Lower word)
3509	Pn809	0x0000	0x0000	0xFFFF	None	Abs PG Zero Point Offs HW	Absolute PG zero point offset (Upper word)
3510	Pn80A	100	1	65535	None	Const Linear Accel 1	1st-stage linear acceleration constant
3527	Pn81B	0x0000	0x0000	0x1111	None	Mask MFC BankSel 0 3	Model following control mask when Loop gain bank 0-3 is selected.
3528	Pn81C	500	0	30000	ms	Tactor Off Delay Time	Time from tactor-off ready to actual tactor-off.

A.2 List of Servo unit parameter switches

User Constant No.	Digit	Name	Setting	Description	Factory default setting
MD3000 (Pn000) Fundamental function selection	0	Rotation direction selection	0	Defines that CCW is forward rotation.	0
			1	Defines that CW is forward rotation. (Reverse rotation mode)	
	1	Control method selection	1	Position control	7
			2 - 6	Reserved	
			7	Position control ⇔ Speed control	
	2	Reserved	0 - F	—	0
	3	Reserved	0	—	0
MD3001 (Pn001) Applied function selection	0	Stopping motor when Servo is off and alarm is on	0	Stops a motor using dynamic brake (DB).	0
			1	Stops a motor with DB and then release DB.	
			2	Brings a motor into free-run mode without using DB.	
	1	Stopping motor when over-travel (OT) happens	0	Stops a motor using DB or free-run. (The same stopping method as Pn001.0)	0
			1	Stops a motor after deceleration with Pn406 as maximum torque, and puts it in Servo lock mode.	
			2	Stops a motor after deceleration with Pn406 as maximum torque, and puts it in free-run mode.	
	2	Reserved	0	—	0
	3	Reserved	0	—	0
MD3002 (Pn002) Applied function selection	0	Reserved	0	—	0
	1	Reserved	0	—	0
	2	Use of Absolute encoder	0	Uses an Absolute encoder as an absolute encoder.	0
			1	Uses an Absolute encoder as an incremental encoder.	
	3	Use of external PG pulse	0	Does not use.	0
			1	Uses without C phase. (Incremental encoder)	
			2	Uses with C phase. (Incremental encoder)	
			3	Uses without C phase as reverse mode. (Incremental encoder)	
			4	Uses with C phase as reverse mode. (Incremental encoder)	
			5	Uses without C phase. (Absolute encoder)	
			6	Uses with C phase. (Absolute encoder)	
			7	Uses without C phase as reverse rotation mode. (Absolute encoder)	
			8	Uses with C phase as reverse rotation mode. (Absolute encoder)	
MD3003 (Pn003) Applied function selection	0	Analog monitor 1 selection	0	Motor revolution speed :1V ／ 1000 min^{-1}	2
			1	Speed reference :1V ／ 1000 min^{-1}	
			2	Torque reference :1V ／ 100 %	
			3	Position deviation :0.05V ／ 1 command unit	
			4	Position amplitude deviation :0.05V ／ 1 command unit	
			5	Position command speed [min^{-1} conversion] :1V ／ 1000 min^{-1}	
			6	Observer speed :1V ／ 1000 min^{-1}	

User Constant No.	Digit	Name	Setting	Description	Factory default setting
MD3003 (Pn003) Applied function selection (Continued)	0	Analogue monitor 1 selection	7	Collision detection amount :1V ／ 100 %	2
			8	Quadrant error compensation amount :1V ／ 100 %	
			9	Speed feed forward :1V ／ 100 min^{-1}	
			A	Torque feed forward :1V ／ 100 %	
			B	Model torque reference :1V ／ 100 %	
			C	Model position deviation :0.05V ／ 1 command unit	
			D	Estimated disturbance torque :1V ／ 100 %	
			E	Anti-vibration monitor :1V ／ 1000 min^{-1}	
			F	System constant setting data output	
	1	Analog monitor 1 magnification	0	1 time	0
			1	10 times	
			2	100 times	
			3	1/10 times	
			4	1/100 times	
	2	Analog monitor 2 selection	0 - F	The same as the descriptions for "Analog monitor 1 selection"	0
	3	Analogue monitor 2 magnification	0 - 4	The same as the descriptions for "Analog monitor 1 magnification"	0
MD3004 (Pn004) Applied function selection	0	Optional board selection	0	Without optional board	0
			1	With analogue speed reference input option	
			2	With linear scale option	
	1	Reserved	0 - 1	—	0
	2	Command mode	0	Network	0
			1	Optional speed reference input mode	
			2	Parking	
			3	Reserved	
	3	Reserved	0	—	0
MD3005 (Pn005) Applied function selection	0	Brake control signal selection	0	Does not control a brake at local path.	0
			1	Controls a brake at local path.	
	1	Reserved	0	—	0
	2	Reserved	0	—	0
	3	Reserved	0	—	0
MD3006 (Pn006) Applied function selection	0	Tandem selection	0	Does not select tandem configuration	0
			1	Master	
			2	Slave	
	1	The other tandem-axis number	0 - 7	Sets the other tandem axis	0
	2	Full-close	0	Type 2 specification	0
			1	Type 1 specification	
	3	Reserved	0	—	0

User Constant No.	Digit	Name	Setting	Description	Factory default setting
MD3041 (Pn10B) Gain-related applied switch	0	Mode switch selection	0	Selects internal torque reference as a condition. (Level setting: Pn10C)	4
			1	Selects speed reference as a condition. (Level setting: Pn10D)	
			2	Selects acceleration as a condition. (Level setting: Pn10E)	
			3	Selects deviation pulse as a condition. (Level setting: Pn10F)	
			4	Does not use mode select switch.	
	1	Speed loop control method	0	PI control	0
			1	IP control	
	2	Reserved	0	—	0
	3	Anti-vibration control selection	0	Anti-vibration control is not used.	0
			1	M1 type anti-vibration control	
			2	M2 type anti-vibration control	
			3	A type anti-vibration control	
MD3046 (Pn110) Auto tuning	0	On-line auto tuning method	0	Uses auto tuning only for initializing operation.。	0
			1	Always uses auto tuning.	
			2	Does not use auto tuning.	
	1	Speed feedback compensation function selection	0	Uses the function.	0
			1	Does not use.	
	2	Viscous friction compensation function selection	0	Friction compensation: None	0
			1	Friction compensation: Small	
			2	Friction compensation: Large	
	3	Model following control selection	0	Does not use model following control.	0
			1	Uses rigid model following control.	
			2	Uses 2-inertia model following.	
MD3068 (Pn126) Function switch	0	Reserved	0	—	0
	1	Quadrant error compensation	0	Inactive	0
			1	Active (without pulse suppression)	
			2	Active (with pulse suppression)	
	2	Scale overshoot	0	Inactive	0
			1	Active	
	3	Reserved	0	—	0
MD3069 (Pn127) Function switch	0	Variable position loop gain selection	0	Inactive	0
			1	Active	
	1	Speed FF smoothing selection	0	Inactive	0
			1	Active	
	2	Reserved	0	—	0
MD3069 (Pn127) Function switch (Continued)	3	Reserved	0	—	0

User Constant No.	Digit	Name	Setting	Description	Factory default setting
MD3070 (Pn128) Loop gain bank switch	0	2nd loop gain bank selection	0	Inactive	0
			1	Active	
	1	3rd loop gain bank selection	0	Inactive	0
			1	Active	
	2	4th loop gain bank selection	0	Inactive	0
			1	Active	
	3	Reserved	0	—	0
MD3079 (Pn131) Predictive control-relations	0	1st predictive control switch	0	Inactive	0
			1	Active（Tp = 0.001）	
			2	Active（Tp = 0.002）	
	1	2nd predictive control switch	0	Inactive	0
			1	Active（Tp = 0.001）	
			2	Active（Tp = 0.002）	
	2	3rd predictive control switch	0	Inactive	0
			1	Active（Tp = 0.001）	
			2	Active（Tp = 0.002）	
	3	Reserved	0	—	0
MD3200 (Pn200) Position control	0	Reserved	0	—	0
	1	Reserved	0	—	0
	2	Clearing operation	0	Clears deviation counter on base-block.	1
			1	Does not clear deviation counter. (Only CLR signal can clear.)	
			2	Clears deviation counter on an alarm.	
			3	Does not clear deviation counter.	
	3	Reserved	0	—	0
MD3207 (Pn207) Position control function switch	0	Position command filter selection	0	Uses position command acceleration/deceleration filter.	0
			1	Uses position command moving average filter.	
	1	Position control speed FF	0	None	0
			1	Uses V-REF for speed FF input.	
	2	Backlash compensation selection	0	Inactive	0
			1	Corrects toward forward rotation.	
			2	Corrects toward reverse rotation.	
	3	External PG type selection	0	Pulse encoder (Linear scale)	0
			1	Pulse encoder (Rotary)	
			2	Serial encoder	
			3	MP scale	

User Constant No.	Digit	Name	Setting	Description	Factory default setting
MD3358 (Pn408) Torque-related function switch	0	1st-stage notch filter selection	0	None	0
			1	Uses 1st-stage notch filter for torque reference.	
	1	2nd-stage notch filter selection	0	None	0
			1	Uses 2nd-stage notch filter for torque reference.	
	2	Variable-torque limit selection	0	Inactive	0
			1	Active	
	3	Reserved	0	—	0
MD3527 (Pn81B) Model following control mask	1	Mask to select Model following control when loop gain bank 0 is selected.	0	Enable model following control	0
			1	Disable model following control	
	2	Mask to select Model following control when loop gain bank 1 is selected.	0	Enable model following control	0
			1	Disable model following control	
	3	Mask to select Model following control when loop gain bank 2 is selected.	0	Enable model following control	0
			1	Disable model following control	
	4	Mask to select Model following control when loop gain bank 3 is selected.	0	Enable model following control	0
			1	Disable model following control	

A.3 List of Inverter parameter

Note: The values shown in this table are based on the values shown in the operator panel of the CNC. On the digital operator of the SERVOPACK, the decimal point is displayed. In other words, the unit for the value displayed on the operator panel is different from the unit for the value on the digital operator.

◀ EXAMPLE ▶ When the zero speed detection level is set to 30 min^{-1}, the displayed value are as follows.

MD6030: 300[0.1 min^{-1}] on the operator panel of the CNC

Cn030: 30.0[min^{-1}] on the digital operator of the SERVOPACK

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6020	Cn020	0	0	2	None	Reference Selection	Operation command selection
6030	Cn030	300	30	600	0.1min^{-1}	Zero-speed Det Level	Zero speed detection level
6031	Cn031	20	0	300	0.1min^{-1}	Zero-speed Det Width	Zero speed detection width
6032	Cn032	0	0	100	0.1sec	Zero-speed Braking Time	Zero speed braking time
6050	Cn050	1	1	60000	0.1sec	Soft Start Time	Soft start time
6060	Cn060	300	10	20000	0.1%/Hz	ASR P Gain H 1	Speed control proportional gain (H)
6061	Cn061	6000	1	10000	0.1msec	ASR I Time H 1	Speed control integration time (H)
6062	Cn062	300	10	20000	0.1%/Hz	ASR P Gain M L 1	Speed control proportional gain (ML)
6063	Cn063	6000	1	10000	0.1msec	ASR I Time M L 1	Speed control integration time (ML)
6064	Cn064	400	10	20000	0.1%/Hz	ASR P Gain H 2	Speed control proportional gain (H Servo)
6065	Cn065	1000	1	10000	0.1msec	ASR I Time H 2	Speed control integration time (H Servo)
6066	Cn066	400	10	20000	0.1%/Hz	ASR P Gain M L 2	Speed control proportional gain (ML Servo)
6067	Cn067	1000	1	10000	0.1msec	ASR I Time M L 2	Speed control integration time (ML Servo)
6071	Cn071	50	0	50	0.1msec	ASR Primary Delay Time	Torque reference filter time constant
6072	Cn072	0	0	500	msec	ASR T Time	Torque reference lead time
6073	Cn073	0	0	1	None	ASR P Gain Select	Speed proportional gain selection
6100	Cn100	100	0	250	0.01	Torque Comp Gain	Torque compensation gain
6101	Cn101	20	0	10000	msec	Torque Comp Time Constant	Torque compensation temporary delay time
6110	Cn110	10	0	25	0.1	Slip Comp Gain	Slip correction gain
6111	Cn111	200	0	10000	msec	Slip Comp Delay Time	Slip correction temporary delay time constant
6112	Cn112	200	0	250	%	Slip Comp Limit	Slip correction limit
6113	Cn113	0	0	1	None	Slip Comp in Regeneration	Slip correction during regeneration operation
6120	Cn120	0	0	2	None	Carrier Frequency 1	High-speed winding carrier frequency
6121	Cn121	0	0	2	None	Carrier Frequency 2	Low-speed winding carrier frequency
6130	Cn130	1	0	1	None	Hunting Prevention Sel	Antihunting function selection
6131	Cn131	100	0	250	0.01	Hunting Prevention Gain	Antihunting gain

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6132	Cn132	25	0	500	msec	Hunting Time	Antihunting time constant
6133	Cn133	10	0	100	%	Hunting Limit	Antihunting limit
6150	Cn150	1900	0	4600	v	Voltage Cntrl Volt	Voltage limiting control setting voltage
6151	Cn151	100	0	10000	0.01	Voltage Cntrl P Gain	Voltage limiting control proportional gain
6152	Cn152	40	0	5000	sec	Voltage Cntrl I Time	Voltage limiting control integration time
6153	Cn153	20	0	5000	sec	Voltage Cntrl Fil Time	Voltage limiting control output filter time constant
6154	Cn154	10	0	5000	sec	D Axis Torque Filter	d-axis current torque filter time constant
6155	Cn155	0	0	1	None	Voltage Cntrl Sel	Voltage limiting control selection
6156	Cn156	0	0	1	None	Max Torque Sel	Max. torque coefficient control selection
6200	Cn200	15	10	100	%	Motor Flux Lower Limit	Motor flux lower limit level
6201	Cn201	100	30	100	%	Sv Mode Flux Level H	Servo mode flux level (H)
6202	Cn202	100	100	500	0.01	Sv Base Speed Ratio H	Servo mode base speed ratio (H)
6203	Cn203	100	30	100	%	Sv Mode Flux Level M L	Servo mode flux level (ML)
6204	Cn204	100	100	500	0.01	Sv Base Speed Ratio M L	Servo mode base speed ratio (ML)
6259	Cn259	0	0	1	None	Load Ratio Output Ref	Load ratio meter output reference selection
6263	Cn263	0	0	3	None	Load Ratio Meter Filter	Load ratio meter filter time constant
6400	Cn400	15	10	50	%	Speed-agree Width	Speed matching signal
6401	Cn401	1000	0	10000	0.01%	Speed Detection Level	Speed detection signal level
6402	Cn402	100	0	10000	0.01%	Speed Detection Width	Speed detection signal hysteresis
6403	Cn403	0	0	1	None	Excessive Speed Dev Sens	Dynamic sensitivity selection of excessive speed deviation
6404	Cn404	0	0	3	None	Excessive Speed Dev Time	Delay time selection of excessive speed deviation protection
6405	Cn405	0	0	1	None	Speed Agree Signal Sel	AGR output condition selection
6410	Cn410	100	50	2000	0.1%	Torqu Detection Level	Torque detection signal level
6411	Cn411	10	0	100	0.1%	Torqu Detection Width	Torque detection signal hysteresis
6412	Cn412	0	0	1	None	Torque Detection Output	TDET output method at acceleration
6420	Cn420	10	0	210	%	Ext Torque Limit	External steering torque limiting level
6421	Cn421	150	0	210	%	Torque Limit	Torque limiting level at electric operation side
6422	Cn422	150	0	210	%	Regeneration Torque Limit	Torque limiting level at regeneration side
6423	Cn423	0	0	1	None	Torqu Limit Select	Torque limiting selection
6450	Cn450	190	150	210	v	Undervoltage Detect Level	Low voltage detection level
6472	Cn472	0	0	799	None	Monitor 1 Output	Monitor 1 output description
6475	Cn475	1	0	799	None	Monitor 2 Output	Monitor 2 output description
6495	Cn495	0xB	0x0000	0x002F	Hex	Inverter Capacity Sel	Inverter capacity selection
6500	Cn500	7000	100	60000	min^{-1}	Rated Speed Setting	Rated speed setting
6504	Cn504	0	0	1	None	Torqu Limit Auto Judge	Torque limit auto detect selection

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6510	Cn510	0	0	1	None	Twice Speed Selection	n100 twice selection
6511	Cn511	10000	0	10000	msec	Emergency Stop Time	Emergency stop signal wait time
6522	Cn522	1	0	1	None	Multi Function Sel SSC	Multi-function selecting SSC
6523	Cn523	0	0	1	None	Multi Function Sel MGX	Multi-function selecting MGX
6525	Cn525	0	0	1	None	Multi Function Sel PPI	Multi-function selecting PPI
6529	Cn529	0	0x0000	0x00FF	Hex	Encoder Specifications 0	Encoder specification（0）
6530	Cn530	0	0x0000	0x00FF	Hex	Encoder Specifications 1	Encoder specification（1）
6533	Cn533	12	1	65535	None	Number of encoder Puls 0	Encoder pulse count (0)
6534	Cn534	0	0	0	None	Number of Encoder Puls 1	Encoder pulse count (1)
6540	Cn540	10	10	20000	%/Hz	ASR P Gain C	C-axis speed control proportional gain (C)
6541	Cn541	10	10	10000	msec	ASR I Time C	C-axis speed control integration time constant (C)
6542	Cn542	100	1	255	$0.1min^{-1}$	Zero-speed Det Level C	C-axis zero speed level
6543	Cn543	100	10	1000	min^{-1}	Rated Speed Setting C	C-axis rated number of revolutions
6544	Cn544	0	0	100		Enc Phase C Puls Width	C-phase pulse width
6545	Cn545	0	0	8192	None	Zero Point Comp	Zero point correction value
6546	Cn546	0	0	150	0.01KHz	Notch Center Puls 1	Notch center frequency 1
6547	Cn547	0	0	250	Hz	Notch Band Width 1	Notch band width 1
6548	Cn548	0	0	150	0.01KHz	Notch Center Puls 2	Notch center frequency 2
6549	Cn549	0	0	250	Hz	Notch Band Width 2	Notch band width 2
6550	Cn54a	100	50	150	0.01	Motor Rated Current ratio C	C-axis rated secondary current ratio
6551	Cn54b	20	1	200	0.1Ω	ACR P Gain A1 Cax	C-axis ACR gain
6552	Cn54c	10	0	200	0.1msec	ACR I Time Cax	C-axis ACR integration time
6553	Cn54d	0	0	0xF	Hex	Select Code C1	C-axis selection code 1
6554	Cn54e	0	0	0xF	Hex	Select Code C2	C-axis selection code 2
6555	Cn54f	0	0	65535	None	Reserved S3 01	Primary delay filter time constant 1
6556	Cn550	0	0	65535	None	Reserved S3 02	Primary delay filter time constant 2
6568	Cn568	5	0	200	Pulse	Reserved S4 09	Positioning completion detection width
6569	Cn569	10	0	200	Pulse	Reserved S4 10	Positioning completion release width
6595	Cn583	50	5	100	%	Ort Db Gain Dec Ratio H	Gain reduction ratio (H) at positioning completion
6596	Cn584	50	5	100	%	Ort Db Gain Dec Ratio L	Gain reduction ratio (L) at positioning completion
6600	Cn600	1	0	1	None	Serch Pole Select	Initial magnetic pole detection selection
6601	Cn601	300	10	20000	None	Serch Pole P Gain	Speed control proportional gain for initial magnetic pole detection
6602	Cn602	30	1	10000	0.1msec	Serch Pole I Time	Speed control integration gain for initial magnetic pole detection
6603	Cn603	5	1	500	0.1%	Serch Pole Speed Ref	Initial magnetic pole detection speed reference
6604	Cn604	450	0	3600	deg	Serch Pole Angle	Initial magnetic pole detection angle increment

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6605	Cn605	3000	0	20000	0.1msec	Serch Pole Pre Count	Initial magnetic pole detection estimated time
6606	Cn606	100	1	20000	0.1msec	Serch Pole Level	Initial magnetic pole detection control time
6607	Cn607	200	1	1000	0.1%	Serch Pole Torque Limit	Initial magnetic pole detection torque limit
6608	Cn608	1	0	1	None	Serch Enc Phase C Select	C-phase detection selection
6700	Cn700	1500	10	60000	min^{-1}	Base Speed 1	H winding base speed
6701	Cn701	3500	10	60000	min^{-1}	Max Output Decrease Start 1	H winding max. output reduction starting point
6702	Cn702	3500	10	60000	min^{-1}	Rated Speed 1	H winding constant output speed
6703	Cn703	3500	100	65000	min^{-1}	Maximum Speed 1	H winding motor max. speed
6704	Cn704	22	1	750	0.1Kw	Continuous Rated Output 1	H winding continuous rated output
6706	Cn706	44	1	1500	0.1Kw	Max Output 1	H winding max. output
6707	Cn707	44	1	1500	0.1Kw	Max Output Dec 1	H winding max. output reduction 1
6710	Cn710	44	1	1500	0.1Kw	Max Output Dec A1	H winding max. output reduction A1
6711	Cn711	169	0	4000	0.01Hz	Motor Rated Slip 1	H winding rated slip frequency
6712	Cn712	134	10	4000	0.1A	Motor Rated Current 1	H winding motor secondary current
6713	Cn713	135	10	2000	0.1A	Motor No-load Current 1	H winding rated exciting current reference
6714	Cn714	80	0	500	V	Base Voltage 1	H winding motor no-load voltage
6715	Cn715	100	0	250	0.01	Motor Iron Sat Coeff A1	H winding exciting current correction coefficient A
6716	Cn716	100	0	250	0.01	Motor Iron Sat Coeff B1	H winding exciting current correction coefficient B
6717	Cn717	0	0	200	0.1%	Base Iron Loss 1	H winding base core-loss current
6718	Cn718	0	0	200	0.1%	Max Iron Loss 2	H winding max. number of revolutions core-loss current
6719	Cn719	50	0	600	0.01Ω	ACR P Gain A1	H winding ACR gain A
6720	Cn720	50	0	600	0.01Ω	ACR P Gain B1	H winding ACR gain B
6721	Cn721	50	0	600	0.01Ω	ACR P Gain C1	H winding ACR gain C
6722	Cn722	50	0	600	0.01Ω	ACR P Gain D1	H winding ACR gain D
6723	Cn723	200	0	1000	0.01msec	ACR Time Constant 1	H winding ACR time constant
6724	Cn724	100	0	200	%	Mgnetiging Current Limit 1	H winding exciting current limiter
6729	Cn729	120	100	150	%	Motor Accel Level 1	H winding motor overspeed level
6736	Cn736	1000	0	65000	0.0001Ω	Term Resistance 1	H winding motor line resistance
6737	Cn737	500	0	60000	0.001mH	Leak Inductance d1	H winding d-axis inductance
6738	Cn738	500	0	60000	0.001mH	Leak Inductance q2	H winding q-axis inductance
6739	Cn739	0	0	250	%	Magnetiging Current 1	H winding weakening magnetic field current
6740	Cn740	1000	0	10000	0.1Hz	Base Frequency	V/F Base frequency
6741	Cn741	500	0	10000	0.1Hz	Mid Output Frequency	V/F intermediate frequency
6742	Cn742	130	0	5000	0.1V	Mid Output Frequency Volt	V/F intermediate output frequency voltage
6743	Cn743	5	0	10000	0.1Hz	Min Output Frequency	V/F min. output frequency

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6744	Cn744	100	0	5000	0.1V	Min Output Frequency Volt	V/F min. output frequency voltage
6745	Cn745	2000	0	5000	0.1V	Max Output Frequency Volt	V/F max. output frequency voltage
6750	Cn750	1500	10	60000	min^{-1}	Base Speed 2	L winding base speed
6751	Cn751	3500	10	60000	min^{-1}	Max Output Decrease Start 2	L winding max. output reduction starting point
6752	Cn752	3500	10	60000	min^{-1}	Rated Speed 2	L winding constant output speed
6753	Cn753	3500	100	65000	min^{-1}	Maximum Speed 2	L winding motor max. speed
6754	Cn754	22	1	750	0.1Kw	Continuous Rated Output 2	L winding continuous rated output
6756	Cn756	44	1	1500	0.1Kw	Max Output 2	L winding max. output
6757	Cn757	44	1	1500	0.1Kw	Max Output Dec 2	L winding max. output reduction 2
6760	Cn760	44	1	1500	0.1Kw	Max Output Dec A2	L winding max. output reduction A2
6761	Cn761	100	0	4000	0.01Hz	Motor Rated Slip 2	L winding rated slip frequency
6762	Cn762	200	10	4000	0.1A	Motor Rated Current 2	L winding rated secondary current
6763	Cn763	100	10	2000	0.1A	Motor No-load Current 2	L winding rated exciting current command
6764	Cn764	80	0	500	V	Base Voltage 2	L winding motor no-load voltage
6765	Cn765	100	0	250	0.01	Motor Iron Sat Coeff A2	L winding exciting current correction coefficient A
6766	Cn766	100	0	250	0.01	Motor Iron Sat Coeff B2	L winding exciting current correction coefficient B
6767	Cn767	0	0	200	0.1%	Base Iron Loss 2	L winding base core-loss current
6768	Cn768	0	0	200	0.1%	Max Iron Loss 2	L winding max. number of revolutions core-loss current
6769	Cn769	200	0	600	0.01Ω	ACR P Gain A2	L winding ACR gain A
6770	Cn770	200	0	600	0.01Ω	ACR P Gain B2	L winding ACR gain B
6771	Cn771	200	0	600	0.01Ω	ACR P Gain C2	L winding ACR gain C
6772	Cn772	200	0	600	0.01Ω	ACR P Gain D2	L winding ACR gain D
6773	Cn773	10	0	1000	0.01msec	ACR Time Constant 2	L winding ACR time constant
6774	Cn774	100	0	200	%	Magnetiging Current Limit 2	L winding exciting current limiter
6779	Cn779	120	100	5000	%	Motor Accel Level 2	L winding motor acceleration level
6786	Cn786	1000	0	65000	0.0001Ω	Term Resistance 2	L winding motor line resistance
6787	Cn787	500	0	60000	0.001mH	Leak Inductance d2	L winding d-axis inductance
6788	Cn788	500	0	60000	0.001mH	Leak Inductance q2	L winding q-axis inductance
6789	Cn789	0	0	250	%	Magnetiging Current 2	L winding weakening magnetic field current
6800	Cn800	0xB	0x0000	0x002f	None	kVA Selection	Applicable inverter capacity selection
6801	Cn801	3	0	4	None	Motor Selection	Motor selection
6802	Cn802	4	2	48	None	Number of Motor Poles	Number of poles
6803	Cn803	107	50	200	℃	Motor OH Detection	Motor overheat detection level
6805	Cn805	0	0	200	0.01	Rotor Thermal Gain	Rotor thermal gain
6806	Cn806	90	10	180	min	Motor Thermal Time Const	Motor thermal time constant
6809	Cn809	0x0001	0x0000	0xFFFF	None	Selection Code1	Selection code 1
6819	Cn819	500	0	30000	msec	Tactor off delay time	Tactor-off delay time

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6820	Cn820	0x0000	0x0000	0xFFFF	None	Function basic switch	Fundamental function selection switch
6821	Cn821	0x0000	0x0000	0xFFFF	None	Function appli switch1	Fundamental function selection switch 1
6824	Cn824	0x0000	0x0000	0xFFFF	None	Function appli switch4	Fundamental function selection switch 4
6828	Cn828	40	1	2000	None	Kp	Position loop gain
6832	Cn82C	40	1	2000	None	Kp2	2nd position loop gain
6837	Cn831	0x100	0x0000	0xFFFF	None	Gain switch	Gain-related applied switch
6871	Cn853	400	1	20000	None	Kp3	3rd position loop gain
6874	Cn856	40	1	2000	None	Kp4	4th position loop gain
6905	Cn875	0x0000	0x0000	0xFFFF	None	Position control switch	Position control command type selection switch
6906	Cn876	16384	16	16384	None	PG divider	PG dividing ratio
6907	Cn877	4	1	65535	None	Electric gear Numerator	Electronic gear ratio (numerator)
6908	Cn878	1	1	65535	None	Electric gear Denominator	Electronic gear ratio (denominator)
6909	Cn879	0	0	6400	None	1st index accel Const	1st exponential acceleration/ deceleration time constant (Position command acceleration/deceleration time constant)
6910	Cn87A	65535	0	65535	None	Multi turn limit	Multi-turn limit setting
6911	Cn87B	16384	513	32768	None	Full closed PG pulse	Full-closed PG pulse count/encoder revolution
6912	Cn87C	0x0000	0x0000	0xFFFF	None	Position ref switch	Position command function switch
6913	Cn87D	0	0	6400	None	1st position moving avr	1st position command moving average time
6914	Cn87E	0	0	6400	None	2nd position moving avr	2nd position command moving average time
6915	Cn87F	4096	0x0000	0xFFFF	None	Full closed PG pulse L 1	Full-closed PG pulse count/motor revolution (Lower word)
6916	Cn880	0x0000	0x0000	0xFFFF	None	Full closed PG pulse H 1	Full-closed PG pulse count/motor revolution (Upper word)
6919	Cn883	0x0001	0x0000	0xFFFF	None	Numerator electric gear L 1	Electronic gear ratio numerator (Lower word)
6920	Cn884	0x0000	0x0000	0xFFFF	None	Numerator electric gear L 2	Electronic gear ratio numerator (Upper word)
6921	Cn885	0x0001	0x0000	0xFFFF	None	Denminator electric gearH 1	Electronic gear ratio denominator (Lower word)
6922	Cn886	0x0000	0x0000	0xFFFF	None	Denminator electric gearH 2	Electronic gear ratio denominator (Upper word)
6923	Cn887	0	0	65535	None	1st bias index vel	1st exponential acceleration/ deceleration bios
6924	Cn888	0	0	6400	None	2nd bias index vel time	2nd exponential acceleration/ deceleration time constant
6925	Cn889	0	0	65535	None	2nd bias index vel	2nd exponential acceleration/ deceleration bios
6960	Cn8AC	7	0	250	None	Positioning completed W	Positioning completion width
6964	Cn8B0	7	1	250	None	Near window	NEAR signal width
6965	Cn8B1	1024	1	32767	None	Overflow level	Overflow level

CNC parameter number	Drive parameter number	Initial value	Lower limit	Upper limit	Unit	Display name	Description
6979	Cn8BF	7	0	250	None	Position window 1	1st positioning completion width
6980	Cn8C0	7	0	250	None	Position window 2	2nd positioning completion width
6981	Cn8C1	7	0	250	None	Position window 3	3rd positioning completion width
6988	Cn8C8	0x0000	0x0000	0xFFFF	None	Reserved for user 0F	Reserved for user 0F
7018	Cn8E6	0x0000	0x0000	0xFFFF	None	Alarm Mask	Alarm mask
7019	Cn8E7	0x0000	0x0000	0xFFFF	None	System Switch	System switch
7046	Cn902	0	3000	15000	None	PWN Frequency	PWM frequency
7047	Cn903	(0 << 8) + 0	(0 << 8) + 0	(255 << 8) + 30	None	On Delay Time and Comp	Lower byte: On-delay time; upper byte: On-delay compensation constant
7050	Cn906	0xACA3	0	65535	None	AD Parameter 1	A/D detection-setting parameter 1
7059	Cn90F	0	-32768	32767	None	Current Det Zero Adj U	Current detection zero adjustment (U-phase)
7060	Cn910	0	-32768	32767	None	Current Det Zero Adj V	Current detection zero adjustment (V-phase)
7061	Cn911	0	-32768	32767	None	Current Det Gain Adj UV	Current detection gain adjustment (U and V-phases)
7068	Cn918	0x0000	0x0000	0x00FF	None	PG Power Voltage Zero Adj	Lower byte: PG power voltage adjustment Upper byte: Not used
7074	Cn91E	0	0	0xFFFF	None	Standalone Flag	Stand-alone switch
7075	Cn91F	0x0000	0x0000	0xFFFF	None	MotorTyp PowerVolt EncTyp	Motor type (8-bit) Input voltage (4 bits) Encoder type (4 bits)
7076	Cn920	0x0000	0x0000	0xFFFF	None	Encorder Soft Version	Encoder software version
7077	Cn921	0	0	65535	None	Motor Size	Motor capacity

A.4 List of parameters common to all drives

The following parameters (MD0-2999), common to Servo unit and Inverter, are drive parameters displayed in a parameter screen for each drive.

- Each of the parameters is used as an interface through which a CNC receives data from a drive.
- They are read-only so that they can't be set through a drive parameter screen.
- Their values to be displayed are automatically generated in each drive according to changes in drive parameters (MD3000-8999) or changes in data (such as alarm data) of each drive.
- They are not displayed in the digital operators of the drives.
- Their values to be displayed in the drive parameter screen are read from each drive; the values are not updated automatically.

If you want to update the parameters, use the [Update] key in the drive parameter screen.

The following shows the contents of each parameter

CNC parameter No.	Lower limit	Upper limit	Unit	Name	Description	Related MD and remark
604	-100000	100000	%	UTILIZATION_MOTOR	Torque and Load data	Spindle load display value (Short-time rated torque)
762	-8192	3	—	FIRMWARE_DOWNLOAD_DP_SUBMOD	Optional firmware-updating process status for 611u communication	Not used
820	0	0xffffffff	ms	FAULT_END_TIME	Fault end time	Not used
821	0	0xffffffff	ms	TIMESTAMP_FAULT_STAT_CHANGE	Time stamp when alarm data changes	Alarm information
822	0	0xffffffff	ms	TIMESTAMP_WARN_STAT_CHANGE	Time stamp when warning data changes	Not used
823	0	0xffff	—	ACT_FAULT_NUMBER	Fault number	Not used
824	0	0xffff	—	ACT_FAULT_CODE	Fault code	Alarm code
825	0	0xffffffff	ms	ACT_FAULT_TIME	Fault time stamp	Alarm time stamp
826	0	0x00ffffff	—	ACT_FAULT_VALUE	Fault value	Alarm time stamp
870	0	0xffff	—	MODULE_TYPE	Control module type	Not used
871	0	0xffff	—	MODULE_VERSION	Control module version	Not used
872	0	0xffff	—	OPTION_MODULE_TYPE	Communication option type	DPC31 Synchronous mode
873	0	0xffff	—	OPTION_MODULE_VERSION	Communication option version	Not used
875	0	4	—	EXPECTED_OPTION_MODULE_TYPE	Necessary communication option type	DPC31 Synchronous mode
879	0	0xffff	—	ISOCHRON_PROFIBUS_CONFIG	Cyclic configuration	Allowable number of abnormal life signs
880	0	100000	min^{-1}	NORMALIZATION_OVER_PROFIBUS	Max. feed speed or Max. number of revolutions	Max. number of motor revolutions Refer to 14.1.7.
915	0	65535	—	SETPOINT_ASSIGN_PROFIBUS	Command value	Not used
916	0	65535	—	ACTUAL_VALUE_ASSIGN_PROFIBUS	Feedback value	Not used

CNC parameter No.	Lower limit	Upper limit	Unit	Name	Description	Related MD and remark
918	0	126	—	PROFIBS_NODE_ADDRESS	PROFIBUS station number	See Section 14.1.4
945	0	0xffff	—	FAULT_CODE	Fault code history	Not used
947	0	0xffff	—	FAULT_NUMBER	Fault number history	Not used
948	0	0xffffffff	ms	FAULT_TIME	Fault time stamp history	Not used
949	0	0x00ffffff	—	FAULT_VALUE	Fault value history	Not used
952	0	0xffff	—	NUM_FAULTS	The number of faults that happened	Not used
953	0	0xffff	—	WARNINGS800_TO_815	Occurrence status of warnings 800-815	Not used
954	0	0xffff	—	WARNINGS_816_TO_831	Occurrence status of warnings 816-831	Not used
955	0	0xffff	—	WARNINGS_832_TO_847	Occurrence status of warnings 832-847	Not used
956	0	0xffff	—	WARNINGS_848_TO_863	Occurrence status of warnings 848-863	Not used
957	0	0xffff	—	WARNINGS_864_TO_879	Occurrence status of warnings 864-879	Not used
958	0	0xffff	—	WARNINGS_880_TO_895	Occurrence status of warnings 880-895	Not used
959	0	0xffff	—	WARNINGS_896_TO_911	Occurrence status of warnings 896-911	Not used
960	0	0xffff	—	WARNINGS_911_TO_927	Occurrence status of warnings 912-927	Not used
967	0	0xffff	—	PROFIBUS_CONTROL_WORD	Control word (STW1)	PROFIBUS-controlling CNC transmission data
968	0	0xffff	—	PROFIBUS_STATAS_WORD	Status word (ZSW1)	PROFIBUS-controlling CNC reception data
969	0	0x00ffffff	ms	ACT_TIME_DIFF	Time elapsed after power-on	Not used
1005	0	65535	—	ENC_RESOL_MOTOR	Motor encoder resolution	MD31020[0]
1007	0	0X007fffff	—	ENC_RESOL_DIRECT	Direct encoder resolution	MD32020[1]
1012	0	0x1195	—	FUNC_SWITCH	Function switch	Fixed according to CNC specification
1022	0	999999	—	ENC_ABS_SINGLETURN_MOTOR	Motor absolute encoder resolution	Not used
1025	0	0xffff	—	ENC_MOTOR_SERIALNO_LOW	Motor encoder serial number (LOW)	Not used
1026	0	0xffff	—	ENC_MOTOR_SERIALNO_HIGH	Motor encoder serial number (HIGH)	Not used
1027	0	0x0178	—	ENC_CONFIG	Motor encoder type	bit3 0: Incremental 1: Absolute bit4 0: Rotary 1: Linear
1032	0	0xffffffff	—	ENC_ABS_RESOL_DIRECT	Direct absolute encoder resolution	Not used

CNC parameter No.	Lower limit	Upper limit	Unit	Name	Description	Related MD and remark
1037	0	0xffff	—	ENC_CONFIG_DIRECT	Direct encoder type	bit3 0: Incremental 1: Absolute bit4 0: Rotally 1: Linear
1038	0	0xffff	—	ENC_MOTOR_SERIAL NO_LOW	Direct encoder serial number (LOW)	Not used
1039	0	0xffff	—	ENC_MOTOR_SERIAL NO_HIGH	Direct encoder serial number (HIGH)	Not used
1042	0	11	—	RESOLUTION_G1_XIS T1	Motor encoder resolution magnification 1 (power of 2)	Changes MD31025[0] to a power of 2
1043	0	11	—	RESOLUTION_G1_XIS T2	Motor encoder resolution magnification 2 (power of 2)	Changes MD31025[0] to a power of 2
1044	0	11	—	RESOLUTION_G2_XIS T1	Direct encoder resolution magnification 1 (power of 2)	Changes MD31025[1] to a power of 2
1045	0	11	—	RESOLUTION_G2_XIS T2	Direct encoder resolution magnification 2 (power of 2)	Changes MD31025[1] to a power of 2
1102	0	0xffff	—	MOTOR_CODE	Motor type	Servo-axis=1, Spindle=1001
1401	-100000	100000	U/min	MOTOR_MAX_SPEED	Max. motor speed	Max. number of rated motor revolutions
1405	100	110	%	MOTOR_SPEED_LIMIT	Allowable max. speed or number of revolutions	Fixed to 120%
1711	-100000	100000	m/min	SPEED_LSB	Speed resolution	MD880/Ox40000000
1783	0	0xffff	—	PARAM_DATA_RX_PR OFIBUS	Parameter data	
1784	0	0xffff	—	CONFIG_DATA_RX_PR OFIBUS	Configuration data	
1785	0	0xffff	—	LIFESIGN_DIAGNOSIS _PROFIBUS	Life sign error counter	
1786	0	0xffff	—	PKW_DATA_RX_PROFI BUS	PKW receiving data	Not used
1787	0	0xffff	—	PKW_DATA_TX_PROFI BUS	PKW transmission data	Not used
1788	0	0xffff	—	PZD_DATA_RX_PROFI BUS	Cyclically receiving data	
1789	0	0xffff	—	PZD_DATA_TX_PROFI BUS	Cyclic transmission data	
1794	0	999999	—	OPTMOD_BOOTCODE _VERSION	Loader version for optional module	
1795	0	999999	—	OPTMOD_FIRMWARE_ VERSION	Optional module software version	
1799	0	999999	—	FIRMWARE_VERSION	ACC file version	See Section 14.1.9
2401	-100000	100000	U/min	MOTOR_MAX_SPEED_ 2ND_MOTOR	2nd motor max. speed	To be used for controlling Spindle-combined C axis when motor speed is different.
2405	100	110	%	MOTOR_SPEED_LIMIT _2ND_MOTOR	2nd motor allowable max. speed	To be used for controlling Spindle-combined C axis when motor speed is different.

Note: Such values are invalid that are displayed for parameters not being used.

Appendix B Alarm/monitor data

B.1 List of Servo unit alarms

CNC code	Drive code	Item	CNC code	Drive	Description
2	0x02	EEPROM data error	97	0x61	C-phase signal detection failure
2	0x02	Flash memory error	98	0x62	C-phase signal width failure
3	0x03	Main circuit detecting element error	99	0x63	Error with pulse count per rotation when encoder is used
3	0x03	CNV main circuit detecting element error	99	0x63	Error with pulse count per rotation when magnetmetric sensor is used
3	0x03	Main circuit detecting element error	99	0x63	Encoder pulse count error
4	0x04	Parameter setting error	100	0x64	Position-detecting signal wire break
5	0x05	Motor/Servo capacity unmatched	101	0x65	INC signal error when encoder is used
6	0x06	DPRAM error	101	0x65	INC signal error when magnetmetric sensor is used
16	0x10	Over current (Short-circuit current)	102	0x66	Magnetmetric sensor signal detection error
17	0x11	Ground fault	103	0x67	Magnetmetric sensor signal wire break.
18	0x12	Carrier frequency error	104	0x68	Orientation card unmatched
19	0x13	On-delay error	105	0x69	Winding change-over failure
20	0x14	Motor over-current	106	0x6A	Initial zero point loading error
32	0x20	Fuse blow-out	107	0x6B	Emergency stop operation failure
33	0x21	MC operation failure	113	0x71	Over-load (Momentary max. load)
34	Ox22	Converter fuse blow-out	114	0x72	Over-load (Max. continuous load)
48	0x30	Regeneration error	115	0x73	DB over-load
50	0x32	Regeneration over-load	116	0x74	Inrush current resistance over-load
50	0x32	Regeneration over-load	117	0x75	Control panel temperature rise to 60 ℃
51	0x33	Main power wiring error	117	0x75	Internal cooling fan error
52	0x34	Converter regeneration over-current	118	0x76	Load error
64	0x40	Over-voltage	119	0x77	Collision
64	0x40	CNV over-voltage	121	0x79	Motor overheat
65	0x41	Low-voltage	121	0x79	Motor thermistor wire break
65	0x41	CNV low-voltage	122	0x7A	Heat sink over-heat
66	0x42	Initial charging error	122	0x7A	Fin temperature rise for more than 1 minute
67	0x43	Control circuit low-voltage	122	0x7A	Heat sink thermistor wire break
68	Ox44	Control power low-voltage	123	0x7B	Fin temperature rise for more than 1 minute
81	0x51	Over-speed (at motor)	129	0x81	PG back-up error
82	0x52	Over-speed (at machine)	130	0x82	PG sum check error
83	0x53	Excessive speed deviation	131	0x83	PG battery error
84	0x54	Over-speed (at low-speed winding motor)	132	0x84	PG absolute error
96	0x60	Tune-up incomplete when encoder is used	133	0x85	PG over-speed
96	0x60	Tune-up incomplete when magnetmetric sensor is used	134	0x86	PG over-heat

CNC code	Drive code	Item	CNC code	Drive	Description
145	0x91	Over-load warning	199	0xC7	FPG wire break (PC)
146	0x92	Regeneration over-load warning	200	0xC8	PG clearing error
147	0x93	Battery warning	201	0xC9	PG communication error
148	0x94	Network data setting warning	202	0xCA	PG parameter error
149	0x95	Network command warning	203	0xCB	PG echo back error
150	0x96	Network communication warning	204	0xCC	Multi-turn limit value inconsistency
151	0x97	Heat sink overheat (warning)	205	0xCD	FPG F/B wire break
152	0x98	Motor over-heat (warning)	206	0xCE	FPG multi-turn error
153	0x99	Normal	208	0xD0	Excessive position deviation
159	0x9F	Controller warning	211	0xD3	Position data over-flow
177	0xB1	Speed reference A/D error	224	0xE0	Invalid optional board setting
178	0xB2	Torque reference A/D error	225	0xE1	Time out error
178	0xB2	CPU-embedded A/D error	226	0xE2	Converter WDC failure
179	0xB3	Current detecting A/D error	227	0xE3	Optional board alarm
179	0xB3	U-phase A/D converter error	228	0xE4	Dummy optional warning
179	0xB3	V-phase A/D converter error	229	0xE5	Network WDT error
182	0xB6	Communication gate array error	230	0xE6	Network communication error
182	0xB6	Communication hardware error	230	0xE6	Link setting error
183	0xB7	Link setting error	231	0xE7	Optional I/F error
189	0xBD	Converter system error	234	0xEA	No SGDH
189	0xBD	Converter ROM error	234	0xEA	No drive response
189	0xBD	Controller failure	234	0xEA	Drive initial access error
189	0xBD	Converter watch-dog error	235	0xEB	SGDH timeout
190	0xBE	1: System error	236	0xEC	Drive WDC error
191	0xBF	0: System error	237	0xED	Incomplete command execution
193	0xC1	Runaway detection	241	0xF1	Missing power line phase detection
194	0xC2	Phase detection error	242	0xF2	Excessive power frequency deviation
195	0xC3	Wire break in pulse encoder A and B phases	244	OxF4	Low voltage power
196	0xC4	Wire break in pulse encoder C-phase	Undisplayable	CPF00	Control circuit error 1
197	0xC5	Motor magnetic pole detection error	Undisplayable	CPF01	Control circuit error 2
198	0xC6	FPG wire break (PA and PB)			

B.2 List of Inverter alarms

CNC code	Drive code	Item	CNC code	Drive	Description
2	0x02	EEPROM data error	97	0x61	C-phase signal detection failure
2	0x02	Flash memory error	98	0x62	C-phase signal width failure
3	0x03	Main circuit detecting element error	99	0x63	Error with pulse count per rotation when encoder is used
3	0x03	CNV main circuit detecting element error	99	0x63	Error with pulse count per rotation when magnetmetric sensor is used
4	0x04	Parameter setting error	99	0x63	Encoder pulse count error
5	0x05	Motor/Servo capacity unmatched	100	0x64	Position-detecting signal wire break
6	0x06	DPRAM error	101	0x65	INC signal error when encoder is used
16	0x10	Over current (Short-circuit current)	101	0x65	INC signal error when magnetmetric sensor is used
17	0x11	Ground fault	102	0x66	Magnetmetric sensor signal detection error
18	0x12	Carrier frequency error	103	0x67	Magnetmetric sensor signal wire break.
19	0x13	On-delay error	104	0x68	Orientation card unmatched
20	0x14	Motor over current	105	0x69	Winding change-over failure
32	0x20	Fuse blow-out	106	0x6A	Initial zero point loading error
33	0x21	MC operation failure	107	0x6B	Emergency stop operation failure
48	0x30	Regeneration error	113	0x71	Over-load (Momentary max. load)
50	0x32	Regeneration over-load warning	114	0x72	Over-load (Max. continuous load)
50	0x32	Regeneration over-load warning	115	0x73	DB over-load
51	0x33	Main power wiring error	116	0x74	Inrush current resistance over-load
52	0x34	Converter regeneration over-current	117	0x75	Control panel temperature rise to 60 ℃
64	0x40	Over-voltage	117	0x75	Internal cooling fan error
64	0x40	CNV over-voltage	117	0x75	Load error
65	0x41	Low-voltage	121	0x79	Motor over-heat
65	0x41	CNV low-voltage	121	0x79	Motor thermistor wire break
66	0x42	Initial charge error	122	0x7A	Heat sink over-heat
67	0x43	Control circuit low-voltage	122	0x7A	Fin temperature rise for more than 1 minute
81	0x51	Over-speed (at motor)	122	0x7A	Heat sink thermistor wire break
82	0x52	Over-speed (at machine)	129	0x81	PG back-up error
83	0x53	Excessive speed deviation	130	0x82	PG sum check error
84	0x54	Over-speed (at low-speed winding motor)	131	0x83	PG battery error
85	Ox55	Over-speed (C-axis)	132	0x84	PG absolute error
96	0x60	Tune-up incomplete when encoder is used	133	0x85	PG over-speed
96	0x60	Tune-up incomplete when magnetmetric sensor is used	134	0x86	PG over-heat

CNC code	Drive code	Item	CNC code	Drive	Description
145	0x91	Over-load warning	198	0xC6	FPG wire break (PA and PB)
146	0x92	Regeneration over-load warning	199	0xC7	FPG wire break (PC)
147	0x93	Battery warning	200	0xC8	PG clearing error
148	0x94	Network data setting warning	201	0xC9	PG communication error
149	0x95	Network command warning	202	0xCA	PG parameter error
150	0x96	Network communication warning	203	0xCB	PG echo back error
151	0x97	Heat sink overheat (warning)	204	0xCC	Multi-turn limit value inconsistency
152	0x98	Motor over-heat (warning)	205	0xCD	FPG F/B wire break
153	0x99	Normal	206	0xCE	FPG multi-turn error
159	0x9F	Controller warning	208	0xD0	Excessive position deviation
177	0xB1	Speed reference A/D error	211	0xD3	Position data over-flow
178	0xB2	Torque reference A/D error	224	0xE0	Invalid optional board setting
178	0xB2	CPU-embedded A/D error	225	0xE1	Time out error
179	0xB3	Current detecting A/D error	226	0xE2	Converter WDC failure
179	0xB3	U-phase A/D converter error	227	0xE3	Optional board alarm
179	0xB3	V-phase A/D converter error	228	0xE4	Dummy optional warning
182	0xB6	Communication gate array error	229	0xE5	Network WDT error
182	0xB6	Communication hardware error	230	0xE6	Network communication error
183	0xB7	Link setting error	230	0xE6	Link setting error
183	OxB7	ASIC PWM comparison unmatched	231	0xE7	Optional I/F error
184	OxB8	ASIC WDC1 error	234	0xEA	Missing SGDH
189	0xBD	Converter system error	234	0xEA	No drive response
189	0xBD	Converter ROM error	234	0xEA	Drive initial access error
189	0xBD	Controller failure	235	0xEB	SGDH timeout
189	0xBD	Converter watch dog error	236	0xEC	Drive WDC error
190	0xBE	1: System error	237	0xED	Incomplete command execution
191	0xBF	0: System error	241	0xF1	Missing power line phase detection
193	0xC1	Runaway detection	242	0xF2	Excessive power frequency deviation
194	0xC2	Phase detection error	Undisplayable	CPF00	Control circuit error 1
195	0xC3	Wire break in pulse encoder A and B phases	Undisplayable	CPF01	Control circuit error 2
196	0xC4	Wire break in pulse encoder C-phase	Undisplayable	CPF01	Control circuit error 2
197	0xC5	Motor magnetic pole detection error			

B.3 List of Servo unit monitor data

The following monitor data have been confirmed with a digital operator for drives

UN number	Item	Description	Unit
Un000	Actual motor rotation speed		min^{-1}
Un001	Speed reference currently input		min^{-1}
Un002	Internal torque reference	Percentage to a rated torque	%
Un003	Rotation angle 1	Pulse count from zero point	Pulse
Un004	Rotation angle 2	Angle from zero point (Electrical angle)	deg
Un005	Input signal monitor		—
Un006	Output signal monitor		—
Un007	Input reference pulse speed		min^{-1}
Un008	Deviation counter value	Position deviation	Command Unit
Un009	Cumulative load ratio	A percentage of effective torque, measured every 10 seconds, to a rated torque.	%
Un00A	Regenerative load ratio	A percentage of regenerated power consumed, measured every 10 seconds, to total regenerated power that can be used.	%
Un00B	DB resistor power consumption	A percentage of power consumed for dynamic brake, measured every 10 seconds, to total power that can be used.	%
Un00C	Input reference pulse counter	Displayed in hexadecimal	—
Un00D	Feedback pulse counter	Displayed in hexadecimal	—
Un00D	External encoder absolute	Displayed in hexadecimal	—

B.4 List of Inverter monitor data

The following monitor data have been confirmed with a digital operator for drives.

UN number	Item	Description	Unit
Un001	Speed feedback		min^{-1}
Un002	Speed reference		min^{-1}
Un003	Reserved		
Un004	Torque reference	Short-time duration rated torque	%
Un005	Reserved		
Un006	Inverter output current		A
Un007	Output frequency		Hz
Un008	Internal status of the sequence [4] [3] [2] [1] [0] RUN2 RUN1 RUN JOG1 ACCDECDY ACCDEC IRDY ACC — — — — — — —	RUN2 /* At operation */ RUN1 /* Operation command */ RUN /* Operation command */ JOG1 /* JOG command */ ACCDECDY /* At acceleration/deceleration */ ACCDEC /* At acceleration/deceleration */ IRDY /* Inverter ready */ ACC /* At acceleration */	
Un009	External input signals [4] [3] [2] [1] [0] RDY EMG FOR REV TLH TLL SC — CHW PPI ORT LGR MGR CAX —	RDY /* At operation preparation */ EMG /* Emergency stop */ FOR /* Forward rotation */ REV /* Reverse rotation */ TLH /* Torque limit H */ TLL /* Torque limit L */ SC /* Soft start cancelled */ CHW /* Winding switch-over ON: Low-speed winding*/ PPI /* Speed controlling PP1 switch-over ON: PI*/ ORT /* Orientation */ LGR /* L gear selection */ MGR /* M gear selection */ CAX /* C-axis switch-over */	
Un010	External output signals [4] [3] [2] [1] [0] ZSPD AGR SDET TDET TLE ORGSIG OREND CHWEND FLTSIG TALM — — — — CAXCMP	ZSPD /* Zero speed */ AGR /* Speed matching */ SDET /* Speed detection */ TDET /* Torque detection */ TLE /* At torque limit */ ORGSIG /* Load-axis zero point */ OREND /* Orientation completed */ CHWEND /* Winding switch-over completed ON: Low-speed winding*/ FLTSIG /* Failure */ TALM /* Error warning */ CAXCMP /* C-axis switch-over completed */	
Un011	Inverter capacity		kW
Un012	Motor temperature		℃
Un013	Heat sink temperature		℃
Un014	Direct-current voltage of the bus		V

UN number	Item	Description	Unit
Un015	Reserved		
Un016	Alarm being issued	Alarms being issued now (10 alarms at max.)	
Un017	U-phase current		0x3FF: 10V
Un018	W-phase current		0x3FF: 10V
Un019	Reserved		
Un020	LED check		
Un021	PROM number	The numbers of Software versions	

Note: As to the signals, described in 3 lines, in the Item column of Un008, Un009, and Un010; each of the signals corresponds to the 3 horizontal LED segments of the 7-segment LED’s for the 5 digit display of the Digital Operator.

Yaskawa Siemens CNC Series

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.
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Machine Tool OEM Sales Div.

Gate City Osaki West Tower, 1-11-1, Osaki, Shinagawa-ku, Tokyo 141-8644, Japan
PHONE +81-3-3493-7411 FAX +81-3-3493-7422

Siemens Japan K.K.
http://www.siemens.co.jp

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